1969



CHASSIS
SERVICE MANUAL

CHEVROLET · CHEVELLE
CAMARO · Chevy NOVA
CORVETTE

CHEVROLET

ST 130-69

DAVE GRAHAM
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QUICK REFERENCE INDEX. To use, move either the hand or selection tool directly over the section you desire to reference. Simply click once with the mouse button and the manual will automatically jump to that section.

1969

CHEVROLET, CHEVELLE, CAMARO, CHEVY NOVA AND CORVETTE CHASSIS SERVICE MANUAL

AND CORVETTE BODY SERVICE MANUAL

FOREWORD

This manual includes procedures for maintenance and adjustments, minor service operations, removal and installation for components, except the body, of Chevrolet, Chevelle, Camaro, Chevy Nova and Corvette vehicles, and service information for Corvette bodies. Procedures involving disassembly and assembly of major components for these vehicles are contained in the 1969 Chassis Overhaul Manual. Service information for 1969 Chevrolet, Chevelle, Camaro and Chevy Nova body items is contained in the 1969 Body Service Manual.

The Section Index on this page enables the user to quickly locate any desired section. At the beginning of each section containing more than one major subject is a Table of Contents, which gives the page number on which each major subject begins. An Index is placed at the beginning of each major subject within the section.

Summaries of Special Tools, when required, are found at the end of major sections while specifications covering vehicle components are presented at the rear of the manual.

This manual should be kept in a handy place for ready reference. If properly used, it will enable the technician to better serve the owners of Chevrolet built vehicles.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

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CHEVROLET MOTOR DIVISION
General Motors Corporation
DETROIT, MICHIGAN

SECTION INDEX

SECTION	NAME
0	GENERAL INFORMATION AND LUBRICATION
1A	HEATER AND AIR CONDITIONING
1B	CORVETTE BODY
2	FRAME
3	FRONT SUSPENSION
4	REAR SUSPENSION AND DRIVELINE
5	BRAKES
6	ENGINE
6K	ENGINE COOLING
6M	FUEL SYSTEM
6T	AIR INJECTION REACTOR SYSTEM
6Y	ENGINE ELECTRICAL
7	CLUTCH AND TRANSMISSION
8	FUEL TANK AND EXHAUST SYSTEM
9	STEERING
10	WHEELS AND TIRES
11	CHASSIS SHEET METAL
12	ELECTRICAL—BODY AND CHASSIS
13	RADIATOR AND GRILLE
14	BUMPERS
15	ACCESSORIES
	SPECIFICATIONS

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SECTION 0

GENERAL INFORMATION AND LUBRICATION

CONTENTS OF THIS SECTION

	Page
General Information	0-1
Lubrication	0-9

GENERAL INFORMATION

	Page
Model Identification and Vehicle Dimensions	0-1
Chevrolet	0-1
Chevelle	0-2
Nova	0-2
Camaro	0-2
Corvette	0-3
Unit and Serial Numbers	0-3
Engine and Transmission Number (V.I.N.)	0-3
Vehicle Serial Number	0-3
Keys and Locks	0-4
Pushing, Towing and Lifting	0-4

MODEL IDENTIFICATION—CHEVROLET

Series	Model Number		Description
	6-Cyl.	V-8	
Biscayne	15311	15411	2-Door Sedan, 6-Pass.
	15369	15469	4-Door Sedan, 6-Pass.
	15336	15436	4-Door Station Wagon, 2-Seat (Brookwood)
Bel Air	15511	15611	2-Door Sedan, 6-Pass.
	15569	15669	4-Door Sedan, 6-Pass.
	15536	15639	4-Door Station Wagon, 2-Seat (Townsman)
	15546	15646	4-Door Station Wagon, 3-Seat (Townsman)
Impala	16369	16469	4-Door Sedan, 6-Pass.
	16339	16439	4-Door Sport Sedan, 6-Pass.
	16337	16437	2-Door Sport Coupe, 5-Pass.*
	—	16467	2-Door Convertible, 5-Pass.*
	—	16436	4-Door Station Wagon, 2-Seat (Kingswood)
	—	16446	4-Door Station Wagon, 3-Seat (Kingswood)
Impala Custom	—	16447	2-Door Sport Coupe, 5-Pass.*
Caprice	—	16639	4-Door Sport Sedan, 6-Pass.
	—	16647	2-Door Sport Coupe, 5-Pass.*
	—	16636	4-Door Station Wagon, 2-Seat (Estate Wagon)
	—	16646	4-Door Station Wagon, 3-Seat (Estate Wagon)

*4-Passenger when optional bucket front seats specified.

VEHICLE DIMENSIONS—CHEVROLET

Pertinent dimensions for the different models are shown in the following chart.

Model	Sedan	2-Door Sport Coupe	Convertible Coupe	Station Wagon
Length Overall	214.7"	214.7"	214.7"	213.9"
Width Overall (Body)	79.6"	79.6"	79.6"	79.6"
Height Overall	55.8"	54.3"	54.3"	56.7"
Wheelbase	119.0"	119.0"	119.0"	119.0"
Tread-Front	62.5"	62.5"	62.5"	63.5"
Tread-Rear	62.4"	62.4"	62.4"	63.4"
Curb Weight: Approximately 3635 lbs. 4-Door Sedan with L-6 Engine; 3770 lbs. with V-8 Engine.				

MODEL IDENTIFICATION—CHEVELLE

Series	Model Number		Description
	6-Cyl.	V-8	
Nomad	13135	13235	4-Door Station Wagon, 2-Seat
	13136	13236	4-Door Station Wagon, 2-Seat
300 Deluxe	13369	13469	4-Door Sedan, 6-Pass.
	13327	13427	2-Door Pillar Coupe, 5-Pass.
	13337	13437	2-Door Sport Coupe, 5-Pass.
	13335	13435	4-Door Station Wagon, 2-Seat (Greenbrier)
	13336	13436	4-Door Station Wagon, 2-Seat (Greenbrier)
	13346	13446	4-Door Station Wagon, 3-Seat (Greenbrier)
Malibu	13569	13669	4-Door Sedan, 6-Pass.
	13539	13639	4-Door Sport Sedan, 6-Pass.
	13537	13637	2-Door Sport Coupe, 5-Pass. *
	13567	13667	2-Door Convertible, 5-Pass. *
	13536	13636	4-Door Station Wagon, 2-Seat (Concours)
	13546	13646	4-Door Station Wagon, 3-Seat (Concours)
Super Sport	-	13837	2-Door Sport Coupe, 5-Pass.*
Concours Estate Wagon	-	13836	4-Door Station Wagon, 2-Seat
	-	13846	4-Door Station Wagon, 3-Seat
El Camino	13380	13480	2-Door Sedan Pickup, 3-Pass. Deluxe
	13580	13680	2-Door Sedan Pickup, 3-Pass. Malibu
	-	13880	2-Door Sedan Pickup, 3-Pass. Super Sport

*4-Passenger when optional bucket seats are ordered.

VEHICLE DIMENSIONS—CHEVELLE

Pertinent dimensions for the different models are shown in the following chart.

Model	Sedan	2-Door Sport Coupe	Convertible Coupe	Station Wagon	Sedan Pickup
Length Overall	201.8"	197.1"	197.1"	207.1"	207.1"
Width Overall (Body)	75.7"	75.7"	75.7"	75.7"	75.7"
Height Overall	53.3"	52.7"	53.2"	55.2"	54.0"
Wheelbase	116.0"	112.0"	112.0"	116.0"	116.0"
Tread-Front	59.0"	59.0"	59.0"	59.0"	59.0"
Tread-Rear	59.0"	59.0"	59.0"	59.0"	59.0"
Curb Weight. Approximately 3250 lbs. 4-Door Sedan with L-6 Engine 3395 lbs. with V-8 Engine.					

MODEL IDENTIFICATION—NOVA

Model Number			Description
4-Cyl.	6-Cyl.	V-8	
11127	11327	11427	2-Door Sport Coupe, 5-Pass.
11169	11369	11469	4-Door Sedan, 6-Pass.

MODEL IDENTIFICATION—CAMARO

Model Number		Description
6-Cyl.	V-8	
12337	12437	2-Door Sport Coupe, 4-Passenger
12367	12467	2-Door Convertible, 4-Passenger

VEHICLE DIMENSIONS—NOVA

Model	Sedan	2-Door Sport Coupe
Length Overall	189.4"	189.4"
Width Overall (Body)	70.5"	70.5"
Height Overall	53.7"	54.4"
Wheelbase	111.0"	111.0"
Tread-Front	59.0"	59.0"
Tread-Rear	58.9"	58.9"
Curb Weight: Approximately 2920 lbs. 4-Door Sedan with L-4 Engine; 3050 lbs. with L-6 Engine; 3175 with V-8 Engine.		

VEHICLE DIMENSIONS—CAMARO

Model	Sport Coupe	Convertible
Length Overall	184.6"	
Width Overall (Body)	72.3"	
Height Overall	50.8"	
Wheelbase	108.0"	
Tread-Front	59.6"	
Tread-Rear	59.5"	
Weight: Sport Coupe with L6 Engine 2950 lbs.; with V-8 Engine 3105 lbs.		

MODEL IDENTIFICATION—CORVETTE

Model Number	Description
19437	2-Door Sport Coupe, 2-Passenger
19467	2-Door Convertible, 2-Passenger

VEHICLE DIMENSIONS—CORVETTE

Model	Convertible	Sport Coupe
Length Overall	182.1"	
Width Overall (Body). .	69.2"	
Height Overall	47.8"	47.8"
Wheelbase.	98.0"	
Tread-Front	58.3"	
Tread-Rear.	59.0"	
Curb Weight: 3220 lbs. Convertible 3210 lbs. Sport Coupe with Base V-8		

UNIT AND SERIAL NUMBER LOCATIONS

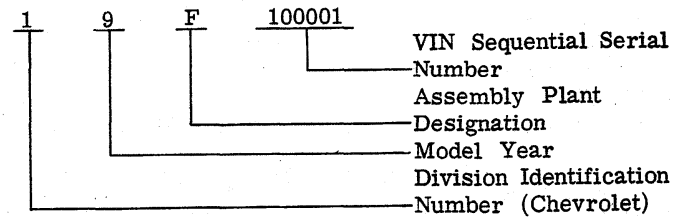
For the convenience of servicemen when writing up certain business papers, such as L. & M.R.'s Product Information Reports, or reporting product failures in any way, we are showing on a chart, the location of various unit numbers. These unit numbers and their prefixes and suffixes are necessary on these papers for various reasons--such as accounting, follow-up on production, etc.

The prefixes on certain units identify the plant in which the unit was manufactured, and thereby permits proper follow-up of the plant involved to get corrections made when necessary.

ENGINE AND TRANSMISSION NUMBER

The Vehicle Identification Number is stamped on the engine and transmission of each vehicle (see chart for location).

Example:



At multi-car plants where more than one Chevrolet series is produced, the VIN sequence numbers will be staggered to eliminate duplication of component identification numbers.

Example:

Los Angeles	VIN Sequence
15000-16000 Series (First Vehicle)	100001
12000 Series (First Vehicle)	500001

VEHICLE COMPONENT SERIAL AND UNIT NUMBER LOCATION

Component	Model	Location
Vehicle Serial Number Plate	All	Top of instrument panel left, front
Body Number, Trim and Point Plate	Chevrolet Chevelle Nova Camaro Corvette	Upper right-hand side of dash panel Upper left-hand side of dash panel Upper left-hand side of dash panel Upper left-hand side of dash panel Upper left-hand door hinge pillar
Engine and Transmission Vehicle Identification Number	4 & 6 Cyl. 8 Cylinder 3-Spd. (Muncie) 4-Spd. (Muncie) 3-4 Spd. (Saginaw) Powerglide Turbo Hydra-matic 350 Turbo Hydra-matic 400	On pad at right-hand side of cylinder block at rear of distributor On pad at front, right-hand side of cylinder block On boss right above filler plug On right side of case at lower rear of cover flange On lower right side of case adjacent to rear of cover On left upper flange of converter opening of transmission housing
Rear Axle Number	All except Corvette Corvette	On right or left axle tube adjacent to carrier On bottom surface of carrier at cover mounting flange
Delcotron	All	On top drive end frame
Starter	All	Stamped on outer case, toward rear
Battery	All	On cell cover segment, top of battery

Vehicle Serial Number

A typical vehicle serial number tag yields manufacturer's identity, vehicle type, model year, assembly plant and production unit number when broken down as shown in the following chart.

Manufacturer Identity [1]	Body Style [2]	Model Year [3]	Assembly Plant [4]	Unit Number [5]
1	5645	9	F	100025

[1] Manufacturers identity number assigned to all Chevrolet built vehicles.
[2] See Model Identification in this section.
[3] Last number of model year (1969).
[4] F-Flint
[5] Unit numbering will start at 100,001 at all plants.

KEYS AND LOCKS

Four keys (two rectangular head and two oval head) are provided with each vehicle. The rectangular head key operates the ignition switch and front door locks. The oval-head key operates the locks for the glove box and rear compartment lid (spare tire compartment lid lock on Corvette).

PUSHING, TOWING AND LIFTING

Pushing

NOTE: Towing car to start is not recommended due to the possibility of the disabled car accelerating into tow car.

AUTOMATIC TRANSMISSION

Do not attempt to start the engine by pushing the car. Should the battery become discharged, it will be necessary to use an auxiliary battery with jumper cables to start the engine.

CAUTION: To prevent damage to electrical system, never connect booster batteries in excess of 12 volts and connect positive to positive and negative to negative.

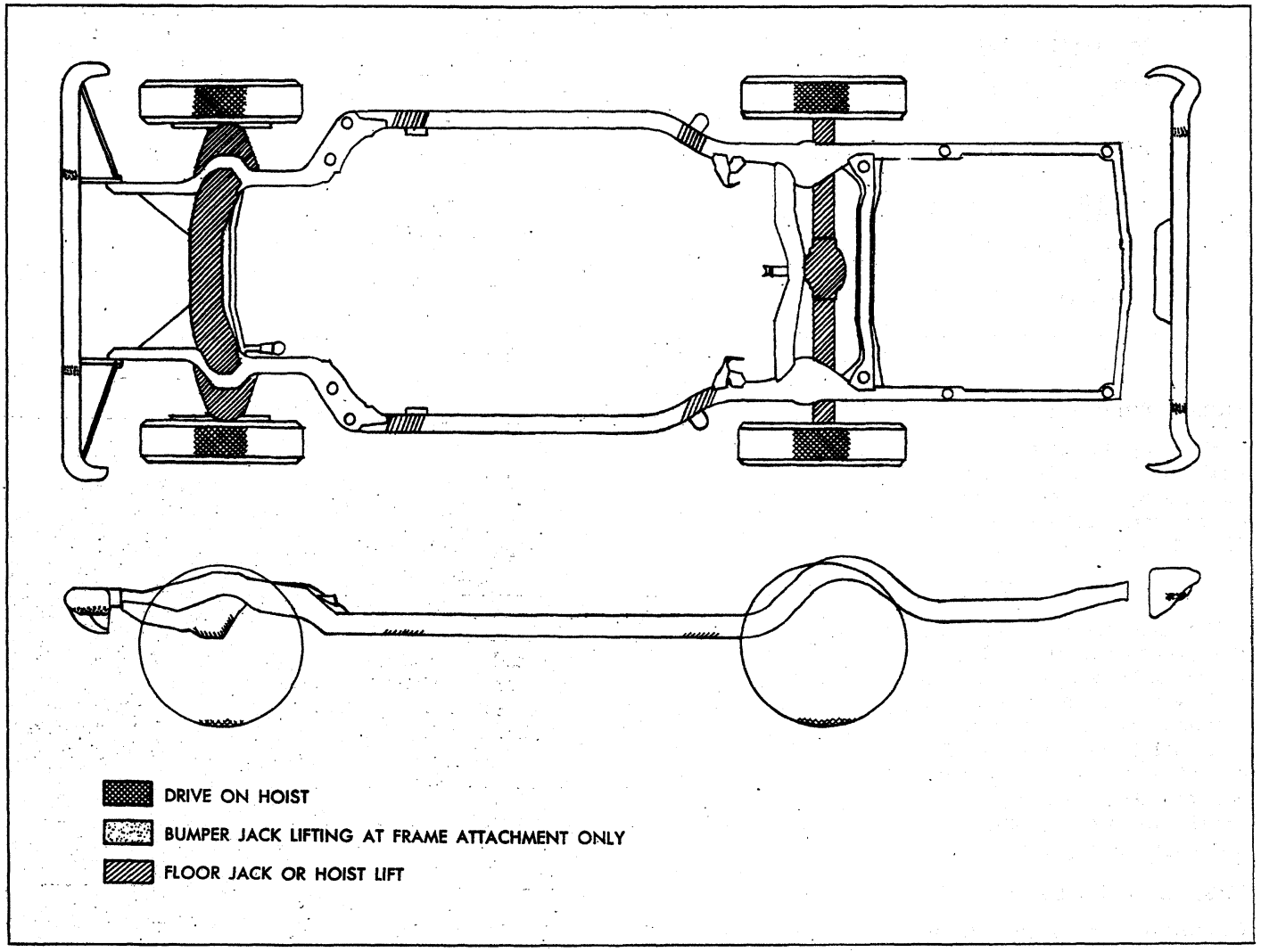


Fig. 1—Vehicle Lifting Points—Chevrolet

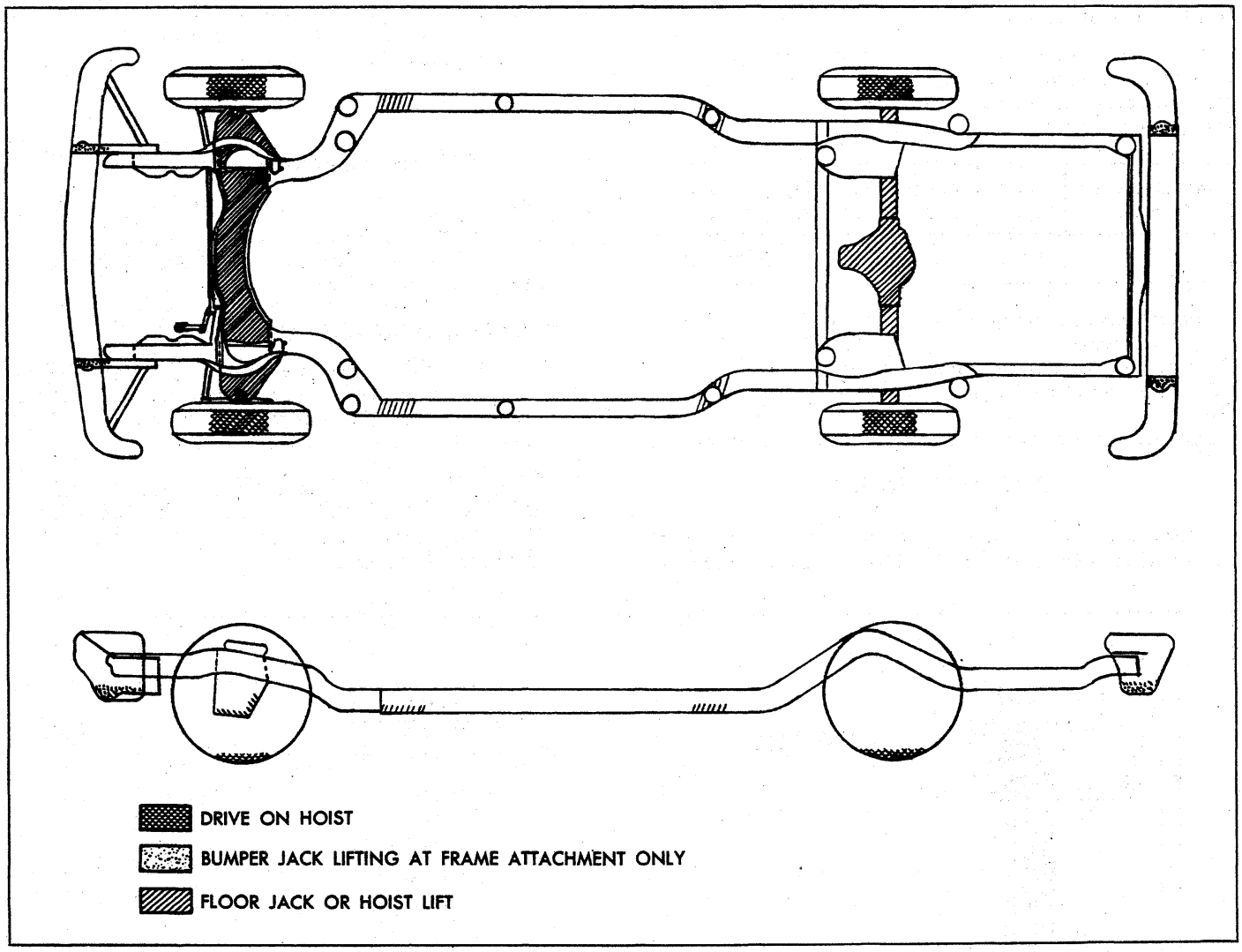


Fig. 2—Vehicle Lifting Points—Chevelle

Manual Transmission

When a push start is necessary turn off all electrical loads such as heater, radio, and if possible, lights, turn on the key, depress the clutch, and place the shift lever in high gear. Release the clutch when your speed reaches 10 to 15 miles per hour.

TOWING

The car may be towed safely on its rear wheels with the (selector lever in "N" (Neutral) position at speeds of 35 mile per hour or less under most conditions.

However, the drive shaft must be disconnected or the car towed on its front wheels if 1) Tow speeds in excess of 35 MPH are necessary, 2) Car must be towed for extended distances (over 50 miles) or, 3) Transmission is not operating properly. If car is towed on its front wheels, the steering wheel should be secured to maintain a straight ahead position.

TOWING THE CORVETTE

Towing with Rear End Raised (Figure 3 & 4)

Secure steering wheel to maintain a straight ahead position. Connect standard chain hook ends around torque control arms just outboard of shock mounting bracket.

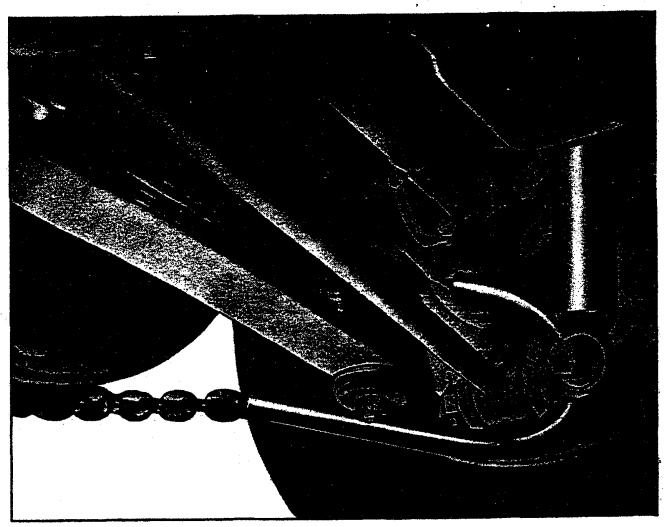


Fig. 3—Connect Hooks Outboard of Shock Bracket

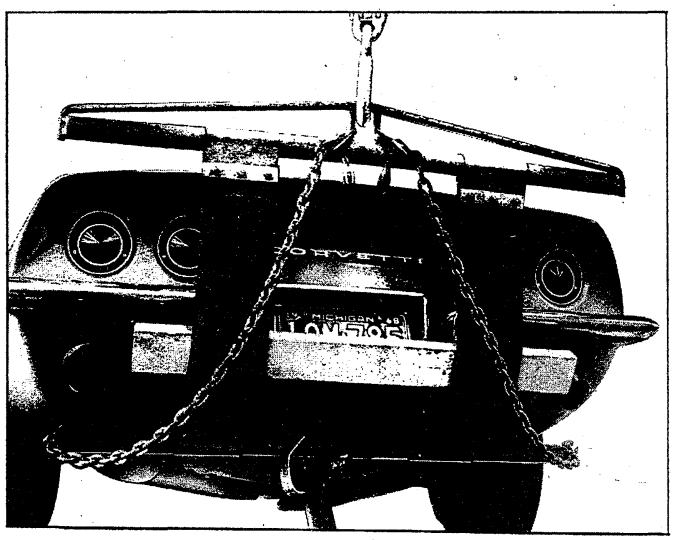


Fig. 4—Attaching Sling Assembly

Wire a 2 inch x 4 inch x 38 inch board securely to the rear bumper vertical bars as shown. Attach chains to lower lifting sling bar so that bar is underneath and just forward of rear valance panel. Slings should be adjusted on upper and lower sling bars so that they bear on bumper vertical bars.

Towing with Front End Raised (Figure 5 & 6)

The vehicle may be towed on its rear wheels with the selector lever in "N" (Neutral) position at speeds of 35 MPH or less under most conditions. The drive shaft must be disconnected if:

1. Tow speeds in excess of 35 MPH are necessary.
2. Car must be towed for extended distances (over 50 miles).
3. Transmission is not operating properly.

Connect standard chain hook ends around opening in front lower control arm near front inner bushing. The chain should be attached to the lower lifting sling bar so that it rests against the front bumper vertical bars.

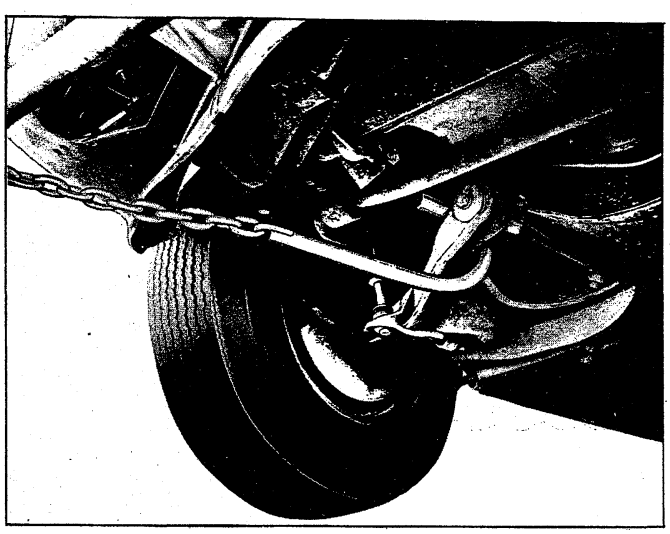


Fig. 5—Placing Hooks through Lower Control Arms

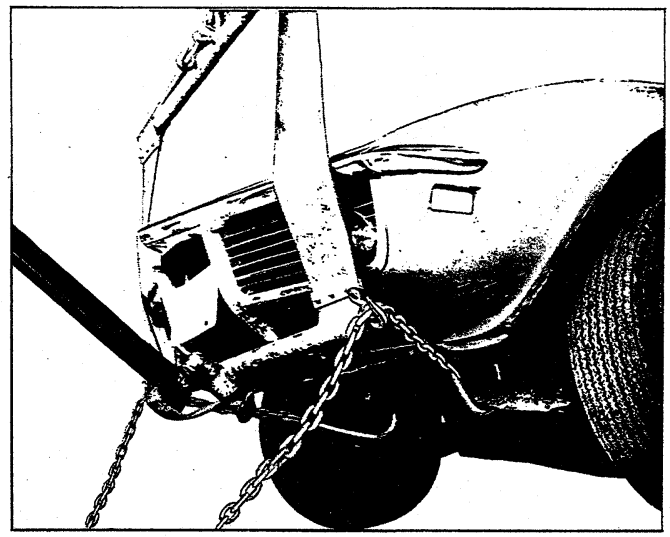


Fig. 6—Rest Lower Sling Bar against Bumper Vertical Bars

IMPORTANT: Due to the body overhang on the Corvette, it is recommended that the front or rear wheel be raised no more than three inches off the ground during towing, unless dollies are used. A height of 3" should provide the needed clearance for any road irregularities while still maintaining the needed clearance between the lowest portion of the body overhang and the ground.

Lifting Car

Many dealer service facilities and service stations are now equipped with a type of automotive hoist which must bear upon some part of the frame in order to lift the vehicle. In Figures 1, 2, 7, 8 the shaded areas indicate areas recommended for hoist contact.

LIFTING THE CORVETTE

Shaded areas in Figure 8 indicate recommended points for hoist or jack contact. When using a single post hoist place hoist on frame side rail behind kickup at front and forward of #3 body mount at rear. When using a twin-post hoist, two methods are recommended.

a. If no rear axle or suspension work is contemplated, use either suspension adapters or drive-on adapters at the front, and drive-on adapters at the rear. If a need for axle work develops, use jack stands beneath the frame side rails on each side and lower rear post.
b. If rear axle work is contemplated, use either suspension adapters or drive-on adapters at the front and frame lift adapters as shown in Figure 9. If frame lift adapters are not available, use jack stands.

NOTE: Wooden blocks, bolted to steel beam shown in Figure 9 are necessary to allow beam to clear exhaust system.

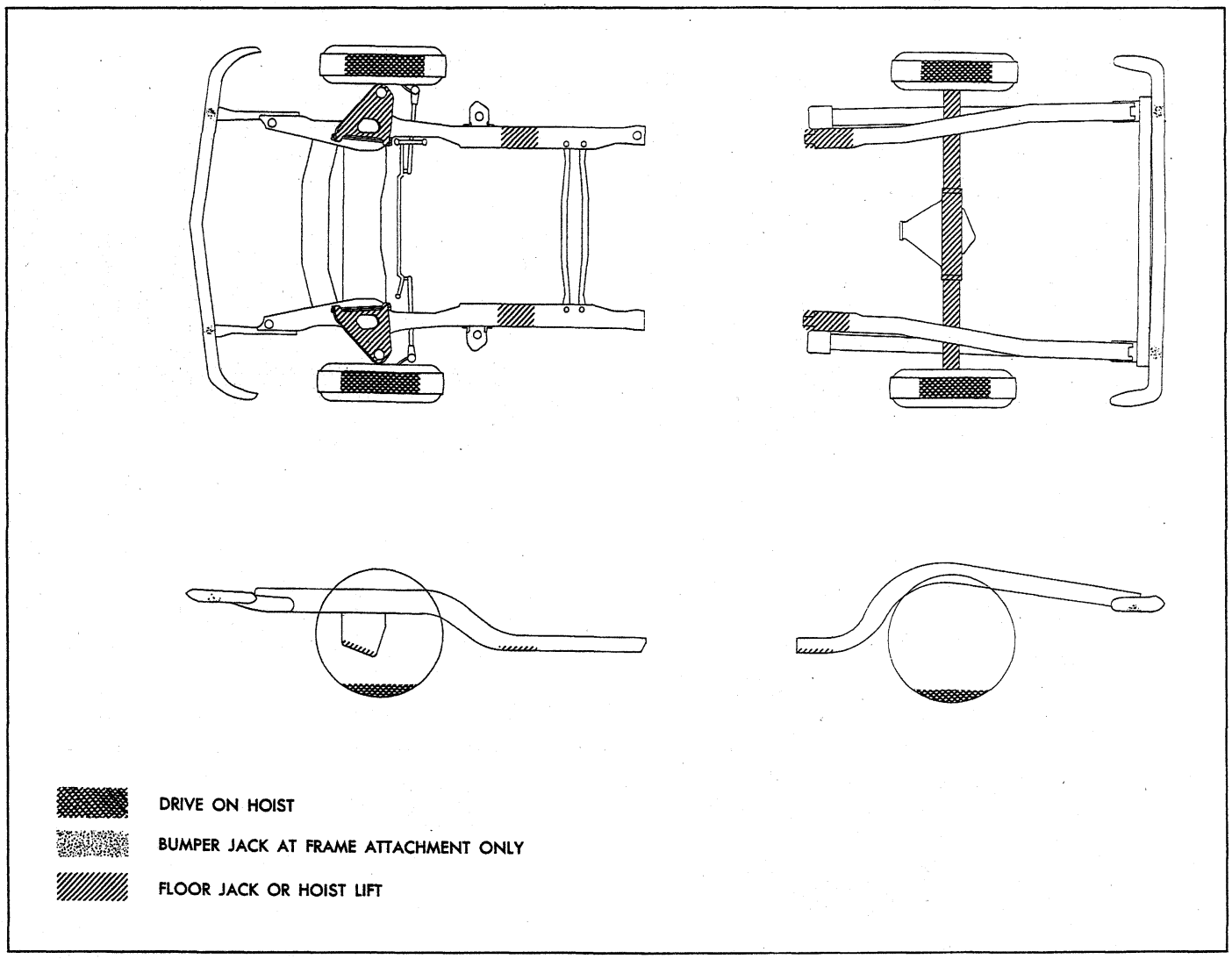


Fig. 7—Vehicle Lifting Points—Nova and Camaro

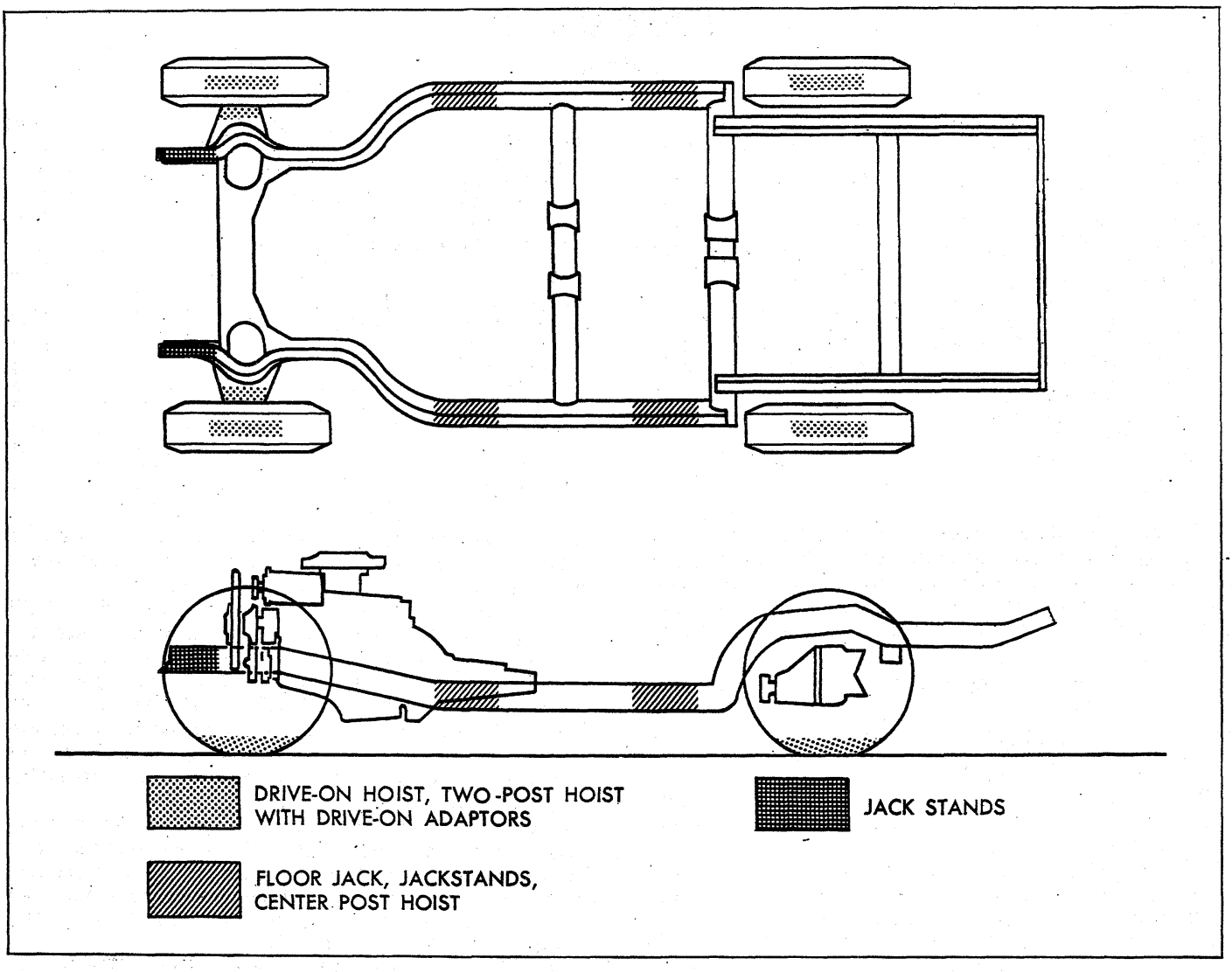


Fig. 8—Vehicle Lifting Points—Corvette

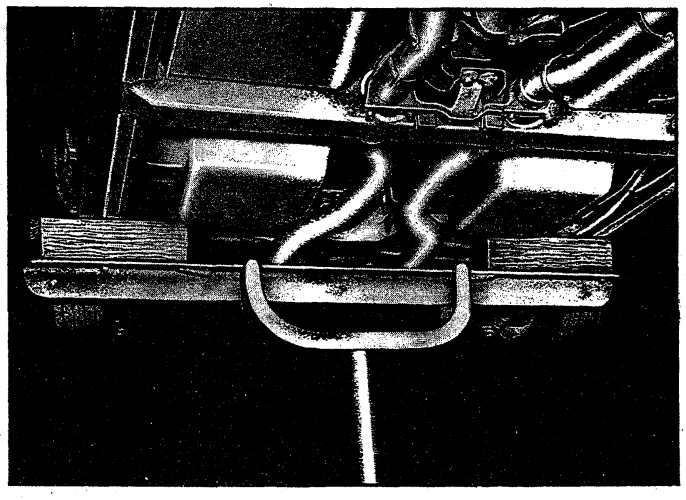


Fig. 9—Frame Lift Adapters—Corvette

LUBRICATION
INDEX

	Page
Engine	0-9
Crankcase Capacities	0-9
Lubrication	0-9
SAE Viscosity Oils	0-9
Types of Oils	0-10
Maintaining Oil Level	0-10
Crankcase Dilution	0-10
Crankcase Ventilation	0-10
Positive Crankcase Ventilation (P.C.V.) Valve	
Air Injection Reactor (A.I.R.)	0-10
Manifold Heat Control Valve	0-11
Engine Oil Filter	0-11
Air Cleaner	0-11
Polyurethane Type	0-11
Oil Wetted Paper Element Type	0-11
Fuel Filter	0-11
Distributor Cam Lubricator	0-11
Rear Axle	0-11
Transmission	0-11
3 and 4-Speed	0-11
Control Linkage	0-11
Clutch Cross Shaft	0-11
Automatic Transmissions	0-11
Chassis	0-12
Chassis Lubrication	0-12
Front Wheel Bearings	0-12
Brake Master Cylinder	0-12
Parking Brake	0-12
Steering Gear	0-12
Electrical	0-12
Battery Care (Energizer)	0-12
Dual Action Safety Hood Latches	0-13
Air Conditioning	0-13
Body Lubrication	0-13
Body Lubrication Points (Corvette)	0-13

The time or mileage intervals on the following pages are intended as a general guide for establishing regular maintenance and lubrication periods for your car. Sustained heavy duty or high speed operations or operation under adverse conditions may necessitate more frequent servicing.

ENGINE

CRANKCASE CAPACITY

4 Cylinder	4 qt.
6 Cylinder	4 qt.
8 Cylinder (302)	4 qt.
8 Cylinder (307)	4 qt.
8 Cylinder (327)	4 qt.
8 Cylinder (350)	4 qt.
8 Cylinder (396)	4 qt.
8 Cylinder (427) Chevrolet	4 qt.
8 Cylinder (427) Corvette	5 qt.

For 4 Cyl. Add .5 qt. with filter change;
1 qt. for 6 and 8 Cyl. engines.

LUBRICATION

Crankcase oil should be selected to give the best performance under the climatic and driving conditions in the territory in which the vehicle is driven.

During warm or hot weather, an oil which will provide adequate lubrication under high operating temperatures is required.

During the colder months of the year, an oil which will permit easy starting at the lowest atmospheric temperature likely to be encountered, should be used.

When the crankcase is drained and refilled, the crankcase oil should be selected, not on the basis of the existing temperature at the time of the change, but on the lowest temperature anticipated for the period during which the oil is to be used.

Unless the crankcase oil is selected on the basis of viscosity or fluidity of the anticipated temperature, difficulty in starting will be experienced at each sudden drop in temperature.

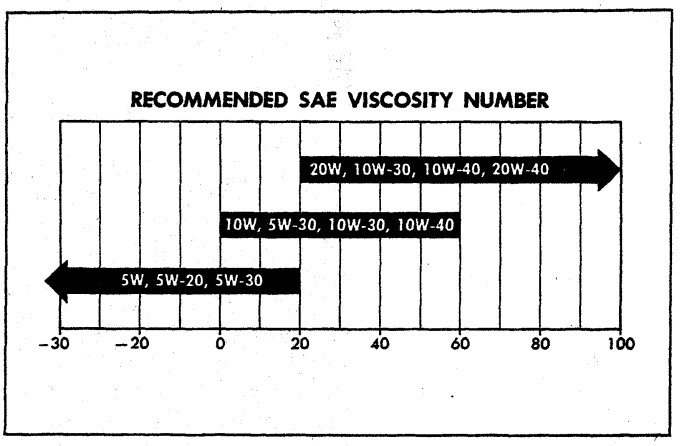
SAE VISCOSITY OILS

SAE Viscosity Numbers indicate only the viscosity or body of the oil, that is, whether an oil is a light or a heavy body oil, and do not consider or include other properties or quality factors.

The lower SAE Viscosity Numbers, such as SAE 5W and SAE 10W which represents the light body oils, are recommended for use during cold weather to provide easy starting and instant lubrication. The higher SAE Viscosity Numbers such as SAE 20 and SAE 20W, which represents heavier body oils, are recommended for use during warm or hot weather to provide improved oil economy and adequate lubrication under high operating temperatures.

Oils are available which are designed to combine the easy starting characteristics of the lower SAE Viscosity Number with the warm weather operating characteristics of the higher SAE Viscosity Number. These are termed "multi-viscosity oils," SAE 5-10W, SAE 5W-20, SAE 10W-20W, and SAE 10W-30.

The following chart will serve as a guide in selecting the proper oil viscosity. In addition to providing proper lubrication, the correct viscosity helps assure good cold and hot starting by reducing friction and thus increasing cranking speed.



- SAE 5W and 5W-20 oils are not recommended for sustained high speed driving.
- SAE 30 oils may be used at temperatures above 60°F.

Types of Oils

In service, crankcase oils may form sludge and varnish and under some conditions, corrosive acids unless protected against oxidation.

To minimize the formation of these harmful products and to assure the use of oil best suited for present day operating conditions, automobile manufacturers have developed a series of sequence tests designed to evaluate the ability of any oil to properly lubricate automobile engines.

It is recommended that only those oils which are certified by their suppliers as meeting or exceeding the maximum severity requirements of these sequence tests (or GM Standard 6041-M) be used in Chevrolet engines. Certified sequence tested oils will be described as such on their containers.

MAINTAINING OIL LEVEL

The oil gauge rod is marked "Full" and "Add Oil." These notations have broad arrows pointing to the level lines. The oil level should be maintained between the two lines, neither going above the "Full" line nor under the "Add Oil" line. DO NOT OVERFILL. After operating vehicle allow a few minutes for oil to return to crankcase before checking oil level.

Check the oil level frequently and add oil when necessary.

ENGINE OIL CHANGE INTERVALS

NOTE: Under prolonged dusty driving conditions, it is recommended that these operations be performed more often.

To insure continuation of best performance, low maintenance cost and long engine life, it is necessary to change the crankcase oil whenever it becomes contaminated with harmful foreign materials. Under normal driving conditions draining the crankcase and refilling with fresh oil every 4 months or every 6000 miles whichever occurs first, is recommended.

It is always advisable to drain the crankcase only after the engine has become thoroughly warmed up or reached normal operating temperature. The benefit of draining is, to a large extent, lost if the crankcase is drained when the engine is cold, as some of the suspended foreign material will cling to the sides of the oil pan and will not drain out readily with the cold, slower moving oil.

CRANKCASE DILUTION

Probably the most serious phase of engine oil deterioration is that of crankcase dilution which is the thinning of the oil by fuel vapor leaking by pistons and rings and mixing with the oil and by condensation of water on the cylinder walls and crankcase.

Leakage of fuel, or fuel vapors, into the oil pan occurs mostly during the "warming up" period when the fuel is not thoroughly vaporized and burned. Water vapor enters the crankcase through normal engine ventilation and through exhaust gas blow-by. When the engine is not completely warmed up, these vapors condense, combine with the condensed fuel and exhaust gases and form acid compounds in the crankcase.

As long as the gases and internal walls of the crankcase are hot enough to keep water vapor from condensing, no harm will result. However, when the engine is run in low temperatures moisture will collect and unite with the gases formed by combustion resulting in an acid formation. The acid thus formed is likely to cause serious etching or pitting which will manifest itself in excessively rapid wear on piston pins, camshaft bearings and other moving parts of the engine, oftentimes causing the owner to blame the car manufacturer or the lubricating oil when in reality the trouble may be traced back to the character of the fuel used, or a condition of the engine such as excessive blowby or improper carburetor adjustment.

Automatic Control Devices to Minimize Crankcase Dilution

All engines are equipped with automatic devices which aid greatly in minimizing the danger of crankcase dilution.

The thermostat, mounted in the cylinder head water outlet, restricts the flow of water to the radiator until a predetermined temperature is reached, thus minimizing the length of time required to reach efficient operating temperature, reducing the time that engine temperatures are conducive to vapor condensation.

A water by-pass is included in the cooling system, utilizing a hole in the front of the cylinder block. This allows a limited circulation of coolant, bypassing the thermostat until thermostat opening temperatures are reached. This system provides a uniform coolant temperature throughout the engine, eliminating localized hot-spots, improving exhaust valve life, provides fast warm-up of lubricating oil and fast temperature rise in the coolant which provides fast heater operation in cold weather.

A thermostatic heat control on the exhaust manifold during the warming up period, automatically directs the hot exhaust gases against the center of the intake manifold, greatly aids in proper vaporization of the fuel.

An automatic choke reduces the danger of raw or unvaporized fuel entering the combustion chamber and leaking into the oil reservoir.

An efficient crankcase ventilating system drives off fuel vapors and aids in the evaporation of the raw fuel and water which may find its way into the oil pan.

CRANKCASE VENTILATION VALVE

VALVE TYPE

Every 12,000 miles or 12 months the valve should be replaced. Connecting hoses, fittings and flame arrestor should be cleaned. At every oil change the system should be tested for proper function and serviced, if necessary.

AIR INJECTION REACTOR SYSTEM (A.I.R.)

The Air Injection Reactor system should have the A.I.R. pump filter serviced and the drive belt inspected for wear and tension every 12 months or 12,000 miles, whichever occurs first. In addition, complete effectiveness of the system, as well as full power and performance, depends upon idle speed, ignition timing, and idle fuel mixture being set according to specification. A quality tune-up which includes these adjustments should be performed periodically to assure normal engine efficiency, operation and performance.

MANIFOLD HEAT CONTROL VALVE

Every 6,000 miles, check valve for freedom of operation. If valve shaft is sticking, free it up with GM Manifold Heat Control Solvent or its equivalent.

OIL FILTER

Change engine oil filter at first engine oil change and every second oil change thereafter.

NOTE: For Vehicles in heavy duty operation involving continuous start-stop or prolonged idling, engine oil should be changed after 2500-3000 miles of operation. The filter should be changed after 5000-6000 miles of operation.

AIR CLEANER

NOTE: Under prolonged dusty driving conditions, it is recommended that these operations be performed more often.

Polyurethane Type—

Every 12,000 miles clean element in solvent, squeeze out solvent, then soak in engine oil and squeeze out excess.

Oil Wetted Paper Element Type—

First 12,000 miles inspect element for dust leaks, holes or other damage. Replace if necessary. If satisfactory, rotate element 180° from originally installed position. Replace at 24,000 miles. Element must not be washed, oiled, tapped or cleaned with an air hose.

If so equipped, replace Bow-Tie filter every 24,000 miles.

FUEL FILTER

Replace filter element located in carburetor inlet every 12 months or 12,000 miles whichever occurs first.

DISTRIBUTOR

4 and 6-Cylinder Engine--Remove distributor cap and rotate lubricator 1/2 turn at 12,000 mile intervals. Replace at 24,000 mile intervals.

8-Cylinder Engine--Change cam lubricator end for end at 12,000 mile intervals. Replace at 24,000 mile intervals.

REAR AXLE AND 3-SPEED 4-SPEED TRANSMISSIONS

The passenger car operates under the most severe lubrication conditions at high speed and requires a hypoid lubricant which will meet this condition.

RECOMMENDED LUBRICANTS

Standard Rear Axles--SAE 90 "Multi-Purpose" gear lubricant.

Positraction Rear Axles--Use special Positraction lubricant.

CAUTION: Straight Mineral Oil gear lubricants must not be used in hypoid rear axles.

Transmissions- -SAE 90 "Multi-Purpose" gear lubricant.

The SAE 90 viscosity grade is recommended for year round use. However, when extremely low temperatures are encountered for protracted periods during the winter months, the SAE 80 viscosity grade may be used.

"Multi-Purpose" Gear Lubricants

Gear lubricants that will satisfactorily lubricate hypoid rear axles have been developed and are commonly referred to as "Multi-Purpose" gear lubricants meeting U.S. Army Ord. Spec. MIL-L-2105B.

These lubricants can also be satisfactorily used in manual transmissions.

CAUTION: With Positraction rear axles use special Positraction lubricant.

"Multi-Purpose" gear lubricants must be manufactured under carefully controlled conditions and the lubricant manufacturer must be responsible for the satisfactory performance of his product. His reputation is the best indication of quality.

Lubricant Additions

The lubricant level in the axle and transmission housings should be checked periodically. (Every 6,000 miles.)

It is recommended that any additions required to bring up the lubricant level be made using the same type lubricant already in the housing.

When checking lubricant level in transmission or rear axle the unit being checked should be at operating temperature. With unit at operating temperature the lubricant should be level with bottom of the filler plug hole. If the lubricant level is checked with the unit cold the lubricant level should be 1/2 inch below the filler plug hole.

Lubricant Changes

The rear axle lubricant does not require changing for the life of the vehicle. If additions are needed, or when refilling the axle after service procedures, use lubricants described above.

Transmission Shift Linkage (Manual and Automatic)

Every 6000 miles or 4 months lubricate shift linkage and on manual transmission floor controls lever contacting faces with water resistant EP chassis lubricant which meets GM Specification 6031M.

Clutch Cross—Shaft

Periodic lubrication of the clutch cross shaft is not required. At 36,000 miles or sooner, if necessary; remove plug, install lube fitting and apply EP CHASSIS LUBRICANT which meets GM Specification GM 6031M.

AUTOMATIC TRANSMISSIONS

NOTE: At first transmission fluid change, it is recommended that the Powerglide and Torque Drive low band be adjusted as specified in Section 7 of this manual.

Powerglide, Torque Drive, and Turbo Hydra-Matic 350

Every 6,000 miles check fluid level on dipstick with engine idling, selector lever in neutral position, parking brake set and transmission at operating temperature. If fluid level is below full mark on dipstick, add small amount of automatic transmission fluid. Recheck fluid level and again add a small amount of fluid if needed to bring level to full mark. DO NOT OVERFILL.

General Motors DEXRON ® Automatic Transmission Fluid, Part numbers 1050568, 69, 70 which has been especially formulated and tested for use in your automatic transmission is recommended. Other Automatic Transmission Fluids identified with the mark DEXRON ® are also recommended.

Every 24,000 miles (more frequently, depending on severity of service, if vehicle is used to pull trailers, carry full loads during high ambient temperatures, operate in mountainous terrain or operate under other severe conditions) remove fluid from the transmission sump and add 2 quarts* U.S. measure (1 2/3 quarts* Imperial measure) of fresh fluid for Chevrolet and Chevelle; add one and a half (1 1/2) U.S. measure and (1 1/4 quarts Imperial measure) for Chevy II and Camaro. Operate transmission through all ranges and check fluid level as described above. For Turbo Hydra-Matic 350, add 2.5 quarts U.S. measure (2.0 quarts Imperial measure).

It is not necessary to remove the pan because a drain plug is provided.

Turbo Hydra-Matic 400

Lubrication for the Turbo Hydra-Matic 400 will, except for fluid capacity and filter change listed below, follow the recommendations above. After checking transmission fluid level it is important that the dipstick be pushed all the way into the fill tube.

Every 24,000 miles after removing fluid from the transmission sump, approximately 7 1/2 pints U.S. measure (6 pints Imperial measure) of fresh fluid will be required to return level to proper mark on the dipstick.

Every 24,000 miles the transmission sump strainer should be replaced.

*Except if vehicle is equipped with transmission provided in heavy duty service options. If so equipped, drain converter and sump every 24,000 miles and add approximately 9 quarts U.S. Measure (7 1/2 quarts Imperial Measure) of fresh fluid for Chevrolet and Chevelle and 7 1/2 quarts U.S. Measure (6 1/4 quarts Imperial Measure) for Nova.

CHASSIS

CHASSIS LUBRICATION

For chassis lubrication, consult the lubrication chart. It shows the points to be lubricated and how often the lubricant should be applied.

The term "chassis lubricant" as used in this manual, describes a water resistant EP chassis lubricant which meets GM Specification GM 6031M designed for application by commercial pressure gun equipment.

FRONT WHEEL BEARINGS

It is necessary to remove the wheel and hub assembly to lubricate the bearings. The bearing assemblies should be cleaned before repacking with lubricant. Do not pack the hub between the inner and outer bearing assemblies or the hub caps, as this excessive lubrication results in the lubricant working out into the brake drums and linings.

Front wheels of all passenger car models are equipped with tapered roller bearings and should be packed every 24,000 miles with a high melting point water resistant front wheel bearing lubricant which meets GM Specification GM 6031M whenever wheel and hub are removed.

CAUTION: "Long fibre" or "viscous" type lubricant should not be used. Do not mix wheel bearing lubricants. Be sure to thoroughly clean bearings and hubs of all old lubricant before repacking.

The proper adjustment of front wheel bearings is one of the important service operations that has a definite bearing on safety. A car with improperly adjusted front wheel bearings lacks steering stability, has a tendency to wander or shimmy and may have increased tire wear. The adjustment of these bearings is very critical. The procedure is covered in Section 3 of this manual under Front Wheel Bearings--Adjust.

BRAKE MASTER CYLINDER

Check level every 6,000 miles and maintain 1/4" below lowest edge of each filler opening with GM Hydraulic Brake Fluid Supreme No. 11.

PARKING BRAKE

Every 6,000 miles, apply water resistant lubricant which meets GM Specification GM 6031M to parking brake cable, cable guides and at all operating links and levers.

STEERING GEAR

Manual

Check lubricant level every 36,000 miles. If required, add EP Chassis Lubricant which meets GM Specification GM 6031M. (See Section 9)

Power Steering Pump

On models equipped with power steering gear, check fluid at operating temperature in pump reservoir. Add GM Power Steering Fluid, or, if this is not available, use Dexron ® Automatic Transmission Fluid to bring level to full mark on dip stick.

ELECTRICAL

BATTERY CARE (ENERGIZER)

Every 6000 miles—Clean terminals and oil felt washer.

Check the fluid level in each cell of your battery regularly. The electrolyte level indicator in the cap of one cell will glow if the fluid level is low. In this case each cell should be checked. Keep filled with distilled water to the bottom of the split ring in the vent tube.

DUAL ACTION SAFETY HOOD LATCHES

Every 12,000 miles or 12 months, whichever occurs first, apply Lubriplate or its equivalent to the hood catch and lock plate.

AIR CONDITIONING

Every 6,000 miles check sight glass under the hood, after the system has been in operation for several minutes. Sight glass should be clear but may, during milder weather, show traces of bubbles. Foam or dirt indicate a leak which should be repaired immediately.

BODY LUBRICATION

See Body Service Manual for Body Lubrication. (Except Corvette)

BODY LUBRICATION POINTS (CORVETTE)

Lubricate the following items when possible.

Hood Latch Mechanism and Hinges--Apply light engine oil to pivot points. Don't oil lock pins or catch plates.

Rear Compartment Lid Release and Hinges--Apply light engine oil.

Side Door Hinge Pins -- Apply light engine oil.

Door Lock Rotor and Strike Plate--Apply light engine oil or stainless stick lubricant.

Lock Cylinders -- Lubricate with powdered graphite.

Window Regulators and Controls and Door Lock Remote Link -- Apply light engine oil.

Gas Tank Filler Cap Hinge-- Apply light engine oil.

Weatherstrips and Rubber Bumpers -- Coat lightly with a rubber lubricant.

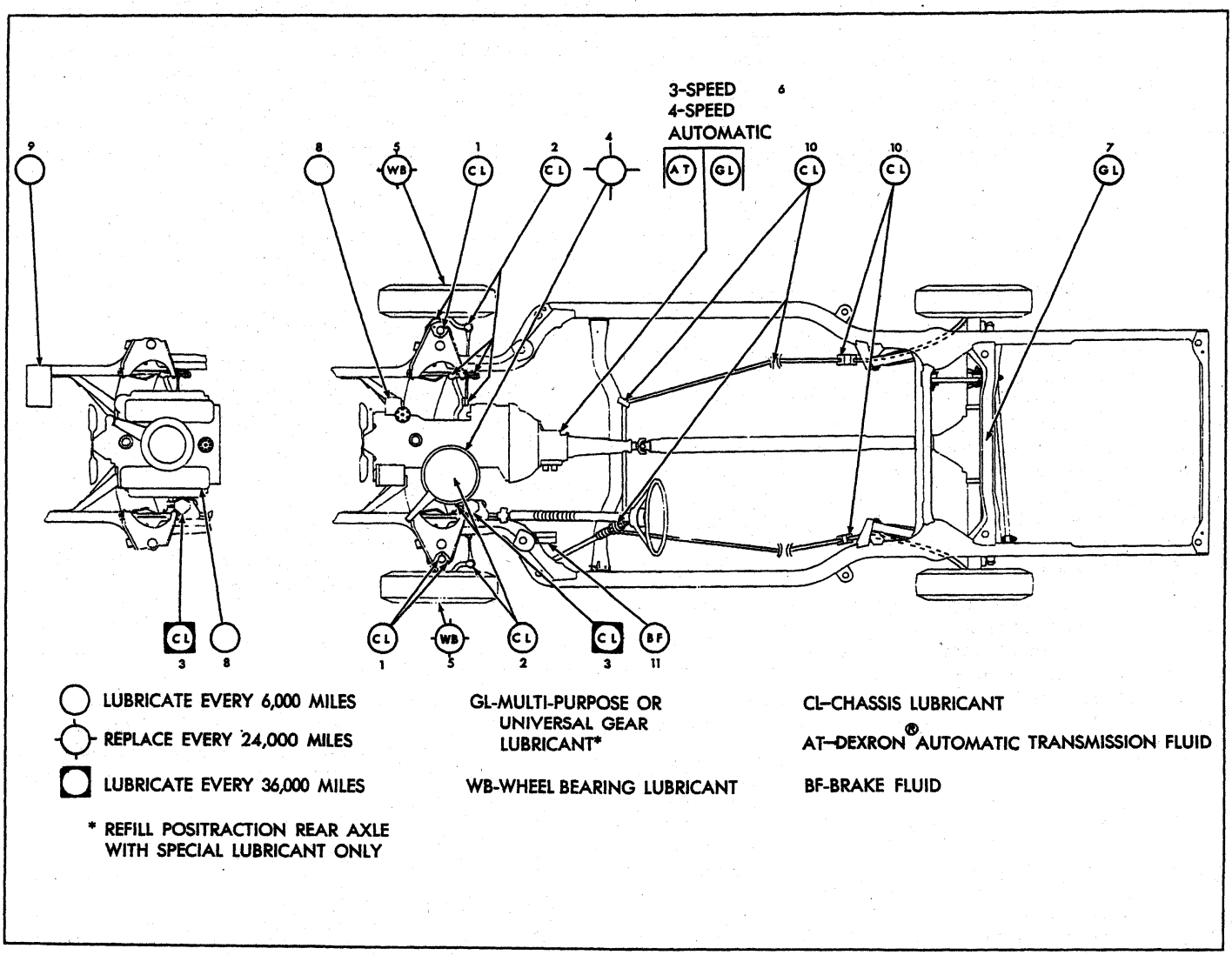


Fig. 10—Lubrication Diagram—Chevrolet

1. Front Suspension
2. Steering Linkage
3. Steering Gear
4. Air Cleaner
5. Front Wheel Bearings
6. Transmission
7. Rear Axle
8. Oil Filter
9. Battery
10. Parking Brake
11. Brake Master Cylinder

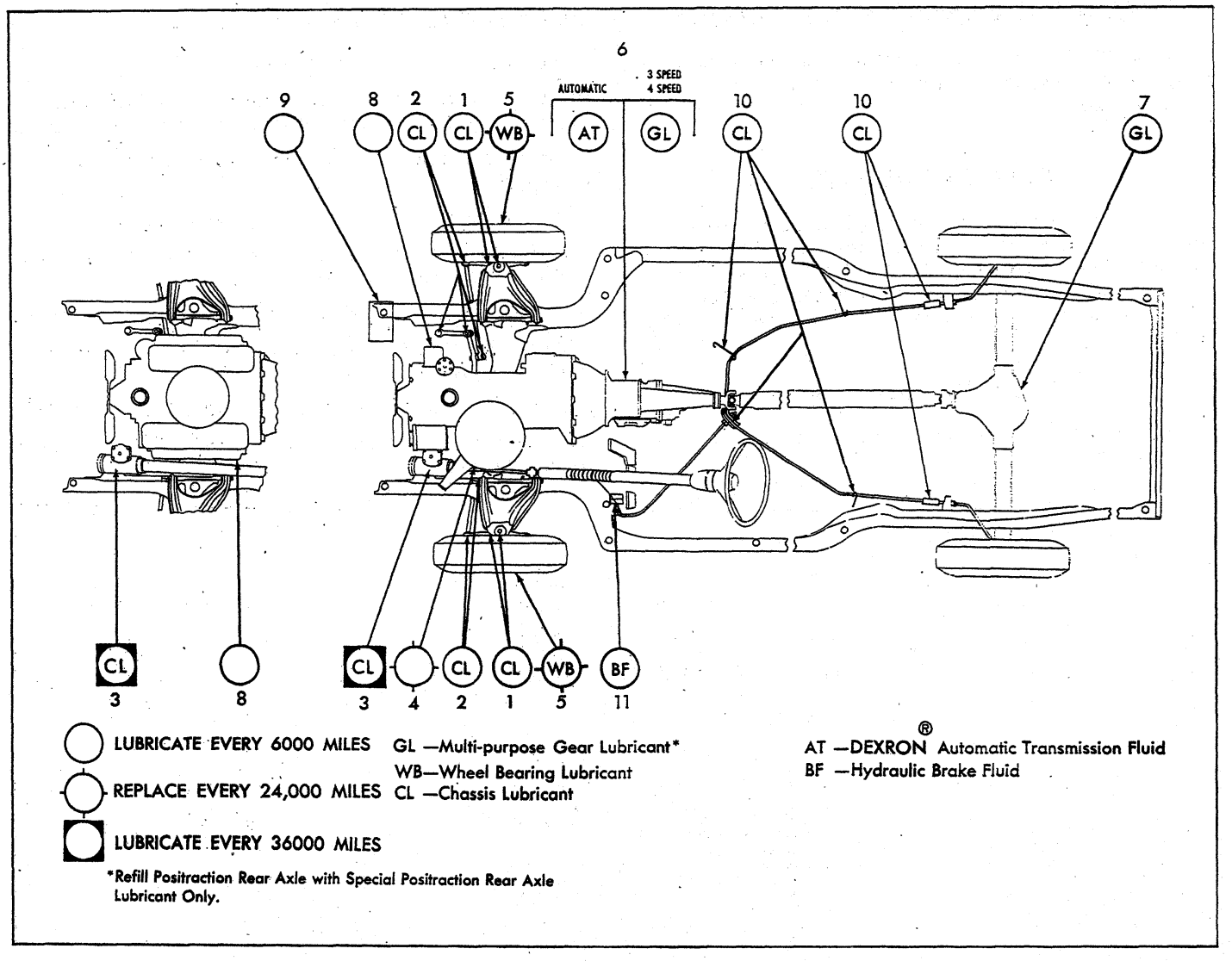


Fig. 11—Lubrication Diagram—Chevelle

1. Front Suspension
2. Steering Linkage
3. Steering Gear
4. Air Cleaner
5. Front Wheel Bearings
6. Transmission
7. Rear Axle
8. Oil Filter
9. Battery
10. Parking Brake
11. Brake Master Cylinder

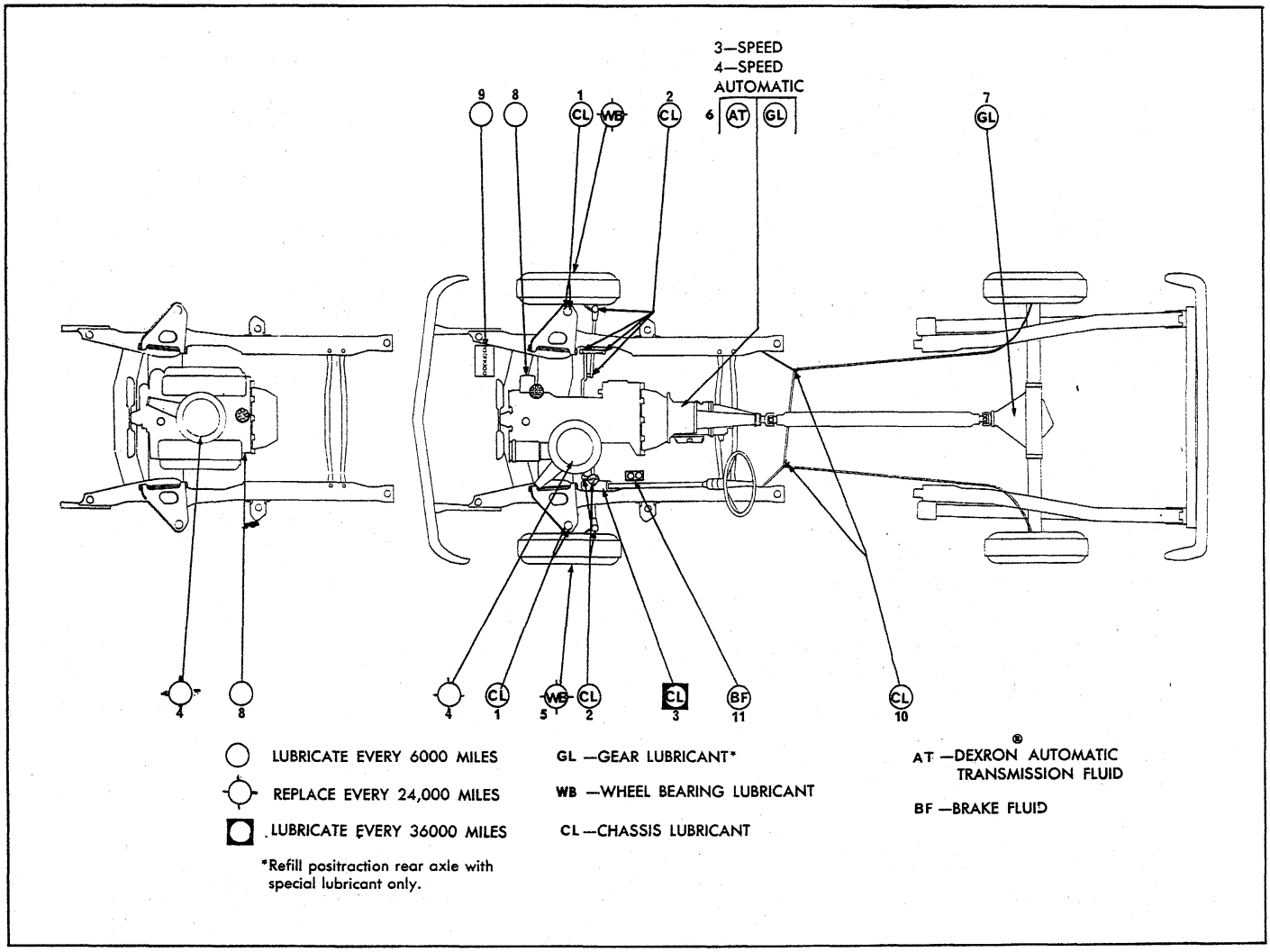


Fig. 12—Lubrication Diagram—Nova and Camaro

1. Front Suspension
2. Steering Linkage
3. Steering Gear
4. Air Cleaner
5. Front Wheel Bearings
6. Transmission
7. Rear Axle
8. Oil Filter
9. Battery
10. Parking Brake
11. Brake Master Cylinder

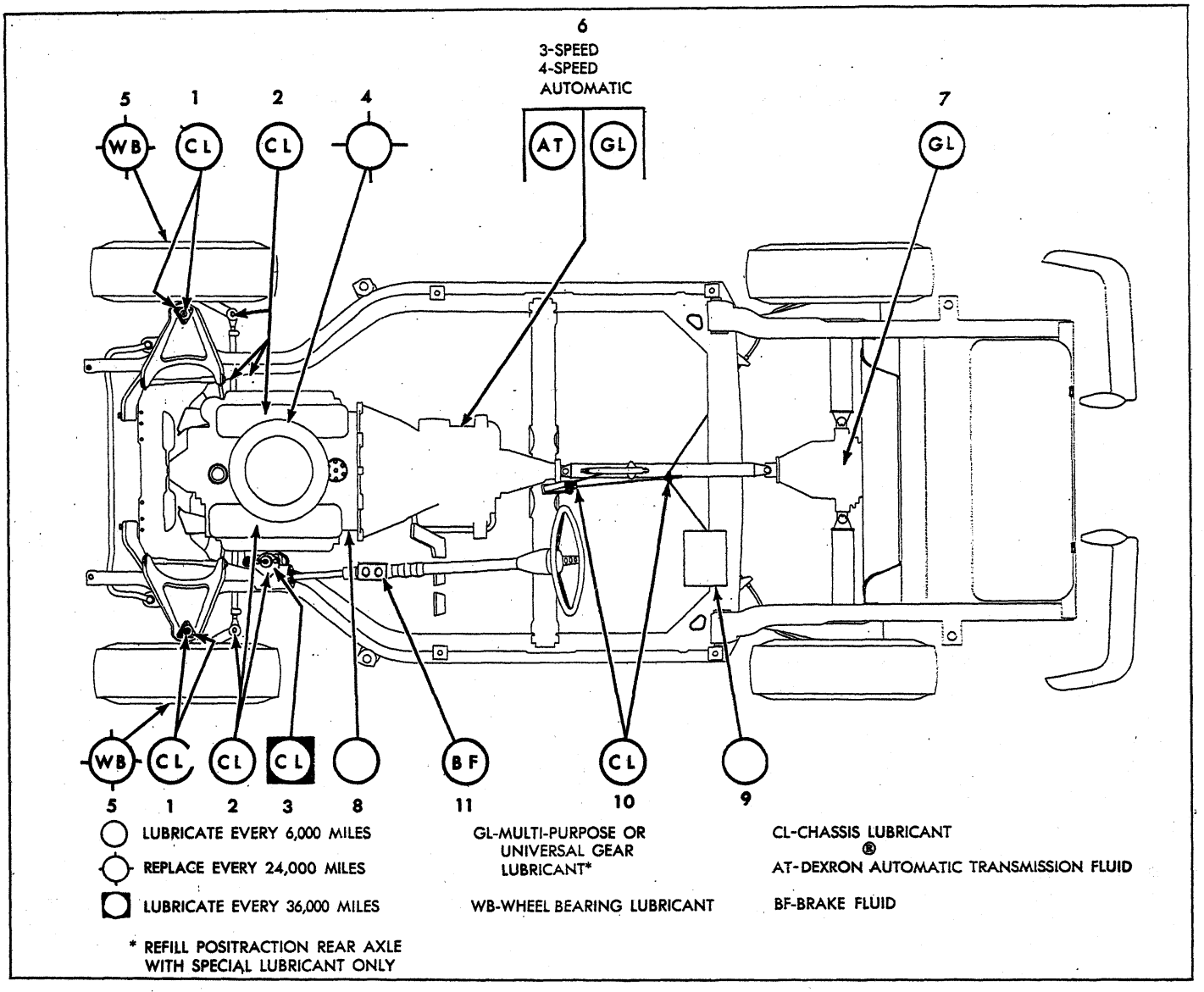


Fig. 13—Lubrication Diagram—Corvette

1. Front Suspension
2. Steering Linkage
3. Steering Gear
4. Air Cleaner
5. Front Wheel Bearings
6. Transmission
7. Rear Axle
8. Oil Filter
9. Battery
10. Parking Brake
11. Brake Master Cylinder

SECTION 1A
HEATER, ASTRO-VENTILATION AND AIR CONDITIONING

CONTENTS OF THIS SECTION

	Page
Heater	1A-1
Astro-Ventilation	1A-9
Air Conditioning	1A-12

HEATER

INDEX

Subject	Page
General Description	1A-1
Controls	1A-2
Chevrolet, Chevelle, Chevy Nova and Camaro	1A-2
Corvette	1A-2
Component Replacement and Repair	1A-3
Blower Assembly	1A-3
Air Distributor Duct and Core - All Vehicles	1A-4
Heater Hoses	1A-5
Control Head Assembly	1A-5
Defroster Duct - All Vehicles	1A-6
Bowden Cables - All Vehicles	1A-6
Vacuum Lines	1A-7
Blower Switch - All Vehicles	1A-7
Resistor - All Vehicles	1A-7

GENERAL DESCRIPTION

Heating components are attached to the firewall on the right side of the vehicle. The blower and air inlet assembly and water hoses are located on the engine side of the firewall while the heater core and distributor duct are on the passenger side.

The heater operates on outside air only, with the blower receiving its airflow from the cowl vent plenum chamber.

Since the unit has no water valve, water circulation keeps the core hot at all times. Air passing through the core receives maximum heat from the core.

Heater airflow is determined by positioning the three doors (Air, Temperature and Defroster) located in the distributor duct as shown in Figure 1.

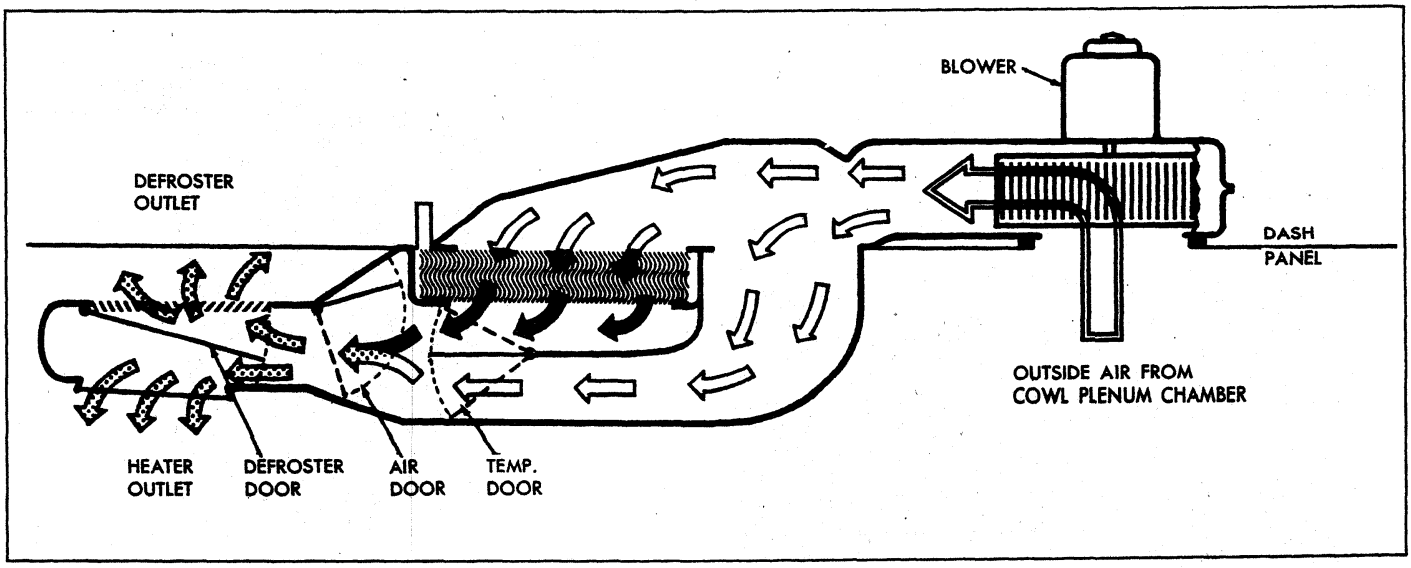


Fig. 1—Heater Air Flow - All Vehicles

CONTROLS

CHEVROLET, CHEVELLE, CHEVY NOVA AND CAMARO

The 1969 heater controls are found in three different locations: Chevrolet controls are left of the steering column, Chevelle in the middle of the dash and Nova and Camaro are located in the instrument cluster to the right of the steering column. Control operation is the same for all systems; however, Chevrolet and Chevelle controls operate horizontally while Nova and Camaro controls operate vertically (see Figures 2 and 3). All four controls incorporate three levers which make use of bowden cables to position the AIR, TEMPERATURE and DEFROSTER doors.

AIR-FAN Lever

The AIR-FAN lever is a combination control. Moving the lever half way, from "OFF" position, opens the AIR door to allow outside air to flow through the system. Further movement of the lever actuates the three-speed blower motor (LOW-MED-HIGH), which regulates the volume of airflow.

TEMPERATURE Lever

This lever controls the positioning of the TEMPERATURE door in the selector duct assembly. All incoming outside air is directed around the heater core in the "COLD" position or through the core in the "HOT" position. The desired outlet temperature is obtained by blending the heated and unheated air according to the setting of the temperature lever.

DEFROST Lever

The DEFROST lever controls the position of the DEFROSTER door. In the "OFF" position, almost all airflow is directed to the floor or heater outlet (a small amount of air is directed to the defroster outlets). In the "DE-ICE" position, all airflow is diverted to the defroster outlets. Moving the lever part way, as desired, will split airflow between the floor and defroster outlets for defogging operations.

CORVETTE

The Corvette controls are of a thumb-wheel design and are located in the floor console (Figure 4). The left-hand control uses vacuum to operate the AIR and DEFROSTER doors while the right control uses a bowden cable to actuate the TEMPERATURE door. Refer to Figures 1 and 4 while reviewing control operations described below.

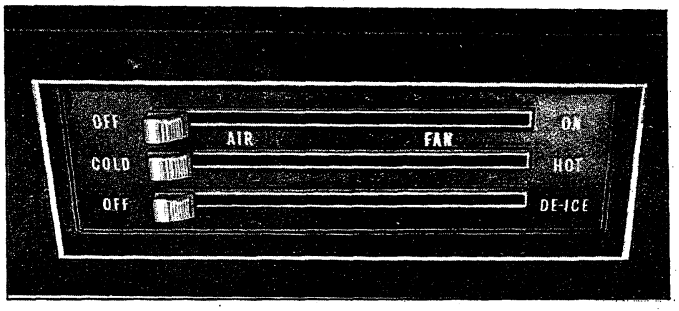


Fig. 2—Heater Controls - Chevrolet and Chevelle

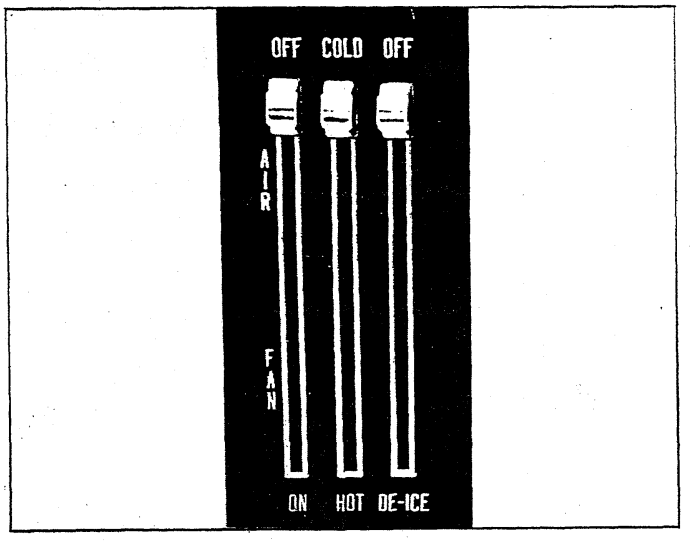


Fig. 3—Heater Controls - Nova and Camaro

AIR—DE-ICE Control

With the control at "OFF" (engine running), vacuum closes the AIR door, preventing air circulation through the system. At "AIR", there is no vacuum applied to the AIR door, allowing it to fully open. At the same time, vacuum is applied to the DEFROSTER door to send almost all airflow to the floor outlets (a small amount of air is permitted to bleed to the defroster outlets). At "DE-FOG", there is no vacuum applied to the DEFROSTER door, allowing airflow to be split between the floor and defroster outlets. At "DE-ICE", vacuum is applied to the DEFROSTER door directing almost all airflow to the defroster outlets.

NOTE: This system is designed in such a manner, that if there is a lack of vacuum for any reason, the AIR door will automatically be open and the DEFROSTER door will allow airflow to be split between floor and defroster outlets.

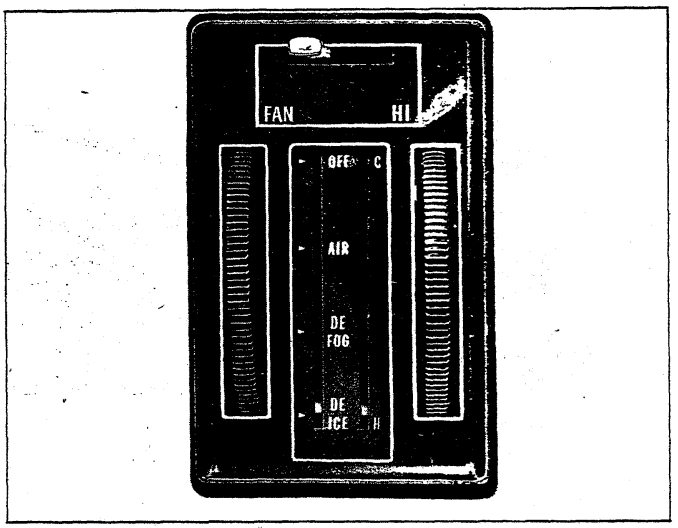


Fig. 4—Heater Controls - Corvette

TEMPERATURE Control

This thumb wheel controls the positioning of the TEMPERATURE door in the selector duct assembly. All incoming outside air is directed around the heater core in the "C" (cold) position or through the core in the "H" (hot) position. The desired outlet temperature is obtained by blending the heated and unheated air according to the setting of the temperature thumb wheel.

FAN Control

The blower fan lever is located at the forward side of the control panel. With the lever fully left, fan is inoperative. Moving the lever to the right activates the three-speed blower (LOW-MED-HIGH). The blower should not be turned on unless the AIR door has been opened.

COMPONENT REPLACEMENT AND REPAIR

BLOWER ASSEMBLY—Figure 5

Chevrolet

Replacement

1. Remove battery and battery tray.
2. Remove all wires, hoses, etc. attached to skirt.
3. Remove the rear skirt extension.
4. Remove skirt attaching bolts.
5. Once skirt is freed, lower and rest skirt on wheel.
6. Disconnect the blower motor wire at the motor flange.
7. Remove the motor attaching screws and remove motor. Pry the flange gently if the sealer acts as an adhesive.
8. Remove the blower wheel retaining nut and separate blower and motor.
9. To install, follow the removal procedure in reverse order.

NOTE: Assemble the blower wheel to the motor with the open end of the blower away from the motor.

Chevelle

Replacement

1. Disconnect battery ground cable.
2. Remove battery. Remove all heater hoses, wires, etc. attached to the right fender skirt.
3. Raise front of vehicle on hoist.
4. Remove all skirt attaching bolts and lower skirt on tire.

NOTE: On vehicles with plastic fender skirts, remove only those screws required to bend plastic skirt out of way and gain access to the blower motor.

5. Disconnect blower motor wire and remove screws retaining blower motor to case. Remove blower motor.
6. Remove the blower wheel retaining nut and separate blower and motor.
7. Reverse the removal procedure for installation.

NOTE: Assemble the blower wheel to the motor with the open end of the blower away from the motor.

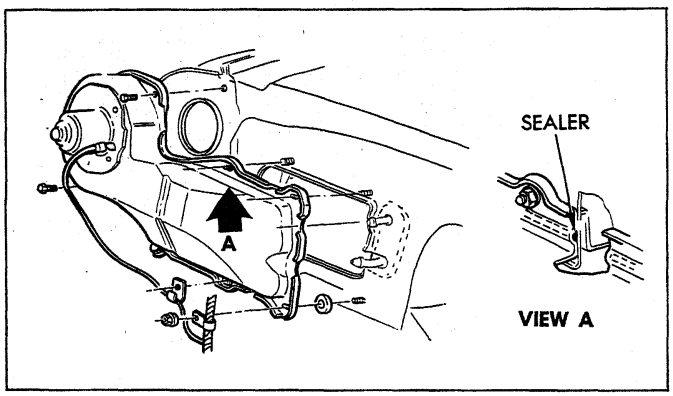


Fig. 5—Blower and Case (Typical)

Nova

Replacement

1. Disconnect battery ground cable.
2. Remove all wires, hoses, etc. attached to the right fender skirt.
3. Place front of vehicle on hoist and remove right front wheel.
4. Remove all skirt attaching screws and lower skirt on wheel.
5. Remove blower motor wire.
6. Remove blower to case attaching screws and remove blower assembly. Pry the flange gently if the sealer acts as an adhesive.
7. Remove the blower wheel retaining nut and separate the blower and motor.
8. To install, reverse the removal procedure.

NOTE: Assemble the blower wheel to the motor with the open end of the blower away from the motor.

Camaro

Replacement

1. Disconnect battery ground cable.
2. Disconnect hoses, wiring, etc. at fender skirt.
3. Remove wheel opening trim if so equipped.
4. Remove rocker panel molding to fender and rear quarter panel screws and remove molding.
5. Loosen rear lower fender to body bolt.
6. Remove the (9) rearmost fender skirt attaching screws.
7. Pull out on lower edge of fender at rear edge of wheelhouse, pull downward on skirt and place a 2x4" block of wood (about 6" long) between the fender and skirt.
8. Remove the blower to case attaching screws and remove blower assembly. Pry the flange gently if the sealer acts as an adhesive.
9. Remove the blower wheel retaining nut and separate the blower and motor.

10. To install, reverse the removal procedure.

NOTE: Assemble the blower wheel to the motor with the open end of the blower away from the motor.

Corvette

Replacement

1. Disconnect battery ground cable.
2. Remove radiator supply tank screws, if so equipped, and lay tank to one side.
3. Disconnect blower motor wires.
4. Remove the blower motor to case mounting screws and remove motor assembly. Pry the flange gently if the sealer acts as an adhesive.
5. Remove the blower wheel retaining nut and separate blower and motor.
6. To install, reverse the removal procedure.

NOTE: Assemble the blower wheel to the motor with the open end of the blower away from the motor.

AIR DISTRIBUTOR DUCT AND CORE— ALL VEHICLES (Fig. 6)

Replacement

1. Disconnect battery ground cable.
2. Drain radiator.
3. Disconnect heater hoses at core connections by air inlet assembly and install plugs in core tubes to prevent spilling coolant when removing core and air distributor assembly.

NOTE: The hose from the water pump must go to the top heater core pipe; the other hose runs from the thermostat housing to the lower core pipe (fig. 7).

4. Remove the nuts from air distributor duct studs on engine side of firewall.
5. Chevrolet and Nova - Remove glove box and door assembly. Corvette - Remove right instrument panel pad (See Section 1B). Remove right hand dash braces. Remove center dash console duct and floor outlet duct.

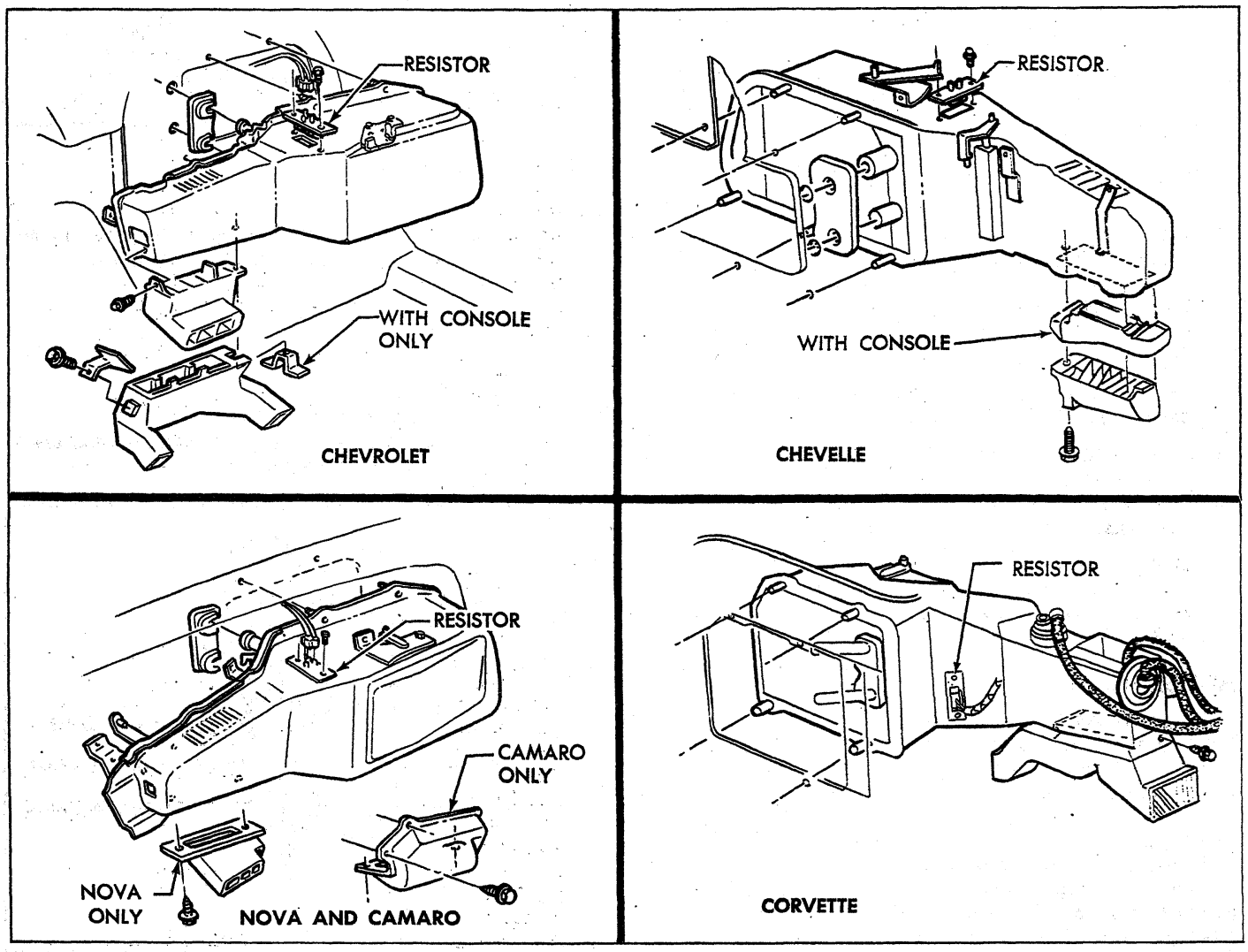


Fig. 6—Heater and Air Distributor

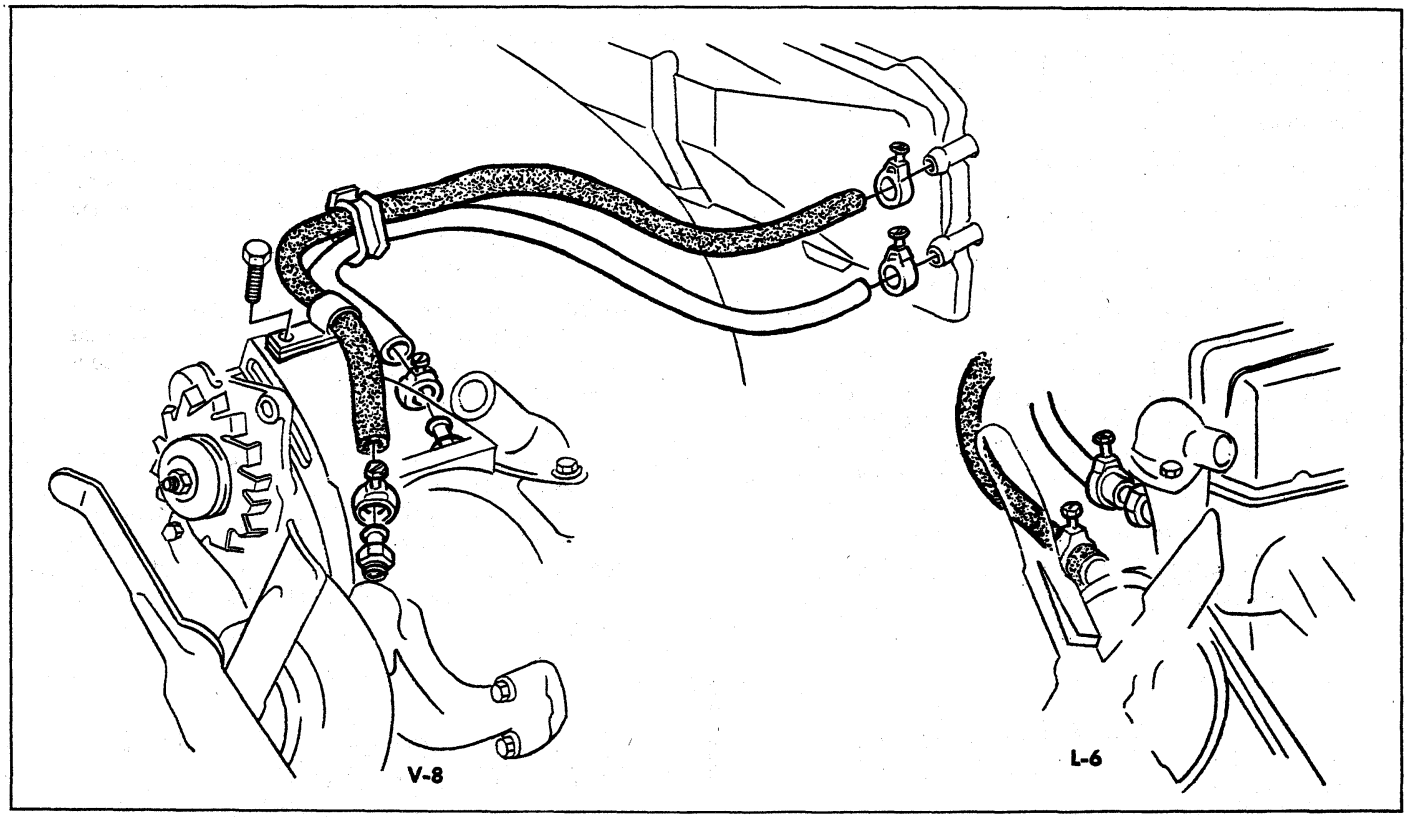


Fig. 7—Heater Hose Routing (Chevrolet Shown as Typical)

6. All except Corvette - From under dash, drill out lower right hand distributor stud with a 1/4" drill. Corvette - Remove radio and center dash console.
7. Pull distributor duct from firewall mounting. When clearance is obtained, remove resistor wires. Lay distributor duct on the floor.

   NOTE: When removing distributor duct, be very careful not to bend or kink the bowden cables.

8. Remove the core assembly retaining springs and remove core.
9. To install, reverse the removal procedure. Check for coolant leaks.

   NOTE: Be sure the core to case sealer is intact before replacing core. Replace with new sealer if necessary. Replace drilled-out stud with a new screw and pall nut (stamped nut).

HEATER HOSES

Heater hoses are routed from the water pump and thermostat housing to the core inlet and outlet pipes as shown in Figure 7. Hoses are attached at each end with screw type clamps.

Replacement

The heater core can be easily damaged in the area of the core tube attachment seams whenever undue force is exerted on them. Whenever the heater core hoses do not readily come off the tubes, the hoses should be cut just forward of the core tubes. The portion of the hose remaining on the core tube should then be split longitudinally. Once the hoses have been split, they can be removed from the tubes without damage to the core.

CONTROL HEAD ASSEMBLY

Chevrolet

Replacement (Fig. 8)

1. Disconnect battery ground cable.
2. Remove radio knobs and pry out cluster trim plate.
3. Remove control head brace.

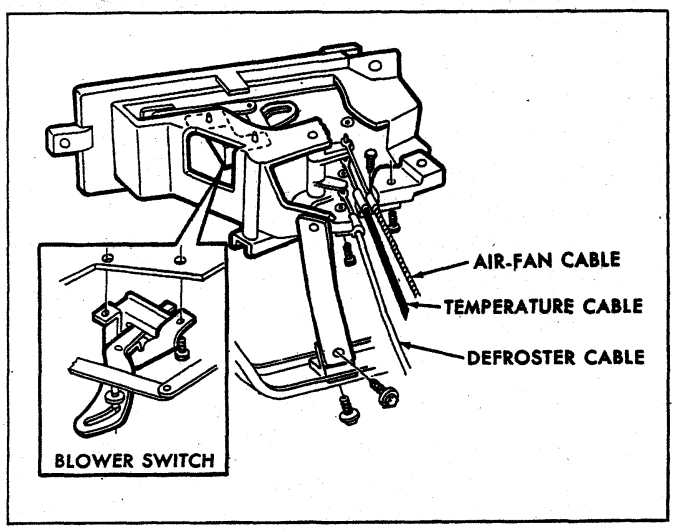


Fig. 8—Chevrolet Control Head Assembly

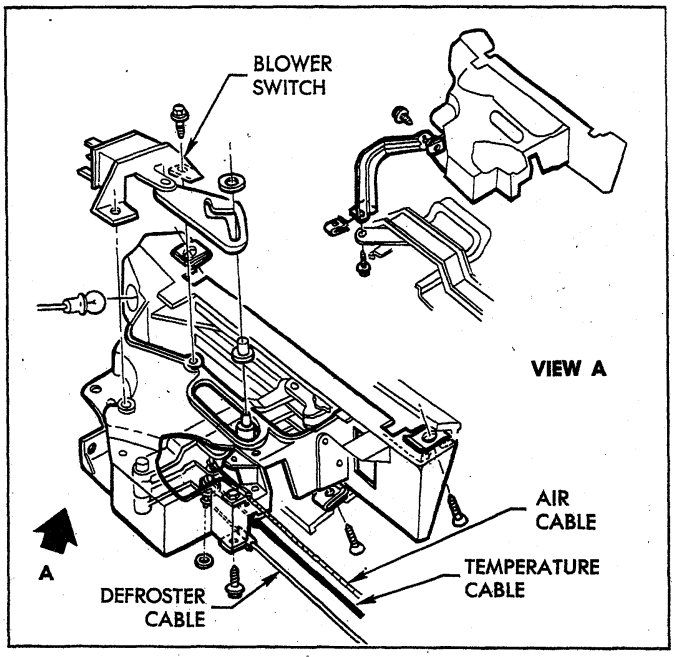


Fig. 9—Chevelle Control Head Assembly

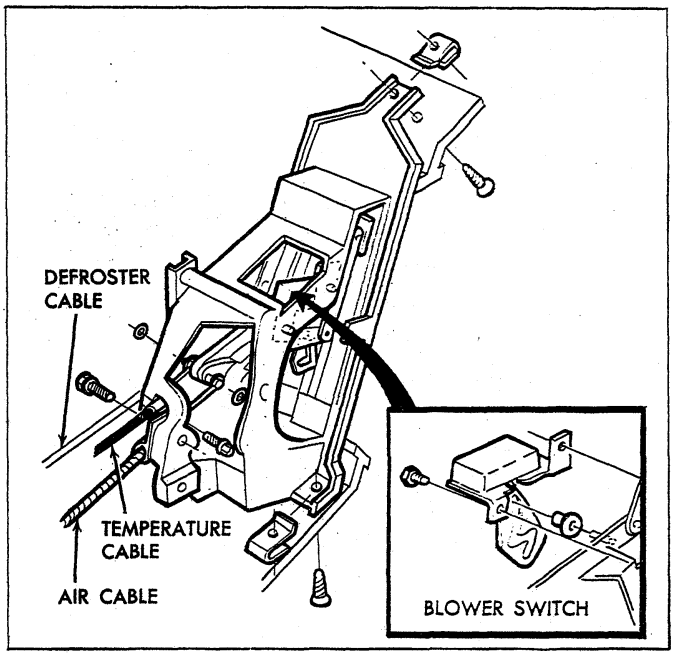


Fig. 10—Nova and Camaro Control Head Assembly

4. Remove screws securing control and lower control assembly from vehicle, being careful not to kink the bowden cables.
5. Disconnect the bowden cables and wires and remove control.
6. To install, reverse the removal procedure.

Chevelle, Nova and Camaro

Replacement (Figs. 9 and 10)

1. Disconnect battery ground cable.
2. Camaro - Remove instrument panel pad.
   Chevelle - Remove ash tray. Remove three screws attaching ash tray retainer to dash and remove retainer.
3. Remove radio (see Section 15).
4. Remove control head to instrument panel screws and lower control assembly from dash.
5. Remove bowden cables and wires from control head and remove control head.
6. To install, reverse the removal procedures.

Corvette

Replacement (Fig. 11)

1. Disconnect battery ground cable.
2. Remove floor console trim plate screws and remove trim plate.
3. Remove control panel screws and lift up, pulling slightly rearward.
4. Disconnect bowden cables, vacuum lines and wiring and remove control head assembly.
5. To install, reverse the removal procedure.

DEFROSTER DUCT—ALL VEHICLES

Defroster duct installation is illustrated in Figure 12.

Replacement

1. Follow Air Distributor Duct removal procedure as outlined previously.
2. Chevelle - Remove heater control head as outlined under "Control Head Assembly".
3. Remove defroster duct to firewall mounting screws and carefully lower from vehicle.
4. To install, reverse the removal procedure.

BOWDEN CABLES—ALL VEHICLES

Chevelle, Nova, Camaro and Corvette vehicles incorporate a new plastic bowden cable. Chevrolet uses the 1967 design steel cable.

Bowden cable attachment should be made in the following manner:

1. With the cables attached to the control assembly levers, move the levers to their fully left or closed position. Move the appropriate distributor duct door to the full off position.

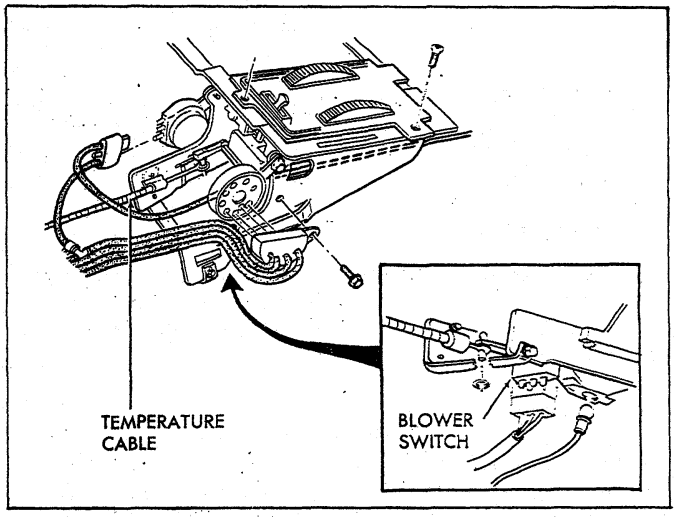


Fig. 11—Corvette Control Head Assembly

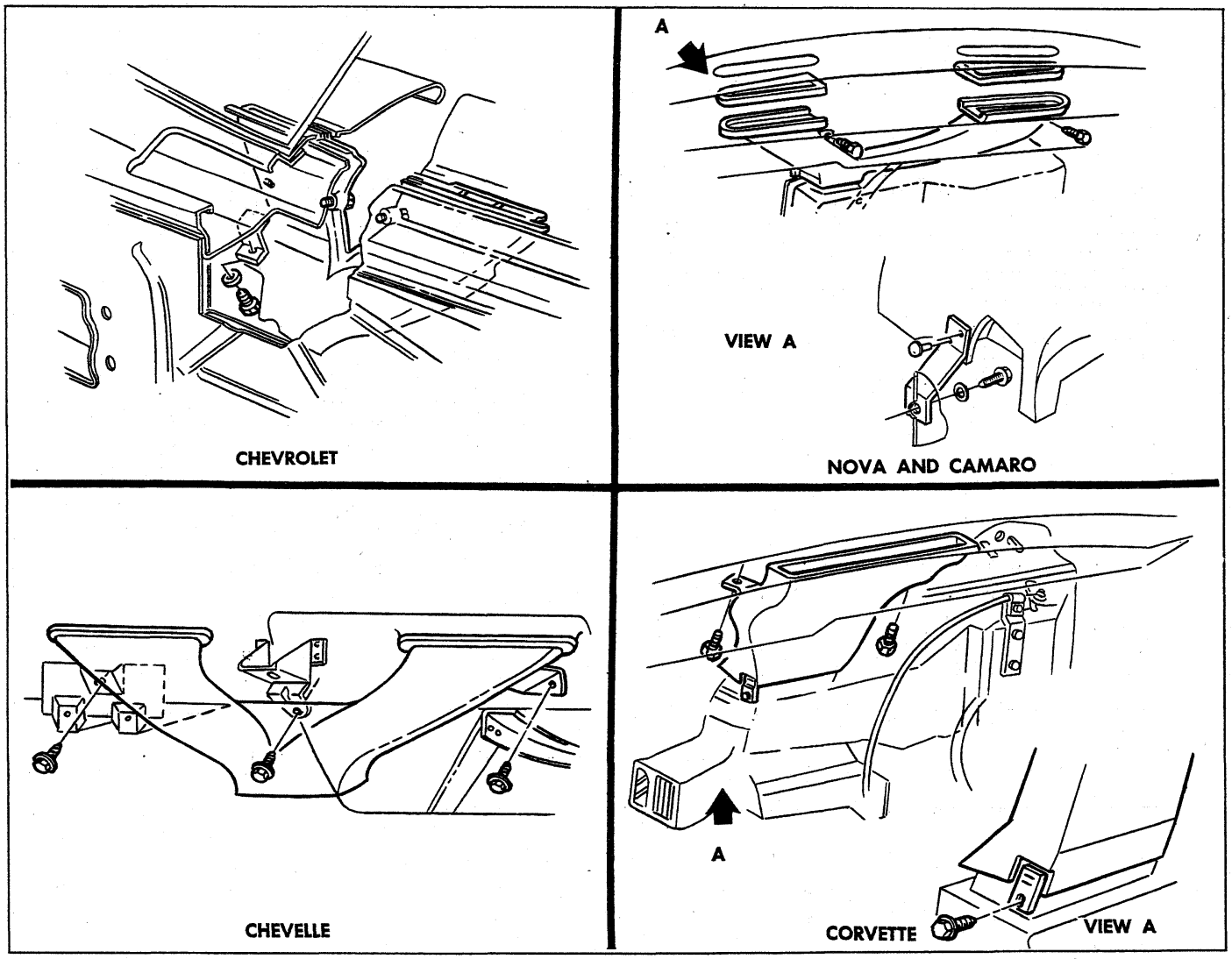


Fig. 12—Defroster Ducts

2. Attach cable wires to the duct door lever and tighten cable attaching bracket screws.
3. Check for proper cable operation.

VACUUM LINES

Vacuum lines are used on Corvette heating systems. The lines are molded to a connector which attaches to a vacuum control port on the control head assembly (see Figure 14).

In case of leakage or hose collapse, it will not be necessary to replace the entire harness assembly. Repair can be made by cutting the hose and inserting a plastic connector.

If an entire hose must be replaced, cut all hoses off at the control head connector, discard the connector and assemble the hoses directly to the vacuum switch (fig. 13).

BLOWER SWITCH—ALL VEHICLES

Replacement

1. Chevelle, Nova and Camaro - Follow Control Head Assembly Replacement Steps 1-4.

   Corvette - Follow Control Head Assembly Replacement Steps 1-3.

2. Remove blower switch to control assembly screws and remove switch assembly.

3. Remove blower switch electrical connector.

4. To install, reverse the removal procedure.

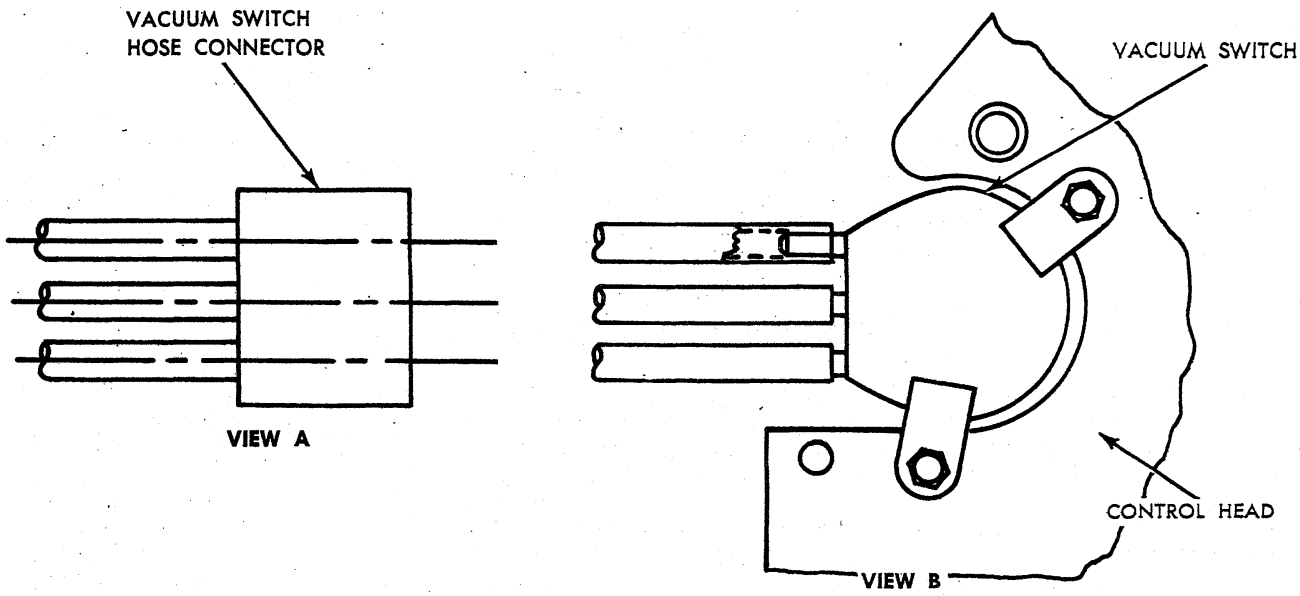
RESISTOR—ALL VEHICLES

Replacement

1. Disconnect wire at resistor unit.

2. Remove two screws to distributor duct and remove resistor unit.

3. To install new unit, reverse removal procedure.



When an individual hose is being replaced that leads into the Vacuum Switch Hose Connector —

1. Cut all hoses off connector (View A).
2. Discard connector.
3. Assemble hoses directly to vacuum switch (View B).

Fig. 13—Vacuum Hose Repair (Typical)

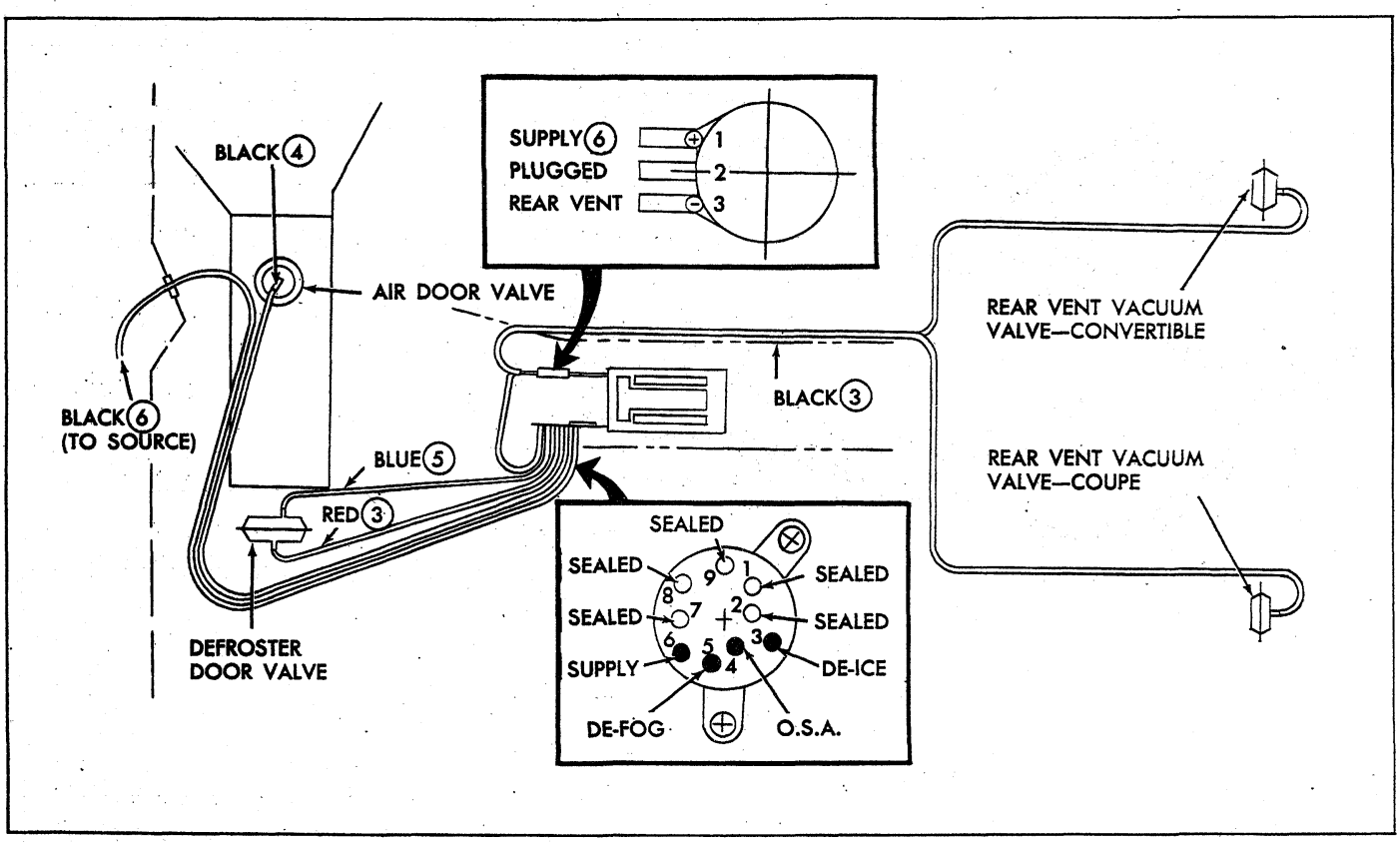


Fig. 14—Corvette Vacuum Harness

ASTRO-VENTILATION

INDEX

Subject	Page
General Description	1A-9
Component Part Replacement and Minor Repair	1A-10
Dash Outlet and Duct	1A-10
Rear Exhaust Doors - Corvette Only	1A-11
Vacuum Control - Corvette	1A-11

GENERAL DESCRIPTION

Astro-Ventilation is designed to provide ventilation air at breath level. Normally this air would be supplied by the front door vent window; however since the innovation of the one-piece front door window, another source was developed.

Astro-Ventilation is provided on all Chevrolet, Corvette and Camaro and some Chevelle models. Air inlet ducts are designed into the cowl plenum area. An air shut-off door, in the duct, is operated by a push-pull knob on the kick panel (Chevrolet, Chevelle and Camaro) or in the instrument panel (Corvette).

The cowl inlets are connected to side dash outlets by ducts or hoses. The side dash outlets are identical to those used with Air Conditioning. Chevrolet and Camaro side outlets are rectangular in design and can be rotated vertically or horizontally to direct airflow. Chevelle and Corvette models incorporate spherical outlets that can be rotated to provide soft diffused air or spot cooling.

On Chevrolet, Chevelle and Camaro, air is vented to the atmosphere through exhaust outlet grilles located in the left and right rear lock pillars.

Corvette models incorporate a vacuum operated door to exhaust air to the atmosphere (See Figure 15 for air flow pattern). This door is located behind the rear window and is open unless the temperature control is moved off "C" on the heater control panel.

Refer to the Fisher Body Service Manual for air flow patterns and plenum door and cable replacement on Chevrolet, Chevelle and Camaro models.

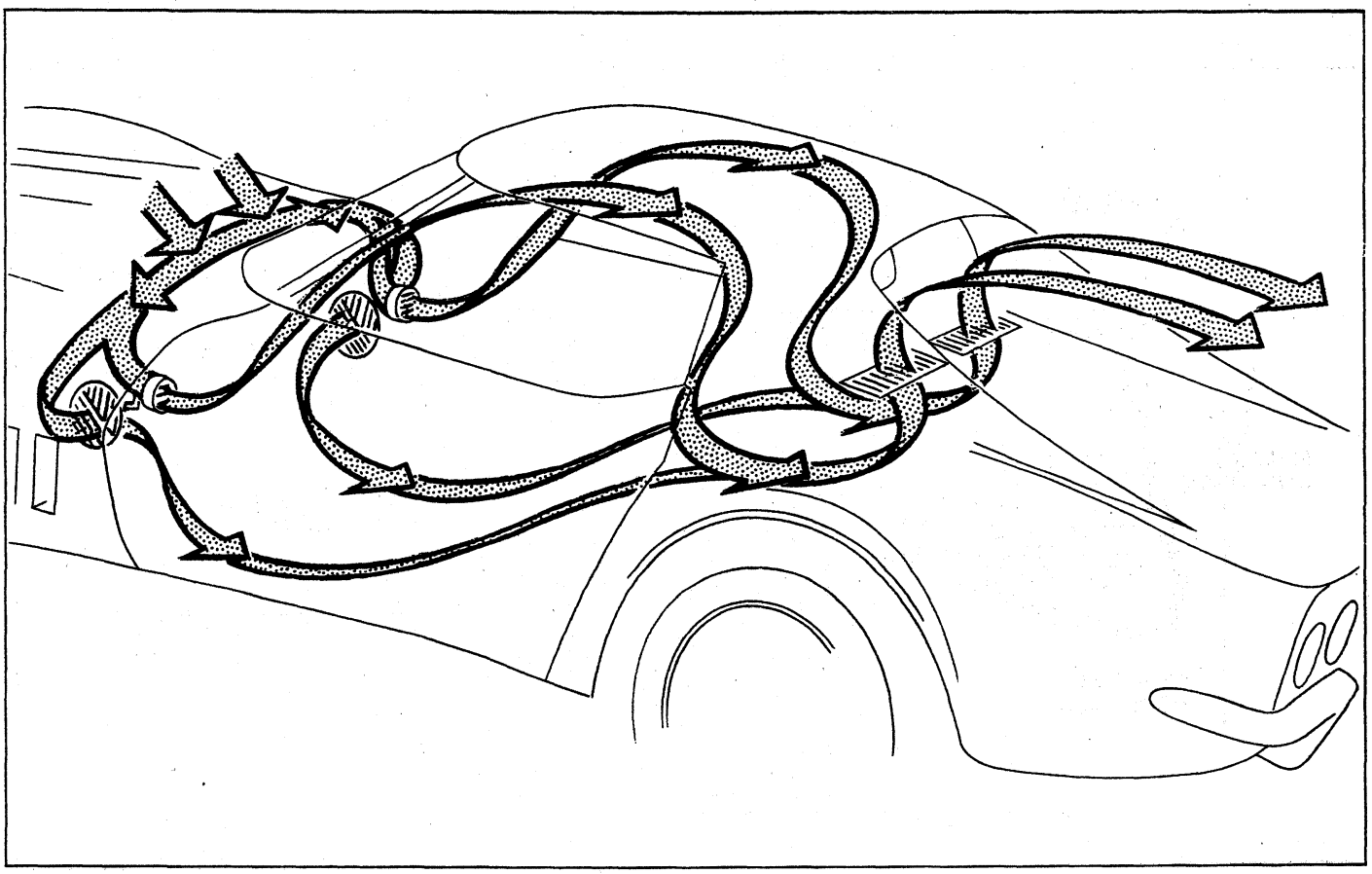


Fig. 15—Air Flow Pattern - Corvette

COMPONENT PART REPLACEMENT AND MINOR REPAIR

DASH OUTLET AND DUCT (Fig. 16)

Chevrolet

Replacement

1. Disconnect the battery ground.
2. Left Side - Remove the windshield pillar pad. Right Side - Remove the glove box. Remove the instrument panel pad far enough to gain access to the outlet screw.
3. Remove the outlet upper screw to the instrument panel.
4. Remove the duct to cowl screw and remove the duct and outlet.
5. To install, reverse Steps 1 through 4.

Chevelle

Replacement

1. Disconnect the battery ground cable.
2. Remove the outlet bezel screws and remove the bezel, ball outlet and housing as a unit.
3. Remove the adapter screws and remove the adapter and flexible hoses.
4. To install, reverse Steps 1 through 3.

Camaro

Replacement

1. Disconnect the battery ground cable.
2. Right Side - Remove the glove box assembly. Remove the instrument panel pad far enough to remove the outlet screw.
3. Remove the outlet assembly retaining screws and remove the outlet assembly and duct.
4. To install, reverse Steps 1 through 3.

Corvette

Replacement

1. Disconnect the battery ground cable.
2. Remove duct to cowl wing-nut and remove the duct.
3. Remove the adapter to instrument panel screws and remove the ball outlet assemblies.
4. To install, reverse Steps 1 through 3.

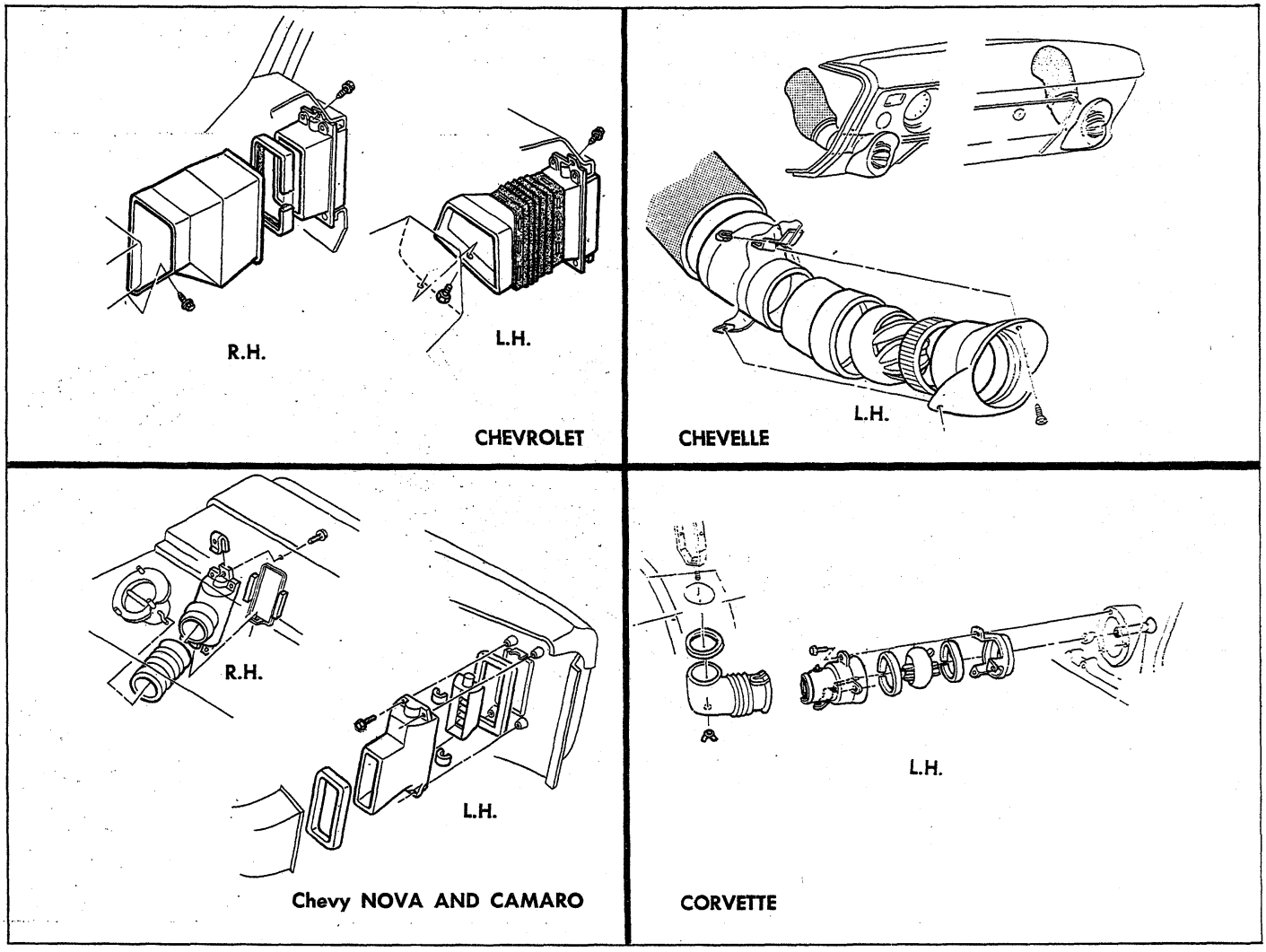


Fig. 16—Dash Outlets and Ducts

REAR EXHAUST DOORS—CORVETTE ONLY (Fig. 17)

Replacement

1. Disconnect the battery ground cable.
2. Remove the vacuum valve bracket screws.
3. Disconnect the valve at the door actuating rod, disconnect the vacuum hose and remove the valve assembly.
4. With the doors in the closed position, remove the three screws attaching each door assembly to the rear plenum and remove the door assemblies.
5. To install, reverse Steps 1 through 4.

VACUUM CONTROL—CORVETTE

Vacuum control is shown in the "HEATER" section of this manual under "Heater Control Head Assembly"; see Figure 14.

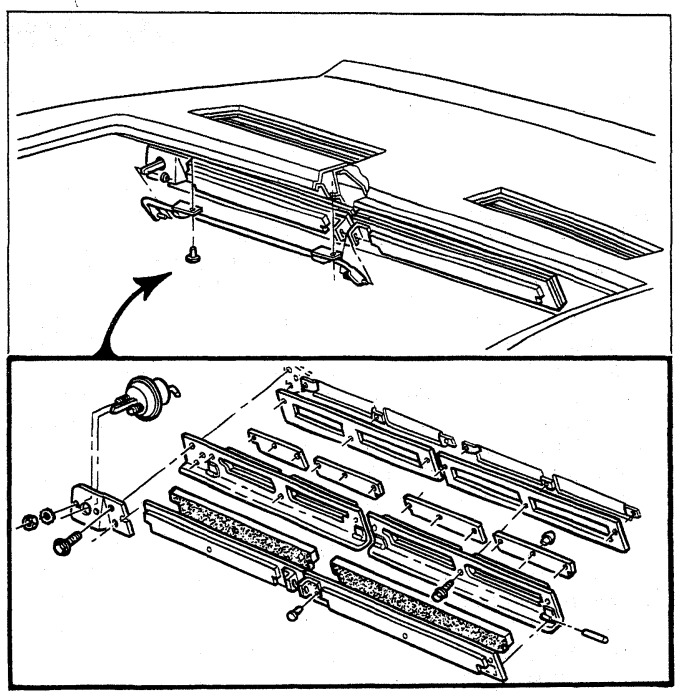


Fig. 17—Rear Exhaust Door - Corvette (Typical)

AIR CONDITIONING

INDEX

Subject	Page
General Description	1A-12
Four-Season System	1A-13
System Controls - Chevrolet and Corvette	1A-14
System Controls - Chevelle, Chevy Nova and Camaro	1A-15
Comfortron System	1A-16
System Components	1A-16
Controls	1A-19
GM Chevrolet Air Conditioner	1A-21
Controls	1A-21
General Information	1A-21
Precautions In Handling Refrigerant-12	1A-21
Precautions In Handling Refrigerant Lines	1A-22
Maintaining Chemical Stability In The Refrigeration System	1A-22
J-8393 Charging Station	1A-22
Gauge Set	1A-23
Vacuum Pump	1A-23
Leak Testing The System	1A-24
Availability Of Refrigerant-12	1A-25
Compressor Oil	1A-25
Compressor Serial Number	1A-25
Inspection and Periodic Service	1A-25
Pre-Delivery Inspection	1A-25
6000 Mile Inspection	1A-25
Periodic Service	1A-25
Installing Charging Station Gauge Set To Check System Operation	1A-26
Performance Data	1A-26
Performance Test	1A-26
Comfortron System Operational Test	1A-28
Chevrolet Comfortron Tester	1A-28
Check-Out Of Complete Electrical Circuit	1A-28
Complete System Checks	1A-30
Vacuum System Component Function	1A-34
Maintenance and Adjustments	1A-35
Evaporator Control Valve (POA)	1A-35
Thermostatic Switch	1A-36
Expansion Valve	1A-36
Engine Idle Compensator	1A-37
Evacuating and Charging Procedures	1A-37
Air Conditioning System Capacities	1A-37
Refrigerant Quick-Check Procedure	1A-38
Purging The System	1A-38
Evacuating and Charging The System	1A-38
Checking Oil	1A-40
Component Part Replacement and Minor Repair	1A-41
All Systems	1A-41
Preparing System For Replacement Of Component Parts	1A-41
Foreign Material In The System	1A-41
Refrigerant Line Connections	1A-41
Repair Of Refrigerant Leaks	1A-42
Refrigerant Hose Failure	1A-42
Condenser	1A-42
Receiver-Dehydrator	1A-44
Sight Glass Replacement - All Vehicles	1A-45
Compressor	1A-45
Compressor Failure	1A-46
Collision Procedure - All Systems	1A-46
Four-Season And Comfortron Systems	1A-48
Blower Motor	1A-48
Evaporator Core	1A-48
Evaporator Control Valve (POA)	1A-49
Expansion Valve	1A-49
Vacuum Tank	1A-50
Kick Pad Valve	1A-51
Plenum Valve	1A-52
Fuses	1A-53
Four-Season System Only	1A-53
Air Distributor and Heater Core	1A-53
Control Head	1A-56
Vacuum Lines	1A-56
Lower Heater Hose	1A-56
Water Valve	1A-57
Ambient Temperature Switch	1A-57
Blower Resistor	1A-59
Diverter Door Switch	1A-59
Comfortron Systems Only	1A-59
Air Selector Duct and Core Assembly	1A-59
Control Head	1A-60
Amplifier	1A-60
Power Servo	1A-61
Duct Feedback Potentiometer	1A-61
In-Car Sensor	1A-62
Sun-Ambient Sensor	1A-62
Master and High Blower Relays	1A-62
Blower Speed Resistor	1A-62
Water Valve	1A-62
Transducer	1A-62
GM Chevrolet Air Conditioning System Only	1A-63
Entire Evaporator Assembly	1A-63
Blower Assembly	1A-64
Expansion Valve, Evaporator and/or Evaporator Case	1A-64
Thermostatic and/or Blower Switches	1A-64
Resistor	1A-65
Fuse	1A-65
Wiring and Vacuum Diagrams	1A-66
Special Tools	1A-73

GENERAL DESCRIPTION

Three air conditioning systems are covered in this section. They are:

1. The Four-Season System (all vehicles).
2. The Comfortron System (Chevrolet).
3. The GM Chevrolet Air Conditioner (Chevrolet, Chevelle, Chevy Nova, Camaro).

Underhood components (that is, the compressor, condenser and receiver-dehydrator) are much the same in type, location and method of attachment on all of the above systems. The six-cylinder reciprocating compressor is bracket-mounted to the engine and belt driven from the crankshaft pulley. The condenser is mounted ahead of the engine cooling radiator and the receiver-dehydrator is mounted in the refrigerant line downstream of the condenser. Cooling system components are connected by means of flexible refrigerant lines.

Evaporator size and location differ from system to system as do methods of temperature control and air supply and distribution.

FOUR-SEASON SYSTEM (Fig. 18)

The Four-Season System may be identified by the fact that it uses an evaporator pressure control known as the POA (Pressure Operated Absolute) suction throttling valve.

Both the heating and cooling functions are performed by this system. Air entering the vehicle must pass through the cooling unit (evaporator) and through (or around) the heating unit, in that order, and the system is thus referred to as a "reheat" system.

The evaporator provides maximum cooling of the air passing through the core when the air conditioning system is calling for cooling. The control valve acts in the system only to control the evaporator pressure so that minimum possible temperature is achieved without core freeze-up. The valve is preset, has no manual control, is automatically altitude compensated, and non-repairable.

All models incorporate a water shut off valve which shuts off coolant flow through the heater core when the system is set for maximum cooling (control set at "MAX").

System operation is as follows (See Figure 19). Air, either outside air or recirculated air enters the system and is forced through the system by the blower. As the air passes through the evaporator core, it receives maximum cooling if the air conditioning controls are calling for cooling. After leaving the evaporator, the air enters the Heater and Air Conditioner Selector Duct Assembly where, by means of manually operated diverter doors, it is caused to pass through or to bypass the heater core in the proportions necessary to provide the desired outlet temperature. Conditioned air then enters the vehicle through either the floor distributor duct or the dash outlets. When, during cooling operations, the air is cooled by the evaporator to below comfort level, it is then warmed by the heater to the desired temperature; during "heating only" operations the evaporator will not be in operation and ambient air will be warmed to the desired level in the same manner.

The Chevrolet, Nova and Camaro side outlets are rectangular in design. The outlets are placed vertically in the vehicle and can be rotated horizontally or vertically to direct air as desired. Metering valves are provided

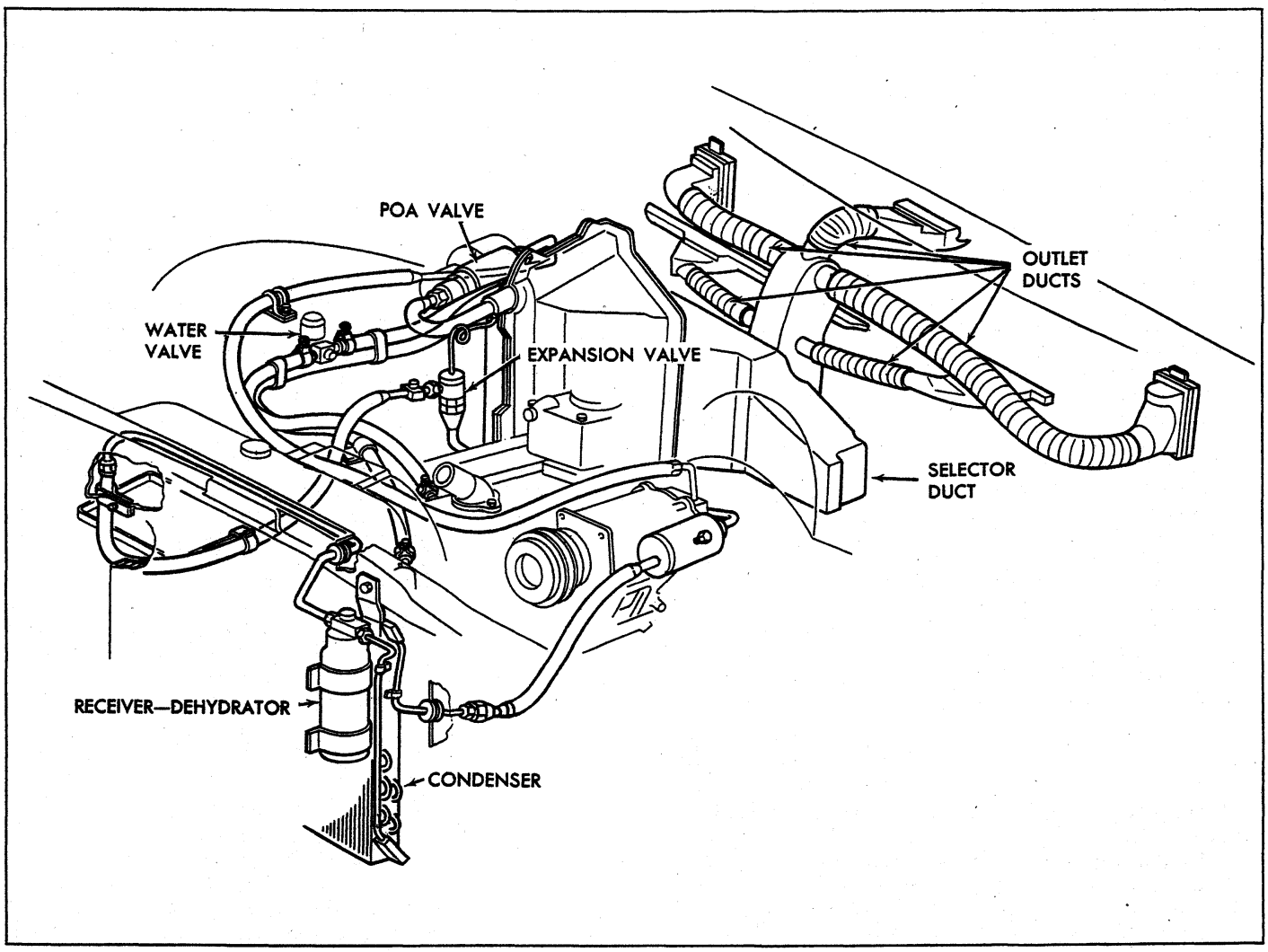


Fig. 18—Four-Season System Components (Chevrolet Shown as Typical)

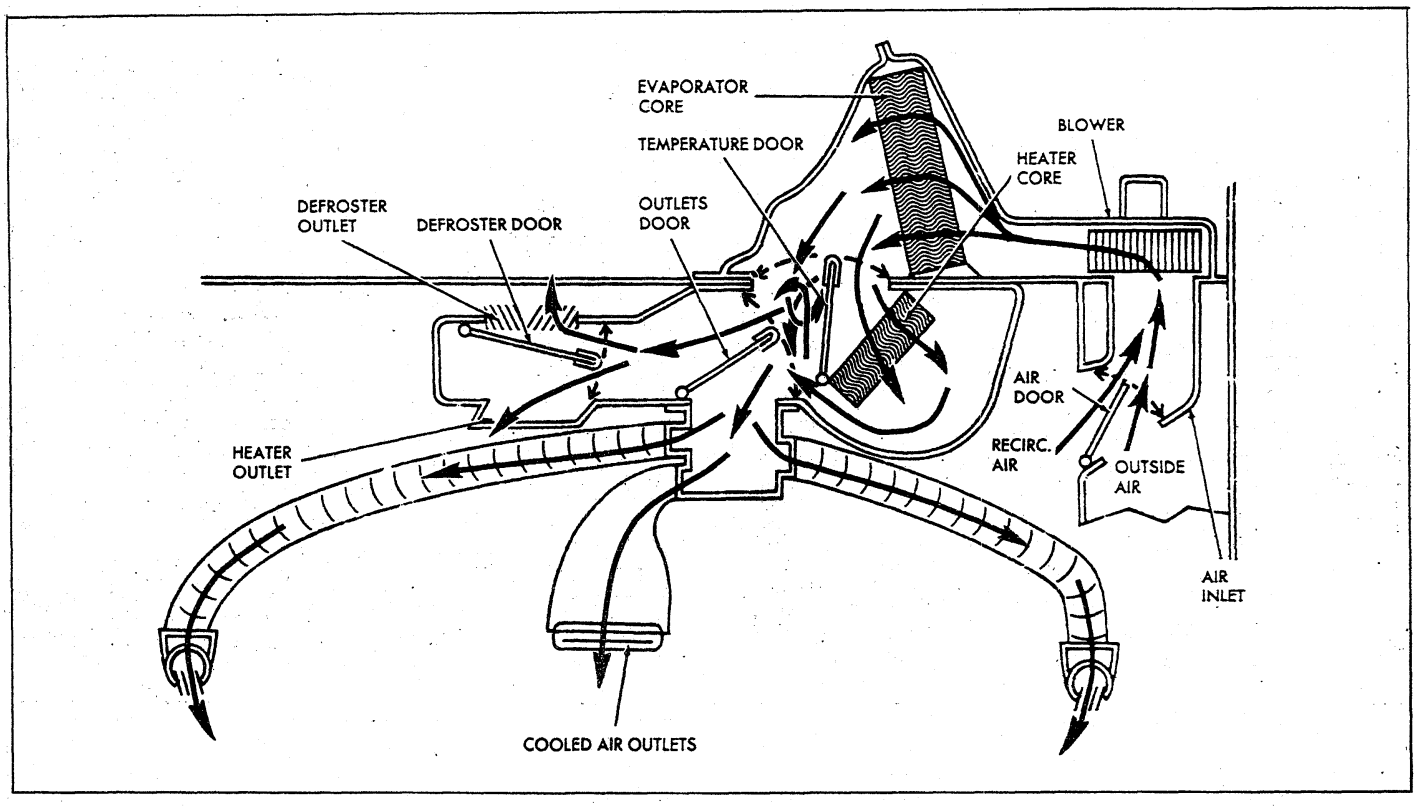


Fig. 19—Air Flow Schematic - Chevrolet Four-Season and Comfortron Shown

at each outlet to regulate the air supply. The Chevelle and Corvette models also incorporate metering valves but continue with spherical side outlets that may be rotated to supply either soft diffused airflow, spot cooling or completely shut off air flow. All models incorporate two independent rectangular center outlets that can be operated horizontally or vertically; a metering valve is also provided. Chevrolet models incorporate two lap coolers mounted to the dash under the steering column and glove box. Vertical vane control is provided. Under each lap cooler is located a floor cooler with an on-off selector control.

SYSTEM CONTROLS—CHEVROLET AND CORVETTE

Full control of Chevrolet and Corvette Four-Season Systems is maintained through the use of two levers (Chevrolet) or two thumb wheel controls (Corvette), plus a four-speed fan switch; see Figures 20 and 21. The upper lever (Chevrolet) or left thumb wheel (Corvette) makes use of a vacuum supply and electrical switches to operate various doors, the compressor and to operate the blower at "low" speed in "air-conditioning mode"; there are no bowden cables attached to this lever. The lower lever (Chevrolet) or right thumb wheel (Corvette), uses a bowden cable to operate the temperature door in the selector duct assembly.

For the purpose of clarification in the following description, selector control will be used to denote upper lever (Chevrolet) or left thumb wheel (Corvette) and temperature control will be used to denote lower lever (Chevrolet) or right thumb wheel (Corvette). The follow-

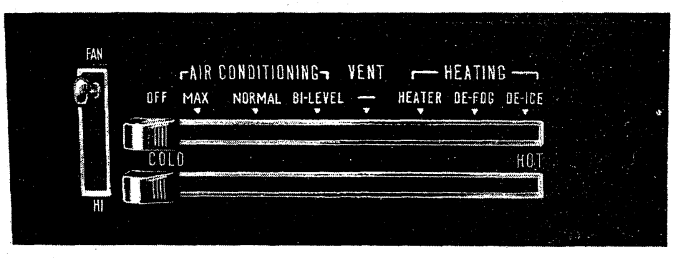


Fig. 20—Four-Season Controls - Chevrolet

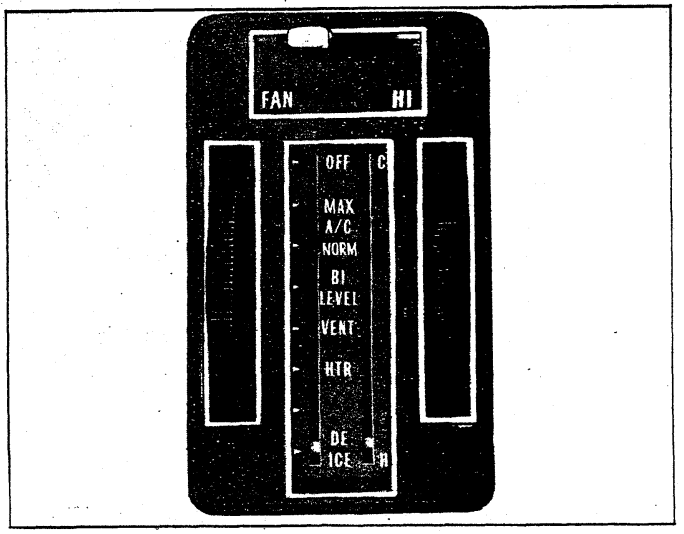


Fig. 21—Four-Season Controls - Corvette

ing terms are also synonymous: "NORM" and "NORMAL", "HTR" and "HEATER", "C" and "COLD", "H" and "HOT".

Selector Control

When this control is in the "OFF" position, the system is totally inoperative.

Air Conditioning— When the control is in any one of three positions ("MAX". "NORM" or "BI-LEVEL"), the compressor is "on" (providing the air temperature at the ambient switch is above 37°F) and the blower is automatically on "low". At the "MAX" position, the system is operating on inside air and the water valve is closed preventing coolant flow through the heater core (maximum cooling is obtained in this position). In the "NORM" and "BI-LEVEL" positions the system is operating on outside air and the water valve is open. In the "BI-LEVEL" position air flow is split between the dash and floor outlets with slightly warmer air coming out the floor outlets.

Vent— In this position the outside air door is open and the compressor is turned off, allowing unrefrigerated air (air may be warmed as desired) to enter the vehicle through the dash outlets and foot coolers.

Heating— With the control at "HEATER", vacuum is applied to the defroster door, directing almost all heat flow out the floor outlet (a small amount of heat is allowed to bleed to the defroster outlets). With the control at "DE-FOG" (Chevrolet) or arrow between "HTR" and "DE-ICE" (Corvette) airflow is split between floor and defroster outlets; there is no vacuum applied to the defroster door. At "DE-ICE", vacuum is applied to the defroster door diverting entire airflow out defroster outlets.

Temperature Control

This control operates the temperature door through use of a bowden cable. In "COLD" no airflow is allowed through the heater core. In "HOT" all air flows through the heater core. This control also operates an override vacuum switch which closes the water shut off valve when placed in the maximum cold position and will put the system into outside air whenever heat is called for, regardless of the position of the selector control.

Fan Switch

The fan switch controls the operation of the four-speed blower motor except when the selector lever is in the "OFF" position. This switch controls the volume of air flowing from the system.

Operating Hints

Maximum Heat

1. Move selector control to "HEATER".
2. Move temperature control to "HOT".
3. Move fan switch to "HI".

Maximum Cooling

1. Move selector control to "MAX".
2. Move temperature control to "COLD".
3. Move fan switch to "HI".

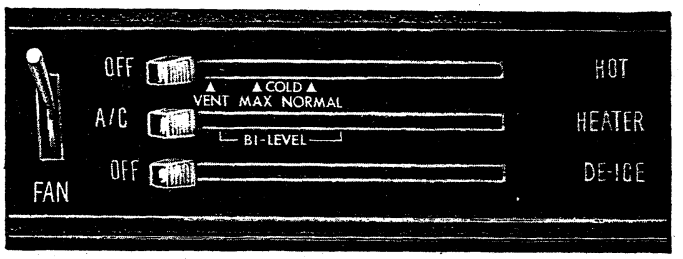


Fig. 22—Four-Season Controls - Chevelle

De-Ice

1. Move selector control to "DE-ICE".
2. Move temperature control to "HOT".
3. Move fan switch to "HI".

NOTE: The above conditions may be tempered by changing the position of the temperature control and/or varying the fan speed.

Whenever heat is called for, the system will always shift to outside air even if the selector control is left on the "MAX" position.

SYSTEM CONTROLS—CHEVELLE, CHEVY NOVA AND CAMARO

These three controls are similar in design and operation with the following exceptions: The Chevelle controls operate horizontally while the Nova and Camaro controls operate vertically (Fig. 22 and 23). The following paragraphs explain each control.

Upper Level (Chevelle), Left Lever (Chevy Nova and Camaro)

When this lever is in the "OFF" position, the system is totally inoperative; airflow is shut off, the blower will not operate and the compressor is "off". In the "VENT" position, the air selector doors are in the "outside air" position, allowing unconditioned ram air to enter the vehicle through the instrument panel outlets. At "MAX" (maximum A/C performance), the air selector doors are in the "inside air" or recirculating air position, the vacuum operated water valve has shut off water supply

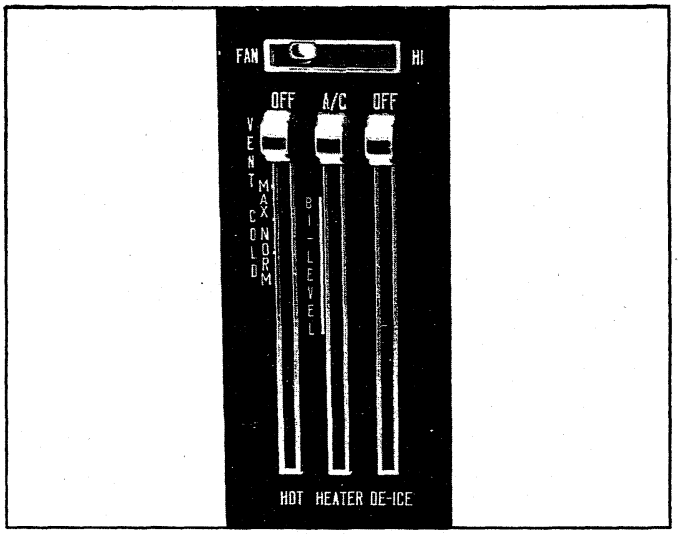


Fig. 23—Four-Season Controls - Nova and Camaro

to the heater core, the blower is automatically on "low" and the compressor is "on" (providing the air temperature at the ambient switch is above 37°F and the center lever is not placed at "HEATER"). At "NORMAL" or "NORM", the air selector doors are in the "outside air" position, no vacuum is supplied to the water valve allowing it to open and permit coolant flow to the heater core, the blower is still automatically on "low" and the compressor is still "on". Moving the lever between "NORM" and "HOT", tempers the condition of air flowing from the outlets.

NOTE: The compressor is "on" when this lever is in any position except "OFF" and "VENT" (providing the air temperature at the ambient switch is above 37°F and the center lever is anywhere except at "HEATER").

Center Lever

At "A/C" all air flows from the instrument panel outlets. Moving this lever to "BI-LEVEL", splits air flow between the floor and instrument panel outlets with slightly warmer air at the floor outlets. At "HEATER", all air flows from the heater or defroster outlets and the compressor is "OFF" regardless of the position of any other lever.

Lower Lever (Chevelle), Right Lever (Chevy Nova and Camaro)

This lever directs air to the defroster outlets. With the lever in "OFF", a fixed bleed permits a small quantity of air to flow to the defroster outlets while the major volume of air flows from the floor outlets. In the "DE-ICE" position, all air is diverted to the defroster outlets. Since the air must be in the heater duct in order to be directed by the defroster door, the center lever should be placed at "HEATER".

Fan Switch

The fan switch controls the operation of the four-speed blower motor except when the "upper lever" (Chevelle) or "left lever" (Nova and Camaro) is in the "OFF" position. This switch controls the volume of air flowing from the system.

Operating Hints

Maximum Heat

1. Move upper lever (Chevelle), left lever (Nova and Camaro) to "HOT".
2. Move center lever to "HEATER".
3. Move fan switch to "HI".

Maximum Cooling

1. Move upper lever (Chevelle), left lever (Nova and Camaro) to "MAX".
2. Place center lever at "A/C".
3. Move fan switch to "HI".

De-Ice

1. Move all three levers fully right (Chevelle), fully down (Nova and Camaro).
2. Move fan switch to "HI".

NOTE: Rapid windshield de-fogging, under certain temperature and humidity conditions, can be readily accomplished by placing the center lever in the "BI-LEVEL" position.

The above conditions can be tempered by moving the upper lever (Chevelle) or left lever (Nova and Camaro) between "NORM" and "HOT" and by varying the setting of the four-speed fan.

COMFORTRON SYSTEM

The Chevrolet Comfortron Air Conditioning System is basically the same as the Chevrolet Four-Season system but with the additional feature of completely automatic control. See Figures 24, 25 and 26 for views of the Comfortron system. To the customer, the most noticeable difference between the two systems, will be in the control panel. In place of the two-lever/one-switch panel of the Four-Season system, the Comfortron has a single control lever plus a temperature dial similar to that found in a home thermostat. After the dial is set to the desired temperature indication and the lever is moved to place the system in operation, the Comfortron will automatically control the heating and air conditioning functions to maintain the selected interior temperature regardless of changes in outside air temperatures.

Most Comfortron parts are located in the passenger compartment (fig. 26).

SYSTEM COMPONENTS

In-Car Sensor

The function of the in-car sensor is to determine the temperature of the interior of the automobile. It is located beneath the overhang of the instrument panel.

Feedback Potentiometer

The feedback potentiometer indicates to the amplifier system the position of the temperature door.

Control Head (Fig. 25)

A thumb wheel is provided to select the desired in-car temperature. A control lever performs the following functions:

1. Operates a switch that allows the customer to select the type of blower program desired.
2. Operates the control head vacuum switch except when the TEMPERATURE lever is in the OFF position, thus programming the vacuum system.
3. Operates the defroster through the control head vacuum switch. The defroster door is partially opened in the "DE-FOG" position, and fully open in the "DE-ICE" position.

A two transistor amplifier is located on the bottom side of the control head. It receives information from the sensors, and in turn operates the transducer.

Transducer

The transducer will produce a varying vacuum output in response to the input voltage provided by the amplifier. An increase in the applied voltage results in a reduced vacuum output.

Power Servo

The power servo receives a vacuum signal from the transducer, and is capable of assuming any position

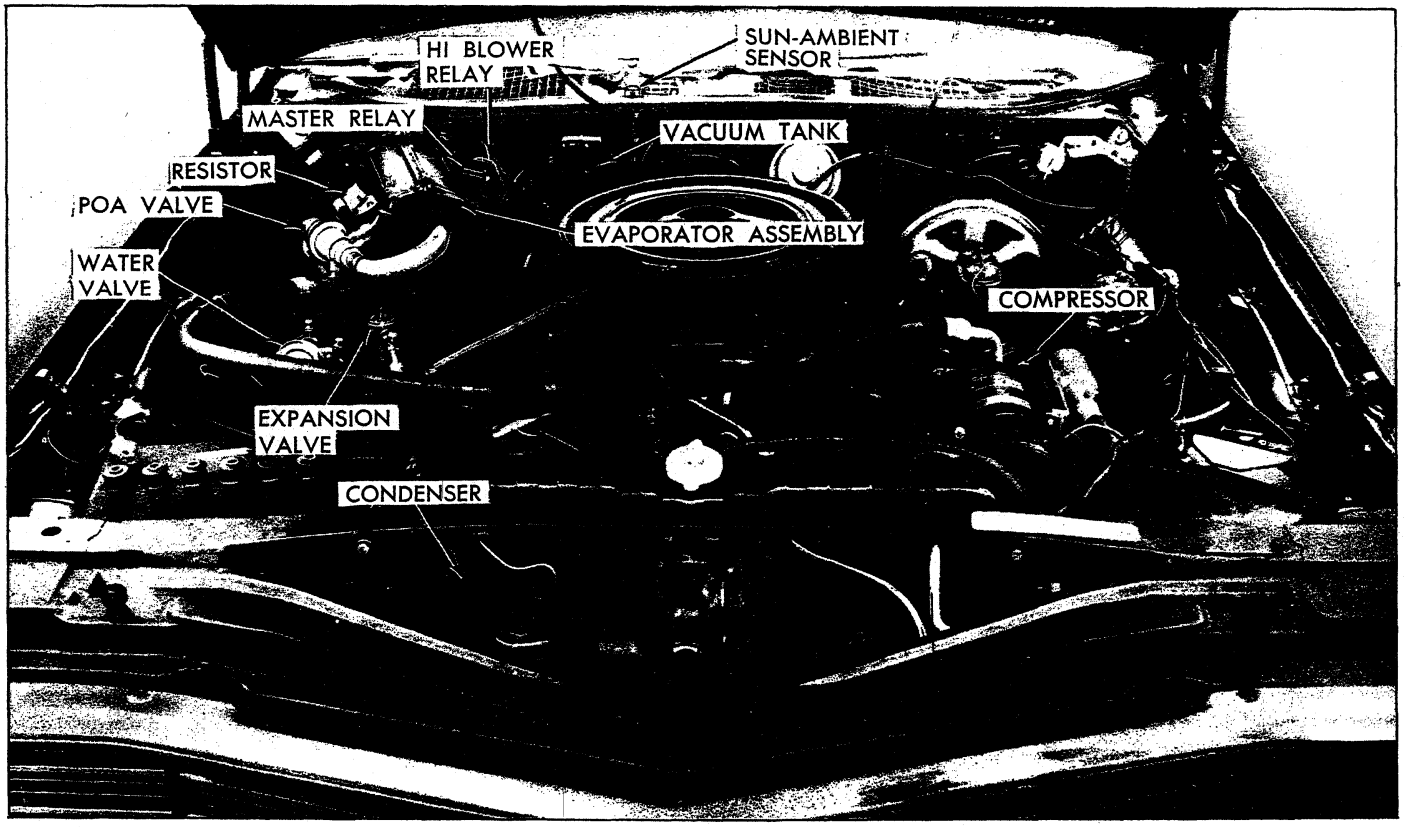


Fig. 24—Comfortron Engine Compartment Components

that is called for by the sensors, amplifier, and transducer. The power servo performs the following functions:

1. Positions the temperature mix door via the temperature door link. The position of this door determines the portions of hot and cold air being blended and discharged into the car.
2. Operates the power servo vacuum valve which determines the air flow paths for heating and air conditioning.
3. Contains a printed circuit board which controls the blower speed. The power servo position determines the blower speed, but the control lever switch can modify the blower program depending upon the customer's preference.
4. Contains the "master delay thermistor".

Outside Air Diaphragm

When there is no vacuum applied to the diaphragm, the outside air door allows a mixture of inside and outside air to enter the system. With vacuum applied to one side of the diaphragm, air is taken from the inside of the vehicle and re-circulated. Applying vacuum to the other side of the diaphragm opens the door to admit outside air.

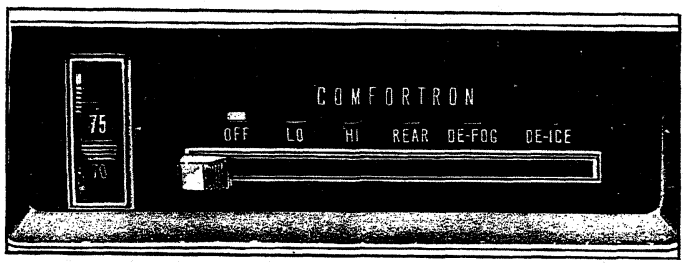


Fig. 25—Comfortron Control

Mode Door Diaphragm

Located behind the duct work, the mode door diaphragm operates the mode door and directs the air flow out either the air conditioning outlets, the heater floor outlet, or both the heater and air conditioning outlets. This is a push-pull type diaphragm actuated by vacuum through two hoses and controlled by the power servo vacuum switch.

Defroster Door

The defroster door is in the defog position until vacuum is applied to the two-way actuator to obtain either full heat or full de-ice position.

Master Delay Thermistor

This thermistor delays the initial operation of the blower in cool weather to allow the engine water to warm up so that the operator will not be subjected to cold air from the heater outlets. When the thermistor passes enough current to energize the master relay, the blower will operate at about 11 volts unless the Hi-Blower Relay is simultaneously activated in which case the system will come on at 14 volts if the control is in the Hi or Rear position.

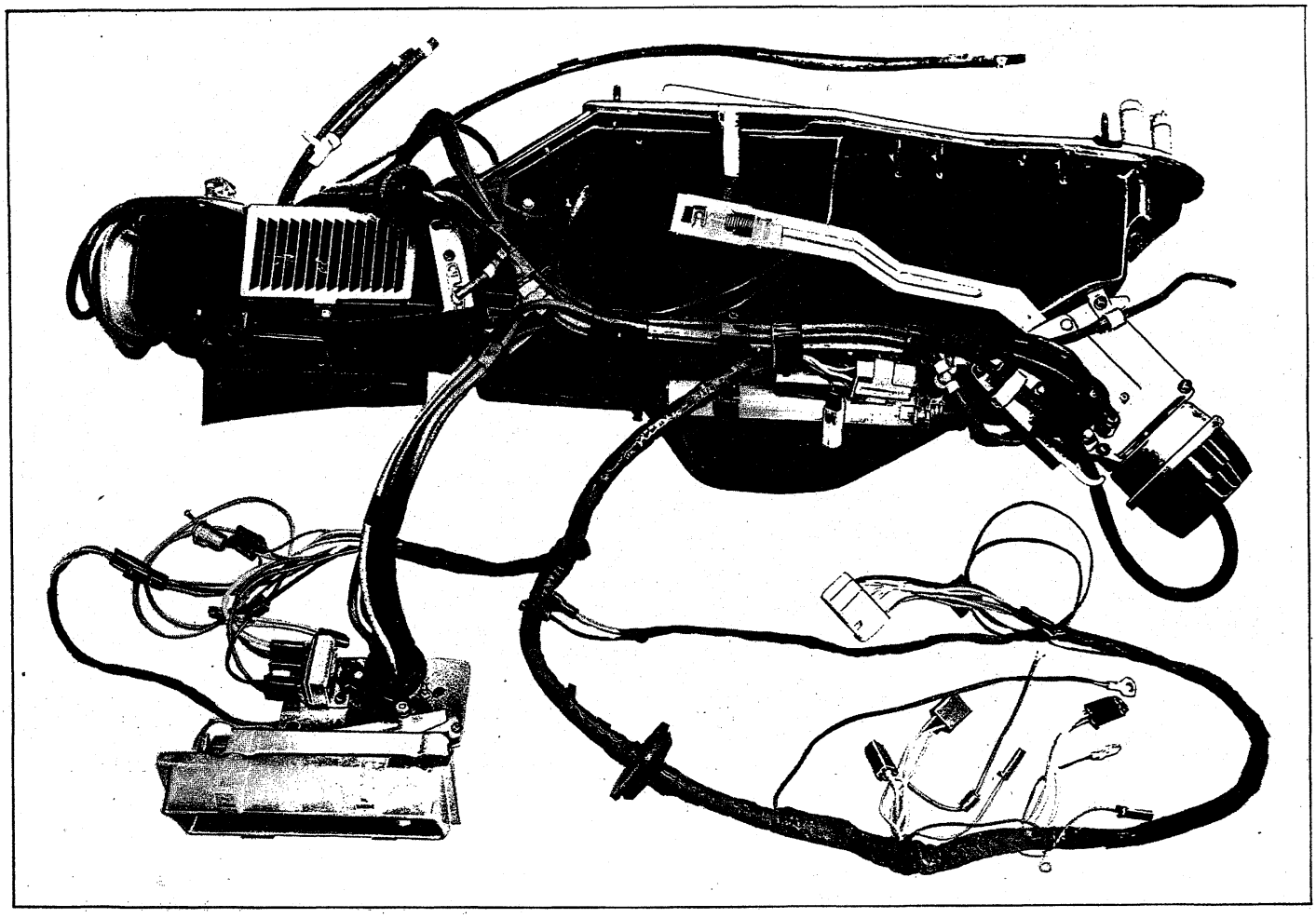


Fig. 26—Comfortron Underdash Components

Vacuum Tank

During heavy acceleration, the vacuum supply from the carburetor drops. The vacuum tank, using a check valve, stores vacuum so that under these conditions vacuum will be available for the Comfortron.

Vacuum Relay Valve

This relay valve will shut off transducer vacuum to the power servo whenever the vacuum from the engine intake manifold falls below the vacuum in the power servo supply line (engine stopped or operating at low manifold vacuum for long periods). This causes the power servo to be held in position when the vacuum supply falls too low to maintain servo control.

Sun—Ambient Sensor

The sun-ambient sensor measures the temperature of the air entering the air intake grille in front of the windshield. The sensor is exposed to sun light so that it can lower the in-car temperature slightly when the sun is shining (fig. 27).

Ambient Switch

The ambient switch operates the air conditioning compressor clutch. When the outside temperature is above 37°F. the switch will be closed and the compressor will be running. This switch is mounted on the blower side of the evaporator case.

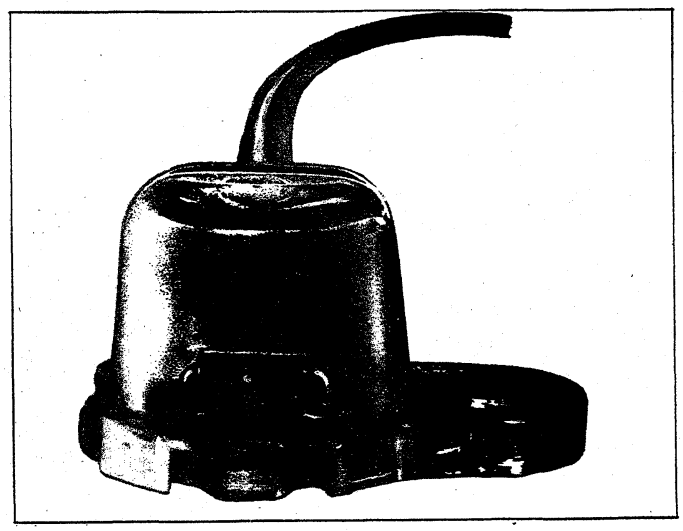


Fig. 27—Sun-Ambient Sensor

Resistor Assembly

The blower resistors are located in the evaporator housing. The printed circuit board switch in the power servo determines which of the resistors is being used, and as in conventional systems, the resistors control the blower speed.

System Operation

When starting the Comfortron System in cold weather, the following sequence of events occurs:

1. Initially the system is inoperative. In LO FRONT and HI FRONT positions, the master delay thermistor is warming (self-heating because current is flowing through it) and its resistance is decreasing. The air door is in the outside air position, allowing ram air to purge the ducts of cold air, until the master delay thermistor has been warmed sufficiently to pass enough current to energize the master relay.
2. When the master relay has been energized, the relay circuit powers the blower motor.
3. The system will always operate on outside air except when maximum air conditioning is required.
4. In warm or hot weather the start up sequence is the same except little or no delay will be experienced and if the car interior is hot enough, the system will come on using recirculated air.
5. If the controls are set for DE-FOG or DE-ICE, full outside air and full voltage to the blower motor are effective immediately regardless of temperatures or elapsed times.

In accomplishing automatic control, the system follows three steps to transform an electronic signal into mechanical energy through which the control is achieved.

Electronic Circuit

Two temperature sensors (Thermistors), and the duct potentiometer connected in series, are located so as to sense the temperature of the outside air, inside air and system output air. The resistance of each sensor will vary according to its temperature. The control head temperature dial varies in resistance as it is adjusted by the operator to suit his comfort requirements. The resistance of the temperature dial control is applied directly to the amplifier and is not in series with the sensors and duct potentiometer. Thus temperature differences in the sensor string plus the requirements fed into the system by the operator cause changes in total circuit resistance which allow a varying current flow through the circuit.

Changing the Electronic Signal to Electrical Voltage

This minute current flow from the sensor string - temperature dial circuit - is fed into the amplifier where it is transformed into a usable amplifier output voltage, the strength of which is determined by the strength of the original amplifier input signal. This voltage is then supplied to the transducer.

Changing the Electrical Voltage to a Vacuum Signal

Amplifier output voltage, varying according to temperature requirements, is converted by the transducer into a modulating transducer output vacuum. This modulated vacuum is applied to the Power Servo.

Changing the Vacuum Signal to Mechanical Energy

The Power Servo, controlled by the modulated Transducer output vacuum, operates the vacuum, electrical and mechanical components of the system as required to provide automatic control of system operation.

Other major system components are mounted conventionally in the engine compartment. Underhood components and system airflow remain much the same as in the Four-Season system except for the addition of the automatic control provisions. The system operates on 100% outside air, a mixture of outside and inside air, or 100% recirculated air depending on the demands of the system. The diaphragm operated air selector door will modulate outside air to the system during maximum air conditioning requirements when the control unit is in "Hi Front" position. Control of the blower is also completely automatic and dependent upon system demands.

CONTROLS

The Comfortron Controls regulate the Chevrolet air conditioner and heater in such a precise manner that the automobile temperature remains relatively constant under all driving conditions. By adjusting the thumb wheel on the Control Head to any temperature desired between 65° and 85°F. (See Figure 25) the automatic system will adjust the in-car temperature even though the outside weather conditions may vary considerably. The system will provide maximum capacity for heating or cooling until the in-car temperature reaches the pre-set Control Head Temperature. Where cooling is required, the system will start immediately upon being turned "ON". During marginal ambient temperatures the system will not always start at the highest blower speeds of the control setting. Therefore, occasionally the system can't be heard starting.

Five over-riding functions are available so that special conditions can be handled. Each Control Head function will be discussed in detail below:

"Off" Position

In the "Off" position, the blower is turned off and the outside air door is closed. No outside air should enter the automobile.

"Lo Front" Position

The blower has five low to moderate speeds. The blower voltage will shift as directed by the automatic controls. The "Lo Front" position provides a quieter mode of automatic operation due to reduction of blower noise. The system always operates on outside air in this position.

"Hi Front" Position

The "Hi Front" position provides five high blower speeds as called for by the automatic controls: The use of the "Hi" blower speed results in a rapid cool down in hot weather and rapid heating during cold weather. As the in-car temperature approaches the temperature setting on the Comfortron Control Head, the blower speed will change, provided mild outside temperatures are experienced. During very hot or cold weather, the blower will reduce its speed only to the point where it is still capable of maintaining the correct in-car temperature.

The system will operate on outside or recirculated air depending on demand.

"Rear" Position

The "Rear" position provides five high blower speeds. The automatic controls select these speeds and blend the discharge air to the proper temperature. By the use of high blower speeds, increased airflow is obtained for better rear seat passenger comfort.

"De-Fog" Position

In the event that the front windshield should require removal of a fogging condition, the owner at his option may direct air to the windshield. The "De-Fog" position directs part of the air to the windshield while retaining a certain amount through the floor outlets. The temperature of the air remains the same as it was prior to the control being placed in the "De-Fog" position. Five blower speeds are available. The temperature of the air and the blower speed are selected by the automatic controls and are dependent upon the in-car temperature.

"De-Ice" Position

The "De-Ice" position provides full heat with "Hi" blower directing the entire airflow to the windshield to melt ice. The automatic controls are completely defeated and as a result, full heat with "Hi" blower are the only conditions that can be received. The system will turn on immediately in this position even though the engine coolant might be cold.

General Information

Three start up conditions can be achieved with Comfortron.

Weather	Method of Starting System
Cold	System starts as soon as the master delay thermistor has warmed enough to energize the master relay.
Hot	System starts immediately when AC is required.
Any	System starts immediately in "De-Ice" position.

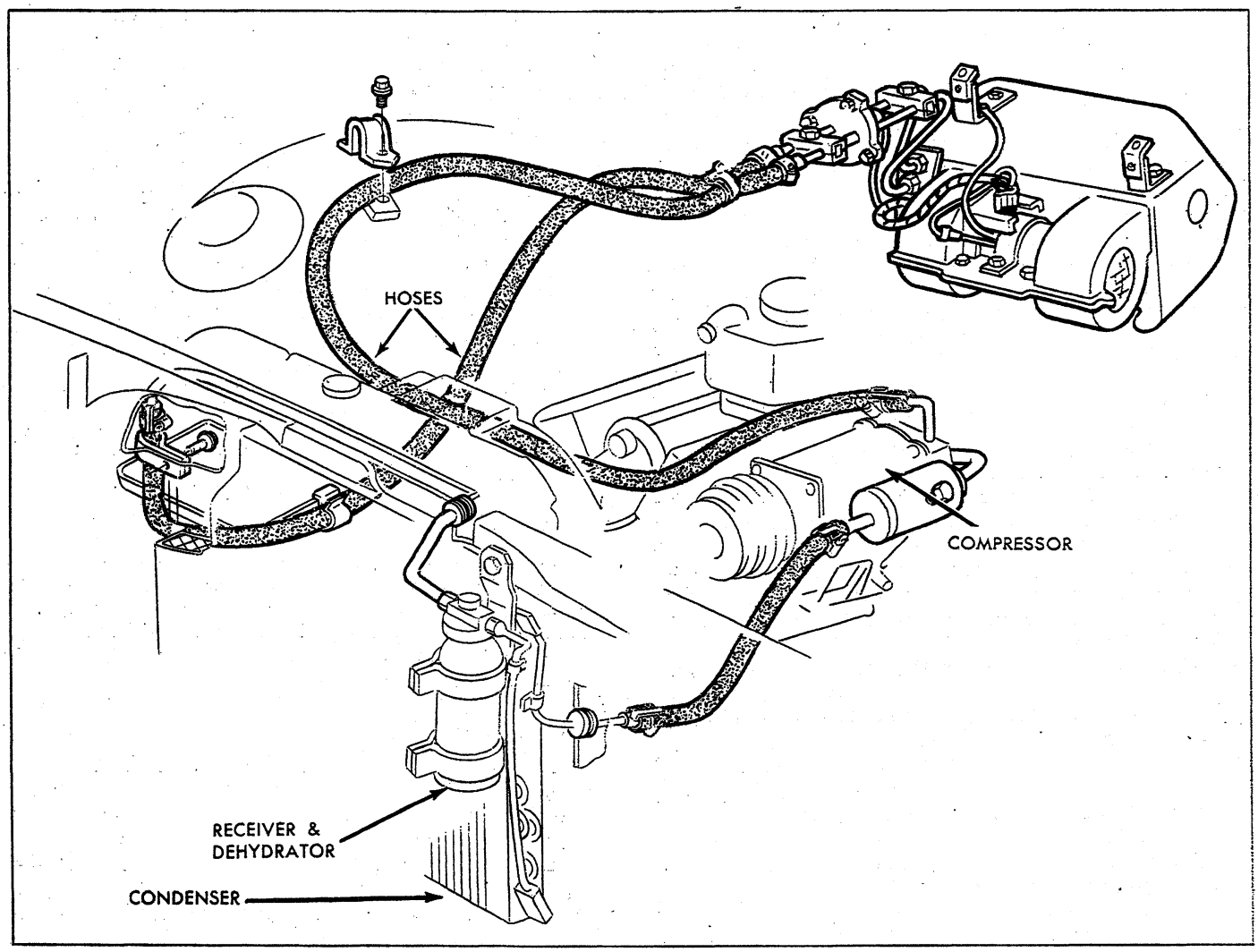


Fig. 28—GM Chevrolet Air Conditioning System Components

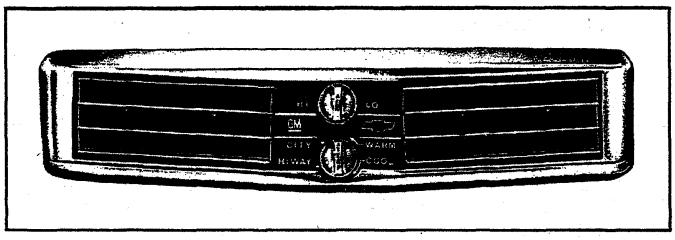


Fig. 29—GM Chevrolet Air Conditioner Unit

GM CHEVROLET AIR CONDITIONER (Fig. 29)

A self-contained unit, the dealer installed G.M. Chevrolet Air Conditioning System operates on recirculated air only and entirely independent of the vehicle heater. Recirculated inside air is drawn into the unit, passed through the evaporator core and into the car through the adjustable outlets in the evaporator case. The entire unit mounts compactly beneath the dash. Temperature control is by means of a thermostatic switch.

The compressor used with this system is identical to that used for the Four-Season system except for displacement. Underhood components are similar in placement, as noted in Figure 28.

CONTROLS

System controls are the AIR knob controlling the three speed blower motor switch and the TEMP knob which controls the setting of the thermostatic switch. When operating this system, the Heater must be fully off for maximum cooling.

Air Knob

Turning the AIR knob clockwise operates the three speed blower motor.

Temp Knob

This knob may be regulated to control the degree of cooling desired. Fully clockwise at CITY provides maximum cooling; however, turning the knob to HIWAY provides adequate cooling for highway operation.

NOTE: Reduced cooling could be encountered when operating at highway speeds with the controls at the "CITY" setting.

GENERAL INFORMATION

In any vocation or trade, there are established procedures and practices that have been developed after many years of experience. In addition, occupation hazards may be present that require the observation of certain precautions or use of special tools and equipment. Observing the procedures, practices and precautions of servicing refrigeration equipment will greatly reduce the possibilities of damage to the customers' equipment as well as virtually eliminate the element of hazard to the serviceman.

PRECAUTIONS IN HANDLING REFRIGERANT-12

Refrigerant-12 is transparent and colorless in both the gaseous and liquid state. It has a boiling point of 21.7°F below zero and, therefore, at all normal temperatures and pressures it will be a vapor. The vapor is heavier than air, and is noninflammable, nonexplosive, nonpoisonous (except when in contact with an open flame) and noncorrosive (except when in contact with water). The following precautions in handling R-12 should be observed at all times.

- All refrigerant drums are shipped with a heavy metal screw cap. The purpose of the cap is to protect the valve and safety plug from damage. It is good practice to replace the cap after each use of the drum.
- If it is ever necessary to transport or carry a drum or can of refrigerant in a car, keep it in the luggage compartment. Refrigerant should not be exposed to the radiant heat from the sun since the resulting increase in pressure may cause the safety plug to release or the drum or can to burst.
- Drums or disposable cans should never be subjected to high temperature when adding refrigerant to the system. In most instances, heating the drum or can is required to raise the pressure in the container higher than the pressure in the system during the operation. It would be unwise to place the drum on a gas stove, radiator or use a blow torch while preparing for the charging operation, for a serious accident can result. Don't depend on the safety plug - many drums have burst when the safety plug failed. Remember, high pressure means that great forces are being exerted against the walls of the container. A bucket of warm water, not over 125°F, or warm wet rags around the container is all the heat that is required.
- Do not weld or steam clean on or near the system. Welding or steam cleaning can result in a dangerous pressure buildup in the system.
- When filling a small drum from a large one, never fill the drum completely. Space should always be allowed above the liquid for expansion. If the drum were completely full and the temperature was increased, hydraulic pressure with its tremendous force would result.
- Discharging large quantities of R-12 into a room can usually be done safely as the vapor would produce no ill effects; however, in the event of an accidental rapid discharge of the system, it is recommended that inhalation of large quantities of R-12 be avoided. This caution is especially important if the area contains a flame producing device such as a gas heater. While R-12 normally is nonpoisonous, heavy concentrations of it in contact with a live flame will produce a toxic gas. The same gas will also attack all bright metal surfaces.
- Protection of the eyes is of vital importance! When working around a refrigerating system, an accident may cause liquid refrigerant to hit the face. If the eyes are protected with goggles or glasses, no seri-

ous damage can result. Just remember, any R-12 liquid that touches you is at least 21.7°F below zero. If R-12 liquid should strike the eyes, here is what to do:

1. Keep calm.
2. Do not rub the eyes! Splash the affected area with quantities of cold water to gradually get the temperature above the freezing point. The use of mineral, cod liver or an antiseptic oil is important in providing a protective film to reduce the possibility of infection.
3. As soon as possible, call or consult an eye specialist for immediate and future treatment.

REMEMBER - "An ounce of prevention is worth a pound of cure."

PRECAUTIONS IN HANDLING REFRIGERANT LINES

- All metal tubing lines should be free of kinks, because of the restriction that kinks will offer to the flow of refrigerant. The refrigeration capacity of the entire system can be greatly reduced by a single kink.
- The flexible hose lines should never be bent to a radius of less than 10 times the diameter of the hose.
- The flexible hose lines should never be allowed to come within a distance of 2-1/2" of the exhaust manifold.
- Flexible hose lines should be inspected at least once a year for leaks or brittleness. If found brittle or leaking they should be replaced with new lines.
- Use only sealed lines from parts stock.
- When disconnecting any fitting in the refrigeration system, the system must first be discharged of all refrigerant. However, proceed very cautiously regardless of gauge readings. Open very slowly, keeping face and hands away so that no injury can occur if there happens to be liquid refrigerant in the line. If pressure is noticed when fitting is loosened, allow it to bleed off very slowly.

  CAUTION: Always wear safety goggles when opening refrigerant lines.

- In the event any line is opened to atmosphere, it should be immediately capped to prevent entrance of moisture and dirt.
- The use of the proper wrenches when making connections on "O" ring fittings is important. The use of improper wrenches may damage the connection. The opposing fitting should always be backed up with a wrench to prevent distortion of connecting lines or components. When connecting the flexible hose connections it is important that the swaged fitting and the flare nut, as well as the coupling to which it is attached, be held at the same time using three different wrenches to prevent turning the fitting and damaging the ground seat.
- "O" rings and seats must be in perfect condition. The slightest burr or piece of dirt may cause a leak.
- Sealing beads on hose clamp connections must be free of nicks and scratches to assure a perfect seal.

MAINTAINING CHEMICAL STABILITY IN THE REFRIGERATION SYSTEM

The metal internal parts of the refrigeration system and the refrigerant and oil contained in the system are designed to remain in a state of chemical stability as long as pure R-12 and uncontaminated refrigeration oil is used in the system.



Fig. 30—System Contaminants

However, when abnormal amounts of foreign materials, such as dirt, air or moisture are allowed to enter the system, the chemical stability may be upset. When accelerated by heat, these contaminants may form acids and sludge and eventually cause the breakdown of components within the system. In addition, contaminants may affect the temperature-pressure relationship of R-12, resulting in improper operating temperature and pressures and decreased efficiency of the system.

The following general practices should be observed to insure chemical stability in the system.

- Whenever it becomes necessary to disconnect a refrigerant or gauge line, it should be immediately capped. Capping the tubing will also prevent dirt and foreign matter from entering.
- Tools should be kept clean and dry. This also includes the gauge set and replacement parts.
- When adding oil, the container should be exceptionally clean and dry due to the fact that the refrigeration oil in the container is as moisture-free as it is possible to make it; therefore, it will quickly absorb any moisture with which it comes in contact. For this same reason the oil container should not be opened until ready for use and then it should be capped immediately after use.
- When it is necessary to open a system, have everything you will need ready and handy so that as little time as possible will be required to perform the operation. Don't leave the system open any longer than is necessary.
- Finally, after the operation has been completed and the system sealed again, air and moisture should be evacuated from the system before recharging.

J-8393 CHARGING STATION

The J-8393 Charging Station is a portable assembly of a vacuum pump, refrigerant supply, gauges, valves, and most important, a five (5) pound metering refrigerant charging cylinder. The use of a charging cylinder eliminates the need for scales, hot water pails, etc.

The chief advantage of this unit is savings. A very definite savings in refrigerant and time can be obtained by using this unit. Since the refrigerant is metered into

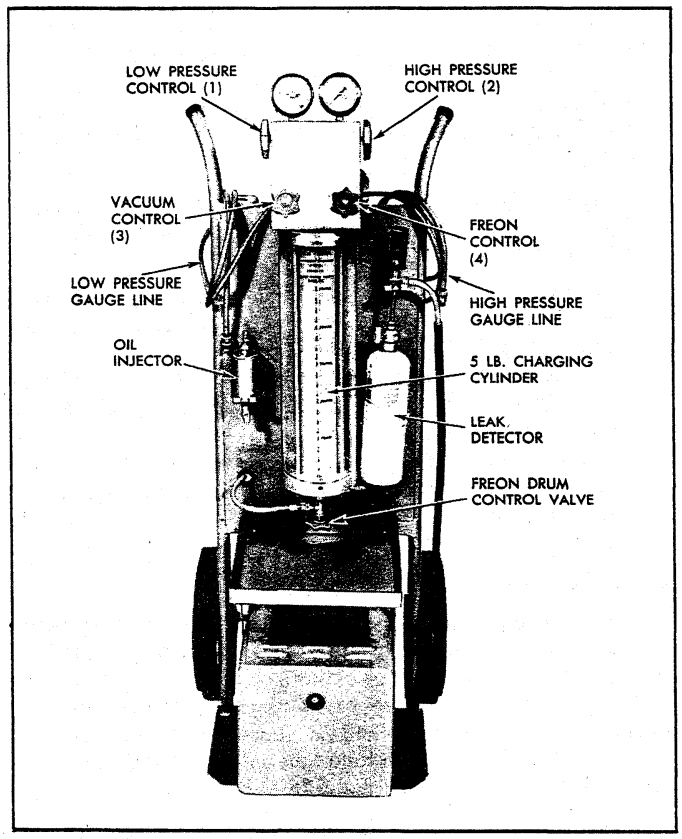


Fig. 31—J-8393 Charging Station

the system by volume, the correct amount may be added to the system and charged to the customer. This, coupled with the fact that the unit remains "plumbed" at all times and thus eliminates loss of refrigerant in purging of lines and hooking-up, combines to enable the operator to get full use of all refrigerant purchased by the dealership.

All evacuation and charging equipment is hooked together in a compact portable unit (fig. 31). It brings air conditioning service down to the basic problem of hooking on two hoses, and manipulating clearly labeled valves.

This will tend to insure that the job will be done without skipping operations. As a result, you can expect to save time and get higher quality work, less chance of an over or undercharge, or comeback.

The pump mount is such that the dealer may use his own vacuum pump. The gauges and manifold are in common use. Thus a current air conditioning dealer can use the equipment on hand and avoid duplication.

GAUGE SET

The gauge set (fig. 32) is an integral part of the J-8393 Charging Station. It is used when purging, evacuating, charging or diagnosing trouble in the system. The gauge at the left is known as the low pressure gauge. The face is graduated into pounds of pressure and, in the opposite direction, in inches of vacuum. This is the gauge that should always be used in checking pressures on the low pressure side of the system. When all parts of the system are functioning properly the refrigerant pressure on the low pressure side never falls below 0 pounds pressure. However, several abnormal conditions can occur

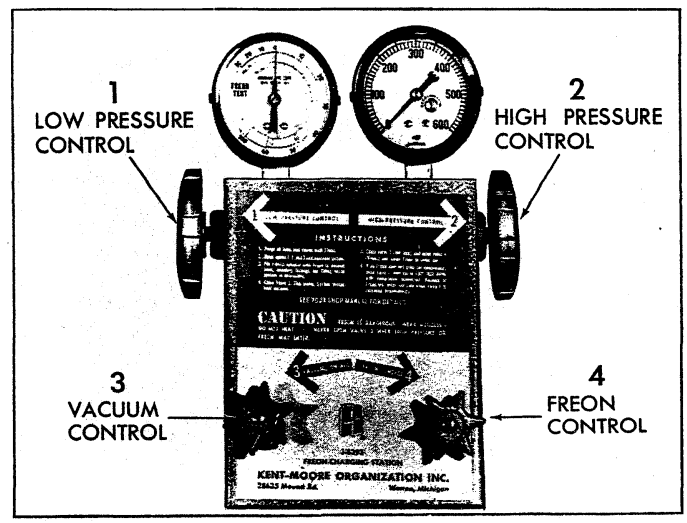


Fig. 32—Gauge Set

that will cause the low pressure to fall into a partial vacuum. Therefore, a low pressure gauge is required.

The high pressure gauge is used for checking pressures on the high pressure side of the system.

The hand shutoff valves on the gauge manifold do not control the opening or closing off of pressure to the gauges. They merely close each opening to the center connector and to each other. During most diagnosing and service operation, the valves must be closed. Both valves will be open at the same time during purging, evacuating and charging operations.

The charging station provides two flexible lines for connecting the gauge set to the system components.

VACUUM PUMP

A vacuum pump should be used for evacuating air and moisture from the air conditioning system.

The vacuum pump (fig. 33), is a component part of Charging Station J-8393, described previously. The following precautions should be observed relative to the operation and maintenance of this pump.

- Make sure dust cap on discharge outlet of vacuum pump is removed before operating.
- Keep all openings capped when not in use to avoid moisture being drawn into the system.
- Oil should be changed after every 250 hours of normal operation.

To change oil, simply unscrew hex nut located on back side of pump, tilt backward and drain out oil (fig. 33). Recharge with 8 ounces of vacuum pump oil Frigidaire 150 or equivalent (fig. 33). If you desire to flush out the pump, use this same type clean oil. Do not use solvent.

NOTE: Improper lubrication will shorten pump life.

- If this pump is subjected to extreme or prolonged cold, allow it to remain indoors until oil has reached approximate room temperature. Failure to warm oil will result in a blown fuse.
- A five ampere time delay cartridge fuse has been installed in the common line to protect the windings of the compressor. The fuse will blow if an excessive

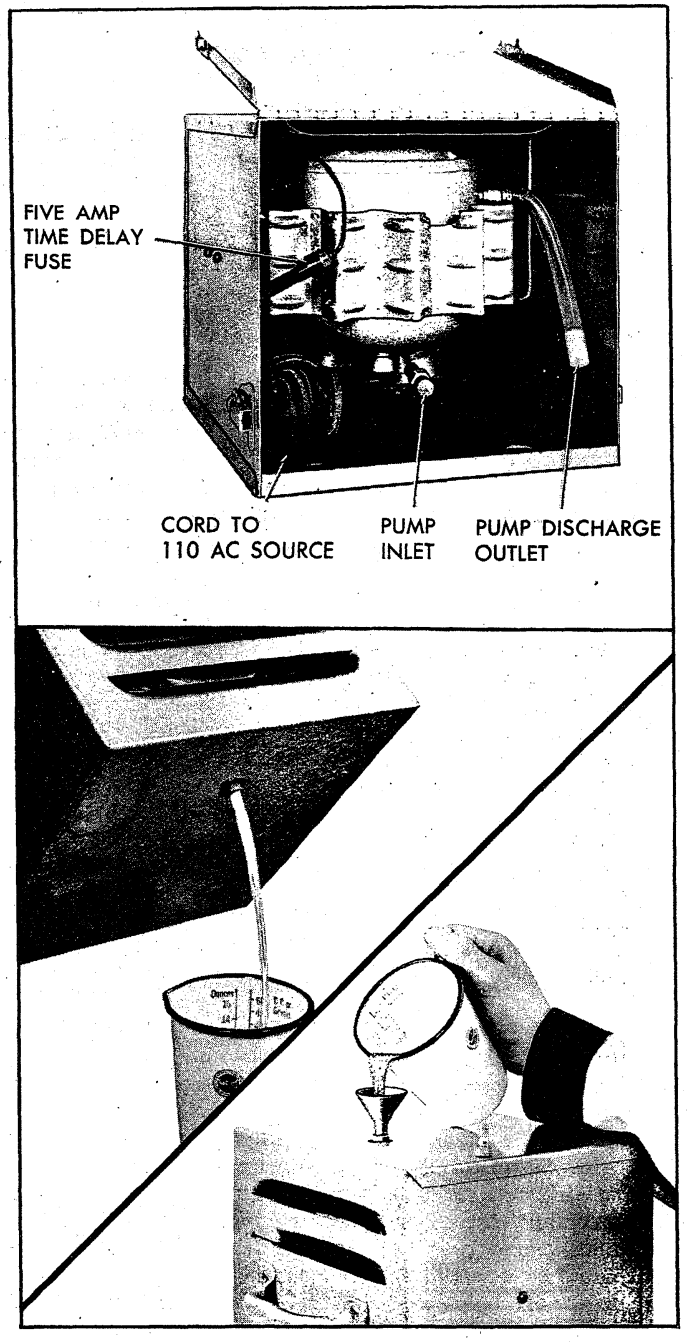


Fig. 33—Vacuum Pump

load is placed on the pump. In the event the fuse is blown, replace with a five ampere time delay fuse - do not use a substitute fuse as it will result in damage to the starting windings.

- If the pump is being utilized to evacuate a burnt-out system, a filter must be connected to the intake fitting to prevent any sludge from contaminating the working parts, which will result in malfunction of the pump.
- Do not use the vacuum pump as an air compressor.

LEAK TESTING THE SYSTEM

Whenever a refrigerant leak is suspected in the system or a service operation performed which results in disturbing lines or connections, it is advisable to test for leaks. Common sense should be the governing factor in performing any leak test, since the necessity and extent of any such test will, in general, depend upon the nature of the complaint and the type of service performed on the system.

NOTE: The use of a leak detecting dye within the system is not recommended because of the following reasons:

1. Refrigerant leakage can exist without any oil leakage. In this case the dye will not indicate the leak, however, a torch detector will.
2. The addition of additives, other than inhibitors, may alter the stability of the refrigeration system and cause malfunctions.
3. Dye type leak detectors which are insoluble form a curdle which can block the inlet screen of the expansion valve.

Leak Detector

Tool J-6084 (fig. 34) is a propane gas-burning torch which is used to locate a leak in any part of the system. Refrigerant gas drawn into the sampling tube attached to the torch will cause the torch flame to change color in proportion to the size of the leak. Propane gas fuel cylinders used with the torch are readily available commercially throughout the country.

CAUTION: Do not use lighted detector in any place where combustible or explosive gases, dusts or vapors may be present.

Operating Detector

1. Determine if there is sufficient refrigerant in the system for leak testing.
2. Open control valve only until a low hiss of gas is heard, then light gas at opening in chimney.

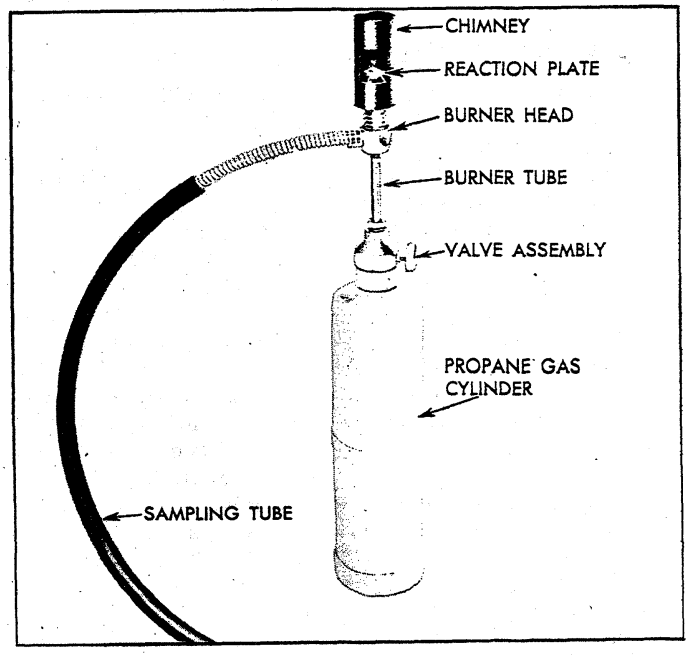


Fig. 34—Leak Detector

3. Adjust flame until desired volume is obtained. This is most satisfactory when blue flame is approximately 3/8" above reactor plate. The reaction plate will quickly heat to a cherry red.
4. Explore for leaks by moving the end of the sampling hose around possible leak points in the system. Do not pinch or kink hose.

   NOTE: Since R-12 is heavier than air, it is good practice to place open end of sampling tube immediately below point being tested, particularly in cases of small leaks.

   CAUTION: Do not breathe the fumes that are produced by the burning of R-12 gas in the detector flame, since such fumes can be toxic in large concentrations of R-12.

5. Watch for color changes. The color of the flame which passes through the reaction plate will change to green or yellow-green when sampling hose draws in very small leaks of R-12. Large leaks will be indicated by a change in color to a brilliant blue or purple; when the sampling hose passes the leak, the flame will clear to an almost colorless pale-blue again. Observations are best made in a semi-darkened area. If the flame remains yellow when unit is removed from leak, insufficient air is being drawn in or the reaction plate is dirty.

   NOTE: A refrigerant leak in the high pressure side of the system may be more easily detected if the system is operated for a few minutes, then shut off and checked immediately (before system pressures equalize). A leak on the low pressure side may be more easily detected after the engine has been shut off for several minutes (system pressures equalized); this applies particularly to the front seal.

AVAILABILITY OF REFRIGERANT-12

Refrigerant-12 is available through Parts Stock in 12 lb. and in 15 oz. disposable containers.

Normally, air conditioning systems are charged making use of the J-8393 Charging Station which uses the 12 lb. container. Evacuating and charging procedures are noted later in this section.

The 15 oz. disposable cans are generally used for miscellaneous operations such as flushing.

COMPRESSOR OIL

Special refrigeration lubricant should be used in the system. It is available in 1 quart graduated bottles through Parts Stock. This oil is as free from moisture and contaminants as it is possible to attain by human processes. This condition should be preserved by immediately capping the bottle when not in use.

See "Air Conditioning System Capacities" for the total system oil capacity.

Due to the porosity of the refrigerant hoses and connections, the system refrigerant level will show a definite drop after a period of time. Since the compressor oil is carried throughout the entire system mixed with the refrigerant, a low refrigerant level will cause a dangerous lack of lubrication. Therefore the refrigerant charge in the system has a definite tie-in with the amount of oil found in the compressor and an insufficient charge may eventually lead to an oil build-up in the evaporator.

COMPRESSOR SERIAL NUMBER

The compressor serial number is located on the serial number plate on top of the compressor. The serial number consists of a series of numbers and letters. This serial number should be referenced on all forms and correspondence related to the servicing of this part.

INSPECTION AND PERIODIC SERVICE

PRE-DELIVERY INSPECTION

1. Check that engine exhaust is suitably ventilated.
2. Check the belt for proper tension.
3. With controls positioned for operation of the system, operate the unit for ten minutes at approximately 2000 rpm. Observe the clutch pulley bolt to see that compressor is operating at the same speed as the clutch pulley. Any speed variation indicates clutch slippage.
4. Before turning off the engine, check the sight glass to see that the unit has a sufficient Refrigerant charge. The glass should be clear, although during milder weather it may show traces of bubbles. Foam in the flow indicates a low charge. No liquid visible and no temperature differential between compressor inlet and outlet lines, indicates no charge.
5. GM Chevrolet Systems – Check hose clamp connections. If clamp screw torque is less than 10 in. lb., retighten to 20-25 in. lb. Do not tighten to new hose specifications or hose leakage may occur.
6. Leak test the complete system.
7. If there is evidence of an oil leak, check the compressor to see that the oil charge is satisfactory.
8. Check the system controls for proper operation.

6000 MILE INSPECTION

1. Check unit for any indication of a refrigerant leak.
2. If there is an indication of an oil leak, check the compressor for proper oil charge.
3. Check sight glass for proper charge of Refrigerant-12.
4. Tighten the compressor brace and support bolts and check the belt tension.
5. Check hose clamp connections as in step 5 of "Pre-Delivery Inspection."
6. Check thermostatic switch setting (GM Chevrolet Air Conditioner).

PERIODIC SERVICE

- Inspect condenser regularly to be sure that the fins are not plugged with leaves or other foreign material.
- Check evaporator drain tubes regularly for dirt or restrictions.
- At least once a year, check the system for proper refrigerant charge and the flexible hoses for brittleness, wear or leaks.
- Every 6000 miles check sight glass for low refrigerant level.
- Check belt tension regularly.

INSTALLING CHARGING STATION GAUGE SET TO CHECK SYSTEM OPERATION

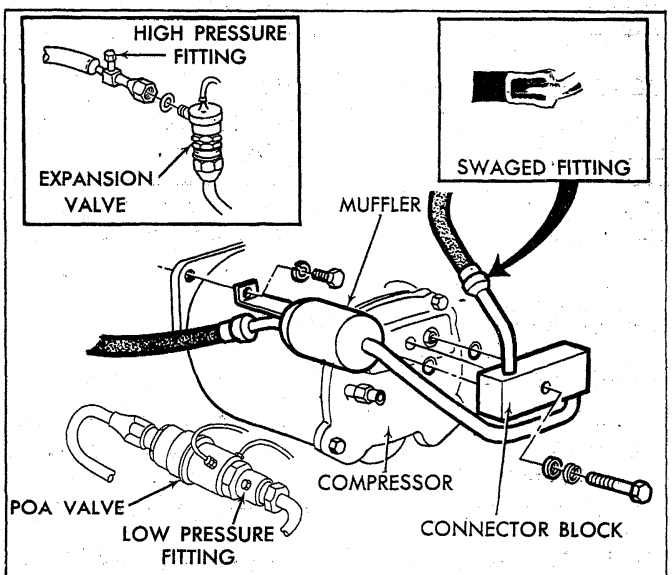
Compressor Suction and Discharge Connector

The compressor connector assembly is of the same basic design on all Four-Season and Comfortron Systems. The connector assembly consists of inlet (suction) and outlet (discharge) lines and hoses with the freon hoses swaged to the metal lines (fig. 35). The metal portion of the outlet line contains a muffler. The high pressure gauge fitting is located at the expansion valve and the low pressure fitting is on the POA valve (the Corvette high pressure fitting is located on the connector block).

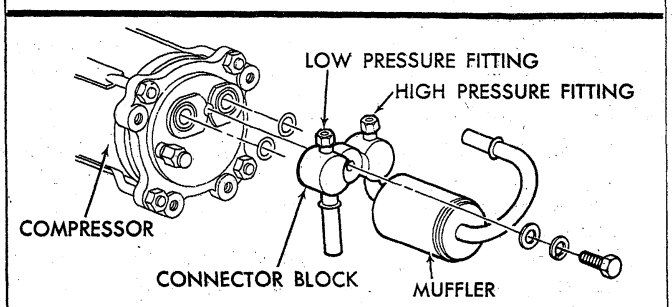
On G.M. Chevrolet Air Conditioning Systems, the connector block contains an inlet line, outlet line, muffler and gauge fittings (fig. 35). Hoses are attached to the inlet and outlet lines with screw-type clamps.

GM Chevrolet Air Conditioning System

1. Install Gauge Adapter (J-5420 or J-9459) onto the high and low pressure hoses of the gauge set.
2. With the engine stopped, remove the caps from the cored valve gauge connectors on the compressor connector block.



FOUR-SEASON AND COMFORTRON SYSTEMS



GM CHEVROLET AIR CONDITIONING SYSTEM

Fig. 35—Compressor Connector Block - Typical

3. Connect the gauge lines with adapters to the threaded fittings on the compressor connector block.

Four-Season and Comfortron Systems

Installation of the gauge set onto the Four-Season and Comfortron systems is accomplished in the same manner as outlined above except that system performance checks must be performed with the low pressure hose line and adapter attached to the fitting on the POA valve. Charging procedures should be performed with the high pressure gauge line connected to the high pressure gauge fitting located at the expansion valve (connector block on Corvette).

CAUTION: When removing gauge lines, be sure to remove the adapters from the fittings rather than the gauge lines from the adapters.

PERFORMANCE DATA

The following Performance Data define normal operation of the system under the above conditions. Relative humidity does not appear in the tables because after running the prescribed length of time on recirculated air and maximum cooling, the relative humidity of the air passing over the evaporator core will remain at approximately 35% to 40% regardless of the ambient temperature or humidity.

Should excessive head pressures be encountered at higher ambient temperatures, an 18" fan placed in front of the vehicle and blowing into the condenser will provide the extra circulation of air needed to bring the pressures to within the limits specified.

PERFORMANCE TEST

This test may be conducted to determine if the system is performing in a satisfactory manner and should be used as a guide by the serviceman in diagnosing trouble within the system. The following fixed conditions must be adhered to in order to make it possible to compare the performance of the system being tested with the standards below:

1. Doors and windows closed. (Car inside or in shade.)
2. Hood up and engine exhaust suitably ventilated.
3. Vehicle in NEUTRAL with engine running at 2000 rpm.
4. Air Conditioning controls set for -
   - Maximum cooling (CITY setting on GM Chevrolet Air Conditioner).
   - High blower speed.
5. TEMP control set for full recirculating air and all air conditioning outlets open. On Comfortron systems move the control lever to REAR and pull the white vacuum hose from the transducer hose "T". Plug the "T". An alternate method is to install the J-22368 Tester (described later in this section) and operate it on MANUAL control to maintain maximum cooling and blower speed.
6. Gauge set installed.
7. System settled out (run-in approximately 10 minutes).
8. A thermometer placed in front of vehicle grille and another in the right hand diffuser outlet.

NOTE: Higher temperatures and pressures will occur at higher ambient temperatures. In areas of high humidity it is possible to have

Four-Season and Comfortron System

Chevrolet

(Refrigerant Charge = 3 Lbs. - 12 Oz.)						
Temperature of Air Entering Condenser	70°	80°	90°	100°	110°	120°
Engine rpm	2000					
Compressor Head Pressure	130 140	150 160	175 185	205 215	245 255	280 290
Evaporator Pressure @ POA	28.5 - 29.5 psi*					
Discharge Air Temp. @ Right Hand Outlet	37- 40	38- 41	38- 42	40- 43	42- 45	43- 46

Chevelle

(Refrigerant Charge = 3 Lbs. - 12 Oz.)						
Temperature of Air Entering Condenser	70°	80°	90°	100°	110°	120°
Engine rpm	2000					
Compressor Head Pressure	140- 150	170- 180	230- 240	260- 270	260- 270	290- 300
Evaporator Pressure at POA	28.0 - 31.0 psi*					
Discharge Air Temp. at Right Hand Outlet	38- 41	39- 42	43- 46	45- 48	47- 50	51- 54

Nova

(Refrigerant Charge = 3 Lbs. - 12 Oz.)						
Temperature of Air Entering Condenser	70°	80°	90°	100°	110°	120°
Engine rpm	2000					
Compressor Head Pressure	145- 155	175- 185	195- 205	215- 225	260- 270	300- 310
Evaporator Pressure at POA	28.0 - 31.0 psi*					
Discharge Air Temp. at Right Hand Outlet	38- 41	39- 42	39- 42	43- 46	46- 49	52- 55

Camaro

(Refrigerant Charge = 3 Lbs. - 12 Oz.)						
Temperature of Air Entering Condenser	70°	80°	90°	100°	110°	120°
Engine rpm	2000					
Compressor Head Pressure	140- 150	170- 180	215- 225	240- 250	270- 280	295- 305
Evaporator Pressure at POA	28.0 - 30.5 psi*					
Discharge Air Temp. at Right Hand Outlet	38- 41	39- 42	41- 43	44- 47	46- 49	50- 53

Corvette

(Refrigerant Charge = 3 Lbs. 4 Oz.)						
Temperature of Air Entering Condenser	70°	80°	90°	100°	110°	120°
Engine rpm	2000					
Compressor Head Pressure	145- 155	170- 180	200- 210	215- 225	220- 230	240- 250
Evaporator Pressure at POA	29.5 - 30.5 psi*					
Discharge Air Temp. at Right Hand Outlet	46- 49	47- 50	49- 52	50- 53	51- 54	53- 56

GM Chevrolet Air Conditioner (All Vehicles)

(Refrigerant Charge = 3 Lbs.)						
Temperature of Air Entering Condenser	70°	80°	90°	100°	110°	120°
Engine rpm	2000					
Compressor Head Pressure**	125- 135	135- 145	160- 170	195- 205	220- 230	250- 260
Suction Pressure psi**	8	9	9	11	14	16
Discharge Air Temperature**	32- 37	32- 37	32- 37	32- 37	33- 38	34- 39

* Refer to "Maintenance and Adjustments - Evaporator Control Valve".

** When compressor clutch disengages.

thermometer and gauge readings approach but not reach the figures listed in the performance tables and still have a satisfactory operating unit. However, it is important to remember that low pressure has a direct relationship to nozzle outlet temperature. If pressure is too low, ice will gradually form on the evaporator fins, restricting airflow into the passenger area and resulting in insufficient or no cooling.

COMFORTRON SYSTEM OPERATIONAL TEST

The Comfortron System normally operates within the heating and cooling ranges that are needed for comfort considering the existing ambient and in-car temperatures. Temperature dial movement will not provide maximum heat in hot weather or maximum cooling in cool weather. With warm ambient and in-car temperatures, turning the temperature dial between 65°F and 85°F will cause the system to operate between maximum cooling and partial heating. With cold ambient and in-car temperatures, turning the temperature dial between 65°F and 85°F will cause the system to operate between partial cooling and maximum heating.

CHEVROLET COMFORTRON TESTER (Fig. 36)

The J-22368 Automatic Temperature Control Tester, when in AUTOMATIC position, may be used to perform Comfortron system checks without disturbing normal car operation.

Under MANUAL control, tester allows the operator to set and hold a predetermined blower speed and temperature. The tester can also be used to measure external system voltages by using the probe.

To Install the Tester (Fig. 37)

1. Remove the four terminal male connector from the Amplifier on the Comfortron control head.
2. Plug this connector into the four terminal female connector (with green wire) on the Tester Adapter Harness J-23124.
3. Plug the remaining four-terminal male connector on the Tester into the Amplifier on the control head.

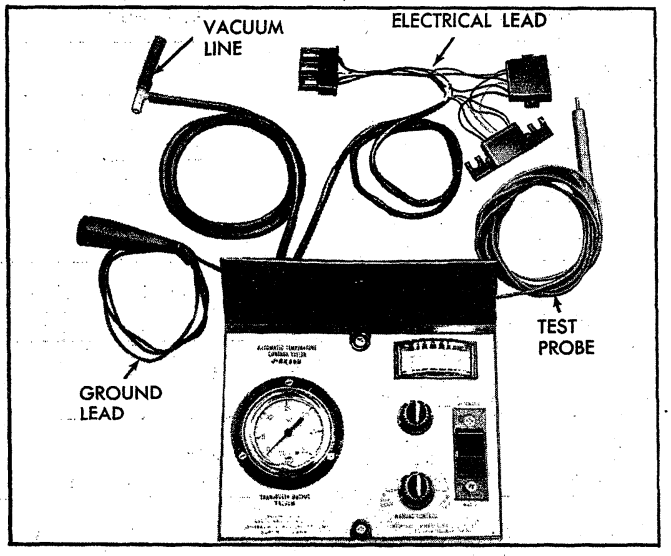


Fig. 36—Comfortron System Tester

4. Plug the Adapter Harness into the Tester Harness.
5. Attach the black ground lead to any good ground point available in the car.
6. Remove the glove box interior. Remove the large transducer vacuum hose from the "T" connection and install it on the tester vacuum hose nipple.
7. Connect the Tester vacuum hose (short hose) to the Transducer hose "T" connection as shown in fig. 37.

Quick Test Procedure

With the J-22368 Tester installed as outlined above, the following quick checks may be made to pinpoint the cause of system malfunctions. This quick check procedure is reproduced on the "swing out" plastic instruction card attached to the back of the Tester.

Before performing the checking procedure, start the engine and allow to run on fast idle until operating temperature is reached. Then set the dash control lever to HI-FRONT position and the dash control Temperature Dial to 75° and proceed with steps outlined above.

NOTE: If water entry has occurred in the vacuum harness, system malfunction will be encountered when the vehicle is operated in ambient temperatures below freezing. Some blower operation will be encountered; however, improper outlet air temperature and/or mode will result. The system, when checked in a warm building, will operate properly after the ice has melted.

CHECK-OUT OF COMPLETE ELECTRICAL CIRCUIT

Providing the air conditioning system is operating properly, perform the following steps:

1. Install Tester J-22368 as previously described.
2. Start the engine and run at fast idle. Move the Comfortron control lever to HI-FRONT.
   - Set Rocker switch to MANUAL.
   - Set Manual Control Knob to 150 ohms on scale.
3. Set the Tester Voltage switch to AMPLIFIER.
4. Rotate Comfortron Temperature dial until the Tester voltmeter reads 6.5 volts. The dial should read 75°. Adjust dial if necessary.
5. After car has run (windows and doors closed) for <u>at least</u> 10 minutes, switch Rocker switch to AUTOMATIC. Voltage reading should remain at 6.5. A change in the voltage indicates a bad sensor.
6. If a bad sensor is indicated in Step 5, check each sensor, disconnected from the system, with an ohmmeter. Approximate resistance of each sensor at 75°F. should be as follows:

In-Car Sensor	-- 50-75 ohms
Ambient Sensor	-- 55 ohms or less
Feedback Potentiometer	-- 70 ohms (approx.) with "O" vacuum on servo. 15 ohms (approx.) with 10" vacuum on servo.
Master Delay Thermistor	-- 70 ohms
High Blower Delay Thermistor	-- 70 ohms

(Located in Power Servo casting)

NOTE: See "System Checks" Diagram for Feedback Potentiometer check.

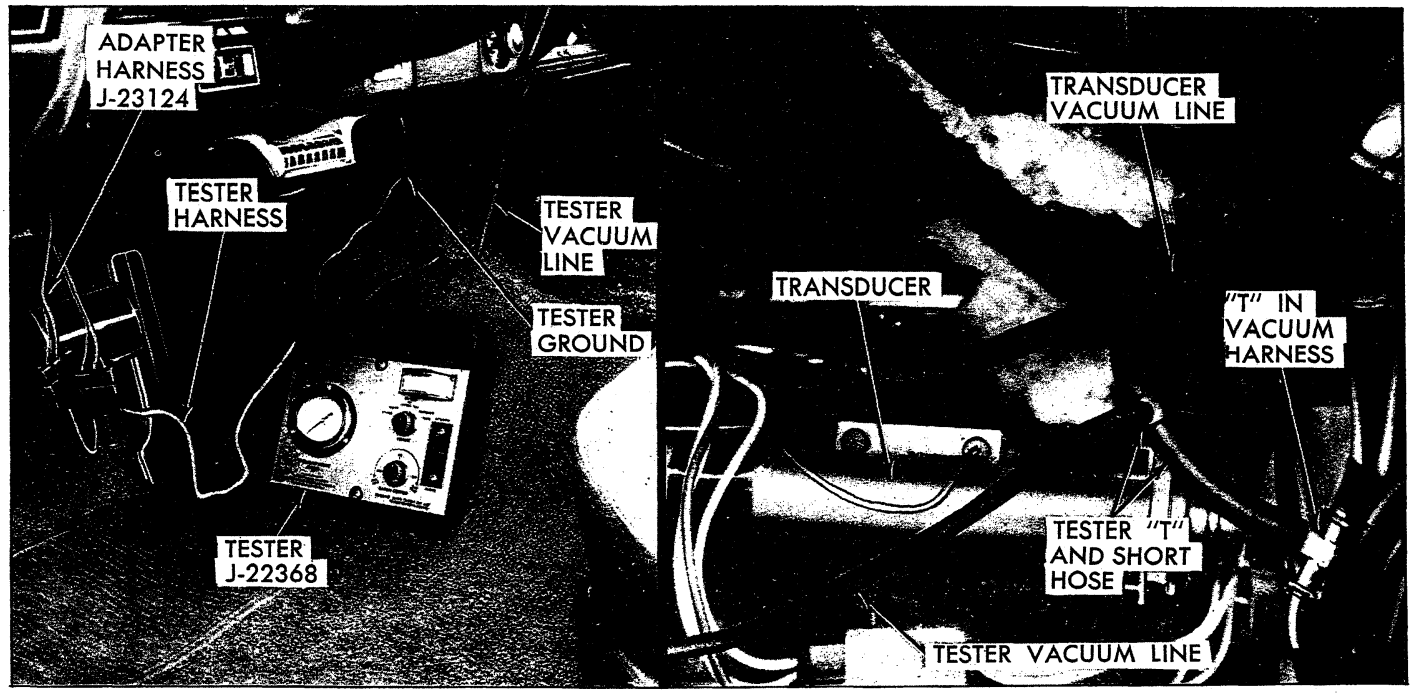


Fig. 37—Comfortron Tester Installation

Step	Tester Settings			Tester Should Indicate:	To Correct Abnormal Indication:
	Rocker Switch	Voltage	Manual Control		
1	Manual	Source	150	Battery Voltage	Check fuse and wiring.
2	Manual	Sensor	150	Battery Voltage	Check for open in sensor circuit.
3	Manual	Amplifier or Control Cal.	a. Max. Heat*	0-4 Volts	See Service Manual: Malfunctioning Amplifier or Temperature Dial.
			b. Max. Cold*	8 Volts Min.	
4	Manual	Transducer	a. Max. Cold*	8 Volts Min. 0-3 in. Vac.	Check for open or bad ground in transducer circuit. Check vacuum relay valve when voltage is correct but vacuum is incorrect in max. cold position.
			b. Max. Heat*	0-4 Volts 9 in. Min. Vac.	
5A	Manual	Amplifier or Control Cal.	Set to 150 for Comfortron System	6.5 Volts	Rotate car temperature dial until meter reads 6.5 volts. Car temperature should indicate 75°. If not, see temperature calibration which follows.
5B	Automatic	Amplifier or Control Cal.	Same as 5A. Allow 5 min. for system to stabilize with doors and windows closed.	5.5 to 7.5 Volts	After 5 minutes of operation check for defective sensor.

*This setting should result in HIGH blower speed. Refer to shop manual for further operational checks.

COMPLETE SYSTEM CHECKS

The following information should be used whenever preliminary checks indicate the need for further, more specific, tests. Together with the Electrical Test Diagram (fig. 38) and the Vacuum Diagram (fig. 39), they may be used to accurately pinpoint any malfunction of the system.

(These tests should be performed with the engine at operating temperature.)

SYSTEM CHECKS							
Control Head Setting	Tester Settings: Function	Tester Settings: Manual Control	Tester Settings: Voltage	Tester Should Indicate:	If not, check the following:	Electrical Diagram Probe Points:	Voltmeter should read
High Front	Manual	Max. Heat	Transducer	High Blower Maximum Heat	Fuse in Block	1-2	Battery Voltage
					In Line Fuse	8-9	Battery Voltage
					High Blower Relay	10-21	Battery Voltage
						20	Minimum 6 volts
					Master Thermistor	18	Battery Voltage
						19	Minimum 6 volts
					Power Servo	39-46	Battery Voltage
					Blower Switch	3	Battery Voltage
					Resistor	22-15	Battery Voltage
					Blower Motor	16	Battery Voltage
					Wiring Harness	Checked during above procedure. (This is a complete step-by-step high blower circuit check which also checks wiring harness.)	
Lo Front				Reduced Blower Speed	Blower Switch	4	Battery Voltage
					Master Relay	12-13	Battery Voltage
						7	Minimum 6 volts
					Resistor	14	Battery Voltage
						22-15	Minimum 8 volts
					Power Servo	39-46	Minimum 8 volts
					Blower Motor	16	Minimum 8 volts
RESISTOR CHECK							
Lo Front	Manual	Rotate from Max. Heat to Max. Cold	Transducer	Complete series of blower changes from Hi to Lo to Hi again.	Resistor	14	Battery Voltage
						22-40-42-44-15	Minimum 6 volts
AMPLIFIER CHECK							
Hi Front	Manual	150	Amplifier	Remove conn. from control head temperature dial. Voltage reading should be 9 volts minimum. Short this lead to ground. Voltage reading should be 0 volts. No voltage change indicates malfunctioning of amplifier.			
COMPRESSOR CLUTCH CHECK							
Hi Front	Manual	Max. Cold	Transducer	Cooling System Operation	Compressor Clutch (Grille Temp. must be above 40°.)	26-27-28	Battery Voltage

DE-ICE CIRCUIT							
Control Head Setting	Tester Settings: Function	Tester Settings: Manual Control	Tester Settings: Voltage	Tester Should Indicate:	If not, check the following:	Electrical Diagram Probe Points:	Voltmeter should read
De-Ice 65° on Temp. Dial	Automatic	Max. Cold	Probe	Assuming rest of system is operating normally: Max. Heat to windshield.	Blower Switch	3-4	Battery Voltage
					Master Relay	20-10-21	Battery Voltage
					Transducer	38	Zero Voltage
SENSOR STRING CHECK							
Hi Front	Automatic	-	Probe	-	Sensor String	29-30	Battery Voltage
POWER SERVO FEEDBACK POTENTIOMETER CHECK							
Hi Front	Manual	Rotate slowly from max. cold to max. heat and vice-versa	Transducer	Remove Power Servo 6-terminal connector and install ohmmeter at pink and yellow connections (points 32 and 33). Ohmmeter needle should move smoothly from approximately 70 ohms at max. cold to approximately 15 ohms at max. heat, or vice-versa. If an erratic movement is noted, the feedback potentiometer is defective.			
TRANSDUCER CHECK							
Hi Front	Manual	Max. Cold	Transducer	0-3" Vac. Reading 8 Volts Min.	Transducer voltage (at Max. Cold position)	37-38	Battery Voltage
						Note: If voltage is correct but vacuum is incorrect, check vacuum relay valve as noted below.	
		Max. Heat		9" Min. Vac. Reading 0-4 Voltage Reading	Transducer Ground		
VACUUM RELAY VALVE CHECK							
Hi Front	Manual	Max. Cold	Transducer	With large vacuum hose from transducer connected to tester and open end of hose (green) removed from transducer closed off, vacuum gauge should indicate no vacuum. If vacuum is indicated, vacuum relay valve is defective.			
VACUUM FUNCTION CHECKS							
Hi Front	Manual	Max. Heat	Trans.	Hi Blower Outside air (air door closed to car body). Hot air from heater outlets.	Defective Power Servo; Leak in Vacuum System; Temp.; Door Link Disconnected or Jammed; Defective Vacuum Relay Valve		
		Max. Cold		Hi Blower Recirc. Air (air door open to car body) cold air from A/C outlets.	Defective Mode Door Diaphragm		

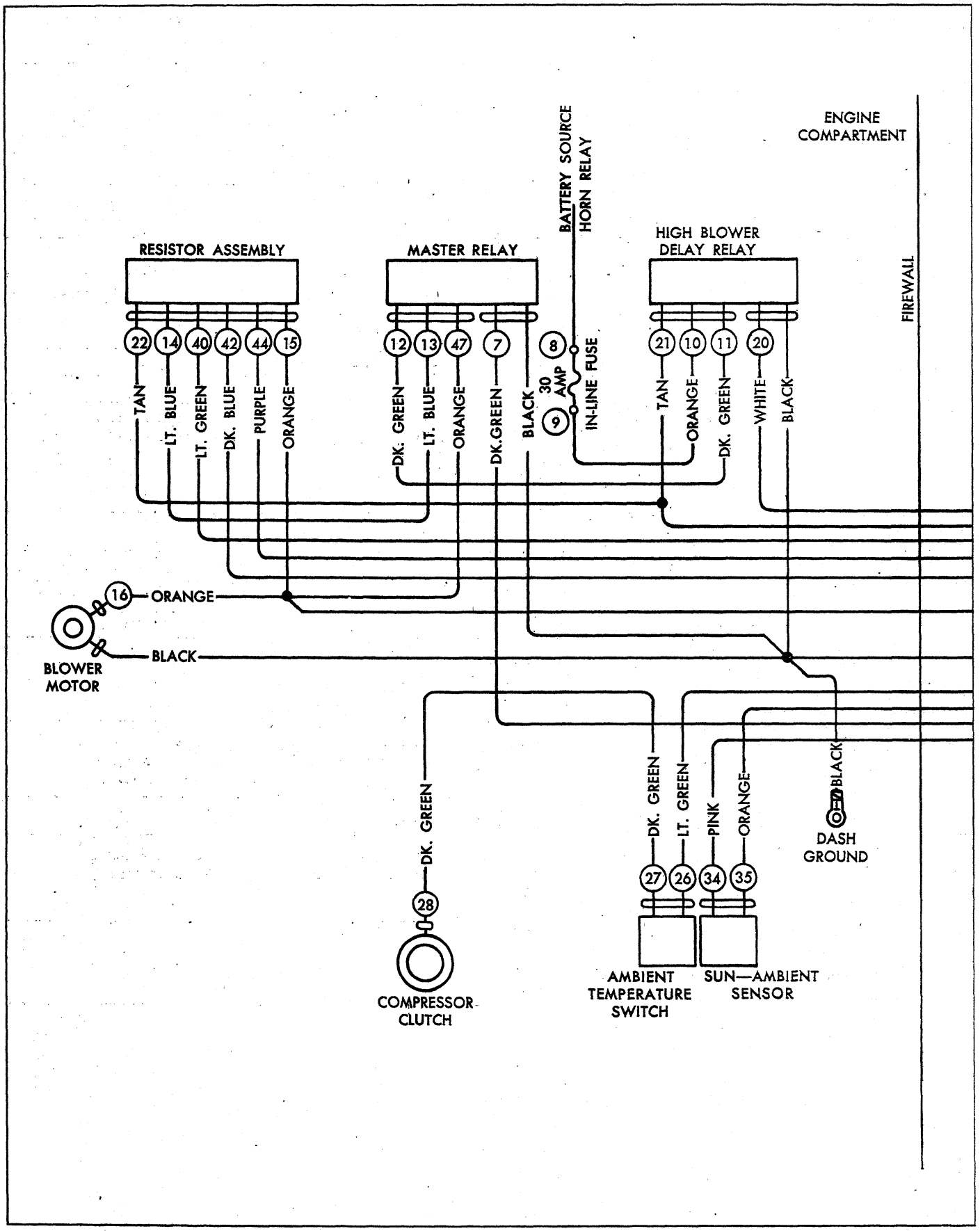


Fig. 38A—Comfortron Wiring Diagram - Underhood

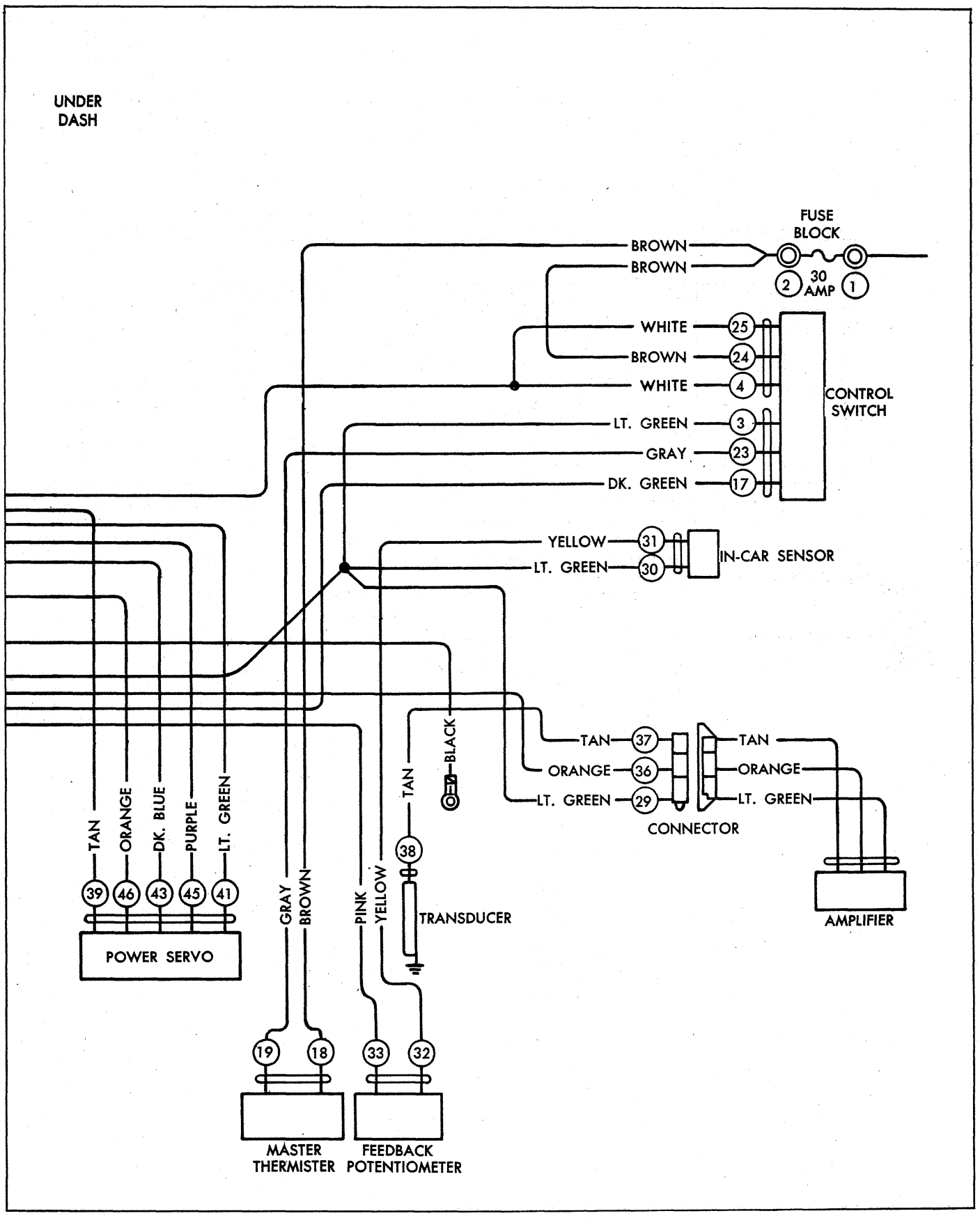


Fig. 38B—Comfortron Wiring Diagram - Underdash

VACUUM SYSTEM COMPONENT FUNCTION

Component	Vacuum Applied		No Vacuum Applied
Inside Air Door Diaphragm (Pink Hose)	Air Door Open to Recirculated Air (Car Body)		Air Door In Mid Position 50% Recir. Air 50% Outside Air
Outside Air Door Diaphragm (Purple Hose)	Air Door Open to Outside Air (Closed to Car Body)		
Power Servo	Maximum Heat		Maximum Cooling
Vacuum Relay Valve	Vacuum Applied to One Port Side Opens a Passage Through the Valve to Allow Transducer Vacuum to be Supplied to the Power Servo		No Vacuum Applied Closes Vacuum Supply to Power Servo
Water Valve	No Water Flow Through the Heater Core		Water Flow Through the Heater Core
Mode Door Diaphragm	Vacuum to Linkage Side	Vacuum to Covered Side	Airflow Out of Upper and Lower Outlets. Door Open 1" From 100% Lower Outlet Position
	Airflow Out Heater Ducts	Airflow Out of Upper Ducts	
Defroster Diaphragm	Full Airflow Out Heater Outlet	Full Airflow Out Defroster Outlets (Full De-Ice)	Airflow Divided 1/3 Out Defroster Outlets, 2/3 Out Heater Outlets
Transducer	Zero Voltage Applied to Transducer Results in Maximum Vacuum Supply		10 Volts Applied to Transducer Results in No Vacuum Supply

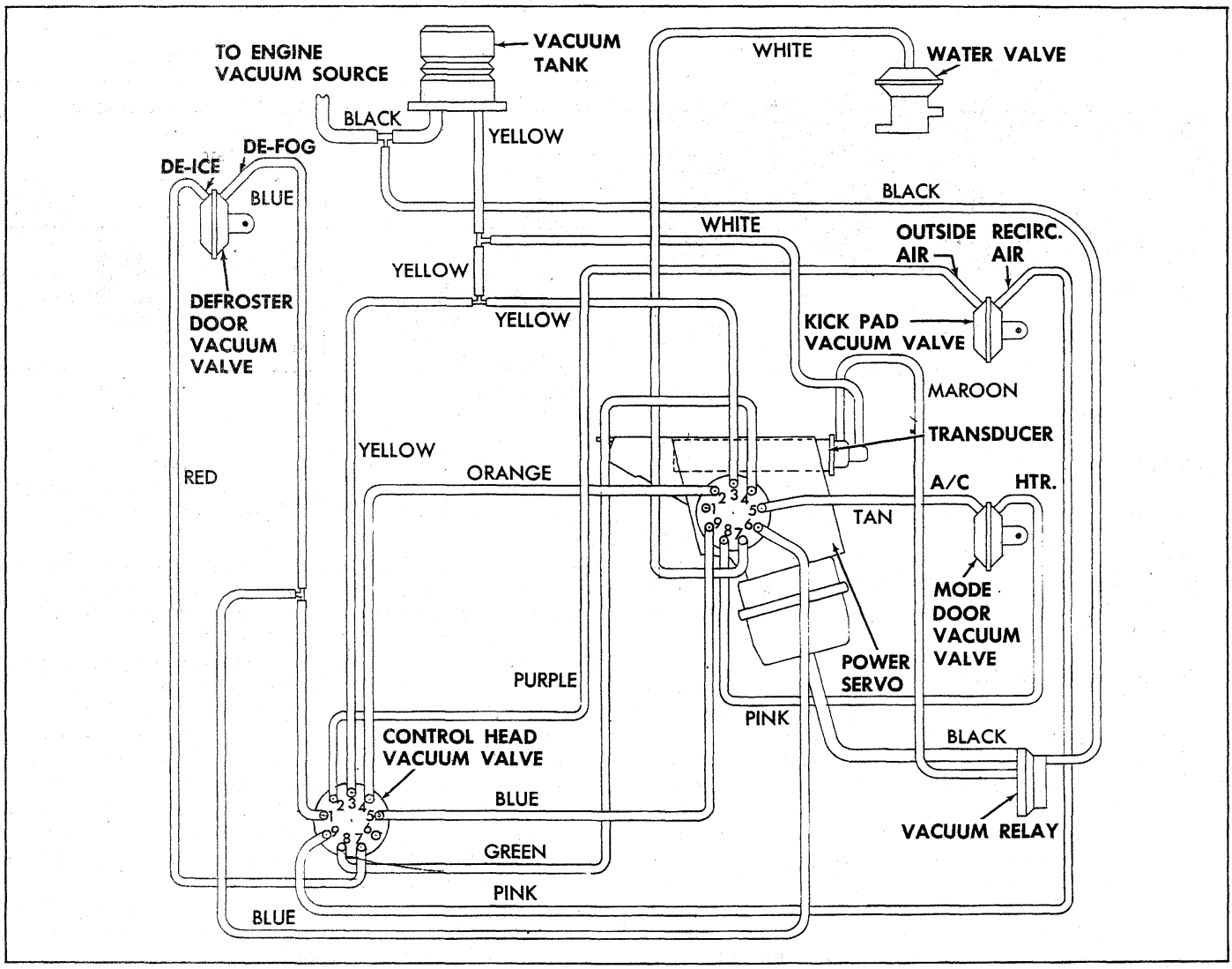


Fig. 39—Comfortron Vacuum Diagram

MAINTENANCE AND ADJUSTMENTS

EVAPORATOR CONTROL VALVE (POA)

(Four-Season—All Vehicles and Chevrolet Comfortron)

The only check for proper POA valve operation is to check the suction pressure at the valve as during a performance test. The POA valve is an absolute valve and will provide different gauge readings based on the altitude where the readings are being taken. Correct gauge reading at sea level is 29.5 psig. Gauge readings will be one-half psi higher for each additional 1000 feet of elevation. The following table lists gauge readings at different altitudes. If a valve gives improper gauge readings, it must be replaced since it is not repairable or adjustable (fig. 40).

29.5 psig. -- Sea Level	32.5 psig. -- 6000 ft.
30.0 psig. -- 1000 ft.	33.0 psig. -- 7000 ft.
30.5 psig. -- 2000 ft.	33.5 psig. -- 8000 ft.
31.0 psig. -- 3000 ft.	34.0 psig. -- 9000 ft.
31.5 psig. -- 4000 ft.	34.5 psig. -- 10000 ft.
32.0 psig. -- 5000 ft.	

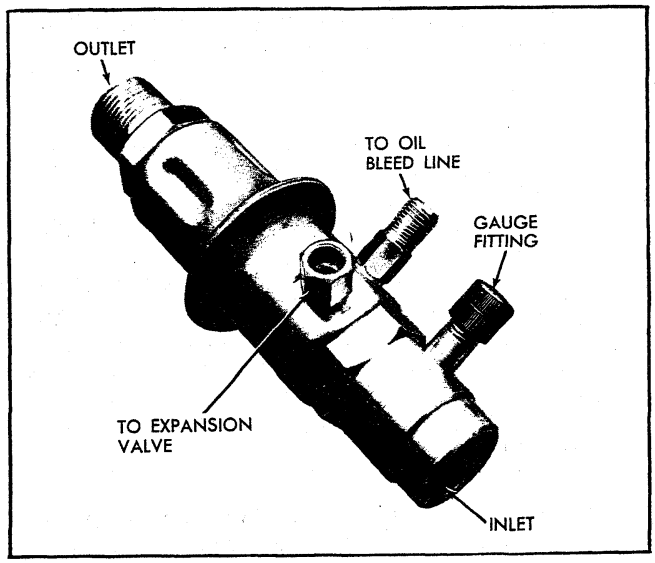


Fig. 40—Evaporator Pressure Control Valve - POA

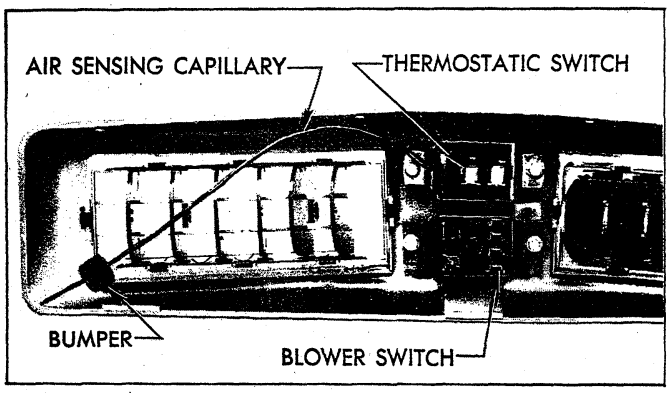


Fig. 41—Thermostatic Switch Installation

THERMOSTATIC SWITCH

GM Chevrolet Air Conditioning System

This system makes use of a thermostatic switch with a self-supporting air sensing capillary. This capillary controls the switch by sensing the temperature of the air leaving the fins (fig. 41).

Checking for Proper Operation

1. Install the gauge set and set up the vehicle as described under "Performance Test."
2. Movement of the temperature control knob should result in a definite change in suction pressure and cycling of the compressor clutch.
   - If compressor continues to operate regardless of the knob adjustment, it indicates that the switch points are fused which will lead to evaporator freeze-up. Replace the switch.
   - If the compressor does not operate, regardless of the position of the knob, a loss of the power element charge is indicated (provided that it has been established that power is supplied to the switch). This, of course, results in no cooling. Replace the switch.
   - Check the switch adjusting screw for stripped or otherwise damaged threads.

Adjusting Switch

If, after the above checks, the switch seems to be operating properly, adjust for proper setting if necessary, as follows:

1. Vehicle must be set up as described in "Performance Test."
2. The suction side of the system, read on the low pressure gauge, should pull down to the pressure shown in the chart in "Performance Data" under the ambient temperature at the time the switch is being set.
3. Remove the face plate retaining screws and remove face plate assembly.

NOTE: When removing face plate, note the position of the air sensing capillary so that it can be reinstalled in the same location as when removed.

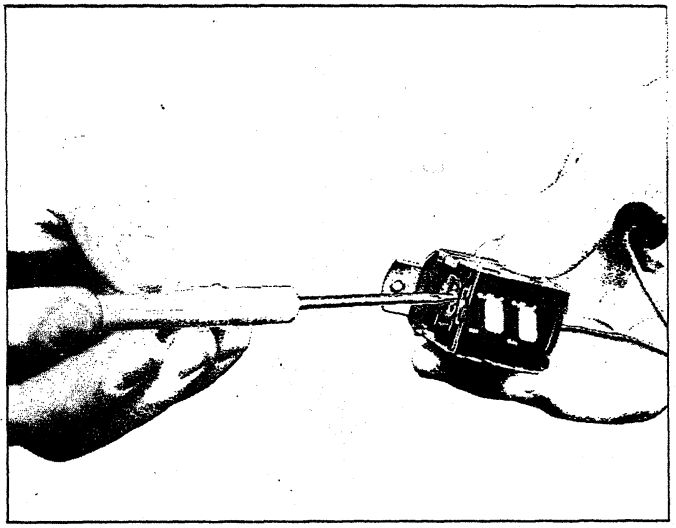


Fig. 42—Thermostatic Switch Adjustment

4. Remove the thermostatic switch retaining screws and remove switch. Remove the non-metal end plate from the switch to gain access to the switch adjusting screw.
5. If the low side pressure was less than the prescribed pressure at the end of each cooling cycle, turn the adjusting screw (See Figure 42) a partial turn clockwise.
6. If the pressure was more than the prescribed pressure, turn the adjusting screw counter-clockwise.
7. Reinstall switch end plate and install switch in face plate. Install face plate on evaporator assembly. Be sure that the air sensing capillary has been replaced properly.
8. Check system performance. If further adjustment is needed, repeat Steps 3 through 7 until the prescribed pressure is reached.

CAUTION: Do not attempt to run a Performance Check with the face plate and switch removed from the evaporator assembly--inaccurate readings would be the result. Always replace the switch and face plate assemblies before checking system performance.

EXPANSION VALVE

A malfunction of the expansion valve will be caused by one of the following conditions: valve stuck open, valve stuck closed, broken power element, a restricted screen or an improperly located or installed power element bulb. The first three conditions require valve replacement. The last two may be corrected by replacing the valve inlet screen and by properly installing the power element bulb.

Attachment of the expansion valve bulb to the evaporator outlet line is very critical. The bulb must be attached tightly to the line and must make good contact with the line along the entire length of the bulb. A loose bulb will result in high low side pressures and poor cooling. On bulbs located outside the evaporator case, insulation must be properly installed.

The external equalizer line shown in Figure 43 is not used in the G.M. Chevrolet Air Conditioning system.

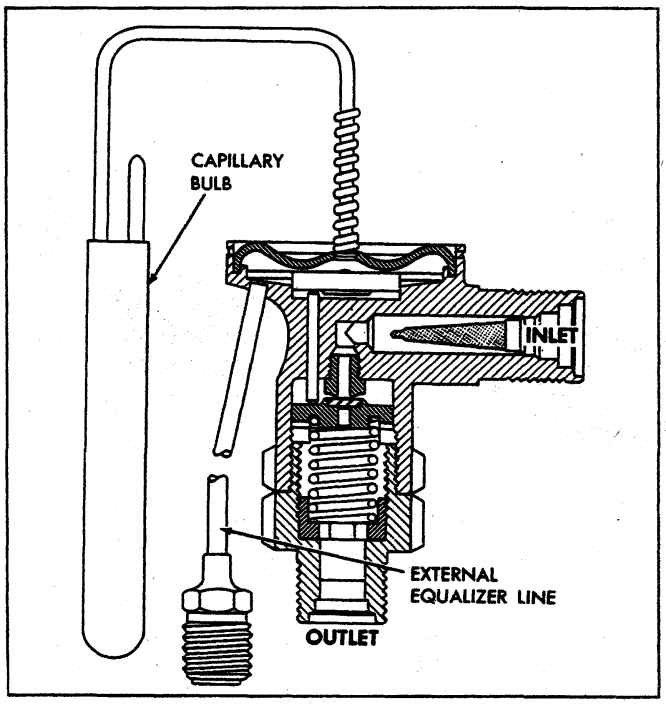


Fig. 43—Expansion Valve

Indications of expansion valve trouble are provided by Performance Tests as follows:

VALVE STUCK OPEN
Noisy Compressor.
No Cooling - Freeze Up.
VALVE STUCK CLOSED, BROKEN POWER ELEMENT OR PLUGGED SCREEN
Very Low Suction Pressure.
No Cooling.
POORLY LOCATED POWER ELEMENT BULB
Normal Pressure.
Poor Cooling.

Check for Defective Valve

The following procedure must be followed to determine if a malfunction is due to a defective expansion valve.

1. Check to determine if the system will meet the performance test as outlined previously. If the expansion valve is defective, the low pressure readings (POA or evaporator pressure) will be above specifications.
2. The loss of system performance is not as evident when the compressor head pressure is below 200 P.S.I. Therefore, it may be necessary to increase the system head pressure by partially blocking the condenser. Disconnect the blower lead wire and repeat the "performance check" to determine if the evaporator pressure can be obtained.
3. The system will also indicate a low refrigerant charge by bubbles occurring in the sight glass. Systems equipped with a POA Valve require the following additional test to determine if the deficiency is the expansion valve.
4. Remove the expansion valve bulb from the evaporator outlet pipe, and the four-wire connector on the blower resistor. Place the blower on "low". With the engine operating at 2,000 rpm, observe the POA gage pressure.
5. Insert the expansion valve bulb in a cup of ice. This should result in the POA pressure being reduced to approximately 30 P.S.I. If the pressure does not reduce to this level, the POA valve is defective. If the pressure falls considerably below 30 P.S.I., the expansion valve is defective.

ENGINE IDLE COMPENSATOR

This additional aid to prevent stalling during prolonged hot weather periods is included with all air conditioned vehicles. The idle compensator is a thermostatically controlled air bleed which supplies additional air to the idle mixture. On V-8 engines, with factory installed air conditioning systems, the compensator is located within the carburetor and is accessible when the engine air cleaner is removed. On all other vehicles the compensator is threaded into a manifold fitting below the carburetor. All compensators are factory set and are non-adjustable. A malfunctioning unit should be replaced.

NOTE: If engine idle is erratic, hold the idle compensator valve closed with a pencil or wooden dowel while adjusting the idle mixture screw(s). Never attempt to bend the bimetal strip or attempt any valve adjustment.

EVACUATING AND CHARGING PROCEDURES

AIR CONDITIONING SYSTEM CAPACITIES

	Refrigerant Charge	Oil Charge
Four-Season Systems (Chevrolet, Chevelle, Chevy Nova and Camaro) Comfortron System (Chevrolet)	3 lbs., 12 oz.	11 ozs. 525 viscosity
Four-Season System (Corvette)	3 lbs., 4 oz.	11 ozs. 525 viscosity
GM Chevrolet Air Conditioning Systems (Chevrolet, Chevelle, Chevy Nova and Camaro)	3 lbs.	11 ozs. 525 viscosity

REFRIGERANT QUICK-CHECK PROCEDURE

The following procedure can be used to quickly determine whether or not an air conditioning system has a proper charge of refrigerant. This check can be made in a manner of minutes thus facilitating system diagnosis by pinpointing the problem to the amount of charge in the system or by eliminating this possibility from the overall checkout.

Start engine and place on fast idle. Set controls for maximum cold with blower on high.

- **Bubbles present in sight glass.** → System low on charge. Check with leak detector. Correct leak, if any, and fill system to proper charge.
- **No bubbles. Sight glass clear.** → System is either fully charged or empty. Feel high and low pressure pipes at compressor. High pressure pipe should be warm; low pressure pipe should be cold.
  - **No appreciable temperature differential noted at compressor.** → System empty or nearly empty. Turn off engine and connect charging station. Induce 1/2# of refrigerant in system (if system will not accept charge, start engine and draw 1/2# in through low pressure side). Check system with leak detector.
  - **Temperature differential noted at compressor.** → Even though a differential is noted, there exists a possibility of overcharge. An overfilled system will result in poor cooling during low speed operation (as a result of excessive head pressure). An overfill is easily checked by disconnecting the compressor clutch connector while observing the sight glass.
    - **If refrigerant in sight glass remains clear for more than 45 seconds (before foaming and then settling away from sight glass) an overcharge is indicated.** Verify with a performance check.
    - **If refrigerant foams and then settles away from sight glass in less than 45 seconds, it can be assumed that there is a proper charge of refrigerant in system.** Continue checking out system using performance checks outlined previously.

PURGING THE SYSTEM

In replacing any of the air conditioning components the system must be completely purged or drained of refrigerant. The purpose is to lower the pressure inside the system so that a component part can be safely removed.

1. With engine stopped, install high and low pressure lines of Charging Station gauge set to the proper high and low pressure gauge fittings. (See "Installing Gauge Set to Check System Operation".)

   NOTE: Before installing lines, be sure that all four controls on the gauge set are closed.

2. Disconnect vacuum line at Charging Station vacuum pump and lay end of line on a clean rag on the floor.
3. Crack open high (2) and low (1) pressure control valves, and allow refrigerant to purge from system.

   CAUTION: Do not open valves too much or compressor oil may be discharged with the refrigerant. Oil loss can be easily detected on rag at discharge line.

EVACUATING AND CHARGING THE SYSTEM

GENERAL NOTE: In all evacuating procedures shown below, the specification of 26-28 inches of Mercury vacuum is used. These figures are only attainable at or near Sea Level Elevation. For each 1000 feet above sea level where this operation is being performed, the specifications should be lowered by 1 inch. Example: at +5000 ft. elevation, only 21 to 23 inches of vacuum can normally be obtained.

Whenever the air conditioning system is open for any reason, it should not be put into operation again until it has been evacuated to remove air and moisture which may have entered the system.

The following procedures are based on the use of the J-8393 Charging Station.

Fill Charging Cylinder

1. Open valve on bottom of charging cylinder allowing refrigerant to enter cylinder.
2. Bleed cylinder valve on top (behind control panel) as required to allow refrigerant to enter. When refrigerant reaches desired level (see "Air Conditioning System Capacities"), close valve at bottom of cylinder and be certain bleed valve is closed securely.

   NOTE: It will be necessary to close bleed valve periodically to allow boiling to subside to check level in sight glass.

Installing Charging Station to System

1. Be certain all valves on charging station are closed.
2. Connect high pressure gauge line to high pressure gauge fitting. (See "Installing Gauge Set to Check System Operations.")
3. See Figure 44. Turn high pressure control (2) one turn counter-clockwise (open). Crack open low pressure control (1) and allow refrigerant gas to hiss from low pressure gauge line for three seconds, then connect low pressure gauge line to low pressure gauge fitting.
4. System is now ready for performance testing.

Evacuating and Charging System

1. Install charging station and purge system as noted under "Purging the System."
2. After system has been purged as above, connect the vacuum line to the vacuum pump, turn on vacuum pump, and open Vacuum Control Valve (3). Run pump until 28-29 inches vacuum is obtained (See

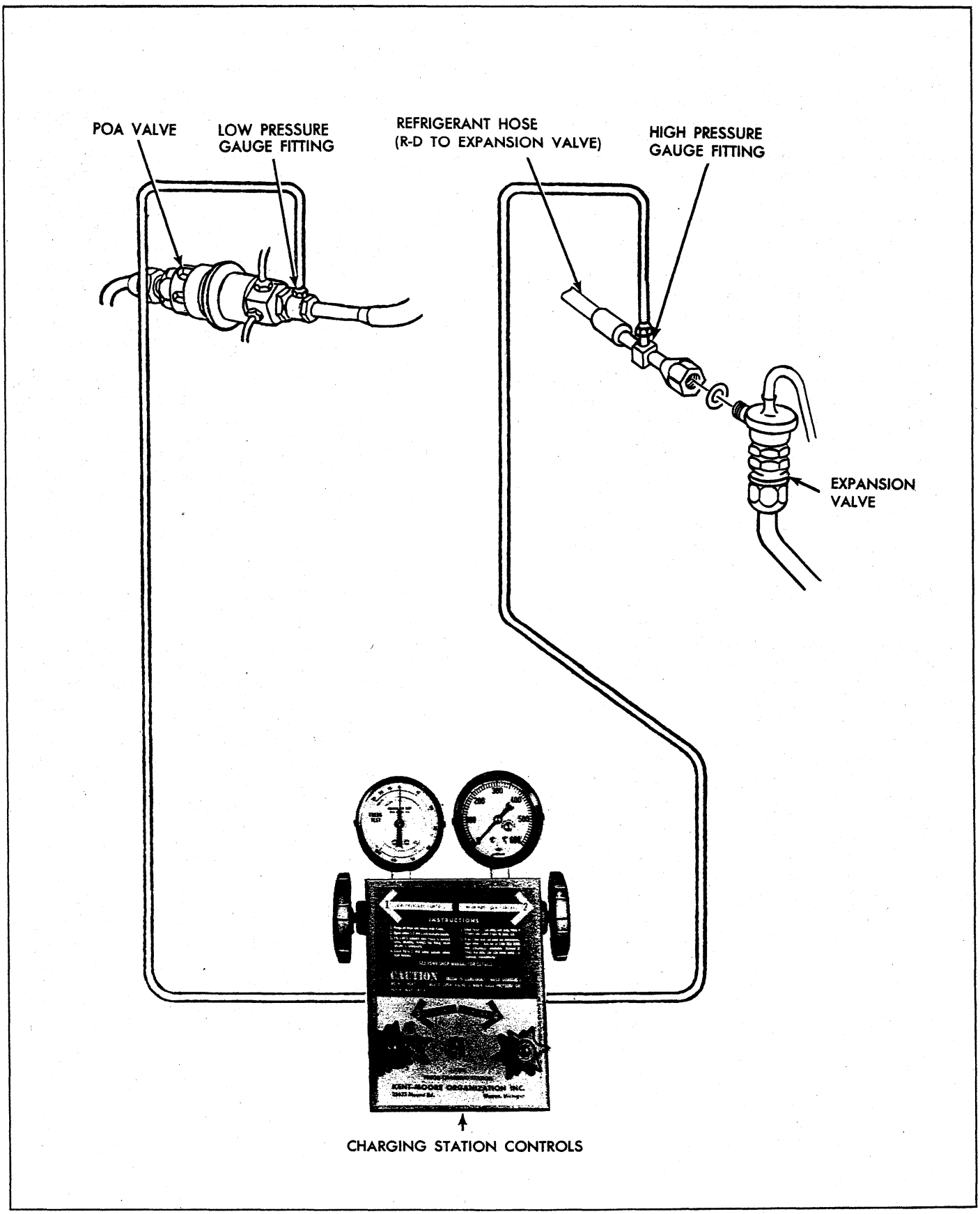


Fig. 44—Charging Schematic

"General Note" under "Evacuating and Charging the System"). Continue to run pump for 15 minutes after the system reaches 28-29 inches vacuum.

NOTE: If 28-29 inches cannot be obtained, close Vacuum Control Valve (3) and shut off vacuum pump. Open Refrigerant Control Valve (4) and allow 1/2 pound of R-12 to enter system. Locate and repair all leaks. Purge this 1/2 pound and re-evacuate for 15 minutes.

3. Only after evacuating as above, is system ready for charging. Note reading on sight glass of charging cylinder. If it does not contain a sufficient amount for a full charge, fill to the proper level.
4. With High and Low pressure Valves (1 and 2) open, close Vacuum Control Valve (3), turn off vacuum pump, open Freon Control Valve (4) and allow freon to enter system.

NOTE: If the charge will not transfer completely from the station to the system, close the high pressure valve at the gauge set, set the air conditioning controls for cooling, check that the engine compartment is clear of obstructions, and start the engine. Compressor operation will decrease the low side pressure in the system.

System is now charged and should be performance tested before removing gauges.

CHECKING OIL

In the six cylinder compressor it is not recommended that the oil be checked as a matter of course. Generally, compressor oil level should be checked only where there is evidence of a major loss of system oil such as might be caused by:

- A broken refrigerant hose.
- A severe hose fitting leak.
- A very badly leaking compressor seal.
- Collision damage to the system components.

As a quick check on compressor oil charge, operate the engine at idle on maximum cold for approximately 10 minutes, turn off the engine and momentarily crack open the oil drain plug on bottom of the compressor letting a slight amount of oil drain out. Retighten plug. Again slightly crack open the plug. If oil comes out, the compressor has the required amount of oil.

NOTE: The oil may appear foamy. This is considered normal.

To further check the compressor oil charge, should the above test show insufficient oil, it is necessary to remove the compressor from the vehicle, drain and measure the oil as outlined under "Checking Compressor Oil Charge".

Checking Compressor Oil Charge

1. Run the system for 10 minutes at 500-600 engine rpm with controls set for maximum cooling and high blower speed.
2. Turn off engine, discharge the system, remove compressor from vehicle, place it in a horizontal position with the drain plug downward. Remove the drain plug and, tipping the compressor back and forth and rotating the compressor shaft, drain the oil into a clean container, measure and discard the oil.
3. a. If the quantity drained was 4 fluid oz. or more, add the same amount of new refrigerant oil to the replacement compressor.
   b. If the quantity drained was less than 4 fluid oz., add 6 fluid oz. of new refrigeration oil to the replacement compressor.
   c. If a new service compressor is being installed, drain all oil from it and replace only the amount specified in Steps 3a and 3b above.
   d. If a field repaired compressor is being installed, add an additional 1 fluid oz. to the compressor.
4. In the event that it is not possible to idle the compressor as outlined in Step 1 to effect oil return to it, proceed as follows:
   a. Remove the compressor, drain, measure and discard the oil.
   b. If the amount drained is more than 1-1/2 fluid oz. and the system shows no signs of a major leak, add the same amount to the replacement compressor.
   c. If the amount drained is less than 1-1/2 fluid oz. and the system appears to have lost an excessive amount of oil, add 6 fluid oz. of clean refrigeration oil to replacement compressor, 7 fluid oz. to a repaired compressor.

   If the oil contains chips or other foreign material, replace the receiver-dehydrator and flush or replace all component parts as necessary. Add the full specified volume of new refrigeration oil to the system.
5. Add additional oil in the following amounts for any system components being replaced.

Evaporator	3 fluid oz.
Condenser	1 fluid oz.
Receiver-Dehydrator	1 fluid oz.

NOTE: When adding oil to the compressor, it will be necessary to tilt the rear end of the compressor up so that the oil will not run out of the suction and discharge ports. Do not set the compressor on the shaft end.

COMPONENT PART REPLACEMENT AND MINOR REPAIR

Component replacement has been separated into five categories as follows:

All Systems - Contains removal or repair procedures that would apply to all three air conditioning systems.

Four-Season and Comfortron Systems - Refers to components that are identical with both Four-Season and Comfortron systems, but does not include procedures already outlined in the All Systems section.

The last three categories ("Four-Season Only", "Comfortron Only" and "GM Chevrolet Air Conditioner Only") contain removal and repair procedures peculiar to that system only.

ALL SYSTEMS

PREPARING SYSTEM FOR REPLACEMENT OF COMPONENT PARTS

Air conditioning, like many other things, is fairly simple to service once it is understood. However, there are certain procedures, practices and precautions that should be followed to prevent costly repairs, personal injury or damage to equipment. For this reason it is strongly recommended that the preceding information in this section be studied thoroughly before attempting to service the system.

Great emphasis must be placed upon keeping the system clean. Use plugs or caps to close system components and hoses when they are opened to the atmosphere. Keep your work area clean.

In removing and replacing any part which requires unsealing the refrigerant circuit the following operations, which are described in this section, must be performed in the sequence shown.

1. Purge the system by releasing the refrigerant to the atmosphere.
2. Remove and replace the defective part.
3. Evacuate and charge the system with R-12.

CAUTION: Always wear protective goggles when working on refrigeration systems. Goggles J-5453 are included in the set of air conditioning special tools. Also, beware of the danger of carbon monoxide fumes by avoiding running the engine in closed or improperly ventilated garages.

FOREIGN MATERIAL IN THE SYSTEM

Whenever foreign material is found in the system, it must be removed before restoring the system to operation.

In the case of compressor mechanical failure, perform the following operations:

1. Remove the compressor.
2. Remove the receiver-dehydrator and discard the unit.
3. Flush the condenser to remove foreign material which has been pumped into it.
4. Disconnect the line from the receiver-dehydrator at the inlet connection of the expansion valve. Inspect the inlet screen for the presence of metal chips or other foreign material. If the screen is plugged, replace it. Reconnect the line to the expansion valve.
5. Install a new receiver-dehydrator.
6. Install the replacement compressor.
7. Add the necessary quantity of oil to the system (one fluid ounce because of receiver-dehydrator replacement plus the quantity needed for the replacement compressor - see "Checking Compressor Oil Charge" under "Checking Oil."
8. Evacuate and charge the system.
9. Check system performance.

REFRIGERANT LINE CONNECTIONS

"O" Rings

Always replace the "O" ring when a connection has been broken. When replacing the "O" ring, first dip it in clean refrigeration oil. Always use a backing wrench on "O" ring fittings to prevent the pipe from twisting and damaging the "O" ring. Do not overtighten. Correct torque specifications are as follows:

Metal Tube O.D.	Thread and Fitting Size	Steel Tubing Torque*	Alum. Tubing Torque*
1/4	7/16	13	6
3/8	5/8	33	12
1/2	3/4	33	12
5/8	7/8	33	20
3/4	1-1/16	33	25

* Foot Pounds

NOTE: Where steel to aluminum connections are being made, use torque for aluminum tubing.

Hose Clamps

When hose clamp connections are encountered, special procedures are necessary for both installation and removal.

Installation

1. Coat tube and hose with clean refrigeration oil.
2. Carefully insert hose over the three beads on the fitting and down as far as the fourth, or locating bead. Hose must butt against this fourth bead.

CAUTION: Use no sealer of any kind.

3. Install clamps on hose, hooking the locating arms over the cut end of the hose.
4. Tighten the hose clamp screw to 35-42 in. lb. torque. DO NOT RETORQUE. The clamp screw torque will normally decrease as the hose conforms to the force of the clamp. The screw should be retorqued only if its torque falls below 10 in. lb. In this case, retorque to 20-25 in. lb. Further tightening may damage the hose.

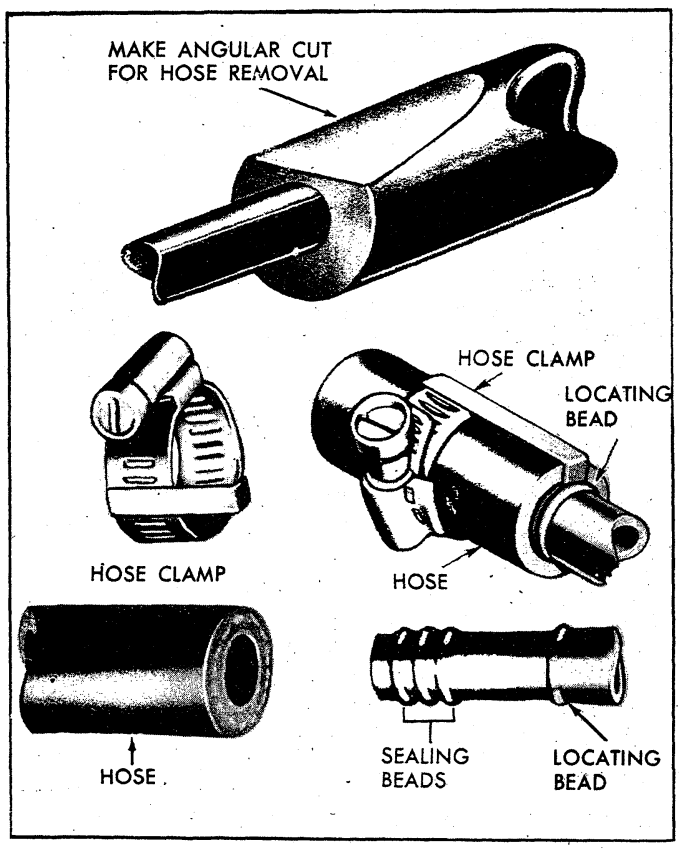


Fig. 45—Hose Clamp Connections

Removal

1. Carefully, with a sharp knife, make an angle cut in the hose as shown in Figure 45. This should loosen the hose so that it may be worked off the fitting.
2. Cut off slit end of hose when reinstalling. Reinstall as described under "Installation".

CAUTION: Use only approved refrigeration hose. Never use heater hose. Use extreme care not to nick or score the sealing beads when cutting off the hose. Cutting the hose lengthwise may result in this problem.

REPAIR OF REFRIGERANT LEAKS

Any refrigerant leaks found in the system should be repaired in the manner given below:

Leaks at "O" Ring Connection

1. Check the torque on the fitting and, if too loose, tighten to the proper torque. Always use a backing wrench to prevent twisting and damage to the "O" ring. Do not overtighten. Again leak test the joint.
2. If the leak is still present, discharge the refrigerant from the system as described under "Evacuating and Charging Procedures."
3. Inspect the "O" ring and the fitting and replace if damaged in any way. Coat the "O" ring with clean refrigeration oil and install carefully.
4. Retorque the fitting, using a backing wrench.
5. Evacuate and charge the system.

Leaks at Hose Clamp Connection

1. Check the tightness of the clamp itself and tighten if necessary. Recheck for leak.
2. If leak has not been corrected, discharge the system, loosen clamp and remove hose from connection. Inspect condition of hose and connector. Replace scored or damaged parts.
3. Dip end of new hose in clean refrigeration oil and carefully reinstall over connector. Never push end of hose beyond the locating bead. Properly torque the clamp.
4. Recheck the system for leaks by installing 1/2 to 1 lb. of R-12 into the system. Do not run compressor.
5. Purge the system, thus removing the 1/2 to 1 lb. installed in Step 4 above.
6. Evacuate and charge the system.

Leaks in the Hose

With the development of the integral hose, muffler and connector block assembly, hose replacement becomes very expensive.

1. Locate the leak.
2. Discharge the system.
3. Cut out the leaking portion of the hose, making sure that all of the failed portion is removed. If only a very small portion of the hose was removed, it may be possible to splice the two ends together using a special hose connector and two hose clamps. If several inches of hose were removed, a new piece of hose should be spliced in using two connectors and four hose clamps. Dip the ends of the hose in clean refrigeration oil before installing onto connector. Never push the end of the hose beyond the locating bead. Properly torque the clamp.
4. Evacuate and charge the system.

Compressor Leaks

If leaks are located around the compressor shaft seal or shell, replacement of necessary seals should be made as outlined under "Compressor" in the Chassis Overhaul Shop Manual.

REFRIGERANT HOSE FAILURE

After a leak or rupture has occurred in a refrigerant hose, or if a fitting has loosened and caused a considerable loss of refrigerant and oil, the entire system should be flushed and recharged after repairs have been made. If the system has been open to atmosphere for any prolonged period of time the receiver-dehydrator should be replaced.

CONDENSER

Chevrolet

Replacement (Fig. 46)

1. Disconnect the battery ground cable.
2. Purge the system of refrigerant.
3. Remove the horn assemblies, hood lock plate and lock plate support.
4. Remove the receiver-dehydrator bracket screws. Disconnect the receiver-dehydrator inlet and outlet lines and cap or tape the open connections at once. Remove the receiver-dehydrator from the vehicle.

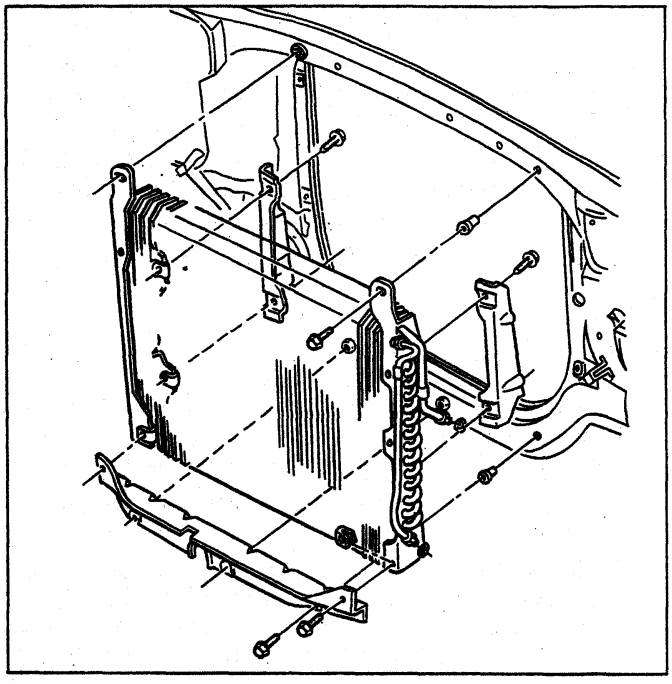


Fig. 46—Chevrolet Condenser

5. Disconnect the condenser inlet line and cap the open connections.
6. Remove the receiver-dehydrator bracket from the condenser. Remove the left hand grille to radiator support bracket.
7. Remove the condenser to radiator support screws and remove the condenser by tilting the condenser and lifting up out of vehicle (right end first).

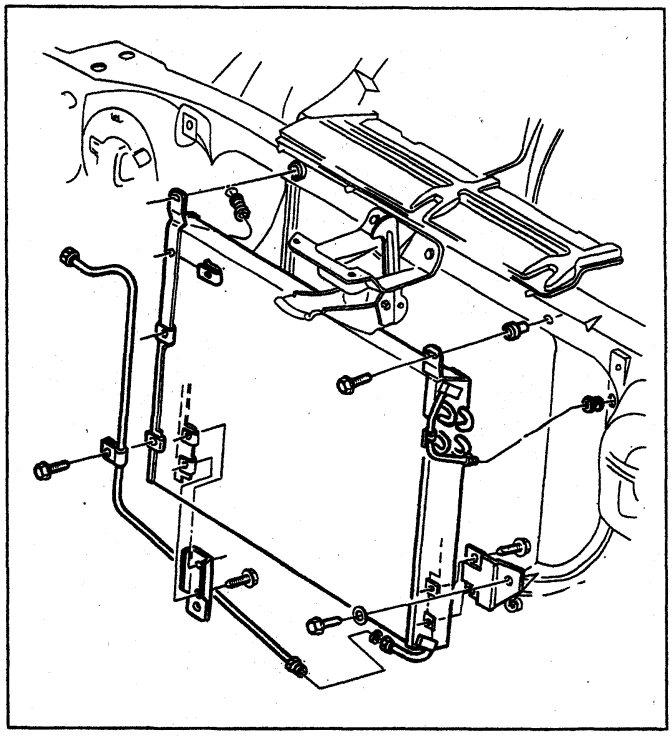


Fig. 47—Chevelle Condenser

8. To install, reverse steps 1-7. Add 1 fluid ounce of refrigeration oil to a new condenser.

   NOTE: Use new "O" ring seals (coated with clean refrigeration oil) when connecting all freon lines.

Chevelle

Replacement (Fig. 47)

1. Disconnect the battery ground cable.
2. Purge the system of refrigerant.
3. Remove the five hood catch screws and remove the catch assembly.
4. Remove the hood catch support screws to header panel, filler panel and radiator support. Bend the support to the left to allow clearance for condenser removal.
5. Remove the receiver-dehydrator bracket to condenser screws and condenser outlet line clamp screw.
6. Disconnect the condenser inlet and outlet lines and cap or tape the open connections at once.
7. Remove the condenser to radiator support screws and lift the condenser from the vehicle.
8. Reverse the removal procedure to install the condenser. Add one fluid ounce of refrigeration oil to a new condenser.

   NOTE: Use new "O" ring seals (coated with clean refrigeration oil) when connecting the freon lines. Torque connections to 13 ft. lbs.

9. Evacuate and charge the system.

Nova

Replacement (Fig. 48)

1. Disconnect the battery ground cable.
2. Purge the system of refrigerant.

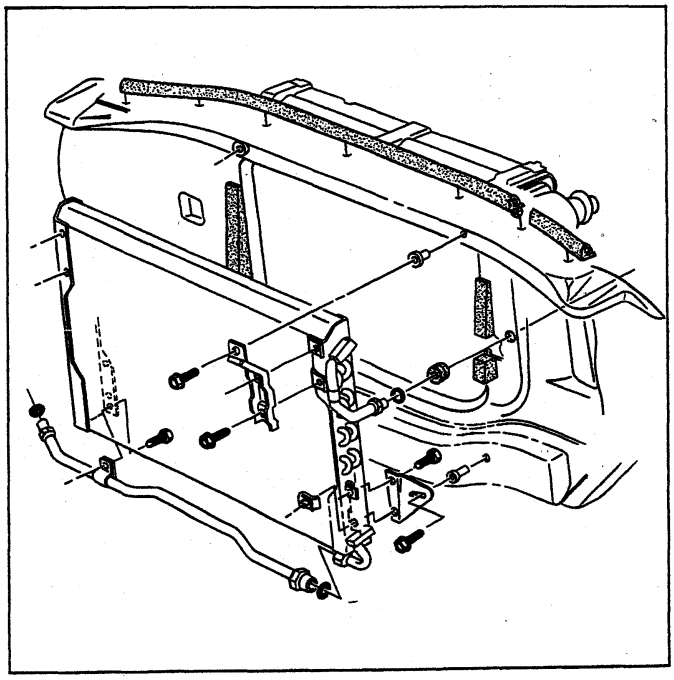


Fig. 48—Nova Condenser

3. Remove the five hood catch screws and remove catch assembly.
4. Remove the hood catch support screws and remove the support.
5. Remove the lower radiator-condenser baffle.
6. Remove the left headlamp bezel and the left grille support to radiator support screws.
7. Disconnect the condenser inlet line and outlet line at right side of condenser. Cap or tape the open connections.
8. Remove the condenser mounting screws and outlet line attaching screws. Pull left side of grille forward far enough to get the condenser inlet line through the radiator support and lower the condenser from the vehicle.
9. To install a new condenser, reverse the removal procedure. Add one fluid oz. refrigeration oil to the new condenser.

   NOTE: Use new "O" ring seals (coated with clean refrigeration oil) when connecting freon lines.

10. Evacuate and charge the system.

Camaro

Replacement (Fig. 49)

1. Disconnect the battery ground cable.
2. Purge the system of refrigerant.
3. Remove the five hood catch screws and remove the hood catch and horn assemblies from the vehicle as a unit.
4. Remove the hood catch support screws from the header panel, valance panel and radiator support and remove catch support.
5. Disconnect the condenser inlet and outlet lines.

   NOTE: Cap or tape the open connections at once.

6. Remove the condenser to radiator support screws and remove the condenser.
7. Reverse the above procedure when installing the new condenser. Add one fluid ounce of refrigeration oil to the new condenser.

   NOTE: Use new "O" ring seals (coated with clean refrigeration oil) when installing freon lines. Torque connections to 13 ft. lbs.

8. Evacuate, and charge the system.

Corvette

Replacement (Fig. 50)

1. Purge the system of refrigerant.
2. Remove the hood from the car, first scribing the hinge attachment location.
3. Disconnect the condenser inlet and outlet lines.

   NOTE: Cap or tape inlet and outlet connections at once.

4. Remove the condenser to radiator support screws and remove the condenser assembly from the vehicle.
5. Reverse the above procedure to install the new assembly. Add 1 oz. refrigeration oil to a new condenser.

   NOTE: Use new "O" ring seals (coated with clean refrigeration oil) when installing inlet and outlet lines. Torque connections to 13 ft. lbs.

6. Evacuate and charge the system.

RECEIVER—DEHYDRATOR

Replacement—All Vehicle (Figs. 51 and 52)

1. Disconnect the battery ground cable.
2. Purge the system of refrigerant.

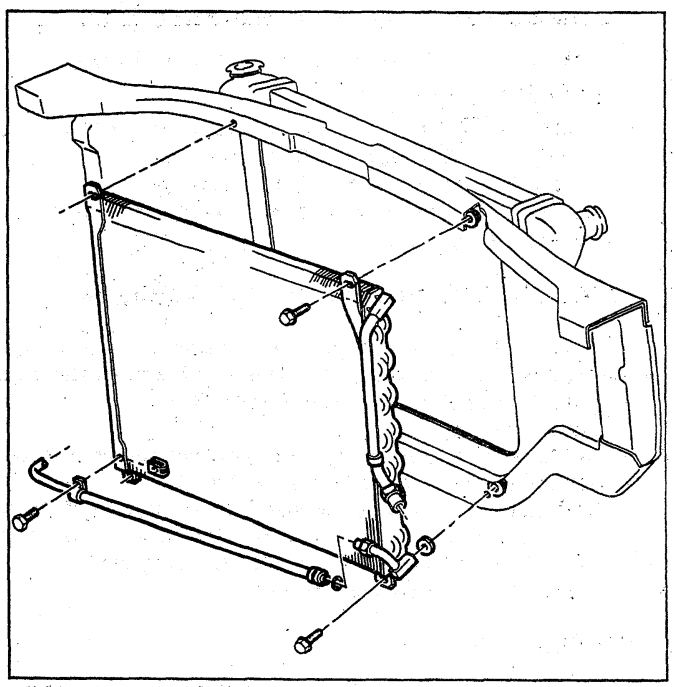


Fig. 49—Camaro Condenser

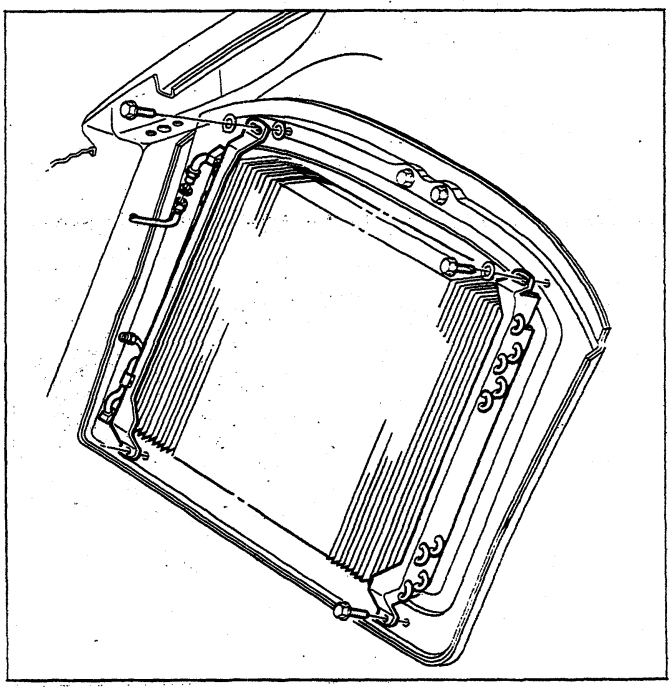


Fig. 50—Corvette Condenser

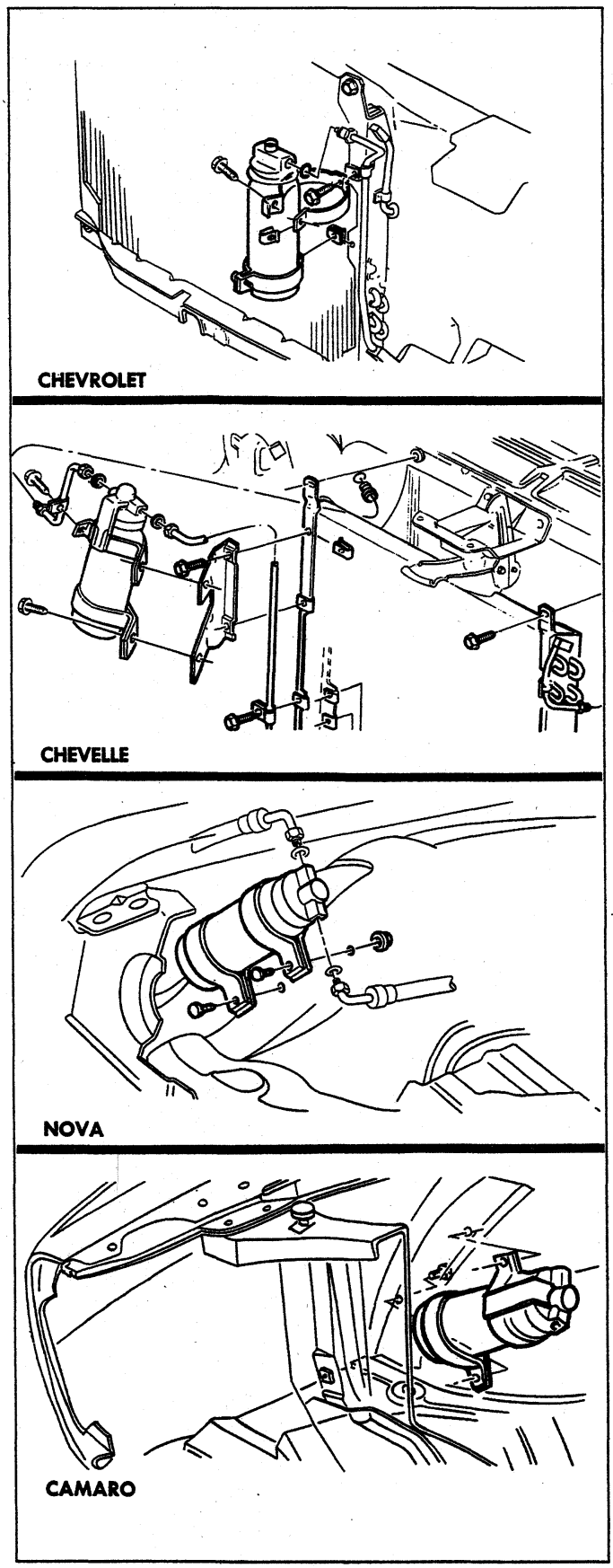


Fig. 51—Receiver-Dehydrator - All Except Corvette

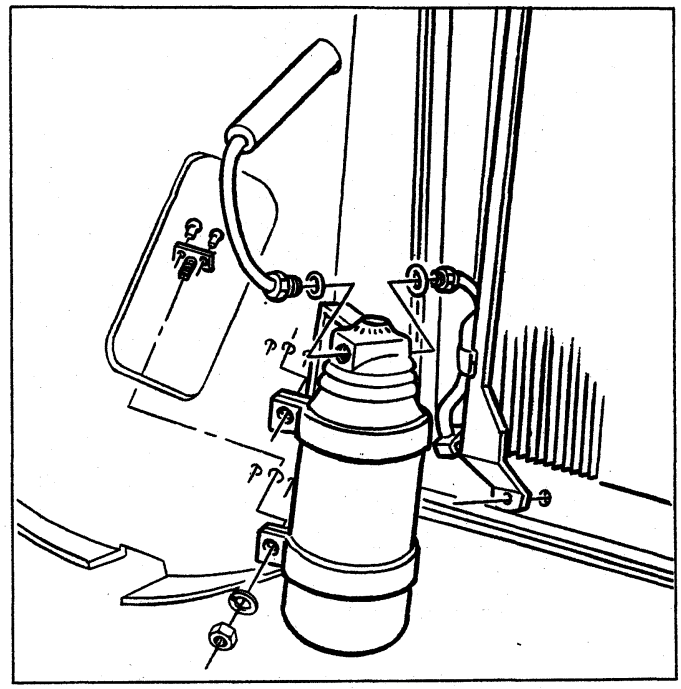


Fig. 52—Receiver-Dehydrator Mounting (Corvette)

3. Chevrolet - Remove the left hand horn.
   Nova and Camaro - Remove the battery assembly.
4. Remove the receiver-dehydrator bracket attaching screws.
5. Disconnect the receiver-dehydrator inlet and outlet lines and cap or tape the open connections at once.
6. Remove the receiver-dehydrator from the vehicle.
7. If a new receiver-dehydrator is being installed, add 1 oz. of clean refrigeration oil to the new unit.
8. Connect the inlet and outlet lines using new "O" ring seals coated with clean refrigeration oil.

   NOTE: Do not uncap the new unit until the last instant before installation.

9. Install the receiver-dehydrator bracket screws.
10. Chevrolet - Install the left hand horn.
    Nova and Camaro - Install the battery.
11. Connect the battery ground cable, evacuate and charge the system.

SIGHT GLASS REPLACEMENT—ALL VEHICLES

If damage to the sight glass should occur, a new sight glass unit should be installed. The unit contains the sight glass, seal and retainer. (See Figure 53.)

1. Purge system.
2. Remove the sight glass retainer nut using a screw driver and remove old glass and seal.
3. Install the new glass and seal and retainer nut, being careful not to turn the nut past the face of the housing. To do so may damage the "O" ring seal.
4. Evacuate and recharge the system.

COMPRESSOR

The same basic six cylinder reciprocating compressor is used in all systems.

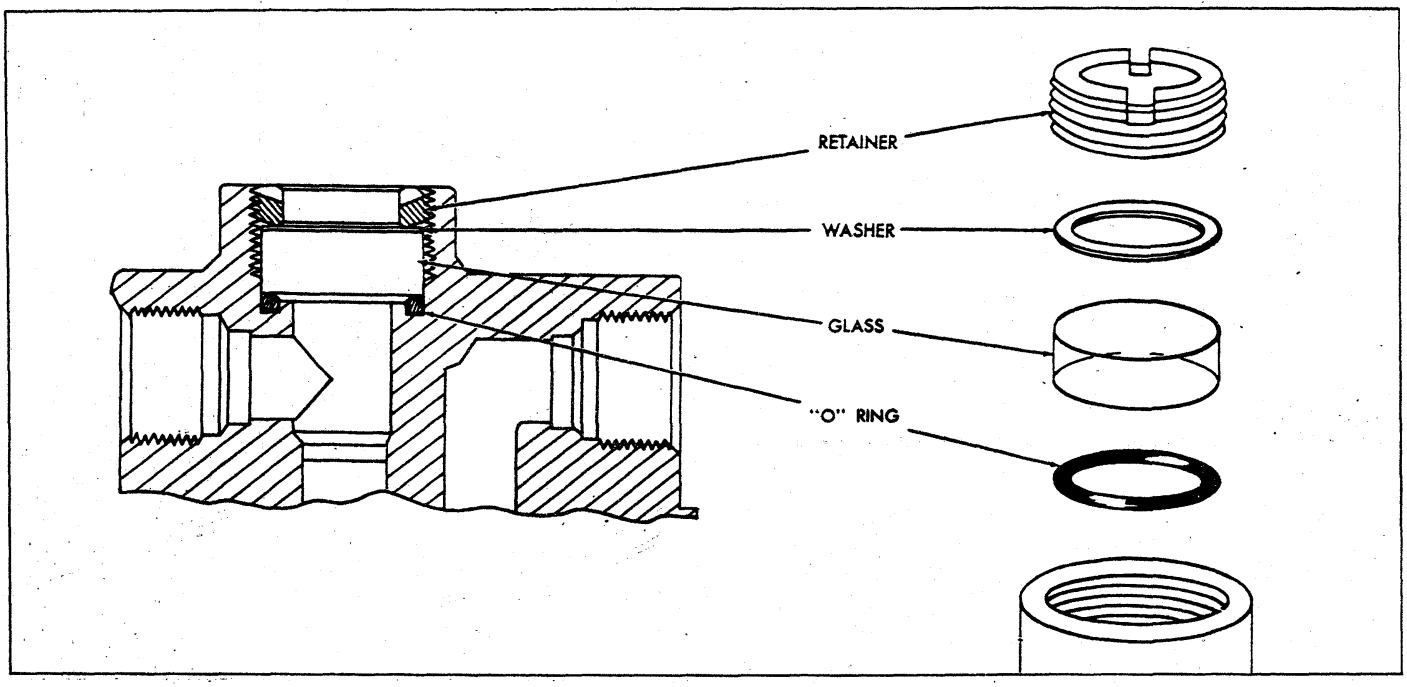


Fig. 53—Sight Glass Replacement

Two variations of the basic compressor are used. One, with a displacement of 12.6 cu. in. is used with the Four-Season System (except Corvette) and Comfortron System. The second model, having displacement of 10.8 cu. in. is used with the Corvette Four-Season System and all GM Chevrolet Air Conditioning Systems.

All Systems

Removal

1. Purge the refrigerant from the system.
2. Remove connector attaching bolt and connector. Seal connector outlets.
3. Disconnect electrical lead to clutch actuating coil.
4. Loosen brace and pivot bolts and detach belt.
5. Remove the nuts and bolts attaching the compressor brackets to the mounting bracket (figs. 54 and 55).
6. Before beginning any compressor disassembly, drain and measure oil in the compressor. Check for evidence of contamination to determine if remainder of system requires servicing. Compressor Servicing information is located in the Chassis Overhaul Manual.

Installation

1. If the oil drained from the compressor showed no evidence of contamination, replace a like amount of fresh refrigeration oil into the compressor before reinstallation. If it was necessary to service the entire system because of excessive contamination in the oil removed, install a full charge of fresh refrigeration oil in the compressor. (See Checking Compressor Oil Charge under Checking Oil.)
2. Position compressor on the mounting bracket and install all nuts, bolts and lock washers.
3. Install the connector assembly to the compressor rear head, using new "O" rings.
4. Connect the electrical lead to the coil and install and adjust compressor belt.
5. Evacuate and charge the system.
6. Leak test the system and check for proper operation.

Compressor Belt Tension Adjustment

Adjust the compressor belt to the specifications shown in the Tune-Up chart in the Engine section of this manual.

COMPRESSOR FAILURE

If the compressor has failed mechanically to the extent that metal chips and shavings are found in it, the system should be checked for foreign material and cleaned as described under Foreign Material in the System.

COLLISION PROCEDURE—ALL SYSTEMS

Whenever a car equipped with an air conditioning unit is involved in a collision or wreck, it should be inspected as

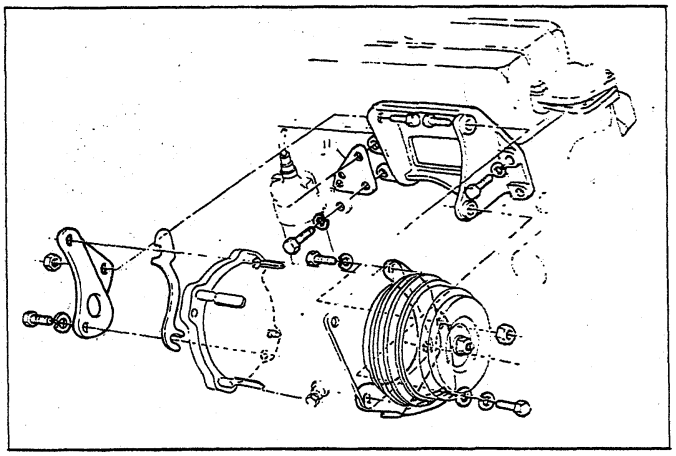


Fig. 54—Compressor Mount - L-6 Engines (Typical)

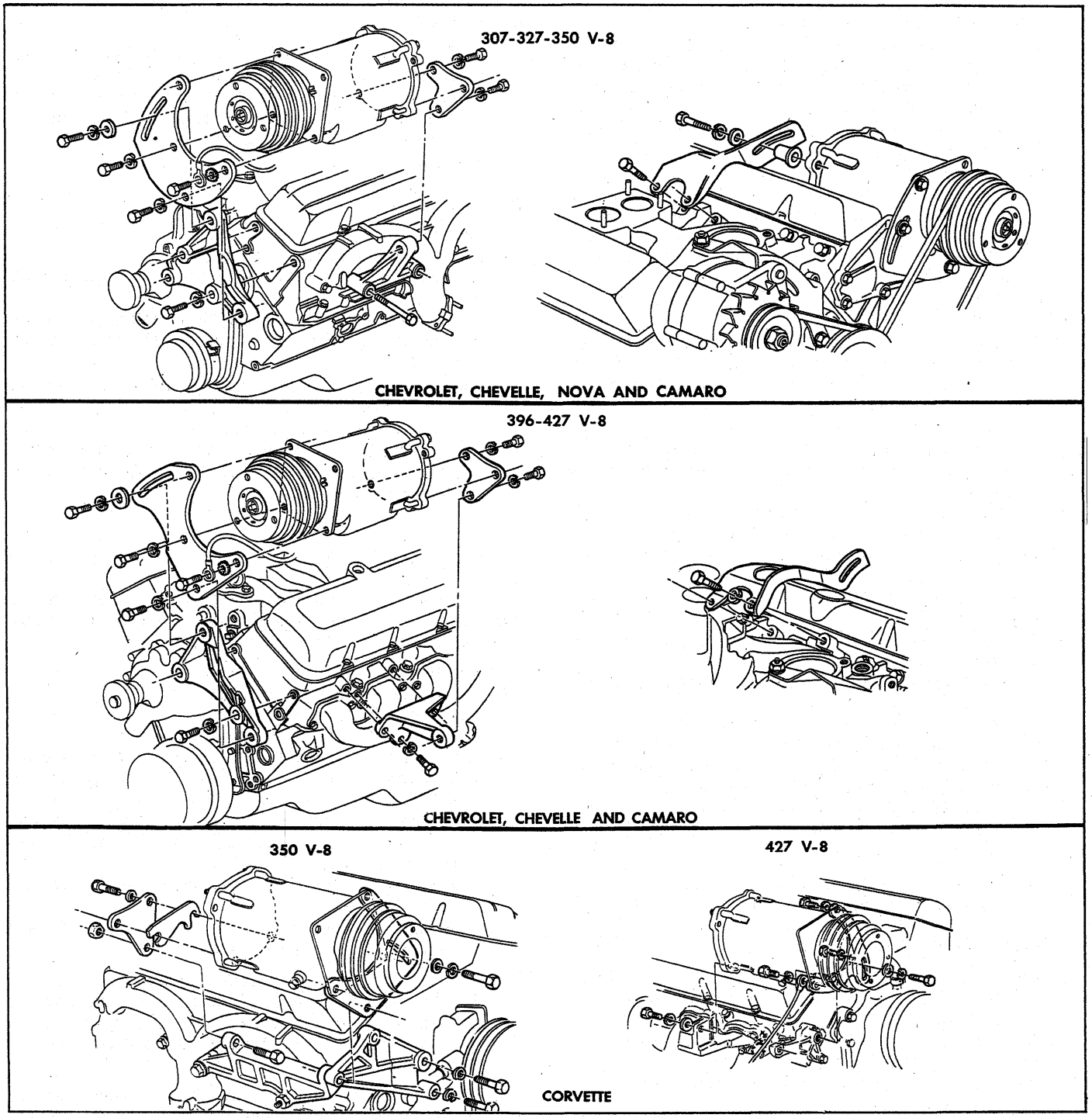


Fig. 55—Compressor Mount - V-8 Engine (Typical)

s(n as possible. The extent of damage to any or all of th component parts and the length of time the system ha: been exposed to the atmosphere will determine the rep acement of parts and processing that will be requi ed. The greater the length of time of exposure to the atmosphere, the greater will have been the chances for air, moisture and dirt to have entered and damaged the system. Every case may be entirely different so it is not possible to establish a hard and fast procedure to follow each time. Good judgment must be used to determine what steps should be taken in each specific case.

The following procedure is presented as a guide for use when inspecting a damaged vehicle equipped with air conditioning.

1. Remove the drive belt. Cut belt off if necessary.
2. Visually inspect the condenser, receiver-dehydrator, compressor, mounting brackets, conditioning unit,

all connecting lines, and all controls to determine the extent and nature of the damage.

a. No repairs, such as soldering, welding or brazing, should be attempted on the condenser because of its construction. If the vapor passages in the horizontal tubes or return bends or manifolds have been damaged in any way, the condenser should be replaced with a new one.
b. The receiver-dehydrator should be replaced if there is any evidence of its having sustained either internal damage or a fracture at any of the lines or welded joints or if the system has been exposed to the atmosphere for an undetermined period of time.
c. Examine the compressor for any visible external damage.
d. The evaporator should be examined for damage and, if necessary, removed or replaced or the entire unit processed where damaged or exposed to the atmosphere.
e. All connecting lines and flexible hoses should be examined throughout their entire length for damage. If damaged in any manner, replace with new lines.
f. Check all controls and connecting wires for damage and replace with new parts where needed.
g. Check the clutch pulley for proper operation and freedom from damage.

3. Install Charging Station.
4. Purge the system.
5. Remove the compressor from mounting and remove the oil test fitting.
6. Pour out the oil into a clean glass container and examine it for any foreign substance such as dirt, water, metal particles, etc. If any of these are present, the compressor and receiver-dehydrator should be replaced and the other system components should be flushed with liquid refrigerant.
7. If the oil is clean and free of any harmful substance, replace oil with Frigidaire 525 Viscosity Oil, or equivalent.

   NOTE: If the system components have been replaced or flushed, replace the full charge of oil. If not, add no more fresh oil than was drained in Step 6.

8. Charge up the compressor to drum or can pressure and leak test the compressor seals prior to installation of compressor.
9. Reinstall the compressor and evacuate the system by following the Evacuating Procedure.
10. Introduce R-12 vapor at cylinder (room) temperature and pressure.
11. Leak test all fittings and connections and give particular attention to a leak test at the compressor shaft seal if compressor has not been leak tested on the bench.
12. Complete system processing and charge system.

FOUR-SEASON AND COMFORTRON SYSTEMS

BLOWER MOTOR

On all vehicles except Corvette, replacement procedures are basically the same as with the heater blower motor (see "Heater Blower Motor Replacement" in the Heater Section).

NOTE: On Nova vehicles, one refrigerant line is routed through the forward end of the fender skirt. When lowering the skirt, extreme caution should be used to prevent damage to this hose; remember, the air conditioning system is still charged.

Corvette

Replacement

1. Disconnect the battery ground cable.
2. Disconnect blower motor wire and rubber air cooling tube.
3. Remove the front three sill plate molding screws and pry out to gain access to right splash shield retaining bolts.
4. Remove splash shield retaining bolts and remove splash shield.
5. Remove motor to case mounting screws and lower motor assembly through splash shield opening. Pry the flange gently if the sealer acts as an adhesive.
6. To install, reverse Steps 1-5.

EVAPORATOR CORE

The evaporator and blower assembly is designed so that the core may be removed without having to remove the entire unit from the vehicle.

Replacement

1. Disconnect battery ground cable.
2. Purge system of refrigerant.
3. Remove carburetor air cleaner assembly.
4. All vehicles - Remove the expansion valve sensing bulb from the core outlet line. Disconnect the oil bleed line and core outlet line at the POA valve. Disconnect the core inlet line at the expansion valve, cap or tape all open connections at once. Remove core outlet line clamp.
   Camaro with RPO L-35 - Remove the POA valve and bracket.
   Corvette - Remove the expansion valve and POA valve and cap the open connections.

   NOTE: On some Corvettes, more clearance can be obtained by disconnecting the compressor connector block and laying the connector block to one side. Be sure to cap the open connections.

5. Corvette only - Remove windshield wiper door actuator assembly. Remove POA valve bracket to case screws.
6. Disconnect all wires and vacuum hoses attached to the evaporator assembly.
7. Remove evaporator cover to firewall stud nuts and cover to evaporator case screws.

   NOTE: On some engines, it may be necessary to remove the A.I.R. combustion pipe.

8. Pull cover outward and upward, being careful not to damage the core in any way.
9. Remove core retaining screws and remove core.
10. Reverse the above steps for core replacement.

NOTE: Add three fluid ounces of refrigerant oil to the new core.

11. Evacuate and charge the system.

EVAPORATOR CONTROL VALVE (POA)

No repairs or adjustments are available on the POA valve. A malfunctioning valve must be replaced. Figure 56 illustrates valve installation on all vehicles.

Replacement

1. Disconnect battery ground cable and purge the system of refrigerant.
2. Remove inlet, outlet, oil bleed and expansion valve lines and cap lines immediately.
3. Remove valve body bracket to evaporator case or case bracket screw and remove valve and bracket from vehicle.
4. To install new POA valve, reverse the removal procedure, evacuate and charge the system.

NOTE: Use new "O" ring seals when installing POA valve lines.

EXPANSION VALVE (Fig. 57)

The thermostatic expansion valve is factory adjusted and pre-set and cannot be adjusted after installation. A malfunctioning valve must be replaced. However, before proceeding, check all other possible causes of the trouble. Make certain that the power element bulb is properly positioned on the low pressure line, tightly clamped and has the insulation in place. Make certain the liquid inlet screen, between valve and receiver-dehydrator line, is not clogged. After checking the screen and the location and mounting of the thermo-bulb, proceed with replacement of the valve assembly. A malfunctioning valve may result from a stuck open or shut needle caused by corrosion, or a discharged power element caused by a broken capillary line or tip.

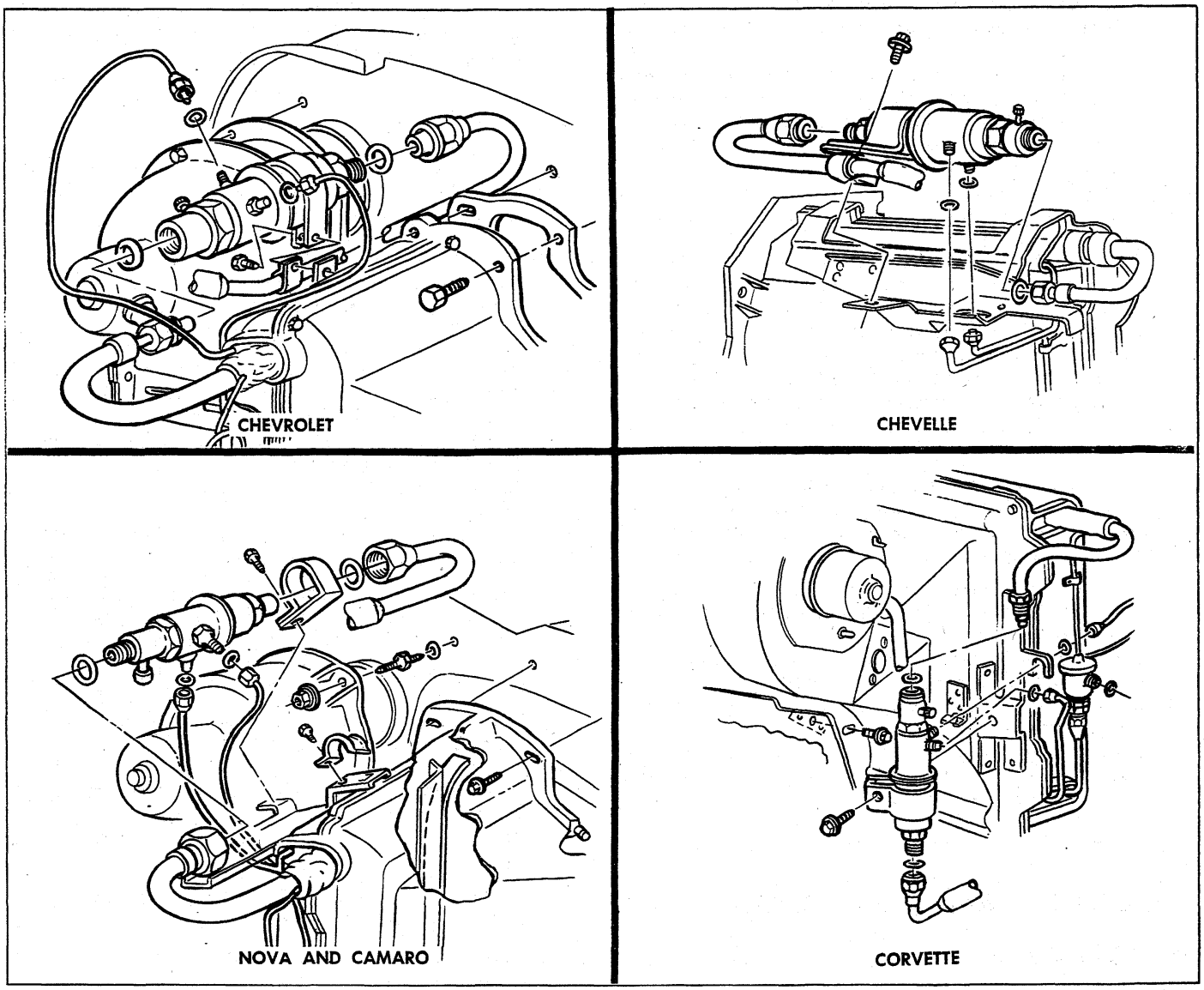


Fig. 56—POA Valve Installation

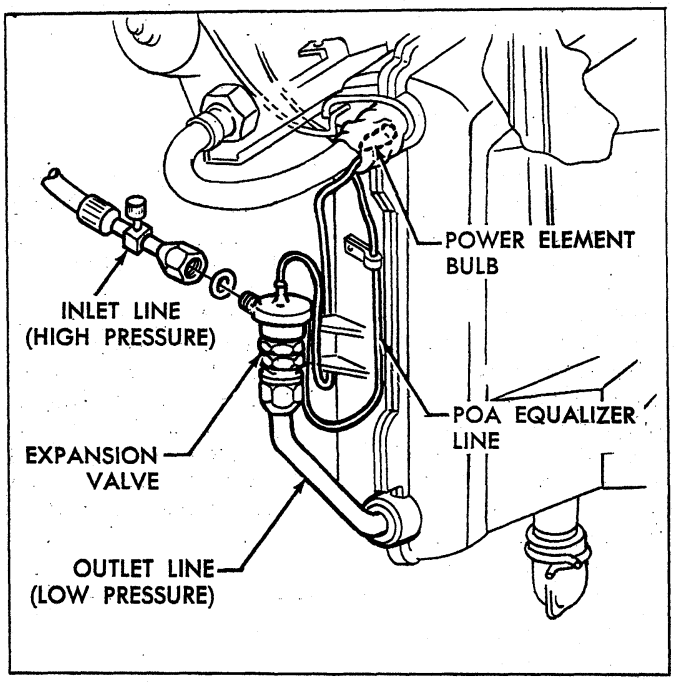


Fig. 57—Expansion Valve Installation (Typical)

Replacement

1. Disconnect battery ground cable and purge system.
2. Remove the expansion valve power element bulb from the low pressure line and the equalizing line from the POA valve.
3. Remove the low and high pressure connectors from the valve, in that order. Remove the screw and bracket attaching the expansion valve to the blower or evaporator case and remove the valve; cap the open connections.
4. Before replacing the valve, check to be certain the inlet screen is not clogged. If the screen is plugged, replace it and check valve operation. If screen is clear or if valve still malfunctions after screen replacement proceed with the valve replacement.
5. Install the new valve by connecting the lines. Clamp the power element bulb of the new valve to the top of the low pressure line and the equalizing line to the POA valve.

   NOTE: Be sure to replace the insulation around the power element bulb and make sure the power element makes good physical contact with the evaporator core outlet line.

6. Connect battery ground cable.
7. Evacuate and charge the system.
8. Check the system for proper operation.

VACUUM TANK

During heavy acceleration, the vacuum supply from the carburetor drops. The vacuum tank, using a check valve, stores vacuum so that under these conditions, vacuum will be available for continuous use.

The vacuum tank is mounted to the engine side of the firewall as illustrated in Figures 58, 59, and 60.

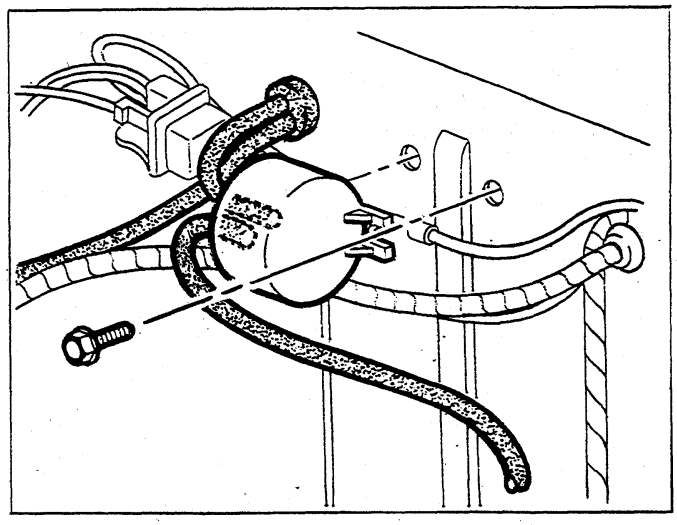


Fig. 58—Vacuum Tank - Chevrolet

NOTE: The Corvette does not incorporate a separate vacuum tank. Vacuum for the air conditioning system is supplied by the production tank located in the left fender area.

Chevrolet and Chevelle

Replacement

1. Disconnect battery ground cable.
2. Disconnect vacuum hoses at tank.
3. Remove two screws attaching tank to firewall or evaporator case and remove tank.
4. To install, reverse removal procedure.

Nova

Replacement

1. Disconnect battery ground cable.
2. Remove left front fender skirt to fender and reinforcement screws.

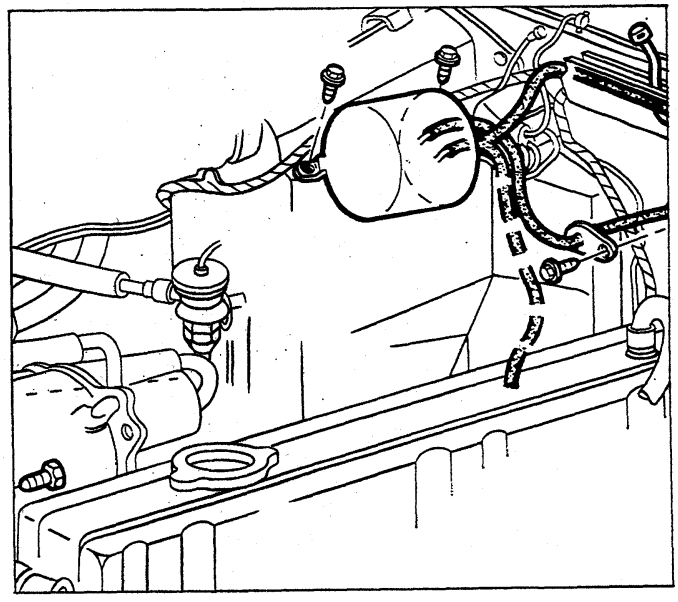


Fig. 59—Vacuum Tank - Chevelle

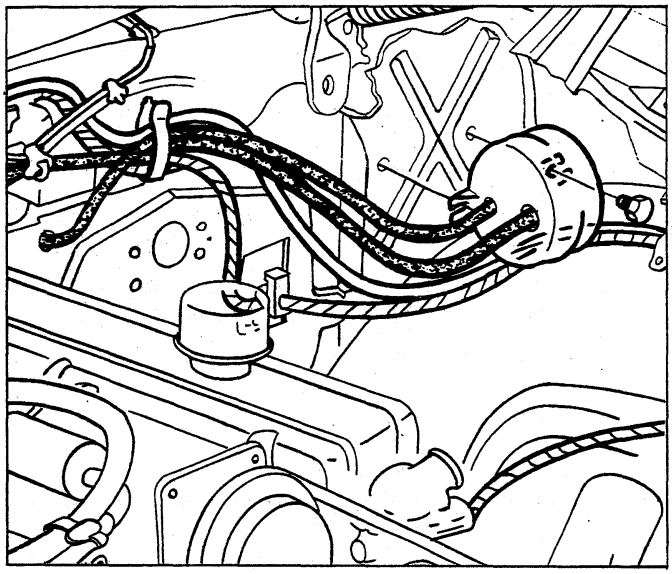


Fig. 60—Vacuum Tank - Nova and Camaro

3. Force rear of skirt downward and hold by placing a 2 x 4 block of wood between the skirt and fender at wheel opening.
4. Disconnect vacuum hoses at tank.
5. Remove tank retaining screws and remove tank.
6. To install a new tank, reverse Steps 1 thru 5.

Camaro

Replacement

1. Disconnect battery ground cable.
2. Raise front of vehicle on hoist.
3. Remove left front tire and wheel assembly.
4. Remove left fender to sill plate screws and remove shims.
5. Remove the (9) rear most fender skirt to fender and reinforcement screws.
6. Pull outward on lower edge of fender and while holding fender, pull downward on rear edge of fender skirt. Place a 2 x 4 block of wood between fender and skirt.
7. Disconnect vacuum lines at tank.
8. Remove vacuum tank mounting screws and remove tank.
9. To install a new tank, reverse Steps 1 thru 8.

NOTE: Make sure that fender, door and rocker panels line up when reinstalling fender to sill plate screws.

KICK PAD VALVE

Figures 61, 62, 63 and 64 illustrate kick pad valve installation on all vehicles. A vacuum tank and check valve is used to assure that the air door will not change its position due to variations in engine vacuum.

Chevrolet

Replacement (Fig. 61)

1. Disconnect the battery ground cable.
2. Remove the blower motor as outlined under "Heater-Blower Motor".

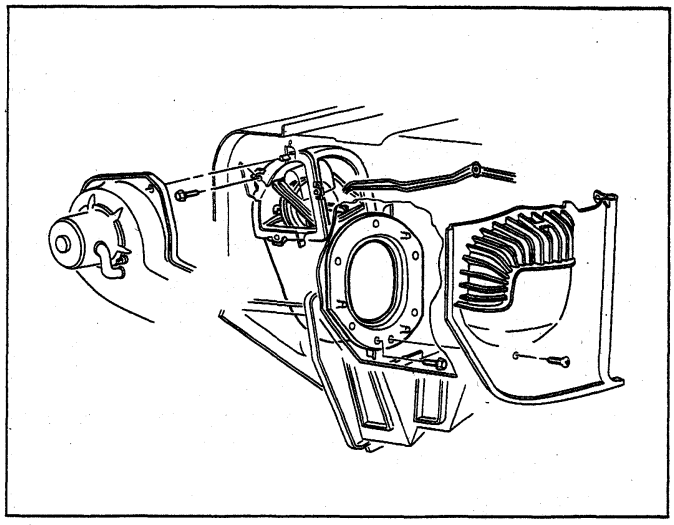


Fig. 61—Chevrolet Kick Pad Valve

3. Remove the valve assembly screws by reaching through the blower motor opening.
4. Remove the right kick pad panel.
5. Remove the six valve to body screws and remove the valve and duct assembly. Disconnect the vacuum hose.
6. Once removed from the vehicle, the valve may be removed from the duct.
7. To install, reverse Steps 1 through 6.

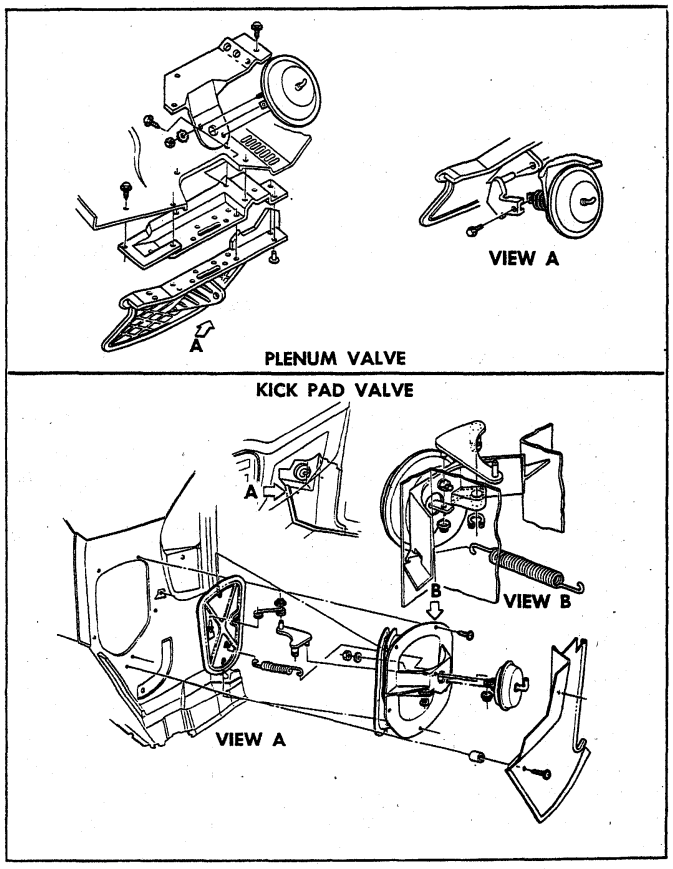


Fig. 62—Chevelle Air Inlet Valves

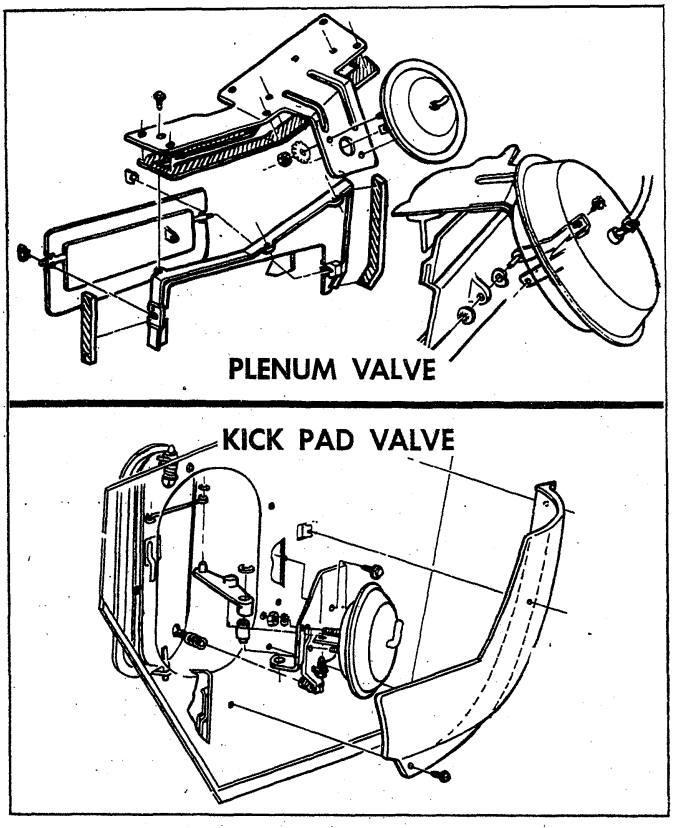


Fig. 63—Nova and Camaro Air Inlet Valves

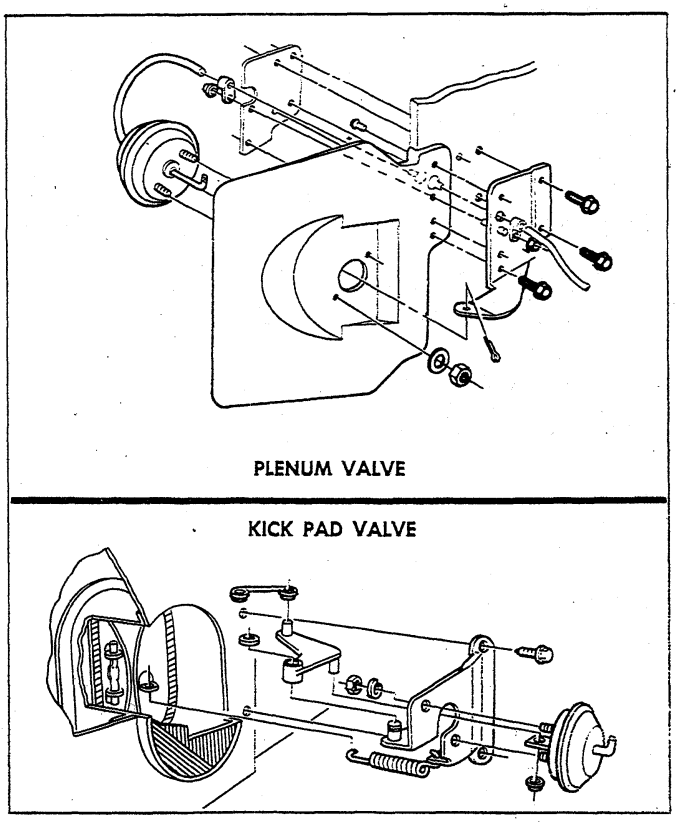


Fig. 64—Corvette Air Inlet Valves

Chevelle

Replacement (Fig. 62)

1. Disconnect the battery ground cable.
2. Remove the kick pad cover.
3. Remove the activating arm push nut and disconnect the valve at the arm.
4. Remove the valve vacuum hose.
5. Remove the valve to bracket nuts and remove the valve.
6. To install, reverse Steps 1 through 5.

Nova and Camaro

Replacement (Fig. 63)

1. Remove the valve cover.
2. Remove the two valve bracket to kick panel screws.
3. Disconnect the link and spring at the plenum door and remove the valve and bracket assembly.
4. Once removed from the vehicle, the valve and bracket may be separated by removing three screws.
5. To install, reverse the removal procedure.

Corvette

Replacement Fig. 64)

1. Disconnect battery ground cable.
2. Remove the three forward right door sill plate screws.
3. Remove right kick pad screws and while lifting up slightly on forward edge of sill plate, remove kick pad.
4. Disconnect the right distributor duct at dash outlet end.
5. Remove right radio speaker assembly.
6. Remove valve bracket screws, disconnect valve bracket spring, remove link from valve arm and remove valve and bracket assembly.
7. Remove push nut from valve arm, remove valve to bracket screws and remove valve.
8. To install, reverse Steps 1 through 7.

PLENUM VALVE

The plenum valve is not used on the Chevrolet. Chevelle, Nova, Camaro and Corvette all incorporate plenum valves to admit outside air to the system.

Chevelle (Fig. 62)

Replacement

1. Raise hood. Disconnect valve vacuum lines.
2. Remove four screws securing valve bracket to cowl.
3. With a screw driver or similar object, reach through the slotted hole and press valve arm forward out of plenum door. Remove valve and bracket assembly from vehicle.
4. Remove valve to bracket and link screws and remove valve.
5. To install, reverse Steps 1 through 4.

Nova and Camaro (Fig. 63)

Replacement

1. Remove windshield wiper arms.
2. Remove cowl vent grille.
3. Remove screws securing plenum valve assembly to plenum chamber. Disconnect vacuum line. Position

door in closed position and lift assembly from vehicle.
4. Remove valve to bracket and link screws and remove valve.
5. To install, reverse Steps 1 through 4.

Corvette (Fig. 64)

Replacement

1. Remove vacuum operated windshield wiper door, arms, linkage, actuator and remove vent grille; see Section 12.
2. Remove plenum door bracket screws and remove door, valve and bracket as a unit.
3. Once removed from vehicle, valve may be removed from the bracket.
4. To install, reverse Steps 1 through 3.

FUSES

A fuse, located in the junction block protects the entire air conditioning system except for the blower when operating at high speed.

A second fuse, to protect the high speed blower circuit, is located in the electrical wiring between the horn relay and the Air Conditioner relay.

FOUR-SEASON SYSTEM ONLY

AIR DISTRIBUTOR AND HEATER CORE

Chevrolet (Fig. 65)

Replacement

1. Disconnect the battery ground cable.
2. Drain the radiator (do not purge refrigerant from the system).
3. Remove the heater hoses from the core tubes and install plugs in the tubes to prevent coolant spillage when removing the core.
4. Remove nuts from the selector duct studs projecting through the firewall.
5. Remove the glove box and door.
6. Remove the center distributor duct hoses (5 in all), the duct bowden cables, the center distributor duct to selector duct screws and remove the center duct.

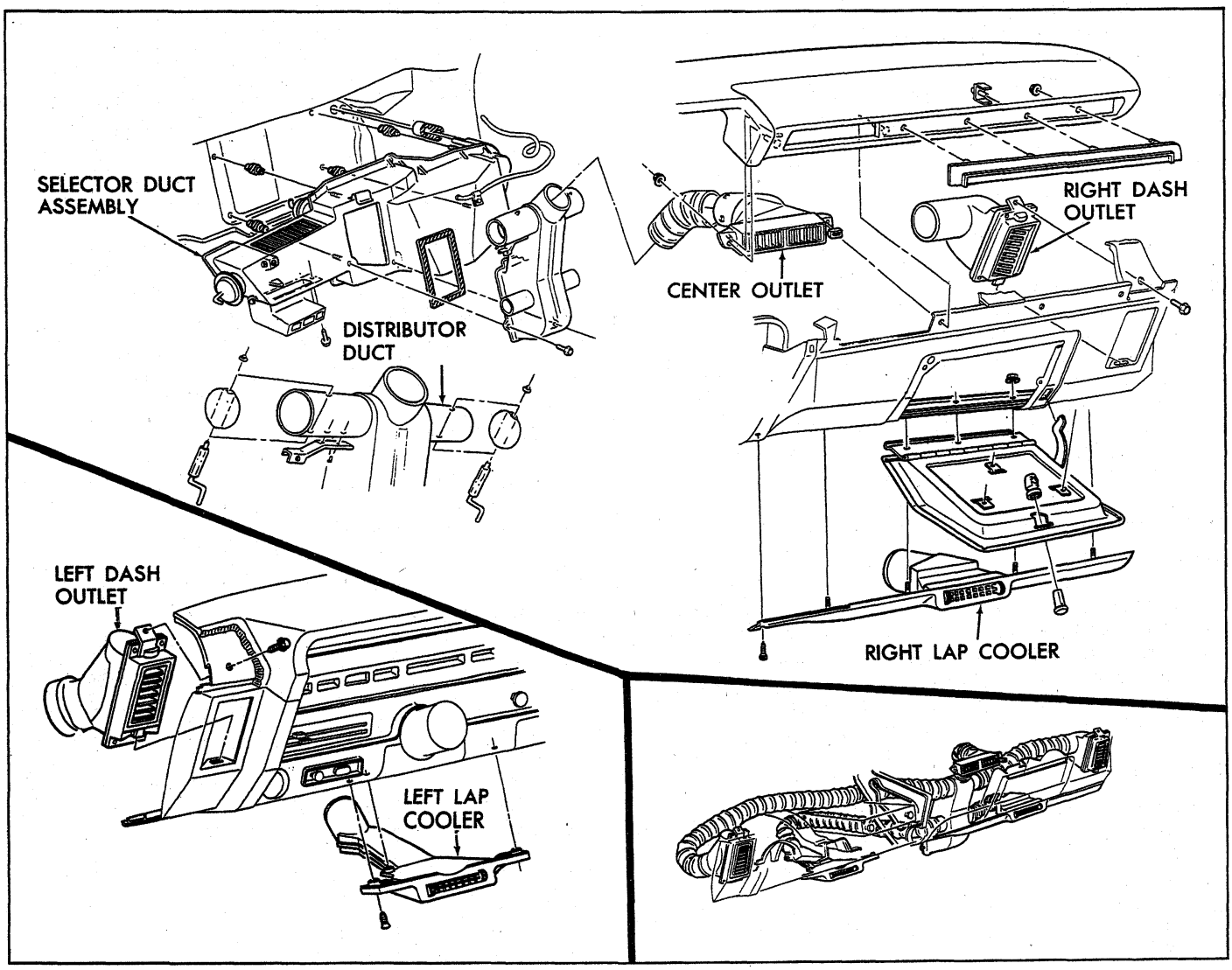


Fig. 65—Chevrolet Air Selector and Ducts

7. Drill out the lower right hand case stud (from inside the vehicle) using a 1/4" drill.
8. Remove the floor distributor duct.
9. Remove the selector duct to firewall screws and carefully pull the selector duct from the firewall.
10. Remove all electrical wires, vacuum lines and bowden cables attached to the assembly and remove from the vehicle.
11. Scribe the location of the temperature door camming plate on the selector duct and remove the camming plate. Remove the core and core housing from the selector duct.
12. To install, reverse Steps 1 through 11.

Chevelle (Fig. 66)

Replacement

1. Disconnect battery ground cable.
2. Drain radiator (do not purge refrigerant from system).
3. Remove heater hoses at core connections and plug core tubes to prevent coolant spillage.
4. Remove nuts from distributor case studs projecting through the firewall.
5. Remove glove box and door assembly.
6. Remove right kick pad cover and remove recirculating air valve.
7. Remove center distributor duct to selector duct screws and remove center duct.
8. Remove floor distributor duct.
9. Drill out lower right hand selector duct stud (from inside vehicle).
10. Remove remaining screws securing air selector to firewall and lower selector assembly. Remove bowden cables and all electrical connections. Scribe location of temperature door camming plate on selector duct and remove camming plate. Remove core and core housing from selector assembly.
11. To install, reverse Steps 1 through 10.

NOTE: Replace the drilled-out-stud with a screw and pall nut (stamped nut).

Chevy Nova (Fig. 67)

Replacement

1. Disconnect battery ground cable. Drain radiator. Do not purge refrigerant from system.
2. Disconnect heater hose from upper core pipe. Remove accessible nuts from air selector duct studs.
3. Remove right fender skirt to fender and skirt reinforcement screws. Lower skirt to wheel. Remove remaining stud nut.
4. Remove heater hose from lower core pipe. Install plugs in both core tubes to prevent coolant spillage.
5. Remove glove box and door assembly.
6. Remove right kick pad recirculating air valve.
7. Remove center distributor to selector duct attaching screws and remove center duct.
8. Remove floor duct. Remove screws securing left half of selector to right half and separate.
9. Remove screws securing right half of selector to firewall and remove selector duct. Disconnect bowden cables and electrical connections. Scribe loca-

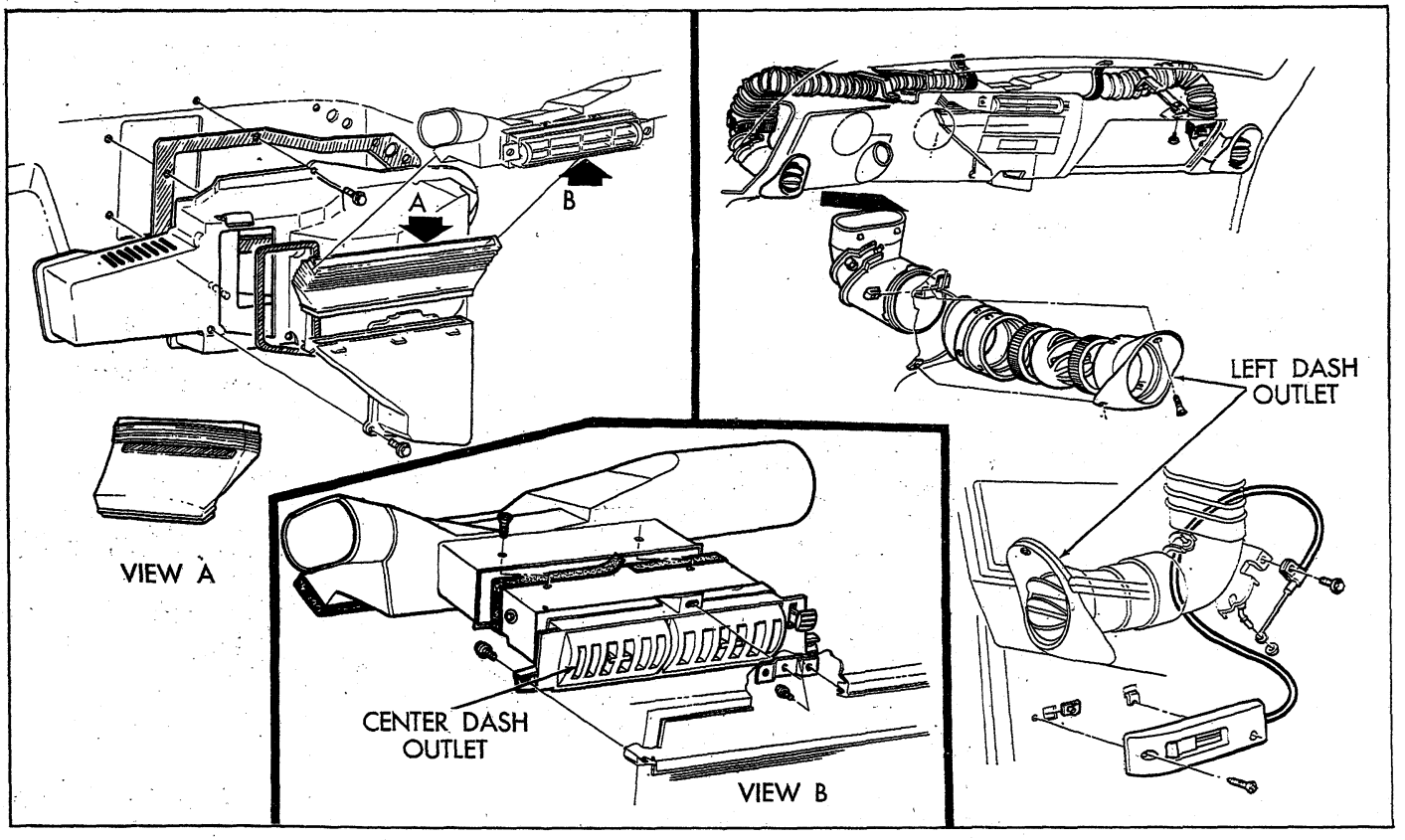


Fig. 66—Chevelle Air Selector and Ducts

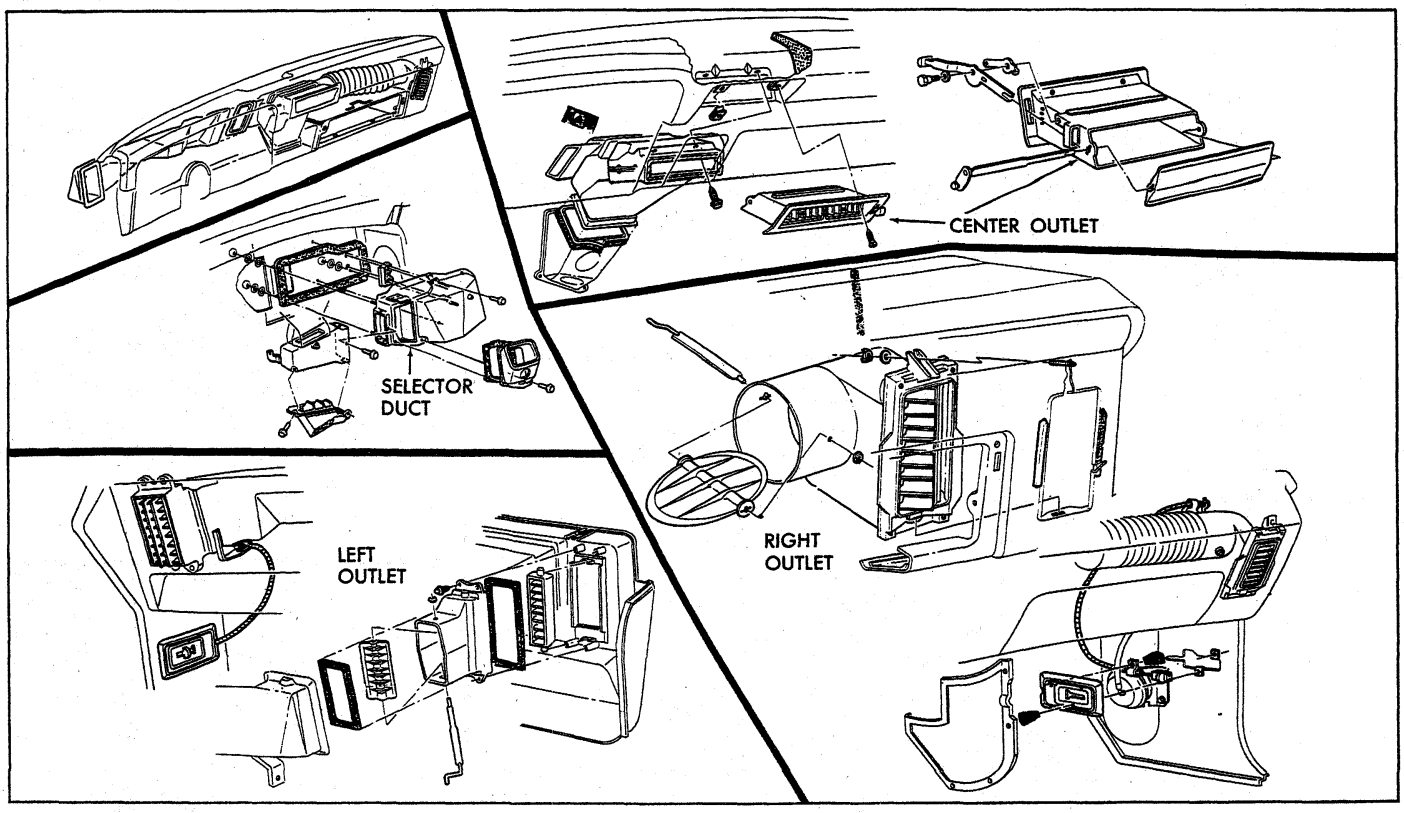


Fig. 67—Chevy Nova Air Selector and Ducts

tion of temperature door camming plate on selector duct and remove camming plate.
10. Lay selector duct assembly on floor and remove core and core housing.
11. To install, reverse Steps 1 through 10.

Camaro (Fig. 68)

Replacement:

1. Disconnect battery ground cable. Drain radiator. Do not purge refrigerant from system.
2. Disconnect heater hose from upper heater core pipe. Remove accessible nuts from air selector duct studs.
3. Remove right lower rocker molding. Remove lower fender attaching bolts. Remove skirt to fender and skirt to reinforcement screws. Pull out on lower portion of fender, prying the skirt away from the fender flange and firewall. Block the skirt with a 2" x 4" block of wood.
4. Disconnect lower heater hose and remove right lower stud nut at heater housing. Plug heater core tubes to prevent coolant spillage.
5. Remove glove box and door assembly.
6. Remove right kick pad recirculating air valve.
7. Disconnect left, right and center dash outlet hoses from center duct. Remove center duct from distributor assembly.
8. Remove floor outlet duct. Remove screws securing left half of selector duct to right half and separate the two halves.
9. Remove screws securing the selector duct to firewall and lower carefully. Remove bowden cables and electrical connections as soon as clearance is obtained.
10. Remove selector duct from vehicle. Scribe location of temperature door camming plate on selector duct and remove camming plate. Remove core and core housing from selector.
11. To install, reverse steps 1-10.

Corvette (Fig. 69)

Replacement

1. Disconnect battery ground cable. Drain radiator. Do not purge refrigerant from system.
2. Disconnect heater hoses at core connections and plug core tubes to prevent coolant spillage.
3. Remove nuts from distributor studs on engine side of firewall.
4. Remove the right hand dash pad (Section 1B) and the center instrument cluster (Section 12). Remove dash braces.
5. Disconnect right dash outlet duct from center duct. Remove screws attaching center duct to selector duct and remove center duct.
6. Remove screws attaching selector duct to firewall and pull selector rearward and to the right. Once clearance is obtained, remove bowden cables and wire connectors.
7. Remove selector duct from vehicle. Remove temperature door camming plate from selector duct. Remove core and core housing.
8. To install, reverse steps 1-7.

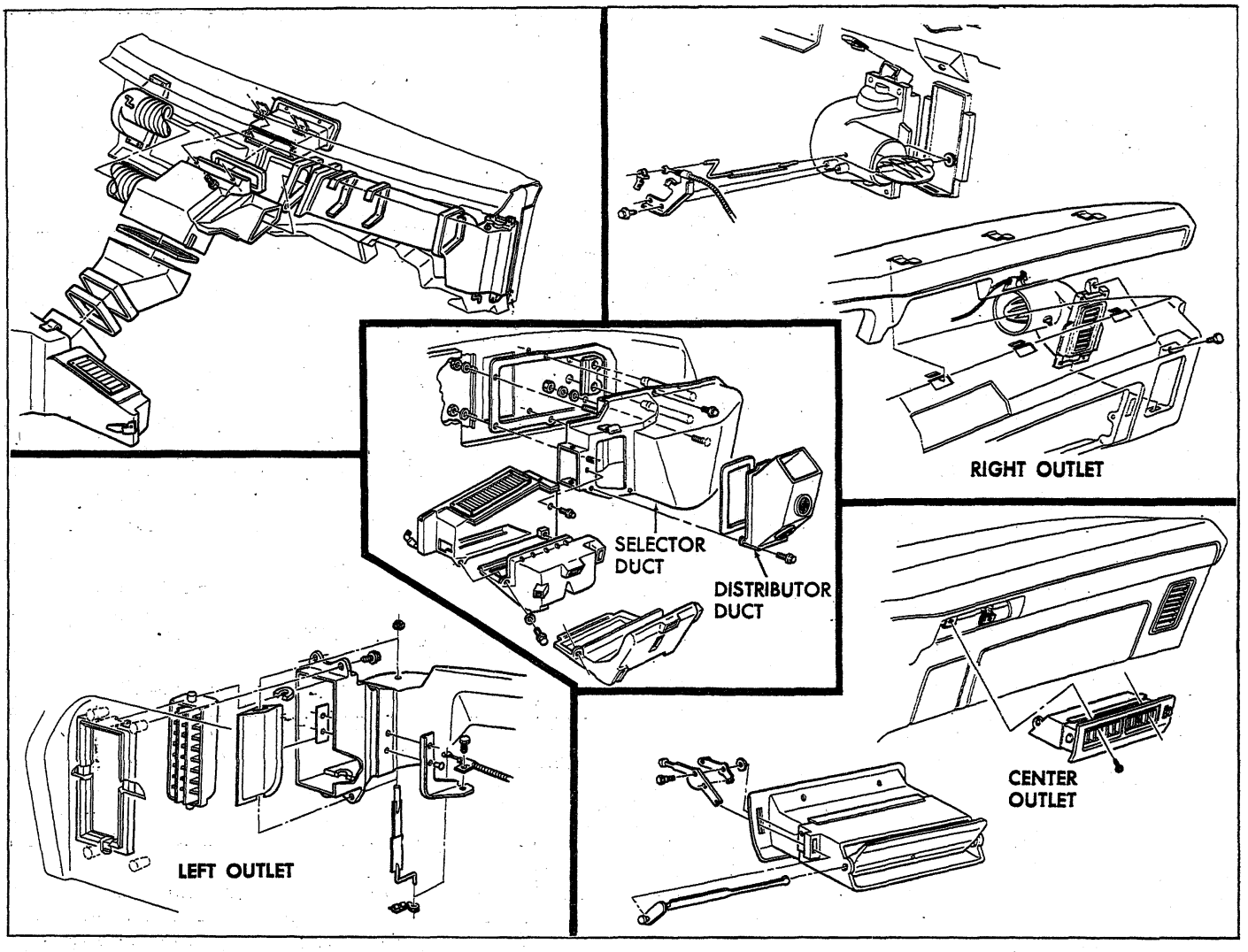


Fig. 68—Camaro Air Selector and Ducts

CONTROL HEAD

The Four-Season control heads are attached to the instrument panel in much the same manner as the heater control head. Refer to the Heater Section for replacement procedures.

Figure 70 illustrates controls for each vehicle, showing location and mounting of the various electrical switches, vacuum control switches and bowden cables.

VACUUM LINES

Vacuum lines are used on all air conditioning systems. These lines are molded to a connector which attaches to a vacuum control switch on the control head assembly (see Fig. 13).

In case of leakage or hose collapse, it will not be necessary to replace the entire harness assembly. Replacement can be made by cutting the hose and inserting a plastic connector. If an entire hose must be replaced, cut all hoses off at the connector and then attach hoses directly to the control head vacuum switch.

Vacuum diagrams are included with the electrical diagrams at the rear of this section.

LOWER HEATER HOSE

The Camaro and Nova lower heater hoses are inaccessible without removing the right front fender skirt assembly. The following procedures should be used when heater hose removal is desired.

Nova

Replacement:

1. Drain radiator.
2. Remove fender skirt to fender and skirt reinforcement screws and lower skirt to wheel.
3. Disconnect lower heater hose at core connection.
4. To install, reverse steps 1-3.

Camaro

Replacement

1. Drain radiator.
2. Remove right rocker panel moulding.
3. Remove lower fender attaching bolts.

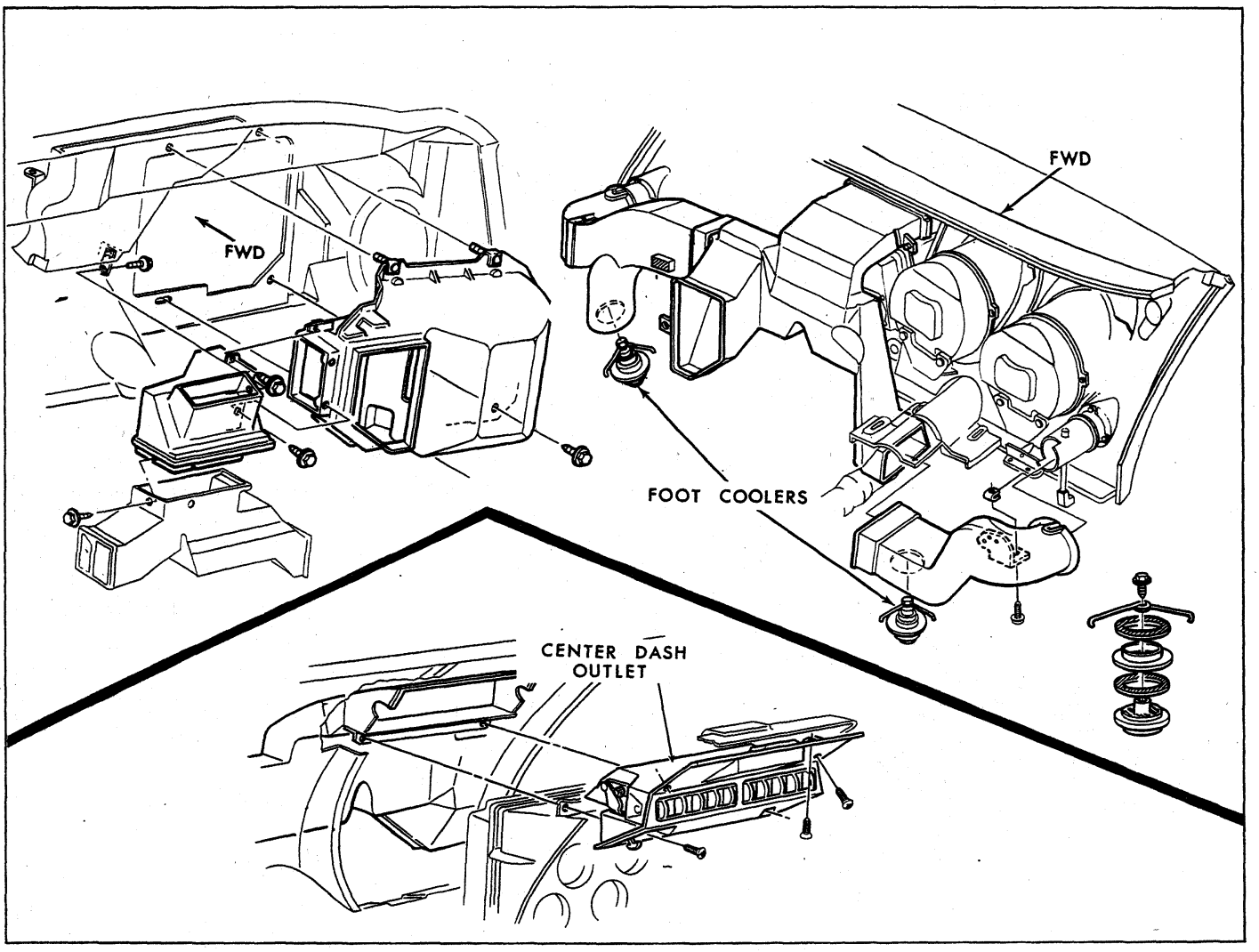


Fig. 69—Corvette Air Selector and Ducts

4. Remove skirt to fender and skirt to reinforcement bolts.
5. Pry the skirt away from the fender flange and away from the firewall. Block the skirt with a 4" long piece of 2" x 4" block of wood. Disconnect hose at lower core tube.
6. To install, reverse steps 1-5.

WATER VALVE

The water shut-off valve is installed in the heater core inlet line. When vacuum is applied to the valve (controls set at "MAX"), the valve is closed, preventing coolant flow through the heater core. When there is no vacuum applied to the valve (controls set at any position except "MAX"), the valve is open, allowing coolant flow. The valve is also open whenever heat is required, regardless of the position of the mode lever.

Replacement (Figs. 71 and 72)

1. Disconnect the battery ground cable.
2. Disconnect the vacuum line at the valve.
3. Place a pan under the vehicle, disconnect the inlet and outlet hoses and drain coolant into the container.
4. Chevrolet - Remove the valve to skirt screws and remove the valve.
   Corvette - Remove the valve to evaporator case screws and remove the valve.
   Chevelle, Nova and Camaro - Drill out the valve to fender skirt rivets and remove the valve.
5. To install a new valve, reverse Steps 1 through 4, replacing the rivets on Chevelle, Nova and Camaro with new rivets, patent clips or sheet metal screws.

AMBIENT TEMPERATURE SWITCH

When the controls are set for bi-level operation, the compressor is operative. The ambient switch prevents the compressor from operating when the air temperature is below 37°F at the ambient switch. This switch is located in the blower and evaporator case as illustrated in Figure 73.

Replacement

1. Disconnect battery ground cable.
2. Disconnect electrical connector at switch.
3. Remove two switch to case screws and remove switch.
4. Install new switch by reversing steps 1 through 3.

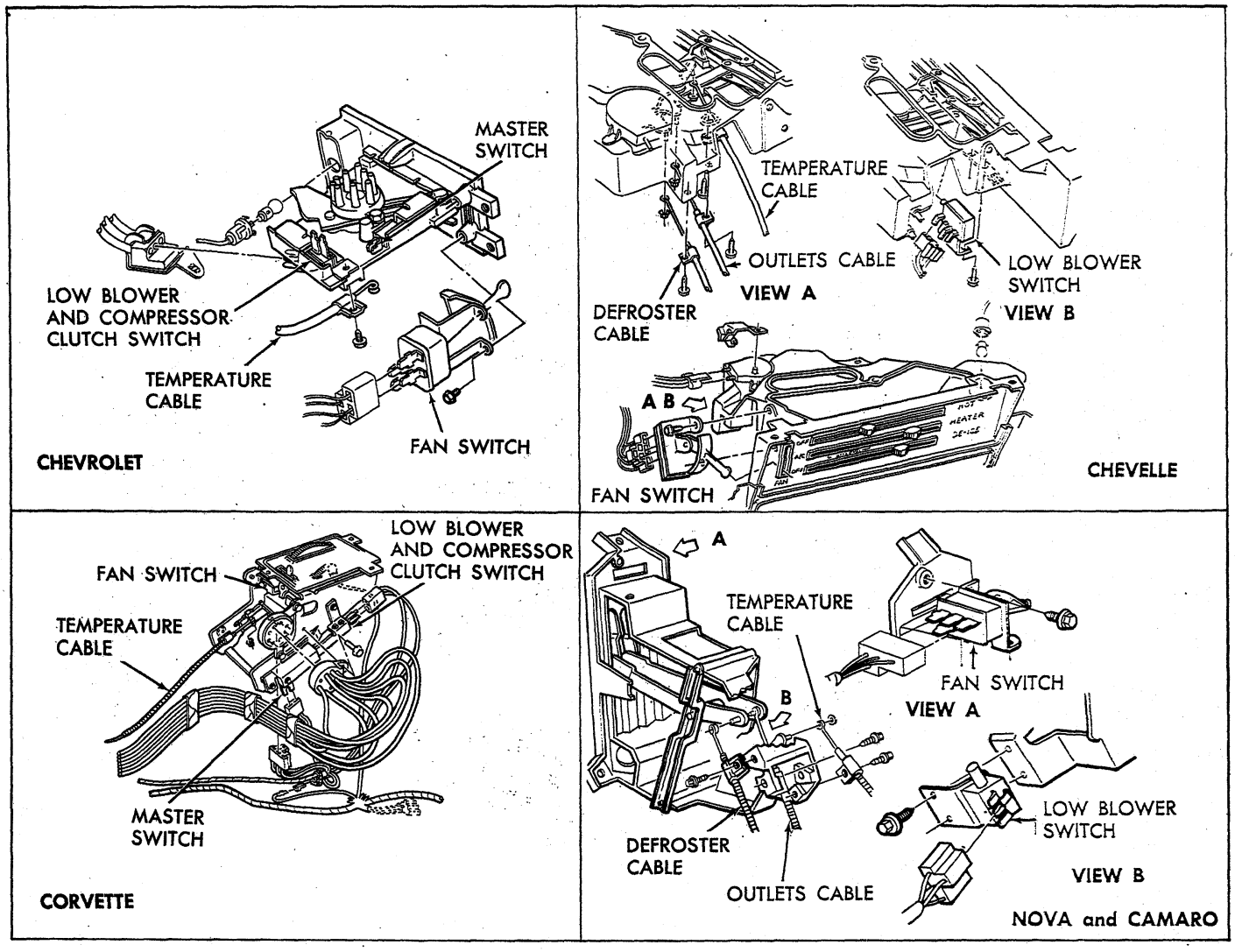


Fig. 70—Four-Season Air Conditioning Control Heads

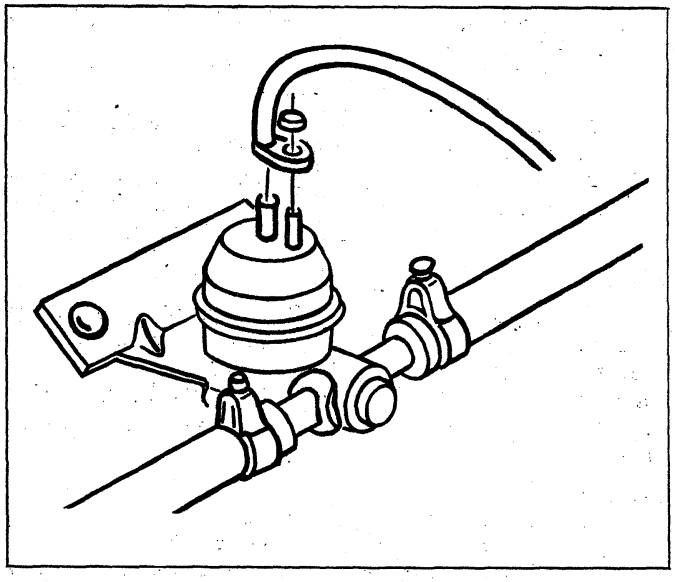


Fig. 71—Water Valve (Typical of Chevrolet, Chevelle, Nova and Camaro)

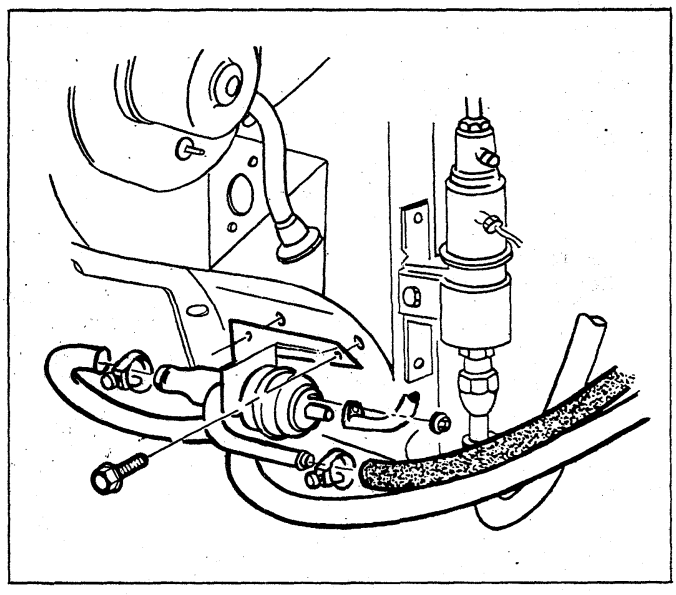


Fig. 72—Corvette Water Valve

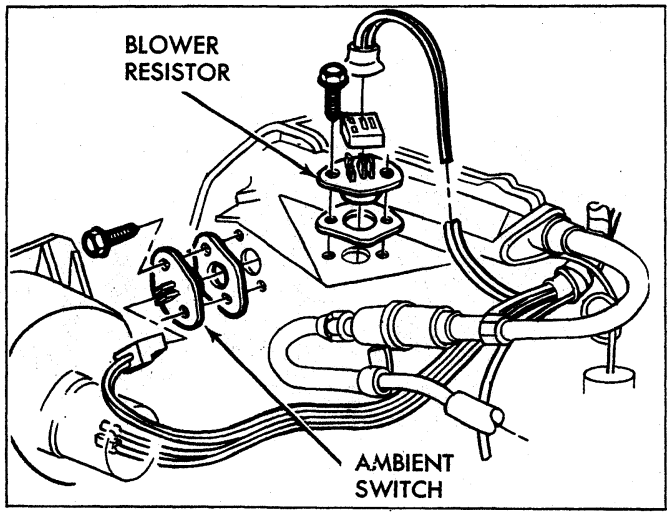


Fig. 73—Ambient Temperature Switch and Blower Resistor (Chevrolet Shown)

BLOWER RESISTOR

The blower resistor is mounted on the blower side of the blower-evaporator case on Chevrolet and Chevelle models and on the evaporator cover on Nova, Camaro and Corvette models

Replacement (Fig. 73)

1. Disconnect the battery ground cable.
2. Disconnect the resistor wiring harness connector.
3. Remove the two resistor mounting screws and remove the resistor.
4. To install, reverse Steps 1 through 3.

DIVERTER DOOR SWITCH

The purpose of this switch is to prevent compressor operation when controls are set for heater mode (center lever fully right on Chevelle or fully down on Nova and Camaro).

Replacement (Fig. 74)

1. Disconnect battery ground cable.
2. All except Corvette - Remove glove box and door assembly.
3. Corvette - Remove selector duct assembly.
4. Remove two screws attaching switch to selector duct and remove switch.
5. Reverse steps 1 through 4 to install new switch.

COMFORTRON SYSTEM ONLY

AIR SELECTOR DUCT AND CORE ASSEMBLY

Removal

1. Disconnect battery ground cable.
2. Drain radiator (do not purge refrigerant system).
3. Disconnect the vacuum hoses coming from under the dash through the large firewall grommet. Push the hose grommet through the firewall to the rear.
4. Disconnect the heater hoses from the core tubes.

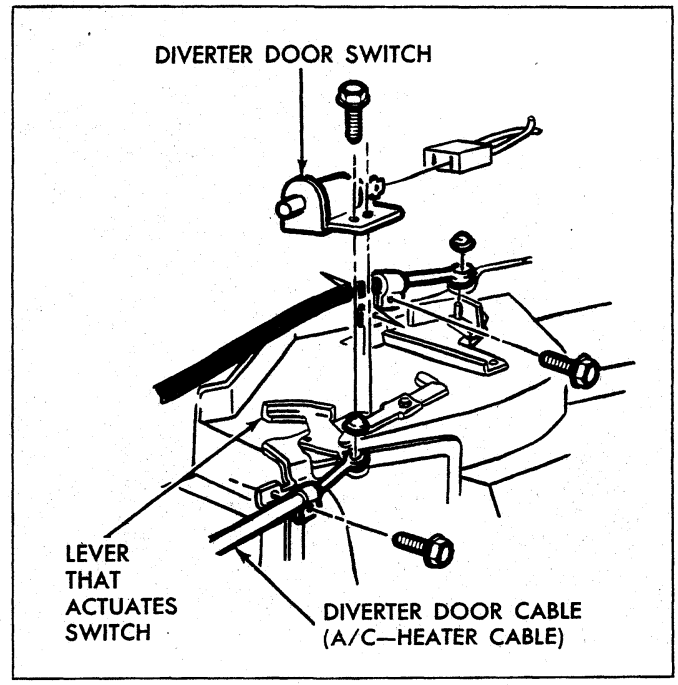


Fig. 74—Diverter Door Switch (Typical)

5. Remove the accessible nuts from heater and air selector duct studs which project through the firewall from the dash side. Only three nuts are accessible from under the hood (2 top nuts and far left lower nut).
6. From inside vehicle, drill out the case lower right stud.
7. Remove screw retaining right-hand courtesy light, leave light assembly hang.
8. Remove glove box door and interior.
9. Remove the floor outlet duct.
10. Disconnect the five center distributor duct hoses and duct shut-off cables and remove the center duct.
11. Disconnect power servo electrical leads. Remove three (3) screws retaining Power Servo assembly to heater and air selector assembly. Tilt Servo assembly to access Servo cover screws. Remove cover screws. Disconnect vacuum line from Servo diaphragm and remove vacuum head. Remove Servo cover and disconnect link at Power Servo (leaving it attached at temperature door pivot). Remove Servo assembly.
12. Remove screws retaining transducer to heater and air selector assembly (NOTE: One of these screws secures a grounding wire). Bring transducer to front of dash leaving vacuum hoses attached. The vacuum lines are not disconnected so as to minimize error when reinstalling assembly.
13. Remove heater and air selector duct as an assembly.
14. Disconnect all electrical and vacuum lines from air selector duct assembly.
15. Remove the screws attaching the die cast plate to the air inlet side of the case. Disconnect the temperature door linkage at the door shaft.
16. Remove the die cast plate with core from the case. Remove the core mounting screws and remove core.

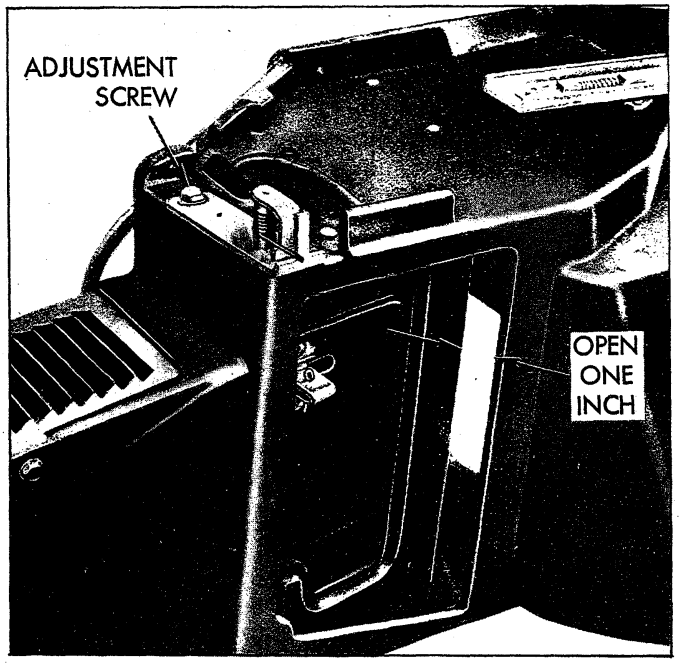


Fig. 75—Mode Shift Vacuum Diaphragm

Installation

1. Seal the replacement core to the cast plate with non-hardening sealer and attach the core with the mounting straps and screws.
2. Install the plate to the case and connect the temperature door linkage.
3. Reverse removal procedures 1-14 to reinstall air selector duct assemblies.

Mode Shift Vacuum Diaphragm

Replacement

1. Remove the air selector duct from the vehicle as outlined under "Air Selector Duct and Core Assembly".
2. Reach into the selector through the AIR door opening to reach and remove the vacuum diaphragm mounting screws and diaphragm to door link screw (remove plug from case to reach this screw).
3. Reverse this procedure to replace.
4. Adjust mode door without vacuum applied to diaphragm. The door should be open one inch from sealing against the air selector opening (inside of case) - See Figure 75.

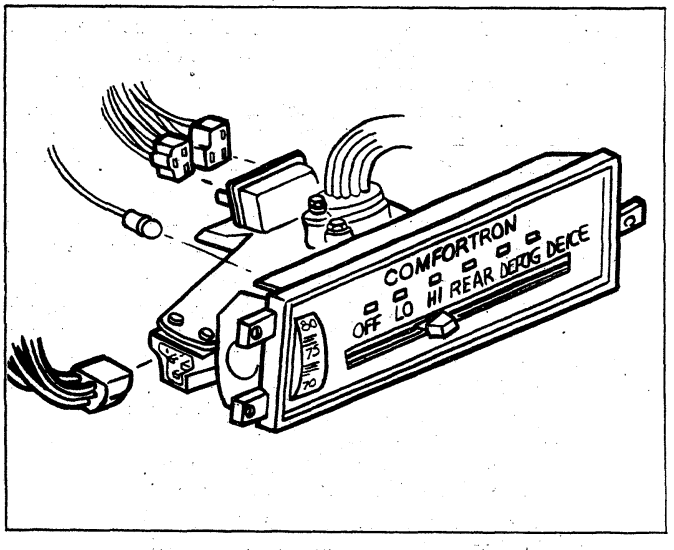


Fig. 76—Comfortron Control Head Installation

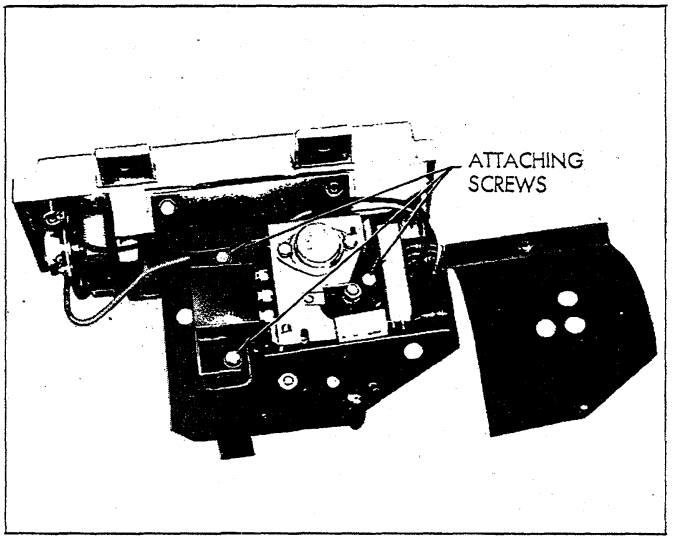


Fig. 77—Amplifier Removal

CONTROL HEAD

The control head is attached to the instrument panel in much the same manner as the Chevrolet heater control panel (Figure 76). Two screws hold the head in place. The amplifier and blower switch are a part of the control head assembly.

AMPLIFIER

After the control head is removed from the instrument panel, the amplifier may be removed as shown in Figure 77.

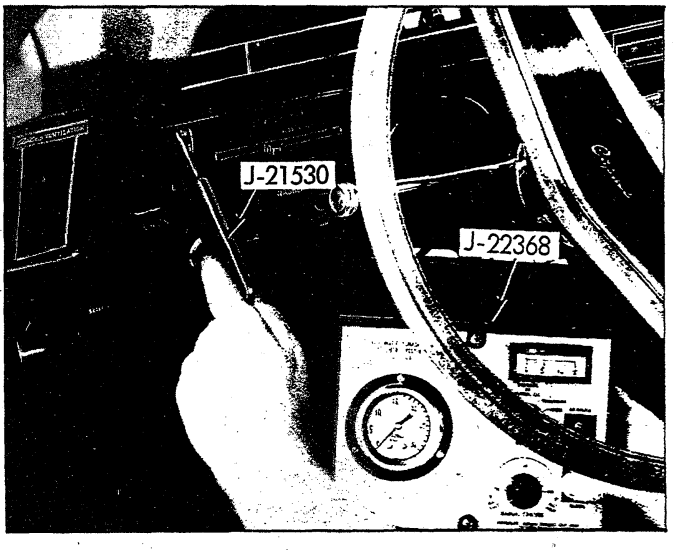


Fig. 78—Temperature Dial Adjustment

Temperature Dial Adjustment

1. Install Tester J-22368 as previously described.
2. Set Tester Voltage switch to Control Calibrate position.
3. Start the engine (fast idle) and set Comfortron Control lever to HI-FRONT.
4. Switch Rocker switch to MANUAL.
5. Set Manual Control Knob to 150 ohms on scale.
6. Rotate the Control Head Temperature Dial until the voltmeter on the tester reads 6.5 volts. The Temperature Dial should now indicate 75°.
7. If the Temperature Dial does not indicate 75°, insert Tool J-21530 in slot to the left of the Dial as shown in Figure 78.
8. With tool in position, rotate the Temperature Dial so that it indicates 75°F.

POWER SERVO

The Power Servo is attached to the selector duct. The entire installation consists of the Servo Assembly and its link assembly to the TEMP door. The Servo is attached to the Air Selector Duct as shown in Figure 79.

Removal

1. Disconnect battery ground cable.
2. Remove glove box door.
3. Disconnect electrical leads. Remove screws retaining servo to selector duct assembly. Tilt servo to gain access to servo cover screws and remove screws.
4. Disconnect vacuum line from servo diaphragm and remove vacuum head. Remove servo cover.
5. Disconnect link at servo and remove servo.
6. To install, reverse steps 1-5.

DUCT FEEDBACK POTENTIOMETER

The feedback potentiometer is located in the power servo assembly. Replacement of the potentiometer should not be attempted without an accurate ohmmeter for calibration.

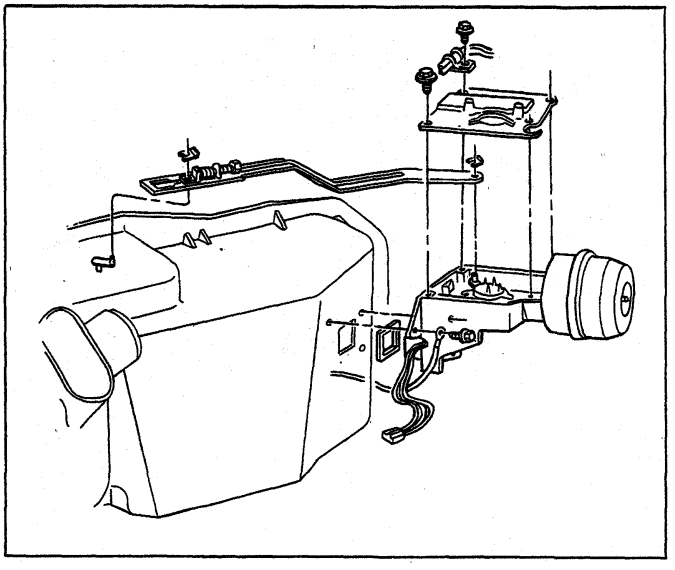


Fig. 79—Power Servo Installation

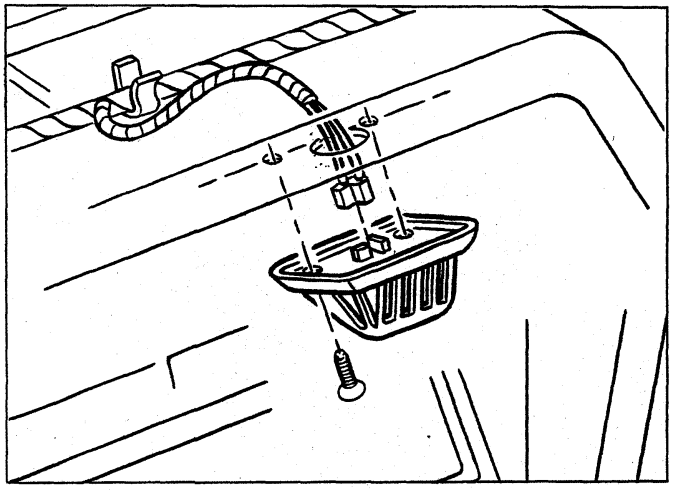


Fig. 80—Comfortron In-Car Sensor

Replacement

1. Remove the power servo assembly as outlined under "Power Servo".
2. Loosen allen set screw in the calibration clutch on the potentiometer shaft.
3. Remove the clutch from the shaft.
4. Remove potentiometer locknut and lock washer and remove potentiometer.
5. Reverse the above procedure for reinstallation.

Calibration

1. With the power servo electrically disconnected, place an ohmmeter across the terminals of the potentiometer.
2. With no vacuum to the servo, adjust the slotted screw on the end of the potentiometer shaft for 68 ± 2 ohms.

IN-CAR SENSOR

Replacement Fig. 80)

1. Remove sensor to instrument panel screws and lower sensor.

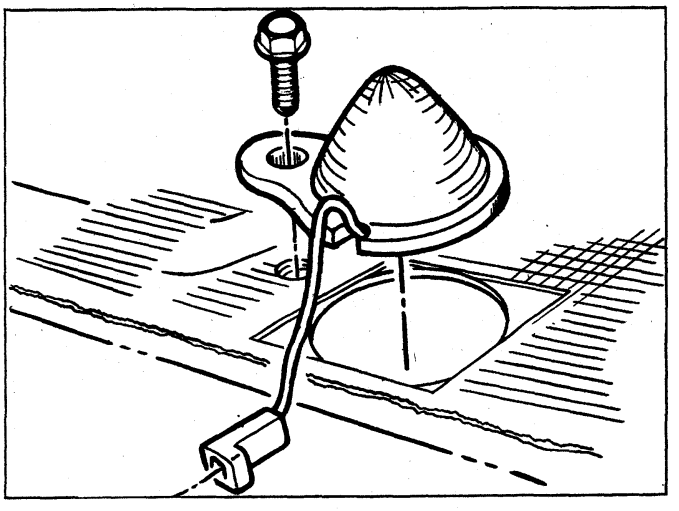


Fig. 81—Comfortron Sun-Ambient Sensor Installation

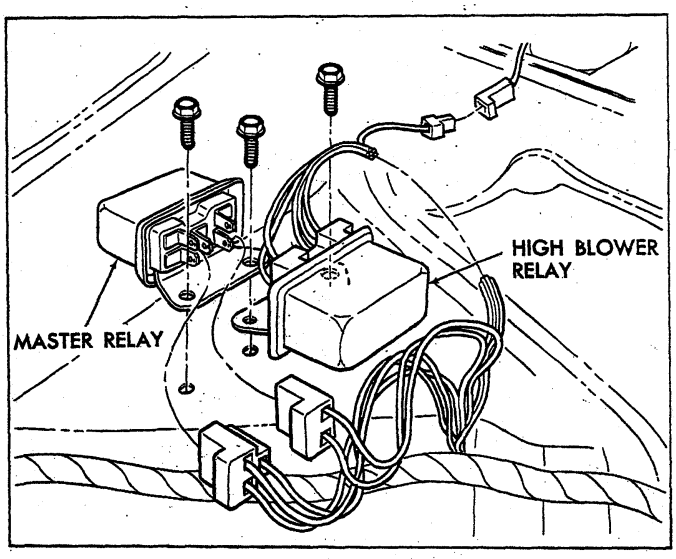


Fig. 82—Comfortron Relays

2. Disconnect electrical connector and remove sensor.
3. Install new sensor by connecting wiring harness and installing the mounting screws.

SUN-AMBIENT SENSOR

This combination unit, which senses outside air temperature and sun load, is mounted to the cowl vent screen (Fig. 81). Replacement can be made by disconnecting the wiring harness and removing the mounting screw.

MASTER AND HIGH BLOWER RELAYS

These relays are mounted to the evaporator core cover with two screws (Fig. 82).

BLOWER SPEED RESISTOR

Figure 83 illustrates the location and installation of the blower speed resistor assembly.

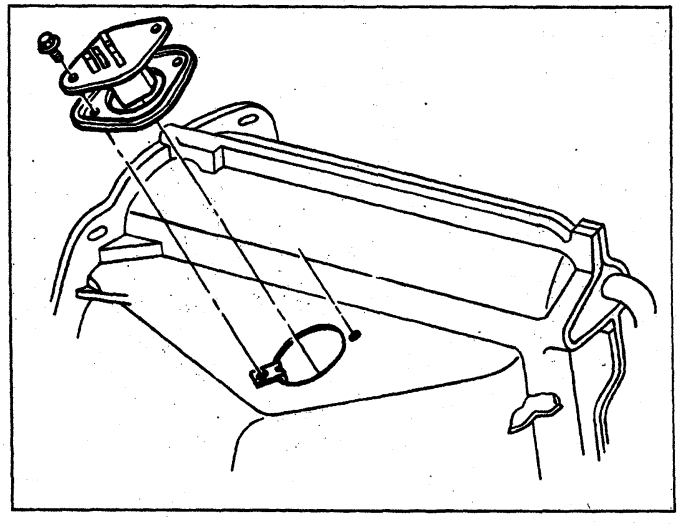


Fig. 83—Blower Speed Resistor

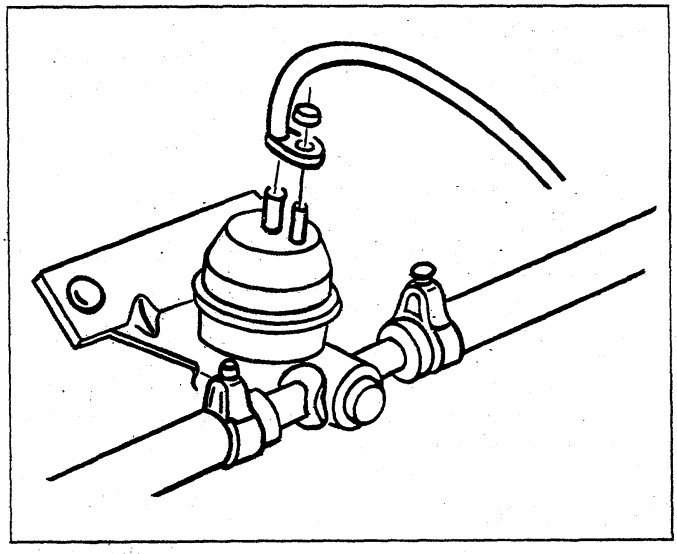


Fig. 84—Water Valve Installation

WATER VALVE

The water shut-off valve is installed in the heater core inlet line. When vacuum is applied to the valve, the valve is closed preventing coolant flow to the heater core. When there is no vacuum applied to the valve, the valve is open, allowing coolant flow.

Replacement (Fig. 84)

1. Disconnect the battery ground cable.
2. Place a container under the vehicle, disconnect the valve inlet and outlet lines and drain coolant into the container.
3. Disconnect the vacuum line.
4. Remove the valve retainer and remove the valve.
5. To install, reverse the removal procedure.

TRANSDUCER

The transducer is bracket mounted to the selector duct assembly (fig. 85). After disconnecting the battery ground

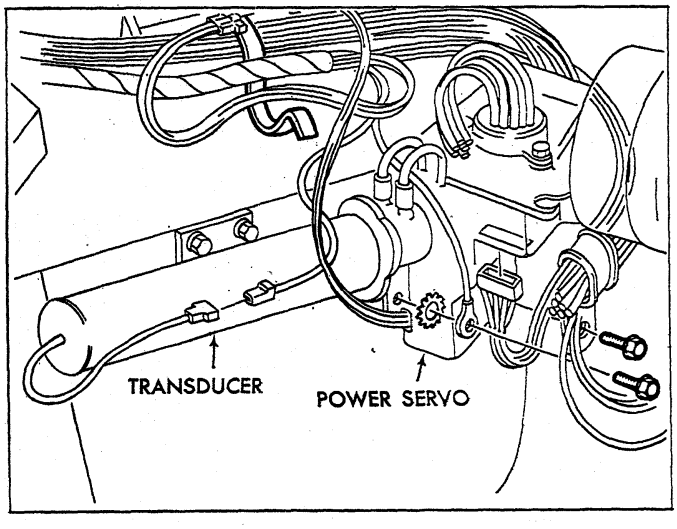


Fig. 85—Transducer Installation

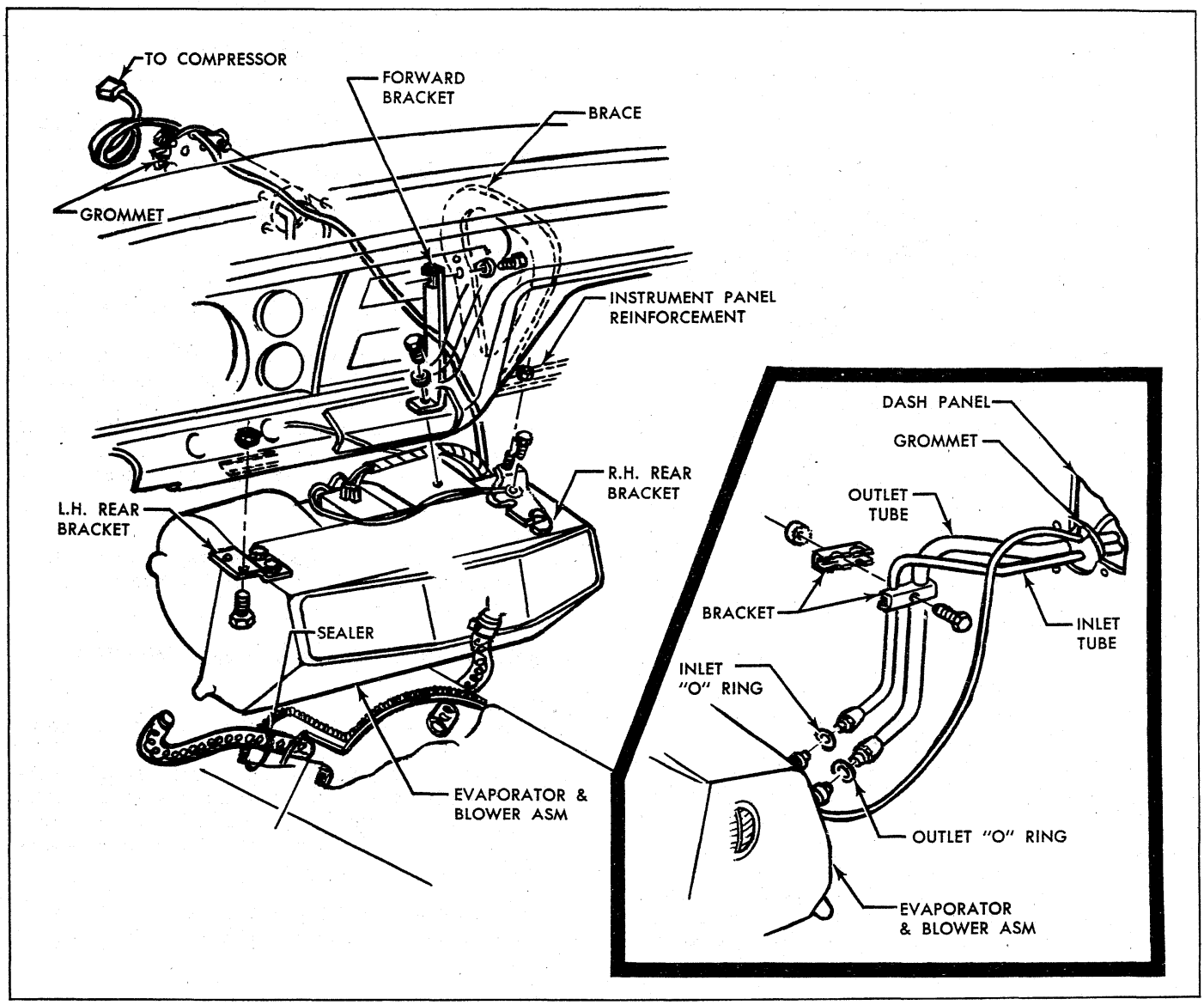


Fig. 86—Evaporator Mounting

cable, the transducer can be replaced by removing the glove box interior, removing vacuum lines, electrical connections and the bracket to case screws.

GM CHEVROLET AIR CONDITIONING SYSTEM ONLY

In order to replace the Blower Motor, Blower Wheels, Evaporator, Expansion Valve, Evaporator and/or Evaporator Case, the entire evaporator assembly must be removed from the vehicle.

ENTIRE EVAPORATOR ASSEMBLY (Fig.86)

Removal

1. Disconnect battery ground cable.
2. Purge system of refrigerant.
3. Remove glove box interior to gain access to evaporator case mounting bolts.
4. Disconnect inlet and outlet refrigerant lines from the back of unit.
5. Disconnect drain tubes from evaporator case.
6. Disconnect electrical connector from compressor. Remove the terminal (See Figure 87) and allow connector to hang on ground wire.
7. Remove screws securing grommet retainer to firewall. Remove wire from grommet through slit.
8. Disconnect electrical lead at connector.
9. Remove unit mounting bolts. Remove unit from vehicle, carefully pulling compressor electrical lead through firewall.

Once the unit has been removed from the vehicle, continue with component replacement as follows:

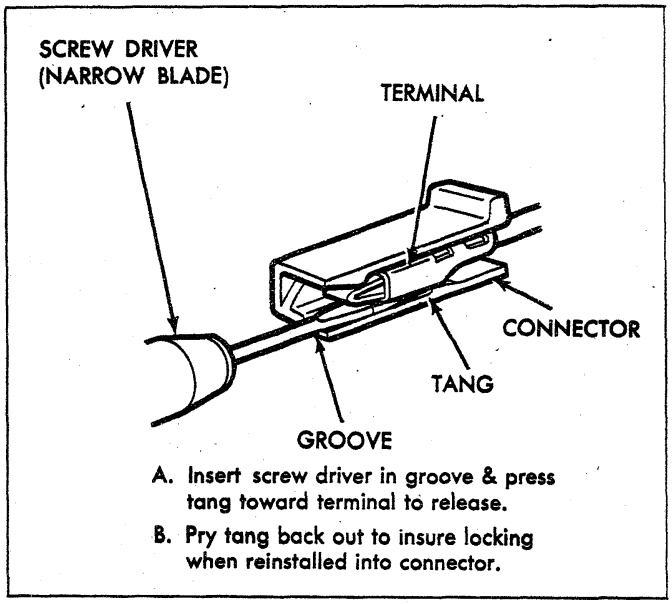


Fig. 87—Terminal Removal

BLOWER ASSEMBLY

Removal

1. Remove the cover plate and separate the upper and lower case halves. Remove blower motor mounting strap screw and remove strap.
2. Remove blower assembly. Loosen the blower wheel setscrews and remove the wheels from the motor shaft.

Installation

1. Install the blower wheels on the motor so that the lower blades curve toward the firewall side of the unit when the motor is placed in the case as illustrated in Figure 88. Do not tighten setscrews at this point.
2. Place the motor in the bracket with the electrical connector side of the motor to the right side of the bracket. Attach the mounting strap. Align blower wheels so that they do not contact case. Tighten setscrews.
3. Assemble the case halves and attach the cover plate.
4. Reverse steps 1-9 on the "Entire Evaporator Assembly" removal procedure.

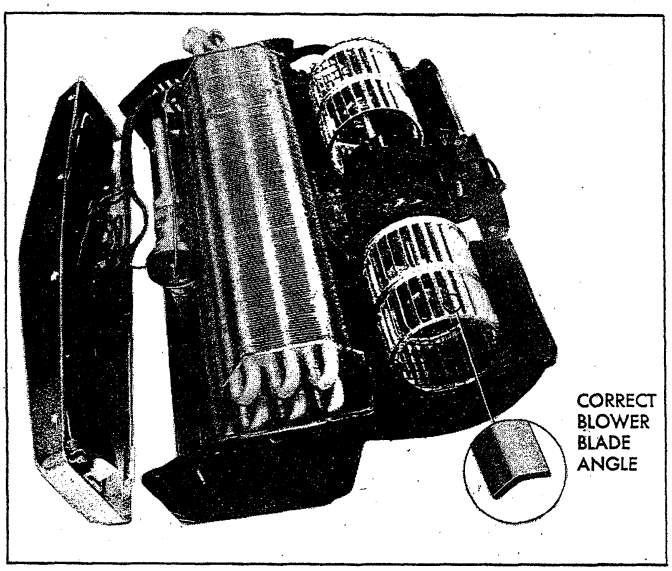


Fig. 88—Blower Assembly (Shown Upside Down)

EXPANSION VALVE, EVAPORATOR AND/OR EVAPORATOR CASE

Removal (Fig. 89)

1. Remove the cover plate and separate upper and lower case halves.
2. Remove inlet and outlet lines from the expansion valve. Remove sensing bulb from the evaporator outlet manifold. Remove expansion valve.
3. Remove evaporator core retaining screws and remove core.
4. Remove blower motor and harness assembly from case.

Installation

1. Reverse applicable steps in the removal procedure.
2. Reverse steps 1-9 of the "Entire Assembly" removal procedure.

THERMOSTATIC AND/OR BLOWER SWITCHES

Replacement

1. Remove the cover plate assembly from the evaporator case.
2. Remove two screws securing either switch to the cover plate and remove appropriate switch (fig. 90).
3. Install replacement switch, reinstall cover plate and reverse steps 1-9 of the "Entire Evaporator Assembly" removal procedure.

NOTE: When installing thermostatic switch, be sure to position sensing capillary as when unit was removed.

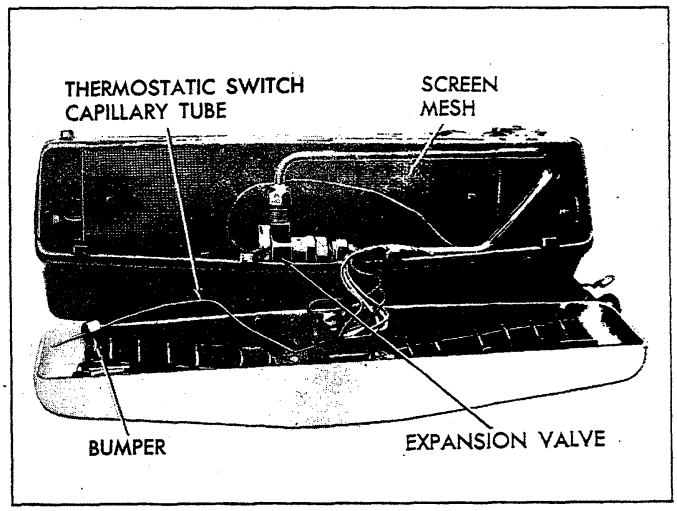


Fig. 89—Expansion Valve and Sensor Installation

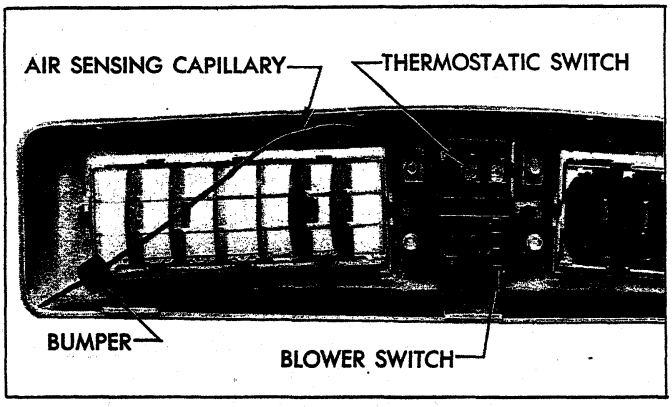


Fig. 90—Thermostatic and Blower Switches

RESISTOR

The blower motor resistor is located on the top of the unit. The entire unit must be removed to replace the resistor (fig. 91).

FUSE

The GM Chevrolet Air Conditioning Unit does not incorporate an in-line fuse as does the Four-Season and Comfortron Systems. The lead wire is connected to the Heater Wiring Harness (Fig. 91) and operates off the 25 amp Heater Fuse.

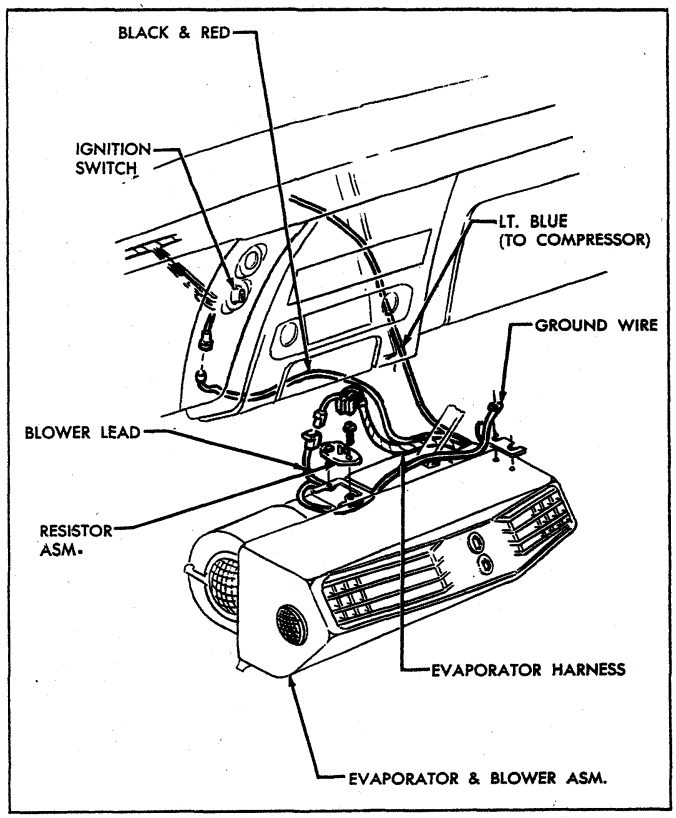
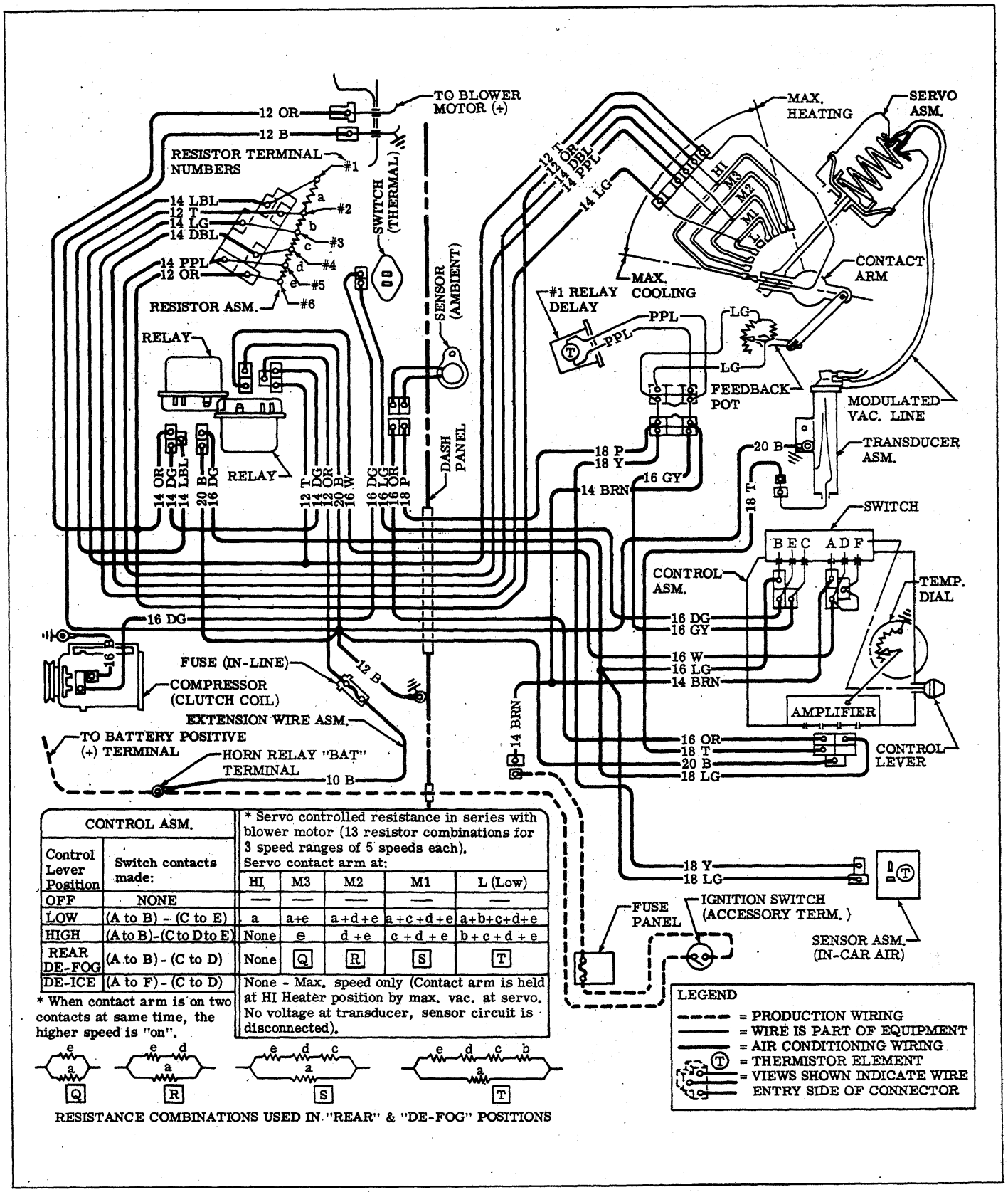


Fig. 91—Underdash Wiring (Typical)

WIRING AND VACUUM DIAGRAMS

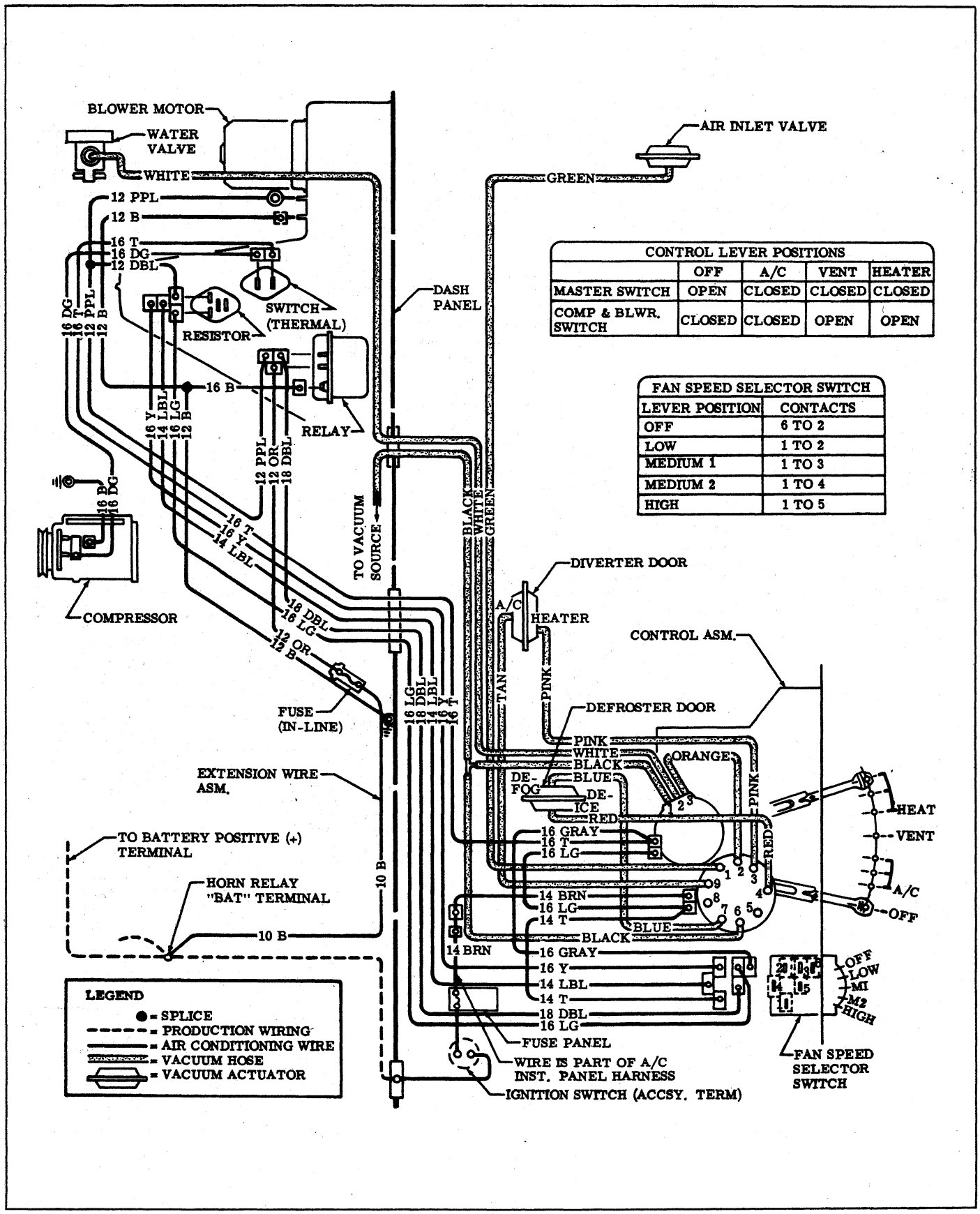


CONTROL ASM.		* Servo controlled resistance in series with blower motor (13 resistor combinations for 3 speed ranges of 5 speeds each). Servo contact arm at:				
Control Lever Position	Switch contacts made:	HI	M3	M2	M1	L (Low)
OFF	NONE	—	—	—	—	—
LOW	(A to B) - (C to E)	a	a+e	a+d+e	a+c+d+e	a+b+c+d+e
HIGH	(A to B)-(C to D to E)	None	e	d+e	c+d+e	b+c+d+e
REAR DE-FOG	(A to B) - (C to D)	None	Q	R	S	T
DE-ICE	(A to F) - (C to D)	None - Max. speed only (Contact arm is held at HI Heater position by max. vac. at servo. No voltage at transducer, sensor circuit is disconnected).				

* When contact arm is on two contacts at same time, the higher speed is "on".

RESISTANCE COMBINATIONS USED IN "REAR" & "DE-FOG" POSITIONS

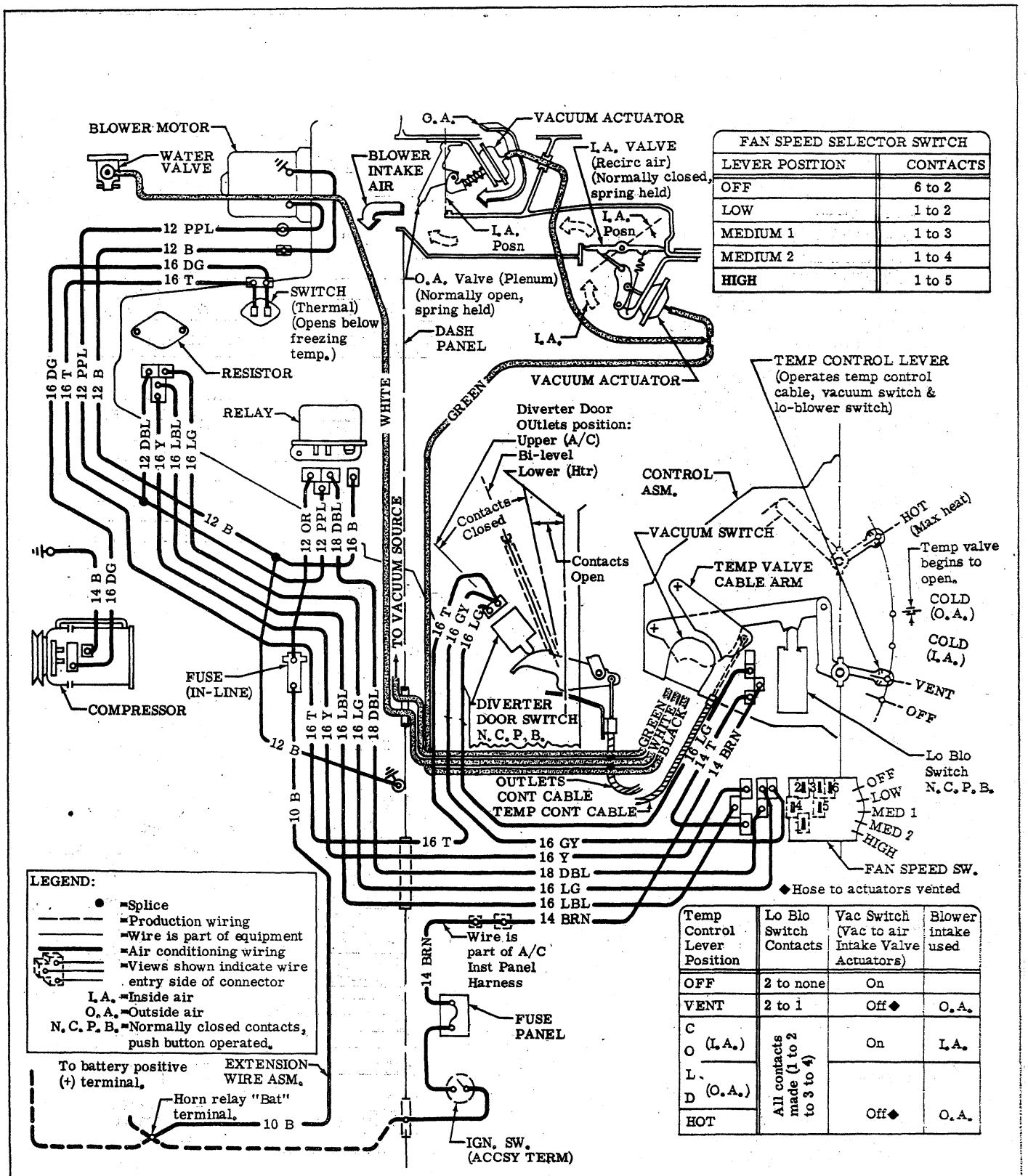
Fig. 92—Chevrolet Comfortron Wiring Diagram



CONTROL LEVER POSITIONS				
	OFF	A/C	VENT	HEATER
MASTER SWITCH	OPEN	CLOSED	CLOSED	CLOSED
COMP & BLWR. SWITCH	CLOSED	CLOSED	OPEN	OPEN

FAN SPEED SELECTOR SWITCH	
LEVER POSITION	CONTACTS
OFF	6 TO 2
LOW	1 TO 2
MEDIUM 1	1 TO 3
MEDIUM 2	1 TO 4
HIGH	1 TO 5

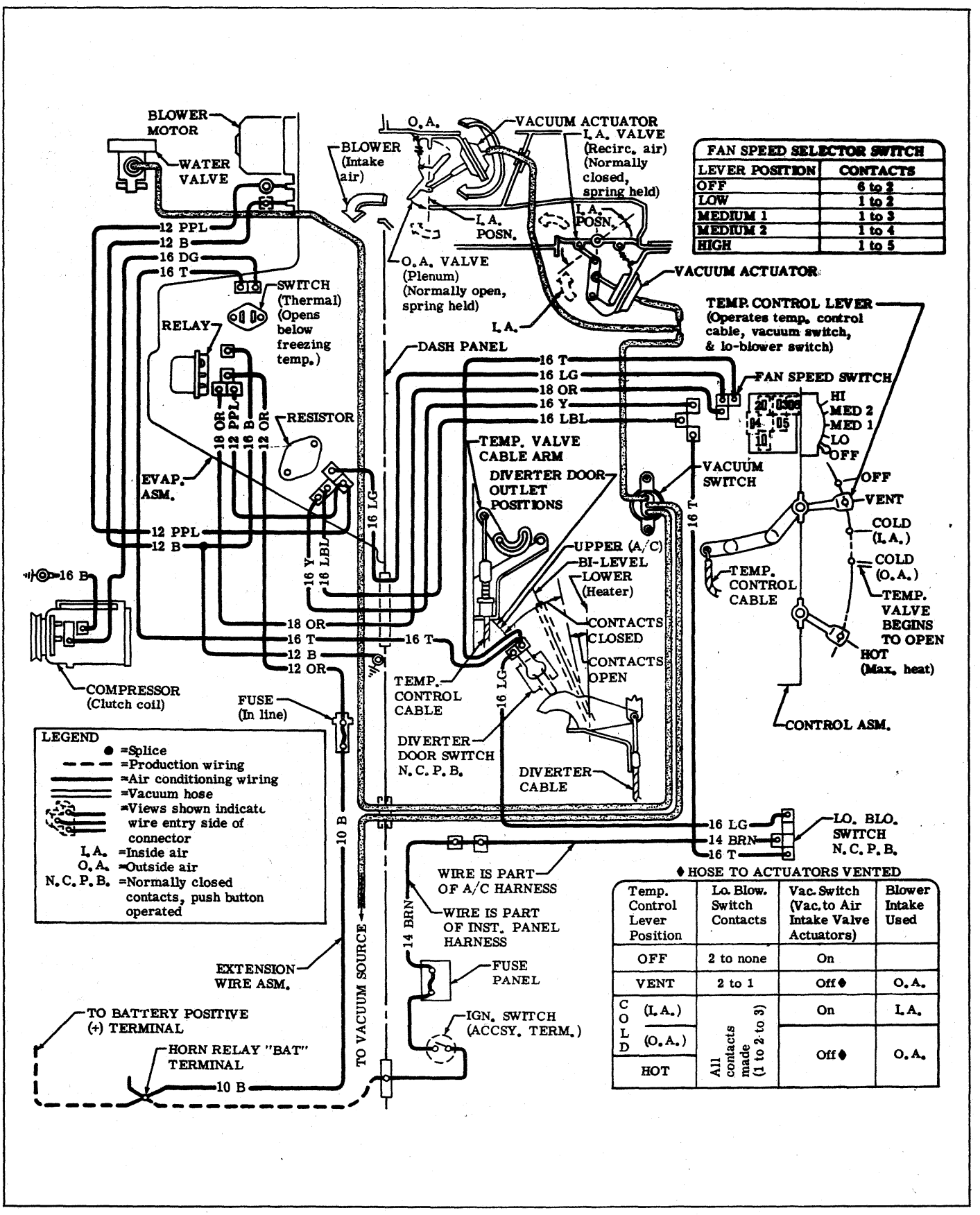
Fig. 93—Chevrolet Four-Season Wiring Diagram



FAN SPEED SELECTOR SWITCH	
LEVER POSITION	CONTACTS
OFF	6 to 2
LOW	1 to 2
MEDIUM 1	1 to 3
MEDIUM 2	1 to 4
HIGH	1 to 5

Temp Control Lever Position	Lo Blo Switch Contacts	Vac Switch (Vac to air Intake Valve Actuators)	Blower intake used
OFF	2 to none	On	
VENT	2 to 1	Off◆	O. A.
COOL (I. A.)	All contacts made (1 to 2 to 3 to 4)	On	I. A.
LOW (O. A.)		Off◆	O. A.
HOT			

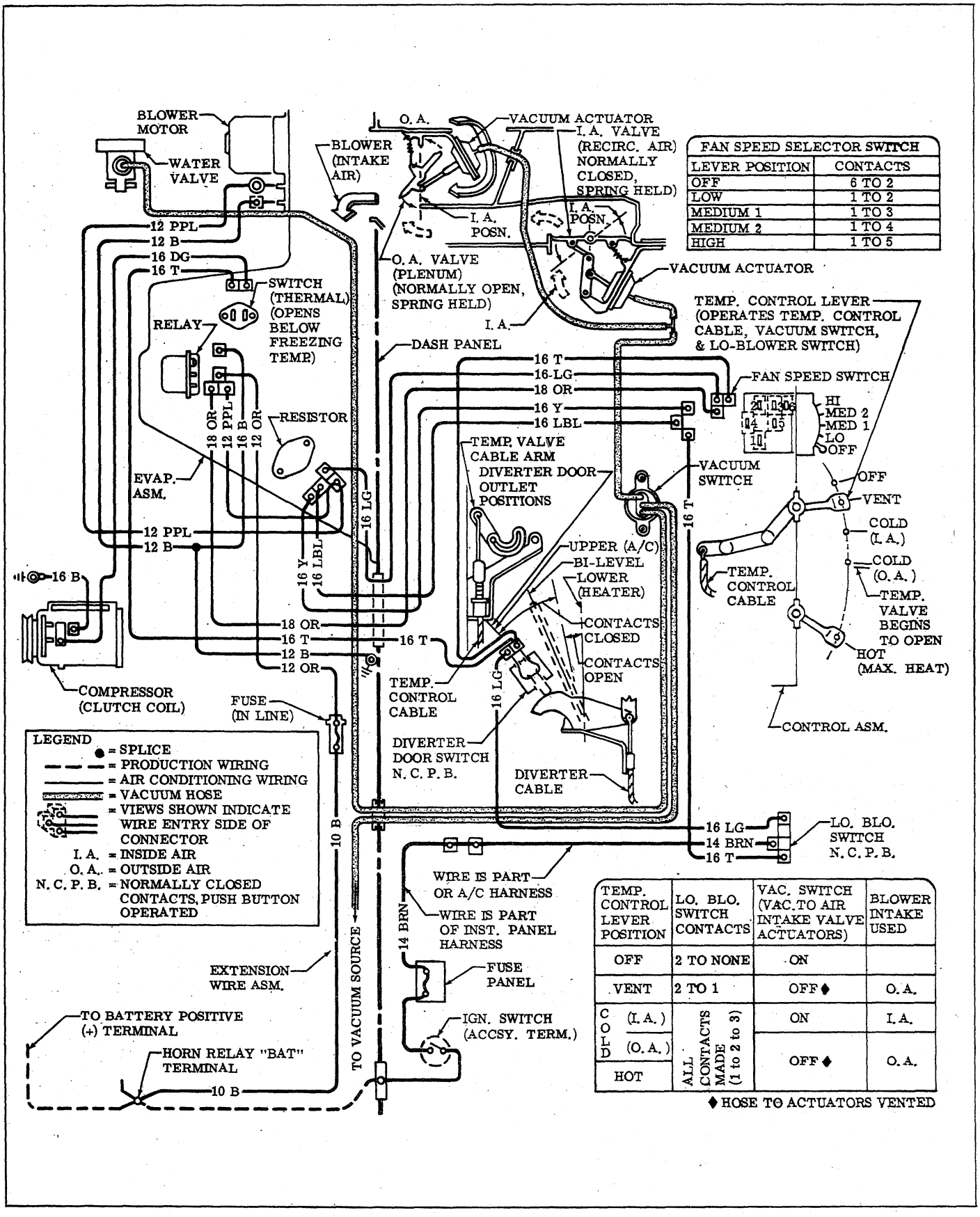
Fig. 94—Chevelle Four-Season Wiring Diagram



FAN SPEED SELECTOR SWITCH	
LEVER POSITION	CONTACTS
OFF	6 to 2
LOW	1 to 2
MEDIUM 1	1 to 3
MEDIUM 2	1 to 4
HIGH	1 to 5

Temp. Control Lever Position	Lo. Blow. Switch Contacts	Vac. Switch (Vac. to Air Intake Valve Actuators)	Blower Intake Used
OFF	2 to none	On	
VENT	2 to 1	Off ♦	O.A.
COLD (I.A.)	All contacts made (1 to 2 to 3)	On	I.A.
COLD (O.A.)		Off ♦	O.A.
HOT			

Fig. 95—Chevy Nova Four-Season Wiring Diagram



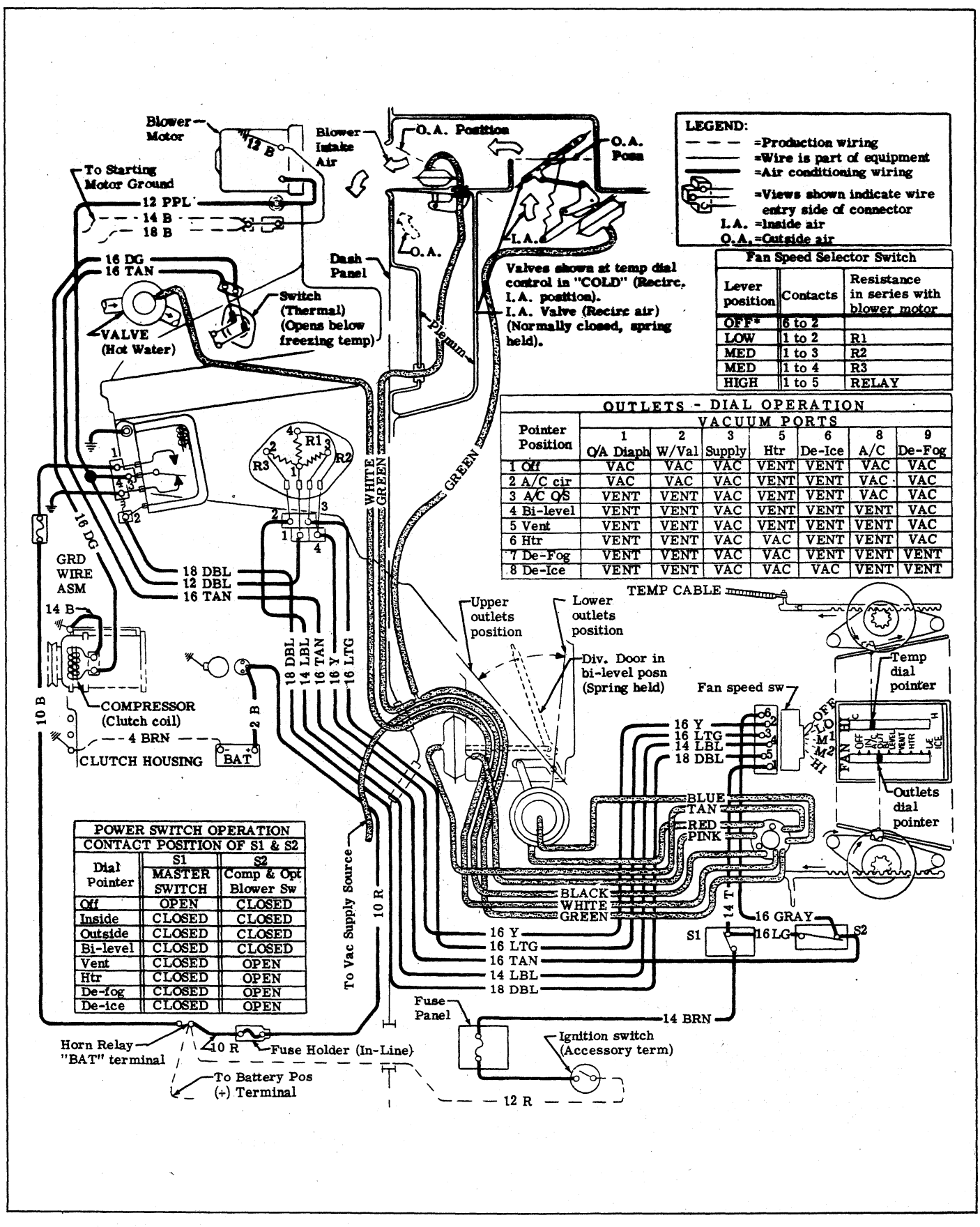
FAN SPEED SELECTOR SWITCH	
LEVER POSITION	CONTACTS
OFF	6 TO 2
LOW	1 TO 2
MEDIUM 1	1 TO 3
MEDIUM 2	1 TO 4
HIGH	1 TO 5

LEGEND
- ● = SPLICE
- = PRODUCTION WIRING
- = AIR CONDITIONING WIRING
- = VACUUM HOSE
- = VIEWS SHOWN INDICATE WIRE ENTRY SIDE OF CONNECTOR
- I. A. = INSIDE AIR
- O. A. = OUTSIDE AIR
- N. C. P. B. = NORMALLY CLOSED CONTACTS, PUSH BUTTON OPERATED

TEMP. CONTROL LEVER POSITION	LO. BLO. SWITCH CONTACTS	VAC. SWITCH (VAC. TO AIR INTAKE VALVE ACTUATORS)	BLOWER INTAKE USED
OFF	2 TO NONE	ON	
VENT	2 TO 1	OFF ♦	O. A.
COLD (I. A.)	ALL CONTACTS MADE (1 to 2 to 3)	ON	I. A.
COLD (O. A.)		OFF ♦	O. A.
HOT			

♦ HOSE TO ACTUATORS VENTED

Fig. 96—Camaro Four-Season Wiring Diagram



Fan Speed Selector Switch		
Lever position	Contacts	Resistance in series with blower motor
OFF*	6 to 2	
LOW	1 to 2	R1
MED	1 to 3	R2
MED	1 to 4	R3
HIGH	1 to 5	RELAY

OUTLETS - DIAL OPERATION								
Pointer Position	VACUUM PORTS							
	1 O/A Diaph	2 W/Val	3 Supply	5 Htr	6 De-Ice	8 A/C	9 De-Fog	
1 Off	VAC	VAC	VAC	VENT	VENT	VAC	VAC	
2 A/C cir	VAC	VAC	VAC	VENT	VENT	VAC	VAC	
3 A/C O/S	VENT	VENT	VAC	VENT	VENT	VAC	VAC	
4 Bi-level	VENT	VENT	VAC	VENT	VENT	VENT	VAC	
5 Vent	VENT	VENT	VAC	VENT	VENT	VENT	VAC	
6 Htr	VENT	VENT	VAC	VAC	VENT	VENT	VAC	
7 De-Fog	VENT	VENT	VAC	VAC	VENT	VENT	VENT	
8 De-Ice	VENT	VENT	VAC	VAC	VAC	VENT	VENT	

POWER SWITCH OPERATION CONTACT POSITION OF S1 & S2		
Dial Pointer	S1 MASTER SWITCH	S2 Comp & Opt Blower Sw
Off	OPEN	CLOSED
Inside	CLOSED	CLOSED
Outside	CLOSED	CLOSED
Bi-level	CLOSED	CLOSED
Vent	CLOSED	OPEN
Htr	CLOSED	OPEN
De-fog	CLOSED	OPEN
De-ice	CLOSED	OPEN

Fig. 97—Corvette Four-Season Wiring Diagram

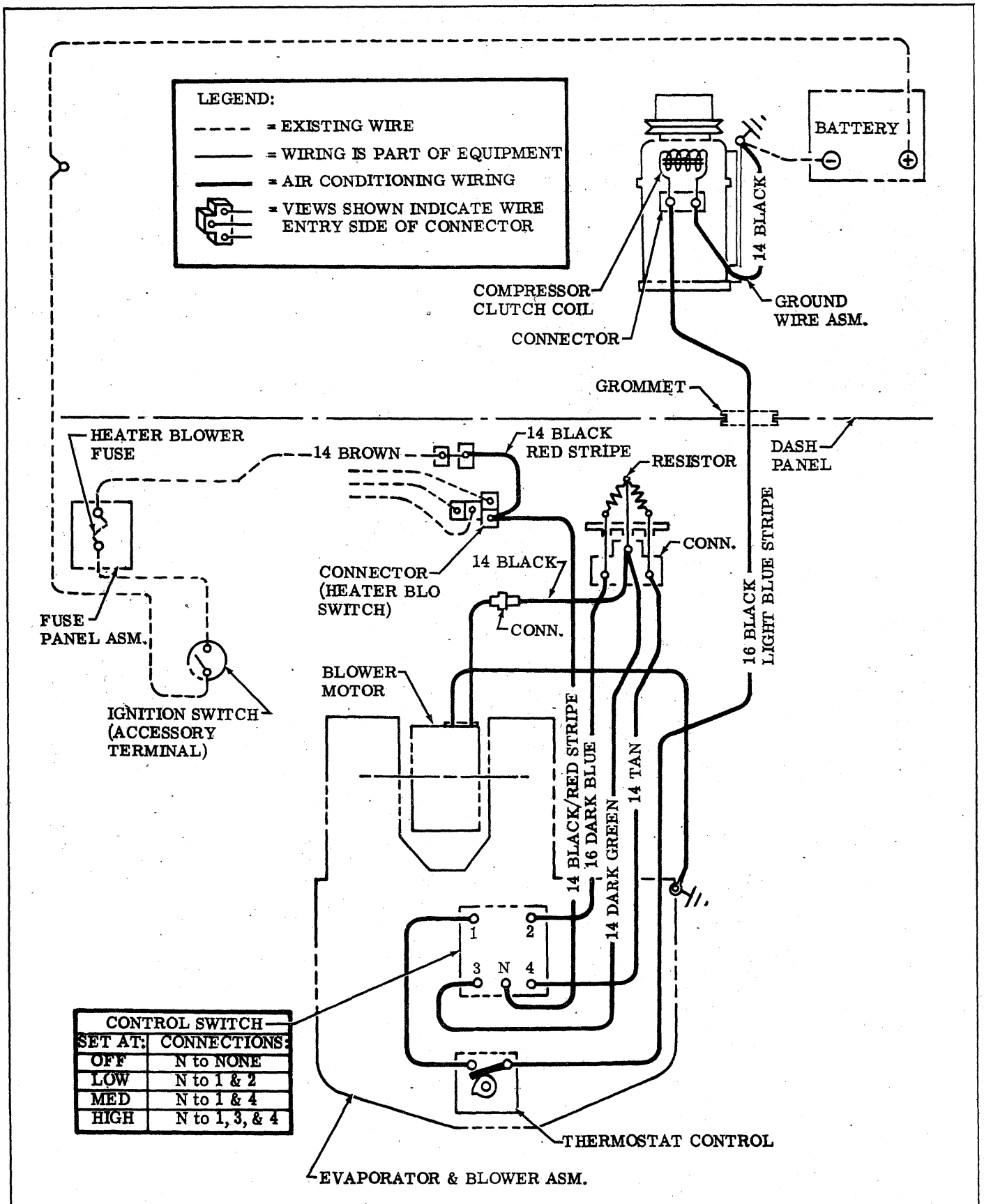


Fig. 98—GM Chevrolet Air Conditioning System Wiring Diagram (Typical)

SPECIAL TOOLS

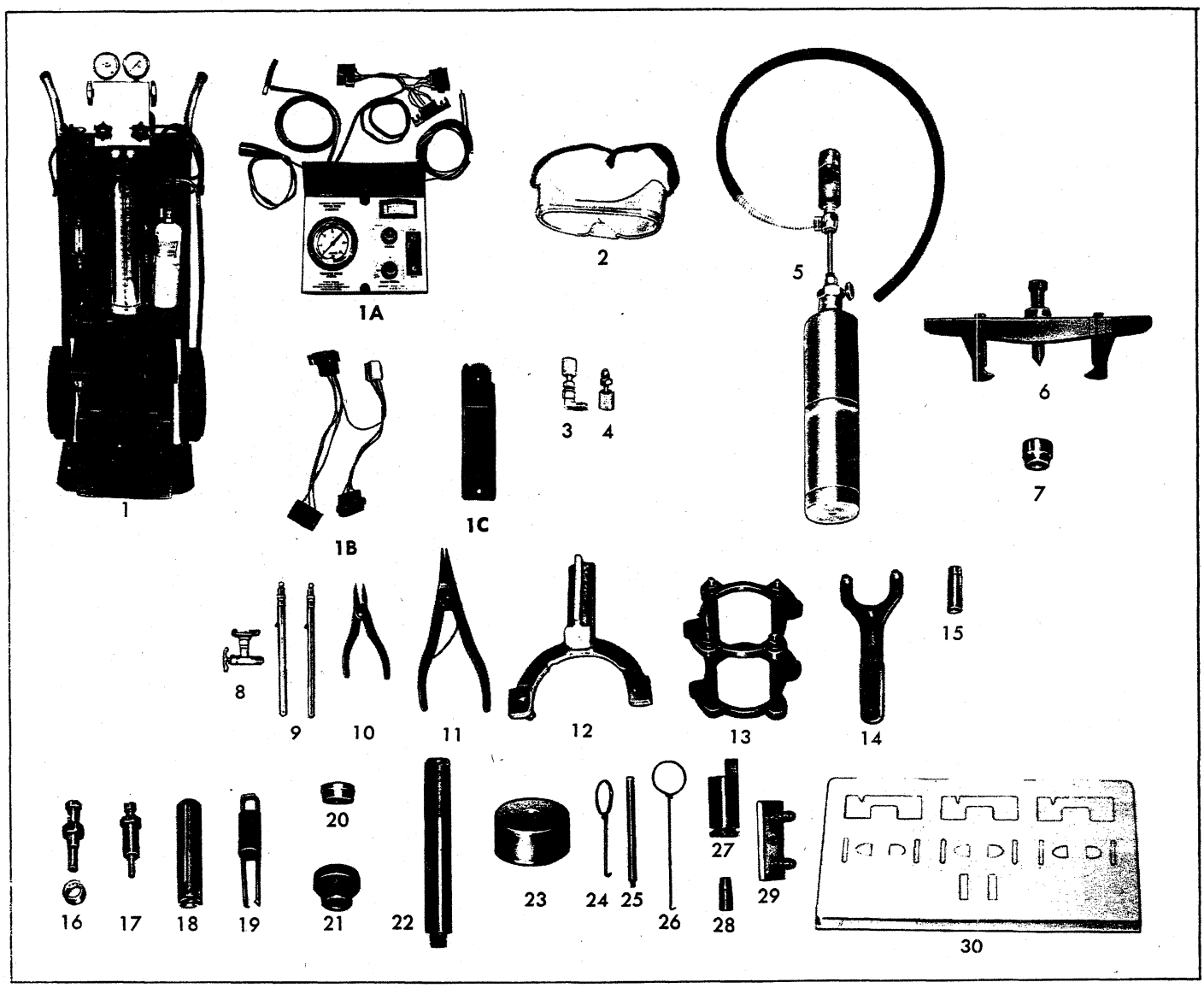


Fig. 99—Air Conditioning - Special Tools

1. J-8393 Charging Station
1A. J-22368 Comfortron System Tester
1B. J-23124 Circuit Board Amplifier Adapter
1C. J-21530 Comfortron Temperature Dial Adjuster
2. J-5453 Goggles
3. J-9459 90° Gauge Line Adapter
4. J-5420 Gauge Line Adapter
5. J-6084 Leak Detector
6. J-8433 Puller
7. J-9395 Puller Pilot
8. J-6271 Fitzall Valve (Single Can)
9. J-5421 Pocket Thermometers (2)
10. J-5403 #21 Snap Ring Pliers
11. J-6435 #26 Snap Ring Pliers
12. J-9396 Compressor Holding Fixture
13. J-9397 Compressing Fixture
14. J-9403 Clutch Hub Holding Tool
15. J-9399 9/16" Thin Wall Socket
16. J-9401 Hub and Drive Plate Assembly Remover
17. J-9480 Hub and Drive Plate Assembly Installer
18. J-9392 Seal Remover
19. J-9393 Seal Seat Remover
20. J-9398 Pulley Bearing Remover
21. J-9481 Pulley and Bearing Installer
22. J-8092 Handle
23. J-21352 Internal Assembly Support Block
24. J-5139 Oil Pickup Tube Remover
25. J-9432 Needle Bearing Installer
26. J-9553 Seal Seat "O" Ring Remover
27. J-21508 Seal Seat "O" Ring Installer
28. J-22974 Shaft Seal Protector
29. J-9527 Pressure Test Connector
30. J-9402 Parts Tray

SECTION 1B

CORVETTE BODY

INDEX

	Page
General Description	1B-1
Maintenance and Replacement	1B-1
Front End	1B-1
Adjustments	1B-1
Hood	1B-1
Hood Assembly	1B-2
Hood Prop	1B-2
Front Emblem	1B-2
Fender Script	1B-2
Cowl Area Trim	1B-2
Console Assembly	1B-4
Rear View Mirror	1B-6
Outside	1B-6
Inside	1B-6
Sun Visor	1B-6
Windshield	1B-6
Cowl Ventilator Assembly	1B-8
Doors	1B-9
Adjustments	1B-9
Door Lock Striker	1B-9
Door Window	1B-9
Hinges—Door Assembly	1B-12
Trim Panel and Inside Handles	1B-13
Door Lock and Remote Controls	1B-13
Weatherstrip	1B-13
Window Outer Seal Assembly	1B-14
Window Anti-Rattle Assembly	1B-14
Window Glass	1B-14
Glass Run Channels	1B-15
Window Regulator—Manual	1B-15
Window Regulator—Power	1B-16
Outer Handle and Lock Cylinder	1B-17
Rear Quarter	1B-18
Door Sill Plate and Molding	1B-18
Underbody Storage Compartment	1B-18
Rear End	1B-19
Folding Top Compartment Lid	1B-19
Adjustments	1B-19
Hinges	1B-19
Lock	1B-20
Control	1B-20
Gas Tank Door and Rear Trim	1B-20
Rear Filler Panel	1B-20
Spare Tire Mount	1B-20
Rear Plenum Drain	1B-22
Rugs and Interior Trim	1B-24
Cleaning Soft Trim	1B-24
Carpets and Covers—All Models	1B-26
Seats	1B-27
Body Mounting	1B-27
Body Repairs	1B-27
General Instructions	1B-27
Repair Panels	1B-29
Precautions	1B-29
Plastic Solder Kit	1B-30
Resin Kit	1B-32
Specific Repairs	1B-33
Scratched Panels, Spot Refinishing	1B-33
Dents in Panels—Surface Cracks	1B-34
Cracked Panels	1B-34
Fractures	1B-37
Panel Replacement	1B-37
Hardtop	1B-38
Care and Storage	1B-38
Rear Window	1B-38
Top Attachments	1B-38
Headlining	1B-38
Weatherstrip and Drip Molding	1B-38
Vinyl Covering	1B-38
Folding Top	1B-39
Care of Folding Top	1B-39
Care of Rear Window	1B-39
Adjustments	1B-41
Top Assembly—Removal and Installation	1B-41
Top Trim and Rear Window Assembly	1B-41
Frame and Linkage	1B-43
Weatherstrip	1B-43
Sport Coupe Model 19437	1B-44
Roof Panels	1B-44
Adjustments	1B-44
Weatherstrip	1B-45
Interior Quarter Trim	1B-46
Center Roof Trim	1B-46
Storage Tray	1B-46
Rear Window	1B-47
Special Tools	1B-47

GENERAL DESCRIPTION

A structural network of steel makes up the frame of the Corvette body (See Figure 1). Combined with fiber glass reinforced plastic body panels, the steel plastic unit displays properties of increased torsional rigidity and greater beaming strength.

There are two body styles available—the regular convertible with a folding top or removable hardtop, and the new coupe series that features removable roof panels. On convertible model base equipment, either top is standard and both are optional.

MAINTENANCE AND REPLACEMENTS

FRONT END

ADJUSTMENTS

(Refer to Figure 2)

Adjustments should be made in order—hood position first, followed by catch adjustments.

Hood

The position of the hood in relation to the hood body opening and fender surfaces is determined by the position of the hinges and position and adjustment of catch and bumpers.

The fore and aft adjustment of the hood is performed by

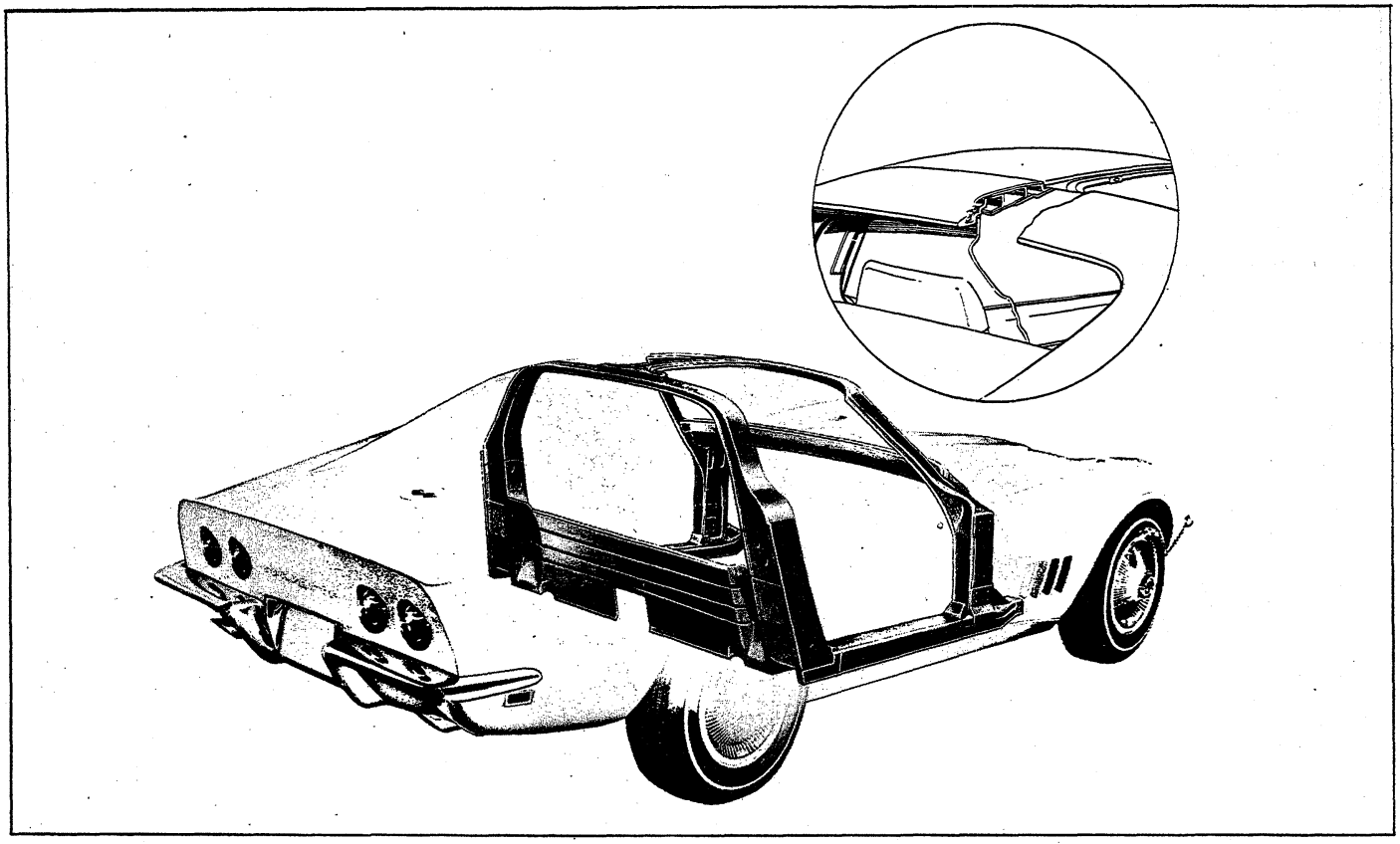


Fig. 1—Steel Reinforcing Members

loosening the hinge retaining bolts (lower) and moving the hood to the limit of slotted holes in hinge strap.

The upper surface of hood may be brought flush with adjacent surfaces by shimming under hinges and adjusting bumper screw and catch bolt engagement. Figure 3 indicates specified spacing.

Entrance of catch bolt into the plate may be adjusted by loosening two (2) catch bolt mounting screws to allow movement of bolt assembly.

Synchronization of catch release may be made by adjusting the cable retainer located at left hand catch bolt assembly.

HOOD ASSEMBLY

Removal

1. If hood is to be reinstalled, scribe a line around hood hinge upper strap as shown in Figure 4.
2. With aid of helper to support hood, remove screws that retain hinge straps and support assembly to hood. If hinges are removed from vehicle, note number of shims under each hinge.

Installation

In replacing original hood, align hinge with scribe marks made on removal, and install retaining screws removed from hinges and support.

If adjustment is required, proceed as outlined in this section under Adjustments—Hood—Hood Catch.

HOOD PROP

Retention Feature

When extended under hood service operations are anticipated, the hood, prop track and slide should be secured by placing a 1/4 inch bolt and nut through the existing hole. This will prevent accidental closing of the hood.

FRONT EMBLEM

Front emblem including flags, numbers, and molding inserts, are retained by special nuts which may be reached by raising hood.

FENDER SCRIPT

Above the front fender louvers the script "Stingray" will be fastened with adhesive.

COWL AREA TRIM

Figure 5 illustrates the mounting and location of instrument panel pads and side trim panels.

Removal

The right-hand dash pad, instrument panel pad and assemblies are removed by:

1. Remove two mounting screws on the outboard flange.
2. Remove two screws at inner flange of center cluster panel.

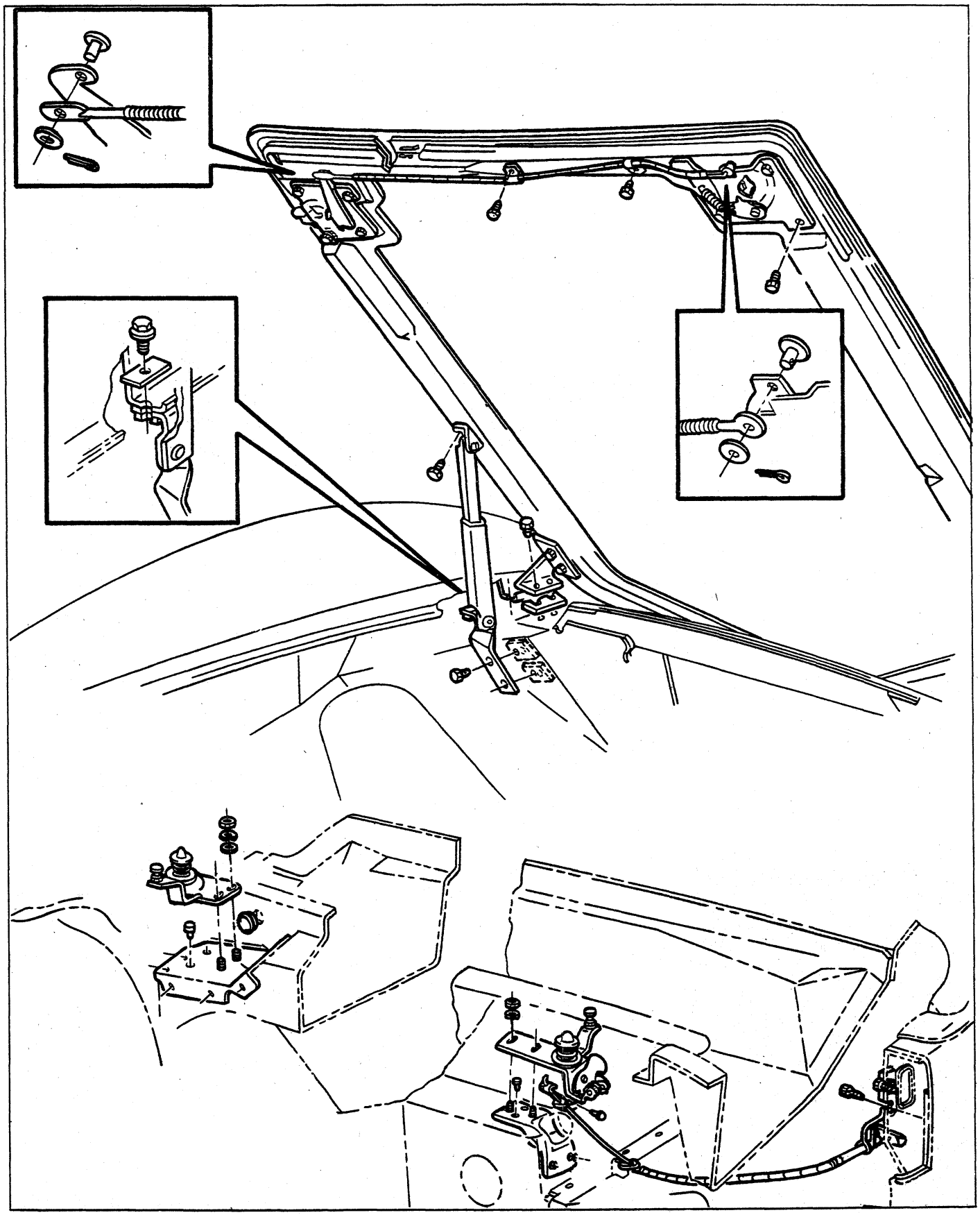


Fig. 2—Hood Hinge and Catch

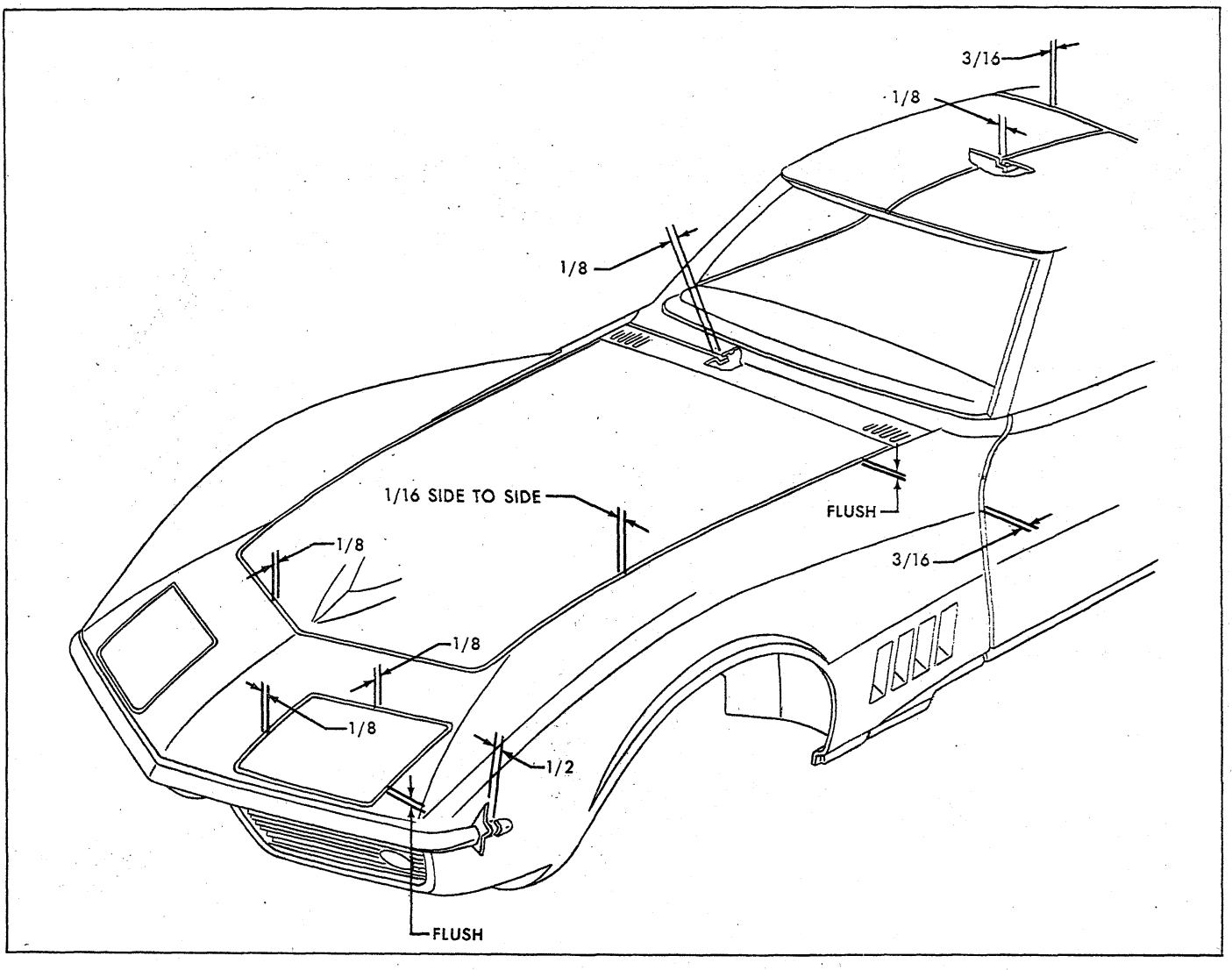


Fig. 3—Hood Spacing

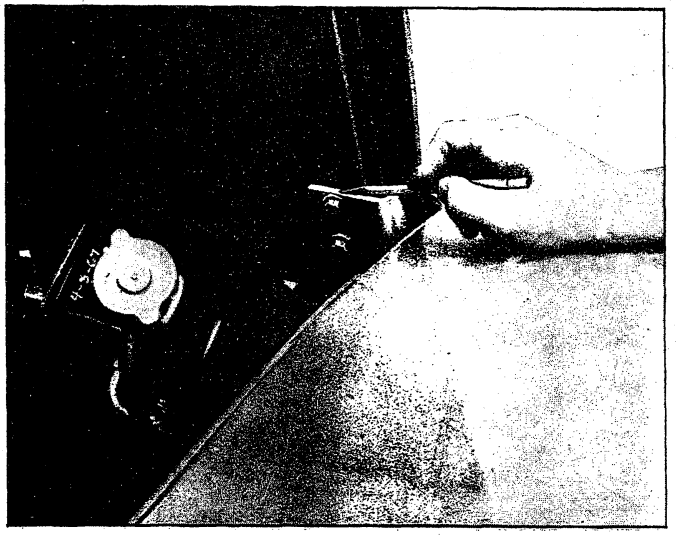


Fig. 4—Scribing Line Around Hood Hinge

3. Pull pad outward to release special plastic retaining clips along top of panel.
4. Pull pad upward to release spring clip at top of trim side panel.

Cowl ventilator and kick panel is removed by:

1. Loosen four (4) screws securing sill plate enough to release force on kick panel.
2. Remove one (1) screw at center of kick panel.
3. Lift out panel with a force in the rearward direction.
4. For installation, follow above steps in reverse order. Side trim panels (left and right) can now be lifted out by pulling downward to release spring clip at front console assembly, after removing screw.

Console Assembly

(Refer to Figure 6)

Because of overlap design, it is necessary that the rear console assembly be first removed or sufficiently loosened before the front console assembly can be removed. Steps for removing the console assemblies are in the following sequence:

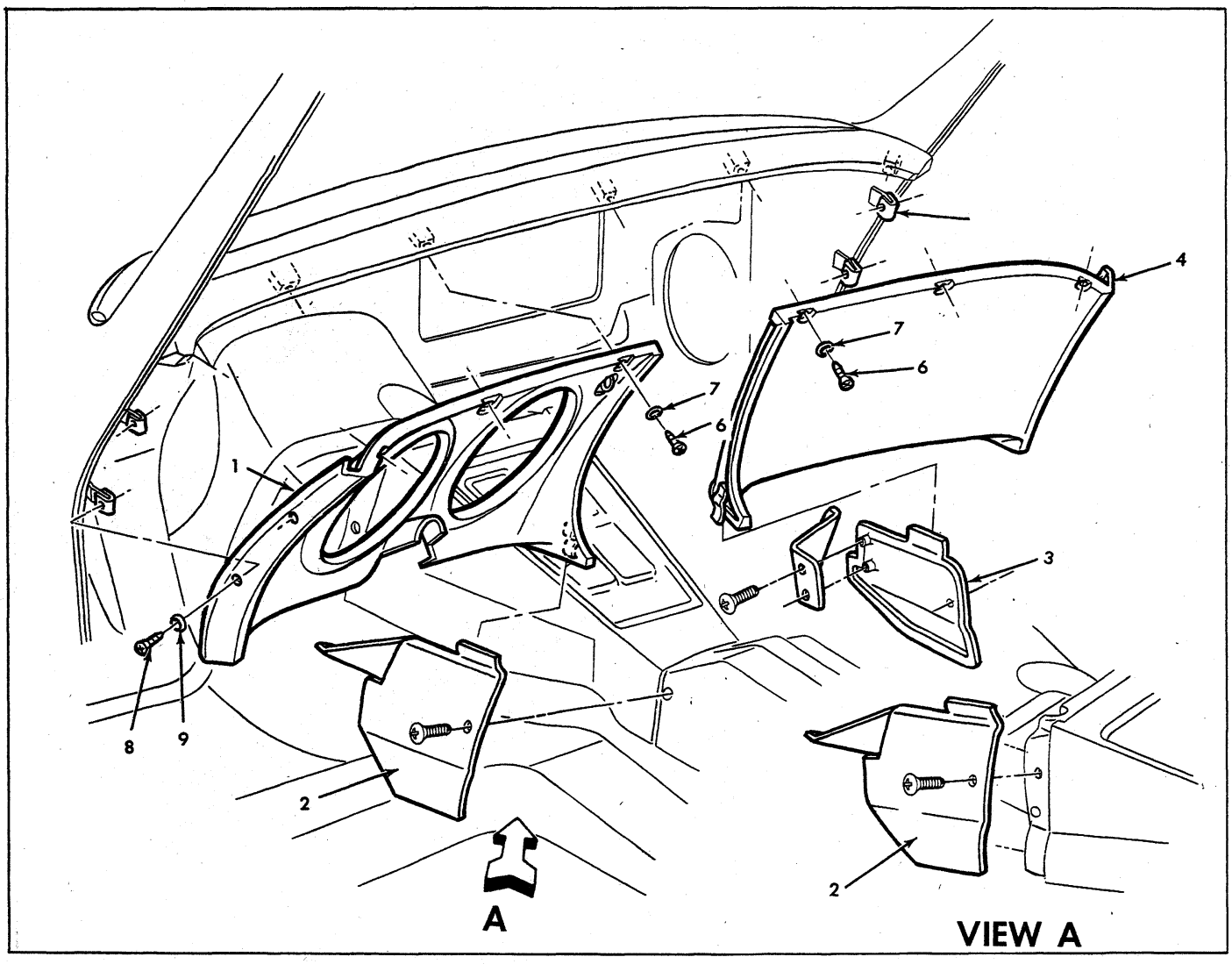


Fig. 5—Cowl Area Trim

1. Instrument Panel Pad L. H.
2. Side Trim Panel L. H.
3. Side Trim Panel R. H.
4. Dash Panel Pad R. H.
5. "J" Nut
6. Screw
7. Special Washer
8. Screw
9. Special Washer

1. Disconnect battery ground cable.
2. Open storage compartment, glove box, and battery lids.
   a. Remove storage compartment interior.
   b. Remove lid hinge screws [total of nine, three (3) per lid].
   c. Remove eight (8) screws on periphery of compartment lid trim plate.
   d. Remove trim plate, lids and glove compartment interior as an assembly.
3. Remove bolt at rear portion of console. Access bolt through opening created in step 2. Remove four (4) screws [two (2) per side] on side of rear portion of console.
4. Lift console. Disconnect electric window switch connectors. Continue raising console while moving it rearward to allow parking brake handle seal to slide out of slot. Remove rear portion of console from vehicle.
5. Service parking brake mechanism as outlined in Section 5 of this Manual or replace concerned power window switch(s).
6. Having first disassembled heater and side vent controls, shift knob assembly, boot assembly, and trim plate, remove front console assembly by carefully pulling rearward and upward (fig. 7).
7. Reverse steps 1-6 on installation, making sure seal is properly installed in its slot before finalizing the installation.

Under Dash Brace Rods (Figure 8)

Convertible style bodies have added reinforcements beneath the dash; two on the right and three on the left

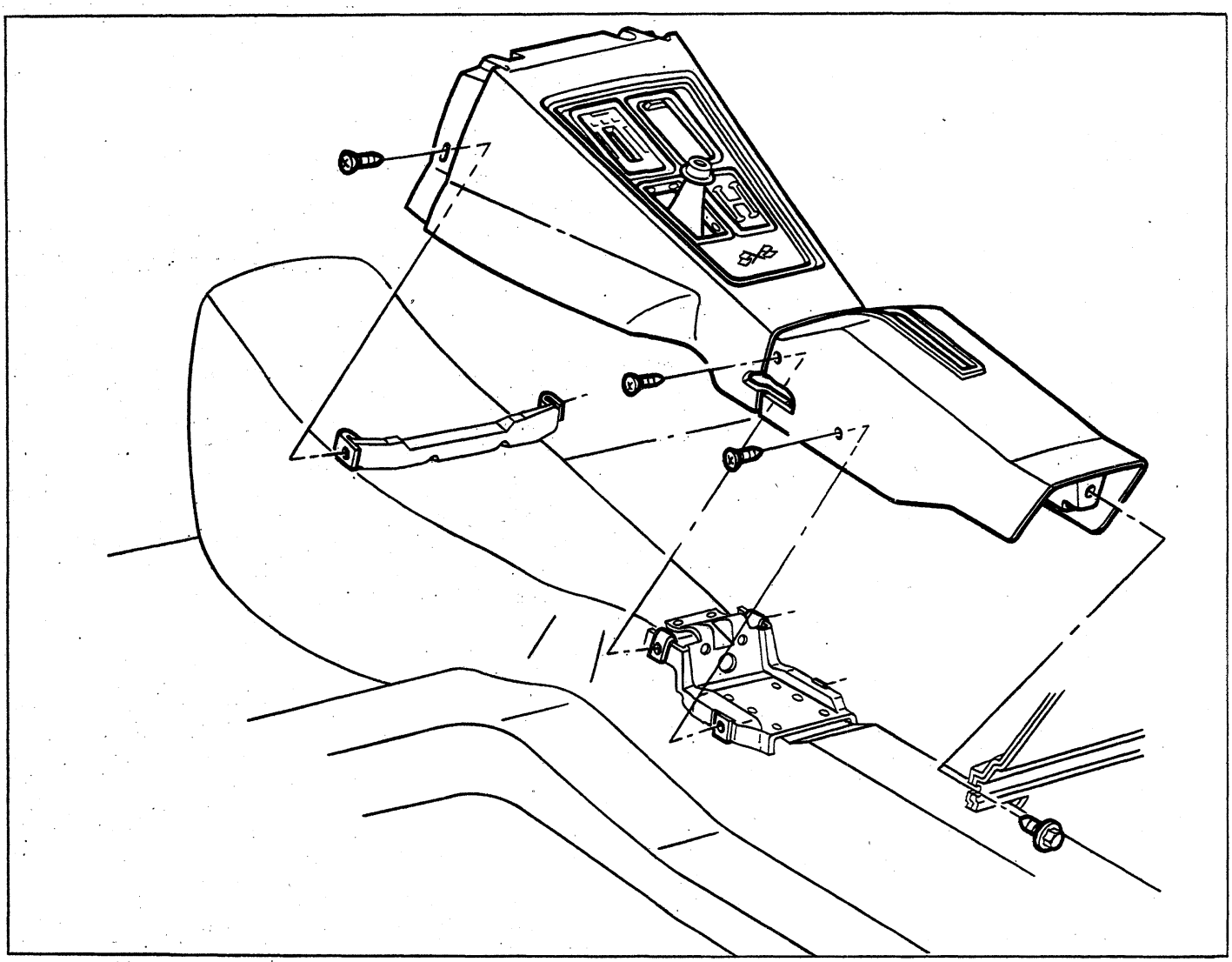


Fig. 6—Front and Rear Console Assemblies

side. The brace rods are bolted into place from the cowl area towards the center of the vehicle.

If the heater core or radio are to be removed, the right-hand under dash braces must be removed first. See Figure 8 for assembly sequence.

REAR VIEW MIRROR

Outside

Removal

The outside rear view mirror is removed from the door by removing the allen head set screw located on the outboard side of the mirror support. (See Figure 9). Mounting assembly is removed by removing two screws to body (fig. 9).

Installation

Mirror may be installed by following removal procedures in reverse order.

Inside

Installation of inside mirror is illustrated in Figure 10. Tension of mirror stud is increased by tightening adjusting screw.

SUN VISOR

Attachment of sun visor assembly to windshield header is made as shown in Figure 10. Turning of adjusting screw clockwise increases friction.

WINDSHIELD

The windshield installation incorporates a synthetic self-curing rubber adhesive caulking compound that adheres to both glass and pinchweld frame in place of the rubber channel that was formerly used. Applied to the glass while in a soft state, the material begins to cure soon after exposure to air. It is therefore essential that installation of glass into body opening quickly follow application of material to glass. It is recommended to use the materials provided in a kit from your authorized dealer which consists of:

a. One tube of Adhesive Caulking Material.
b. Pressure Sensitive Adhesive Sealing Strip.
c. Steel Music Wire (.020" diameter).
d. Adhesive Caulking Primer.

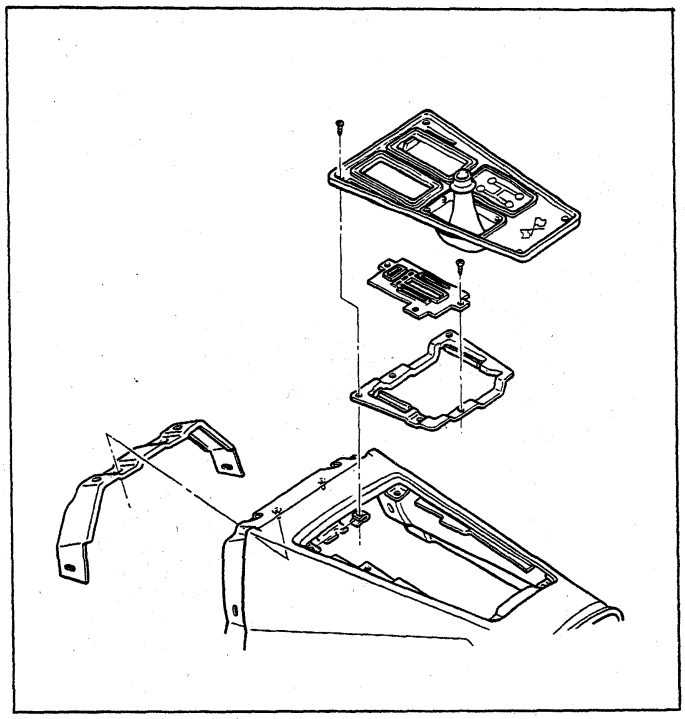


Fig. 7—Front Console Assembly

Additional materials required:

a. Caulking gun
b. Two pieces of wood for wire handles.
c. Black weatherstrip adhesive.
d. Rubber glass spacers.

Removal

(Refer to Figure 11 for parts identification.)

1. Set windshield wiper access door in open position.
2. Remove windshield wiper arms.
3. Remove weatherstrips (L and R) from frame by removing mounting screw, prying from channel, and carefully pulling downward.
4. Remove lower corner reveal moldings (L and R) by removing two (2) screws located at end flanges to fender, and carefully prying out from retaining clips.
5. Remove side retainer moldings (L and R) by removing three (3) screws to frame.
6. Remove side reveal molding (L and R) by removing one (1) remaining screw.
7. After indexing molding and header rail with tape to insure proper reinstallation, remove upper reveal molding by carefully prying out at corner with screw driver and then pulling out remainder by hand.
8. Secure one end of steel music wire to piece of wood for handle. Insert other end through caulking material at lower corner of windshield; then secure end of wire to another piece of wood (fig. 12).
9. With the aid of helper, carefully cut through caulking material (using a sawing motion) with the steel wire; up side of windshield, across top, down opposite side, and across bottom.
10. Remove old glass from windshield opening.
11. Using a sharp scraper or wood chisel, remove adhesive caulking material from pinchweld flange.

NOTE: It is not necessary to clean off all the old caulking material completely from windshield frame; however, there should not be any loose pieces of caulking material left in the opening.

12. Check all upper reveal molding retaining clips for damage (4 clip assemblies required). Replace those that are bent or distorted.
13. Using weatherstrip adhesive, cement rubber spacers at bottom, sides, and top of window opening. The step-type spacers are used at bottom, the flat type are used at the top, and at the sides, window opening as shown in Figure 13.
14. Using suction cup holders, position replacement glass in body opening. Carefully check relationship of glass to body pinchweld completely around opening. The overlap of glass to body pinchweld and retaining flanges should be equal with a minimum overlap of 3/16". Where necessary, position shims under the lower spacers to obtain required overlap of glass to body upper and lower flanges.
15. After proper glass to pinchweld relationship has been attained, mark position with grease pencil on glass and windshield pillar.
16. Remove glass from body opening and place on protected surface.
17. Clean inside edge surface of glass so that glass is free of any foreign material (oil, grease, etc.). By first peeling off paper backing, apply pressure sensitive sealing strip approximately 1/4 inch from edge of inside surface of glass completely around glass. Then apply a film of silane primer to inside edge surface completely around glass; also apply silane primer to sealing surface of windshield frame.
18. Cut off painted portion of cartridge nozzle along edge of paint line.
19. Mix adhesive caulking material and accelerator thoroughly according to directions on container.

NOTE: Once caulking material is mixed, there will be approximately 35 minutes of working time with the material. Subsequent steps should be performed immediately after caulking material is mixed.

20. Place caulking material in cartridge.
21. Carefully apply a smooth continuous bead of caulking material on inside surface of glass next to edge completely around glass (fig. 14). Caulking material should be approximately 1/4 inch wide at the base and form a pyramid 3/8 inch high. If during application the pyramid collapses, wait about 2-3 minutes for material to set up. If an air bubble is encountered in material, back up the applicator and apply sufficient material to fill void and to dispense the bubble before continuing.
22. The reveal molding clips are self-sealing and do not require sealing before installing glass.
23. With aid of helper, lift glass and carefully position glass on spacers, matching up marks on glass and frame.
24. Press glass lightly to set caulking material to windshield opening flanges. Paddle material where necessary to insure proper seal.
25. Water test windshield immediately using a cold

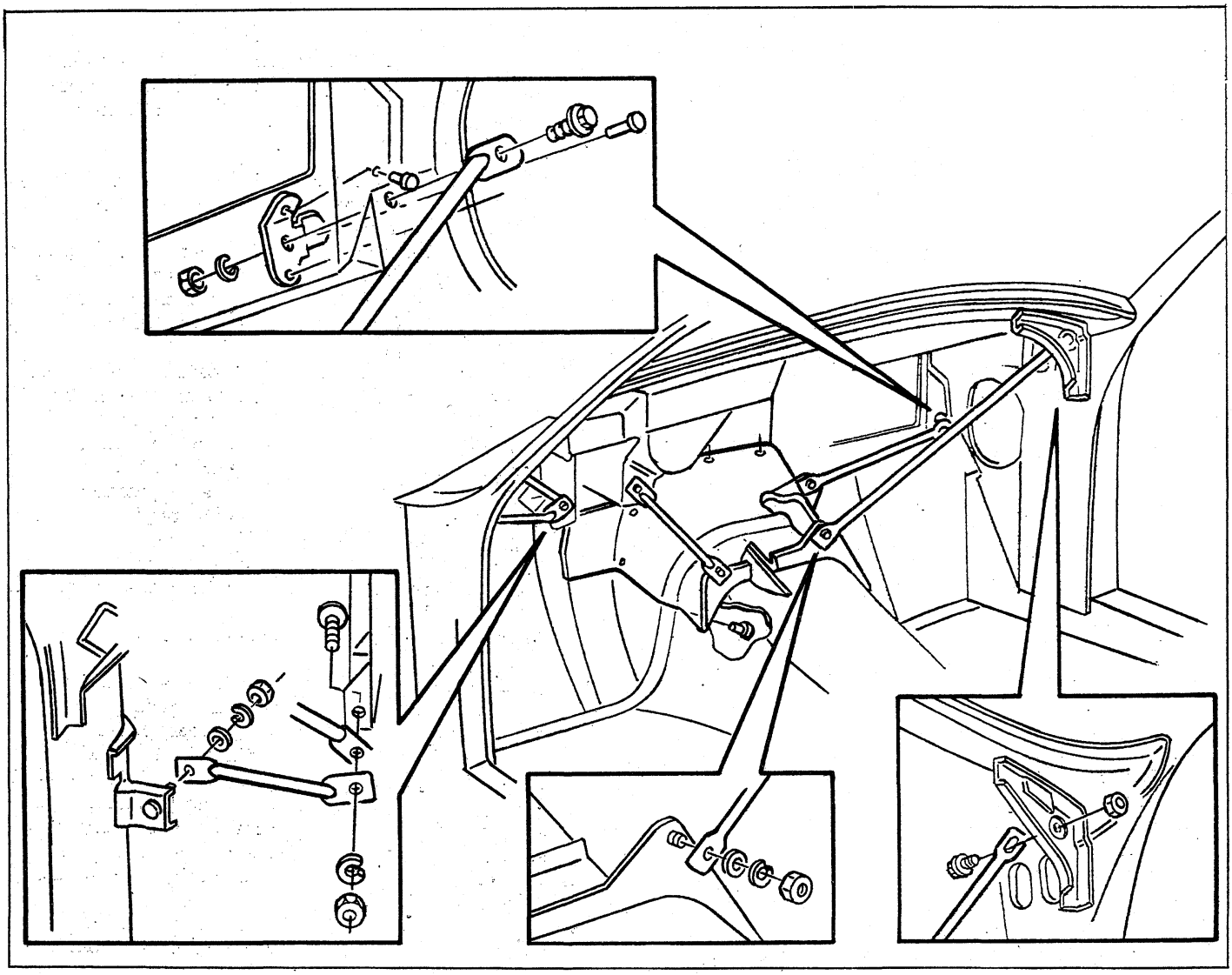


Fig. 8—Under Dash Braces

water spray. If any water leaks are encountered, use flat bladed screw driver or stick, and paddle caulking material into leak point to correct leak. Correction of leak is usually more effectively performed by paddling material from inside the body.

CAUTION: DO NOT RUN A HEAVY STREAM OF WATER DIRECTLY ON CAULKING MATERIAL WHILE THE MATERIAL IS STILL SOFT.

26. Install previously removed hardware and trim in the following order: upper reveal molding, side reveal molding, side retainer molding, lower corner reveal molding, and windshield pillar weatherstrip.

COWL VENTILATOR ASSEMBLY

The following procedure includes either the left or right-hand side. Refer to Figure 15.

Adjustment

Turn plastic adjustment link, located at middle of control cable underneath dash panel, in order to attain desired adjustment. Ventilator valve should be completely closed when knob is at forward position.

Removal

1. Remove cowl kick panel.
2. Disengage control cable fastened to bracket by screw.
3. Remove knob assembly retaining screw.
4. With console trim plate lifted out, remove nut retaining guide.
5. Remove screw retaining cable at inside front of console assembly.
6. Disassemble control mechanism.
7. Remove cable assembly by disconnecting at adjusting link and pulling through.

Installation

Install vent assembly following removal procedure in

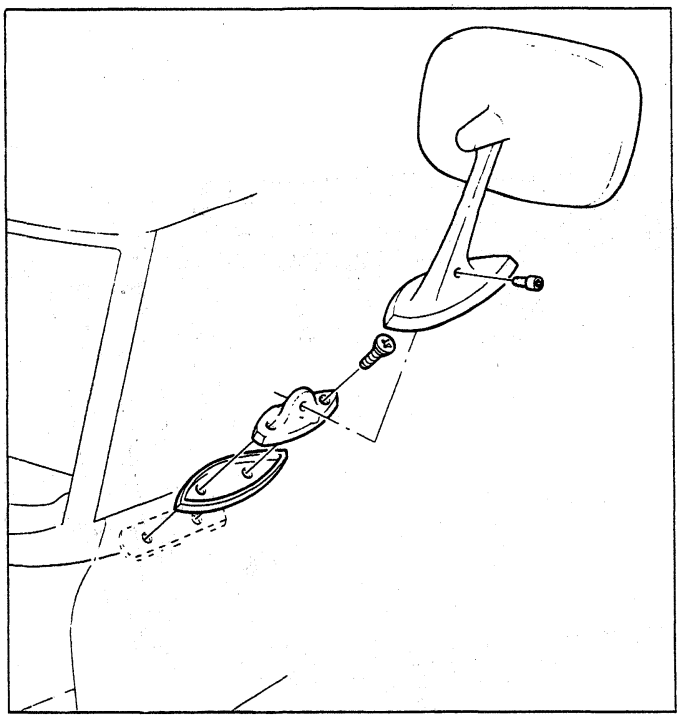


Fig. 9—Outside Rearview Mirror

reverse order. Check operation and adjust accordingly.

DOORS

ADJUSTMENTS

Door Lock Striker

The door lock striker consists of a single metal bolt and washer assembly that is threaded into a tapped, floating cage plate located in the body lock pillar. With this design, the door is secured in the closed position when the door lock fork-bolt snaps over and engages the striker bolt.

1. To adjust striker up or down, or in or out, loosen striker bolt and shift striker as required, and then tighten striker.
2. To determine if striker fore or aft adjustment is required, proceed as follows:
   a. Make certain door is properly aligned.
   b. Apply modeling clay or body caulking compound to lock bolt opening as shown in Figure 16.
   c. Close door only as far as necessary for striker bolt to form an impression as shown in Figure 16.

CAUTION: DO NOT CLOSE DOOR COMPLETELY. COMPLETE DOOR CLOSING WILL MAKE CLAY REMOVAL VERY DIFFICULT.

   d. Measure striker impression as follows: Striker head should be centered fore and aft as shown; however, some tolerances are allowed. In this alignment, it is important that minimum dimensions as outlined in Figure 16 be strictly maintained. The following spacers are available as service parts and can be used individually or in combination to achieve the specified alignment:
   5/64" Spacer
   5/32" Spacer
   1/4" Spacer
   5/16" Spacer

If check indicates need for emergency spacers, proceed as follows:

1. Mark position of striker on body lock pillar using a pencil.
2. Insert a 5/16" wrench into hex-head fitting in head of striker bolt and remove striker.
3. To install, reverse removal procedure. Make certain striker is positioned within pencil mark.

IMPORTANT: Whenever a door has been removed and reinstalled or realigned, the door should not be closed completely until a visual check is made to determine if lock fork-bolt is correctly engaging with striker.

DOOR WINDOW ADJUSTMENT (Figure 17)

In order to perform any of the adjustments listed below, the door trim panel must be removed.

Window Tilted

1. Loosen two bolts (A) and adjust by rotating glass until a constant distance is gained between front edge of glass and the windshield pillar. Retighten bolts A.

Window Rolls Up Too Far

2. Loosen front and rear stop screws (B). Roll glass up until it properly seats in roof weather strip. Move front and rear stops until they contact window rollers. Retighten screws (B).

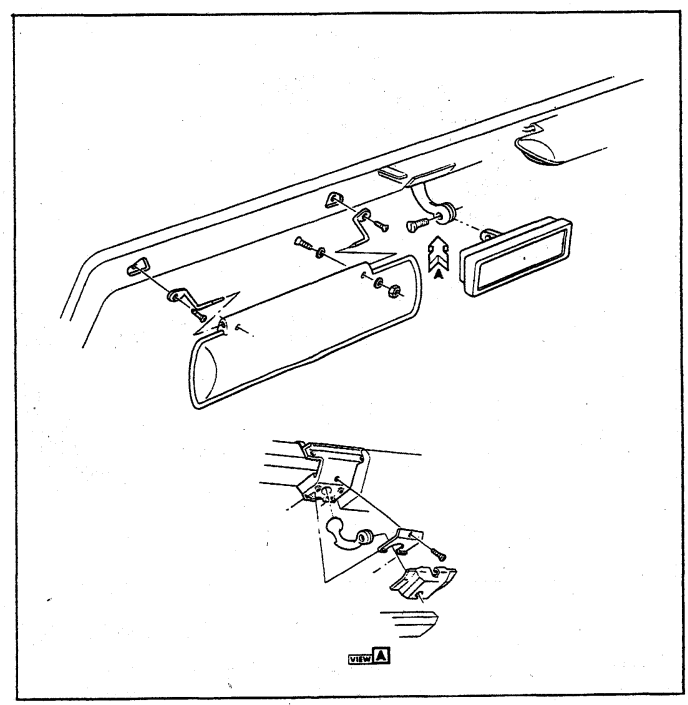


Fig. 10—Sun Visor and Inside Rearview Mirror

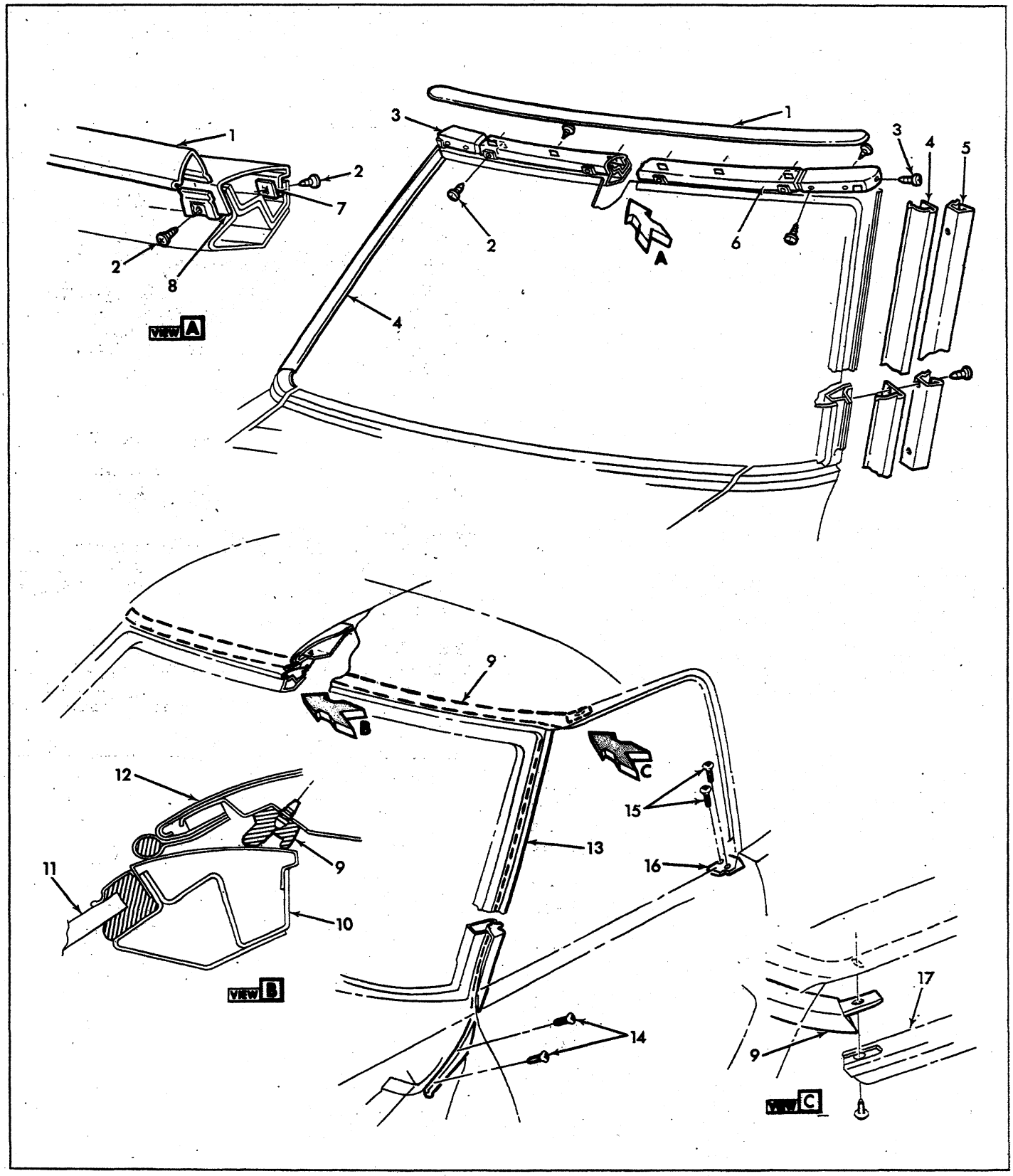


Fig. 11—Windshield Moldings and Weatherstrips

1. Header Molding
2. Screw
3. Header Corner
4. Reveal Molding
5. Retainer Molding
6. Upper Retainer Molding
7. Nut
8. Clip
9. Front Weatherstrip
10. Windshield Header Assembly
11. Windshield Glass
12. Folding Top Assembly
13. Windshield Pillar Weatherstrip
14. Screw
15. Screw
16. Weatherstrip
17. Front Rail Weatherstrip

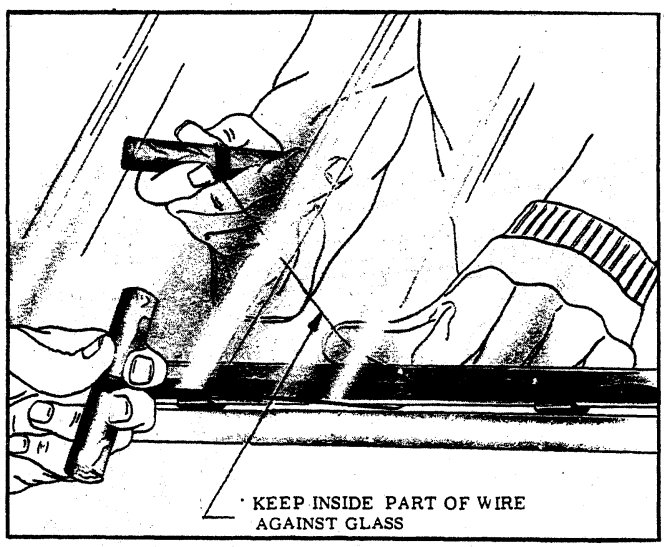


Fig. 12—Removing Old Glass From Opening

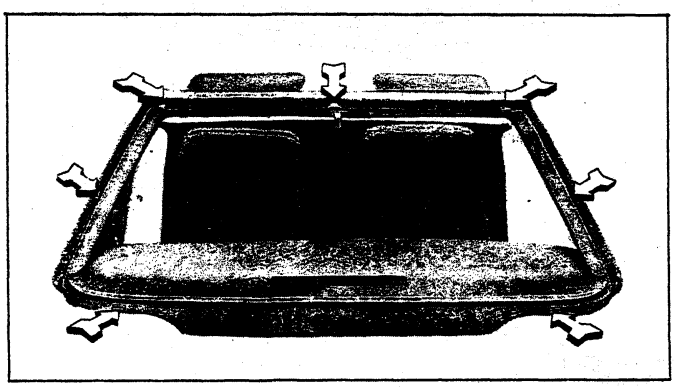


Fig. 13—Windshield Rubber Spacers

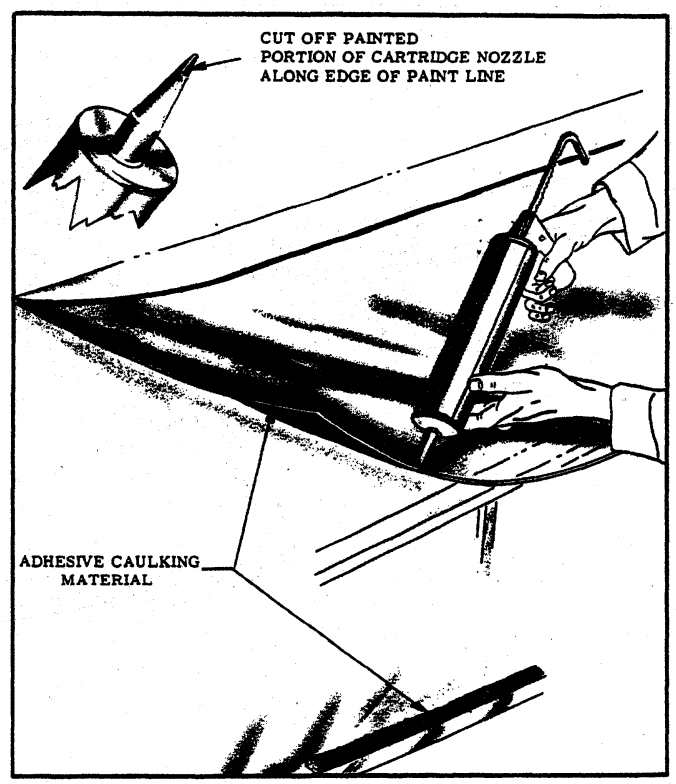


Fig. 14—Applying Caulking Material to Glass

Gap Between Window Forward Edge and Windshield Pillar Too Large or Small

3. Loosen three bolts (C) and nut (F). Move glass towards windshield pillar weather strip until it properly seats in the stripping. Retighten bolts (C) and nut (F).

Glass Too Far Outboard or Inboard

4. Loosen bolts (D & E) and nuts (F). Back off adjusting screws (G). Move top edge of glass inboard

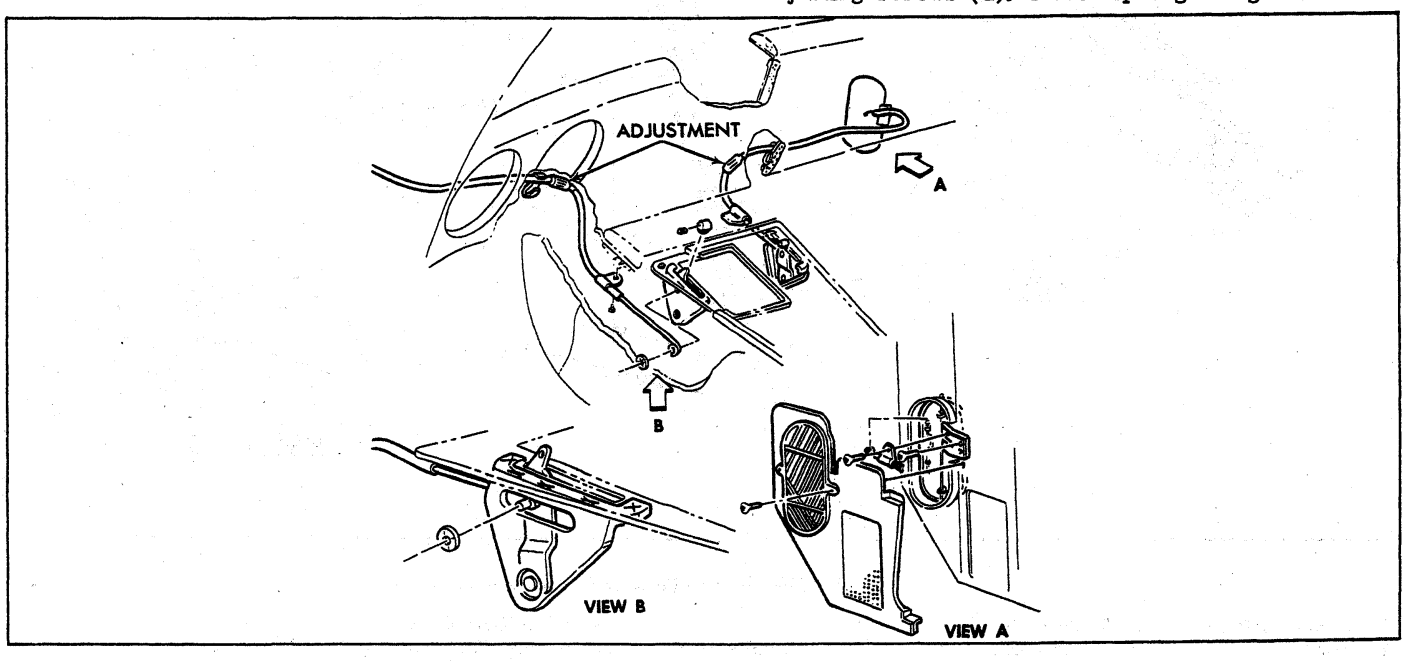


Fig. 15—Cowl Ventilator and Controls

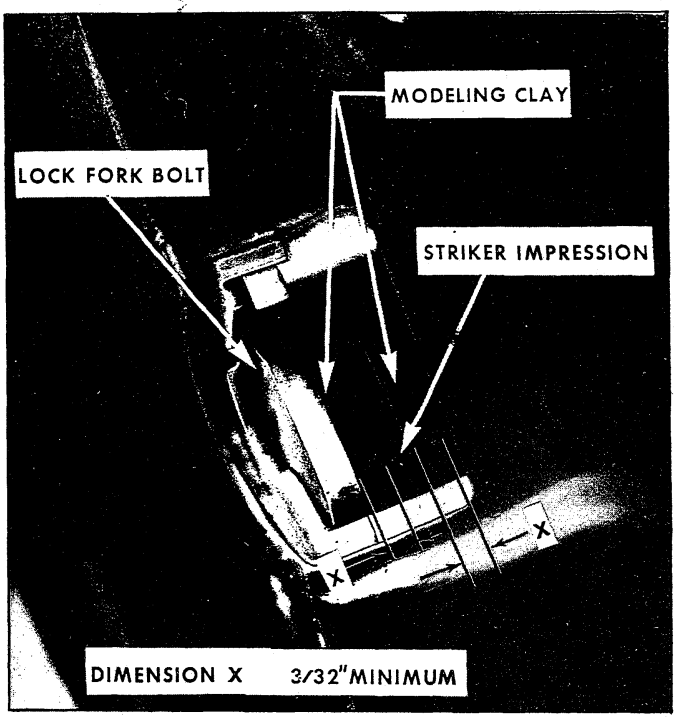


Fig. 16—Checking Adjustment of Striker

until it is properly seated against roof rail weatherstrip. Tighten bolts (D). Move felt weatherstrip against window. Tighten bolts (E). Turn adjusting screws (G) so that the inner nylon pads are in light contact with wedges. Tighten nuts (F).

Window Rolls Down Too Far

5. Loosen screw (H) and roll glass down until top edge is flush with outer panel. Move stop to contact window roller. Retighten screw (H).

If a complete door window adjustment is needed, fully adjust window by following all the steps given above in the order given.

Door Hinges

(Refer to Figure 18)

The position of the door assembly in the body opening is determined by the striker position previously described, and the position of the door on the hinge rear straps. The position of the door is adjusted by sliding the door fore and aft to the limit of the slotted holes in hinge pillar; in and out adjustment is done by installation and removal of shims located between hinge pillar and front straps of hinges; up and down position is determined by adjustment of rear hinge straps in slots of inner door panel. To adjust door, proceed as follows:

1. Remove door trim panel as outlined in this section.
2. Remove lock striker bolt after first scribing line on lock pillar surface following circular flange. This enables proper installation position.
3. For up-and-down adjustment, remove hinge cover (2 screws) for access to upper hinge retaining screws.

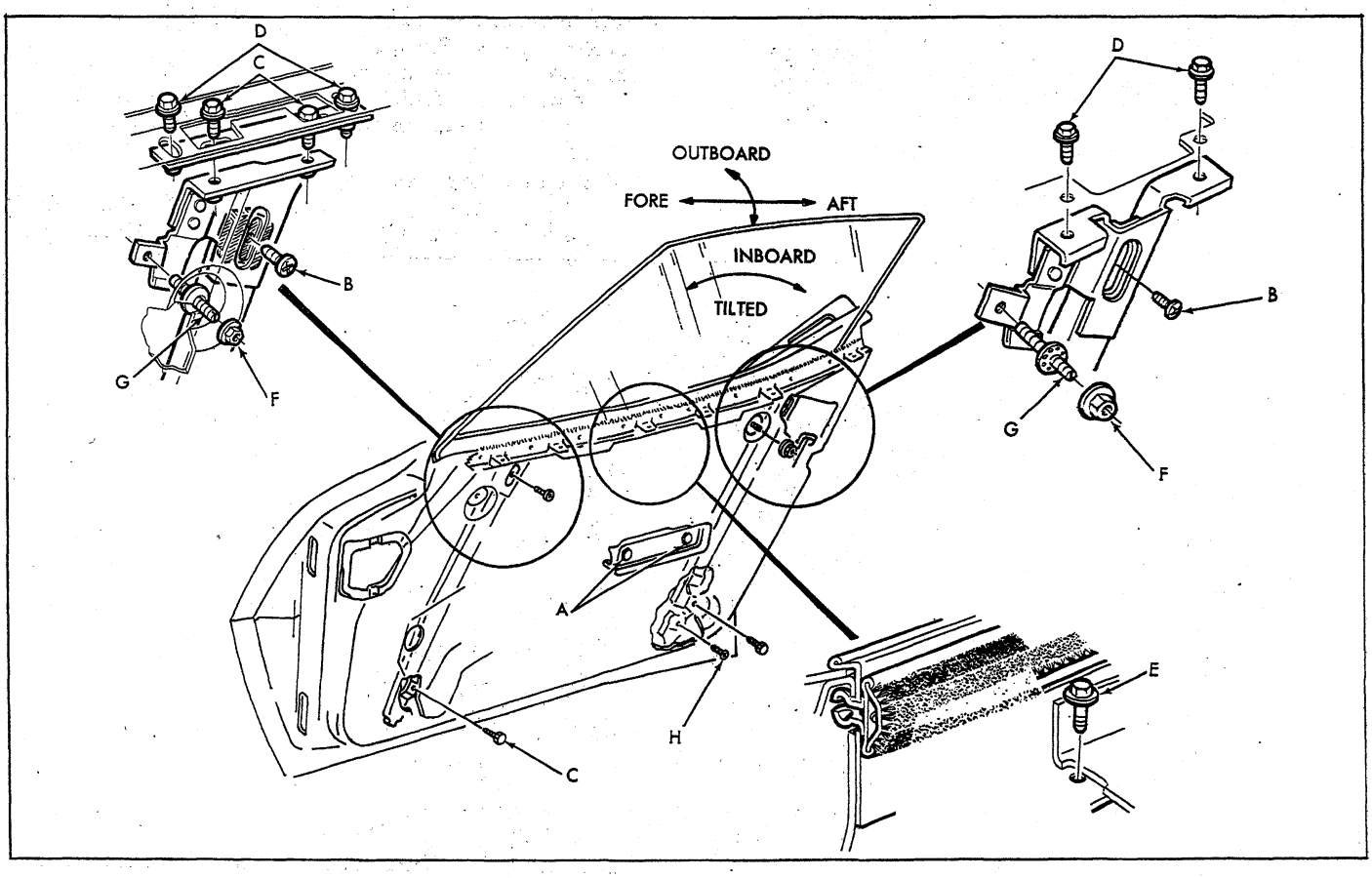


Fig. 17—Door Glass Adjustments

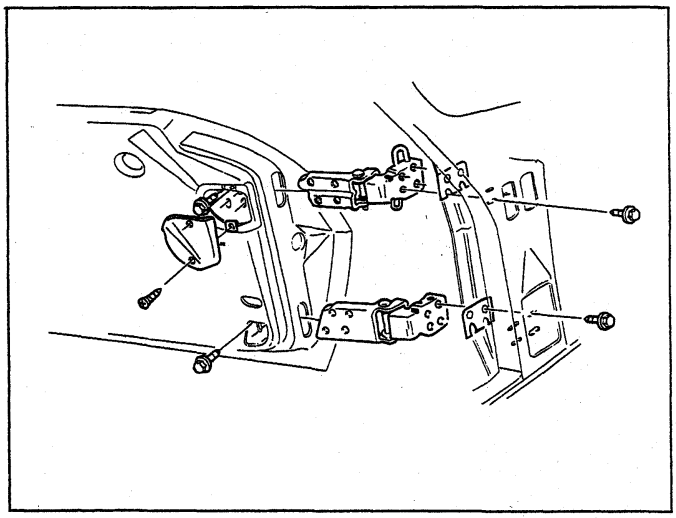


Fig. 18—Side Door Hinges

4. For in-and-out, and fore-and-aft adjustment, it is necessary to first remove instrument panel (left door only), right dash pad (right door), cowl kick panel, air inlet duct, and radio speaker, in order to gain access to hinge retaining screws.
5. Adjust door as required. (Do not allow doors to hang on one hinge without support.)
6. Install previously removed striker assembly, trim pads and panels and lubricate door hinges with lubriplate or equivalent.

NOTE: After performing any door adjustment, the window and lock pillar should be checked for alignment and adjusted as necessary. Do not slam door after adjustment without first checking the door lock and striker engagement. An adjustment may be necessary.

TRIM PANEL AND INSIDE HANDLES

(Refer to Figure 19)

1. Using Tool J-7797, remove clips retaining window crank and lock control as shown in Figure 20.

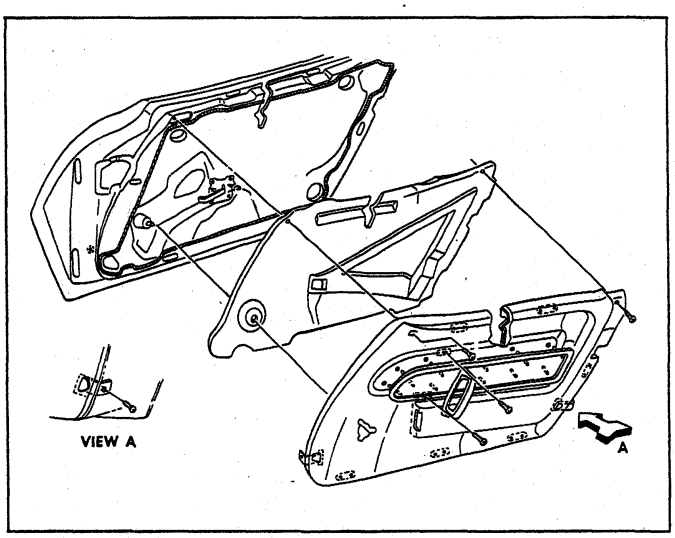


Fig. 19—Door Trim Panel Assembly

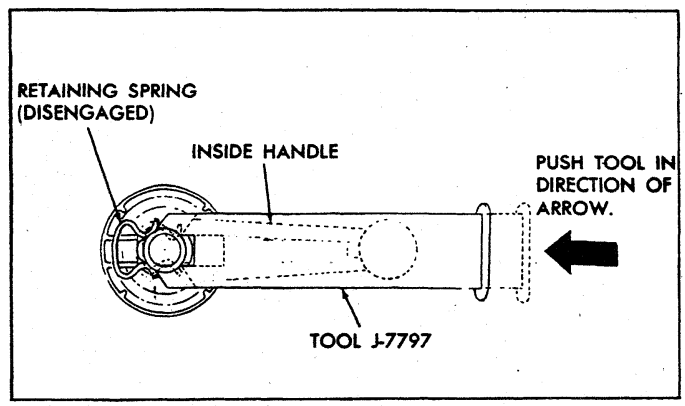


Fig. 20—Removing Window Crank With J-7797

2. Remove four (4) screws securing trim panel located at inside corners of inner door panels.
3. Remove trim panel by carefully prying out at plastic fastener clips located around perimeter of panel.
4. Remove door lock handle by removing one (1) screw and sliding handle forward (fig. 21).
5. Remove formed plastic cover by peeling along edge at adhesive bead.
6. For installation follow above steps in reverse order making sure trim panel is properly aligned.

DOOR LOCK AND REMOTE CONTROLS

For parts identification, refer to Figure 21.

Removal

1. Raise window fully up.
2. Remove door trim panel as outlined in this section.
3. Disengage upper control rod assembly by removing, first, plastic guide clip, releasing carburetor type clips at both ends, and removing rod through access hole.
4. Disengage lock control rods by releasing clips at both ends and lifting outward.
5. Remove remote control assembly by removing four (4) screws to inner door panel.
6. Remove "crank link" (intermediate pivot) by removing two (2) screws to inner panel.
7. Remove door lock by removing three (3) screws and lifting assembly out through access hole.

Installation

For installation, follow preceding steps in reverse order. After assembly of lock mechanism, adjust linkage for proper operation, by removing clip and turning threaded rods. All components should be lubricated before installation.

WEATHERSTRIP

Figure 22 illustrates weatherstrip mounting location on door. When installing new weatherstrip, all dirt, loose paint and old cement must be removed to ensure a good bond. Use only high quality cement designated by the manufacturer as being suitable for weatherstrip application.

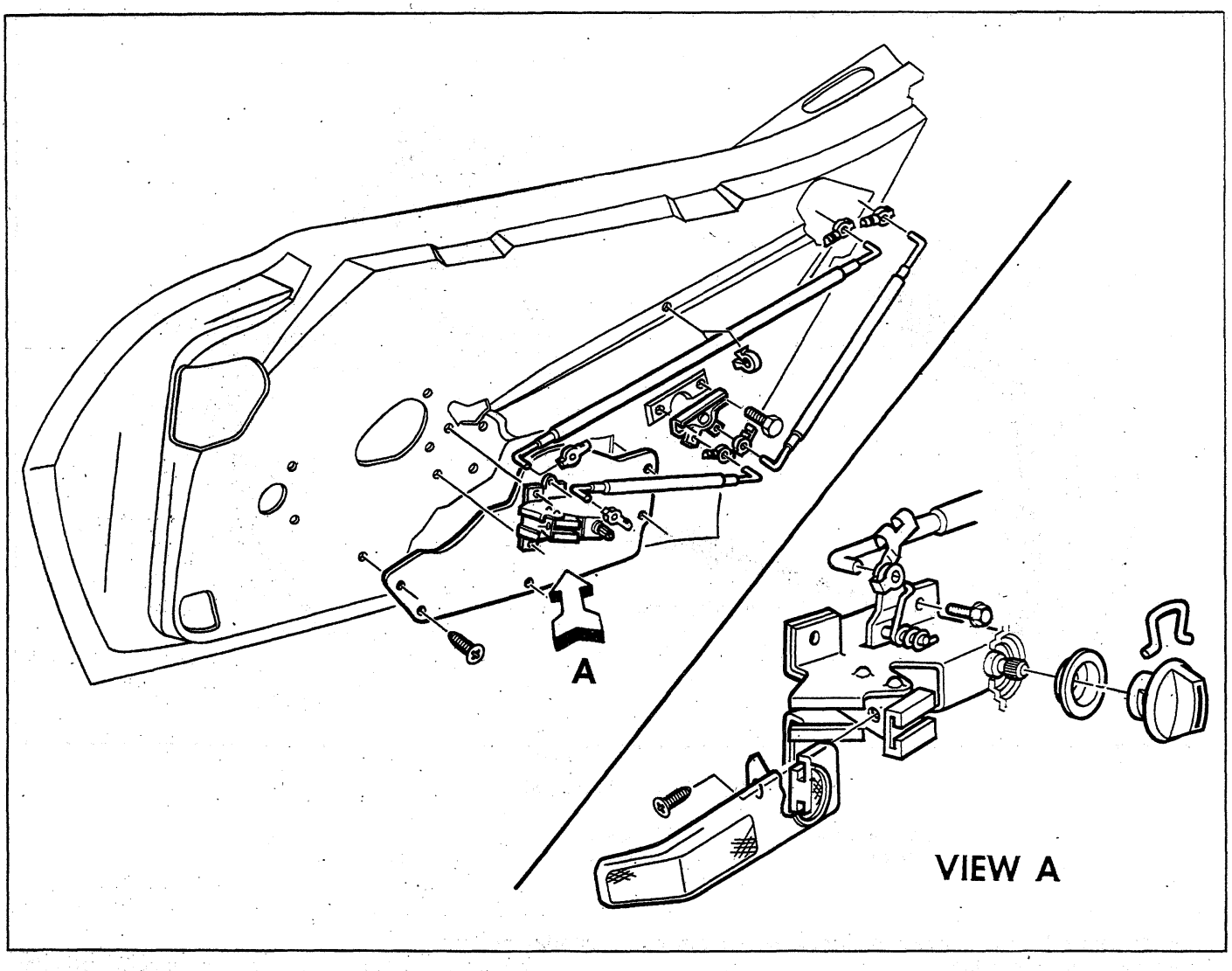


Fig. 21—Door Lock and Remote Control

WINDOW OUTER SEAL ASSEMBLY (Fig. 23)

1. Lower window all the way down.
2. Remove trim panel.
3. Remove two (2) screws one located at each end of seal (fig. 23).
4. Carefully pry out at six (6) retaining clips.
5. Lift seal assembly outward and upward.
6. For installation, secure clips and install the two screws.

WINDOW ANTI-RATTLE (Fig. 23)

1. Lower window
2. Remove trim panel
3. Remove hex head screw
4. Fish anti rattle through access
5. Install anti-rattle through access. Adjust, install trim.

WINDOW GLASS

Removal

1. Remove door trim panel as outlined in this section.
2. Remove window outer seal assembly as outlined in this section.
3. Position window all the way up to line up two (2) sash screws through access holes.
4. Remove two (2) sash screws on horizontal guide channel while holding nut with other hand (fig. 24).
5. Disengage stop by removing one (1) Phillips head screw at top of channel assembly.
6. Adjust front and rear channel assemblies to extreme outboard position to allow ample clearance for window removal.
7. Carefully pull window upward making certain to clear roller assemblies through opening in inner door panel.

Installation

If replacement glass is necessary, disassemble two (2) pads and fasteners, and frame assembly by removing three (3) mounting bolts through glass (fig. 25). Mount frame assembly and pads onto new glass before installation into door.

The following steps are necessary for installation:

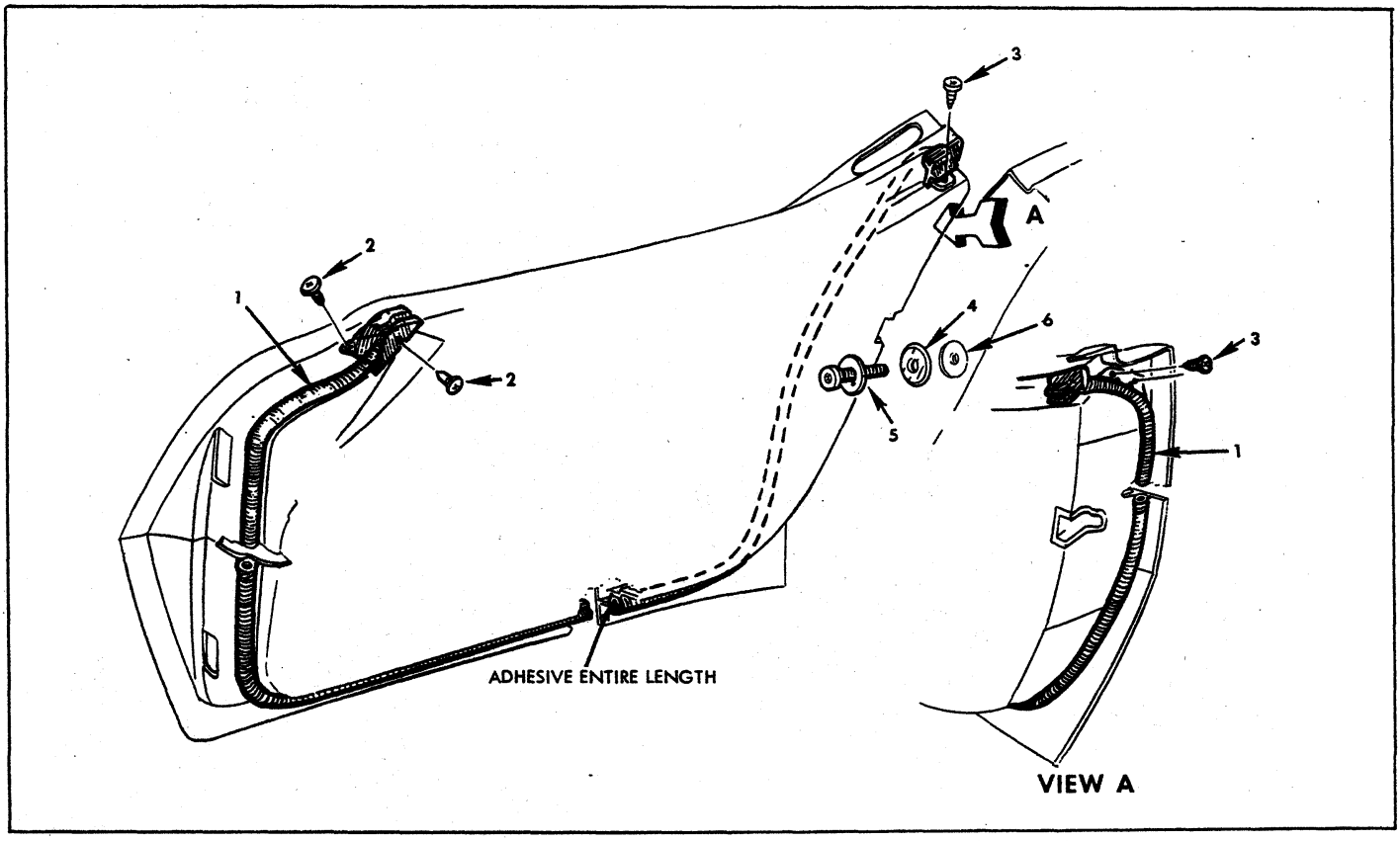


Fig. 22—Door Weatherstrip

1. Weatherstrip
2. Screw
3. Screw
4. Spacer
5. Striker
6. Lock Pillar

1. Insert glass in door pocket with convex curvature towards outside of vehicle.
2. Install and tighten (2) sash bolt and nut assemblies through horizontal guide channel and glass frame.
3. Adjust front and rear channels to proper in and out position.
4. Install inner window seal, and door trim panel.

GLASS RUN CHANNELS

Removal

For parts identification, refer to Figure 26. Removal of either front or rear channel involves the following steps.

1. Remove door trim assembly as outlined in this section.
2. Remove window glass assembly as outlined in this section.
3. Remove retaining screw at lower end of channel and two (2) screws retaining channel to top surface of door inner panel.
4. Remove two (2) screws retaining stationary horizontal guide channel.
5. Remove nut from adjusting stud.
6. Adjust stud to extreme clockwise position to allow proper removal clearance.
7. Carefully lift channel through upper slot as shown in Figure 27 making certain to clear opening.

Installation

1. Position run channel in door and install retaining bolts loosely.
2. Install window glass as outlined in this section.
3. Make necessary adjustments to channel as outlined under Doors - Adjustments - Door Windows. Replace door trim panel.

WINDOW REGULATOR—MANUAL

For parts identifications refer to Figure 28.

Removal

1. Remove trim panel as outlined in this section.
2. Position window all the way up.
3. Remove two (2) sash bolt and nut assemblies retaining window glass.
4. Remove two (2) screws securing stationary horizontal channel.
5. Remove window crank housing by removing three (3) screws.
6. Remove crank shaft, pin and washer spring.
7. Remove two (2) screws located adjacent to spring opening retaining regulator.
8. Remove lower bolt securing front glass channel.
9. Remove nut securing adjusting stud, and adjust front channel outward to provide adequate clearance for window regulator removal.
10. Collapse regulator linkage to elongated position.

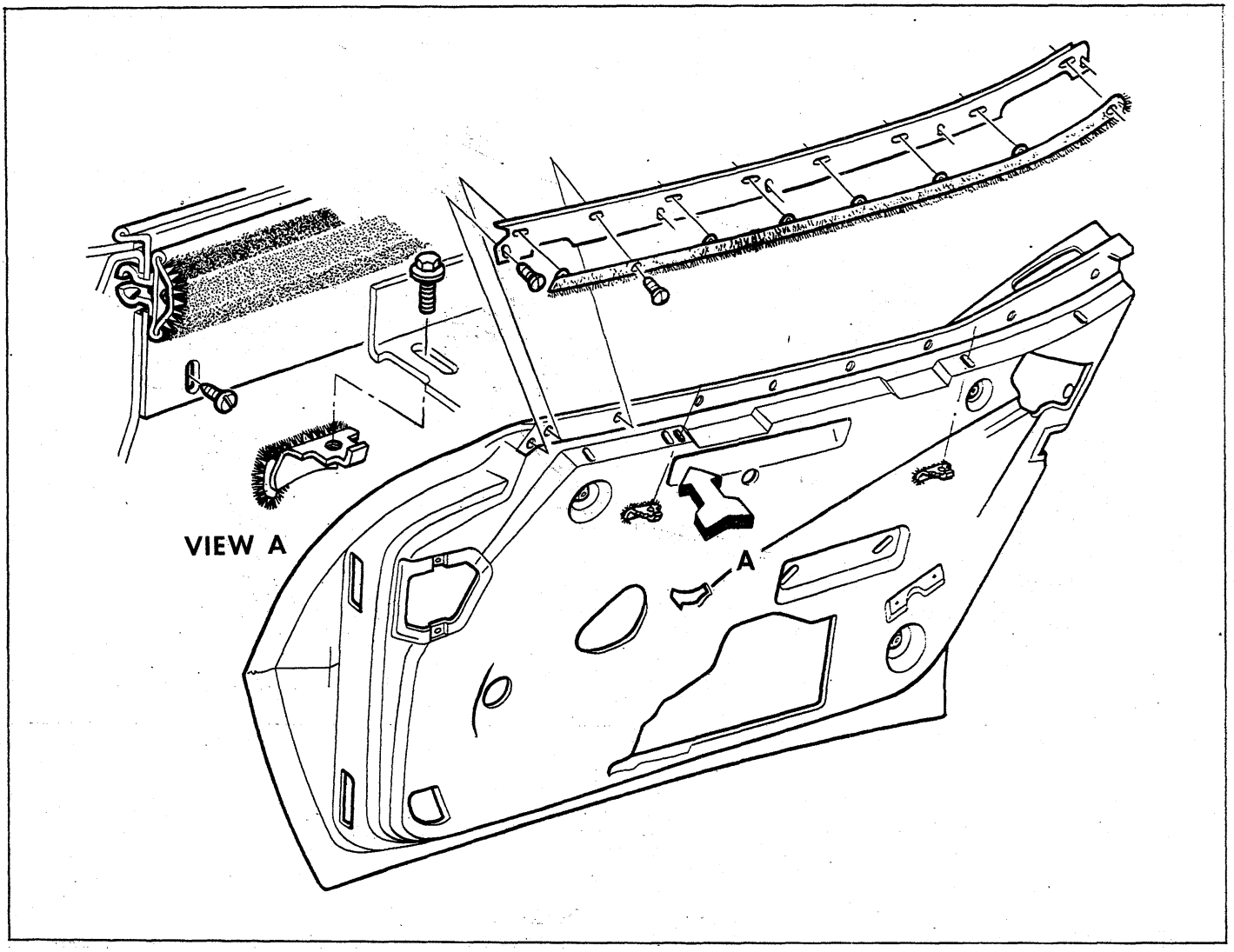


Fig. 23—Window Glass Seals and Molding

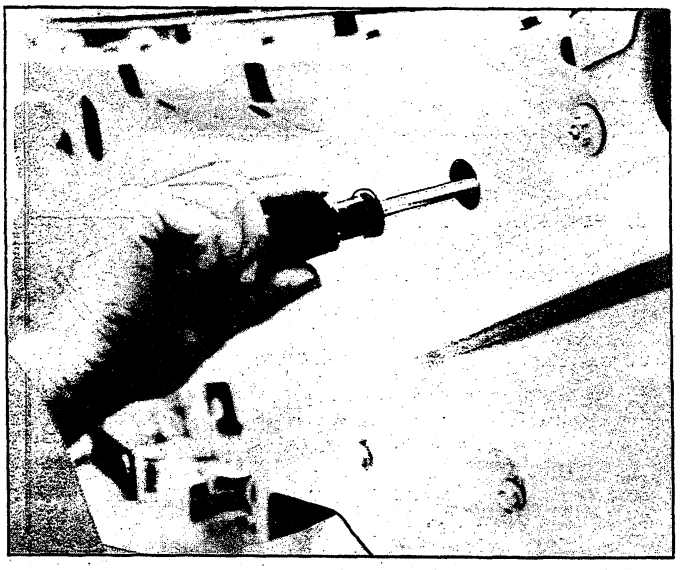


Fig. 24—Removing Sash Screws

11. While depressing front channel outward, slide regulator assembly forward and rearward to remove through access hole as shown in Figure 29.

Installation

Regulator may be installed by following removal procedure in reverse order. Always lubricate all guide rails and rollers when regulator is disassembled. Test regulator thoroughly before installing door trim panel. Adjust window as outlined in this section.

WINDOW REGULATOR—POWER

In the case that window will not operate, check electrical connections first. Figure 30 illustrates location of junctions, switches, and circuit breaker.

Removal

Perform Steps 1 through 12 following Window Regulator—Manual Removal. Note that electrical connectors must be removed from motor before performing any operation on regulator. Figure 30 illustrates location of regulator on door and wiring.

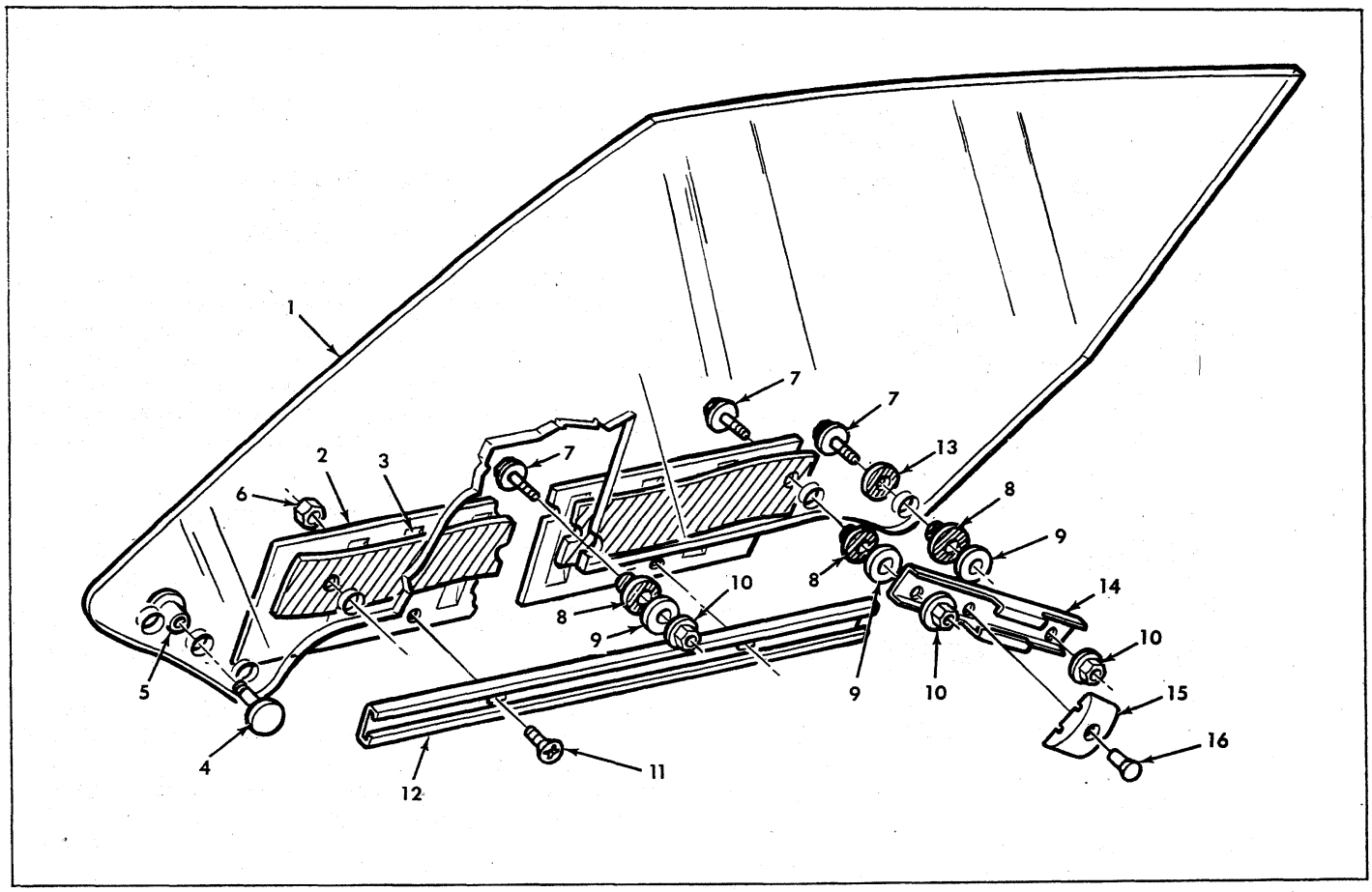


Fig. 25—Glass and Frame Assembly

1. Glass	5. Pad	9. Washer	13. Washer
2. Frame	6. Nut	10. Nut	14. Cam Idler
3. Filler	7. Bolt	11. Screw	15. Pad
4. Fastener	8. Bushing	12. Channel	16. Rivet

Disassembly

NOTE: Do not attempt to remove motor from regulator until the following operations are performed. Arm is spring-loaded and should be locked in position when motor is removed. Refer to Figure 31.

1. Place regulator assembly in vise.
2. Using jumper leads to 12 volt DC source, operate motor until semi-circular hole in sector gear centers over one of two weld nuts on mounting plate.
3. Screw a 1/4" - 20 x 1" bolt into weld nut so that end passes through hole in sector gear. It may be necessary to enlarge hole in gear slightly with file or drill. Install nut on bolt to lock arm position.

Installation

Be sure lock bolt is removed if regulator has been disassembled.

1. Install lubricated regulator assembly and guide rails in reverse order of removal.
2. Install window as outlined in this section.
3. Making sure connectors are securely installed on motor, test operation of window thoroughly.
4. Install door trim panel and control handles as outlined in this section.

OUTER HANDLE AND LOCK CYLINDER (Fig. 32)

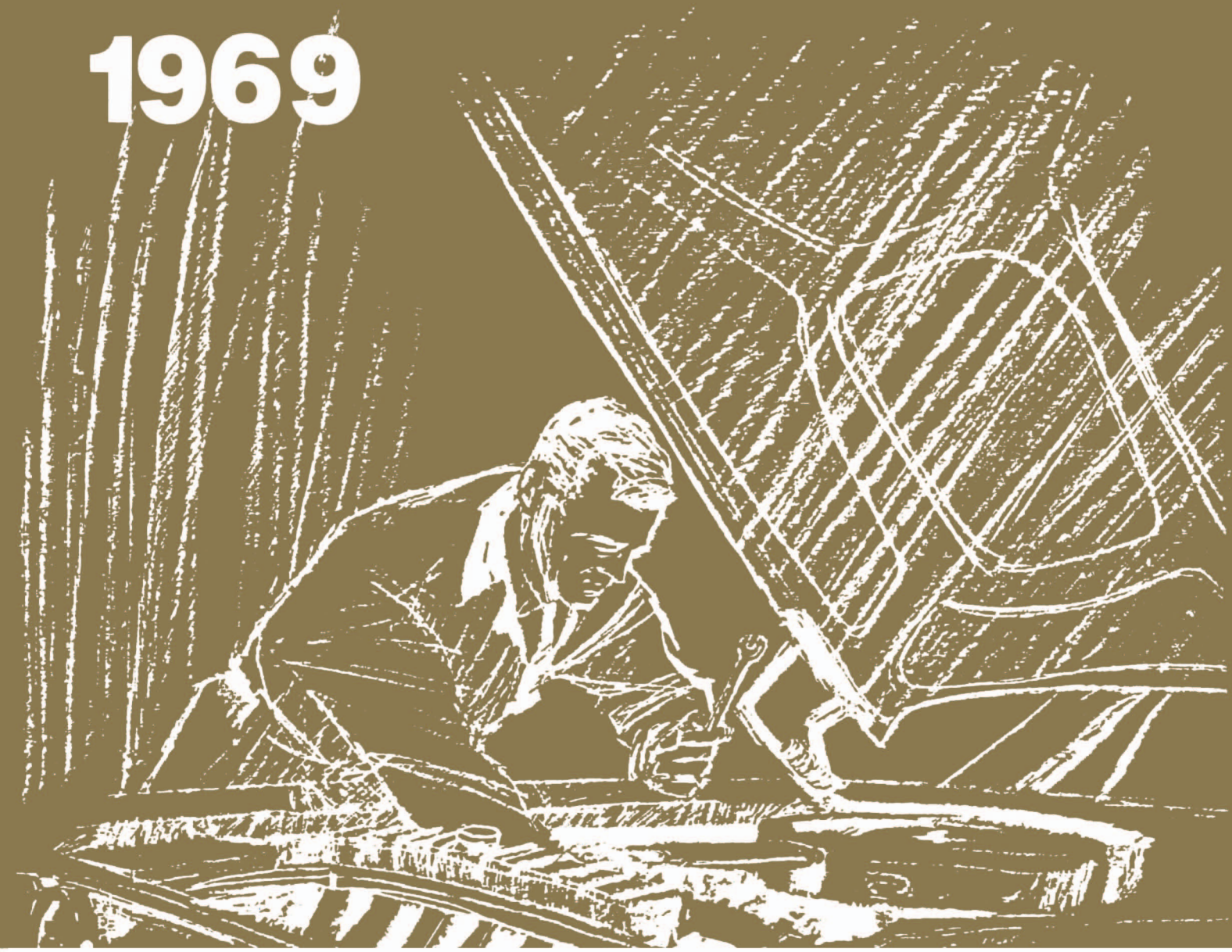
Removal

1. Remove trim pad.
2. Remove lock water shield.
3. Remove handle assembly by first removing (3) three screws retaining lock.
4. Remove (2) nuts attached to handle assembly studs and raise handle assembly after prying pivot link clip loose.
5. Remove lock cylinder by repeating step (2) above then removing 2 clips on rear of cylinder.

Installation

1. If required, install new lock cylinder seal with assembly replacement.
2. Position handle assembly and tighten retaining nuts.
3. Slide lock back into place and secure with (3) three screws.
4. Carefully check operation of door lock, handle and cylinder.
5. Install lock water shield, using foam pressure tape as seal.
6. Install door trim panel as outlined in this section.

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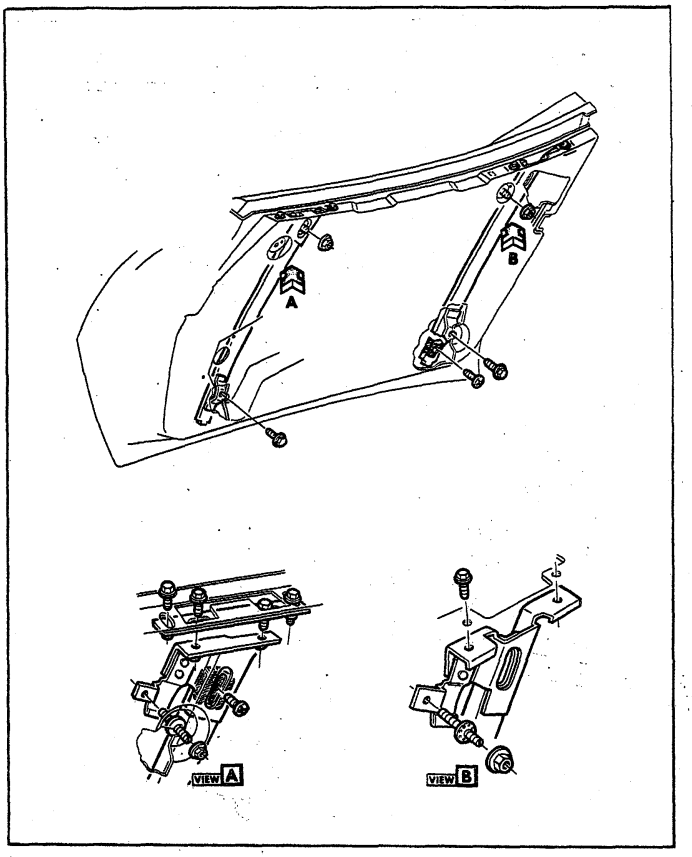


Fig. 26—Window Run Adjustment Points

HINGES—DOOR ASSEMBLY

(Refer to Figure 33)

Removal

1. Remove door trim panel as outlined in this section.
2. Remove hinge access cover from door inner panel.
3. For lower hinge removal, remove door sill plate, cowl kick panel, and radio speaker.
4. For access to upper hinge attaching screws, remove lower mast jacket cover and instrument panel pad (left side), or dash panel pad (right side), and air inlet ducts.
5. If entire door is to be removed and door has electric power window, disconnect and remove wiring between hinge pillar and door.
6. If hinge is to be replaced in same position, scribe around inner strap on door panel and record number of shims found between hinge strap and door panel.
7. Remove bolts retaining hinge to door. DO NOT ALLOW DOOR TO HANG UNSUPPORTED ON ONE HINGE.
8. Remove bolts retaining hinge to body.

Installation

1. If door assembly has been removed from car, scribe around lock striker as explained under Adjustments—Door Lock Striker, and remove striker from lock pillar.
2. Install hinges, replacing same number of shims removed, and aligning door hinge straps with marks scribed at disassembly.
3. As necessary, perform door adjustments as outlined in this section.
4. If door is equipped with power window, reinstall wiring.
5. Replace all trim and panels removed during disassembly.

REAR QUARTER

DOOR SILL PLATE AND MOLDING

Figure 34 illustrates assembly details of both the door sill plate and molding. The sill plate, which retains the carpet, the cowl trim kick panel, and lock pillar front edge trim, is mounted to the body by four (4) screws.

The upper molding is replaced by removing seven (7) screws; the lower molding is replaced by first removing the upper molding and then removing five (5) screws and four (4) nuts at face of molding.

UNDERBODY STORAGE COMPARTMENT

Located directly behind the front seats, the underbody storage compartment assembly is divided into three separate storage areas.

Refer to Figure 35.

1. Remove right hand box by opening lid, and lifting box upward.
2. Unfasten storage assembly by removing eight (8) screws along inner flange of frame and lower strap of door hinges.
3. Remove assembly from underbody by lifting upward.
4. Doors are removed from assembly by removing three (3) screws (outer doors) and two (2) screws (center door) at upper hinge strap.
5. Center storage compartment box is removed by removing seven (7) screws located around inside top edge of box.
6. For installation, follow above steps in reverse order.

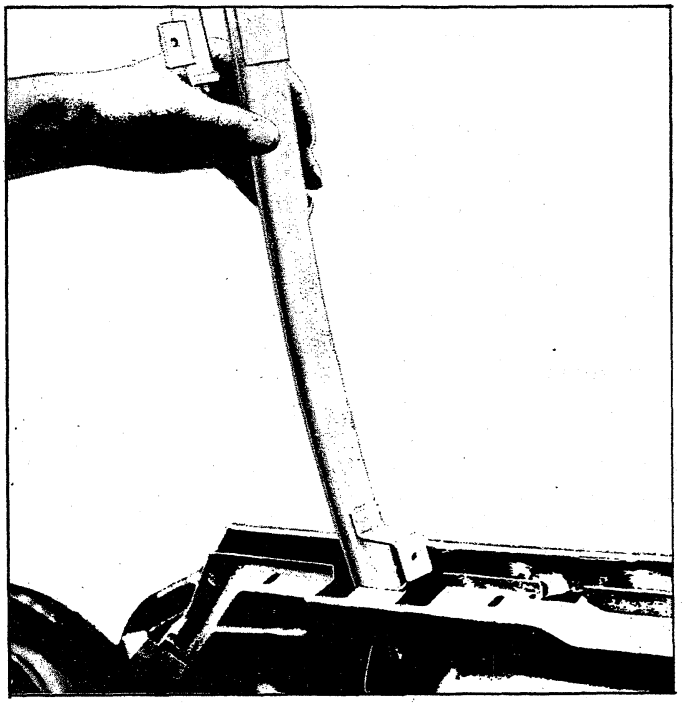


Fig. 27—Removing Front Glass Channel

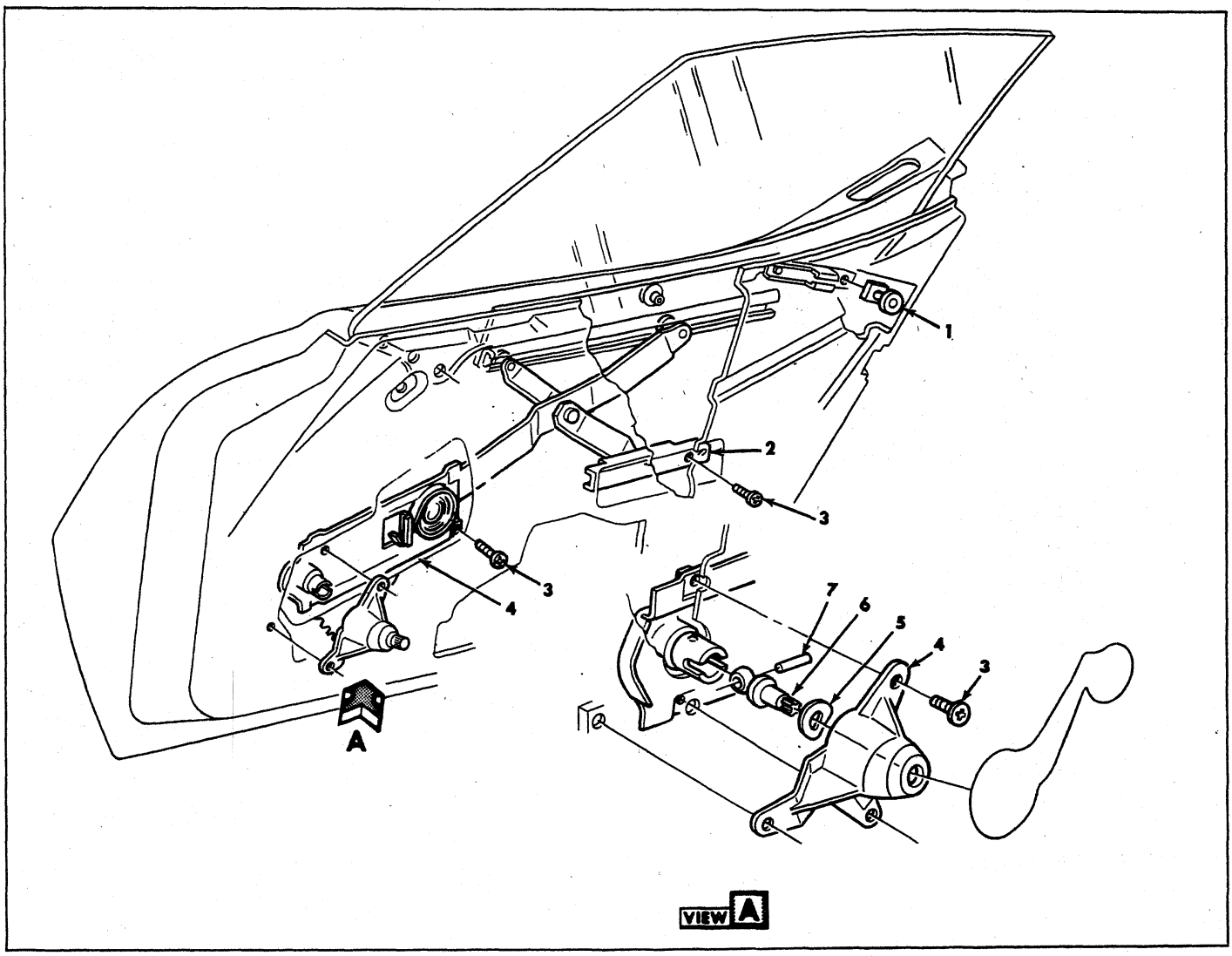


Fig. 28—Manual Window Regulator

1. Roller and Slide Assembly
2. Channel Assembly
3. Screw
4. Housing
5. Washer-Spring
6. Shaft
7. Pin

REAR END

FOLDING TOP COMPARTMENT LID

(Refer to Figure 36 for parts identification.)

Adjustment

Hinges

The folding top compartment lid should be adjusted so that, in the closed position, the surface of the lid is flush with surrounding body surfaces, and space between lid edge and body is 1/16" to 3/16" at sides and 3/16" to 1/4" at rear. Whenever lid position is changed on hinges, lock engagement must be inspected and adjusted if necessary. Adjust hinge position as follows:

1. Scribe a line on lid surface following contour of hinge strap. This line will assist in observation of lid movement during adjustment (fig. 37).
2. To raise or lower top surface of lid, add or remove hinge shims as required.

Lock

Lock engagement is adjusted as follows:

1. Lock striker is adjusted in and out to the extent of slotted mounting holes.
2. Release of lock is adjusted by loosening lock assembly retaining bolts and moving lock fore and aft to the limit of slotted holes in lock base.
3. After adjustment, lock release should be tested and readjusted as required.

Hinges

Removal

1. Scribe around hinge as shown in Figure 37.
2. Hinge is removed as an assembly by opening top compartment lid fully, and removing three (3) retaining screws. Note number of shims found between hinge frame and compartment floor.
3. Remove spring from hinge assembly by closing top compartment lid as far as possible and inserting

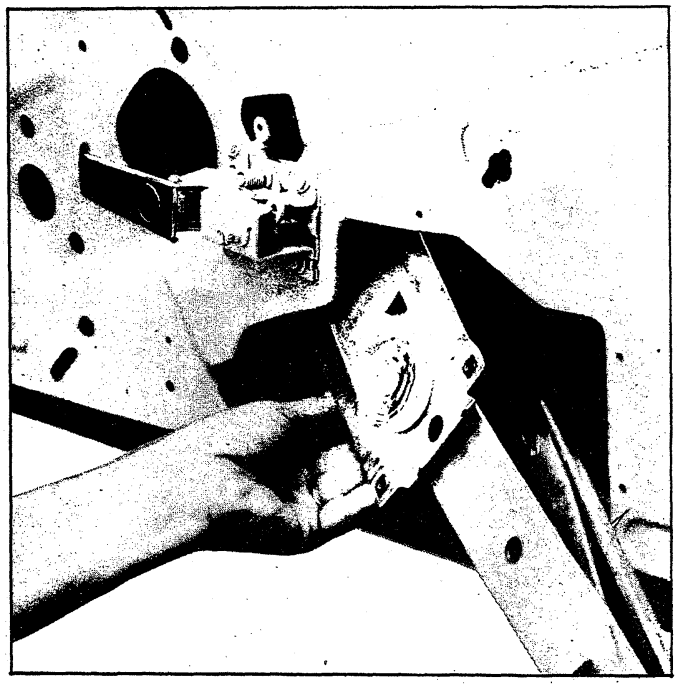


Fig. 29—Removing Window Regulator

Tool J-9559 between expanded coils in spring. Opening top compartment lid fully allows removal of spring as shown in Figure 38.

4. Directly after spring is removed, insert long bolt supplied with J-9559 through holes in end of tool through the spring, and install nut on bolt.

Spring may be removed from J-9559 or J-9559 may be installed in a new spring, by the following method:

1. Place a closed 6 or 8 inch "C" clamp in vise or fasten it to a bench top anchored to floor.
2. Hook one end of spring in clamp and the other end in hook of chain hoist, or "cherry picker", as shown in Figure 39.
3. Elongate the spring enough to allow insertion of J-9559. Install through bolt if spring is not to be installed on hinge immediately.

Installation

1. Install same number of shims as removed or, if repairing collision damage, etc., position hinge in compartment, install upper mounting screws, fill gap between floor and hinge frame with shims and install lower mounting screw.
2. If spring has been removed from hinge, install spring in J-9559 and place spring on hinge with compartment lid raised; closing lid releases J-9559 for removal. Upper end of spring should rest in the one of three notches yielding best lid operation. Approximately three pounds force is necessary to close lid.

Top Lock

1. For locks on either side, remove rod mounting clamps by removing one (1) hex screw.
2. Remove two (2) nut-washer assemblies.
3. After disassembling lock from mounting studs, carefully remove cover and gasket from compartment lid.
4. For installation, follow above steps in reverse order. Test lock and control mechanism for proper operation.

Lock

Removal

1. Remove rod mounting clamps. Remove retainer from control rod assembly and disengage rod from control.
2. Scribe a mark on lid along outer contour of lock assembly.
3. Remove three (3) lock assembly retaining screws and remove lock from compartment lid.

Installation

1. Place lock assembly on compartment lid aligned with scribed line and install retaining screws.
2. Install end of rod in control assembly and fasten retainer securely.
3. Test operation of lock thoroughly, and adjust if necessary as outlined in this section.

Control

Removal

1. Remove inner mounting clamps from both cables, and disengage rods from control by removing retainers.
2. Remove four (4) mounting screws and remove control from compartment lid.

Installation

1. Position control on compartment lid and install mounting screws.
2. Install ends of rods in control and fasten securely with retainers.
3. Engage push rod with retainer.
4. Test operation of locks and adjust if necessary.

GAS TANK DOOR AND REAR TRIM

Figure 40 illustrates installation details of gas tank door, letter trim, and tail pipe bezel.

Gas tank door assembly and bezel are replaced by removing sheet metal screws located around inner surface of bezel.

The holding force of door latch mechanism is adjusted by removing assembly and turning individual lock pins with allen head wrench.

Trim letters are retained by special nuts accessible from underneath vehicle.

REAR FILLER PANEL

1. Remove rear license plate and housing as explained in Section 14.
2. Remove tail pipes from mufflers.
3. Remove eight (8) mounting screws retaining filler panel to body (fig. 40).
4. For installation, follow above steps in reverse order.

SPARE TIRE MOUNT

Refer to Figure 41.

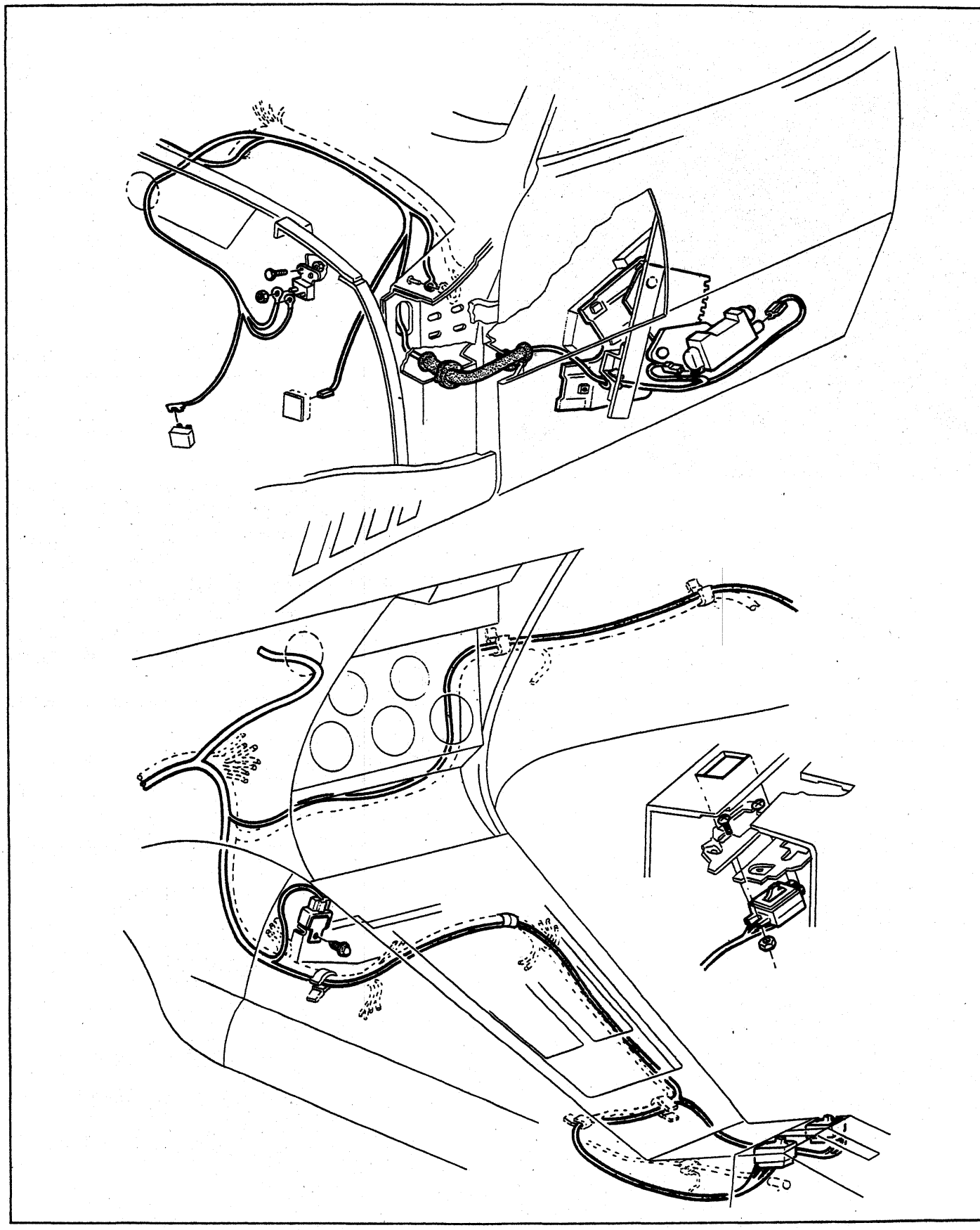


Fig. 30—Power Window Regulator Wiring

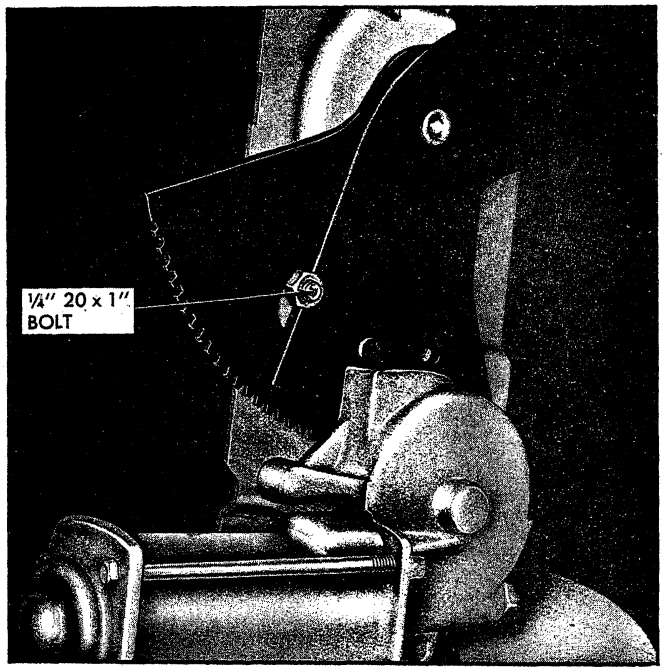


Fig. 31—Locking Arm in Place

Removal

1. Remove spare tire as outlined in Owner's Manual.
2. Loosen pivot bolt lock nuts and turn pivot bolts out of weld nuts in crossmember.
3. Remove two (2) screws retaining swivel bolts assembly to body.
4. Remove four bolts holding cover assembly to body.

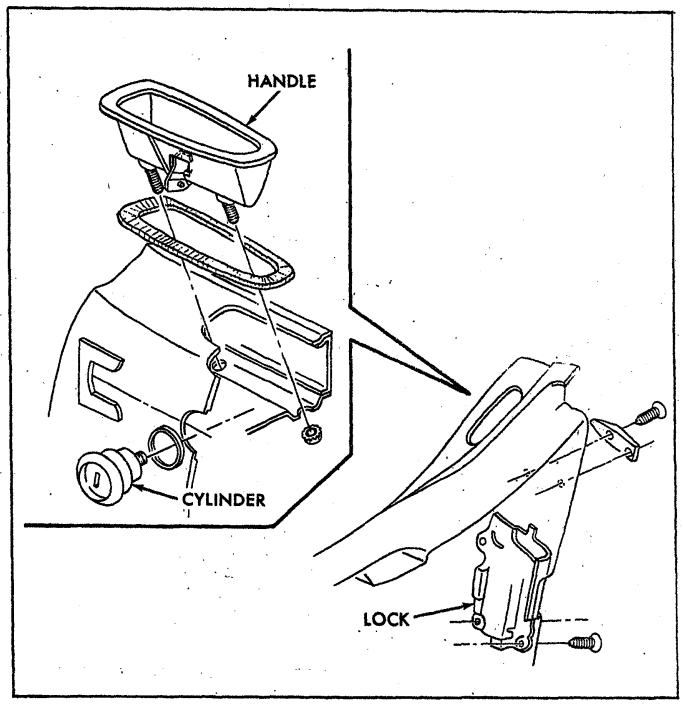


Fig. 32—Door Handle and Lock Cylinder

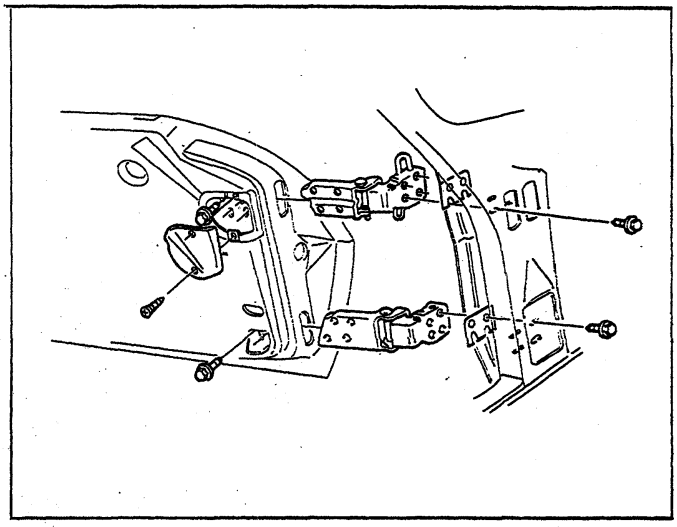


Fig. 33—Side Door Hinges

Installation

Installation is made by following removal procedure in reverse order. Before installation swivel bolt assembly, coat nut and bolt threads with chassis grease.

REAR PLENUM DRAIN (Fig. 42)

The coupe rear plenum drain assembly is located in the left rear quarter of the vehicle. The exterior mounted drain shield is located in the left rear wheelhouse.

Replacement of Drain Hose

1. Remove interior quarter trim panel as outlined further in this section.
2. Loosen clamp on drain hose.
3. Remove and replace drain hose.
4. Install clamp on hose at rear plenum.
5. Reinstall quarter trim panel in the reverse order of removal.

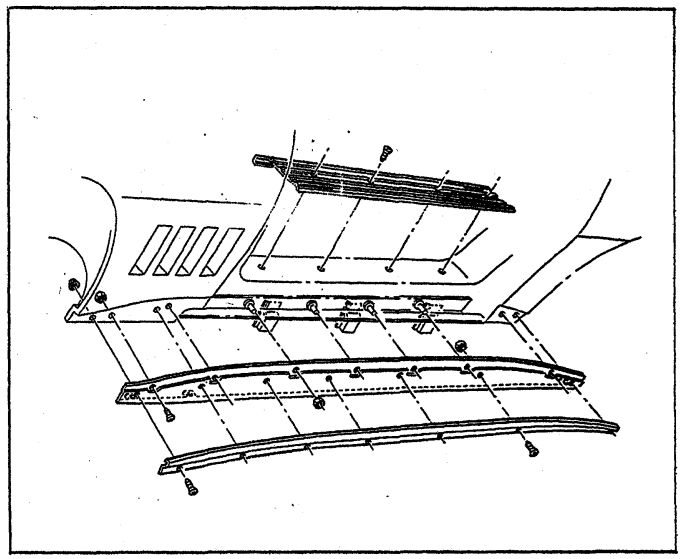


Fig. 34—Sill Plate and Trim Molding

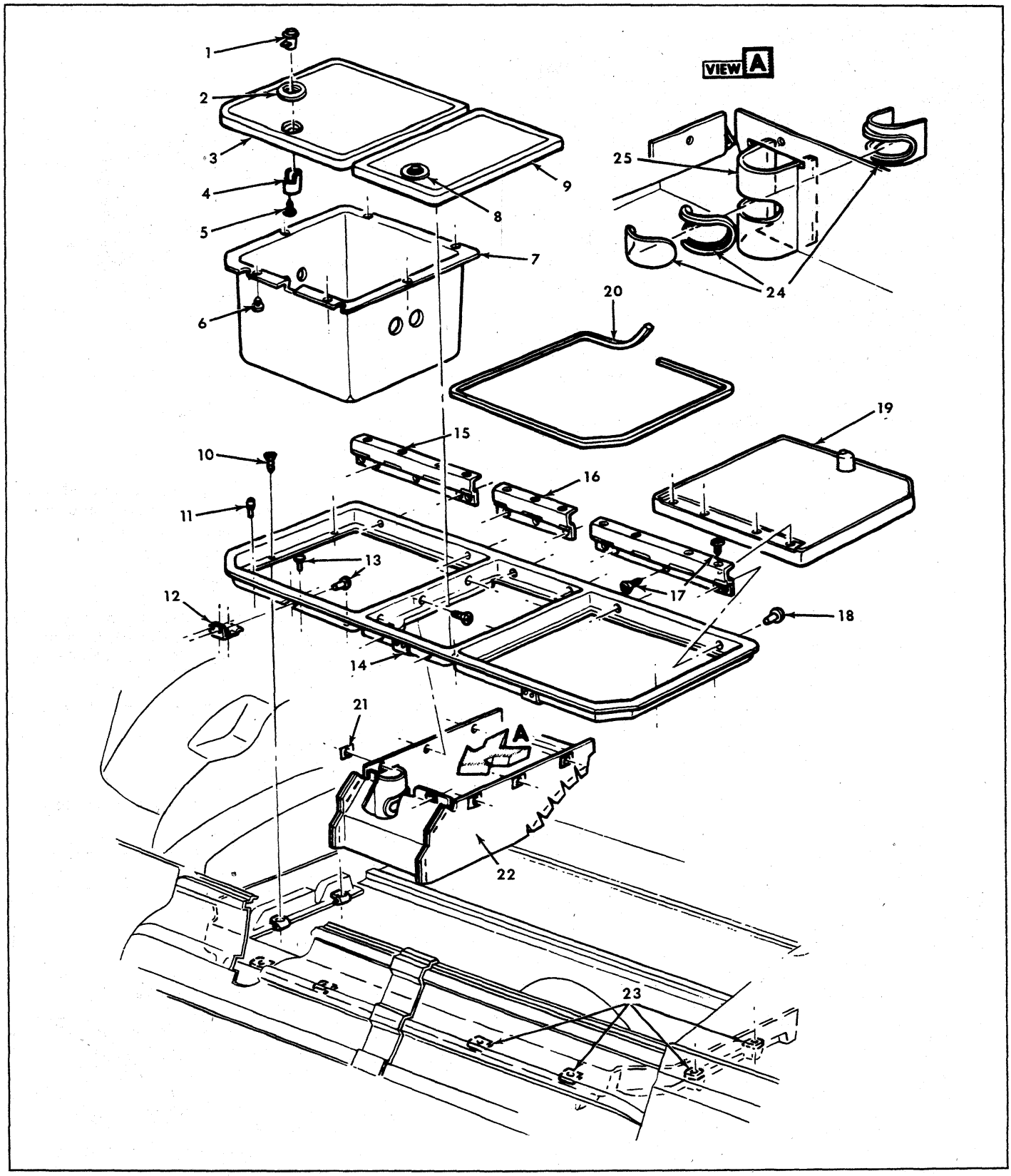


Fig. 35—Under Body Storage Compartment

1. Cylinder and Case Assembly
2. Escutcheon
3. Door
4. Retainer
5. Screw
6. Bumper
7. Cover
8. Cylinder and Case Assembly
9. Center Door
10. Screw
11. Bumper
12. Striker
13. Rivet
14. Striker
15. Hinge
16. Hinge
17. Screw
18. Rivet
10. Door
20. Seal
21. Nut
22. Center Compartment
23. Spring Nut
24. Lens Assembly
25. Shield

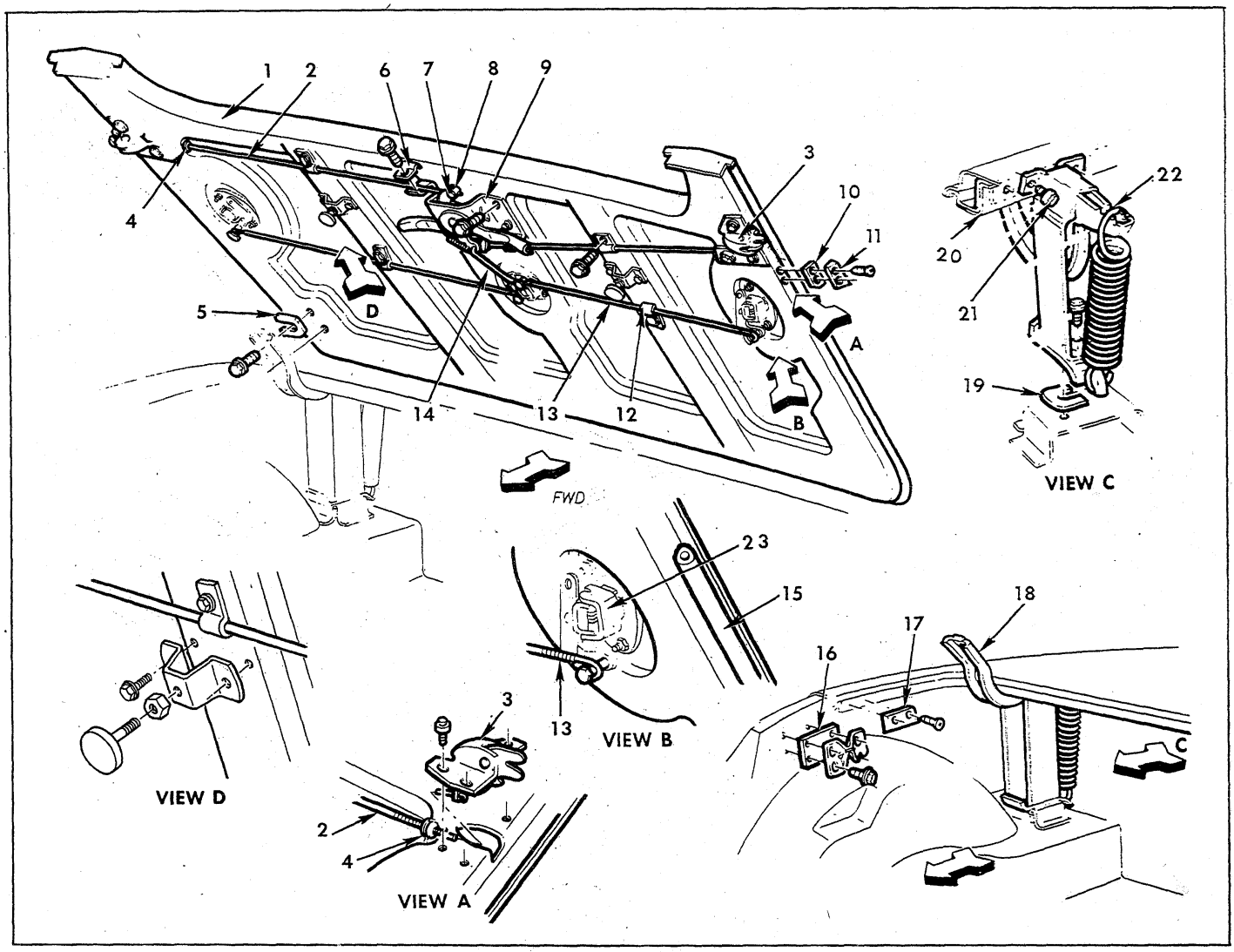


Fig. 36—Folding Top Lid Assembly

1. Lid Assembly
2. Cable
3. Lock Assembly
4. Grommet
5. Shim
6. Clamp
7. Screw
8. Stop
9. Control Assembly
10. Spacer
11. Plate
12. Clip
13. Rod
14. Rod
15. Weatherstrip
16. Spacer
17. Plate
18. Hinge Assembly
19. Shim
20. Body Upper Panel
21. Screw—Lock Washer Assembly
22. Spring
23. Top Lock

RUGS AND INTERIOR TRIM

CLEANING SOFT TRIM

Procedure for Cleaning Folding Top Material

The top should be washed frequently with neutral soap suds, lukewarm water and a brush with soft bristles. Rinse top with sufficient quantities of clear water to remove all traces of soap.

If the top requires additional cleaning after using soap and water, a mild foaming cleanser can be used. Rinse the whole top with water; then apply a mild foaming type cleanser on an area of approximately two square feet. Scrub area with a small soft bristle hand brush, adding water as necessary until the cleaner foams to a soapy consistency. Remove the first accumulated soilage with a cloth or sponge before it can be ground into the top material. Apply additional cleanser to the area and scrub until the top is clean. Care must be exercised to keep the cleanser from running on body finish as it may cause streaks if allowed to run down and dry.

Procedure for Cleaning Coated Fabrics

Care of genuine leather and coated fabrics (includes vinyl coated formed headlining) is a relatively simple but important matter. The surface should be wiped occasionally with a dry cloth, and whenever dirt accumulates, the following cleaning instructions should be used:

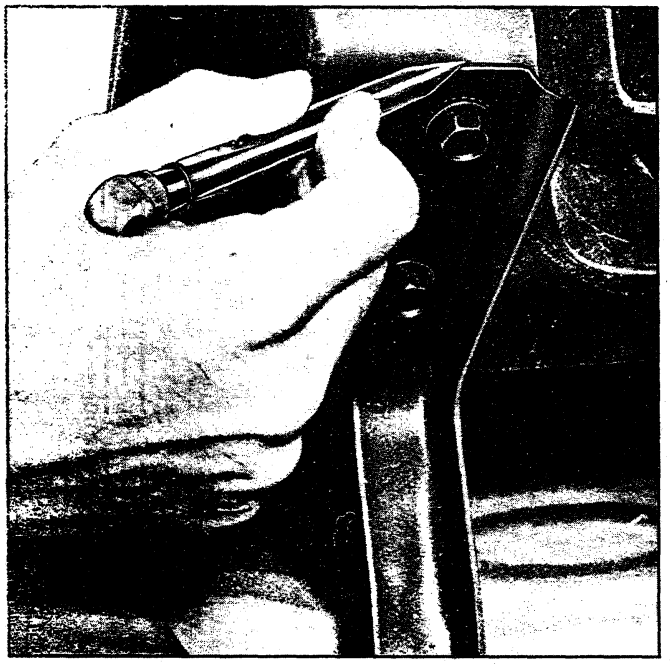


Fig. 37—Marking Hinge Position

1. Lukewarm water and a neutral soap should be used. Apply a thick suds, worked up on a piece of gauze or cheesecloth, to the surface.
2. The operation should be repeated, using only a damp cloth and no soap.

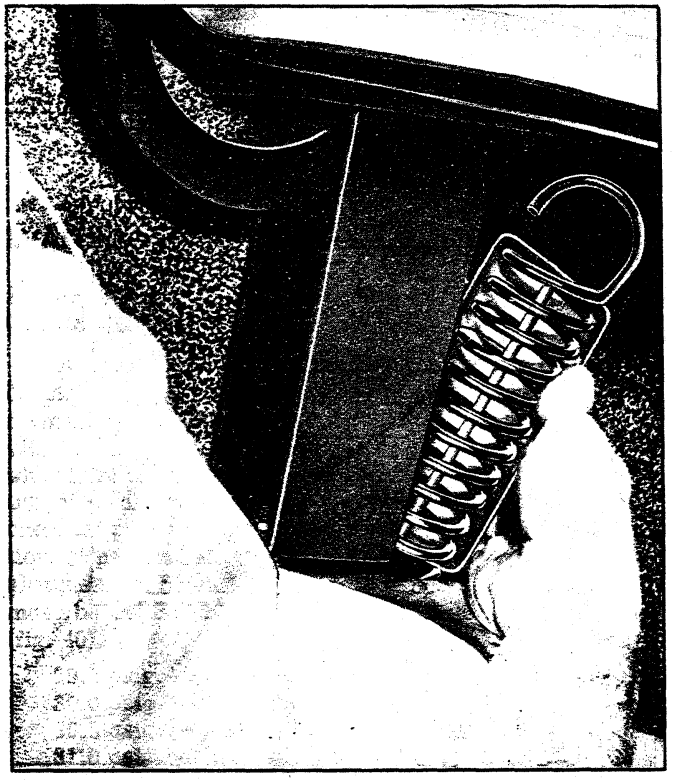


Fig. 38—Removing Hinge Spring

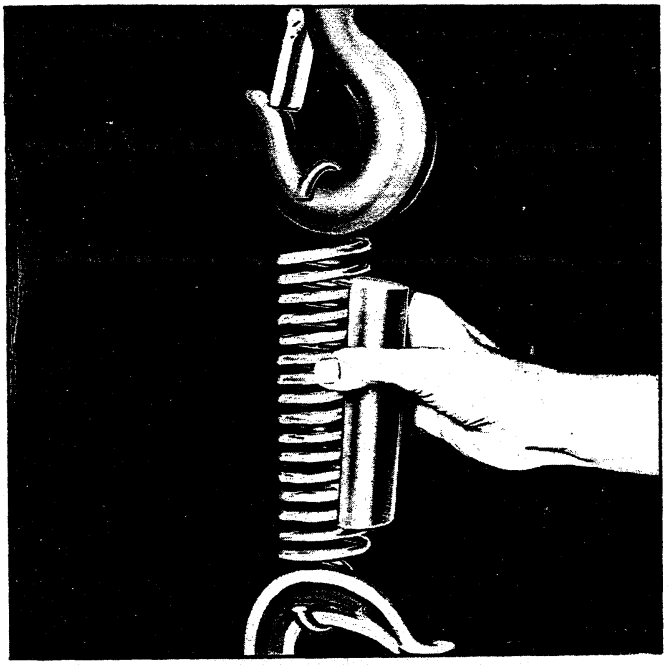


Fig. 39—Installing Tool J-9559 in New Spring

3. The surface should then be wiped dry with a soft cloth.

Polishes and cleaners used for auto body finishes, volatile cleaners, furniture polishes, oils, varnishes or household cleaning and bleaching agents should never be used.

Procedure for Cleaning Carpet

Thoroughly brush or vacuum the floor carpet. In many

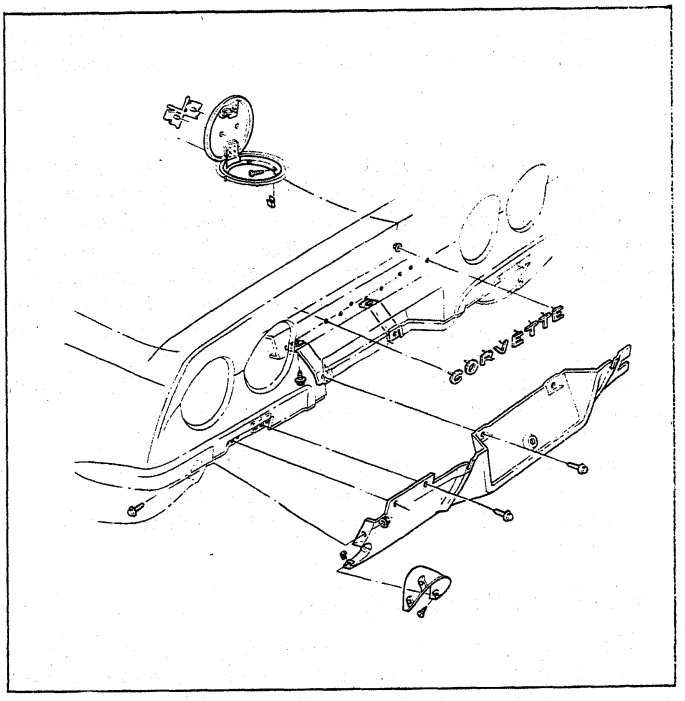


Fig. 40—Gas Tank Door and Rear Trim

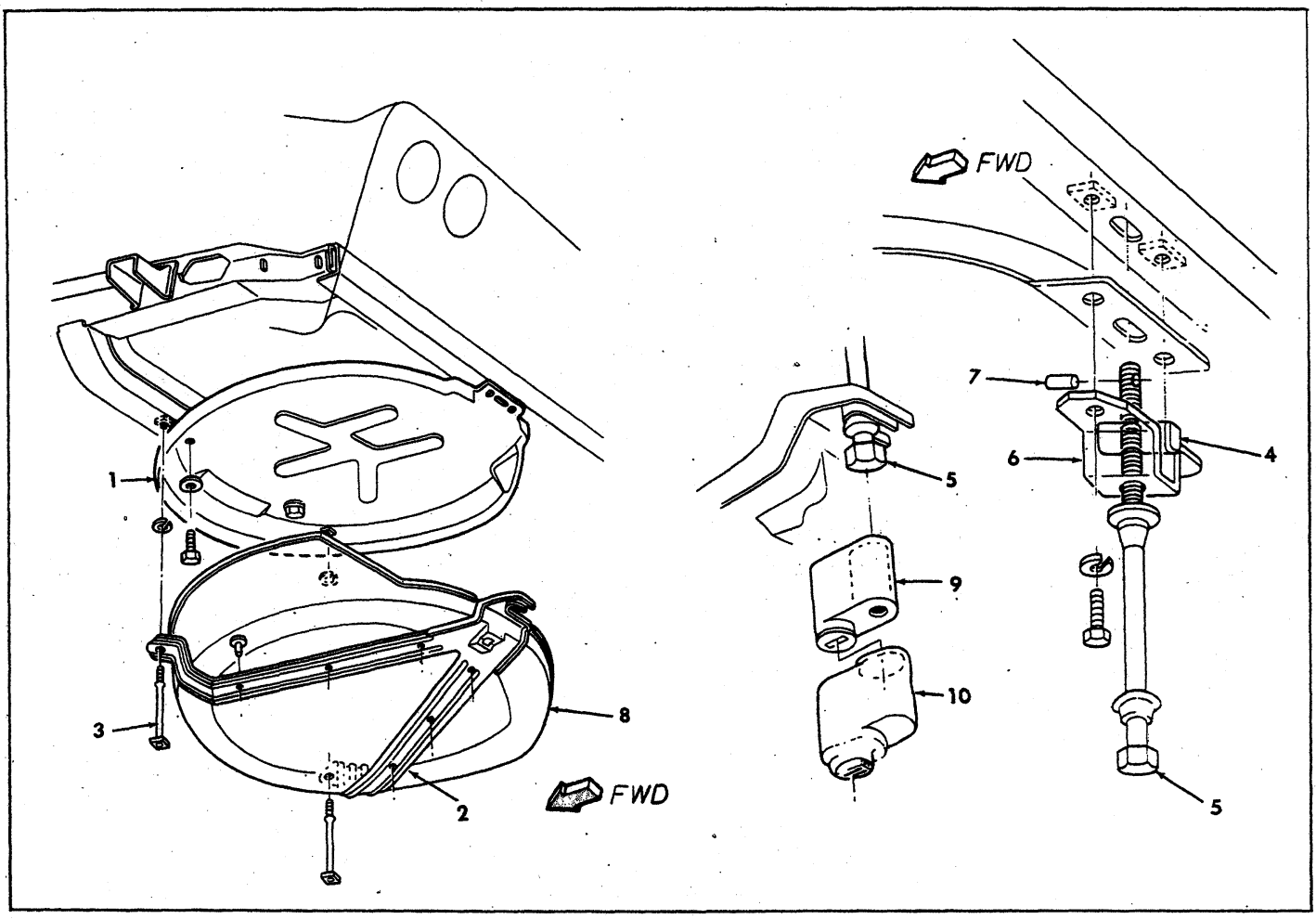


Fig. 41—Spare Tire Mount

1. Cover
2. Strap Assembly
3. Strap Assembly Pivot Bolt
4. Swivel Bolt Nut
5. Swivel Lock Bolt
6. Swivel Bolt Bracket
7. Swivel Bolt Pin
8. Tray
9. Lock Case
10. Lock Cover

instances the floor carpet may require no further cleaning. If the carpet is extremely soiled remove carpet from car and thoroughly vacuum to remove loose dirt; then with a foaming type upholstery cleaner, clean approximately one (1) square foot of carpet at a time. After each area is cleaned, remove as much of the cleaner as possible with a vacuum cleaner. After cleaning the carpet use an air hose to "fluff" the carpet pile, then dry the carpet. After the carpet is completely dried, use an air hose to again fluff the carpet pile.

NOTE: If the carpet is not extremely soiled, it may be cleaned in the car by applying a small amount of foaming type upholstery cleaner with a brush.

Carpets and Covers—All Models

Removal of front compartment carpeting will require removal of sill plates and loosening of console trim; service of these items is covered in this section under Front End-Cowl Area and Console Trim.

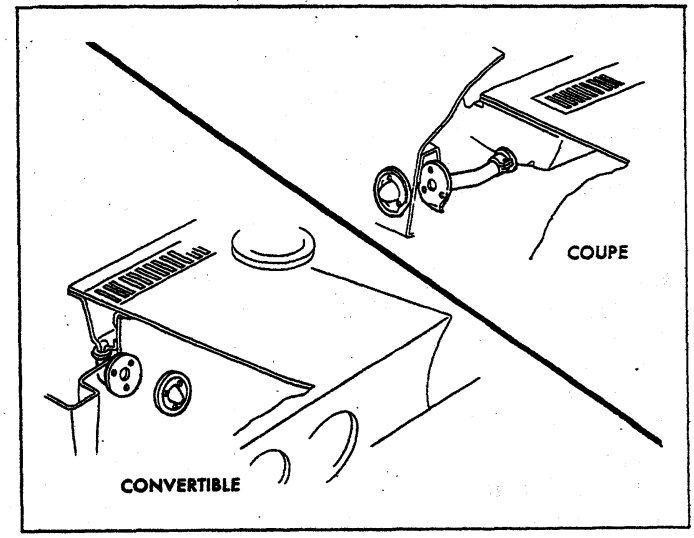


Fig. 42—Rear Plenum Drain

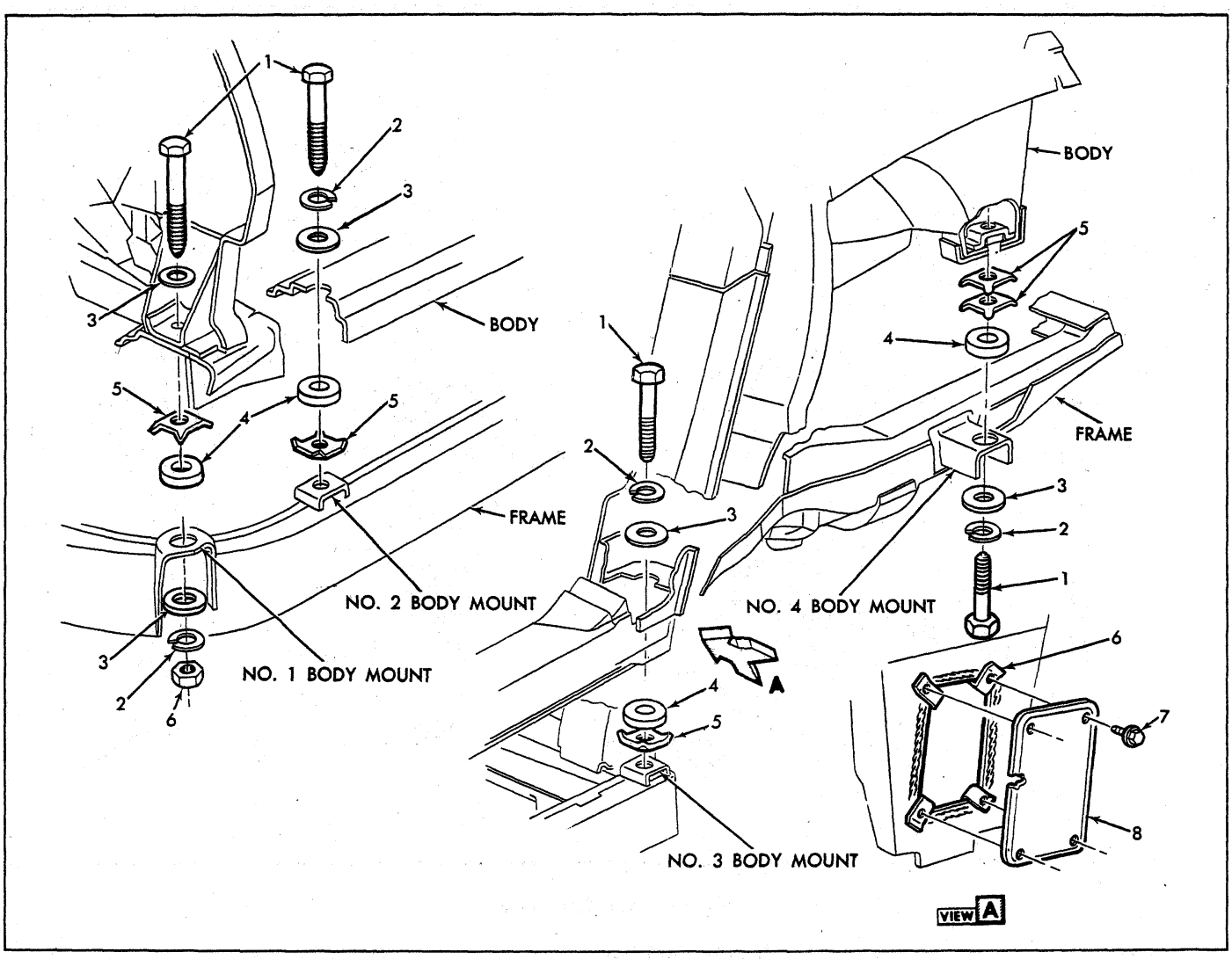


Fig. 43—Body Mounts

1. Bolt
2. Lockwasher
3. Washer
4. Spacer
5. Shim
6. Nut
7. Screw
8. Access Cover

In areas where carpeting is to be cemented, proceed as follows:

1. Remove all old carpeting, jute, etc. which may adhere to floor after original carpet is pulled up.
2. Apply 3M-1711 cement or equivalent, following directions furnished with package. Be sure floor is reasonably clean and dry before applying cement.

SEATS

Removal

1. Remove bolt retaining each forward support to floor.
2. Fold seat back forward.
3. Loosen two bolts retaining each seat hold-down bracket.
4. Move seat forward and out of brackets.

Adjustment

Height of seats is adjustable at both front and rear by means of shims or washers.

Angle of seat backrest may be changed by adjusting stops located on lower edge of seat back.

BODY MOUNTING

Figure 43 illustrates underbody attachment-to-frame body mounting brackets. Shims which are shown on rear crossmember are cemented in place.

The torque of all body mounting bolts should be checked periodically as an aid to preventing annoying squeaks and rattles. All bolts shown in Figure 43 should be torqued 40 to 50 lb. ft.

BODY REPAIRS

GENERAL INSTRUCTIONS

The following gives information necessary for repair of collision damage and performance of general maintenance on Corvette bodies. Included here is information dealing with availability of repair panels, general installation procedures for installing panels and repairing damage to the body.

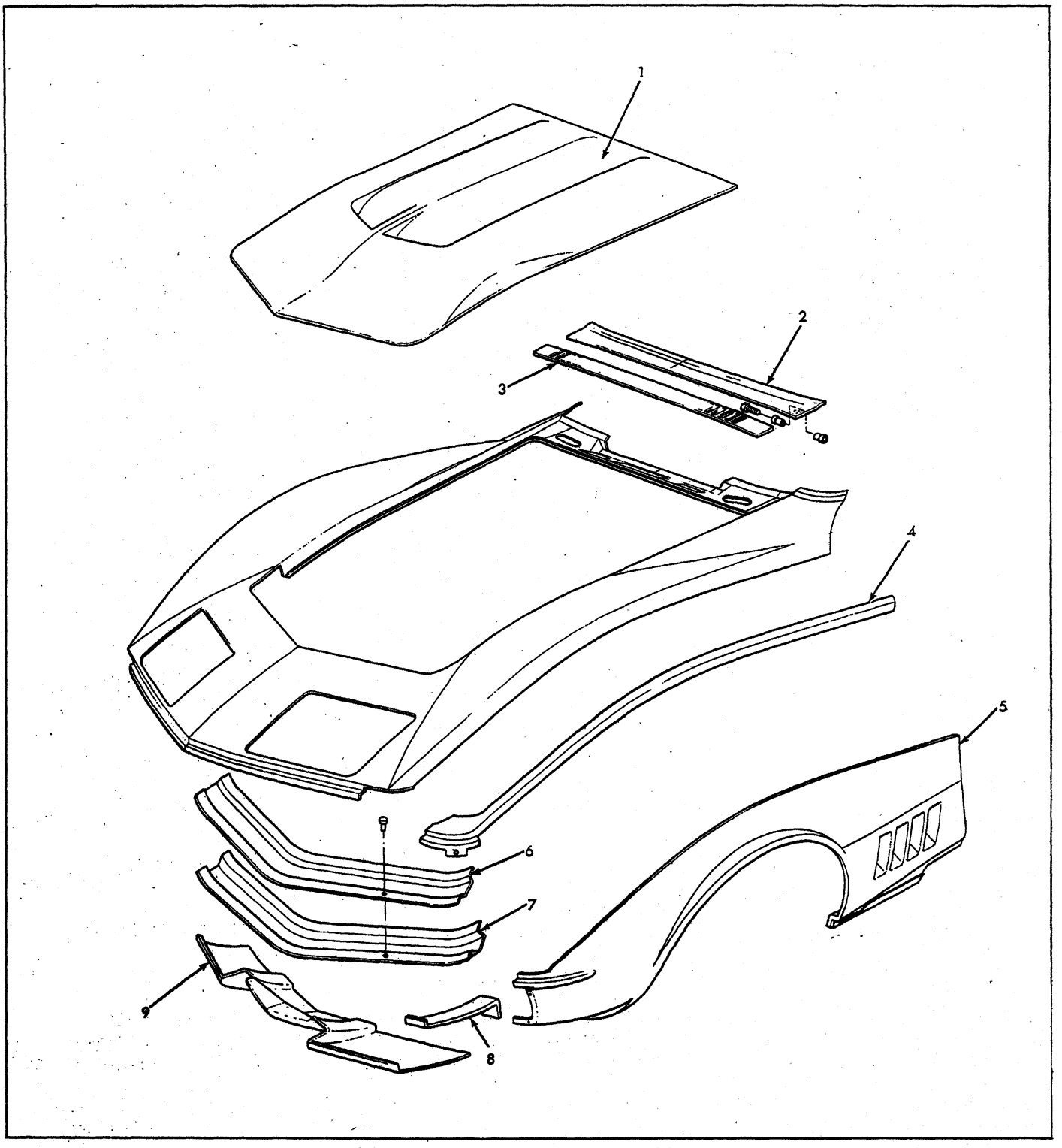


Fig. 44—Front Body Construction

1. Panel—Hood
2. Panel—Access Door
3. Panel—Grille
4. Bonding Strip—Front Fender Upper to Lower
5. Panel—Front Fender Lower Rear
6. Reinforcement—Front Fender
7. Reinforcement—Front Fender
8. Bonding Strip—Front Fender Lower Front to Rear
9. Panel—Radiator Grille Lower

Repair of fiber glass reinforced plastic bodies can be a relatively easy matter if precautions are observed. In cases where welding must be done on steel parts which are installed on body, do not allow flame or welding heat to come into direct contact with plastic body panels. The general area around the welding operation

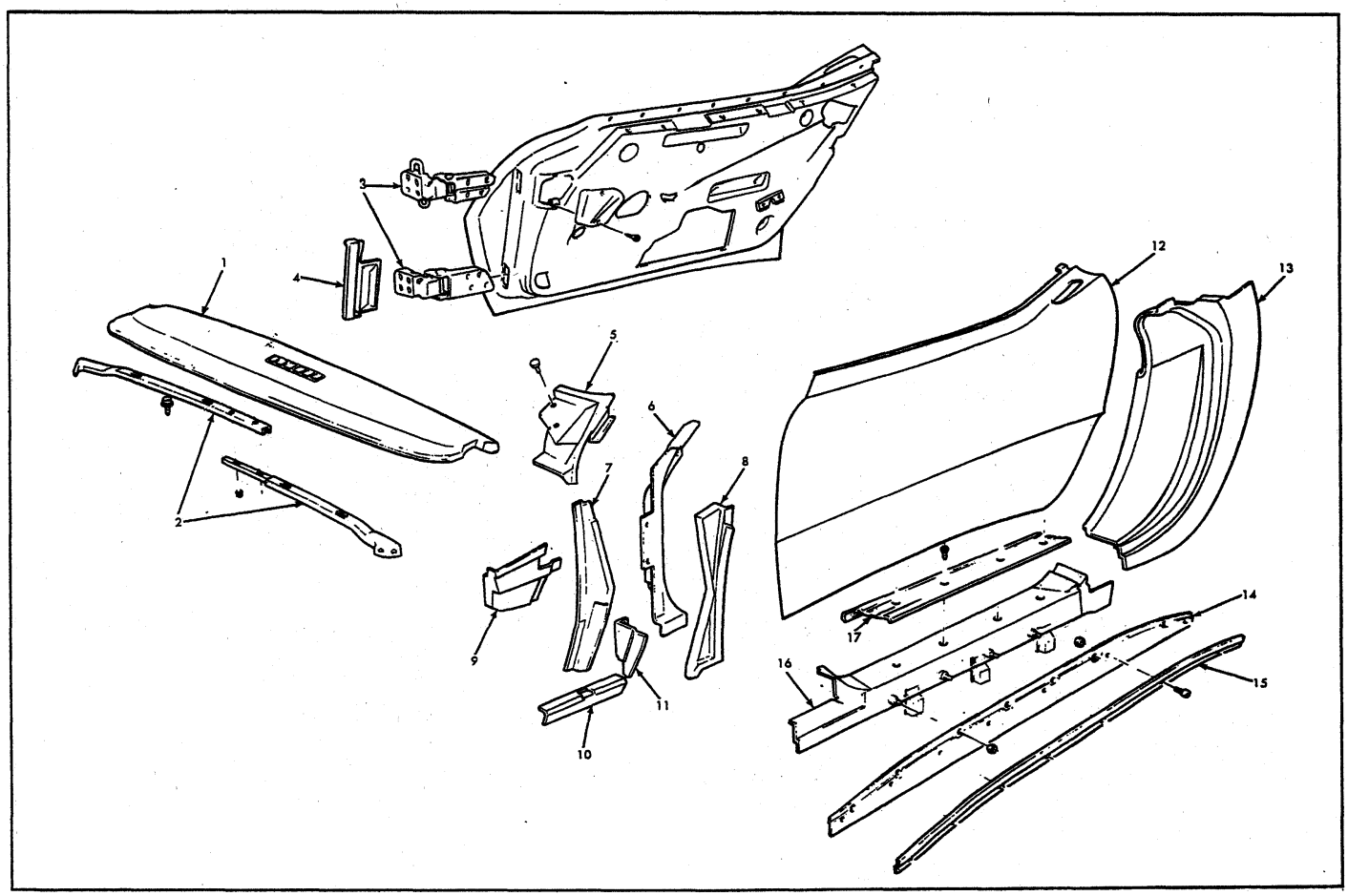


Fig. 45—Center Body Construction

1. Pad—Instrument Panel
2. Reinforcement—Instrument Panel
3. Door Hinge Assembly
4. Panel—Plenum Side Extension
5. Bonding Strip—Lower Outer Windshield
6. Pillar—Body Hinge
7. Plenum Side Panel
8. Dash Extension Panel
9. Sill Inboard Extension
10. Plenum Side Panel Extension
11. Filler Panel
12. Panel—Side Door Outer
13. Pillar Assembly—Door Lock
14. Molding
15. Molding—Upper
16. Door Sill
17. Sill Plate

should be protected with wet asbestos or any other like method (several thicknesses of aluminum foil makes an excellent heat shield if out of the way of direct flame).

Straightening of steel parts while still in body must be done with care. When applying hydraulic jacks or like equipment which operates by exerting force, bear in mind that the part being used to brace the stationary end of tool must be able to withstand such usage and that fiber glass parts, though tougher than steel, will not yield or "take a set" as with steel parts, so they cannot be "straightened". If poor alignment exists due to collision or other physical damage, check steel reinforcements in cowl and sill areas with care.

Tracing line of damaging force and checking body carefully for broken bonds and cracks before, during and after repairs will pay off repeatedly.

Small cracks and faults in bonds and panels will usually grow larger if left unattended.

REPAIR PANELS

Body repair panels are illustrated in Figures 44 through 47. Those shown are typical of panels which are available through Chevrolet parts sources. Procedures which may be used for installing panels are explained in the following paragraphs.

Figure 48 illustrates various bonds which will be encountered during repair procedures.

PRECAUTIONS

Creams are available to protect the skin from a condition known as occupational, or contact dermatitis. This common type of dermatitis is not contagious. Improved resin formulas in the approved kits have almost eliminated skin irritation. Cream is supplied with the kit for persons who may have a tendency toward skin irritation from the resins or dust.

The application of these creams is recommended whenever the Resin Kit materials are used. Generally, the cream is not required when the plastic solder kit is being used. Directions for using the cream is as follows:

1. a. Wash hands clean. Dry thoroughly.
   b. Squeeze about 1/2 inch (or 1/2 teaspoonful) of #71 cream into palm of hand.
   c. Spread evenly and lightly until cream disappears.

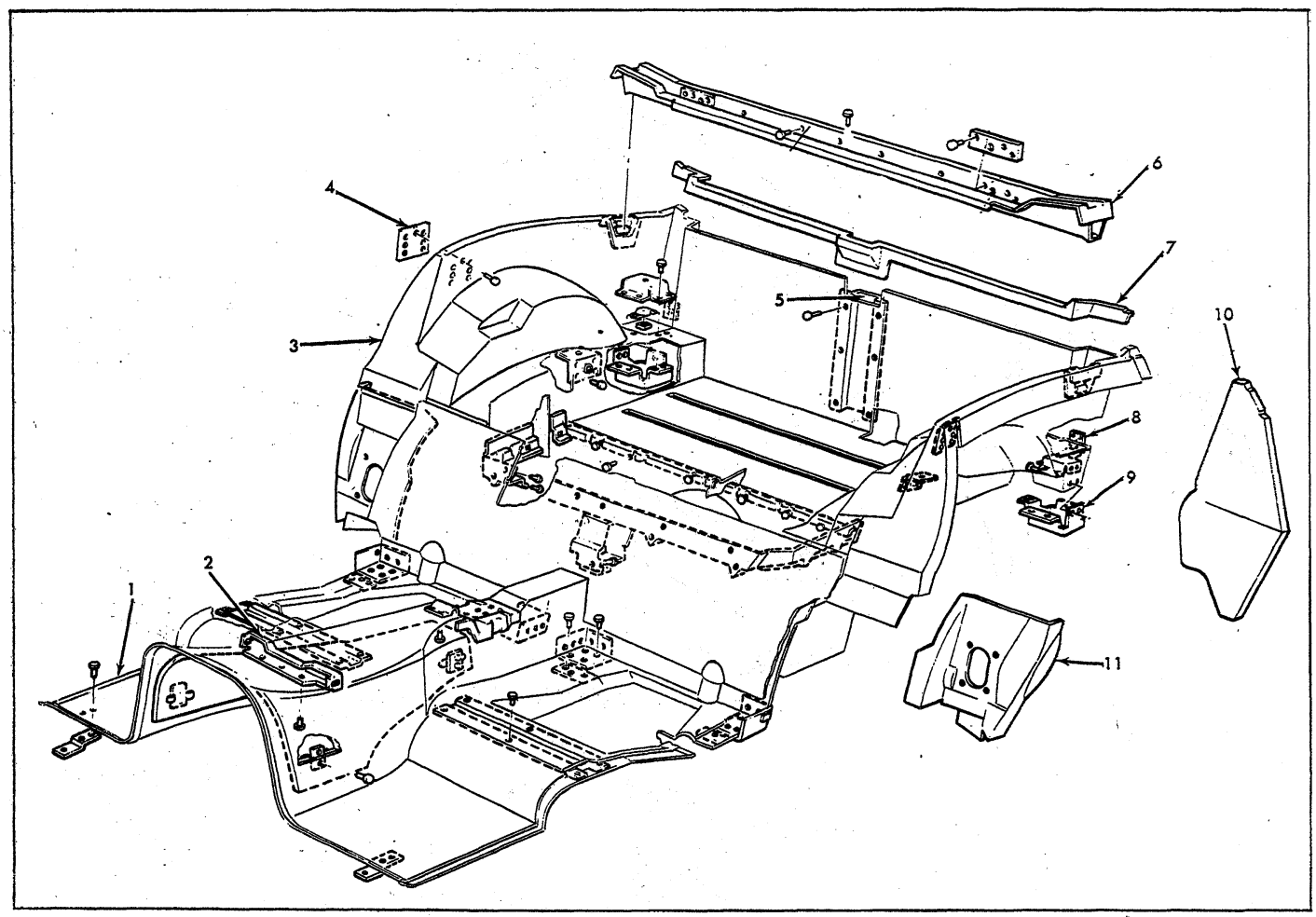


Fig. 46—Under Body Construction

1. Panel—Underbody
2. Support—Console
3. Panel—Wheel Housing Closing—Right Hand
4. Lid Lock Striker Anchor
5. Reinforcement
6. Support—Body Rear
7. Panel—Underbody Closing
8. Reinforcement—Folding Top Hinge Support (19467)
9. Reinforcement—Body Bolt
10. Shield—Rear Quarter
11. Panel—Body Lock Pillar

Work cream into cuticle, between fingers and around wrists.

d. Apply second coat, repeating Steps b and c.
e. Hold hands briefly under cold running water to set cream.

2. Remove resin mixture from hands as soon as possible and imperatively before mixture starts to gel. This can be observed by the action of the material being used. Resin may be removed with lacquer thinner by washing in soap and water.
3. Respirators are recommended when grinding. Also some minor skin irritation from glass and powdered cured resin may be evident. Washing in cold water will help to minimize.
4. Use a belt sander with a vacuum attachment for dust control whenever possible.
5. Resin mixtures may produce toxic fumes and should be used in well ventilated areas.
6. Be careful not to get any resin material on clothing.
7. Use the right materials for the job. It is important to use the approved kits because other materials available may not meet the required engineering and safety standards.
8. Keep materials, utensils and work area clean and dry. These repairs involve chemical reactions, and dirt or moisture may upset the chemical balances and produce unsatisfactory results.
9. Before starting repair operations, look for hidden damage by applying force around the damaged area, looking for hairline cracks and other breakage. Check for minor damage at other points in the vehicle such as around exhaust pipes, grille, headlamps and points of wear. Early repair of minor damage may prevent major repair later.

PLASTIC SOLDER KIT

The Plastic Solder Repair Kit is used for minor repairs on the Corvette body. These materials will produce an easy, quick and lasting repair in the case of small cracks, surface imperfections and small holes.

1. Use paint remover or power sander, and remove

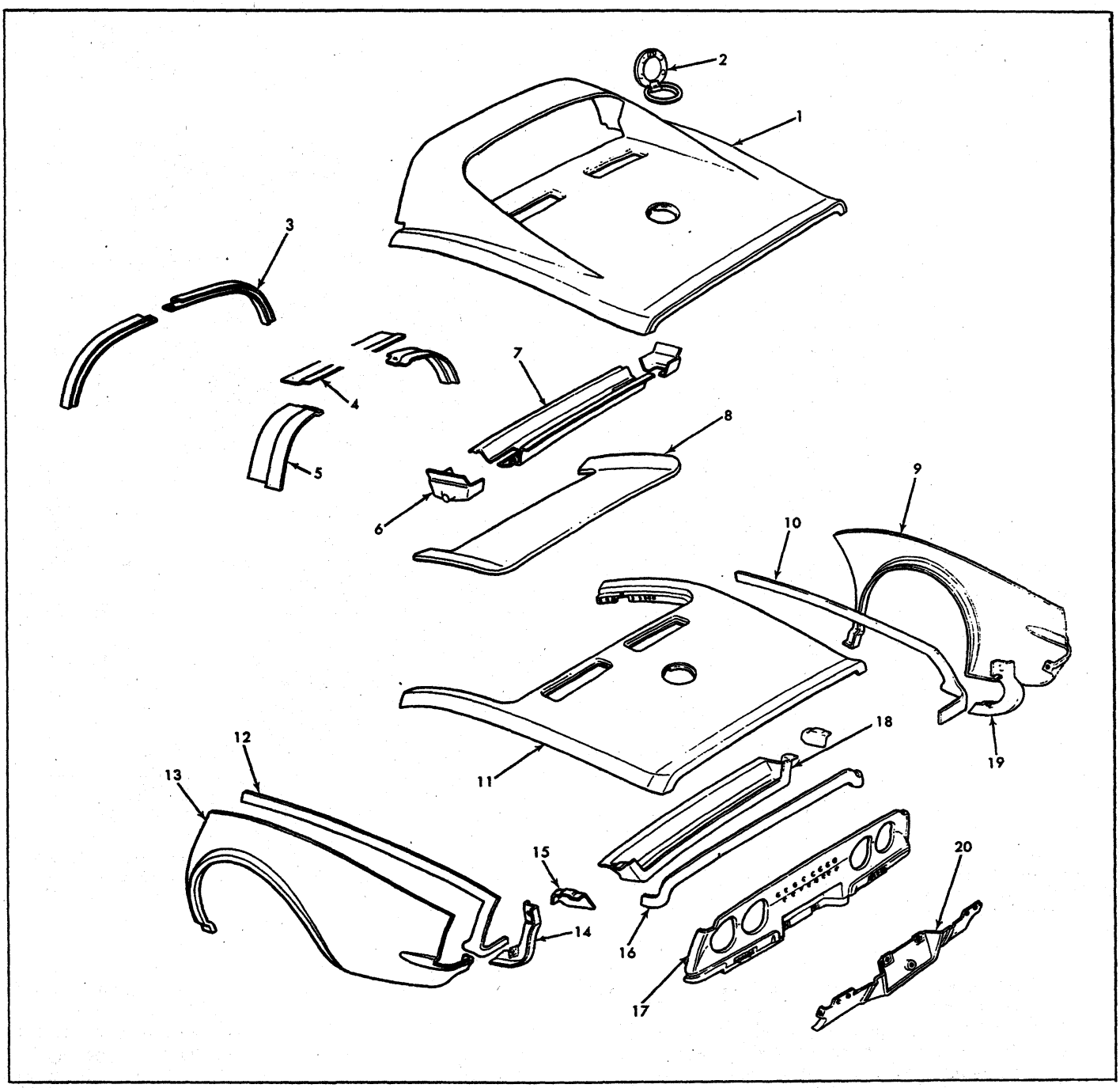


Fig. 47—Rear Body Construction

1. Panel—Body Rear Upper
2. Bezel—Fuel Tank Filler Door
3. Reinforcement Roof—Right Hand
4. Panel—Rear Roof Inner Center—Left Hand
5. Panel—Rear Roof Inner Rear—Left Hand
6. Extension—Body Rear Upper Panel
7. Support—Body Rear Upper Panel
8. Lid—Folding Top Compartment
9. Panel—Rear Quarter—Right Hand
10. Bonding Strip—Body Rear Upper Panel to Quarter Panel—Right Hand
11. Panel—Body Rear Upper
12. Bonding Strip—Body Rear Upper Panel
13. Panel—Rear Quarter—Left Hand
14. Bonding Strip—Body Lower Panel to Quarter Panel—Left Hand
15. Support—Body Rear Upper Panel
16. Bonding Strip—Body Rear Upper
17. Body Rear Lower Panel
18. Support—Body Rear Upper Panel
19. Shield—Rear Quarter Splash
20. Panel—Rear Filler

finish from damaged area. Carefully inspect for other areas requiring repair.

2. Mix the materials (fig. 49).
3. Apply the material, using a putty knife or rubber squeegee, Figure 50. Work the material into the repair and build the material up to the desired

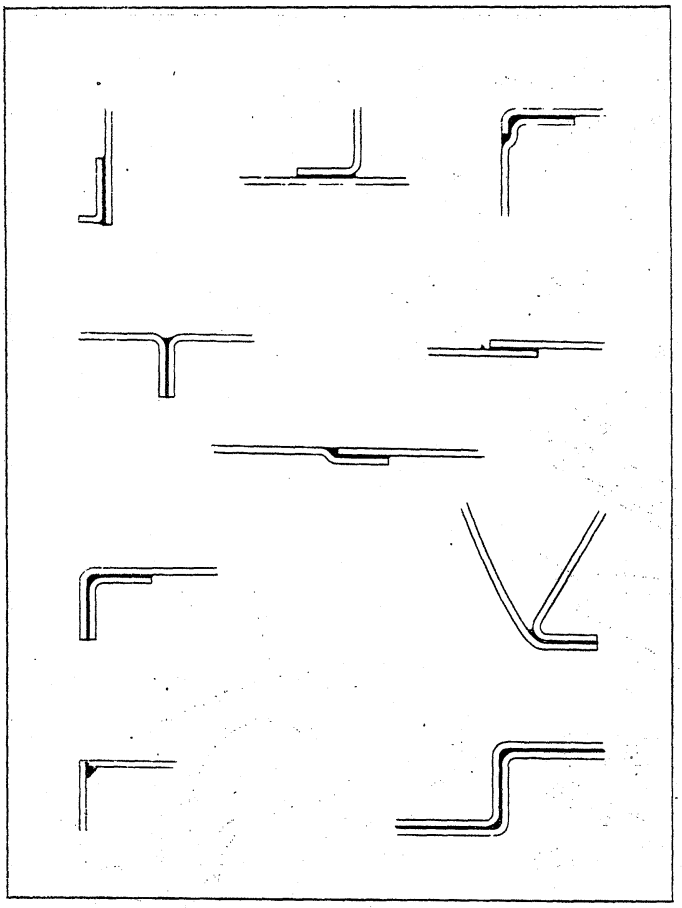


Fig. 48—Typical Body Bonds

contour. For deep filling and on vertical surfaces, several layers may be used, each about 1/2" thick.

4. Finish the repair by grinding, sanding and painting in the usual manner, Figure 51.

RESIN KIT

The Resin Repair Kit, for major repairs, contains resin, hardener, Thixatrope, fiberglass cloth, protecting creams and mixing utensils. Repairs such as torn panels and separated joints require the adhesive qualities of the resin and the reinforcing qualities of the glass fibers.

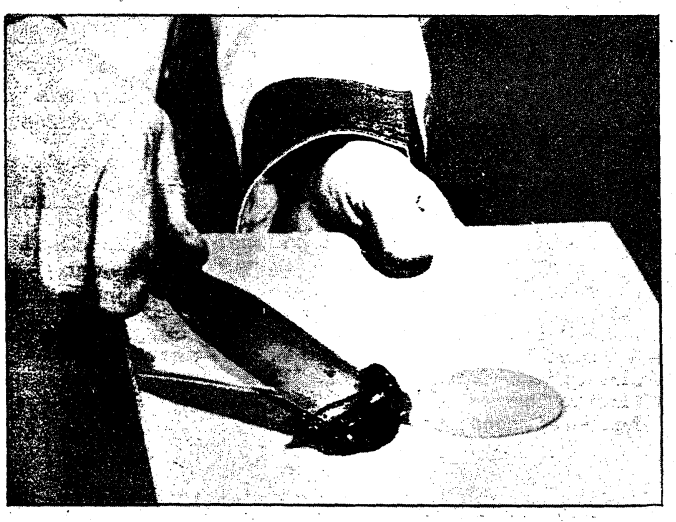


Fig. 49—Mixing Plastic Solder Material

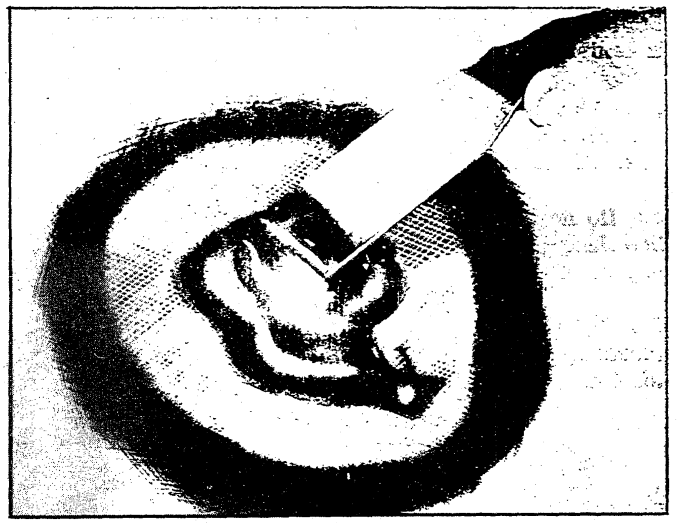


Fig. 50—Applying Plastic Solder

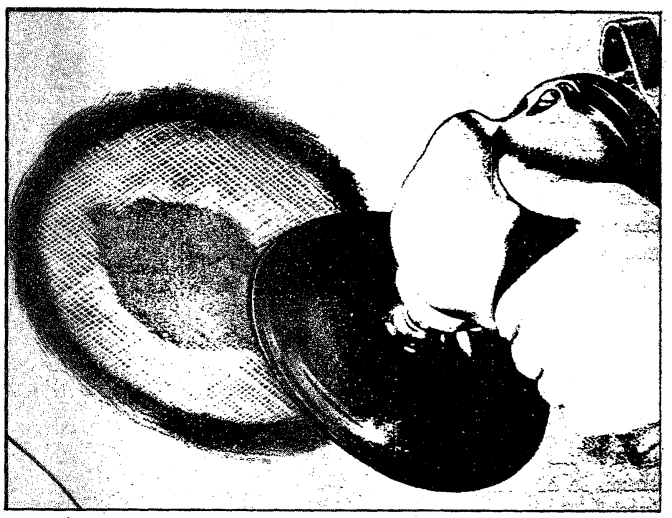


Fig. 51—Finishing Plastic Solder Repair

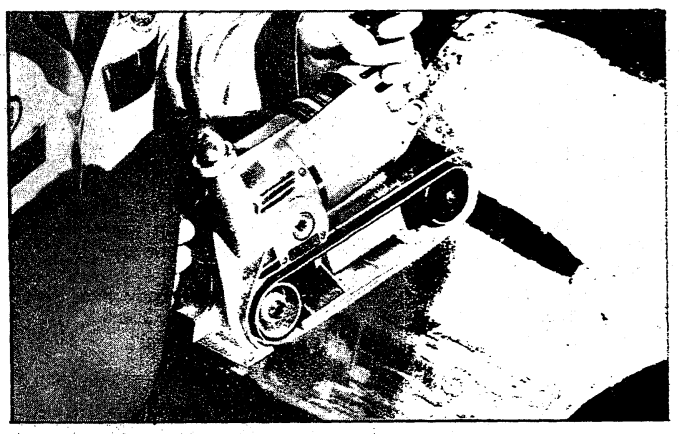


Fig. 52—Grinding "V" at Damaged Area

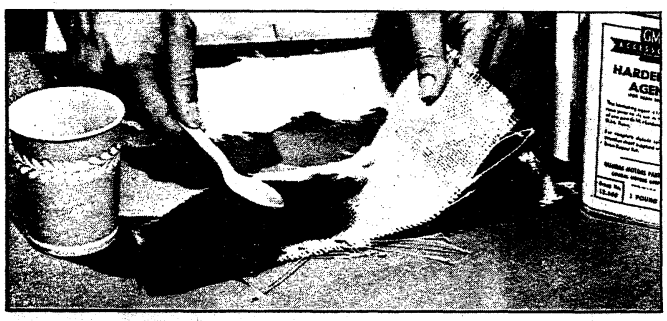


Fig. 53—Applying Resin Mixture to Fiberglass

The following procedure is basic for repairing any plastic (fiberglass component or panel).

1. Look for hidden damage. Apply force by hand around the damaged area.
2. Use paint remover and remove finish from around damage area. Inspect area again for signs of other damage.
3. Grind or file the damaged area to form a "V" at the broken or cracked portion. Side of "V" should have a shallow pitch for maximum bonding surface. A belt sander with a vacuum attachment will minimize the dust problem, Figure 52.
4. If rear of damage is accessible, use a button-type repair. Clean back of area to permit the use of laminate (resin-saturated glass-cloth) on both sides of damaged area.
5. Cut fiberglass cloth to size. Make certain a minimum of five layers is cut for the average repair.
6. Mix resin and hardener, 1 part hardener to 4 parts resin. Add Thixatrope to the mix to give the mix body and reduce the "runniness" of the material.

   CAUTION: Cleanliness is most important. Be certain all containers are dry and clean and the resin and hardener cans are kept closed when not in use. Do not use waxed cups for mixing and do not allow resin to enter hardener can or vice versa.

7. Saturate layers of fiberglass (fig. 53). Place laminate over damage area. Smooth out wrinkles, and make sure general contour of area is maintained, Figure 54.
8. Apply heat to repair area. Heat lamps are recommended, used at least 12" away from repair. Allow 15 to 20 minutes curing time. Trim repair to shape at gel stage.
9. After the repair is cured, grind, file or sand to contour. Files other than body files may be more suitable. A belt sander with a vacuum cleaner attachment will minimize the dust problem. Feather edge and finish sand.

   NOTE: After Resin Repair, small pits or irregularities may appear in finished surface. Imperfections should be repaired using the Plastic Solder Repair Kit.



Fig. 54—Applying Laminate to Body

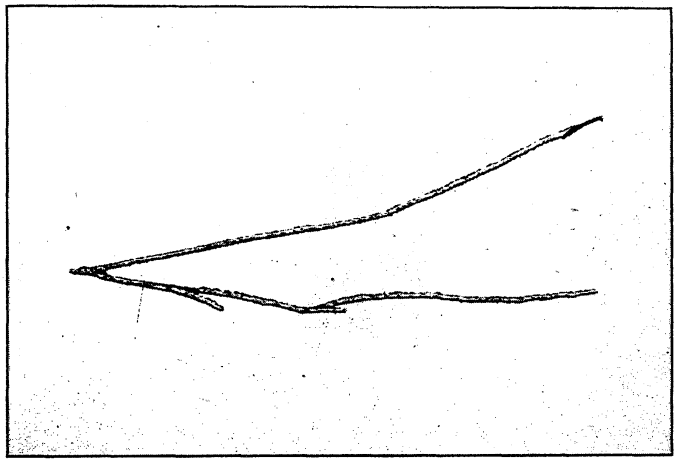


Fig. 55—Typical Scratched Panel

SPECIFIC REPAIRS

Scratched Panels, Spot Refinishing

In many instances, a scratched panel will involve only a paint refinishing job. Figure 55 shows the top of a fender panel which has been scratched through to the plastic.

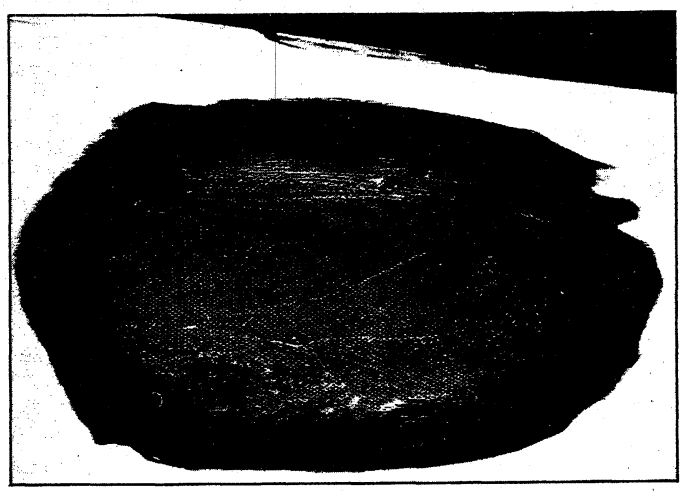


Fig. 56—Repair Area Finish Sanded

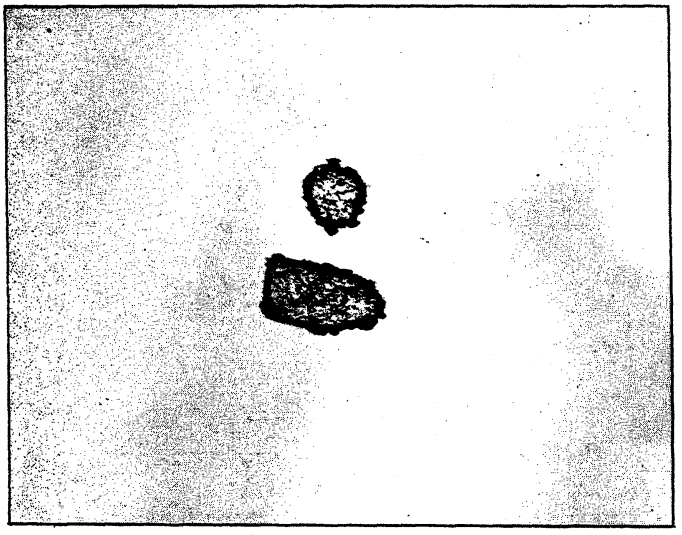


Fig. 57—Typical Pitted Panel

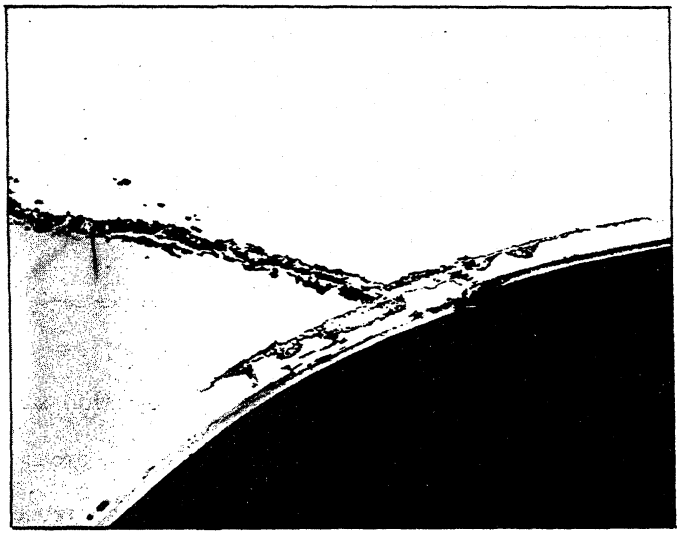


Fig. 58—Typical Cracked Panel

1. Remove all paint down to the plastic from the area surrounding the scratch with Lacquer Removing Solvent.
2. Featheredge the repair area with No. 220 wet or dry sandpaper and finish block sand with No. 320 wet or dry paper, Figure 56.

   CAUTION: Do not sand too deeply into fiberglass mat. Should it be necessary to cut fairly deep into the glass mat use the repair procedure suggested for dents and pits in plastic panels.
3. Clean up repair area using Prep-Sol or equivalent, then finish the clean-up with a tack rag.
4. Protect surrounding panels by masking before performing paint refinishing operations. Use only non-staining type masking tapes on Corvette plastic body.
5. Refinish panel as described in paint refinishing portion of this manual.

Dents or Pits in Panels, Cracks in Glaze Coat

Figure 57 shows a panel which has received a heavy glancing blow, resulting in an indentation or large pit in the panel. The following procedure is advised for a repair of this type of damage. Cracks in the glaze or finish coat of plastic and paint may also use this procedure.

NOTE: This repair may be used wherever the damage is not extensive and the plastic is not pierced, but the damage area does require a plastic build-up.

1. Remove paint down to the plastic from area surrounding the damage with Lacquer Removing Solvent, or its equivalent.
2. Scuff area surrounding damaged area to provide a good bonding surface.
3. Clean up work area with Prep-Sol then use tack rag for finish clean-up.
4. Use the Plastic Solder Repair (previously described) to fill the imperfections.
5. Feather-sand damaged area with No. 220 sandpaper and finish sand with No. 320.
6. Prepare repair area for paint refinishing operation.

Cracked Panels

NOTE: For best results, temperature should be at least 70°-75°F.

1. In the case of a cracked panel, such as shown in Figure 58, cut along the break line with a hacksaw blade and remove broken portion of the panel.
2. Remove the paint down to the plastic from both portions of the panel with a Lacquer Remover or equivalent.
3. Remove dirt and deadener thoroughly, back approximately 2 to 3 inches from the fracture, on the under side of both portions of the panel. Also, remove paint and scuff area clean to provide a good bonding surface.
4. Remove all cracked and fractured material along the break. Bevel the attaching edges of the panels at approximately a 30° angle with a file or grinder and scuff plastic surfaces along edges of break.

NOTE: Mask surrounding panels using a non-staining masking tape.

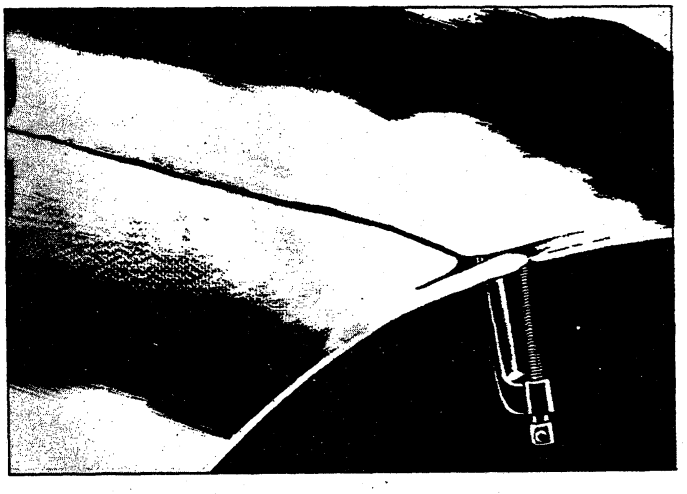


Fig. 59—Cracked Panel Preparation

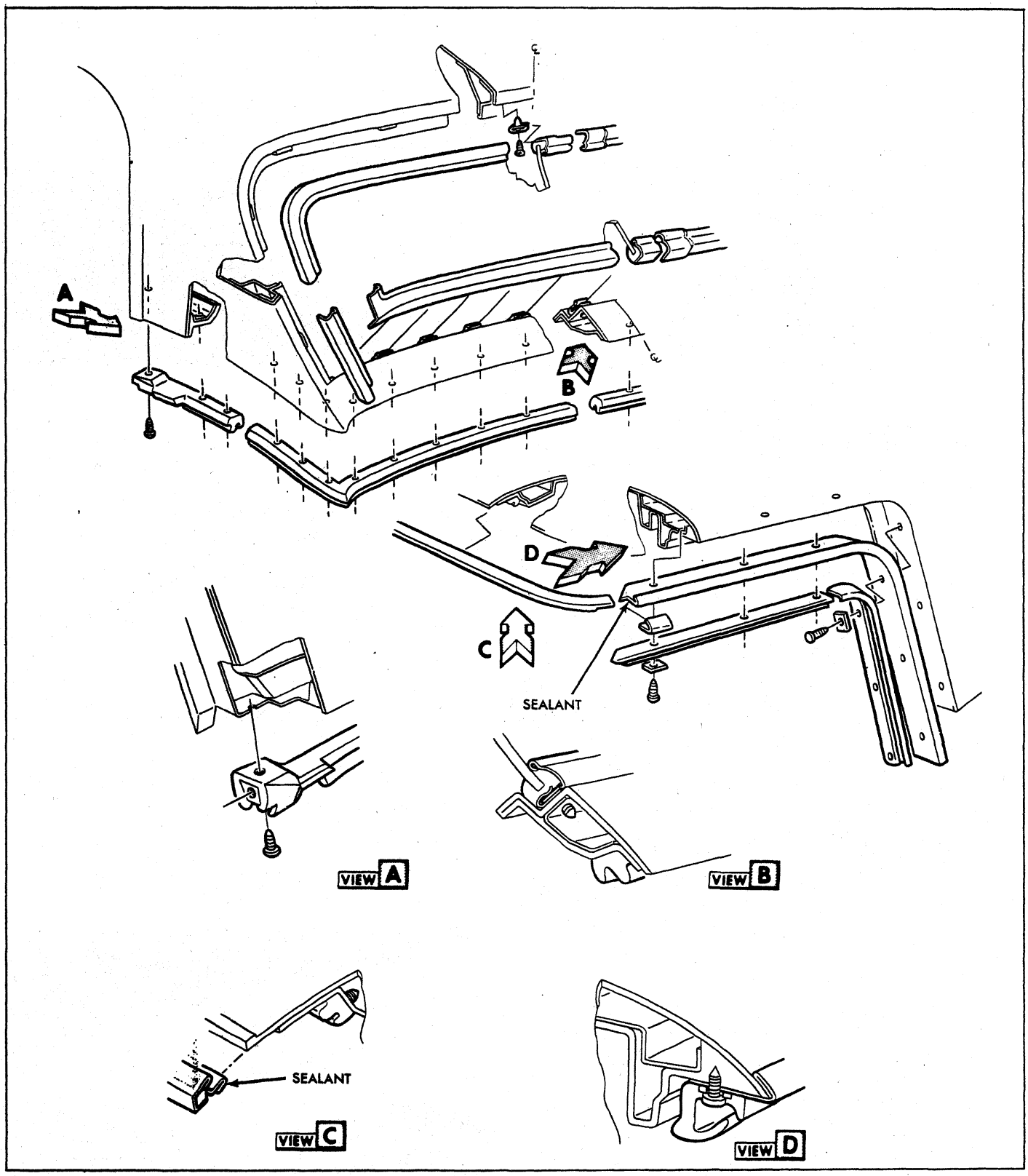


Fig. 60—Molding and Weatherstrip (Convertible Hardtop)

5. **Use "C" clamps to align panel portions allowing approximately 1/8" between the panels or as necessary to provide proper alignment of panels, Figure 59.**

6. Cut two pieces of woven glass fiber cloth for backup of sufficient size to overlap the fracture by approximately two inches.

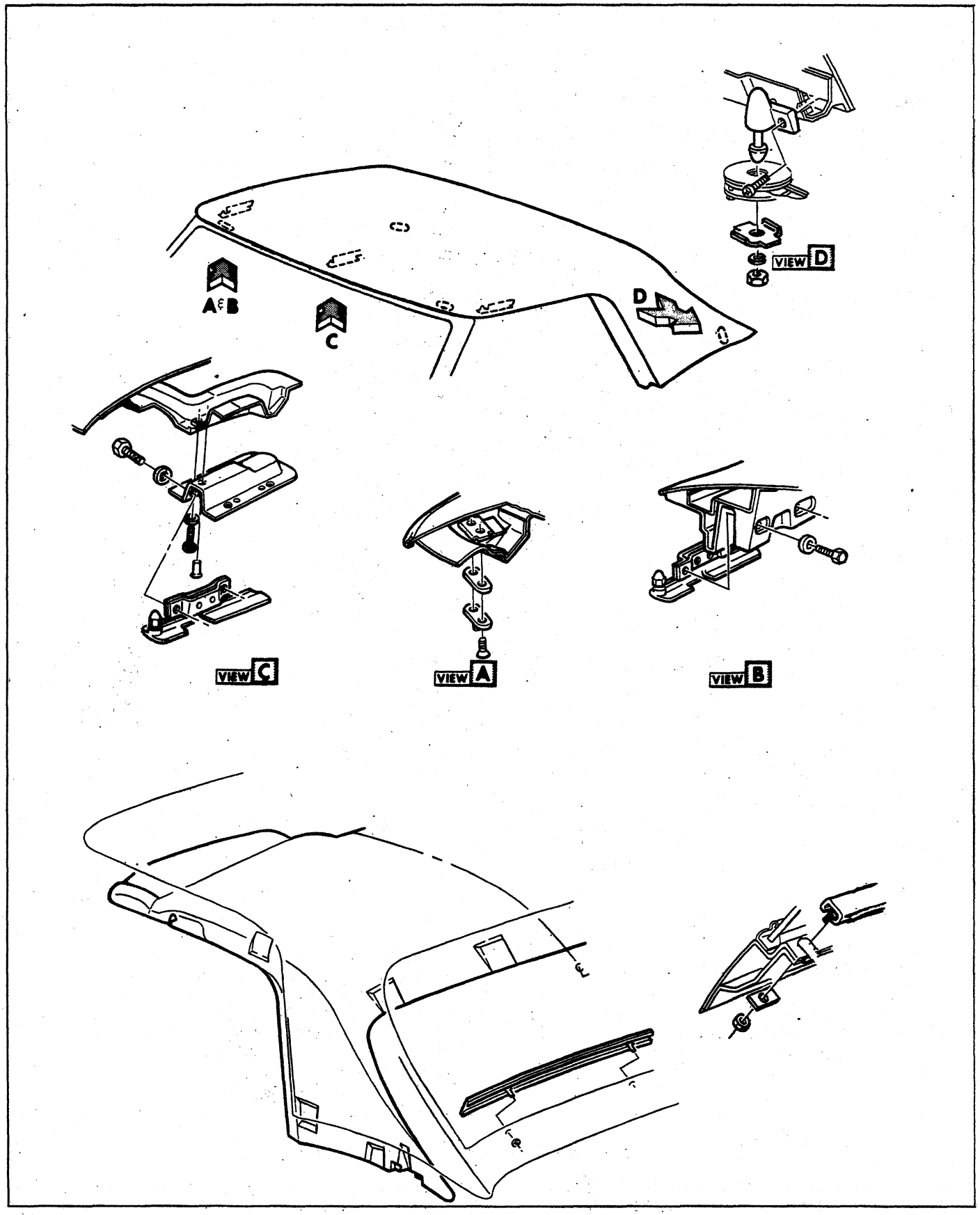


Fig. 61—Top Attachments and Headlining (Convertible Hardtop)

7. Clean up repair area with Prep-Sol, then use tack rag for finish cleanup.
8. Use the Resin Repair Procedure previously described.

NOTE: In some cases it may be advantageous to provide additional reinforcements along a fracture. This may be accomplished by placing glass cloth strips in the panel break before applying the plastic mixture.

Fractured Panels

Sometimes damage will occur to panels where the underside is inaccessible or for reasons of panel contour it is impractical to use back plies of fiberglass cloth. The following repair operations are typical of this type of damage.

1. Prepare the damaged area by grinding or filing all cracked and splintered material away from the fracture.
2. Bevel the edge of the fracture at approximately a 20° angle.
3. Remove paint from area surrounding fracture with Lacquer Solvent, or its equivalent.
4. Scuff surface to provide a good bonding surface. Then, clean up area with Prep-Sol and wipe dry.
5. Protect adjacent panels by masking, use non-staining masking tape.
6. Cut a strip of fiberglass cloth of sufficient size, so the fracture will be lapped from 1 to 2 inches on all sides.
7. Prepare plastic mixture in an unwaxed paper cup. (See Resin Repair Kit procedure.)
8. Impregnate glass fiber cloth by brushing or dipping in plastic mixture. Squeeze excess mixture from cloth.

NOTE: Avoid over-rich plastic areas in the glass cloth, as the strength of the patch is directly proportional to the glass content of the patch.

9. Position plastic impregnated fiberglass over the fracture on the exterior of the panel, lap the break by 1 to 2 inches, and depress into fracture.
10. Carefully work excess plastic out of woven glass by sponging from the center of the break outward.

NOTE: Hold woven glass in place until plastic resin "gels" with Saranwrap or some similar material.

11. Trim excess or loose strands of fiberglass from patch.
12. If low spots exist, prepare another plastic mixture of resin and hardener and mix thoroughly. To this mixture add short fibers cut from glass cloth to give the mixture a putty-like consistency.
13. Liberally apply the plastic mixture with a spatula to fracture and surrounding area. Deposit enough material build-up to allow for filing and sanding operations.
14. Allow the patch to harden.
15. File or grind patch to match the general contour of the panel. Exercise care when performing these operations to avoid gouging the patch or surrounding panel.
16. Use plastic solder as necessary to fill any imperfections.
17. Allow fill to harden, then sand finish preparatory to paint operation.

Panel Replacement

To install a replacement panel, the following method may be used. Various repair panels are available for service. See Repair Panels in general instructions at beginning of this section. These complete panels may be used or sections may be cut to accommodate the type of repair necessary. The panels should be fitted in and all attaching parts installed to insure proper alignment.

To replace panel, proceed as follows:

1. Cut out damaged panel with a hacksaw blade and thoroughly remove all dirt and paint from the underside of the old panel or panels for a distance of approximately 2 to 3 inches back from the attaching line.
2. Remove the paint from the finish side, for a distance of 2 to 3 inches on the panel adjacent to the replacement panel location with lacquer solvent or equivalent.
3. Scuff the surface on both the replacement panel and adjacent panel for a distance of 2 to 3 inches back from the attaching line and wipe clean.
4. Bevel all attaching edges at approximately 30° across the entire thickness of the plastic so a single "V" butt joint will be formed on the finish surface when the pieces are joined. If the replacement panel does not fit closely to the break, reshape to suit.
5. Cut two backup pieces of woven glass fiber cloth to run the entire length of the joint or shorter lengths of fiber cloth may be lapped over entire length of joint, also cut wide enough to lap the junction line on either side by two or three inches.
6. Prepare a sufficient amount of liquid plastic in an un-waxed paper cup by mixing resin with hardener (See Resin Repair procedure).
7. Align replacement panel, then clamp panel in place to form a closed "V" butt joint at the panel junction. When panel cannot be clamped, use 3/16" bolts with large washer on inner and outer of panel to hold panels in alignment or use straps and sheet metal screws.
8. Impregnate backup plies of woven glass cloth with prepared plastic mixture by dipping or brushing. Remove excess plastic from cloth by squeezing.
9. Place impregnated backup plies on underside of panels. If necessary, hold backup plies in place with paper until plastic "gels."
10. Prepare another plastic mixture of resin and hardener and mix thoroughly. To this mixture add cut glass fiber (1/2" lengths) until mixture has a putty-like consistency, or utilize glass cloth.
11. Fill "V" groove with reinforced plastic material or saturated glass cloth. Build up surrounding area with sufficient material to allow for finish operations.
12. Allow patch to harden.
13. File or sand (#80-D sandpaper) to general panel contour.
14. Allow plastic fill to harden, then sand, preparatory to paint operations.

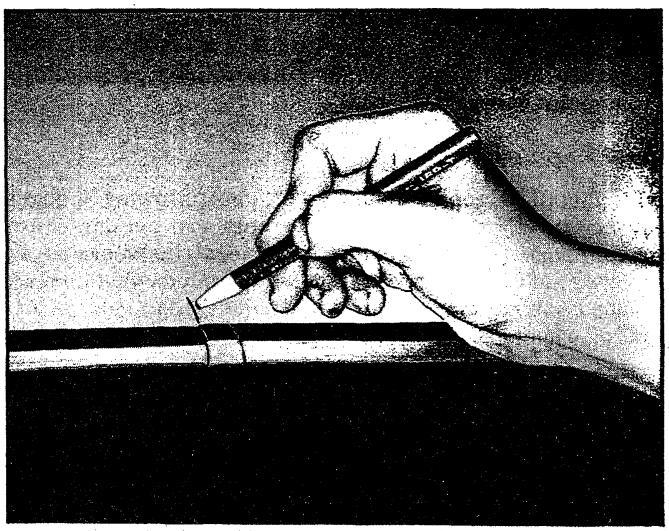


Fig. 62—Marking Molding Position

HARD TOP

CARE AND STORAGE

The outside painted finish of the hard top should be cleaned in the same manner as the rest of the body. The inside headlining should be cleaned as outlined under Cleaning Soft Trim.

When hard top is not in use, it should be stored indoors where it can be kept clean and dry. If stored for a long period of time, keep covered to prevent dirt settling on headlining and outside surface.

REAR WINDOW

Refer to Figures 60 and 61 for parts identification.

Removal

1. Remove hard top from vehicle and place protective covering over headlining.
2. Mark position of right-hand upper reveal molding end (fig. 62) and pry out from retaining clips. Repeat for left-hand and lower molding assemblies.
3. Remove lower (inside) garnish molding by removing four (4) nuts from fixed studs and carefully pulling molding outward.
4. Follow Steps 8 through 13 as outlined in the section entitled FRONT END--WINDSHIELD for removal of glass.

Installation

1. Position replacement glass in opening and carefully check relationship of glass to flange completely around opening. Overlap of glass should be equal with a minimum overlap of 3/16 inches.
2. Where necessary, place shims under lower spaces to obtain required overlap of glass to upper and lower flanges.
3. After proper alignment is attained, mark position on glass and top surface with grease pencil.
4. Follow Steps 16-22 in the section entitled FRONT END--WINDSHIELD for installation of glass.
5. Press glass lightly to set caulking to window opening flanges. Paddle material where necessary to ensure proper seal.
6. Water test immediately using a cold water spray. If water leaks are encountered, use flat bladed screw driver or splint, and from the inside, paddle caulking material into point of leakage.

   CAUTION: DO NOT RUN A HEAVY STREAM OF WATER DIRECTLY ON CAULKING MATERIAL WHILE THE MATERIAL IS STILL SOFT.

7. Install previously removed moldings in reverse order of removal.

TOP ATTACHMENTS

Figure 61 illustrates location and installation of guides and lock mechanisms. With headlining removed as outlined in this section, to adjust left and right hand locks fore and aft, mark original position, loosen two (2) mounting bolts, and move in desired direction. Make certain that lock is engaged in serrations before tighten ing mounting screws.

Up-and-down adjustment is performed by turning hexagonal latch bolts clockwise and counter-clockwise respectively. Header guide pins and rear pin housings are retained by mounting screws located at flanges. Center trim plate is removed by first removing center lock, and then four (4) retaining screws.

HEADLININGS

The headlining assembly is secured to the top by plastic fasteners located around the periphery of the hard top inner panel. The headlining is removed by carefully disengaging fasteners by prying outward with fingers on flat-bladed instrument. After removal from plastic top, the headlining can be disassembled into three parts by removing retaining nuts at inside surface of headlining. For installation, make certain to align headlining to top before engaging plastic fasteners.

WEATHERSTRIP AND DRIP MOLDING

As shown in Figure 60, door window weatherstrip and drip molding are retained by screws to top assembly. Side outer and rear outer weatherstrip are mounted to body at ends by screw and around periphery by special plastic retaining clips. Weatherstrip is replaced by removing two (2) screws and carefully pulling outward at clip location.

Inner forward weatherstrip is replaced by removing mounting screws and disengaging special clips along length of weatherstrip. All drip molding must have pumpable sealer on underside and adhesive applied to weatherstrips.

VINYL COVERING

Removal

1. Remove weatherstrip assemblies.
2. Remove reveal moldings.
3. Prior to removing fabric cover, application of heat to cemented areas will permit easier loosening of cemented edges.

   CAUTION: Apply heat by lamps held 18" (minimum) from fabric only until fabric is warm. If lamps are held too close, or fabric cover is

heated over 200°F, the fabric may loose its grain, blister, or become very shiny.

4. Loosen cemented edges of fabric roof cover.

Installation

1. Wipe roof panel with a Xylol solvent such as 3M Adhesive cleaner or equivalent. Remove or smooth out excess old cement. Apply solvent and allow to soak before rubbing.
2. Where possible, install new cover at room temperature (approximately 72°) to permit easier fitting and removing of wrinkles from the cover assembly.
3. Determine center line of roof panel by marking center points on front of hard top and back window opening. Fold cover lengthwise. Lay cover on roof panel. Determine overhang (approximately 1").
4. Apply nitrile non-staining vinyl trim adhesive (such as 3M Vinyl Trim Adhesive) to the roof panel adjacent to center line of fabric roof cover.
5. Application of nitrile vinyl trim cement should be as thin as possible. An excessive amount of cement may result in trapped solvents (blisters) between fabric cover and roof panel. A mohair roller should be used for thin adhesive application.

   NOTE: If nitrile non-staining cement is not available, neoprene type non-staining weatherstrip cement (3M weatherstrip cement or equivalent) may be used.

6. Apply cement to entire fabric roof cover.

   NOTE: Allow approximately 15 minutes for cement to dry.

7. Fold vinyl cover back to contact adhesive on roof panel. Vinyl cover seam must be parallel to centerline of vehicle.
8. Repeat above steps for opposite side of roof.
9. Use suitable spatula or roller to remove wrinkles and/or bubbles from vinyl cover.
10. Trim excess vinyl around entire top to provide a minimum of 1/2" flange which will be cemented to substructure of removable hardtop with adhesive.
11. Reinstall reveal moldings and weatherstrips.

Vinyl Roof Cover Repairs

Certain types of fabric roof cover discrepancies can successfully be repaired without replacing or removing the cover.

Scuffs or Small Cuts Near Exterior Moldings

If a small cut is present, an attempt should be made to cement the loose ends prior to performing the following:

1. Obtain a scrap piece of fabric roof cover material, or material from a hidden area directly on complaint car (such as under reveal moldings).
2. Using an electric wood burning needle or low heat soldering gun, scrape off an appropriate amount of vinyl from scrap piece of material or from hidden area and immediately apply to scuffed or cut area on car.

   CAUTION: Be certain low heat is maintained to prevent discoloration of cover.

3. Carefully blend applied vinyl to fabric roof cover, utilizing electric needle or soldering gun.

Wrinkles, Blisters and Bubbles

1. Pierce each wrinkle, blister and bubble on fabric roof cover with a small needle.
2. Completely saturate a clean shop towel with water and wring out.
3. Apply cloth to wrinkle or blistered area.
4. Apply a home type laundry iron over shop towel using back and forth strokes until towel is dry. (If iron has heat control settings, control should be set to "wool".)

   CAUTION: Do not continue to use iron after towel has become dry as excess heat may cause permanent damage to vinyl roof cover.

5. Remove towel and inspect area. If slight wrinkles or blisters are still present, perform the following steps:
6. Using a syringe and hypodermic needle filled with clear water, inject sufficient water into wrinkle or bubble to dampen fabric backing.
7. Repeat Steps 2 through 4.

FOLDING TOP

CARE OF THE FOLDING TOP

To avoid water stains, mildew, or possible shrinkage of the top material, do not keep the top folded for extended periods of time if it is damp or water soaked. Permit top to dry out in a raised position before stowing. Also avoid pasting advertising stickers, gummed labels or masking tape on the plastic back window. In addition to being difficult to remove, the adhesive on these stickers may also be injurious to the plastic composition of the window.

Care of Rear Window

The large plastic rear window in the folding top will remain in good condition for the life of the top if given proper care. Due to the texture of the plastic window, it is susceptible to scratches and abrasions; therefore, when cleaning the window, follow the steps outlined below.

1. To remove superficial dust, do not use a dry cloth. Use a soft cotton cloth moistened with water and wipe cross-wise of the window.
2. To wash the rear window, use cold or tepid (not hot) water and a mild neutral soap suds. After washing, rinse with clear water and wipe with a slightly moistened clean soft cloth. A high quality plastic window cleaner is available from Chevrolet parts sources.

   CAUTION: Never use solvents such as alcohol or volatile cleaning agents on the plastic window. These liquids may have a deteriorating effect on the plastic and if spilled, may spot the painted finish on the rear body panels directly below the rear window.

3. When removing frost, snow or ice from the plastic window, DO NOT USE A SCRAPPER. In an emergency, warm water may be used. Use care that the

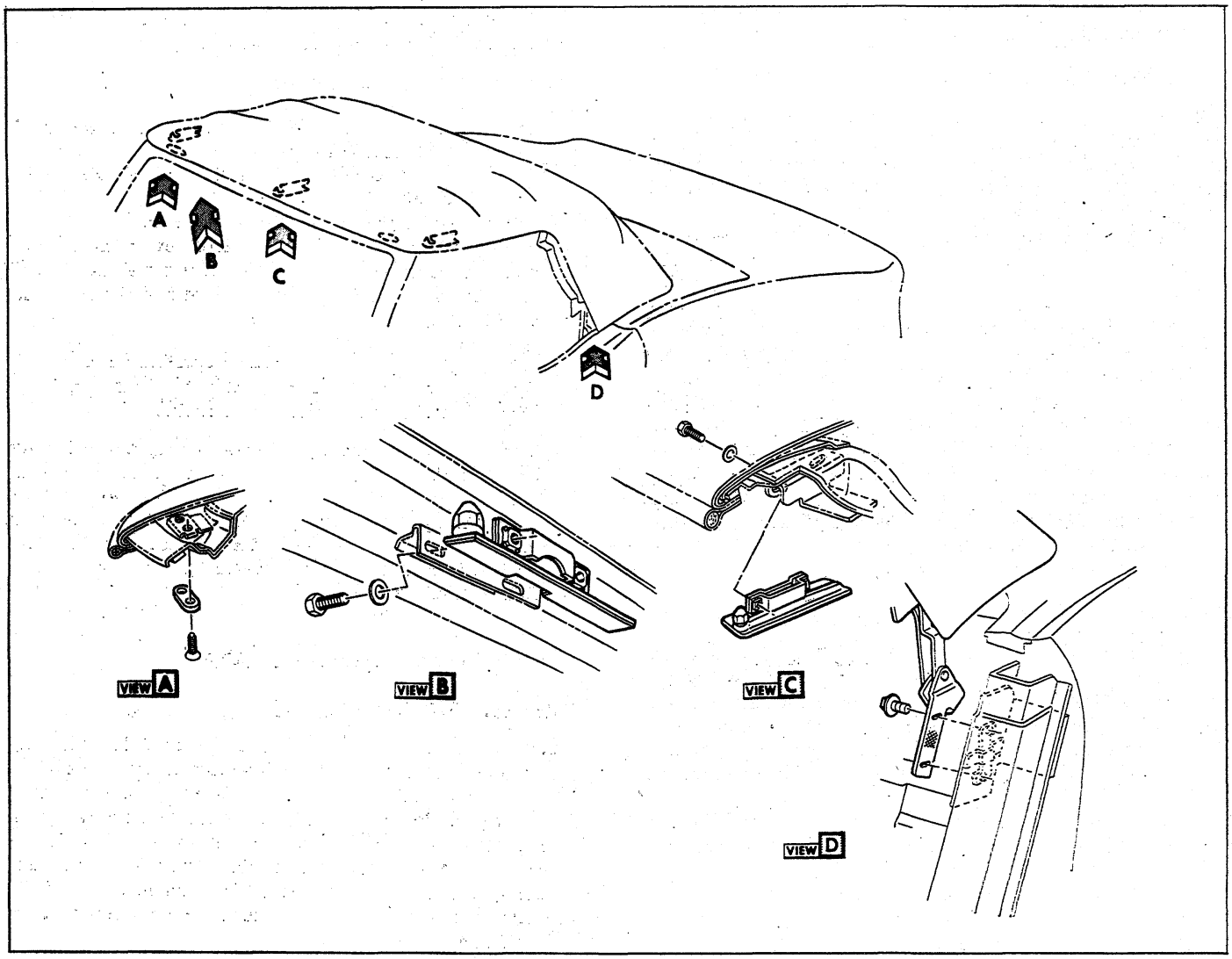


Fig. 63—Folding Top Adjustments

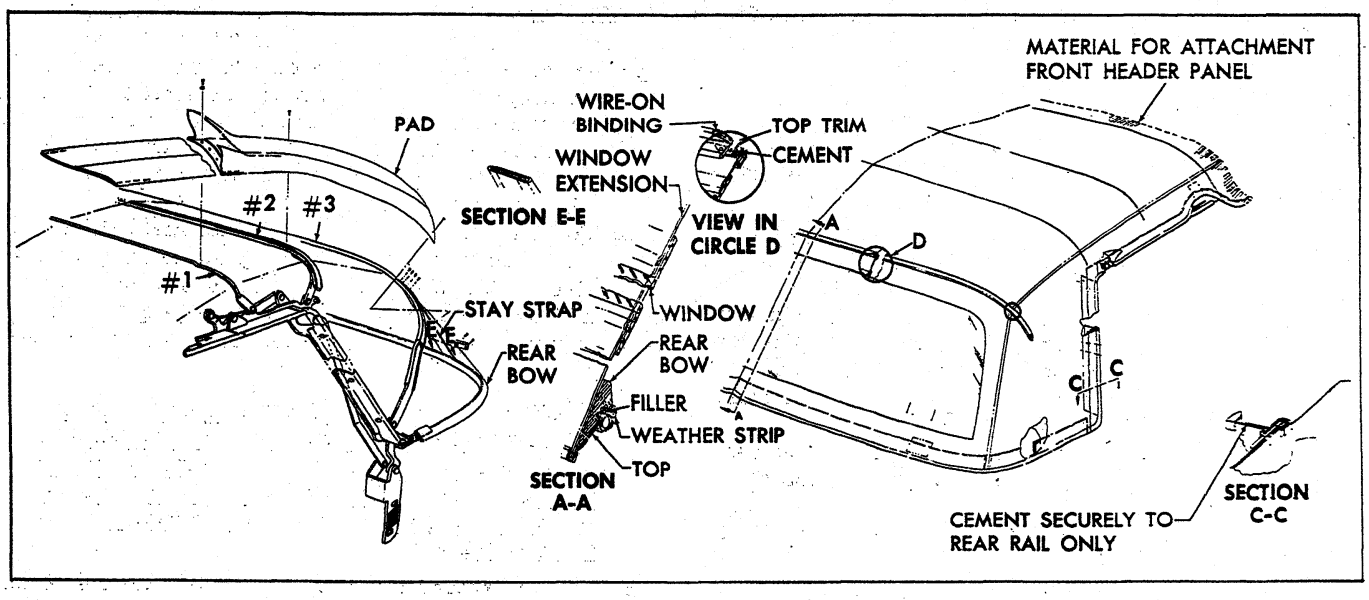


Fig. 64—Folding Top Trim Installation

warm water does not contact the glass windows or windshield.

ADJUSTMENTS

To correct variations in the top fit, adjustments are made at three locations shown in Figure 63. A combination of adjustments may be necessary to correct any given problem, including door and window adjustments which are covered elsewhere in this section.

The folding top adjustments are:

Header

After removing header trim panel, header assembly may be moved fore and aft when the two clamping screws are loosened. This will correct such conditions as header latch guide pin alignment with the holes in the windshield upper frame. Indications of misalignment are loose top trim when top is up and locked, and excessive effort required to engage header locks. Note that it will be necessary to remove side roof rail weatherstrip to gain access to header outer clamping screw. Refer to Weatherstrip portion of this section.

Hinge

The hinges may be moved up and down and fore and aft to the limit of the slotted holes in hinge plate and body. To gain access to hinge, remove rigid plastic trim as explained in Interior Trim portion of this section. Repositioning hinge will correct conditions such as poor top fit at upper and rear edge of windows; faulty fore and aft engagements of rear bow hold-down pins in lock assemblies and loose or over-tight top rear panel when top is raised and properly locked in position.

Rear Bow Hold-Down Locks

Fore and aft adjustment is provided by slotted holes in lock housing. Turning of locating pins adjusts force that holds seal to folding top lid. The hold-down pins may be moved to left or right to center top on body in raised position; thus correcting poor alignment at windows and difficult entry of pins in locks.

TOP ASSEMBLY REMOVAL AND INSTALLATION

The entire top assembly (frame with trim attached) may be removed from vehicle as follows:

1. Raise top, but do not engage header or rear bow locks.
2. Remove rigid plastic trim as outlined in Interior Trim portion of this section.
3. Mark installed position of hinge by scribing outline of hinge plate on lock pillar surface.
4. Remove two screws retaining each hinge to lock pillar and remove top assembly from vehicle.
5. When installing top assembly, carefully match hinge plate with scribed marks on body lock pillar and install screws. If necessary, proceed as outlined under Top Adjustments.

TOP TRIM AND REAR WINDOW ASSEMBLY

The following information deals with removal and installation of the folding top trim and window assembly

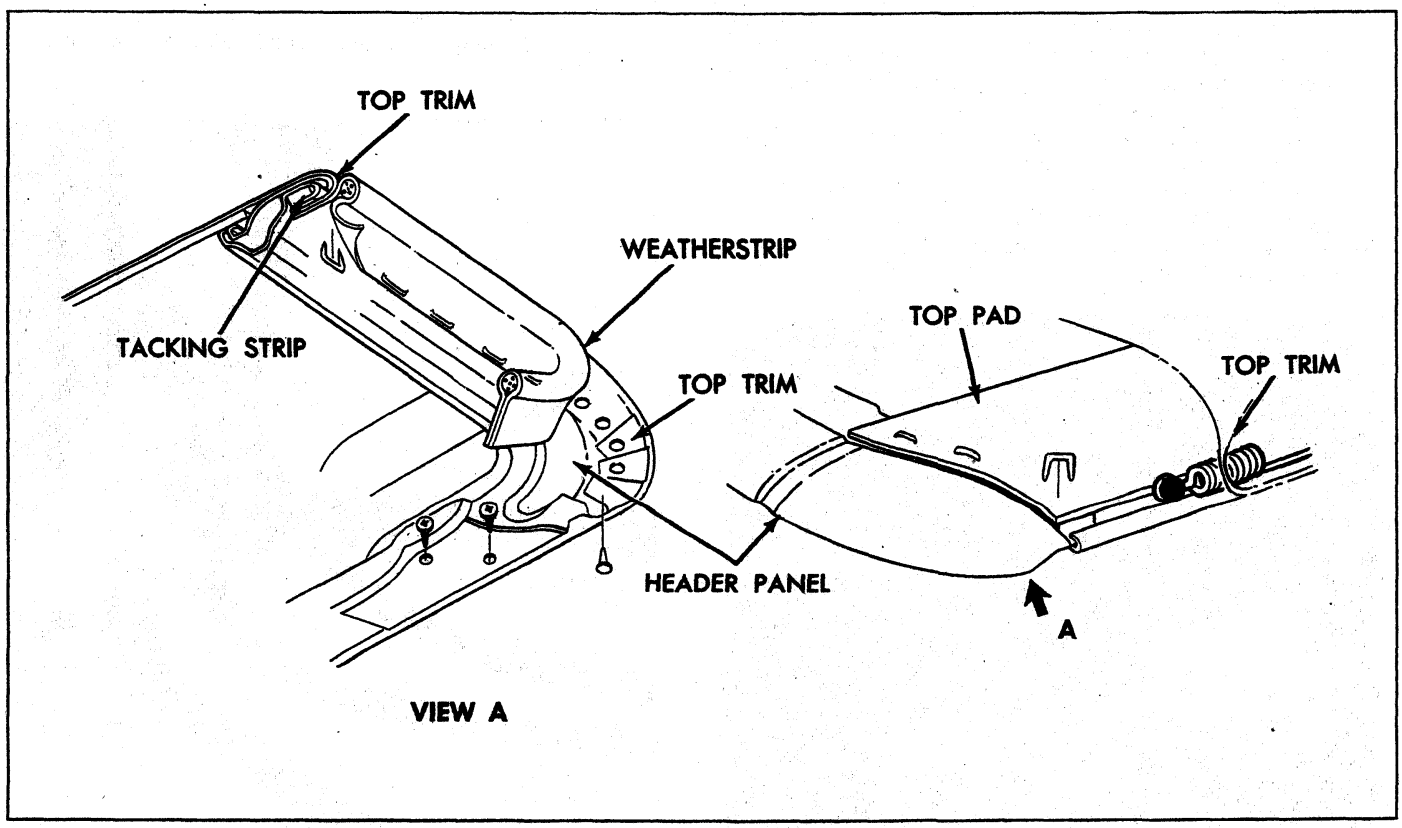


Fig. 65—Trim at Header

complete. Figure 64 may be referred to for parts identifications. Lettered sections (i.e. Section A-A) referred to in the instructions may also be found in Figure 71. Note that the sections are illustrated as they would appear if the parts were cut through on the lettered lines on the top assembly and the cut surface exposed. Arrows indicate direction in which you would have to look in order to see the view shown.

Before old trim assembly is removed, top should be thoroughly adjusted as outlined in this section. As loose parts are removed such as stay straps and pads, their installed positions should be marked as an aid to installation of replacements.

Removal

1. Remove rear side rail window sealing weatherstrip as explained further on in this section; also remove screws from ends of header inner weatherstrip. Note, however, that it is not necessary to remove header weatherstrip entirely and that header strip must be in place during final installation procedures of top trim so that correct tension of installed trim is achieved.
2. Remove tacks securing top and header outer weatherstrip to header (fig. 65).
3. Remove screw securing trim hold cable and spring assembly to header.
4. Pull cemented trim from rear side rail (Section C-C).
5. Remove end caps from wire-on binding; remove tacks securing binding to #3 bow (View F.). See frame and linkage portion for bow identification.
6. Remove staples securing trim to #3 bow.
7. Remove tacks securing upper ends of stay straps to #3 bow. Pads may be removed at this time, if desired. Mark position of pads and straps on head and #3 bow before removal.
8. Disconnect rear bow from top frame assembly. Two screws retain at each side Figure 66.
9. Remove trim-rear bow assembly from vehicle to clean work bench or table.
10. Remove plastic filler from rear bow weatherstrip and pull weatherstrip and trim from rear bow.

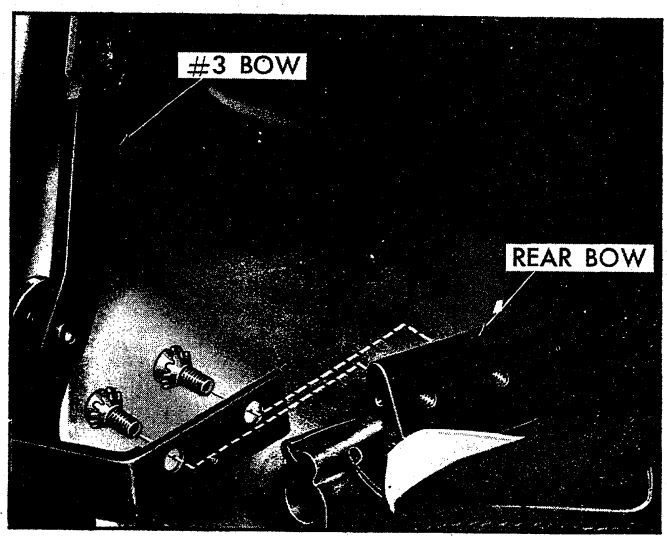


Fig. 66—Rear Bow Retaining Screws

Section A-A shows installed position of these components. Refer also to Figure 67.

Installation

1. Find and mark center of header, #3 bow, rear bow and leading and trailing edges of top trim. Align these marks during installation and recheck their alignment from time to time while installation is in progress, especially during tacking or stapling.
2. Assemble top trim and weatherstrip to rear bow, referring to Section A-A and Figure 67. Note that filler strip locks this assembly together and goes in last. Align center marks.
3. If new pads are required, install at this time, aligning with marks made when old pads were removed. Figure 68 shows pad construction; Figure 69 shows pad installed.
4. Install top trim-rear bow assembly on top frame with four screws removed at disassembly.
5. Lock down rear bow in desired "top up" position. Pull up stay straps and staple or tack to #3 bow (fig. 70).
6. Using a piece of mechanics wire, fish trim hold down cable assembly through top pocket and secure spring cable assembly to header with a screw.
7. Pull leading edge of trim up to header and align center marks. Smooth out fabric and clamp, tack or staple temporarily to header.
8. Draw window extension up to #3 bow, aligning centering marks. Turn an ample amount of fabric under and tack to #3 bow. Apply neoprene trim cement, GM Part #3695016 or equivalent, to area shown in View D of Figure 64. Follow directions on package.
9. Draw roof portion of trim over #3 bow, align marks and tack on staple.
10. Trim off excess material and install wire-on binding

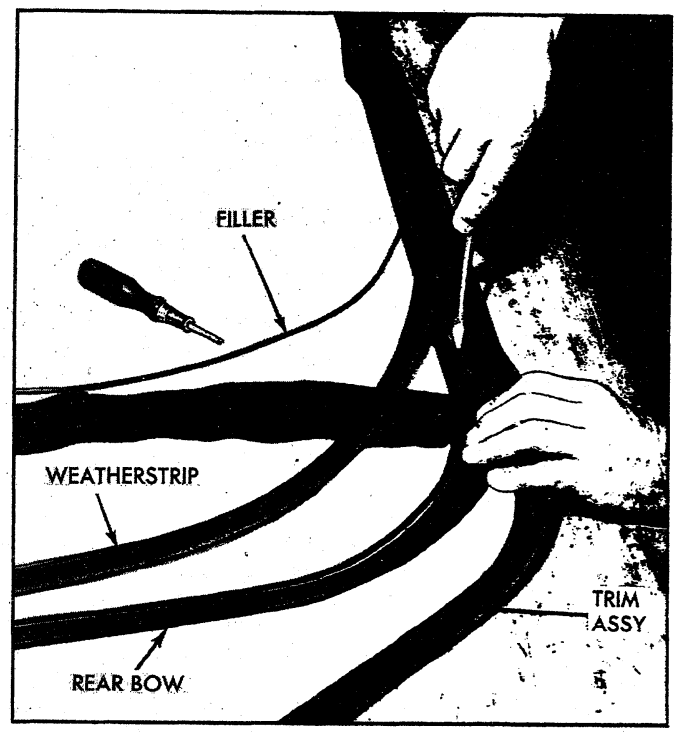


Fig. 67—Installing Trim and Weatherstrip to Rear Bow

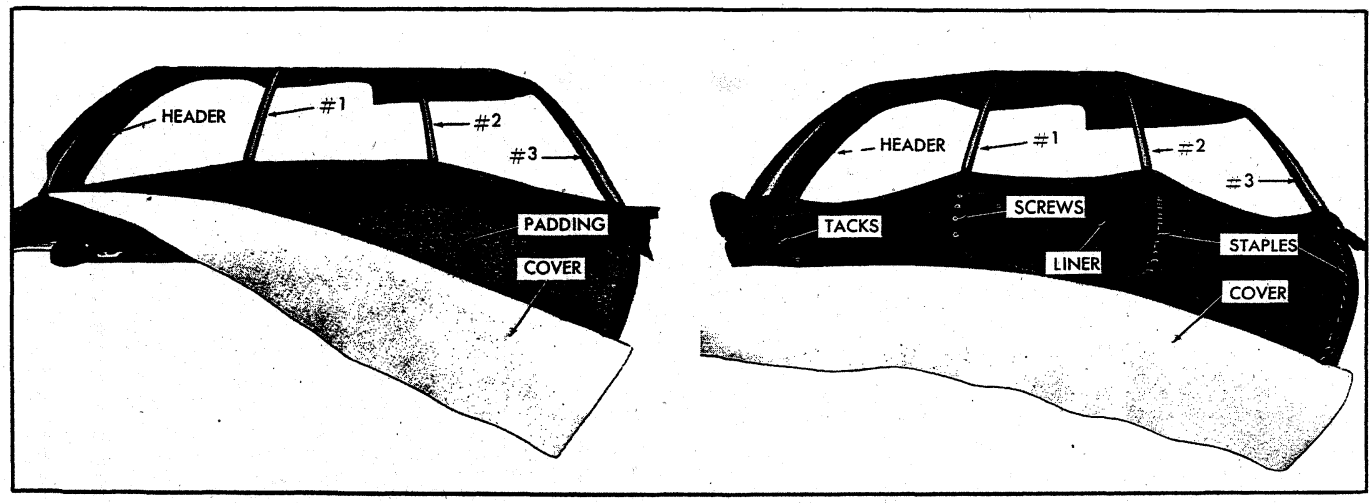


Fig. 68—Pad Construction

a: shown in Figure 71 and View D of Figure 64. Intall binding caps.

11. Rnove temporary clamps or fastenings holding trn to header.
12. Wh header locked down, pull trim assembly up tight an mark for final installation.
13. Aply trim cement to header and rear side rail.
14. Rease header from windshield. Tack or staple trim to ader (fig. 65).
15. Aply trim to rear side frame, previously cemented.
16. Insll weatherstrips which were removed at disasmbly and install retaining screws in header weherstrip.
17. Insll header trim panel.
18. Ma: any adjustments necessary, following instructio: listed under Folding Top—Adjustments.

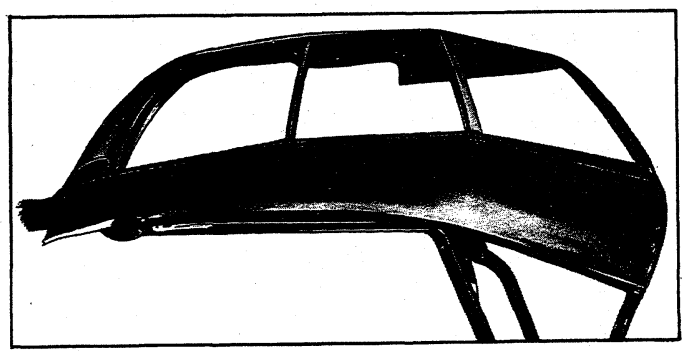


Fig. 69—Pad Installed

FRAMEAND LINKAGE

Figur 72 illustrates construction features of the folding p frame and linkage. Various cross sections in Figure 2 show the pivoting joints and their assembly.

If anoperation is being performed which requires removalof folding top trim, follow directions in this section. The entire frame assembly may be removed and replaceas a unit. Follow instructions for Folding Top Trim a: Rear Window Assembly and Top Assembly—Removalnd Installation.

The poting joints should be lubricated with light machine oil once a year. Apply oil sparingly so as not to stain b trim.

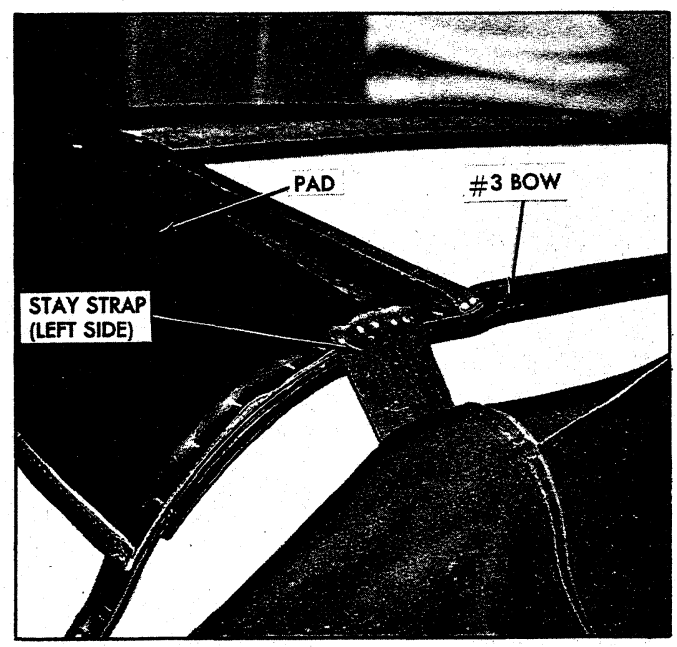


Fig. 70—Installing Stay Strap

WEATHRSTRIP

Side RaiWeatherstrip

Figure'3 illustrates installation of side rail weatherstrip whh acts to seal window opening. The weatherstrip is lld in place by loose screws which are part of the weatlrstrip assembly, and by neoprene base cement which isapplied between weatherstrip and side rail surface.

When :placing weatherstrip remove all rust, old cement al foreign material from the surfaces to be cemented,to assure successful bonding. Use only good

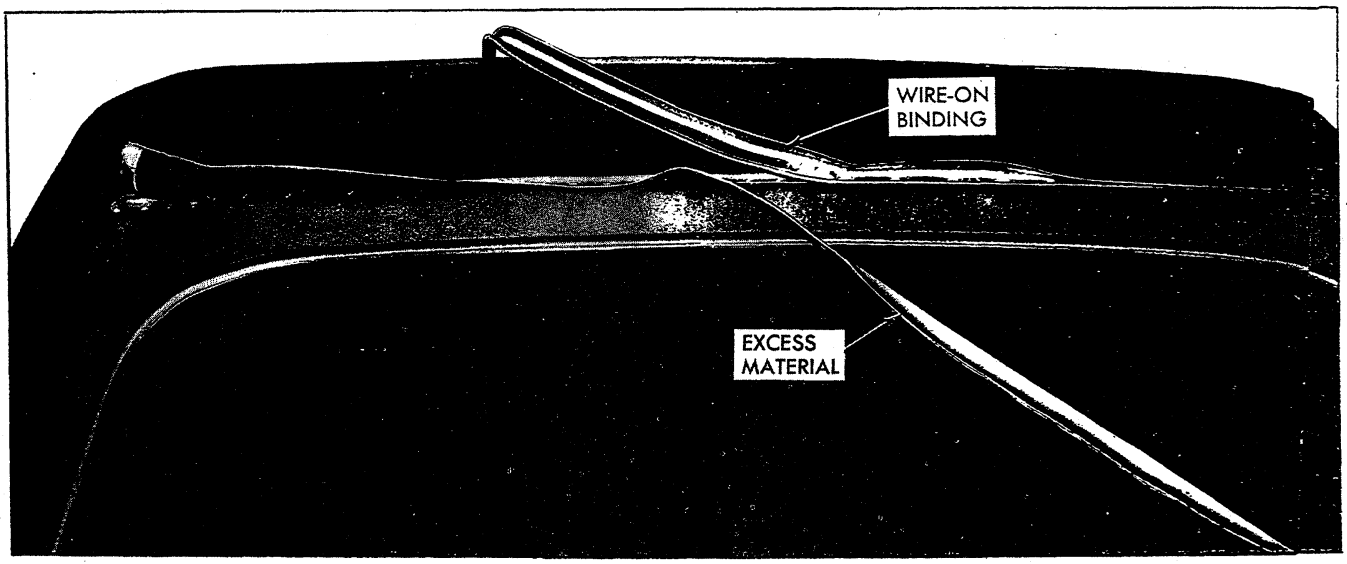


Fig. 71—Installing Binding

quality neoprene cement suitable for weatherstrip application.

Header Weatherstrip

Weatherstrip assembly is retained to the header panel by a combination of studs, and special fasteners as shown in Figure 74 along with neoprene base weatherstrip cement.

SPORT COUPE MODEL 19437

ROOF PANEL ADJUSTMENT (Fig. 75)

Each roof panel is adjusted in relationship to the other

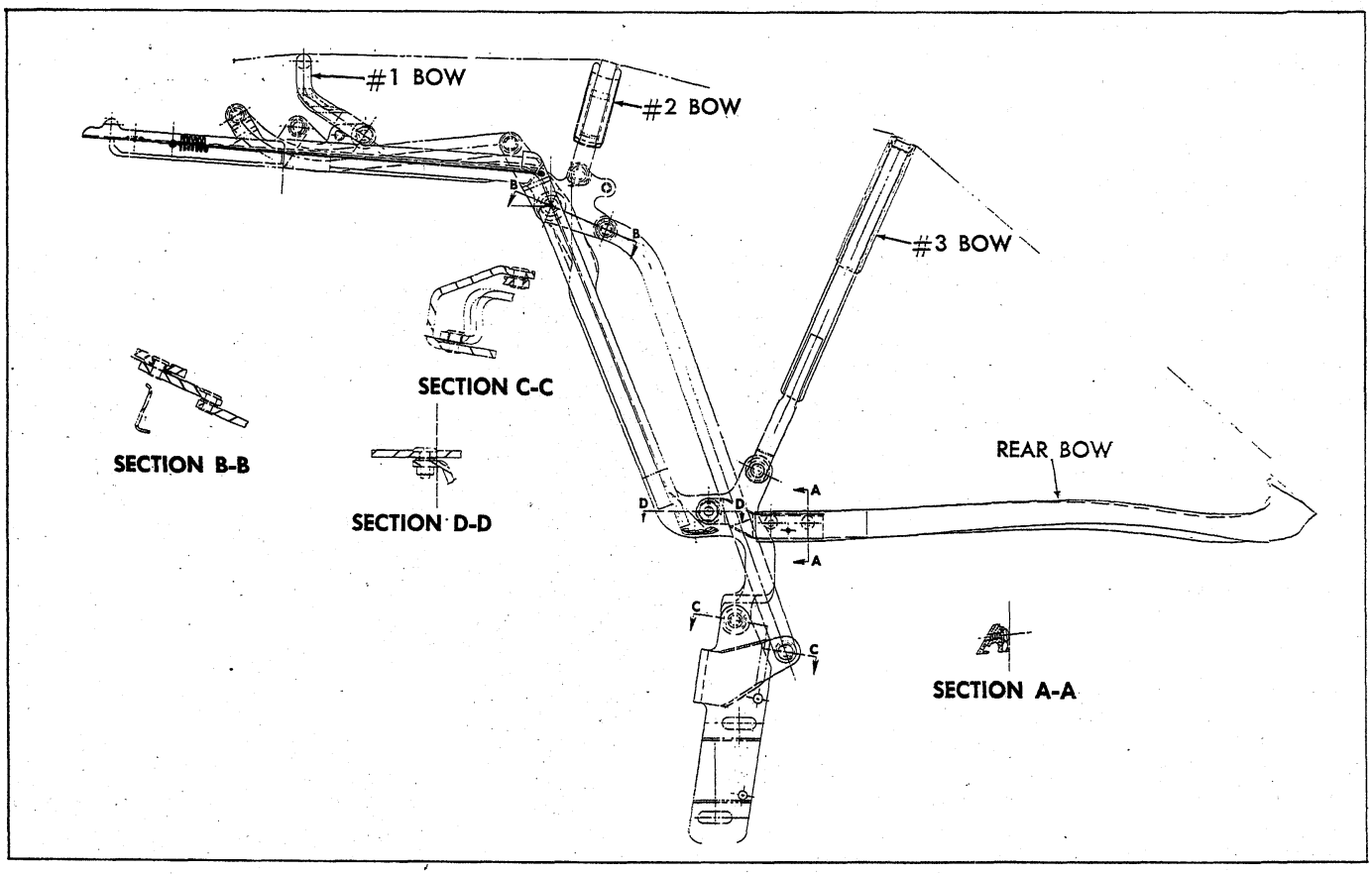


Fig. 72—Top Frame and Linkage

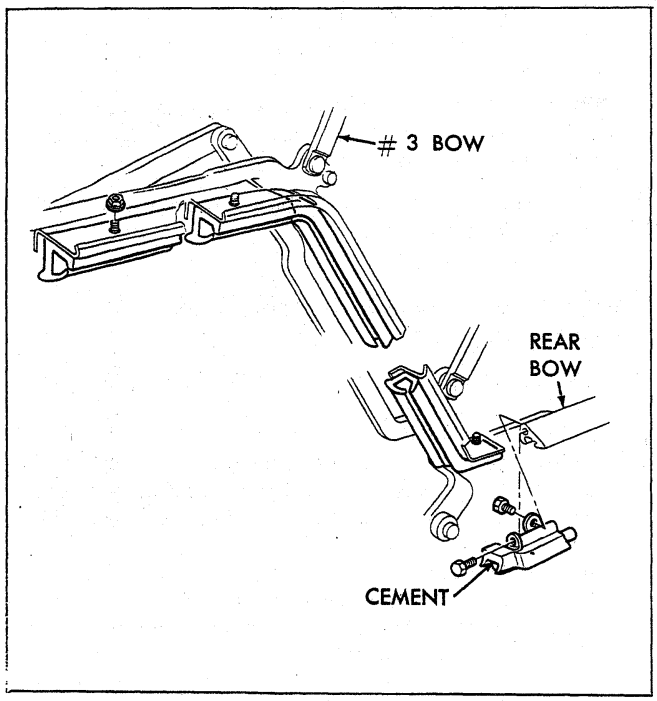


Fig. 73—Side Rail Weatherstrip

ıd to the header and roof crossover.

Roof panel inner edges are spaced parallel 1/16" to /16". The rear edges of the roof panel are spaced 1/8" › 1/4" side to side. The outboard edge of the roof panel › header spacing is determined by the triangular headed in fastened to the roof crossover. The back edge of the riangular headed pin should measure 1/4" from the plate : screws into.

All latches and adjustments must be loose before starting the roof panel alignments. The only shimming possible is at the center guides.

Adjustment Procedure

1. Remove roof panel and place upside down on a clean soft surface.

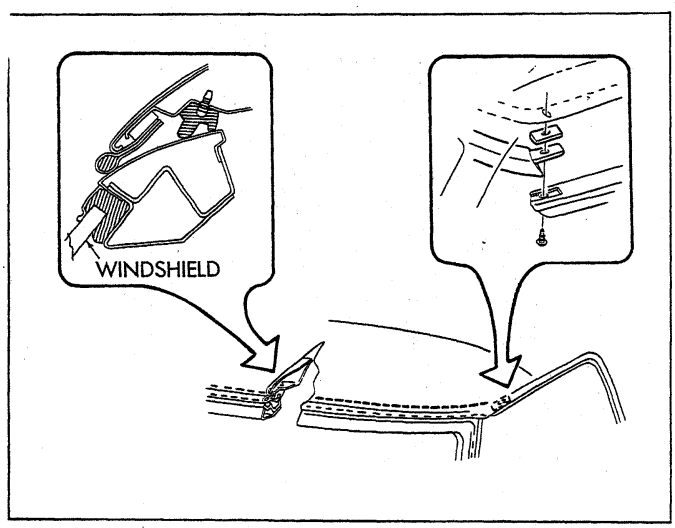


Fig. 74—Header Weatherstrip

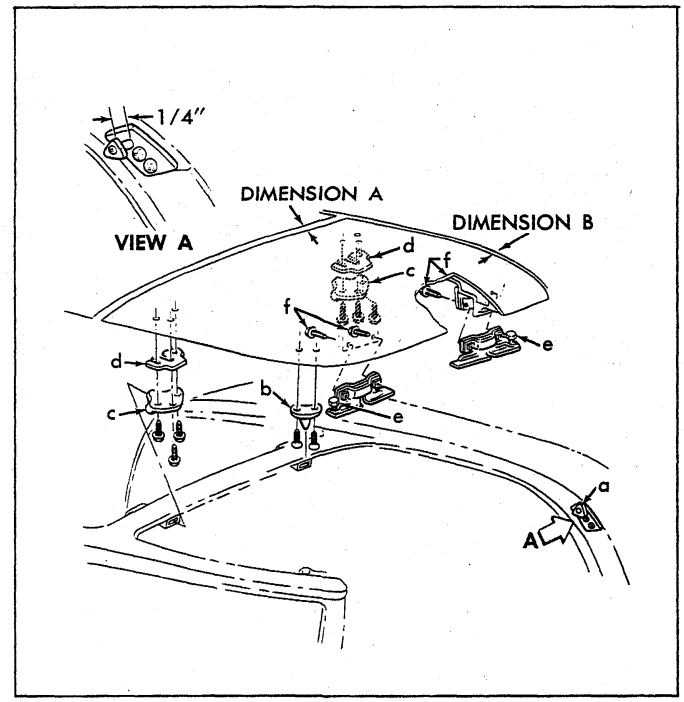


Fig. 75—Roof Panel Alignments

2. Remove screw from each side of headlining panel and gently pry headlining loose from plastic retainers.
3. Loosen screws on underside of roof panel at forward (b) and center guides (c).
4. Repeat steps 1-3 for opposite roof panel.
5. Check dimension of triangular pin (a) on header panel at outer edges of the roof panel attachment locations. Refer to View A.
6. Reinstall roof panels and observe spacing. The roof halves should meet within 1/16"-3/16" in the center (dimension A) and within 1/8"-1/4" to the header (dimension B).

   NOTE: Contour of roof is controlled by shims (d) (no more than 4). It should be noted that the fewer shims used at this location, the more compression on the seating gasket.

7. Once dimensions A and B have been obtained by manipulating each roof panel with respect to one another and the header, tighten the screws securing the center and forward guides in the roof panels.

   NOTE: If compression at the lock locations is needed, adjust bolts (e) accordingly. If point of contact of latch bolt needs adjustment loosen bolts (f) and move latch assemblies fore or aft as necessary.

8. Align headlining with a 3/16" gap all around and push headlining panels upward with firm palm pressure at nylon retainers.
9. Remove panels, make sure all nylon fasteners are engaged and reinstall headlining screws.
10. Reinstall roof panels on vehicle.

Weatherstrip Replacement (Fig. 76)

1. Remove roof panel and place upside down on soft clean surface.

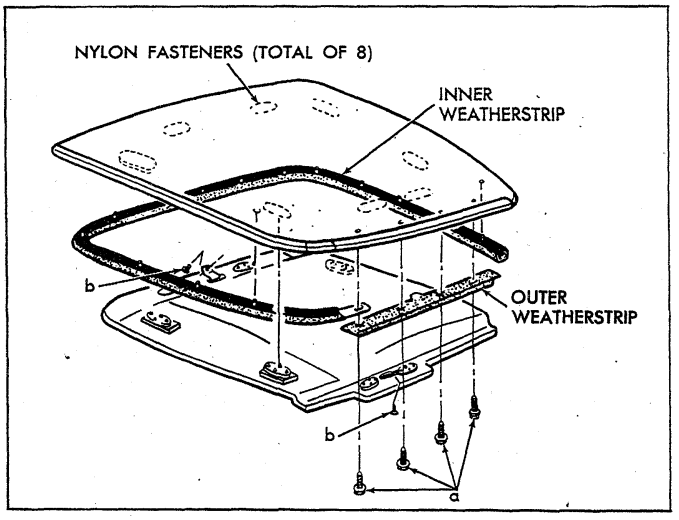


Fig. 76—Roof Panel Weatherstrips

2. Remove four (4) screws (a) retaining outer weatherstrip. Remove weatherstrip.

   NOTE: Butt joints are rubber cemented to inner weatherstrip. Use care when separating.

3. If inner weatherstrip is to be removed, proceed as follows:
   a. Remove screw (b) on each side of headliner panel.
   b. Pry headliner loose from nylon retainers at eight (8) locations. Remove headliner.
   c. Pry out plastic buttons retaining weatherstrip to roof panel. Remove weatherstrip.
4. Clean old sealer off roof panel.
5. If inner weatherstrip was removed, perform the following:
   a. Apply sealer to roof panel along the entire periphery of the roof panel where the inner strip is to lie.
   b. Install new weatherstrip starting at screw attachment end engaging all plastic retainers. Push down along strip to uniformly spread the sealer. Apply rubber cement to butt joint ends.

   NOTE: It may be necessary to cut the rearward end of weatherstrip to have it properly butt against outer weatherstrip.

   c. Reinstall headliner panel.
6. Apply a 3/16" bead of sealer on the roof panel where outer weatherstrip will lie.
7. Apply rubber cement to butt ends of the new outer weatherstrip and reinstall to roof panel with four (4) screws.
8. Reinstall roof panel.

INTERIOR QUARTER PANEL TRIM REMOVAL (Fig. 77)

1. Remove rear window.
2. Gently pry off back window lower garnish molding (f) by pulling lower edge forward, then after unhooking nylon fasteners, lift up.
3. Remove (right or left) rear roof trim panel latch cover (a) secured by screws.
4. Remove (right or left) rear roof trim panel (b).
5. Remove (right or left) quarter trim panel secured by screws.

   NOTE: Four (4) screws retaining forward lip of interior quarter trim panel are removed and installed from inside door jamb.

6. Install interior trim and rear window in the reverse order of removal.

CENTER ROOF REINFORCEMENT TRIM REMOVAL (Fig. 77)

1. Remove both rear roof trim panel latch covers (a)—2 screws each.
2. Remove rear window.
3. Remove both rear roof panels (b) secured by screw.
4. Remove left and right sun visor assemblies. Remove windshield upper garnish molding (c) secured with screws.
5. Remove center roof trim screws. Pull assembly (d) downward to release the attachment stud (e
6. Install interior trim in the reverse order of removal then install rear window.

STORAGE TRAY

The storage tray which provides a means of storing rear window assembly when removed from vehicle, is replaced by removing hinge screws at rear body panel. The latch is adjusted by bending for proper engagement

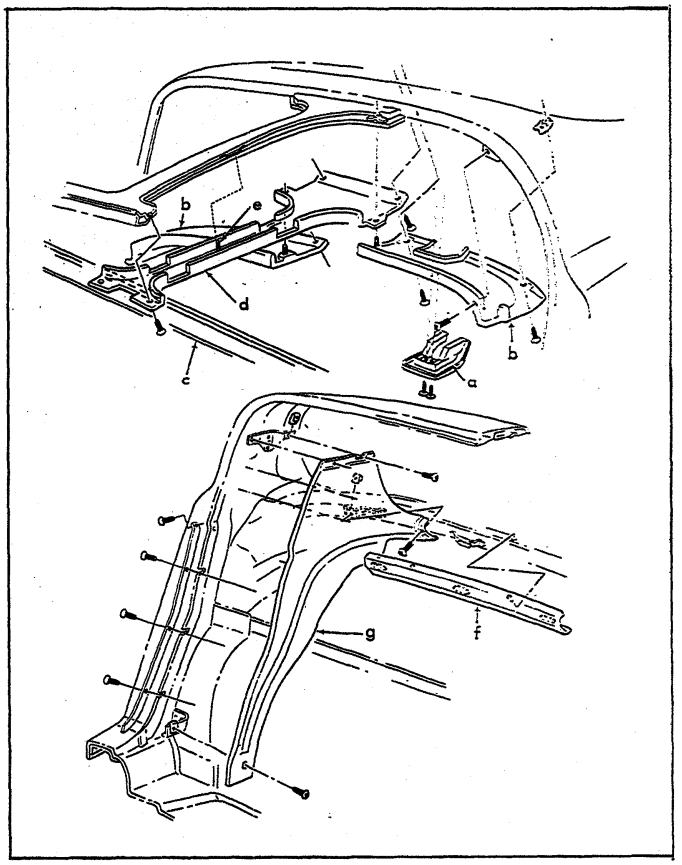


Fig. 77—Interior Quarter Trim

REAR WINDOW

Glass Replacement

To replace rear window glass, the following procedure is recommended:

1. Remove rear window assembly from vehicle and place on bench.
2. Remove lower frame member from old glass and frame assembly.
3. Remove glass from upper frame member and clean out sealer by carefully scraping from groove around entire perimeter of frame.
4. Apply bead of caulking material (polysulfide or equivalent) around slot of both frame components.
5. Insert replacement glass into curved frame member.
6. Assemble frame by aligning lower member with glass.
7. Clean excess caulking material from surface of glass.

Adjustment

The locks and lower receiving plates which determine the holding force are adjusted to the extent of slotted mounting holes to attain an even, adequate seal.

Weatherstrip

The weatherstrip between the rear window assembly and rear body opening is replaced by cementing to rear inner body surface around opening. The weatherstrip is then screwed in place.

SPECIAL TOOLS

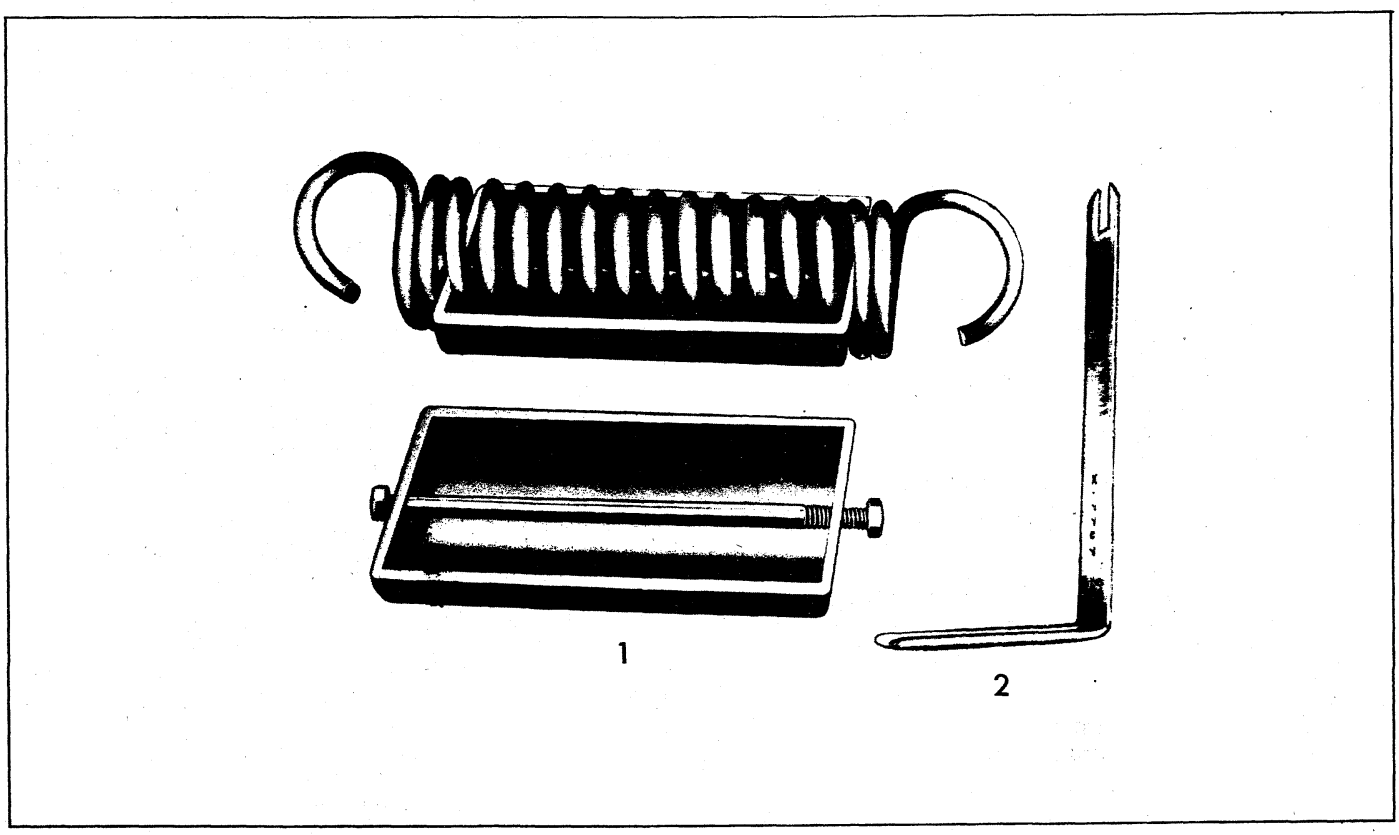


Fig. 78—Special Tools

1. J-9559 Hood Spring Tool
2. J-7797 Door Handle Clip Remover

SECTION 2
FRAME

INDEX

	Page		Page
General Description	2-1	Car Preparation	2-1
Chevrolet	2-1	Tramming Sequence	2-1
Chevelle	2-1	Reference Point Dimensions	2-1
Repair Procedures	2-1		
Checking Frame Alignment	2-1		

GENERAL DESCRIPTION

CHEVROLET AND CHEVELLE

Frames used on Chevrolet and Chevelle lines are basically the same, consisting of full length right and left side members joined laterally by crossmembers. Several different frames are used in each line to meet the various vehicle size and function requirements but the basic shape for each line remains the same. Differences between frames in a given line exist only in metal gauge, part size and numbers of parts necessary to meet the particular structural requirements of the models involved.

CORVETTE

The Corvette frame is a rigid perimeter unit, with five crossmembers. From the rear kick-up forward, trapazoidal shaped, closed side members outline and protect the passenger compartment. At the cowl area, the side members curve inward in a sweeping "S" shape, to provide a sturdy foundation for the engine mounts and clearance for front wheel movement. From the kick-up rearward, box-sectioned side rails provide fore and aft support for the rear axle and suspension. Lateral support is provided by five variously shaped welded-in crossmembers.

NOVA AND CAMARO

Frames used on Nova and Camaro lines are identical consisting of half frame and half unibody construction. The frame consists of short side members extending from behind the front doors to the front of the vehicle joined laterally by crossmembers. This is to provide support for the steering mechanism, front suspension, engine and transmission. The rear section has the frame as an integral part of the body and will be covered in the Body Service Manual.

REPAIR PROCEDURES

CHECKING FRAME ALIGNMENT

Vehicles involved in an accident of any nature which might result in a "swayed" or "sprung" frame should always be checked for proper frame alignment in addition to steering geometry and wheel alignment.

CAR PREPARATION

Preparing the car for the frame alignment check involves the following:

1. Place the car on level surface.
2. The weight of the car should be supported at the wheel locations.
3. A visual damage inspection should be made to eliminate needless measuring. Obviously damaged or misaligned areas can often be located by sight.

TRAMMING SEQUENCE

When checking a frame for alignment in case of damage, the first step is horizontal "X" checking with a tram from similar given points on opposite side of the frame.

Frame alignment checks on all models should be made with the tram points set at the center of each locating point indicated and the cross bar level to insure accuracy.

When "X" checking any section of the frame, the measurements should agree within 3/16". If they do not, it means that corrections will have to be made.

If a tram gauge is not available, the "plumb bob" method of checking may be used. To assure any degree of accuracy when using this method, the vehicle should be on a level floor.

By using this method, it is only necessary to have a piece of cord attached to an ordinary surveyor's plumb bob. When measuring the distance between two points, the free end of the cord should be placed on the reference point allowing the plumb bob to hang on the floor. A check mark should be made on the floor just under the tip of the plumb bob. This operation should be repeated at all reference points. With these points located on the floor, they may easily be measured with a rule.

The second step is checking the vertical dimensions from the datum plane to the points to be trammed. With the proper settings the tram bar will be on a plane parallel to that of the frame. The exception to this would be when one of the reference locations is included in the misaligned area; then the parallel plane between the frame and the tram bar may not prevail. After completion of the repairs, the tram gauge should be set at the specified dimension to check the accuracy of the repair operation.

ALIGNMENT REFERENCE POINT DIMENSIONS

Dimensions to holes are measured to dead center of the holes and flush to the adjacent surface metal.

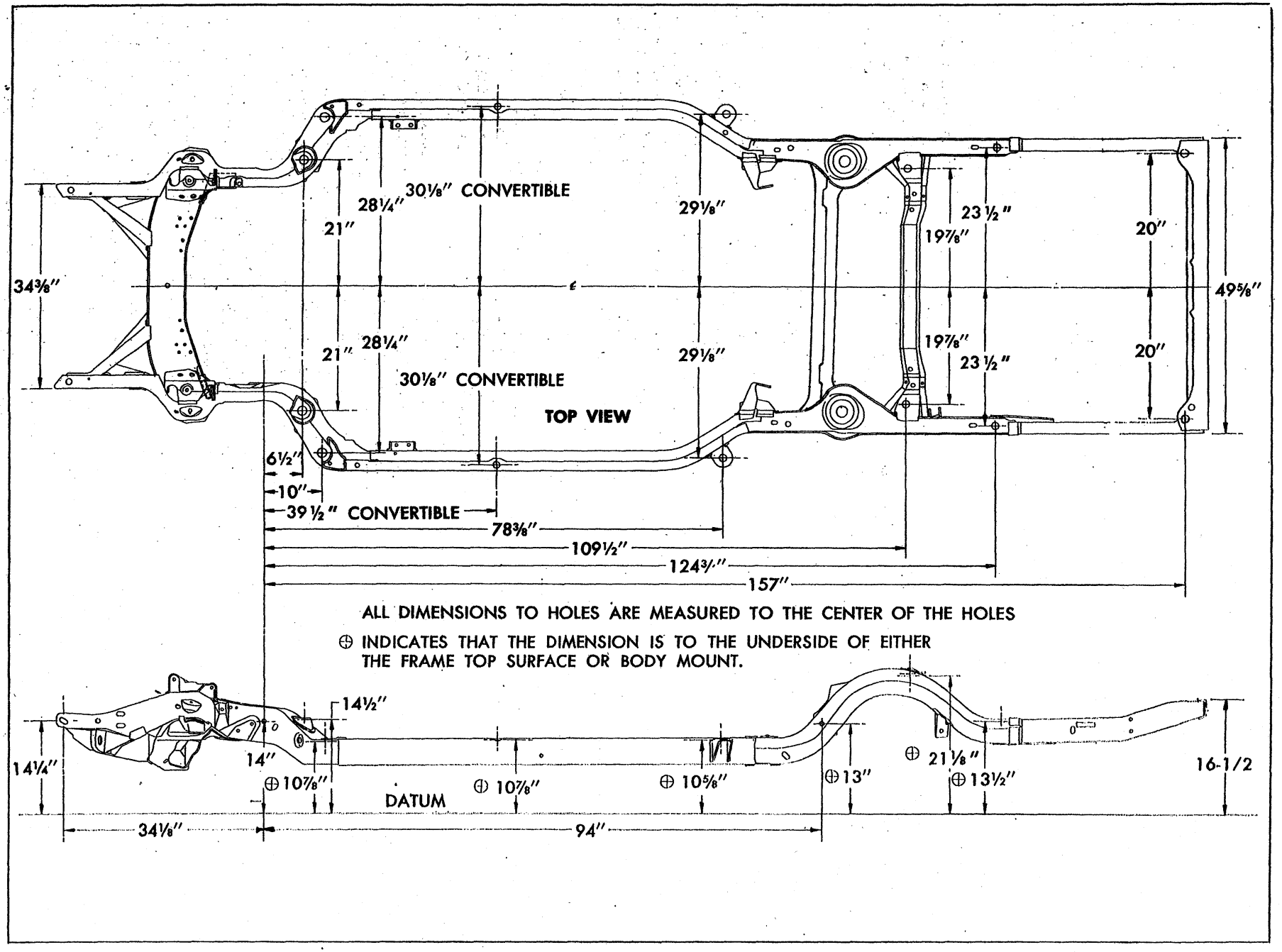


Fig. 1—Frame Dimensions—Chevrolet

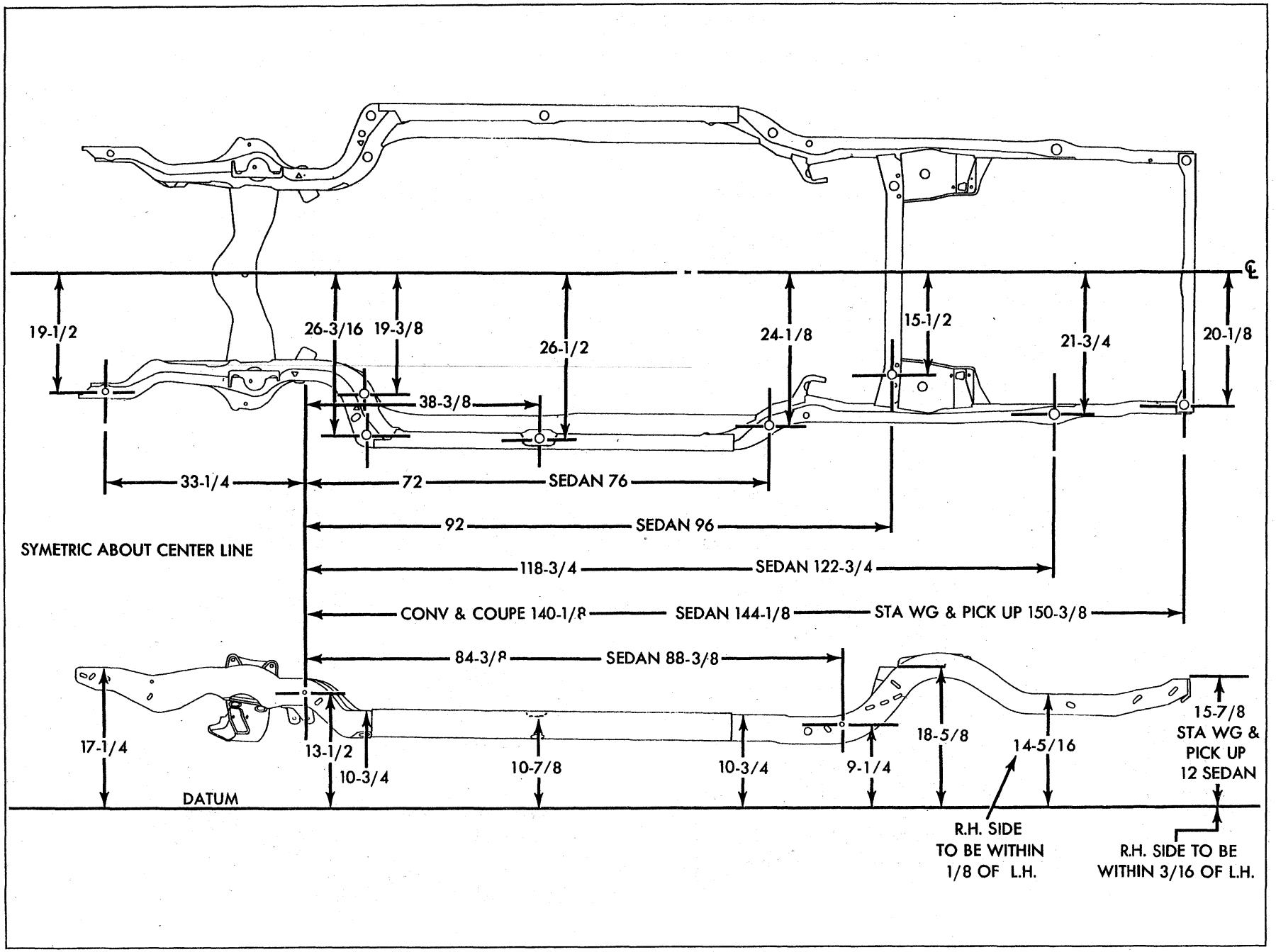


Fig. 2—Frame Dimensions—Chevelle

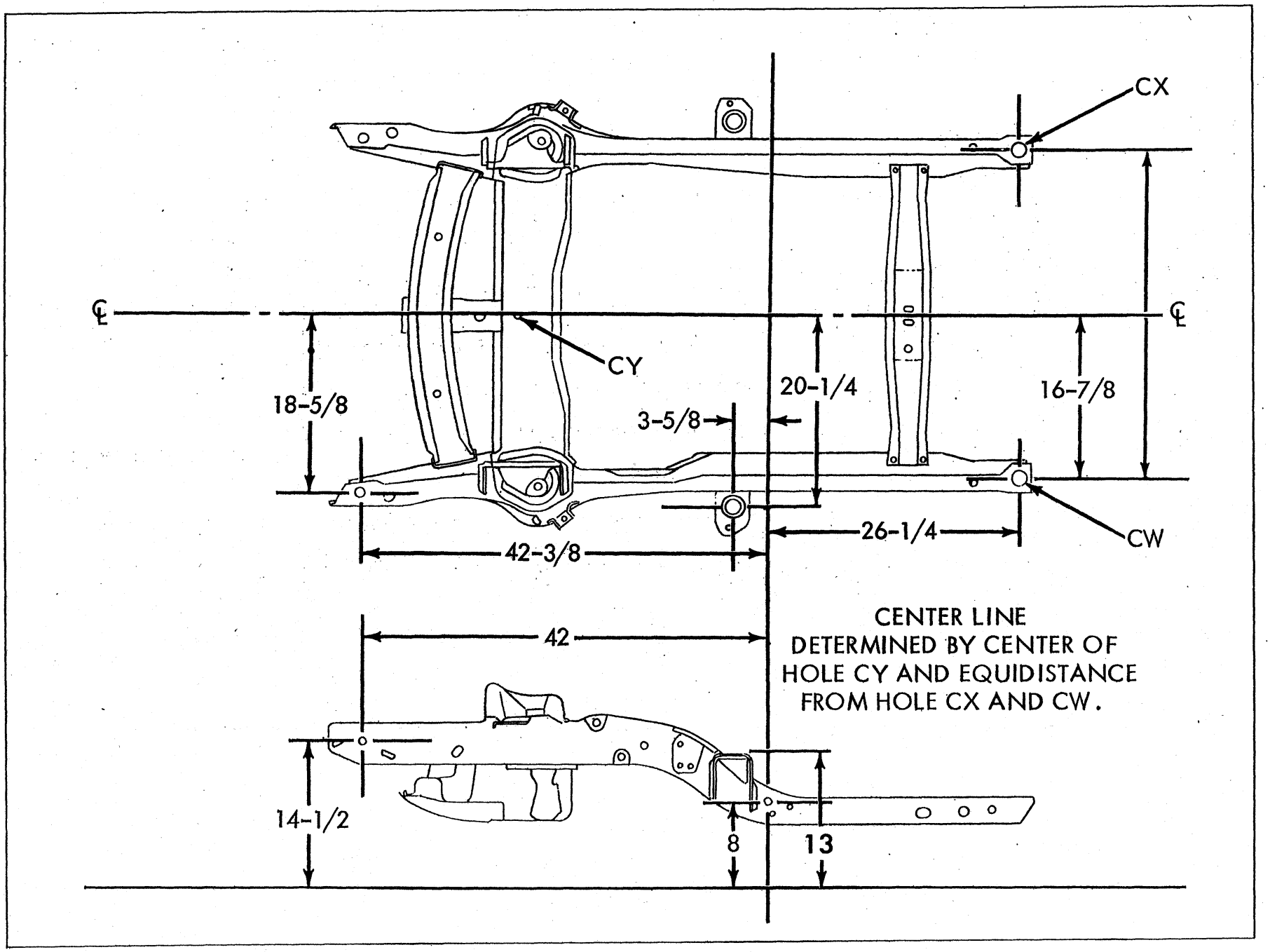


Fig. 3—Frame Dimension—Camaro and Nova

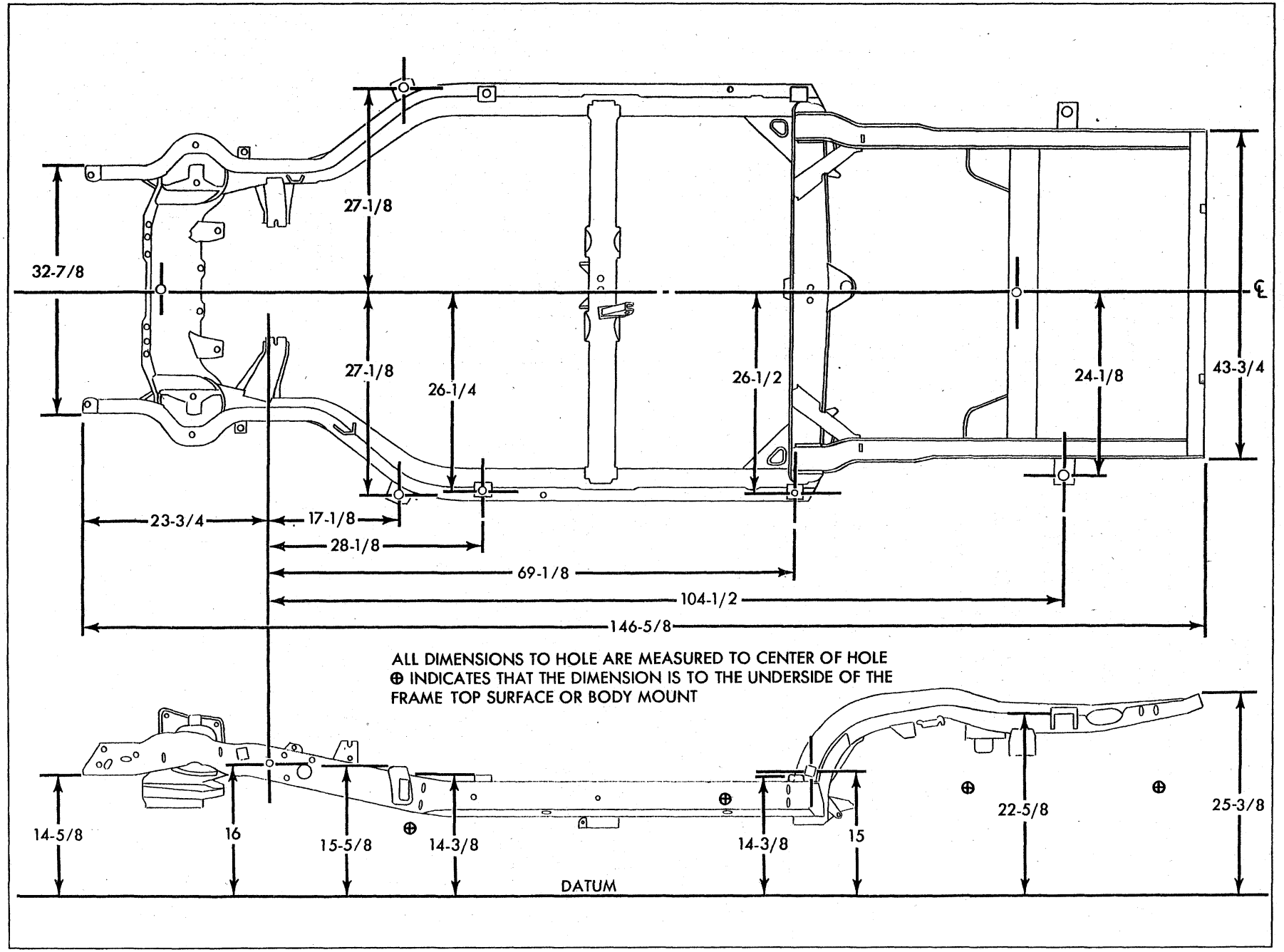


Fig. 4—Frame Dimension—Corvette

BODY MOUNTS

The various type of body mounts and their application are shown in Figures 5 and 6. Torque specifications are listed in the following chart.

Model	Mount	Torque
Chevrolet	Radiator Support to Frame	35 ft. lbs.
	#1 thru #7	35 ft. lbs.
Chevelle	Radiator Support to Frame	35 ft. lbs.
	#1 thru #7	35 ft. lbs.
Camaro Chevy II	#1	35 ft. lbs.
	#2 and #3	80 ft. lbs.
Corvette	All	45 ft. lbs.

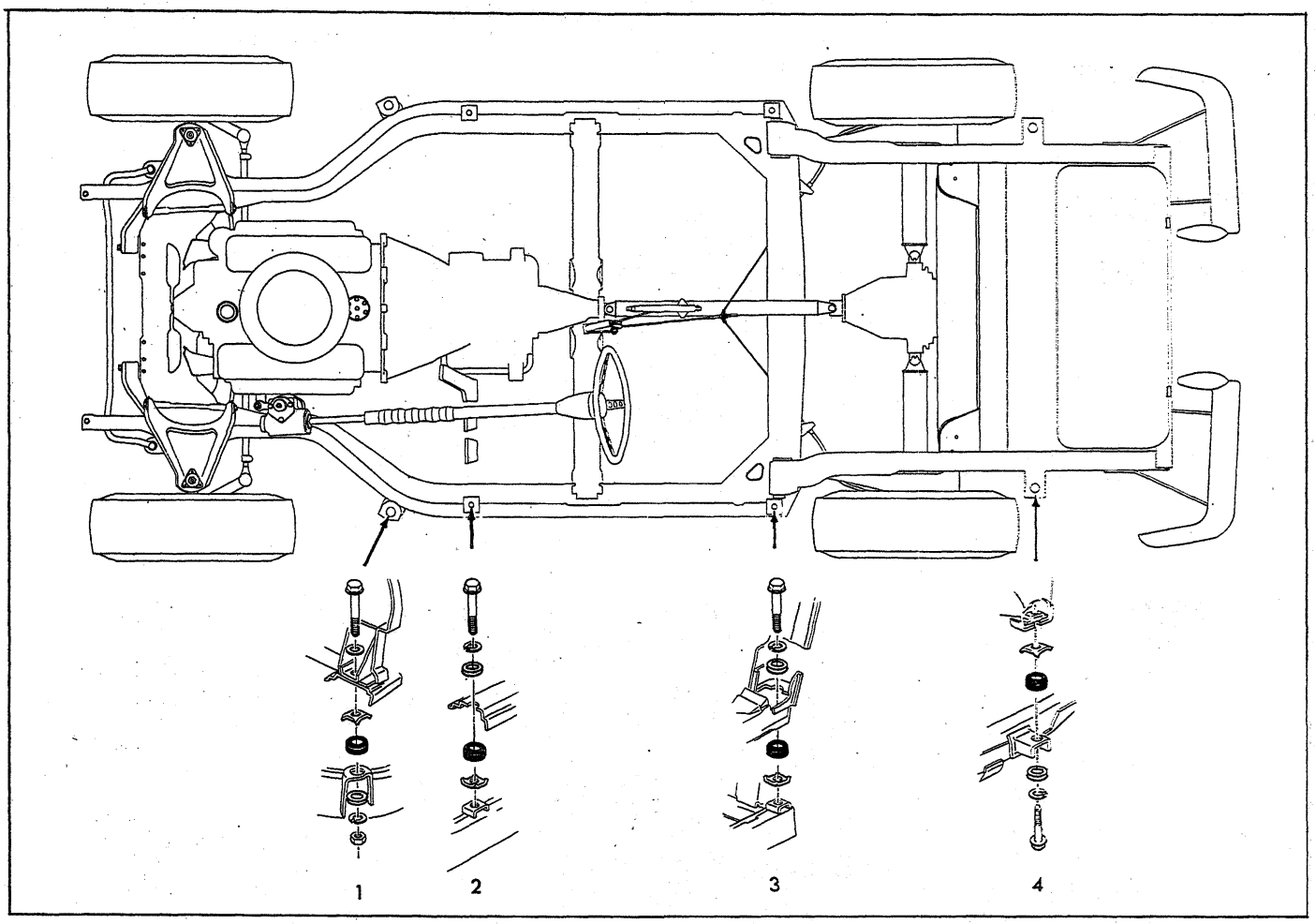


Fig. 5—Body Mount Application—Corvette

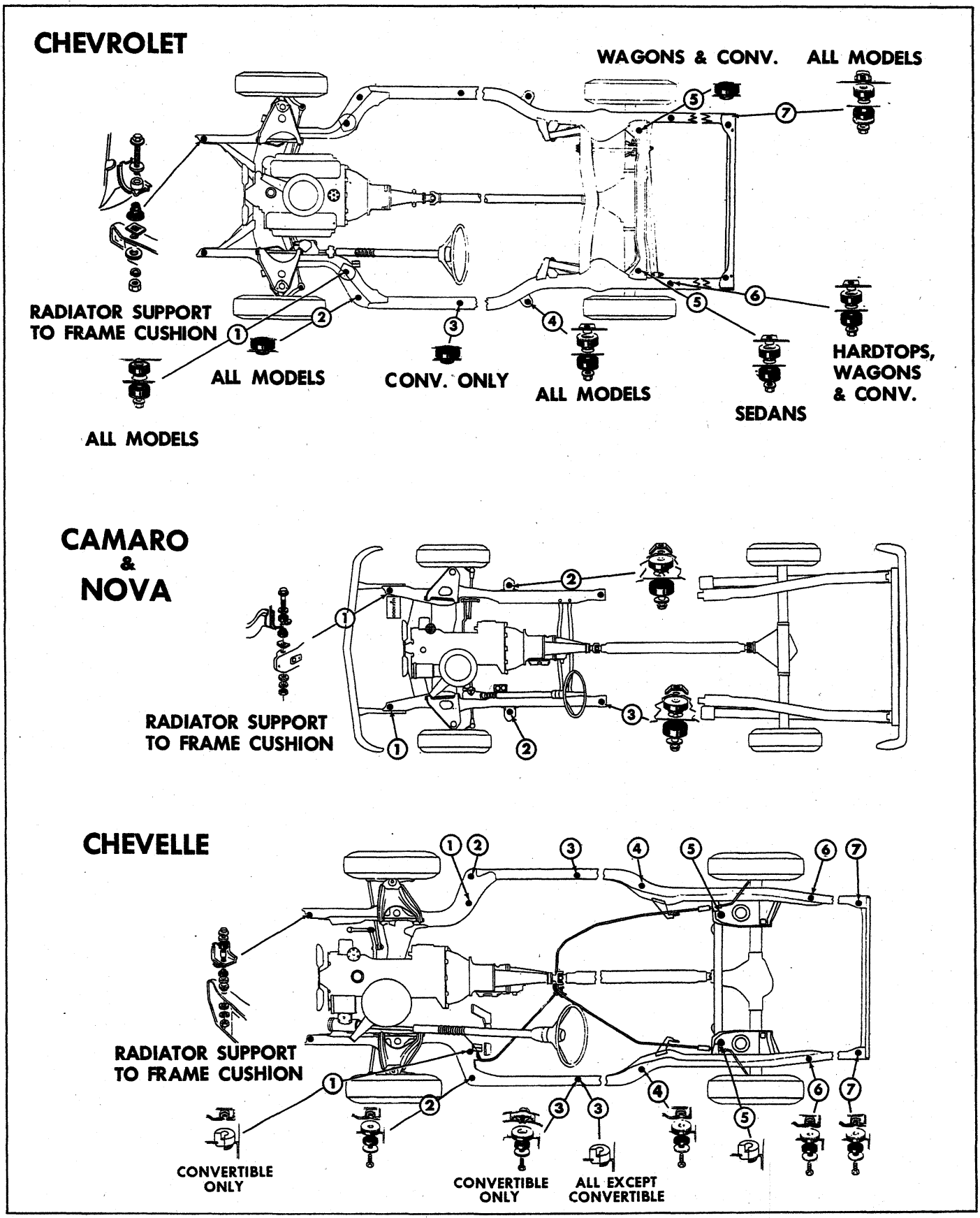


Fig. 6—Body Mount Application—Chevrolet, Chevelle, Camaro and Nova

SECTION 3

FRONT SUSPENSION

INDEX

	Page
General Description	3-1
Maintenance and Adjustments	3-2
Front Wheel Bearing Adjustment	3-2
Front End Alignment	3-3
Alignment Preliminary Steps	3-3
Caster and Camber Adjustments	3-3
Chevelle, Camaro, Nova and Corvette	3-4
Chevrolet	3-5
Steering Axis Inclination	3-5
Toe-In Adjustment	3-5
Riding Height and Coil Spring Sag	3-7
Repair Procedures	3-7
Front Brake Drum (Chevrolet, Camaro, Chevelle, Nova)	3-7
Removal	3-7
Installation	3-7
Front Wheel Hub	3-7
Replacement	3-7
Replacement of Hub Wheel Bolts	3-7
Front Wheel Bearings	3-7
Removal	3-7
Inspection	3-8
Repairs	3-8
Replacement of Bearing Cups	3-8
Installation	3-8
Steering Knuckle	3-8
Removal	3-8
Installation	3-9
Shock Absorber	3-9
Chevrolet, Chevelle, Camaro, Nova and Corvette	3-9
Removal	3-9
Installation	3-9
Stabilizer Bar	3-9
Removal	3-9
Installation	3-10
Strut Rod	3-10
Chevrolet	3-10
Removal	3-10
Installation	3-10
Front Coil Springs	3-10
Chevrolet	3-10
Removal	3-10
Installation	3-11
Chevelle, Camaro and Nova	3-11
Removal	3-11
Installation	3-11
Corvette	3-12
Removal	3-12
Installation	3-12
Lower Control Arm Spherical Joint	3-12
Chevrolet, Chevelle, Camaro, Nova and Corvette	3-12
Inspection	3-12
Chevrolet and Corvette	3-13
Removal	3-13
Installation	3-13
Chevelle, Camaro and Nova	3-13
Removal	3-13
Installation	3-13
Lube Fittings	3-13
Lower Control Arm	3-14
Chevrolet	3-14
Removal	3-14
Installation	3-14
Chevelle, Camaro and Nova	3-14
Removal	3-14
Installation	3-14
Corvette	3-14
Removal	3-14
Installation	3-14
Lower Control Arm Bushings	3-15
Chevrolet	3-15
Removal	3-15
Installation	3-15
Chevelle, Camaro and Nova	3-15
Removal and Installation (Large Bushing)	3-15
Removal and Installation (Small Bushing)	3-15
Cross Shaft and/or Bushings	3-15
Corvette	3-15
Removal	3-15
Installation	3-16
Upper Control Arm Spherical Joint	3-16
Chevrolet, Chevelle, Camaro, Nova and Corvette	3-16
Inspection	3-16
Replacement	3-17
Lube Fittings	3-17
Upper Control Arm	3-17
Chevrolet, Chevelle, Camaro, Nova and Corvette	3-17
Removal	3-17
Installation	3-17
Upper Control Arm Cross Shaft and/or Bushings	3-18
Chevrolet, Camaro, Chevelle and Nova	3-18
Removal	3-18
Installation	3-18
Corvette	3-18
Removal	3-18
Installation	3-19
Special Tools	3-20
Specifications . . See Specifications Section at Back of Manual	

GENERAL DESCRIPTION

The 1969 Chevrolet, Chevelle, Camaro, Nova and Corvette front suspensions are the S.L.A. (short-long arm) type with independent coil springs. The springs ride on the lower control arms. Spherical joints connect the upper and lower control arms to the steering knuckle. Tapered roller wheel bearings are used.

Camber angle is adjusted on the Chevrolet by means of a lower control arm inner pivot cam; on the Chevelle, Camaro, Nova and Corvette by means of upper control arm inner support shaft shims.

Caster angle is adjusted on the Chevrolet by means of a strut rod which runs from the lower control arm forward to the frame brace; on the Chevelle, Camaro, Nova and Corvette by means of upper control arm inner support shaft shims.

A stabilizer bar is used on all Chevelle, Camaro and Corvette models. Chevrolet Impalas, Station Wagons and all Chevrolet and Nova models equipped with V-8 engines are fitted with stabilizer bars.

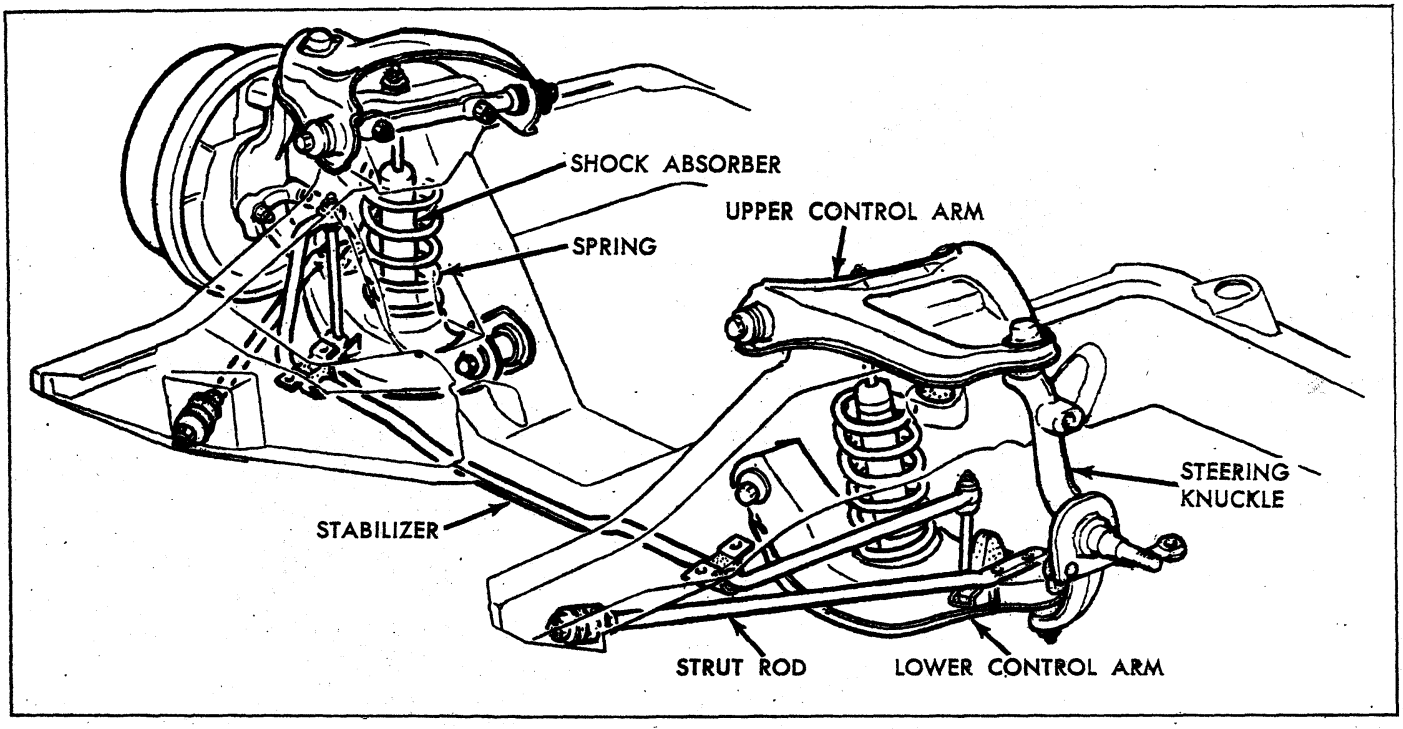


Fig. 1—Front Suspension—Chevrolet

MAINTENANCE AND ADJUSTMENTS

Maintenance intervals recommended for lubrication of front suspension components are covered in Section 0.

NOTE: Unless otherwise indicated all procedures will apply to all five vehicles covered in this manual.

FRONT WHEEL BEARING ADJUSTMENT

Proper front wheel bearing adjustment has a definite bearing on the operation of a vehicle. Improperly adjusted front wheel bearings will result in a lack of steering stability causing wheel wander, shimmy and excessive

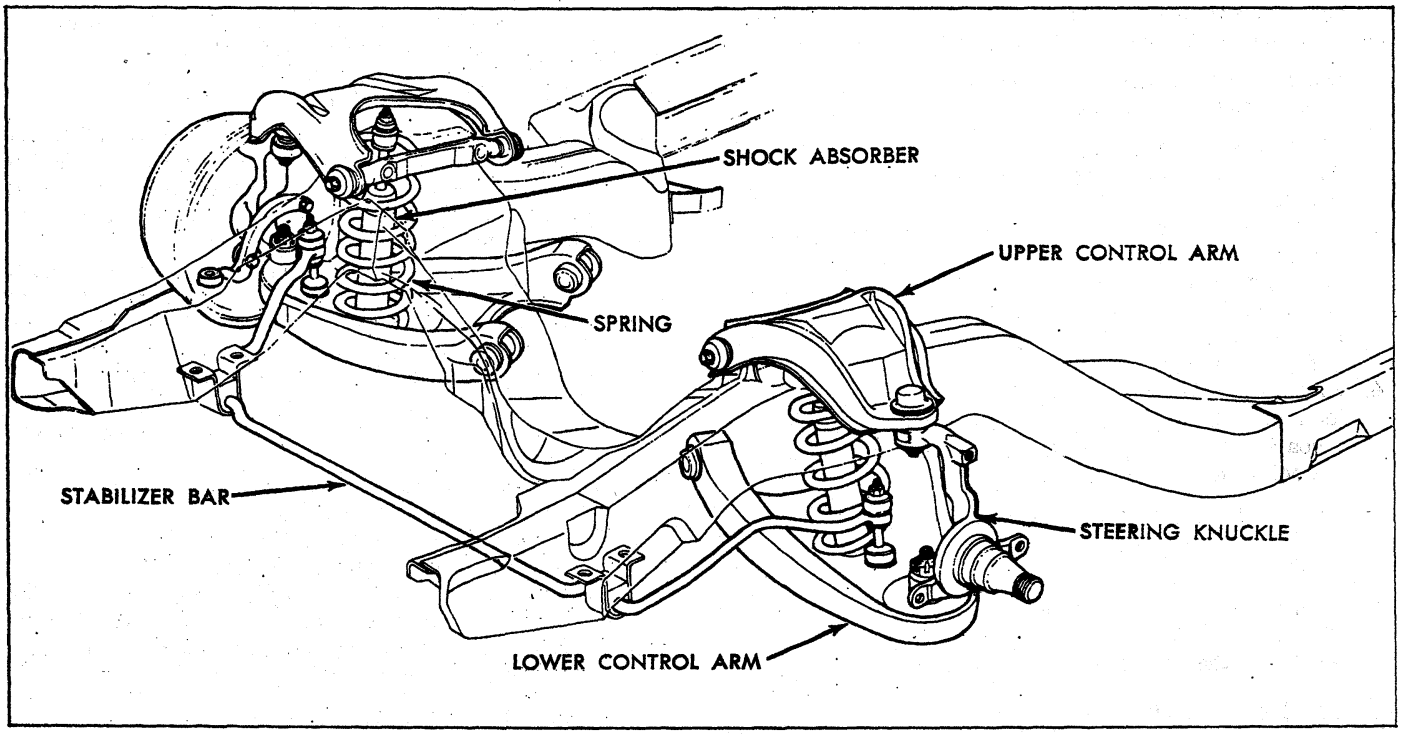


Fig. 2—Front Suspension—Chevelle

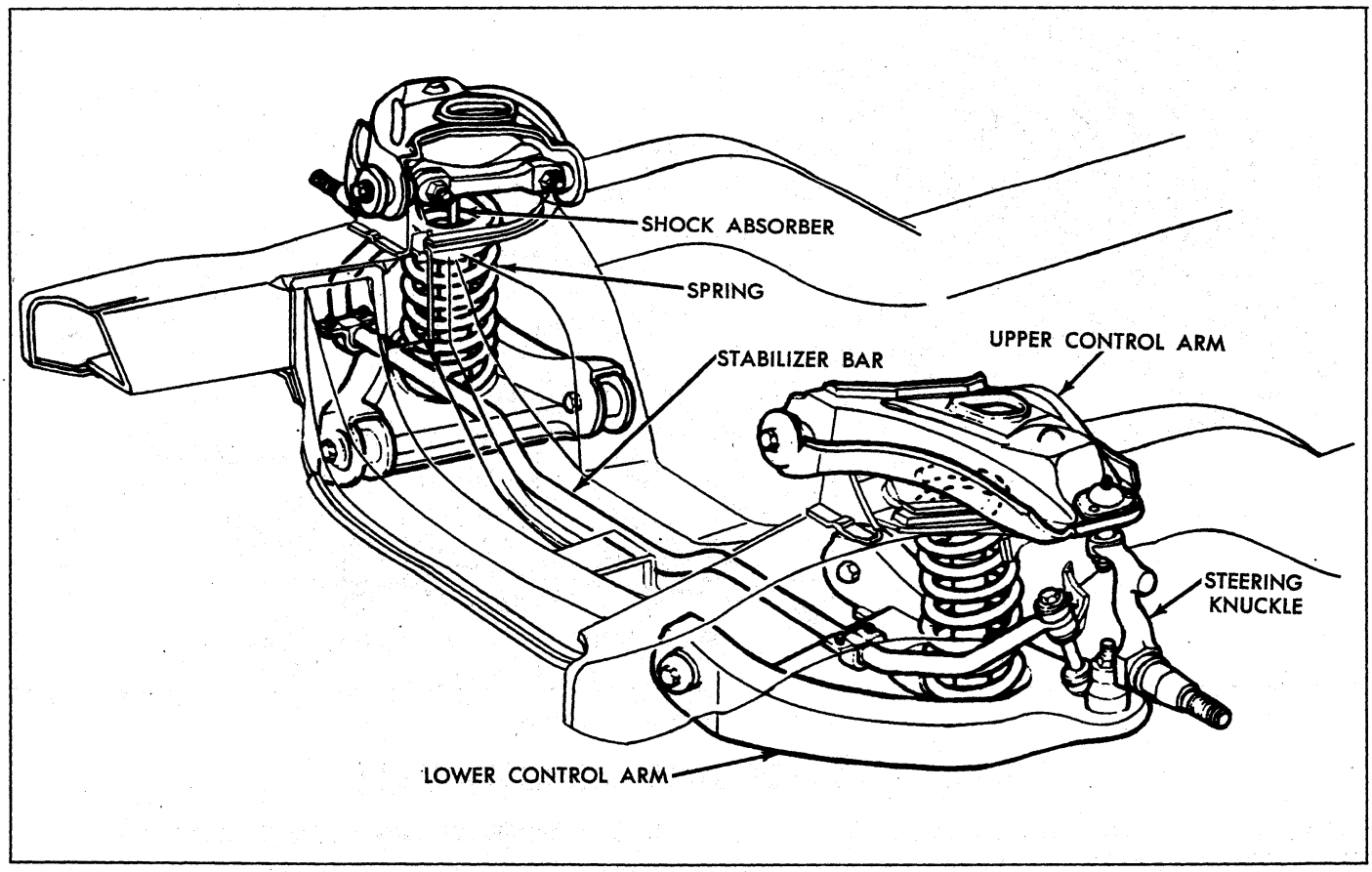


Fig. 3—Front Suspension—Camaro and Nova

tire wear. Very accurate adjustment is possible because the spindles are drilled both vertically and horizontally and the adjusting nuts are slotted in all six sides.

NOTE: Wheel bearings should not be repacked or adjusted as a part of "New Car Conditioning".

1. With wheel raised, remove hub cap and dust cap and then remove the cotter pin from the end of the spindle.
2. While rotating wheel, tighten spindle nut to 12 lbs. ft. torque.
3. Back off adjusting nut one flat and insert cotter pin. If slot and pin hole do not line up, back off the adjusting nut an additional 1/2 flat or less as required to insert cotter pin.
4. Spin the wheel to check that it rolls freely and then lock the cotter pin by spreading the end and bending inboard to avoid possibility of damaging the static collector in the dust cap.

NOTE: Bearings should have zero preload and .001" to .008" end movement when properly adjusted.

5. Install dust cap, hub cap or wheel disc and lower wheel.
6. Perform the same operation on each front wheel.

FRONT END ALIGNMENT

Front end alignment, that is alignment of the inter-related steering components of the front suspension system, must be correctly maintained to assure ease and stability of steering and satisfactory tire life.

Alignment Preliminary Steps

Several different types of machines are available for checking all the factors of front end alignment. The instructions furnished with each particular machine should be followed. In all cases, however, checks should be made with the vehicle level and at curb weight.

Since steering complaints are not always the result of improper alignment a check should be made to see if any of the following conditions exist. Any such conditions should be corrected before proceeding further.

1. Steering gear loose or improperly adjusted.
2. Steering gear housing loose at frame.
3. Excessive wear or play in spherical joints or steering shaft coupling.
4. Tie rod or steering connections loose.
5. Improper front spring heights.
6. Unbalanced or underinflated tires.
7. Improperly adjusted wheel bearings.
8. Shock absorbers not operating properly.

Wheel alignment should always be made with the vehicle rolled forward taking out any slack in the same manner as when the vehicle is traveling forward.

Caster and Camber Adjustment

NOTE: Before adjusting caster and camber

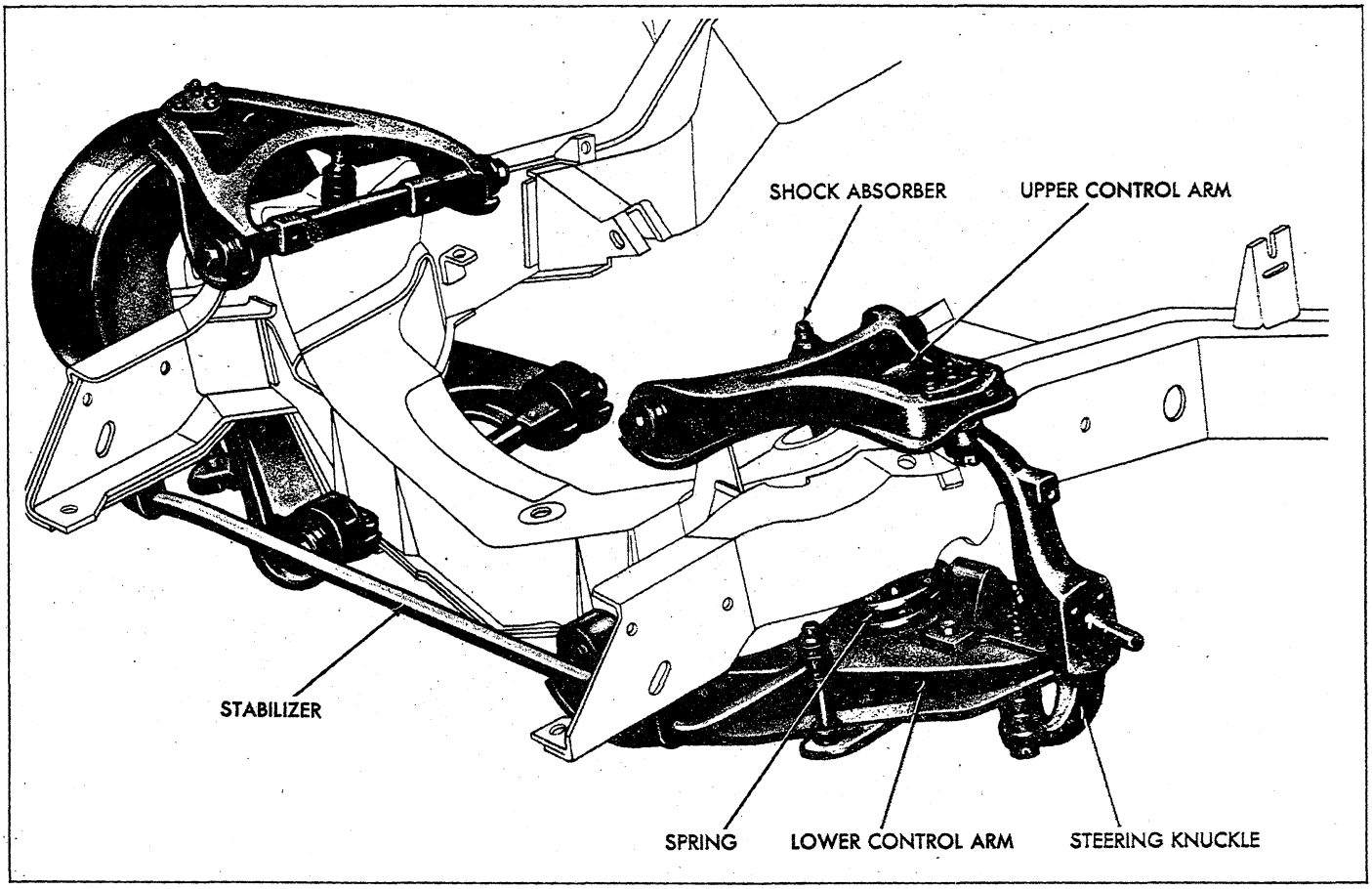


Fig. 4—Front Suspension—Corvette

angles, the front bumper should be raised and quickly released to allow car to return to its normal height.

Chevelle, Camaro, Nova and Corvette

Caster and camber adjustments are made by means of shims inserted between the upper control arm inner sup-

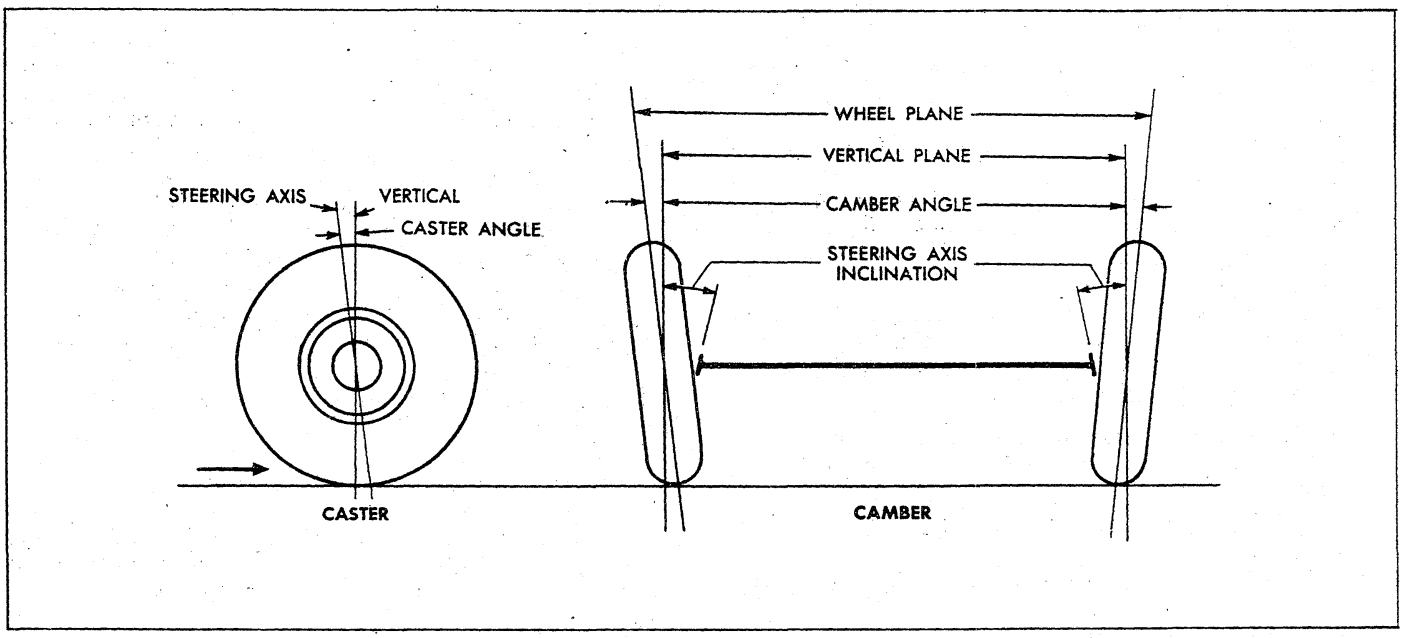


Fig. 5—Caster and Camber

port shaft and the support bracket attached to the frame (fig. 6). Shims may be added, subtracted or transferred to change the readings as follows:

1. Caster - transfer shims, front front to rear or rear to front.

   The transfer of one shim to the front bolt from the rear bolt will decrease positive caster. One shim (1/32") transferred from the rear attaching bolt to the front attaching bolt will change caster (approx.) 1/2°.

2. Camber - change shims at both the front and rear of the shaft.

   Adding an equal number of shims at both front and rear of the support shaft will decrease positive camber. One shim (1/32") at each location will move camber (approx.) 1/5° (Chevelle, Camaro and Nova); 1/6° (Corvette).

To adjust for caster and camber, loosen the upper support shaft to crossmember nuts, add or subtract shims as required and retighten nuts.

NOTE: Caster and camber can be adjusted in one operation.

Caster and camber specifications will be found in the specifications section of this book.

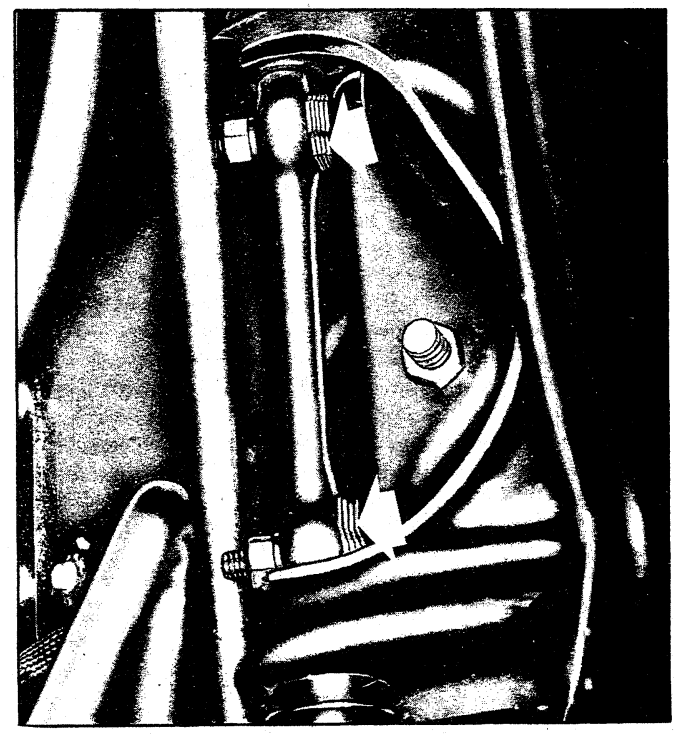


Fig. 6—Caster and Camber Adjustment (Typical) Chevelle, Camaro, Nova and Corvette

Chevrolet

The caster angle is adjusted by turning the two nuts at the front of the lower control arm strut rod (fig. 7). Shortening this rod will increase caster. Lengthening will decrease caster.

Camber angle is adjusted by loosening the lower control arm pivot bolt and rotating the cam located on this pivot (fig. 7). This eccentric cam action will move lower control arm in or out, thereby varying camber.

Steering Axis Inclination Adjustment

"Camber" is the outward tilt of the wheel and "steering axis inclination" is the inward tilt of the knuckle. Camber cannot be changed without changing steering axis inclination. Correct specifications will be found at the end of this section. If, with the camber correctly adjusted, the steering axis inclination does not fall within the specified limits the knuckle is bent and should be replaced.

If a new knuckle is installed, caster, camber and toe-in must be readjusted.

Toe-In Adjustment

Toe-in, the inward pointing of both front wheels, is checked with the wheels in the straight ahead position. It is the difference of the distance measured between the extreme front and the distance measured between the extreme rear of both front wheels. Correct toe-in specifications will be found in the specifications section.

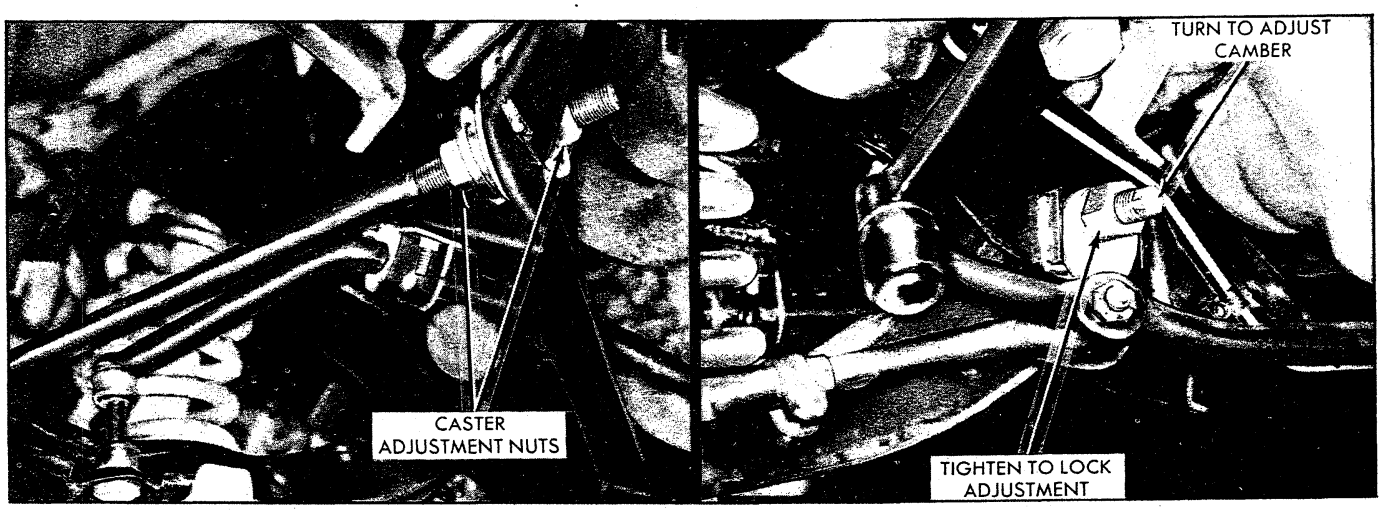


Fig. 7—Caster and Camber Adjustment Points—Chevrolet

NOTE: Toe-in must be adjusted after caster and camber adjustment.

A. If the equipment being used measures the toe-in of each wheel individually:
   1. Set the steering gear on the high point, mark 12 o'clock position on the steering shaft and position the steering wheel for straight ahead driving.
   2. Loosen the clamp bolt at each end of each tie rod and adjust to the total toe-in as given in the specifications at the end of this book.

B. If a tram gauge is being used, proceed as follows:
   1. Set the front wheels in the straight ahead position.
   2. Loosen the clamp bolts on one tie rod and adjust for the proper toe-in as given in the specifications at the end of this book.
   3. Loosen the clamp bolts on the other tie rod. Turn both rods the same amount and in the same direction to place the steering gear on its high point and position the steering wheel in its straight ahead position.

C. After the adjustment has been made:
   1. a. Chevrolet--Position inboard tie rod clamp slot straight down to 90° rearward to avoid stabilizer link bolt interference.

      --Position outboard tie rod clamp slots as near to tie rod sleeve slits as possible.

   b. Chevelle--Position all the tie rod clamps with slots straight down to 45° rearward to avoid interference. Bolt heads must be positioned to rear side of clamp.

   c. Nova and Camaro--Position inboard tie rod clamps with open end of clamp and slot in line. Clamp open end must be within 15° either side of tie rod sleeve slot.

      --Position relative to ground unimportant.

      --Position outer clamps, open end upward, with bolt top facing the rear and the bolt positioned 30° either side of horizontal. Position relative to slot unimportant.

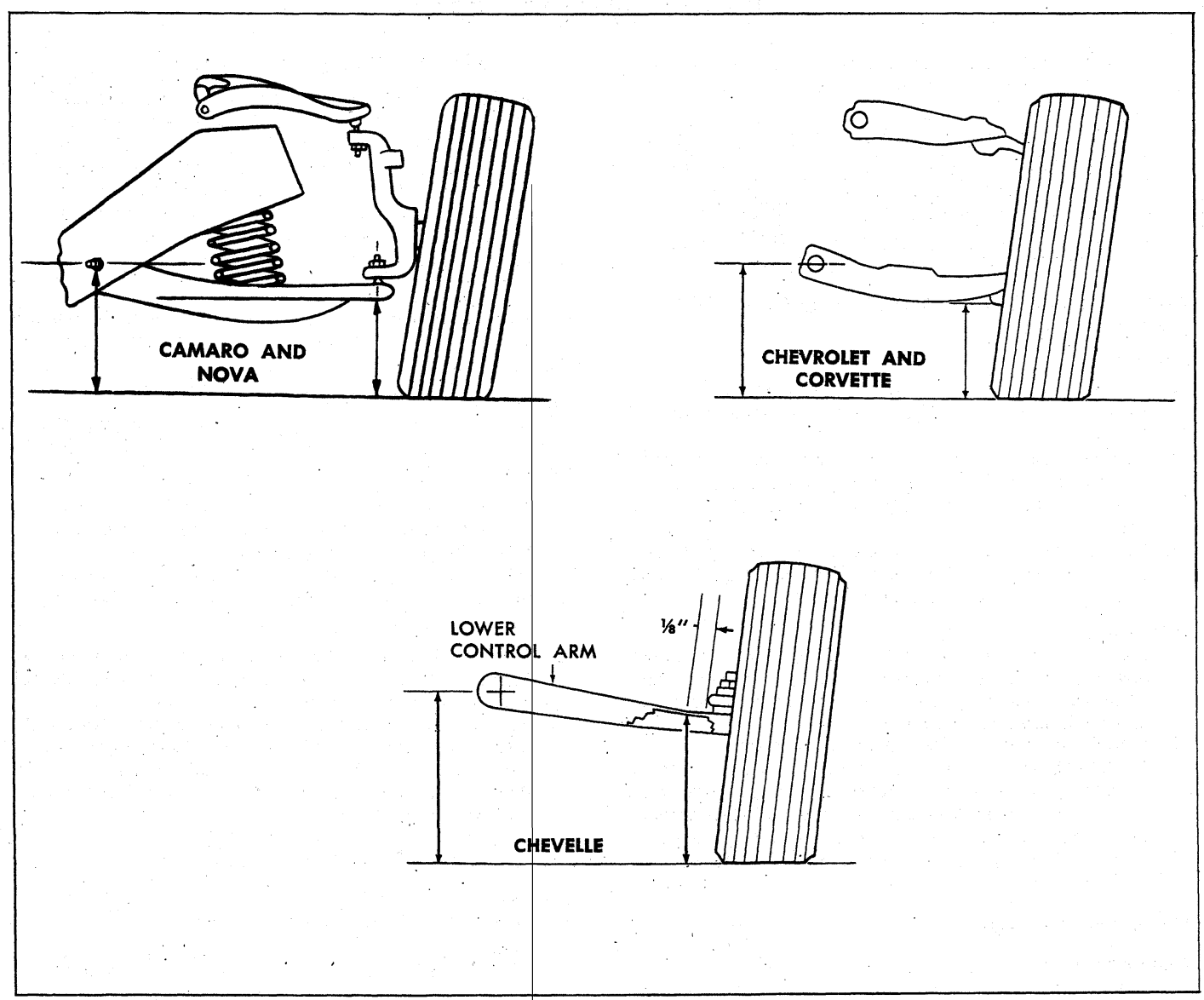


Fig. 8--Checking Riding Height

d. Corvette--Position inner tie rod clamps with open end down and the bolt horizontal. Position outer clamps with open end toward the rear and bolt vertical.

RIDING HEIGHT AND COIL SPRING SAG

The following check will quickly determine whether or not the vehicle riding height is correct.

1. Place the vehicle on a smooth, level floor and bounce and rock the front end several times. Raise vehicle, then allow it to settle to a normal height.
2. Measure the following two distances (fig. 8).
   a. From the floor to the center of the inner pivot of the lower control arm. (On the Chevrolet, Camaro and Nova this measurement must be made at the rear end of the pivot.)
   b. Chevrolet--Measure the distance from the floor to the lower face of the lower steering knuckle boss for the spherical joint on the same side of the vehicle.

      Chevelle--From the floor to the outer pivot which is located 1/8" (.12) inboard from the ball stud boss at the lower surface of the arm.

      Corvette--Measure the distance from the floor to the lower face of the lower steering knuckle boss for the spherical joint on the same side of the vehicle.

      Camaro and Nova--From the floor to the lower inboard edge of ball seat.
3. The difference between these two measurements should be as outlined in the Specifications given at the end of the book with the vehicle at curb weight (full tank of gas, spare tire and jack in trunk, no passengers).
4. Measure the opposite side of the vehicle in the same manner. The measurements for both sides should differ no more than 1/2".
5. To correct the height, springs must be replaced.

REPAIR PROCEDURES

Unless otherwise indicated all repair procedures will apply to all five vehicles covered in this manual.

CAUTION: During any operations which include breaking the ball stud loose from the knuckle boss extreme care must be used to assure that the ball stud seal is not damaged or cut. A recommended way to loosen the stud is to place a flat bar stock against the knuckle boss and strike the bar rather than the knuckle.

FRONT BRAKE DRUM—CHEVROLET, CAMARO, CHEVELLE, NOVA

Removal

1. Remove hub caps, partially loosen wheel nuts and raise vehicle from floor. Remove wheel nuts and wheel.
2. Remove brake drum. In some cases it may be necessary to back off brake adjustment because of scored drum or unevenly worn brake linings, see Section 5.
3. Check brake drum for concentricity, damaged pilot diameter or scored braking surface. Lightly sand braking surface and wipe clean.

Installation

1. Install drum over hub bolts making sure alignment dowel on drum web indexes with hole in wheel hub. This will assure proper drum alignment with hub bolts and hub pilot diameter.
2. Install wheel and partially tighten wheel nuts.
3. Re-adjust brake shoes to original setting. It may be necessary to re-adjust brake shoes on both front and/or rear wheels to assure balanced brake adjustment. See Section 5 for brake adjustment procedure.
4. Lower vehicle to floor, tighten hub wheel nuts and install hub cap.

FRONT WHEEL HUB

Replacement

1. Remove hub caps, break loose the wheel stud nuts and raise vehicle. Remove wheel nuts, wheel and tire and brake drum or brake caliper.

   NOTE: Vehicles equipped with disc brakes; hub and disc are serviced as a complete assembly. Remove bolts holding brake caliper to its mounting and insert a fabricated block (1-1/16 x 1-1/16 x 2 inches in length), between the brake pads as the caliper is being removed. Once removed the caliper assembly can be wired or secured in some manner away from the concerned area.
2. Pry out hub grease cap, cotter pin, spindle nut and washer, and remove hub. Do not drop wheel bearings.
3. Reverse the procedure to install.

Replacement of Wheel Hub Bolts

It may be necessary to replace damaged wheel hub bolts. In this case, service the hub in the following manner.

NOTE: On all vehicles with disc brakes except Corvette, the hub must be separated from the disc. Before removing attaching bolts, index the hub to the disc for assembly. Torque all attaching bolts to 60 lb. ft. Hub and disc are balanced as an assembly.

1. Remove the hub bolts with a press or hammer. These bolts are not peened into the hub. Do not damage wheel mounting surface on hub flange.
2. Install new serrated bolt into hole in hub. Tap lightly with a hammer to start bolt serrations in hole, making sure that bolt is square with hub flange.
3. Press bolt into flange until head is fully seated against hub flange (fig. 9).

FRONT WHEEL BEARINGS

Removal

1. Remove wheel hub as described above.

   NOTE: Discard cotter pin. Install new cotter pin when assembling.
2. Remove outer roller bearing assembly from hub with

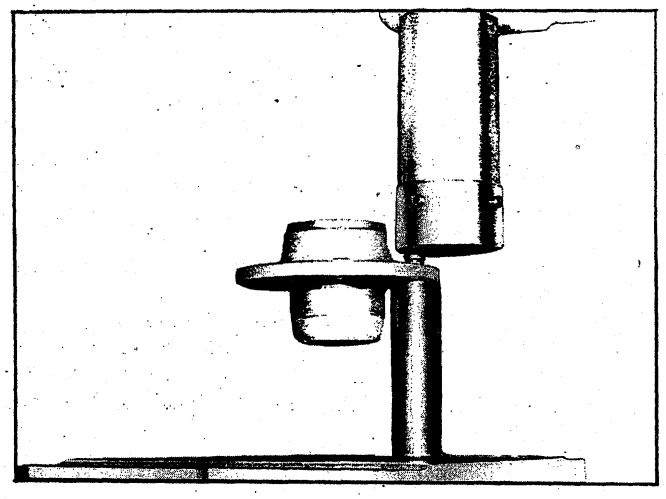


Fig. 9—Pressing Front Hub Bolts (Typical)

fingers. The inner bearing assembly will remain in the hub and may be removed after prying out the inner bearing lip seal assembly. Discard seal.

3. Wash all parts thoroughly in cleaning solvent and blow dry.

Inspection

1. Check bearings for cracked separators or worn or pitted rollers and races.
2. Check brake drum for out-of-round or scoring.
3. Check fit of bearing outer cups in hub.

Repairs

Replacement of Bearing Cups

1. Using steel bar stock, make press-out tools shown in Figure 10.
2. Insert removers through hub, indexing ends into slots in hub shoulder behind bearing cup.
3. Using a suitable extension pipe or rod, press bearing cups from hub.
4. Install new bearing cup in hub using Tool J-8849 on the outer and Tool J-8850 on the inner cup (fig. 11). Use Driver Handle J-8092 with the installers. Make sure that the bearing cups are not cocked and are fully seated against shoulder in hub.

Installation

1. Pack both inner and outer bearings using a high melting point wheel bearing lubricant.
2. Place inner bearing in hub, then install a new inner bearing lip seal assembly. Seal flange should face bearing cup.
3. Carefully install wheel hub over steering spindle.
4. Install outer bearing, pressing it firmly into the hub by hand.
5. Install spindle washer and adjusting nut. Draw up tight and adjust wheel bearings as outlined under "Front Wheel Bearing Adjustment".

STEERING KNUCKLE

It is recommended that vehicle be raised and supported on a twin-post hoist so that the front coil spring remains compressed, yet the wheel and steering knuckle assembly remain accessible. If a frame hoist is used, support lower control arm with an adjustable jackstand to safely retain spring in its curb height position.

Removal

1. Place vehicle on hoist and support lower control arm as noted above.
2. Remove hub cap, wheel hub dust cover, cotter pin, adjusting nut and washer. Withdraw wheel and tire, brake drum, (or, on vehicles equipped with disc

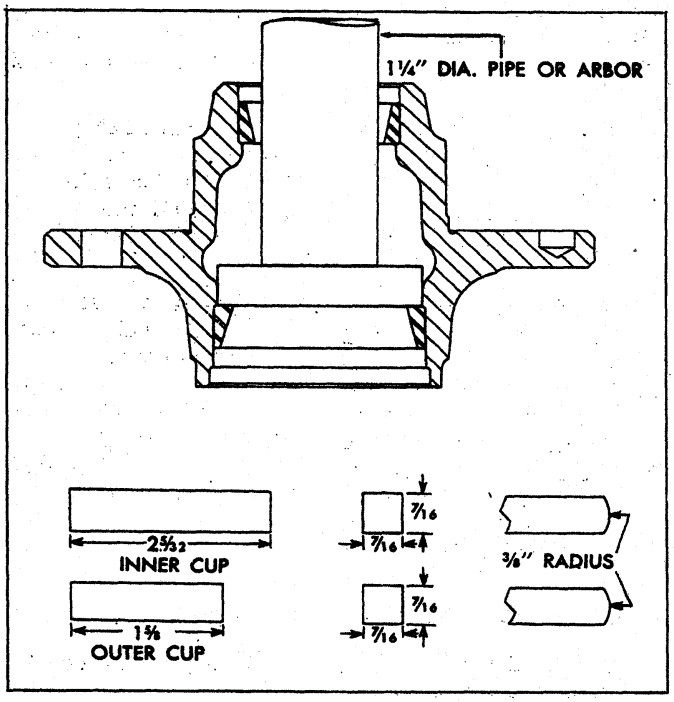


Fig. 10—Front Wheel Bearing Cup Removers

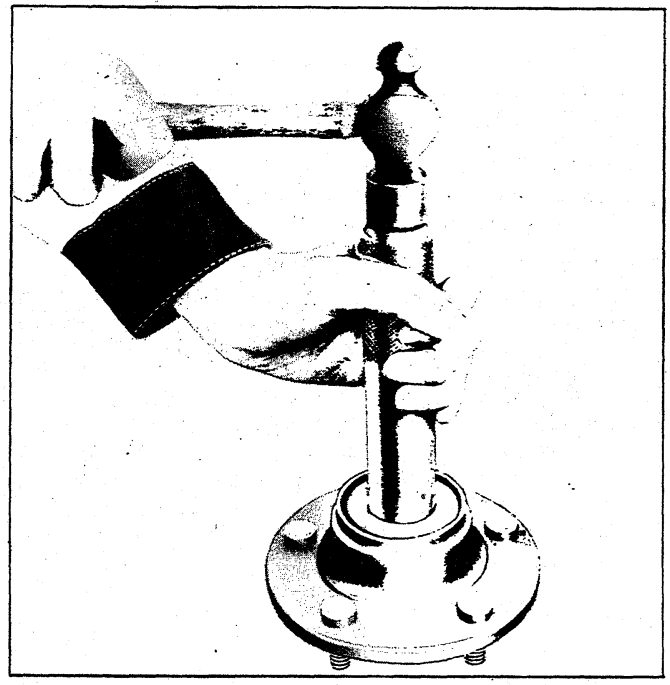


Fig. 11—Installing Front Hub Inner Bearing

brakes, remove caliper as outlined under "Front Wheel Hub") and wheel hub and bearing assembly from steering knuckle spindle.

3. Remove brake shoes from backing plate and clamp wheel cylinder.

CAUTION: Keep brake shoes clean and dry.

4. Remove brake anchor pin and two bolts securing brake backing plate and steering arm to steering knuckle.
5. Withdraw steering arm and brake backing plate from steering knuckle. Wire backing plate to frame (fig. 12). Do not disconnect brake line.

NOTE: Refer to Section 9 - Steering Linkage - Tie Rod, for further steering arm service operations.

6. Remove upper and lower ball studs cotter pins and loosen ball stud nuts. Free steering knuckle from ball studs by rapping on steering knuckle bosses. Remove ball stud nuts and withdraw steering knuckle.

Installation

1. Place steering knuckle in position and insert upper and lower ball studs into knuckle bosses.
2. Install ball stud nuts and tighten nut to specifications. (See Specification Section).

NOTE: If necessary, tighten one more notch to insert cotter pins.

3. Place brake backing plate and wheel cylinder in position on steering knuckle and insert anchor pin.
4. Place steering arm in position on back of steering knuckle and insert two bolts through backing plate, steering knuckle and steering arm. Install locknuts and tighten. (See Specifications.)
5. Torque brake anchor pin (See Specifications).
6. Install brake shoes. (See Section 5.)
7. Install wheel hub, brake drum or, brake caliper and disc and hub assembly, wheel and tire assembly over spindle.
8. Insert outer wheel bearing race and roller assembly, washer and nut. Adjust front wheel bearing as shown under Maintenance and Adjustments in this section. Install new cotter pin, dust cap and hub cap.
9. Remove vehicle from hoist, recheck and readjust wheel alignment where necessary.

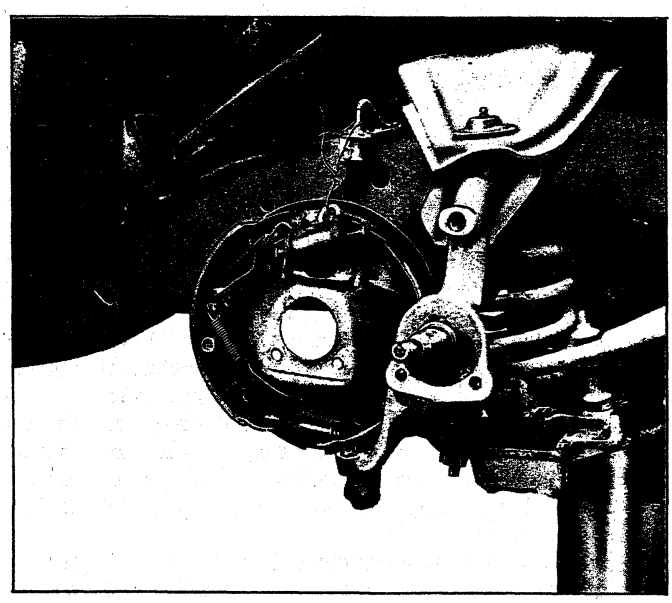


Fig. 12—Backing Plate Removed

SHOCK ABSORBER

Chevrolet, Chevelle, Camaro, Nova and Corvette (Fig. 13)

Removal

1. With an open end wrench hold the shock absorber upper stem from turning, and then remove the upper stem retaining nut, retainer and rubber grommet.
2. Remove the two bolts retaining the lower shock absorber pivot to the lower control arm and pull the shock absorber assembly out from the bottom.

Installation

1. With the retainer and rubber grommet in place over the upper stem, install the shock absorber (fully extended) up through the lower control arm and spring so that the upper stem passes through the mounting hole in the upper support arm.
2. Install the rubber grommet, retainer and attaching nut over the shock absorber upper stem.
3. With an open end wrench, hold the upper stem from turning and tighten the retaining nut. (See Specifications.)
4. Install the two bolts attaching the shock absorber lower pivot to the lower control arm and tighten. (See Specifications.)

STABILIZER BAR (FIG. 14)

Removal

1. Place vehicle on hoist and support both front wheels.
2. Disconnect stabilizer bar from lower control arm.

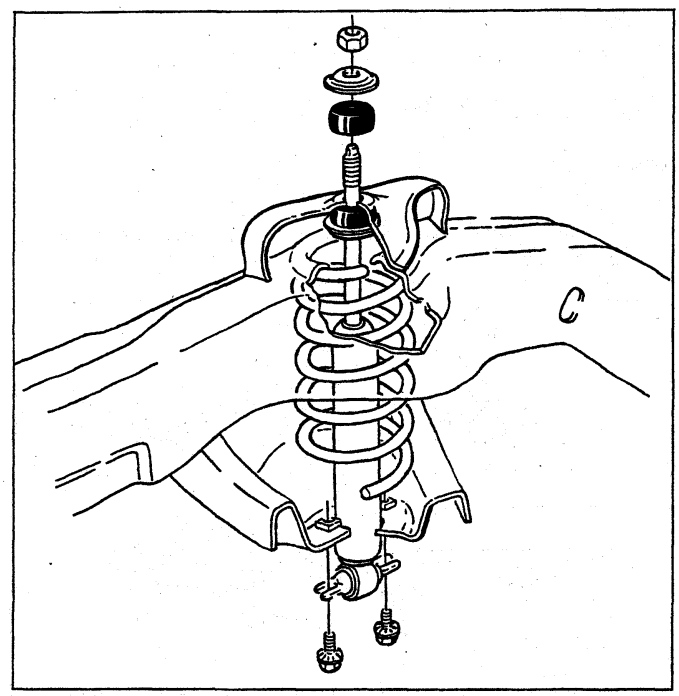


Fig. 13—Shock Absorber Installation (Typical)

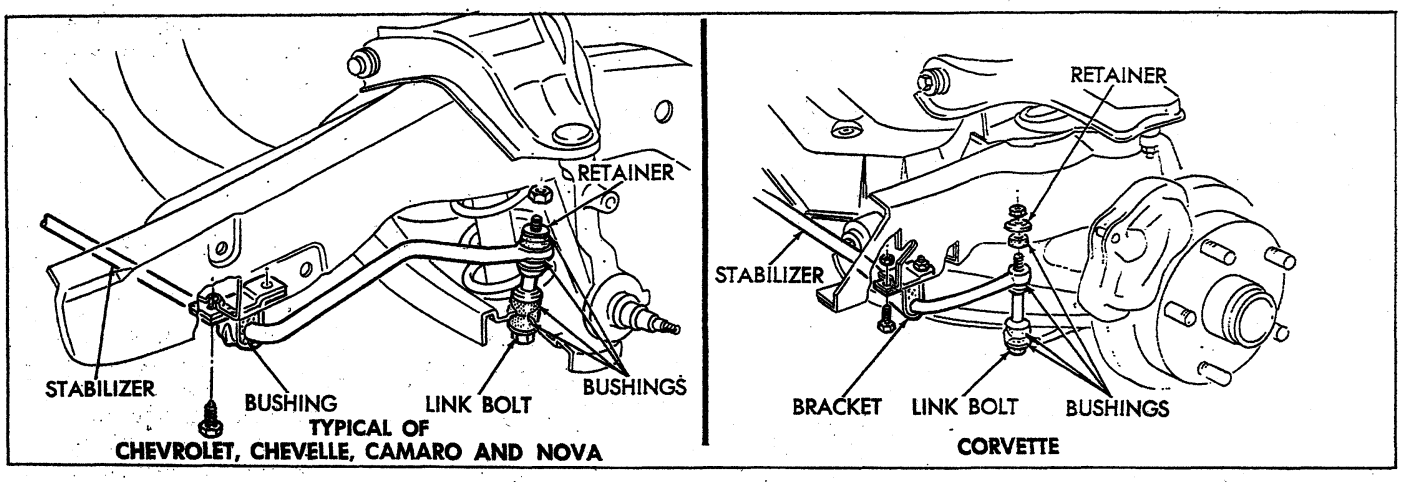


Fig. 14—Stabilizer Bar

3. Remove stabilizer bar brackets from the frame and remove stabilizer.
4. Remove stabilizer link bolts, spacers and rubber bushings from lower control arms.
5. Inspect rubber stabilizer link bushings and stabilizer insulator bushings for aging and wear. Replace if necessary.

Installation

1. If new insulators are necessary, coat stabilizer with recommended rubber lubricant and slide frame bushings into position.
2. Insert stabilizer brackets over bushings and connect to frame. Do not torque at this point. Connect stabilizer ends to link bolts on lower control arms. Torque bracket bolts and link nuts as shown in the Specifications.

   NOTE: Never get lubricant on outside of frame stabilizer bar bushings or they may slip out of brackets.

3. Remove vehicle from hoist.

STRUT ROD (FIG. 15)

Chevrolet

Removal

1. Place vehicle on hoist to provide sufficient working clearance.

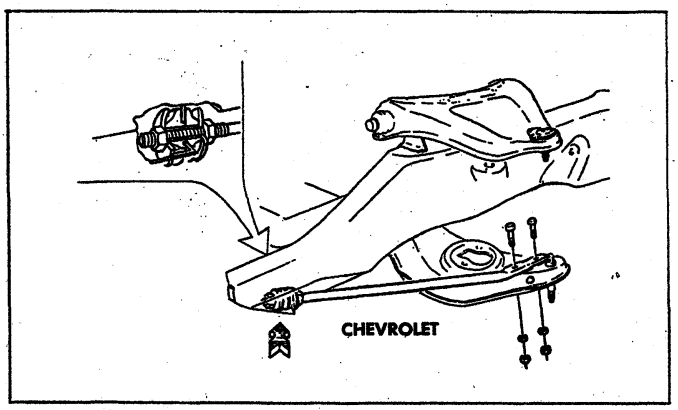


Fig. 15—Strut Rod Chevrolet

2. Remove forward nut, retainer and rubber bushing from front end of strut rod.
3. Remove two nuts from strut rod to lower control arm bolts and remove bolts and washers.
4. Withdraw strut rod from bracket.
5. Remove remaining rubber bushing, retainer, sleeve and nut from strut rod.
6. Inspect rubber bushings for aging and replace if necessary.

Installation

1. Screw rear nut on forward end of rod and position it approximately 3/4" from end of threads. Install rear retainer, sleeve and bushing on rod so pilot diameter faces forward.
2. Insert strut rod in bracket. Install forward bushing on sleeve so raised pilot diameter faces rear to enter hole in bracket and rear bushing, then install forward retainer and nut on rod.
3. Attach strut rod to top of lower control arm with two bolts, washers and nuts.
4. Remove vehicle from hoist, check caster, camber and toe angles and adjust where necessary. Torque nuts as shown in Specifications.

FRONT SPRING

Chevrolet

Removal

1. Place vehicle on hoist and with an open end wrench hold the shock absorber upper stem from turning, and then remove the upper stem retaining nut, retainer and rubber grommet.
2. With the car supported by the frame so that the control arms hang free, remove the wheel and tire assembly (replace one wheel nut to retain the brake drum), shock absorber, stabilizer bar to lower control arm link, strut rod to lower control arm attaching nuts, bolts and lock washers and tie rod end.
3. Scribe the position of the inner pivot camber adjusting cam bolt and then remove the nut, lock washer and outer cam.
4. Install a steel bar (fabricated as shown in Figure 16) through the shock absorber mounting hole in the lower control arm so that the notch seats over the bottom spring coil and the bar extends inboard and

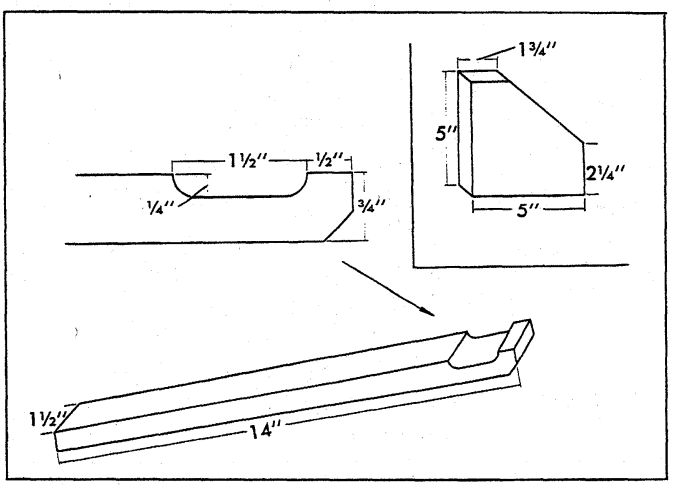


Fig. 16—Spring Removal Tool—Chevrolet

under the inner bushing. Fit a 5" wood block (See Figure 16) between the bar and the bushing as shown in Figure 17.

5. With suitable jack or hoist, lift up slightly on the end of the bar to remove the tension from the inner pivot cam bolt, which can then be removed.
6. Carefully lower the inner end of the control arm. Tension on the spring will be removed before the spring can be removed from the vehicle.
7. Remove the spring.

Installation

1. With the suspension set up as in Step 2 of the disassembly procedure, insert a block of wood between the upper control arm and the spring tower to keep the arm up out of the way.
2. Set the spring in place on the crossmember after checking on proper positioning necessary.
3. Install the steel bar and wood block as shown in Figure 17 and lift the control arm up until the inner pivot cam bolt can be installed.

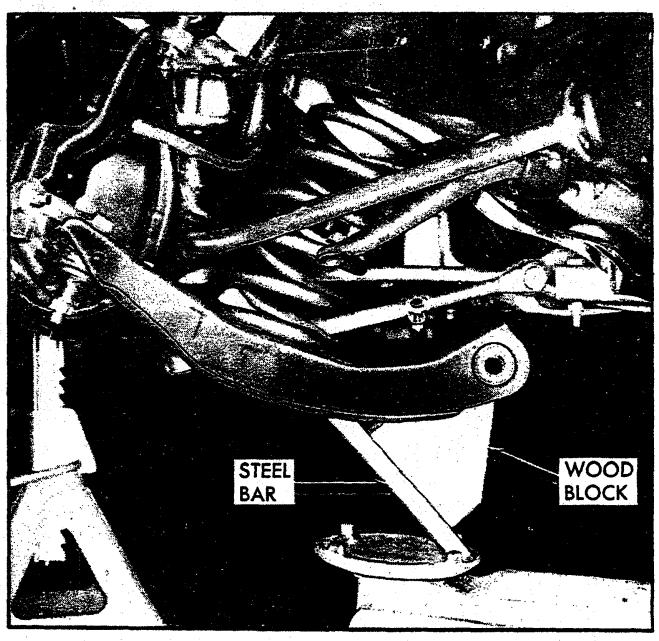


Fig. 17—Front Spring Removal—Chevrolet

NOTE: Lubricate the flat and thread area of the cam bolt with water resistant EP chassis lube.

4. Install the outer cam (identification mark on cam should be against the frame) and loosely install the lock washer and nut.
5. Set the cam bolt on the mark scribed during the removal procedure and hold in this position while tightening the nut (See specifications at the end of this book).
6. Replace the strut rod to lower control arm nuts, bolts and lock washers, the stabilizer bar link, the shock absorber, the tie rod end, and the wheel and tire.
7. Remove vehicle from hoist and install the shock absorber upper stem retaining nut retainer and grommet.
8. Check the camber adjustment.

Chevelle, Camaro and Nova

Removal

1. Place vehicle on hoist and with an open end wrench hold the shock absorber upper stem from turning, and then remove the upper stem retaining nut, retainer and rubber grommet.
2. With the car supported by the frame so that the control arms hang free, remove the wheel and tire assembly (replace one wheel nut to retain the brake drum), shock absorber, and stabilizer bar to lower control arm link. As a safety precaution install a chain through the spring and lower control arm as depicted in Figure 19.
3. Bolt Tool J-22739 to a suitable jack as shown in Figure 18.
4. Place tool under lower control arm bushings so that the control arm bushings seat in the grooves of the tool.
5. Raise the jack to remove tension on the lower control arm pivot bolts and remove bolts.
6. Lower control arm by slowly releasing jack until spring can be removed (Fig. 19).
7. Remove chain. Remove spring.

Installation

1. Properly position spring on the control arm and lift control arm.

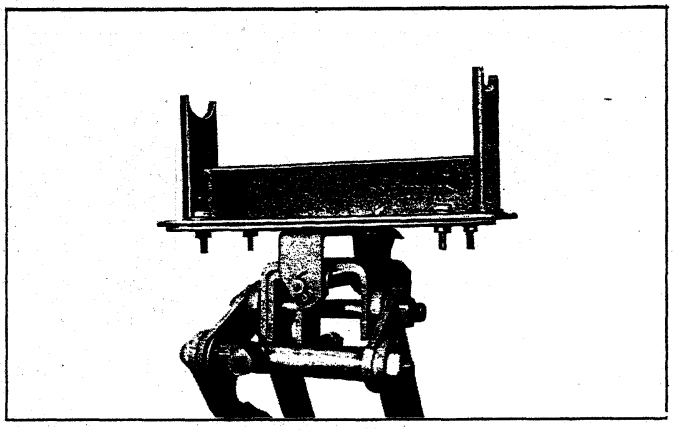


Fig. 18—Tool J-22739 Mounted on Jack

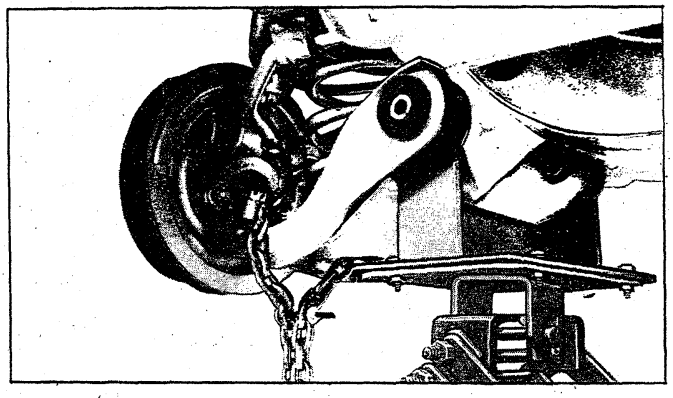


Fig. 19—Removing Spring

2. Position control arm into crossmember and install pivot bolts. Lower jack.
3. Replace the stabilizer bar link, shock absorber, and wheel and tire.
4. Remove vehicle from hoist and install the shock absorber upper stem retaining nut, retainer and grommet.

Corvette

Removal

1. Place vehicle on hoist and remove nut, retainer and grommet from top of shock absorber.
2. With vehicle on a suitable hoist, support front of vehicle so control arms swing free.
3. Disconnect stabilizer bar from lower control arm and remove bolts retaining shock absorber to lower control arm, remove shock absorber.
4. Bolt Tool J-22944 to a suitable jack and place tool under lower control arm bushings so that the control arm bushings seat in the grooves of the tool (fig. 20). As a safety precaution install a chain through the spring and lower control arm.
5. Remove cross shaft rear retaining nut and the two front retaining bolts.
6. Lower control arm by slowly releasing jack until spring can be removed (fig. 20).
7. Remove chain. Swing control arm forward and remove spring.

Installation

1. Properly position spring on the control arm and lift control arm.
2. Using a large drift position control arm to crossmember and install cross shaft retaining bolts. Torque to specifications.
3. Connect the stabilizer bar link and install bolts retaining shock absorber to the lower control arm.
4. Remove vehicle from hoist and install the shock absorber upper grommet, retainer and nut.

LOWER CONTROL ARM SPHERICAL JOINT

Chevrolet, Chevelle, Camaro, Nova and Corvette

Inspection

The lower control arm spherical joint should be replaced whenever wear is indicated in the upper joint inspection.

> **NOTE:** The lower control arm spherical joint is a loose fit in the assembly when not connected to the steering knuckle.

Only if inspection of each upper joint indicates them both to be within limits, inspect each lower joint for excessive wear as follows:

1. After reconnecting upper joints to steering knuckles, support vehicle weight on wheels or wheel hubs.
2. With outside micrometer or caliper, measure distance from top of lubrication fitting to bottom of ball

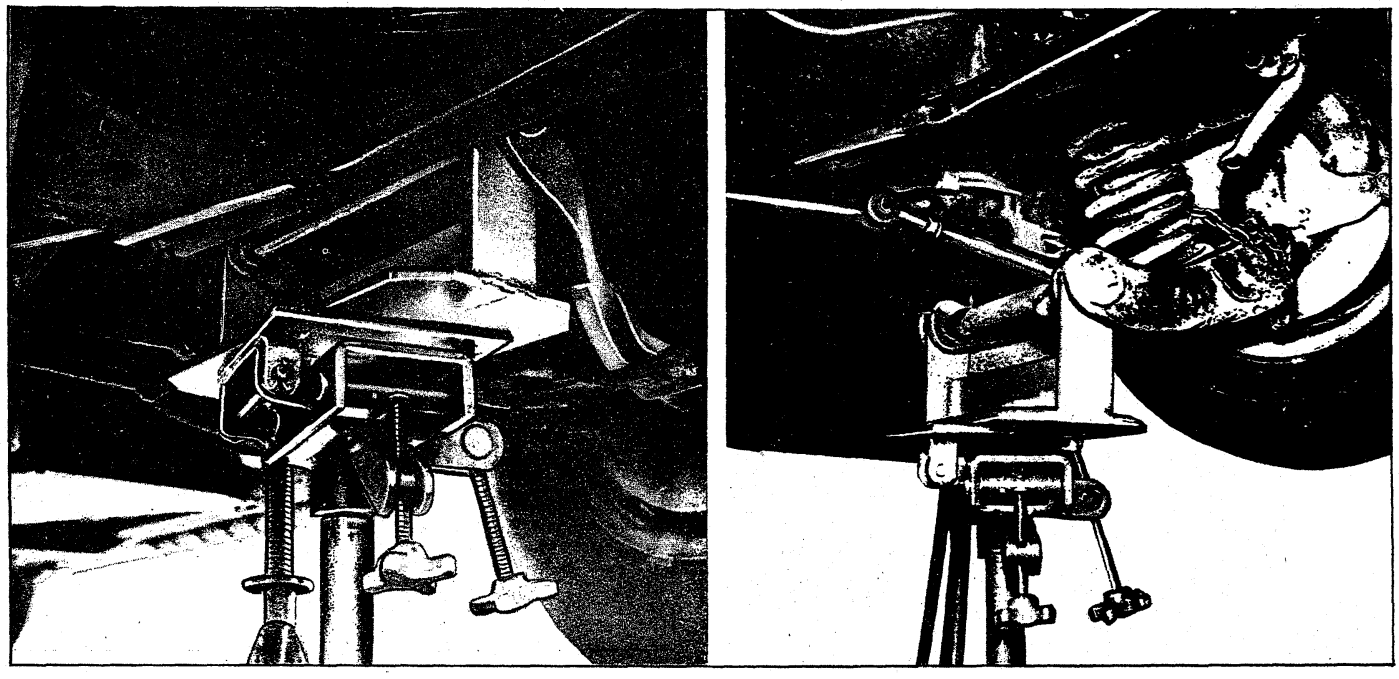


Fig. 20—Removing Front Coil Spring—Corvette

stud, and record the dimensions for each side.

3. Then support vehicle weight at outer end of each lower control arm, so that wheels or wheel hubs are free, then repeat Step 2.
4. If the difference in dimensions on either side is greater than 1/16" (.0625"), the joint is excessively worn and both lower joints should be replaced.

If inspection of lower spherical joints does not indicate excessive wear, inspect further as follows:

5. On Chevrolet and Corvette Only--Examine lubrication hole in each joint assembly after cleaning out hole. Look for evidence of the liner partially or fully blocking lubrication opening. Such evidence indicates that wear is sufficiently advanced that both lower spherical joints should be replaced.

Another indication of lower spherical joint excessive wear is indicated when difficulty is experienced when lubricating the joint. If the liner has worn to the point where the lubrication grooves in the liner have worn away, then abnormal pressure is required to force lubricant through the joint. This is another reason to recommend replacement of both lower joints.

If the above inspections do not indicate any reason for spherical joint replacements, test the torque tightness of the lower ball stud in the knuckle on each side as follows:

1. Wire-brush off nut and cotter pin attaching spherical joint ball stud to steering knuckle and examine for evidence of looseness of stud in knuckle.
2. If no evidence of looseness, remove cotter pin and with prick punch or equivalent, mark nut stud and knuckle to identify relative location.
3. Tighten nut as installed and observe torque reading. If less than 45 lbs. ft., stud may have been loose in steering knuckle and replacement of both lower spherical joints may be recommended.
4. Check to see if torque of 60-94 lbs. ft. can be obtained without bottoming stud or ball joint against knuckle. If bottoming occurs, replace ball joint or steering knuckle.

Chevrolet and Corvette

Removal

1. Place vehicle on hoist and support lower control arm at outer end on floor jack, with hoist or jack pad clear of lower ball stud nut and seal.

   NOTE: On Corvettes or Chevrolets equipped with disc brake remove caliper assembly as outlined in "Wheel Hub Removal".

2. Remove upper and lower ball stud nuts, free ball studs from steering knuckle and wire knuckle and brake drum or disc assembly up to fender skirt to preclude interference while performing next step.
3. Being careful not to enlarge the holes in control arm, cut off rivets.

Installation

1. Install new joint against underside of control arm and retain in place with special bolts and nuts supplied with new joint.

   CAUTION: Use only alloy bolts supplied for this operation. The special thick headed bolt must be installed in the forward side of the control arm.

2. Tighten bolts and nut on ball stud to Specification shown at the end of this book.
3. Lubricate the joint.
4. Remove vehicle from hoist.

Chevelle, Camaro and Nova

Removal

1. Place vehicle on hoist and support lower control arm at outer end on floor jack, with hoist or jack pad clear of lower ball stud and remove the wheel.

   NOTE: On vehicles equipped with disc brakes remove caliper assembly as outlined in "Wheel Hub Removal".

2. Remove the upper and lower ball stud nuts, free the ball studs from the steering knuckle and wire the knuckle and brake drum or disc assembly out of the way to preclude interference while completing the lower ball stud removal procedure.
3. Use a screw driver to pry off the seal and retainer. Install Tools J-9519-10, J-9519-17 and J-9519-7 as shown in Figure 21 and turn down on the hex head screw until the spherical joint is pushed out.

Installation

1. Start the replacement spherical joint into the control arm and install Tools J-9519-10, J-9519-16 and J-9519-17 as shown in Figure 22.

   NOTE: When installing spherical joint position air vent in rubber boot facing inboard.

2. Turn down on the hex head screw until the spherical joint is seated properly in the control arm.

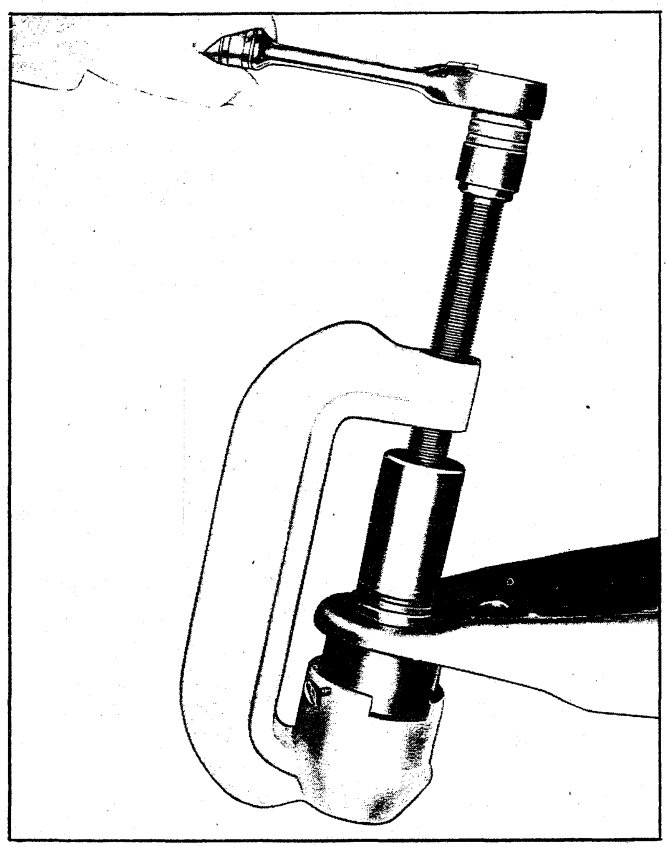


Fig. 21—Removing Lower Spherical Joint—Chevelle, Camaro, and Nova

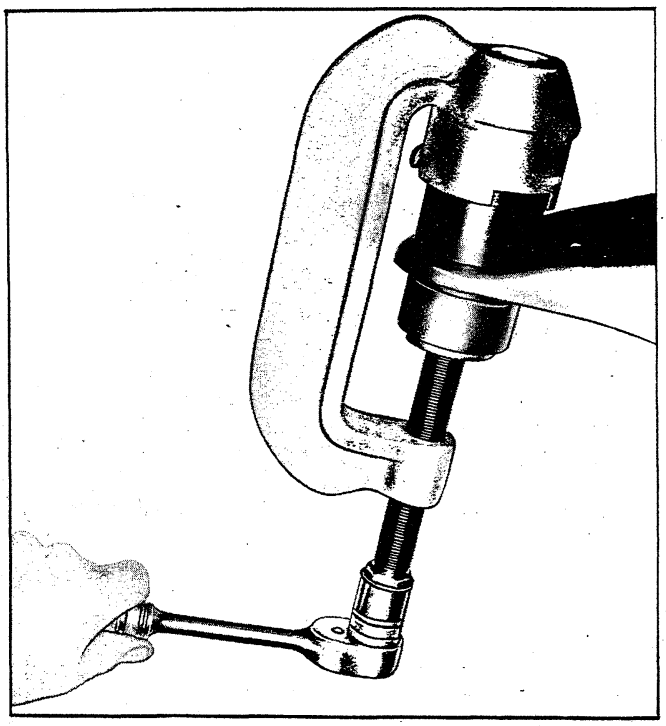


Fig. 22—Installing Lower Spherical Joint—Chevelle, Camaro, and Nova

3. Install the stud into the steering knuckle, secure in place with the attaching nut and install the cotter pin.
4. Replace the wheel and tire.
5. Remove vehicle from hoist.

Lube Fittings

Special self threading type lube fittings are used in the spherical joint assemblies. If it is necessary to replace a fitting a standard threaded type may be used. However, replacement spherical joint assemblies are supplied less the lube fitting. Therefore it will be necessary to install a self threading type fitting into the untapped hole provided when replacing the entire assembly.

LOWER CONTROL ARM

Chevrolet (Fig. 23)

Removal

1. Remove the coil spring as outlined previously.
2. Remove lower control arm ball stud cotter pin and loosen nut. Loosen the ball stud, then remove nut and lower control arm.

   CAUTION: Use extreme care not to damage the seal during this operation.

   NOTE: Inspect cam bolt for shouldering, replace if necessary. If new caps are to be used--replace with large front caps at both ends of the control bushing.

Installation

1. Insert lower control arm ball stud into the steering knuckle boss, install the nut and insert new cotter pin.
2. Install the coil spring as outlined previously.
3. Tighten nuts to torque shown in Specifications.

Chevelle, Camaro and Nova (Fig. 23)

Removal

1. Remove the front coil spring as outlined previously.
2. Remove lower control arm ball stud from the steering knuckle boss as outlined under "Lower Control Arm Spherical Joint".
3. Remove the lower control arm assembly.

Installation

1. Install lower control arm ball stud into steering knuckle boss.
2. Install the coil spring as outlined in "Front Coil Spring".
3. Tighten the nuts to torques shown in Specifications.

Corvette (Fig. 23)

Removal

1. Remove the front coil spring as outlined under "Front Spring, Removal".
2. Remove lower control arm ball stud from the steering knuckle boss as outlined under "Lower Control Arm Spherical Joint."
3. Remove the lower control arm assembly from the vehicle.

Installation

1. Install lower control arm ball stud into steering knuckle boss. Torque to specifications.
2. Install coil spring as outlined under "Front Coil Spring Installation".
3. Tighten cross shaft bolts to specifications.
4. With unit on floor, tighten cross shaft bushing bolts to torque shown in Specifications.

LOWER CONTROL ARM BUSHING

Chevrolet

Removal

1. Remove the lower control arm.
2. Install lower control arm in vise as shown in Figure 24 and using Tool J-22717 remove bushing stake so that bushing may be removed without extensive scoring of the control arm bushing seat.
3. Install Tools J-21058-8, J-21058-15, J-21830-7, J-9519-17, J-21474-8, special thrust washer and a flat washer as shown in Figure 25. Use J-21878 as shown to prevent collapse of the control arm.
4. Turn down on the puller screw nut to remove the bushing from the control arm.

Installation

1. With Spacer J-21878 in place to prevent collapse of the control arm, install Tools J-21058-8, J-21058-15, J-21830-7, J-9519-17, J-21474-2 special thrust washer and flat washer as shown in Figure 25.
2. Turn down on the puller screw nut to install the bushing in the control arm.

Chevelle, Camaro and Nova

The following bushing removal and installation procedures apply to all three vehicles and will be referred to as large or small bushings. Location of the large or small bushing vary from front to rear. The following chart shows location by vehicle.

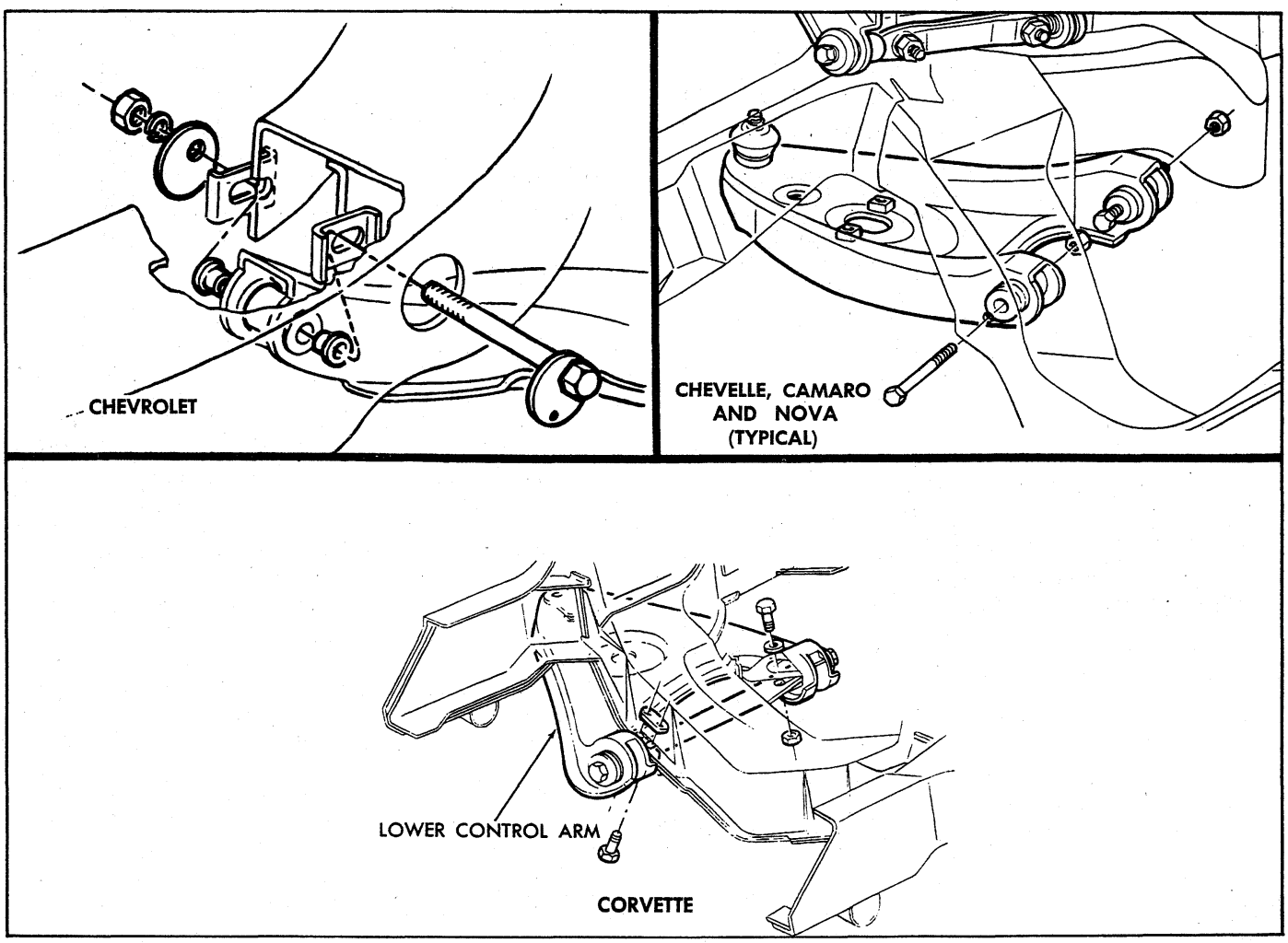


Fig. 23—Lower Control Arm Attachment

Vehicle	Bushing Size	Location in Control Arm
Chevelle	Large Bushing	Rear
	Small Bushing	Front
Camaro	Large Bushing	Front
	Small Bushing	Rear
Nova	Large Bushing	Front
	Small Bushing	Rear

Large Bushing

Removal and Installation

1. Remove the lower control arm.
2. To remove the large bushing, use Tools J-21058-8, J-21058-15, J-21474-5, J-21474-8, J-22323-1 and the thrust bearing installed as shown in the removal illustration in Figure 26.
3. Turn down on the hex head screw of J-21058-15 until the bushing is pushed out. Discard the bushing.
4. Install the new bushing with Tools J-21058-8, J-21058-15, J-21474-13, J-22175, J-22323-1 and the thrust bearing installed as shown in Figure 26.
5. Replace the control arm.

Small Bushing

Removal and Installation

1. Remove and install the small bushing as described

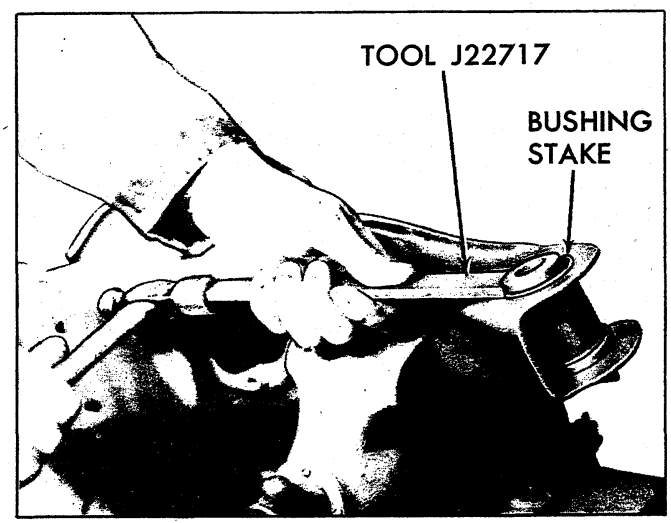


Fig. 24—Relieving Lower Control Arm Stake

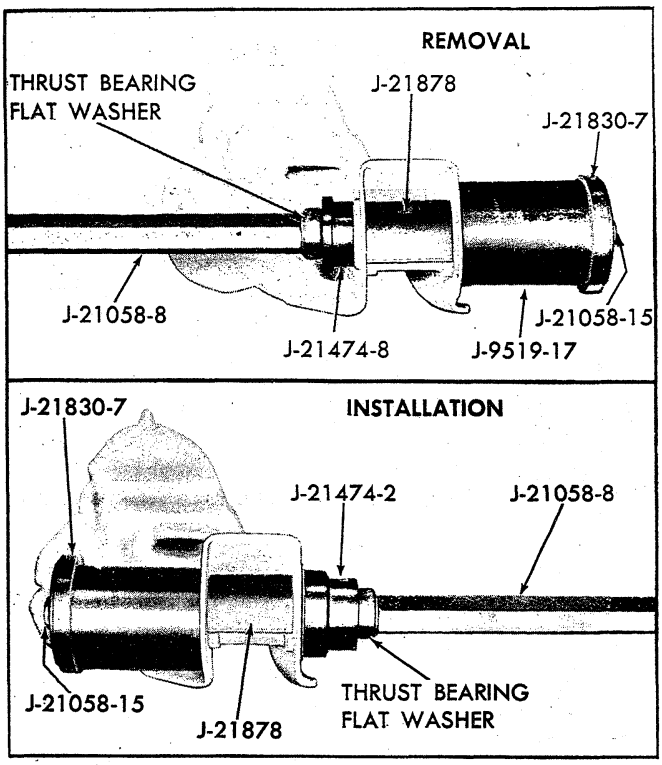


Fig. 25—Lower Control Arm Bushing—Chevrolet

above using Tools J-21058-8, J-21058-15, J-21474-5, J-21474-6, J-22323-1 and the thrust bearing for installation and Tools J-21058-8, J-21058-15, J-21474-6, J-21474-13, J-22323-1 and the thrust bearing for removal as shown in Figure 27.

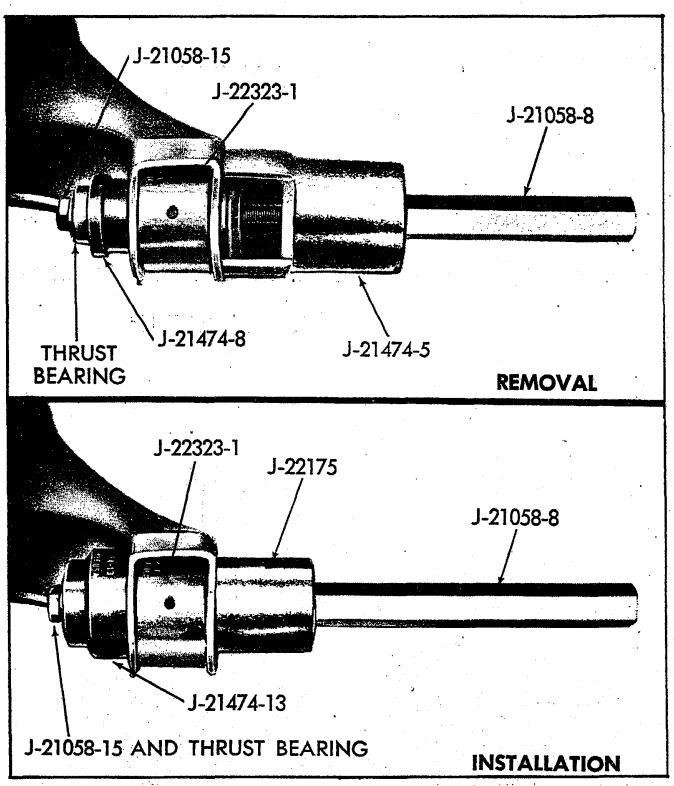


Fig. 26—Lower Control Arm (Large) Bushing

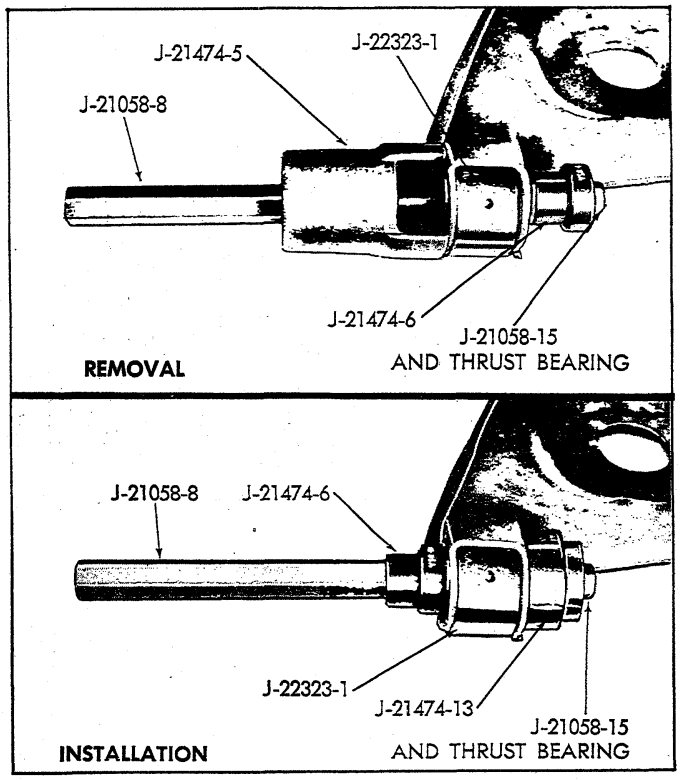


Fig. 27—Lower Control Arm (Small) Bushing

CROSS SHAFT AND/ON BUSHINGS

Corvette

Removal

1. Remove bolt, lock washer and collar from each end of cross shaft.
2. Thread a 7/16 x 20 capscrew (furnished with Tool J-5888) to the bottom of the threads in one end of the cross shaft.
3. Support control arm in an arbor press on Tool J-5888-3, as shown in Figure 28.

   NOTE: Be certain bushing flange does not contact support.

4. Press on cap screw until bushing is free of control arm. Discard bushing.
5. Remove cap screw from cross shaft. Insert it in other end of shaft. Invert control arm on support. Again be certain bushing flange does not contact support.
6. Press on cap screw until bushing is free of control arm. Discard bushing.

Installation

1. With cross shaft in control arm and Tool J-7052-1 in position, place control arm on Tool J-5888-3. Hand start bushing into control arm and over end of cross shaft.

   NOTE: The end of the shaft with the two bolt holes should be toward front of control arm.

2. Install Tool J-7052-5 over bushing. Be certain

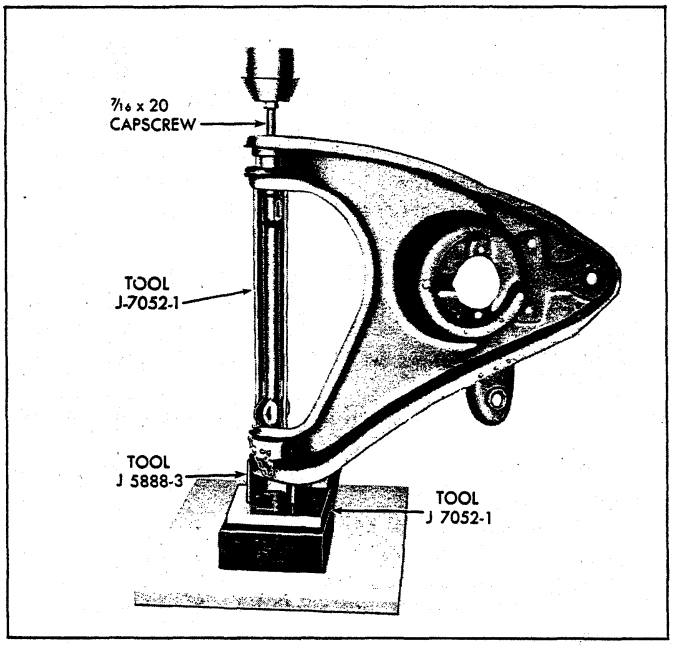


Fig. 28—Removing Lower Control Arm Cross Shaft Bushing (Corvette)

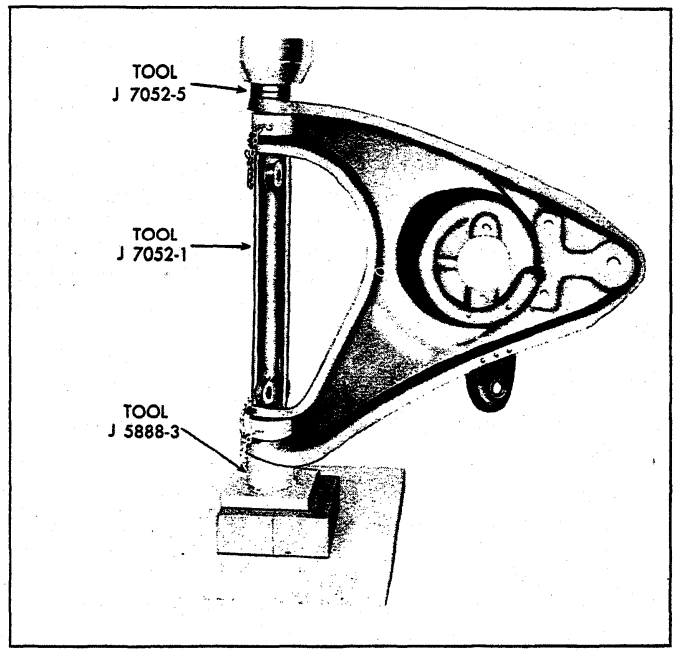


Fig. 29—Installing Lower Control Arm Cross Shaft Bushing (Corvette)

three-piece spacer is not over-lapping bushing holes in control arm.

3. Press bushing into control arm until flange contacts control arm (fig. 29).
4. Invert arm in press and repeat the process on the other bushing. After installation, cross shaft should be free enough to be rotated by hand.
5. Install collar, lock washer and cap screw in each end of cross shaft. Tighten to torque shown in Specifications after spring installation.

UPPER CONTROL ARM SPHERICAL JOINT

Chevrolet, Chevelle, Camaro, Nova and Corvette

Inspection

The upper spherical joint is checked for wear by checking the torque required to rotate the ball stud in the assembly. After performing the first four steps under "Replacement" below, install a stud nut on the stud and measure the torque required to turn the stud in the assembly with a torque wrench. Specified torque for a new joint is 3 to 10 lbs. ft. If torque readings are excessively high or low, replace the ball joint. If excessive wear is indicated in upper joint, both upper and lower joints should be replaced.

NOTE: This inspection does not necessitate upper control arm removal.

Replacement

1. Support the vehicle weight at the outer end of the lower control arm.
2. Remove the wheel and tire assembly.
3. Remove cotter pin and nut from upper control arm ball stud.
4. Remove the stud from knuckle.
5. Cut off the ball joint rivets with a chisel.
6. Enlarge ball stud attaching holes in control arm to 21/64" to accept 5/16" bolts included in unit.

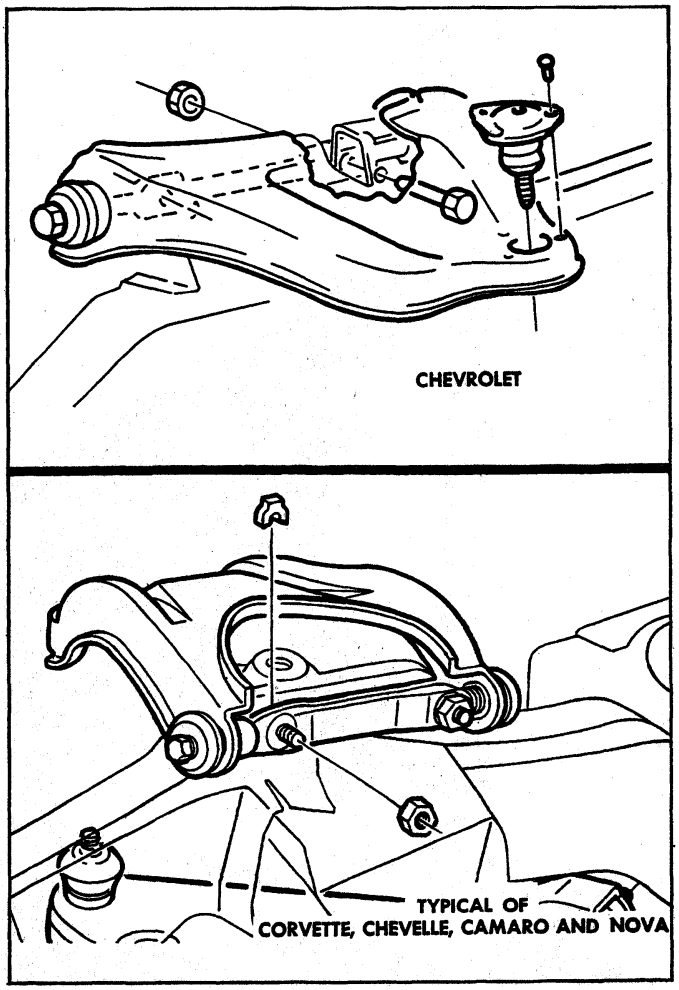


Fig. 30—Upper Control Arm Attachments

7. Install new joint and retain in place with the special nuts and bolts supplied.
8. Reassemble ball stud to the steering knuckle.

LUBE FITTINGS

Special self threading type lube fittings are used in the spherical joint assemblies. If it is necessary to replace a fitting a standard threaded type may be used. However, replacement spherical joint assemblies are supplied less the lube fitting. Therefore it will be necessary to install a self threading type fitting into the untapped hole provided when replacing the entire assembly.

UPPER CONTROL ARM

Chevrolet, Chevelle, Camaro, Nova and Corvette (Fig. 30)

Removal

1. Support vehicle weight at outer end of lower control arm.
2. Remove wheel and tire assembly.
3. Remove cotter pin and nut from upper control arm ball stud.
4. REMOVE the stud from knuckle.
5. Remove two nuts retaining upper control arm shaft to front crossmember. Chevelle, Camaro, Nova and Corvette--Note number of shims at each bolt.)
6. If necessary, remove the bolts attaching the control arm to the frame to allow proper clearance for control arm removal.
7. Remove upper control arm from vehicle.

Installation

1. Install upper control arm in vehicle.
2. Install locknuts, bolts retaining upper control arm shaft to frame. (Chevelle, Camaro, Nova and Corvette--Install same number of shims as removed at each bolt.)
3. Torque nuts as shown in the Specifications at the end of this book.
4. Install ball stud through knuckle, install nut, tighten and install cotter pin.
5. Install wheel and tire assembly.
6. Lower vehicle to floor.
7. Bounce front end of vehicle to centralize bushings and tighten bushing collar bolts as shown in the Specifications.

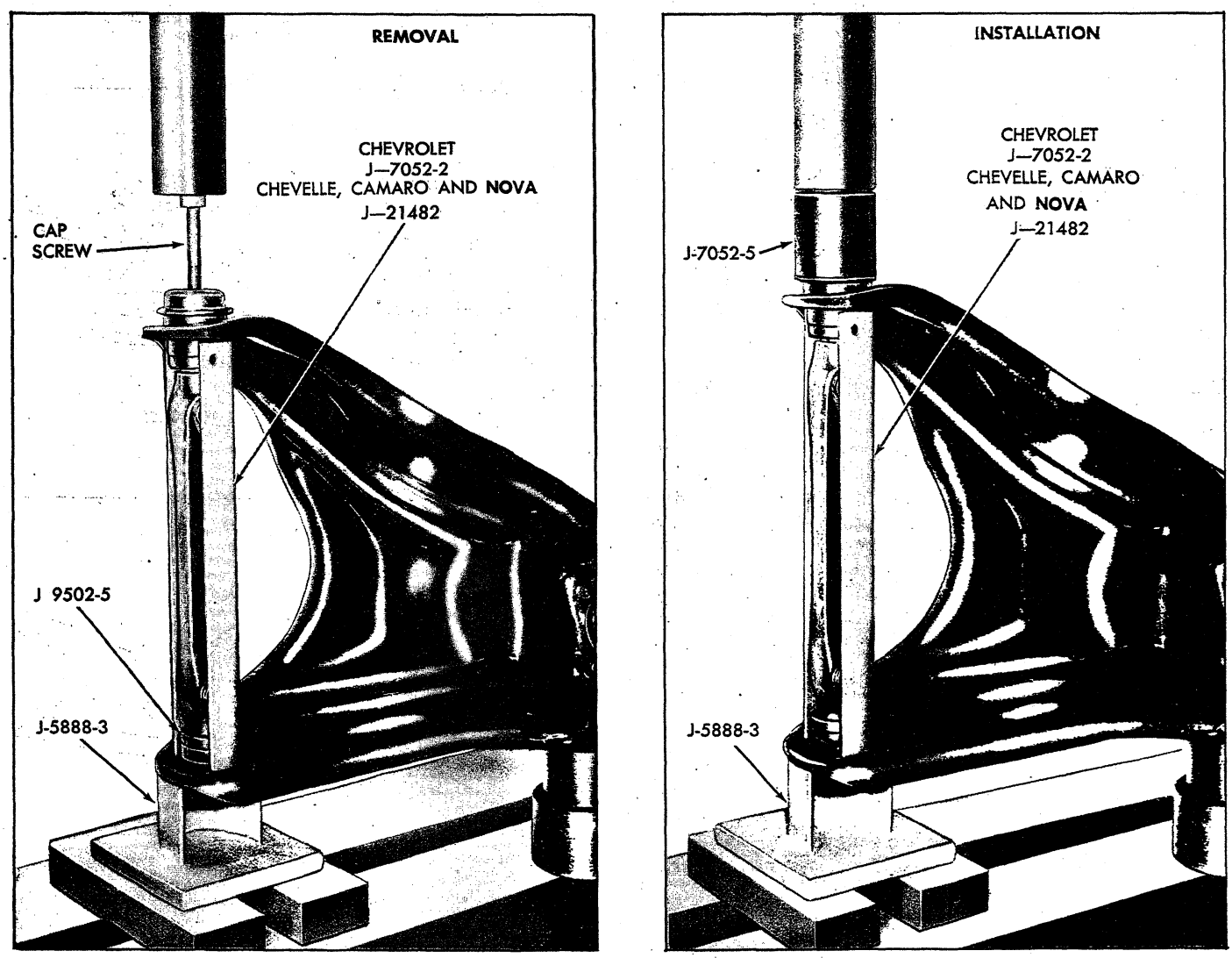


Fig. 31—Removal and Installation of Control Arm Bushings

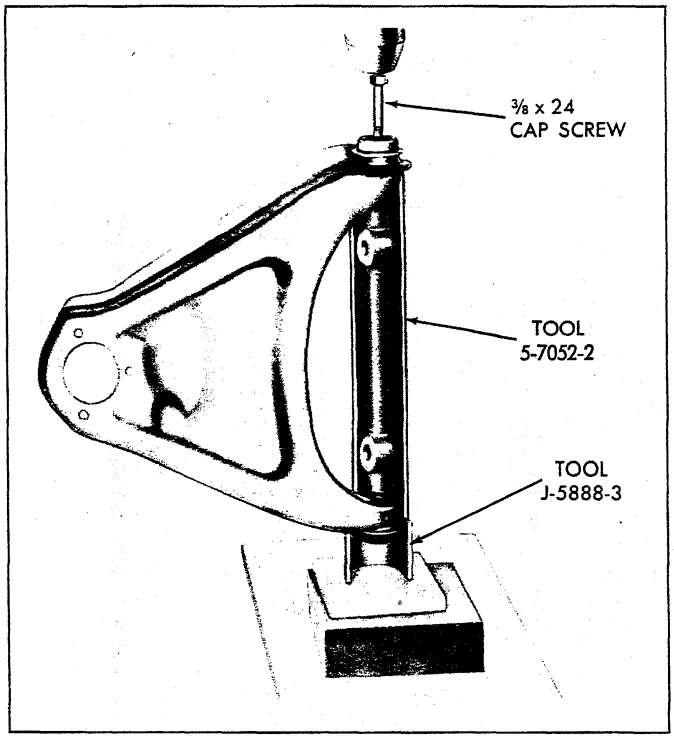


Fig. 32—Removing Upper Control Arm Cross Shaft Bushings—Corvette

UPPER CONTROL ARM CROSS SHAFT AND/OR BUSHINGS

Chevrolet, Chevelle, Camaro and Nova

Removal

1. Remove cap screws, lock washers and collars from both ends of cross shaft.
2. Install a 3/8-24 cap screw in one end of cross shaft.
3. Support control arm in an arbor press on Tool J-5888-3 as shown in Figure 31.

   NOTE: Be certain flange of bushing does not contact support.

4. Press out bushing, invert control arm and repeat process on other bushing. Discard bushings.
5. Remove cap screw from cross shaft.

   NOTE: If bushing rubber is deteriorated to the extent that the bushing sleeve cannot be pushed out, release the press, install J-9502-5 as shown in Figure 31 and press out the sleeve.

Installation

1. Install arm in arbor press with Tool J-7052-2 (Chevrolet) or J-21482 (Chevelle, Camaro and Nova in place and press in one bushing using J-7052-5 as shown while supported on Tool J-5888-3 as shown in Figure 31.
2. Install cross shaft in arm, invert in press, and press in second bushing as above.
3. Cross shaft should be able to be turned by hand.
4. Install collar, lock washer and cap screw in ends of cross shaft. Do not tighten.

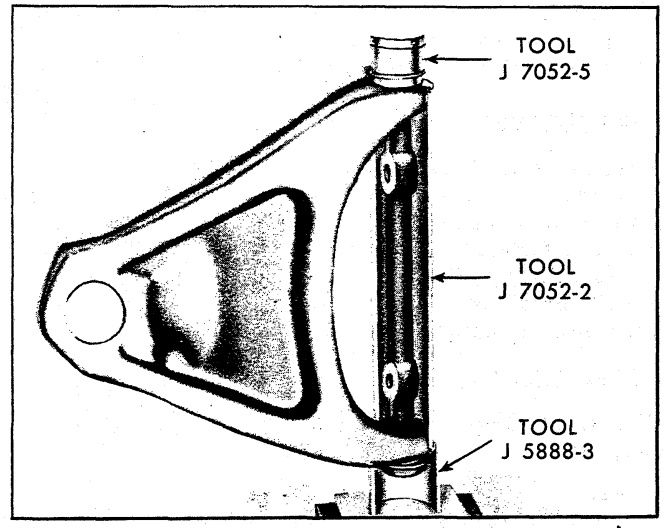


Fig. 33—Installing Upper Control Arm Cross Shaft Bushings—Corvette

Corvette

Removal

1. Remove cap screws, lock washers and collars from both ends of cross shaft.
2. Install a 3/8-24 cap screw (furnished with Tool J-5888) in one end of cross shaft.
3. With control arm supported in an arbor press on Tool J-5888-3 and Tool J-7052-2 in place as shown in Figure 32.

   NOTE: Be certain flange of bushing does not contact support.

4. Press out bushing, invert control arm and repeat process on other bushing. Discard bushings.
5. Remove cap screw from cross shaft.

Installation

1. Install arm in arbor press with Tool J-7052-2 in place and press in one bushing while supported on Tool J-5888-3 as shown in Figure 33.
2. Install cross shaft in arm, invert in press, and press in second bushing as above.
3. Cross shaft should be able to be turned by hand.
4. Install collar, lock washer and cap screw in ends of cross shaft. Do not tighten.

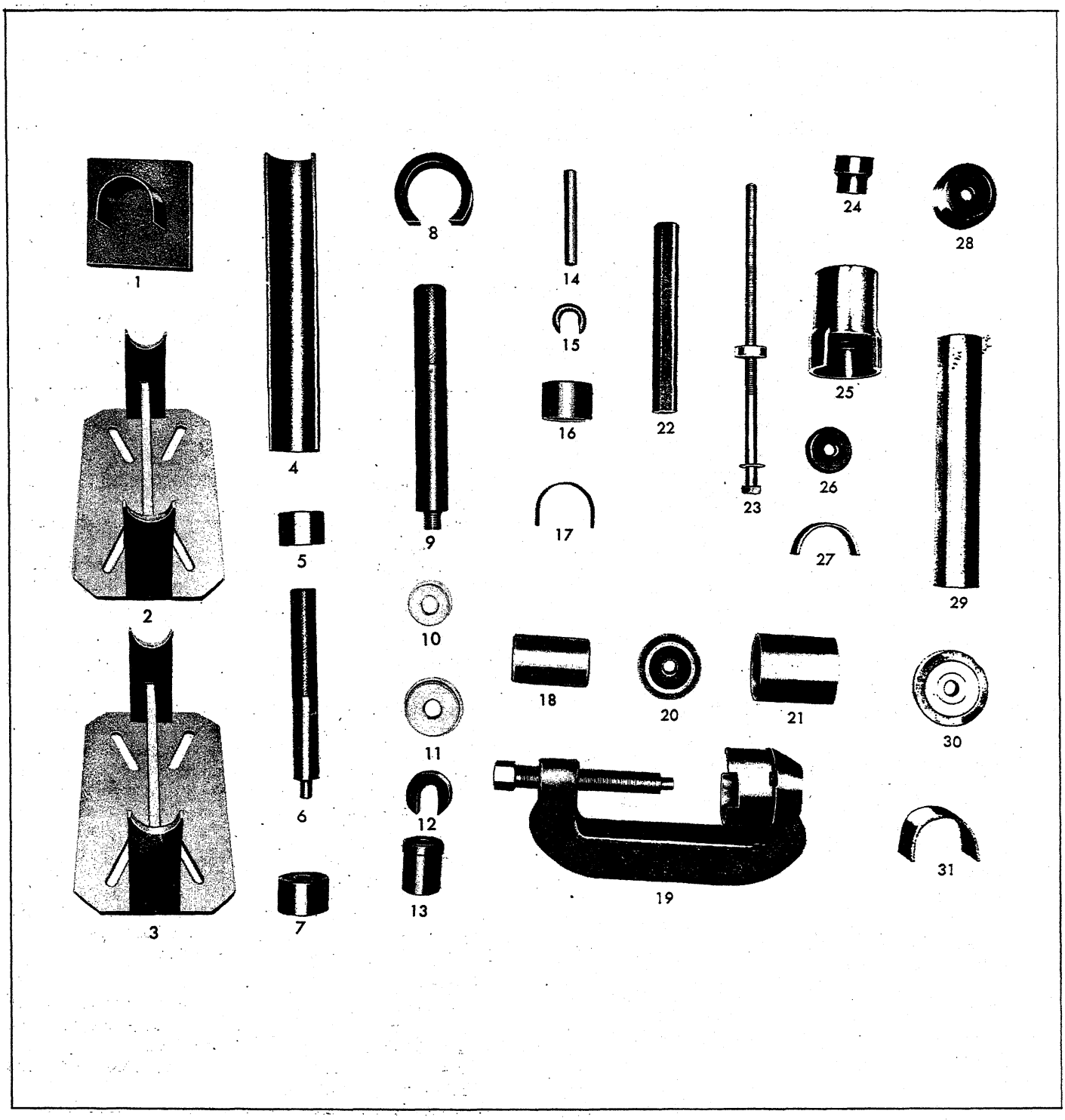


Fig. 34—Front Suspension Special Tools

1. J-5888-3 Support
2. J-22739 Spring Remover (Chevelle, Camaro and Nova
3. J-22944 Spring Remover (Corvette)
4. J-7052-2 Spacer
5. J-7052-5 Installer
6. J-7079-2 Driver Handle
7. J-7574-2 Installer
8. J-7574-4 Support
9. J-8092 Driver Handle
10. J-8849 Installer
11. J-8850 Installer
12. J-9502-3 Remover
13. J-9226 Remover
14. J-9513-1 Remover
15. J-9513-2 Remover
16. J-9513-3 Installer
17. J-9514 Spacer
18. J-9519-7 Remover
19. J-9519-10 Clamp
20. J-9519-16 Installer
21. J-9519-17 Receiver
22. J-21058-8 Nut
23. J-21058-15 Screw
24. J-21474-2 Installer
25. J-21474 Receiver
26. J-21474-8 Remover
28. J-21474-13 Installer
29. J-21482 Spacer
30. J-21830-7 Receiver Bridge
31. J-21878 Spacer
32. J-21474-3 (Not Illustrated)
33. J-21474-4 (Not Illustrated)
34. J-21474-5 (Not Illustrated)
35. J-21474-6 (Not Illustrated)
36. J-22323-1 (Not Illustrated)
37. J-22323-2 (Not Illustrated)

SECTION 4

REAR SUSPENSION AND DRIVE LINE

CONTENTS OF THIS SECTION

	Page
Rear Suspension	4-1
Drive Line	4-23
Rear Axle	4-23
Propeller Shaft and Universal Joints	4-33
Special Tools	4-37

REAR SUSPENSION

INDEX

	Page
General Description	4-1
Chevrolet	4-1
Chevelle	4-2
Nova and Camaro	4-3
Corvette	4-3
Maintenance and Adjustments	4-4
Riding Height Check (Chevrolet, Camaro, Chevelle and Nova)	4-4
Wheel Alignment (Corvette)	4-5
Wheel Bearing Adjustment (Corvette)	4-5
Component Parts Replacement (Chevrolet, Camaro, Chevelle and Nova)	4-7
Coil Spring	4-7
Chevrolet	4-7
Removal	4-7
Installation	4-7
Chevelle	4-7
Removal	4-7
Installation	4-8
Leaf Spring, Spring Seat Pads, Spring Eye Bushings, Spring Leaf	4-8
Camaro and Nova	4-8
Removal	4-8
Spring Leaf Replacement	4-9
Installation	4-9
Shock Absorber	4-10
Chevrolet and Chevelle	4-10
Removal	4-10
Installation	4-10
Nova	4-10
Removal	4-10
Installation	4-10
Camaro	4-10
Removal	4-10
Installation	4-11
Control Arm	4-11
Chevrolet Upper	4-11
Removal	4-11
Bushing Replacement	4-12
Installation	4-12
Chevrolet Lower	4-12
Removal	4-12
Bushing Replacement	4-12
Installation	4-13
Chevelle Upper and Lower	4-13
Removal	4-13
Bushing Replacement	4-13
Installation	4-15
Rear Suspension Tie Rod (Chevrolet)	4-15
Removal	4-15
Bushing Replacement	4-15
Installation	4-15
Component Parts Replacement (Corvette)	4-16
Wheel Spindle and Support	4-16
Removal	4-16
Repairs	4-16
Installation	4-16
Differential Carrier Support Bracket Replacement	4-17
Shock Absorber	4-17
Removal	4-17
Installation	4-17
Strut Rod and Bracket	4-17
Removal	4-17
Repairs	4-18
Installation	4-18
Spring	4-18
Removal	4-18
Repairs	4-19
Installation	4-19
Torque Control Arm	4-20
Removal	4-20
Repairs	4-21
Installation	4-21
Suspension Crossmember	4-22
Removal	4-22
Repairs—Isolation Mount	4-22
Installation	4-22
Stabilizer Shaft Replacement	4-22

GENERAL DESCRIPTION

In the following service procedures reference is made to light and heavy duty axles. Internally, heavy duty axles can be identified by the number of bolts retaining the ring gear to the differential case. Heavy duty axles have twelve retaining bolts; whereas, light duty axles have ten retaining bolts. Externally, they can easily be identified by the number of bolts retaining the axle housing cover. Heavy duty axles have twelve retaining bolts and light duty axles have ten retaining bolts.

CHEVROLET

The link type rear suspension (fig. 1) has two lower control arms which maintain proper axle to frame relationship and also take the acceleration, drive and

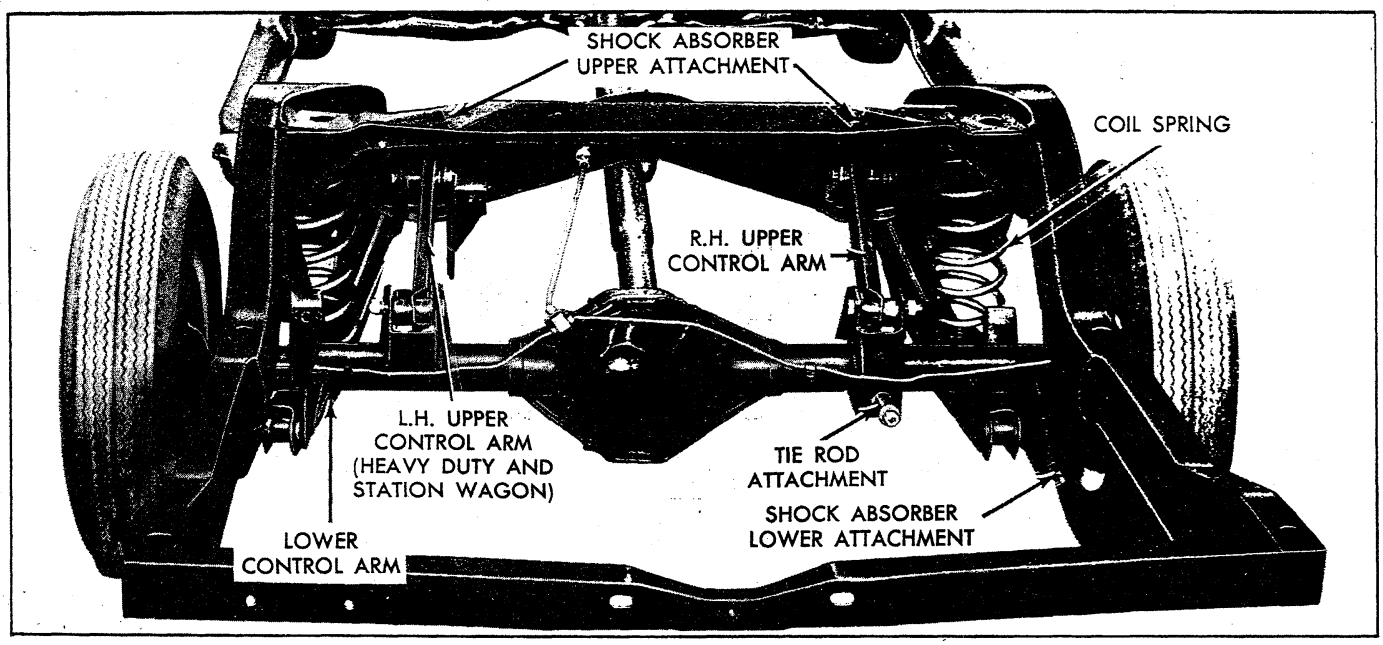


Fig. 1—Chevrolet Rear Suspension Components

braking forces. The upper control arms limit axle rotation when drive, acceleration or braking forces are applied. Lateral movement of the axle is restricted by the axle-to-frame tie rod. Two full coil springs and two direct, double acting shock absorbers are provided for additional ride control.

CHEVELLE

The rear suspension (fig. 2) is of the four-link design utilizing axle mounted, full coil springs and direct, double-acting shock absorbers.

Two rubber-bushed lower control arms, stretching slightly outboard from axle-mounted brackets to frame side member mounted brackets, maintain fore and aft relationship of the axle assembly to the vehicle proper. These lower control arm axle brackets also mount the axle compression bumpers and provide for lower attachment of the shock absorber. Upper attachment of the shock absorber is a platform mount to the rear of the coil spring frame bracket. The coil springs are pigtailed at both ends; the upper end is isolated from the frame seat by a rubber insulator, while the lower end seats on the axle mounted spring bracket which has a vertical flange to retain the spring.

Sideways movement of the axle assembly is controlled by two angularly mounted, rubber-bushed upper control arms. Projecting ears, cast as part of the differential carrier, provide for rear attachment and frame cross-member mounted brackets retain them at the forward end.

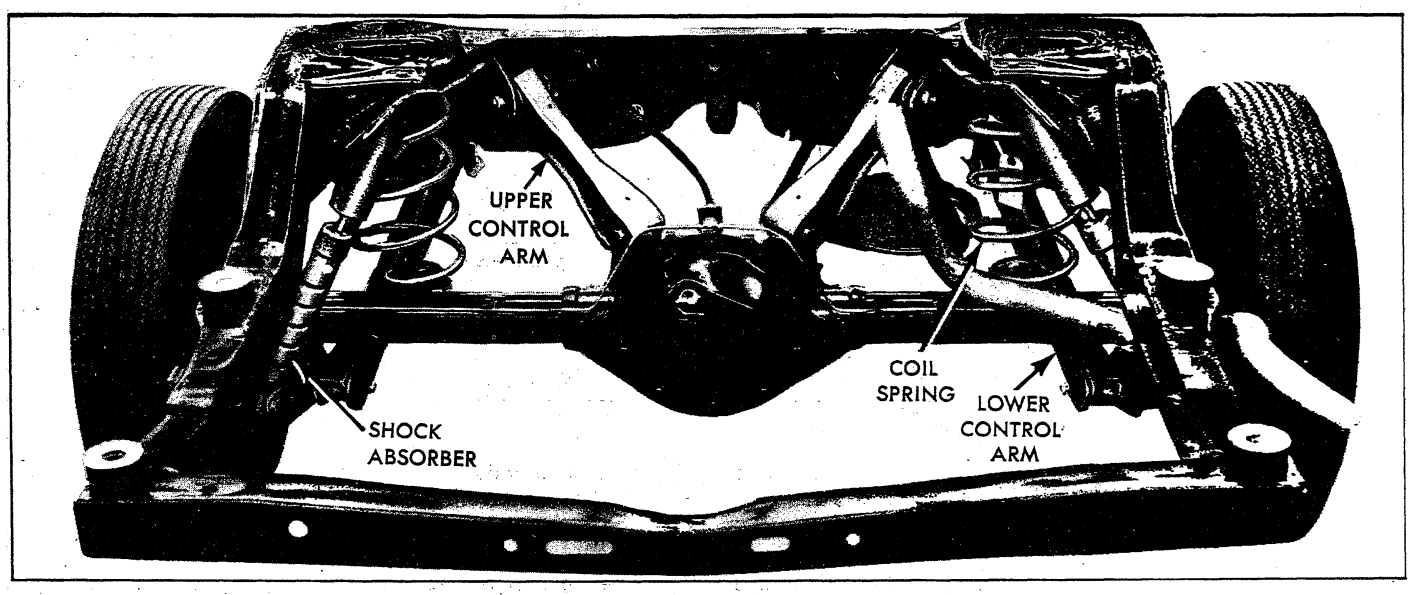


Fig. 2—Chevelle Rear Suspension Components

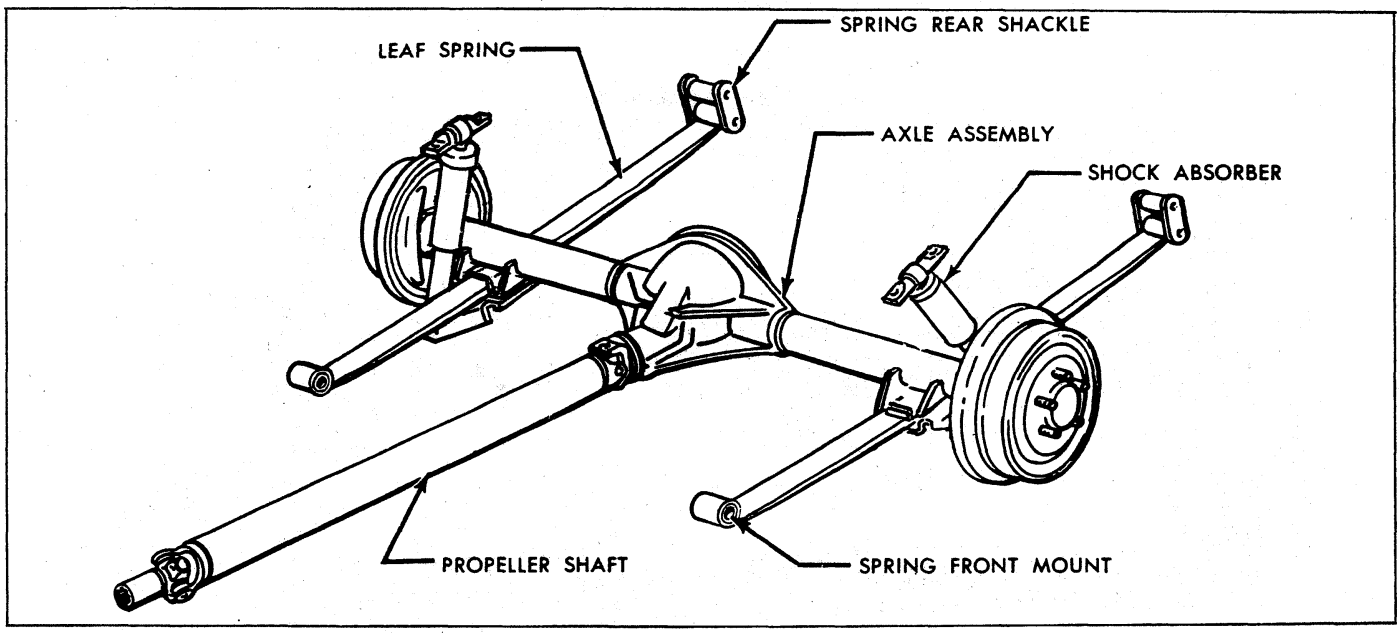


Fig. 3—Nova Rear Suspension Components

NOVA AND CAMARO

The Nova and Camaro rear suspension (fig. 3 and 4) consists of two uniformly stressed rear springs of a single leaf or multi-leaf design. Shock absorbers are staggered mounted to the spring lower seats. The right hand shock absorber is mounted forward of the axle with the left hand shock absorber mounted behind the axle. The springs are rubber mounted at both axle and frame attaching points, thus ensuring uniform spring loading, minimizing transmittal of road vibration to passenger compartment, and providing a pivot to absorb axle wind-up. The single leaf springs are positioned to the axle spring seats by locating pins butt welded to the spring leaf. The multi-leaf springs are positioned to the axle spring seat by a locating bolt which passes through the center of the spring leafs.

CORVETTE

The Corvette independent three-link type rear suspension consists of a fixed differential carrier which is rubber mounted to the frame at three points, with the strut rods, drive shafts and torque control arms forming the three links at each wheel, and a transversely mounted multi-leaf spring (fig. 5).

The box section trailing torque control arms are mounted at the forward end into frame side member

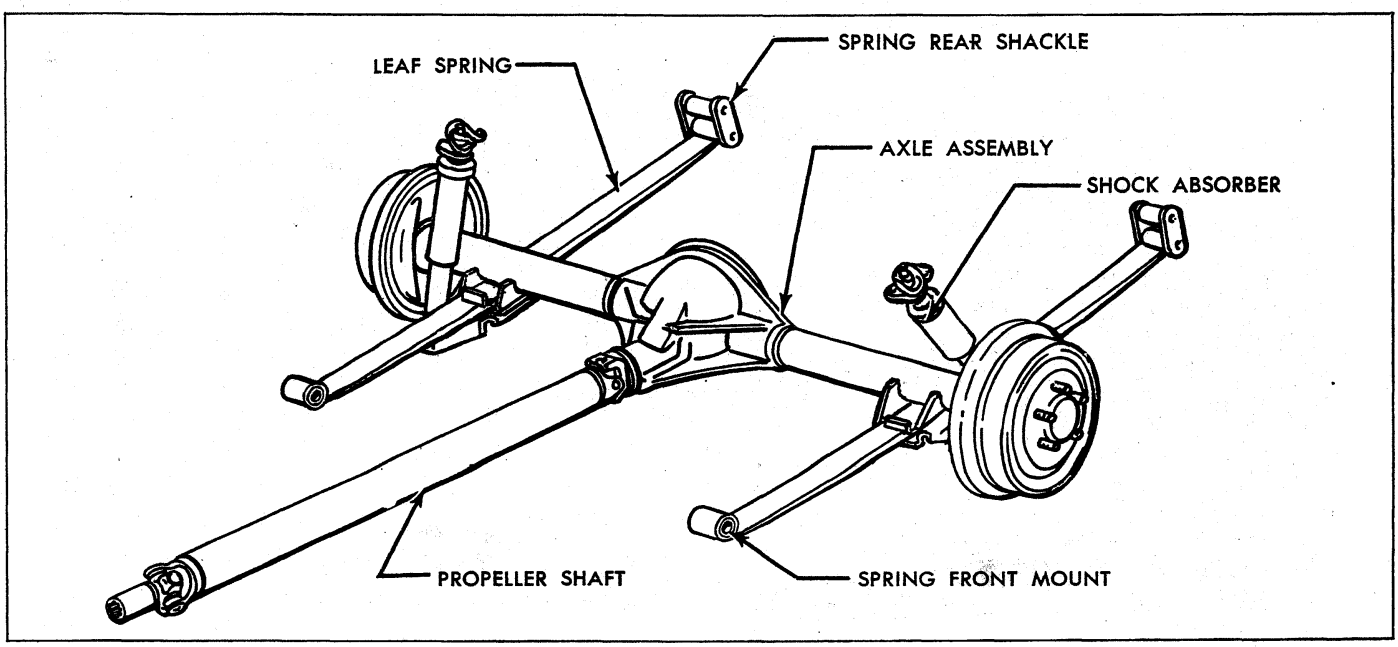


Fig. 4—Camaro Rear Suspension Components

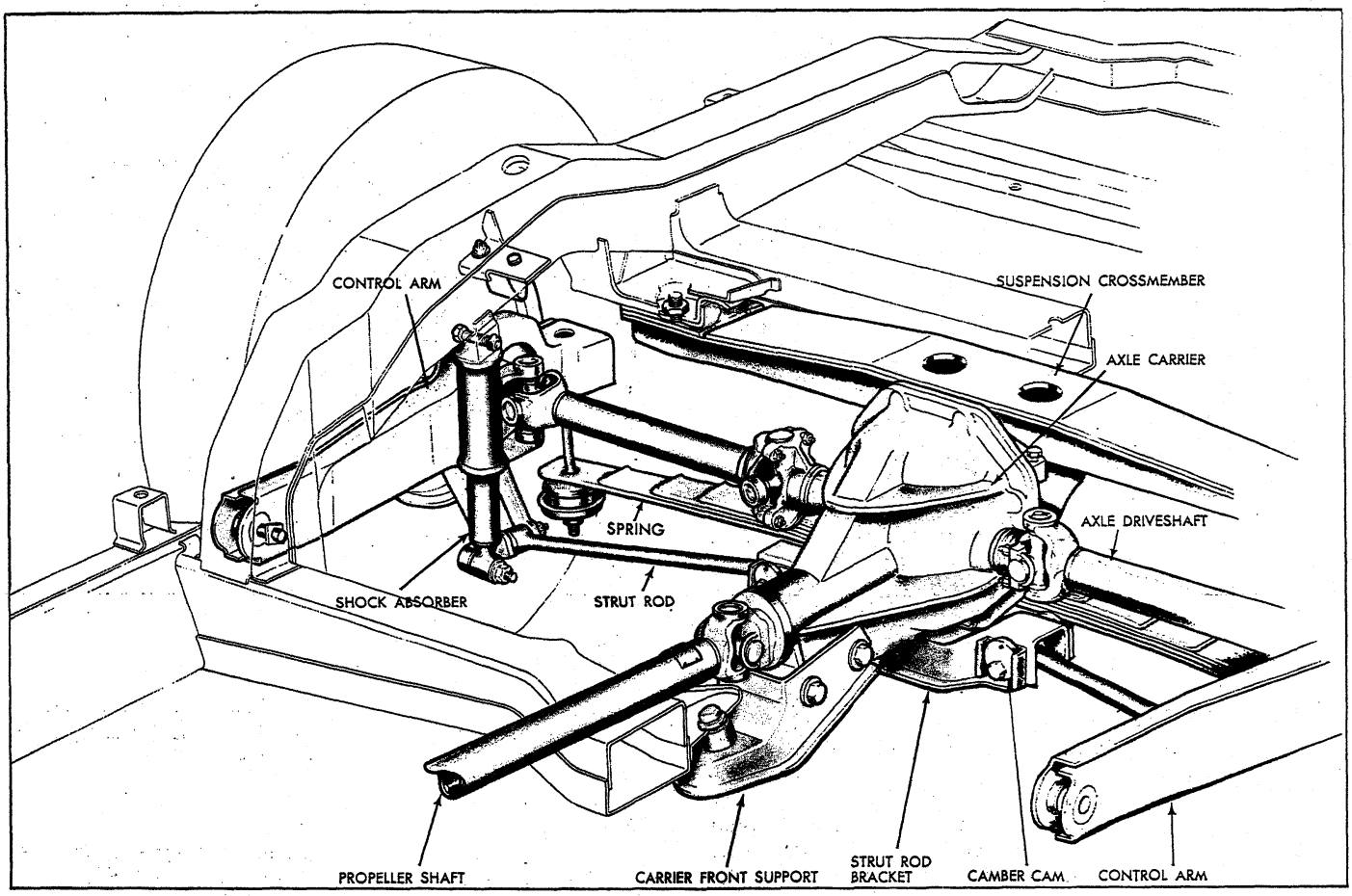


Fig. 5—Corvette Rear Suspension and Driveline Components

openings through pivot bolts and rubber bushings, and extend rearward to connect to the leaf spring. The wheel spindles and spindle supports are attached to the torque control arms through four bolts pressed into the arm. Rear wheel toe-in angle is adjusted through the use of variable thickness shims inserted between the torque arm and the frame side member web at the forward pivoting joint.

The rear wheel spindles are driven through double "U" jointed, tubular drive shafts which are flange mounted to a splined spindle flange at their outboard end and bolted to the differential side gear yokes at their inboard end. Wheel spindle support houses the inner and outer tapered roller bearings, two to each wheel. Bearing adjustment is made through the use of a spacer and variable thickness shims between the bearings.

The spindle supports also incorporate integrally forged, fork-shaped mounting brackets to accept the outer ends of the rubber-bushed strut rods. The strut rods are mounted laterally from the spindle support to a bracket bolted to the lower surface of the axle carrier. The strut rod connection at this point is with an eccentric cam arrangement and provides for rear wheel camber adjustment.

The direct, double-acting shock absorbers are attached at the upper eye to a frame bracket and at the lower eye to the strut rod mounting shaft which incorporates a threaded stud for the shock absorber lower eye.

The transversely mounted multi-leaf spring is clamp bolted at the center section to a lower mounting surface on the differential carrier cover. The outer ends of the main leaf are provided with a hole through which the spring is link bolted to the rear of the torque control arms. The spring assembly is provided with full length liners.

Models equipped with a 427 cu. in. engine incorporate a stabilizer shaft which attaches to the upper rear section of the torque control arms, and stretches rearward where it is connected to the frame by two rubber-bushed mounting brackets.

MAINTENANCE AND ADJUSTMENTS

Other than Corvette and Corvair rear wheel alignment periodic maintenance and adjustments are not required for the rear suspension components. The suspension system should be checked for shock absorber action, condition of suspension bushings, tightness of suspension attaching bolts and an overall visual inspection of components for defects.

RIDING HEIGHT CHECK (Chevrolet, Chevelle Camaro and Nova)

In case of vehicle riding height complaints, a spring height check will show if the rear suspension is at the right height.

1. Position car on smooth level floor.

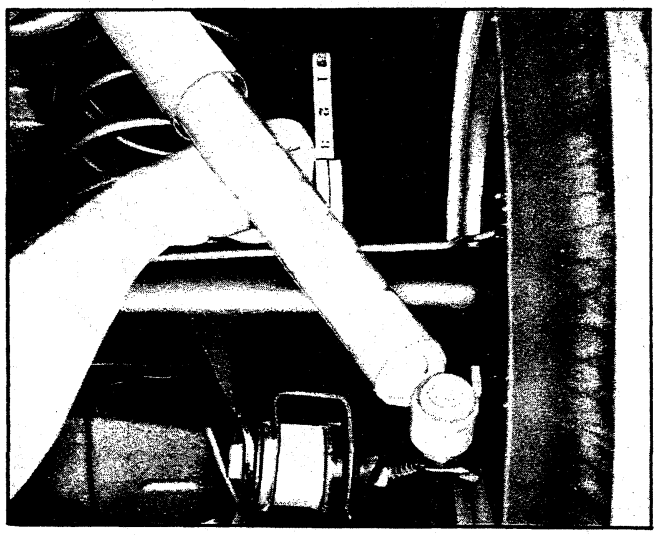


Fig. 6—Measuring Rear Riding Heights (Chevrolet and Chevelle)

2. Vehicle must be at curb weight (full gas tank, no passengers, spare and jack in trunk). Car should be raised up a few times to allow suspension to settle with car weight to eliminate friction at arm pivots.
3. On Chevrolet and Chevelle models, measure riding height as the vertical distance from the top of the axle housing to frame kick-up (fig. 6).
4. On Nova models measure riding height as the distance from jounce bumper upper attaching bolt to top of axle housing (fig. 7).
5. On Camaro models, measure the vertical distance from top of axle housing to a point rearward of the bend in the frame (fig. 7).
6. Riding heights vary between models. Refer to specifications section for vehicle and model application.

WHEEL ALIGNMENT (CORVETTE)

Camber

Wheel camber angle is obtained by adjusting the eccentric cam and bolt assembly located at the inboard mounting of the strut rod (fig. 8). Place rear wheels on alignment machine and determine camber angle. To adjust, loosen cam bolt nut and rotate cam and bolt assembly until specified camber is reached. Tighten nut securely and torque to specifications.

Toe-In

Wheel toe-in is adjusted by inserting shims of varying thickness inside the frame side member on both sides of the torque control arm pivot bushing (fig. 9). Shims are available in thicknesses of 1/64", 1/32", 1/8" and 1/4". To adjust toe-in, remove torque control arm pivot bolt; then position torque control arm to obtain specified toe-in. Shim gap toward vehicle centerline between torque control arm bushing and frame side inner wall.

NOTE: Do not use thicker shim than necessary, and do not use undue force when shimming inner side of torque control arm - to do so may cause toe setting to change.

Shim outboard gap as necessary to obtain solid stack-up between torque control arm bushing and inner wall of frame side member. After correct shim stack has been selected, install pivot bolt and hardened washers (fig. 9) making sure that all shims are retained - torque nut to specifications and install cotter pin. If specified torque does not permit cotter pin insertion, tighten nut to next flat.

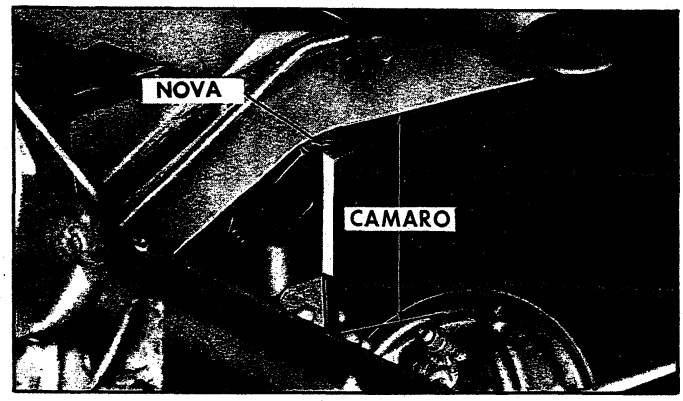


Fig. 7—Measuring Rear Riding Heights (Camaro and Nova)

WHEEL BEARING ADJUSTMENT (CORVETTE)

Inspection

The tapered-roller spindle bearings should have end play of .001" to .008". During inspection, check end play and, when necessary, adjust as outlined in this section.

1. Raise rear of vehicle until wheels clear ground.
2. Disengage bolt lock tabs and disconnect outboard end of axle drive shaft from wheel spindle flange.
3. Mark camber cam in relation to bracket. Loosen and turn camber bolt until strut rod forces torque control arm outward. Position loose end of axle drive shaft to one side for access to spindle.
4. Remove wheel and tire assembly. Mount dial indicator (Tool J-8001) on torque control arm adjacent surface and rest pointer on flange or spindle end (fig. 10).
5. Grasp brake disc and move axially (in and out) while reading movement on dial indicator. If end movement

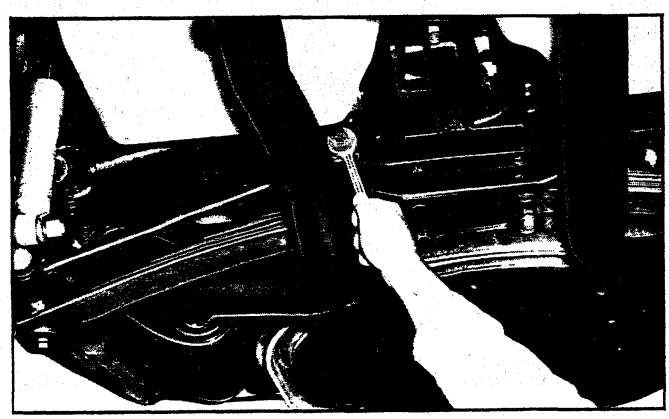


Fig. 8—Adjusting Rear Wheel Camber (Corvette)

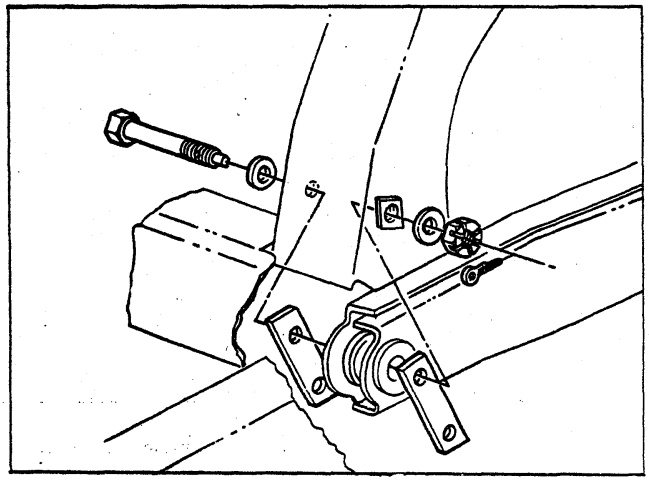


Fig. 9—Toe-In Adjusting Shim Location (Corvette)

is within the .001" to .008" limit, bearings do not require adjustment. If not within .001" to .008" limit, record reading for future reference and adjust bearings as outlined below.

Adjustment

1. Apply parking brake to prevent spindle from turning and remove cotter pin and nut from spindle.
2. Release parking brake and remove drive spindle flange from splined end of spindle.
3. Remove brake caliper and brake disc as outlined in Section 5.
4. Install Thread Protector J-21859-1 over spindle threads; then remove drive spindle from spindle support, using Tool J-22602 as shown in Figure 11.

   CAUTION: When using Tool J-22602 to remove drive spindle, make sure puller plate is positioned vertically in the torque control arm before applying pressure to the puller screw.

5. Remove shim and bearing spacer from spindle support.
6. Note size of shim used. If dial indicator reading was more than .008", select a shim thinner by the amount needed to bring end play within limits. If

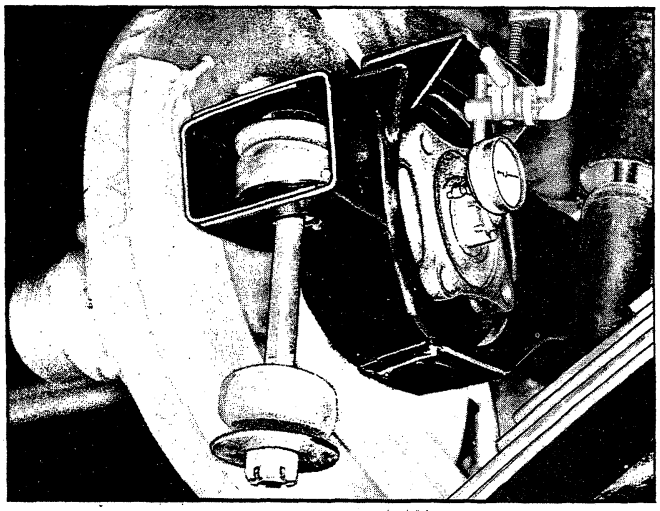


Fig. 10—Checking Wheel Bearing Adjustment (Corvette)

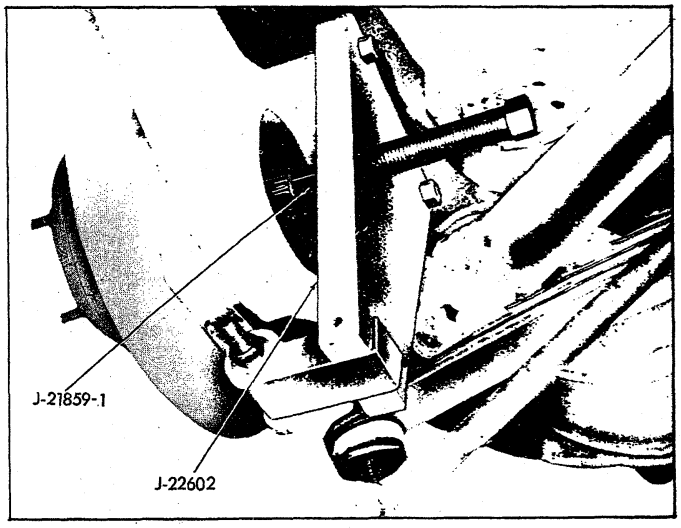


Fig. 11—Removing Drive Spindle from Support (Corvette)

dial indicator reading was less than .001", select a shim thicker by the amount needed to bring end play within limits.

NOTE: Shims are available in thicknesses from .097" to .048" in increments of .003".

EXAMPLE: Bearing end play reading obtained on dial indicator was .011", .003" over limit. Bearing shim removed from spindle measures .145". New shim installed measures .139", .006" smaller. End play is now decreased by .006" and is .005", which is within the .001" to .008" limit.

7. After determining shim thickness, install bearing spacer and shim on spindle. Position spindle in spindle support.

   CAUTION: Place large end of spacer facing outer bearing with shim located between spacer and inner bearing.

8. Press inner bearing race and roller assembly on spindle as follows.
   a. Position Tool J-4731 over spindle and against bearing inner race.

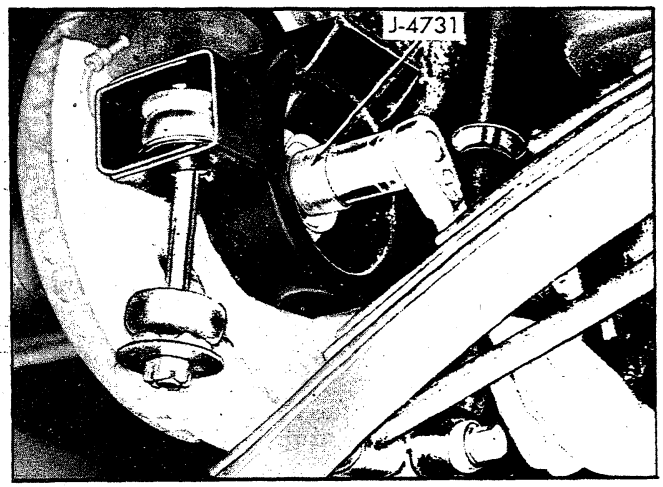


Fig. 12—Installing Drive Spindle to Support (Corvette)

b. Position washer and spindle nut on spindle and proceed to tighten nut until bearing is forced on spindle sufficiently to allow spindle drive flange to be installed (fig. 12). Remove spindle nut, washer and Tool J-4731. Discard nut and use a new one for final assembly.

9. Position drive flange over spindle, making sure flange is aligned with spindle splines. Install washer and nut on spindle then tighten nut to specifications and install cotter pin. If specified torque does not permit cotter pin insertion, tighten nut to next flat.
10. Seat spindle support outer seal in bore by using screw driver, or other suitable tool, to press against metal portion of seal.
11. Install brake disc and caliper. Refer to Section 5 for details of brake disc and caliper installation.
12. Install axle drive shaft, wheel and tire assembly, adjust camber cam to original position and torque all components to specifications.

COMPONENT PARTS REPLACEMENT

(Chevrolet, Chevelle, Nova and Camaro)

COIL SPRING

Chevrolet

Removal

To remove either or both rear coil springs proceed as follows:

1. Raise rear of vehicle and place jack stands under frame. Support vehicle weight at rear, using either a jack or post of twin-post hoist under axle.
2. Remove both rear wheels from vehicle.
3. With the car supported as in Step 1, so that the rear springs are compressed by weight of vehicle; perform the following:
   a. Disconnect both rear shock absorbers from the anchor pin lower attachment.
   b. Loosen the upper control arm(s) rear pivot bolt (do not remove the nut).
   c. Loosen both the left and the right lower control arm rear attachment (do not disconnect from axle brackets).
   d. Remove the rear suspension tie rod from the stud on the axle tube.
4. At the lower seat of both rear coil springs, slightly loosen the nut on the bolt that retains the spring and seat to the control arm. When the nut has been backed off the maximum permissible, all threads of the nut should still be engaged on the bolt.

   CAUTION: Under no condition should the nut, at this time, be removed from the bolt in the seat of either spring.

5. Slowly lower the support (jack or hoist post) that has been in place under the rear axle, thereby allowing the axle to swing down, carrying the springs out of their upper seat and providing access for spring removal.
6. Remove the lower seat attaching parts from each spring, then remove the springs and insulators from the vehicle (fig. 13).

Installation

1. Position the springs and upper rubber insulator in their upper seat so that end of top coil is 3/8" ± 1/8" from end of stop. Install the lower seat parts on the control arm, with the nut finger tight on the spring retainer bolt.

   NOTE: Omit the lock washer under the special high carbon bolt, so that sufficient bolt thread will be available to start the nut. The lock washers will be installed later (in Step 4).

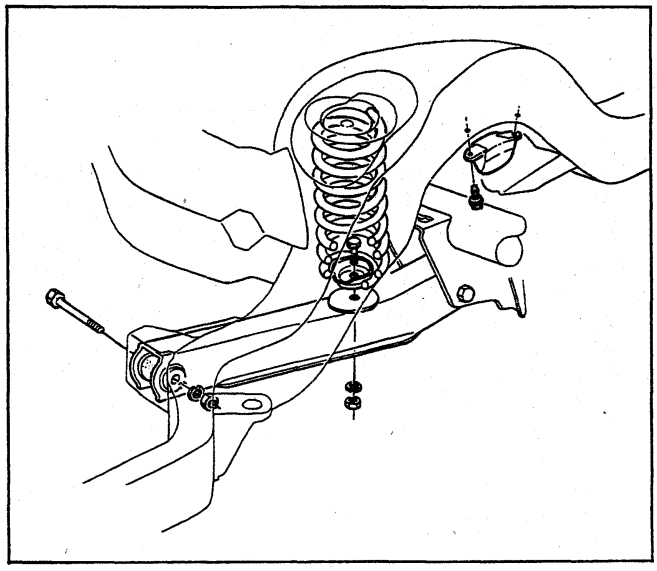


Fig. 13—Coil Spring Installation (Chevrolet)

2. By alternately raising the axle slightly and then re-snugging the nut on each spring lower seat bolt, move the axle upward until vehicle weight is fully supported on the jack. With the spring now compressed to approximately curb height, positively position the springs in the lower seats by torquing the nut on the lower seat bolt (fig. 14).
3. Re-connect shock absorbers, torque rear attachment of upper and lower control arms, and reconnect the axle tie rod at proper torque.
4. With the rear of vehicle still supported by jack under axle; remove the nut from the lower seat bolt of one rear spring, slide proper lock washer on the bolt and reinstall the nut to proper torque. Similarly install a lock washer at the lower seat of the other rear spring.
5. Install rear wheels and lower vehicle to floor.

Chevelle

Removal

The following procedure may be utilized to replace either or both rear coil springs.

1. Raise vehicle to a height that will allow axle assembly to hang freely, and position supports under both frame side rails.
2. Support axle assembly with an adjustable lifting device, and disconnect shock absorber at axle bracket. Shock absorber on side opposite need not be disconnected if only one spring is being removed.

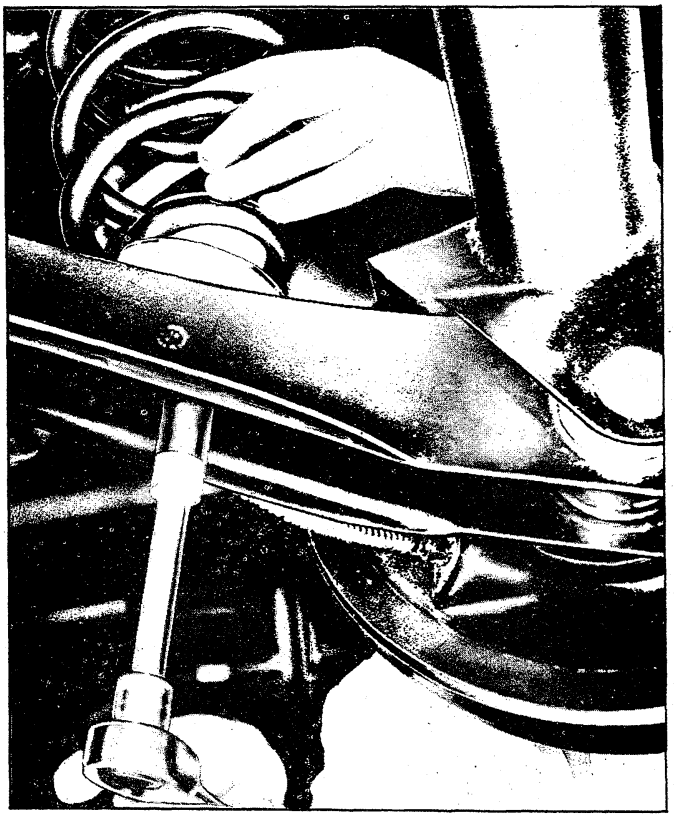


Fig. 14—Installing Coil Spring to Lower Control Arm (Chevrolet)

Refer to Shock Absorber Removal procedures outlined in this section.

3. Lower axle assembly until suspension reaches end of travel; then pry lower pigtail over vertical retainer on axle bracket and remove spring and insulator from vehicle.

Installation

1. Position rubber insulator on end of spring. Install insulator and spring in upper spring seat (fig. 15).
2. Pry lower pigtail portion of spring over vertical flange of the axle bracket spring seat.
3. Raise axle to allow shock absorber installation. Position shock absorber in axle bracket. Torque nut as outlined in Shock Absorber Installation procedures.
4. Lower vehicle and check rear riding height.

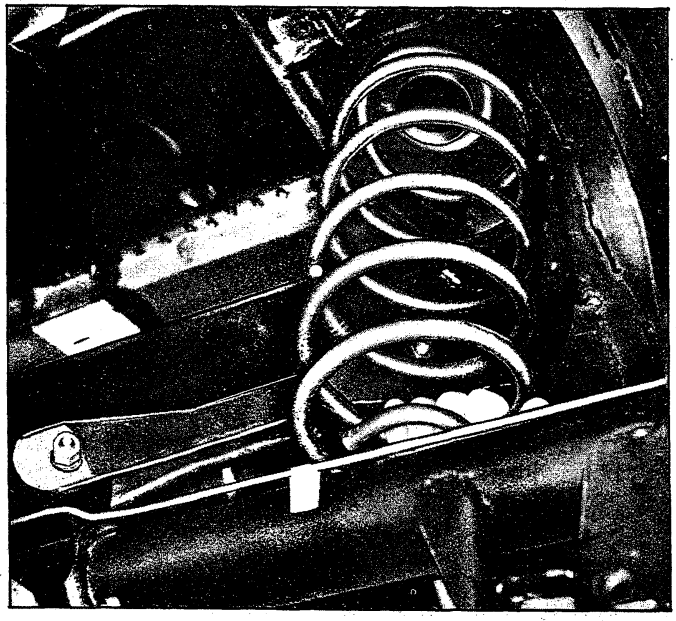


Fig. 15—Coil Spring Installation (Chevelle)

LEAF SPRING, SPRING SEAT PADS, SPRING EYE BUSHINGS, SPRING LEAFS
Camaro and Nova (Fig. 16)

Removal

1. Raise rear of vehicle sufficiently to allow axle assembly to hang freely; then support weight of vehicle at both frame side rails and near front eye of spring.
2. Raise axle assembly so that all tension is removed from spring.
3. Loosen and remove shock absorber lower attaching bolt.
4. Loosen the spring eye-to-bracket retaining bolt.
5. Remove the screws securing the spring retainer bracket to the underbody.
6. Lower axle assembly sufficiently to permit access to spring retainer bracket and remove bracket from spring.
7. The spring eye bushing can be replaced without completely removing the spring from the vehicle, if bushing requires replacement proceed as follows.
   a. Position remover adapter J-21978-1 over puller screw J-21058-15 so that adapter is against head of puller screw. Refer to Figure 17 for view of removal tools.
   b. Position puller screw through eye of bushing so that remover adapter J-21978-1 is against unflanged side of bushing.
   c. Position large end of barrel J-22553-1 over puller screw and seat barrel against spring eye.
   d. Position thrust bearing on puller screw then install and tighten nut J-21058-8 against thrust bearing.

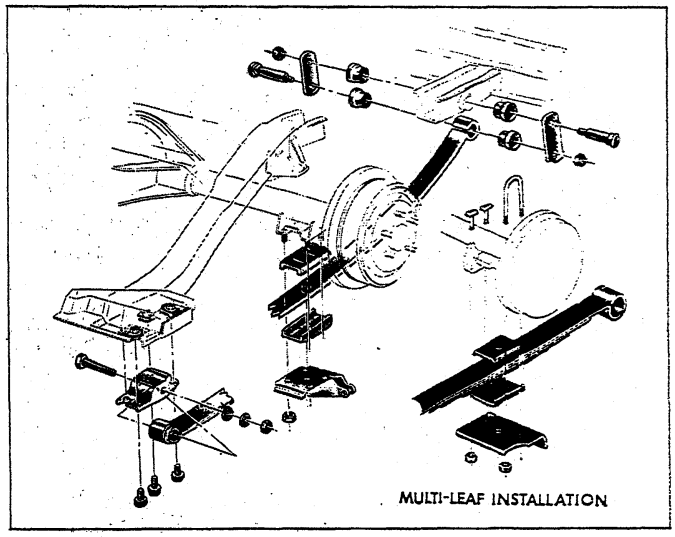


Fig. 16—Rear Spring—Exploded View (Camaro and Nova)

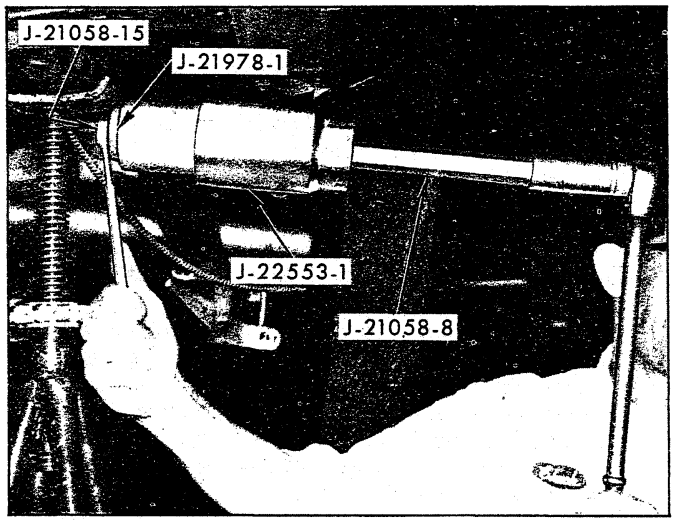


Fig. 17—Removing Spring Front Bushing (Camaro and Nova)

e. Check to make sure that all puller parts are properly aligned then proceed to tighten nut until bushing is pulled free of spring eye--disassemble puller tool.
f. Position installer adapter J-22553-2 over flange end of bushing then position puller screw J-21058-15 through installer adapter and bushing. Refer to Figure 18 for view of installation tools.
g. Position puller screw through spring eye until bushing contacts spring. Install small end of barrel J-22553-1 over puller screw and seat barrel against spring.
h. Install thrust bearing and nut J-21058-8. Check puller tools and bushing for proper alignment; then tighten nut to pull bushing into spring.

NOTE: Do not apply additional torque to nut J-21058-8 after bushing flange contacts spring. Unnecessary torque applied after flange is seated will tend to distort flange and reposition bushing in spring.

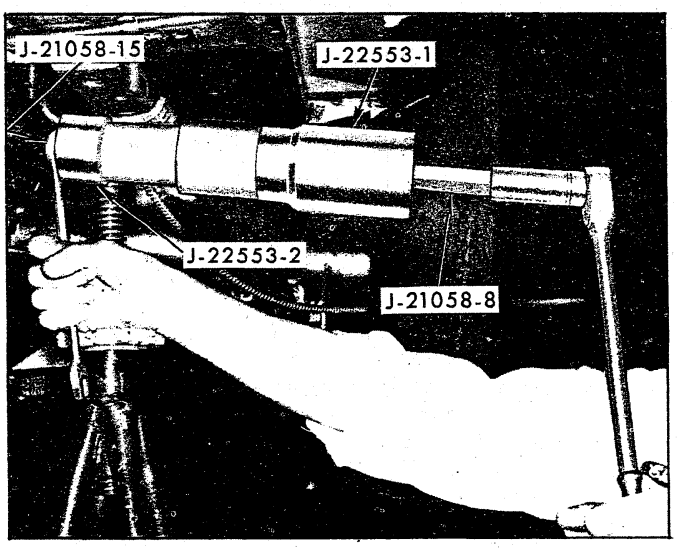


Fig. 18—Installing Spring Front Bushing (Camaro and Nova)

i. Disassemble bushing installation tools and remove from spring.
8. Pry parking brake cable out of the retainer bracket mounted on the spring mounted plate.
9. Remove lower spring plate-to-axle bracket retaining nuts (fig. 19). Lower plate-to-axle attachments are shown in Figure 16.
10. Remove upper and lower rubber spring pads, spring plate.
11. Support spring, then remove lower bolt from spring rear shackle. Separate shackle and withdraw spring from vehicle.
12. Remove rear spring shackle upper bolt and withdraw shackle bushings from frame.

Spring Leaf Replacement

1. Place spring assembly in a bench vise and remove spring clips.
2. Position spring in vise jaws, compressing leaves at center and adjacent to center bolt.
3. File peened end of center bolt and remove center bolt nut. Open vise slowly to allow spring assembly to expand.
4. Replace spring leaf as required, also replace any defective spring leaf inserts at this time.
5. Align center holes in spring by means of a drift and compress spring leaves in a vise.
6. Remove drift from center hole and install a new center bolt - peen bolt to retain nut.
7. Align spring leaves by tapping with hammer, then bend spring clips into place.

NOTE: Spring clips should be tightened sufficiently to maintain alignment, but not tight enough to bind spring action.

Installation

1. Position spring front mounting bracket to spring front eye. Spring attaching bolt must be installed so that head of bolt is toward center of vehicle.
2. Position spring shackle upper bushings in frame, position shackles to bushings and loosely install bolt and nut.
3. Install bushing halves in spring rear eye, place

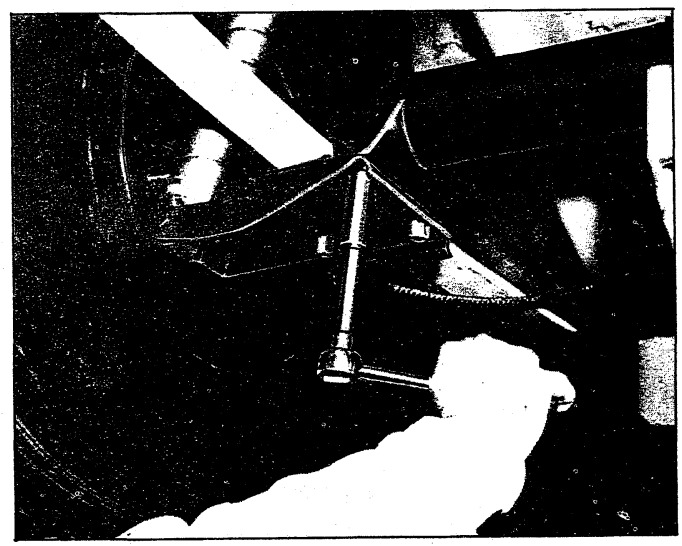


Fig. 19—Removing Lower Plate

spring to shackles and loosely install shackle lower bolt and nut.

NOTE: When installing spring, make sure spring is positioned so that parking brake cable is on underside of spring.

4. Raise front end of spring and position bracket to underbody. Guide spring into position so that it will index in the axle bracket and also make sure that the tab on spring bracket is indexed in slot provided in the underbody.
5. Loosely install spring-to-underbody bracket.
6. Position spring upper cushion between spring and axle bracket so that spring cushion ribs align with axle bracket locating ribs.
7. Place lower spring cushion on spring so that cushion is indexed on locating dowel. Upper cushion and lower cushion will be aligned if installation is correct.
8. Place lower mounting plate over locating dowel on spring lower pad and loosely install retaining nuts.
9. If new mounting plate was installed, transfer parking brake cable retaining bracket to new plate.
10. Position shock absorber to spring mounting plate and loosely install eye bolt and nut - head of bolt should be toward front of vehicle.
11. Position parking brake cable in retaining bracket and securely clamp bracket to retain cable.
12. Remove stand jacks and lower vehicle so that weight of vehicle rests on suspension components. Torque all affected parts to specifications.

SHOCK ABSORBER

Chevrolet and Chevelle

Removal

1. Raise rear of vehicle and support rear axle assembly.

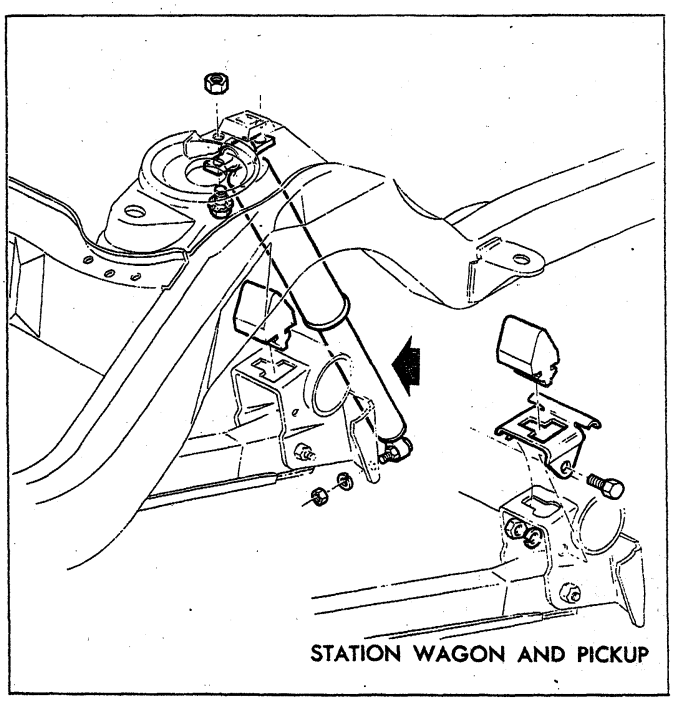


Fig. 20—Shock Absorber Mounting--Exploded View (Chevelle)

2. If equipped with superlift shock absorber, disconnect air line from shock absorber.
3. Disconnect shock absorber at upper mounting bracket by removing the two retaining bolts. Refer to Figure 20 for shock absorber mounting details. (Chevelle components shown as typical.)
4. Disconnect shock absorber at lower attaching bracket and remove shock.

NOTE: When performing any service operations that requires removal or loosening of the lower attaching nut, it is essential that the stud be prevented from turning. A hex is located on the stud between the axle bracket and shock absorber in order that a wrench may be used for this purpose. Failure to hold the stud in this manner will result in damage to the mechanical bond between the shock absorber bushing and the mounting stud.

Installation

1. Loosely install the two shock absorber upper attaching bolts.
2. Position lower attaching stud in axle bracket and loosely install lock washer and nut.
3. Torque upper attaching bolts to specifications.
4. Torque lower attaching nut to specifications, observing procedure outlined in Removal procedure.
5. If equipped with superlift shock absorbers, connect air line to shock absorber and add air to obtain a minimum of 10 psi.
6. Lower vehicle and check shock absorber action.

Nova

Removal (Refer to Fig. 21)

1. Raise vehicle and support axle housing with adjustable jackstand.
2. Loosen and remove shock absorber lower mounting bolt from shock absorber eye.
3. Remove shock absorber upper mounting bracket bolts and withdraw shock absorber.

Installation

1. Loosely install the two shock absorber upper attaching bolts.
2. Insert shock absorber eye into lower bracket, install bolt with nut to rear and torque to specifications.
3. Torque upper bolts to specifications.
4. Lower vehicle and test shock absorber action.

Camaro

Removal (Refer to Fig. 22)

1. Raise rear of vehicle and support rear axle assembly.
2. Loosen and remove shock absorber lower attaching bolt from shock absorber eye.
3. Remove shock absorber upper mounting bracket-to-underbody retaining screws and withdraw shock absorber and bracket.
4. Remove nut, upper retainer and grommet, gasket and bracket, and lower grommet and retainer from the shock absorber rod.
5. Inspect rubber grommets and gasket for damage and deterioration--replace as required.

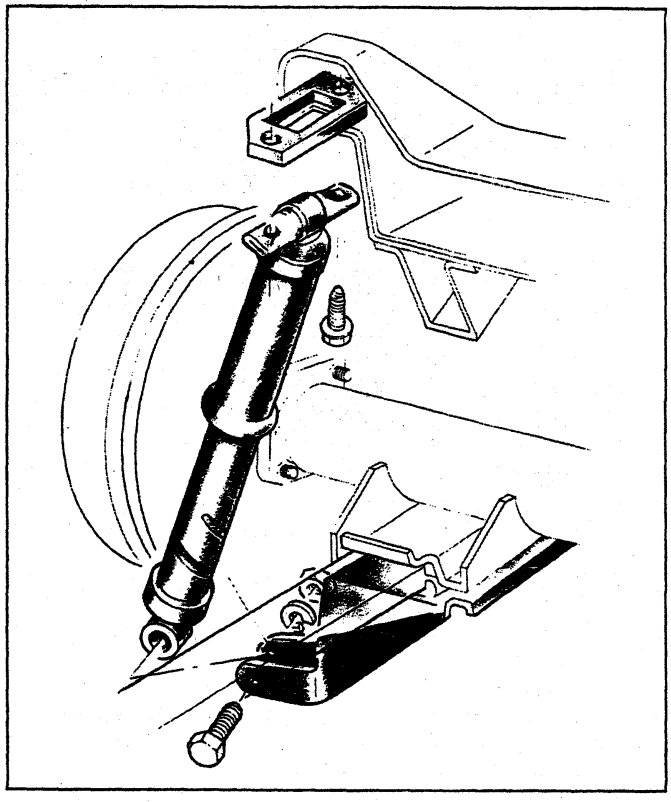


Fig. 21—Shock Absorber Mounting—Exploded View (Nova)

Installation

1. Assemble lower retainer and grommet, bracket and gasket, upper grommet and retainer and nut to the shock absorber rod. Torque nut to specifications.
2. Position shock absorber bracket to underbody and install bracket retaining screws. Torque retaining screws to specifications.
3. Insert shock absorber eye into lower bracket, install bolt with head toward front of vehicle. Torque nut to specifications.
4. Lower vehicle and test shock absorber action.

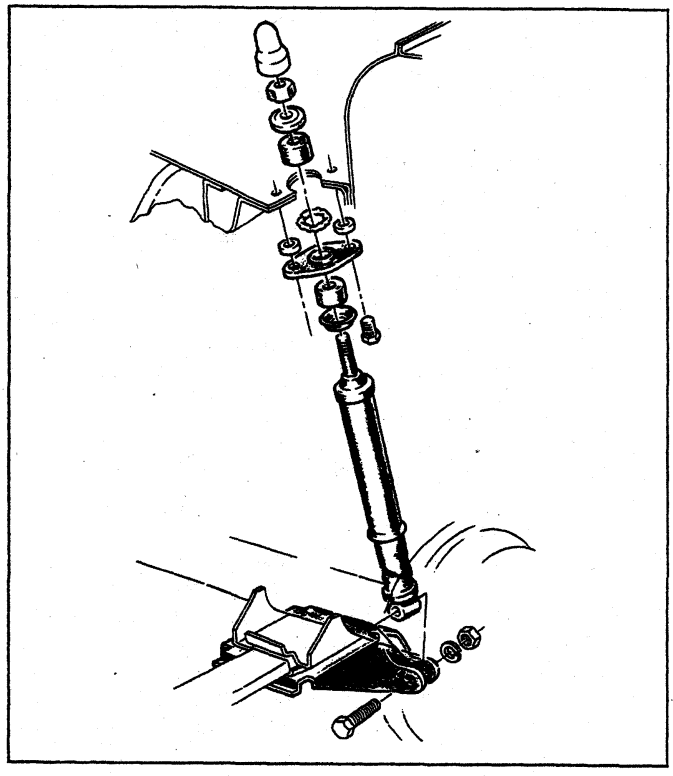


Fig. 22—Shock Absorber Mounting—Exploded View (Camaro)

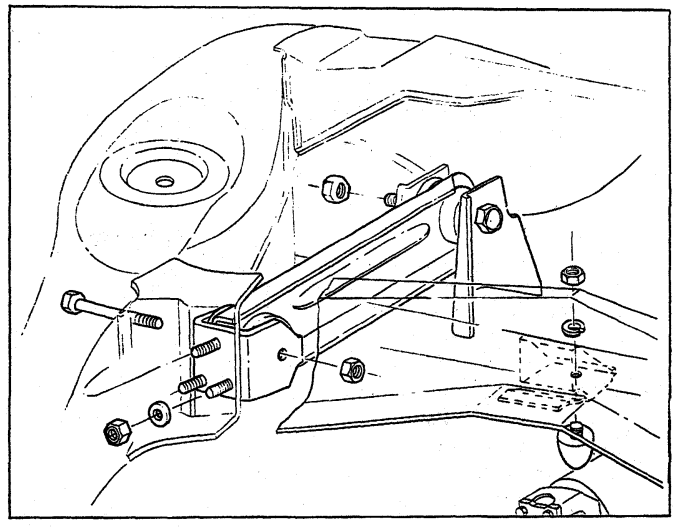


Fig. 23—Rear Suspension Upper Control Arm Attaching Points (Chevrolet)

CONTROL ARM

Chevrolet Upper

Removal

1. Using a suitable hoist that will support the rear axle housing or wheels (such as a twin post or drive on ramp type), remove the rear pivot bushing bolt at the rear axle housing (fig. 23).

   NOTE: The rear axle must be supported in such a way as to prevent the axle housing from rotating about the lower control arm rear pivot, and to also relieve load on the pivot bushing.

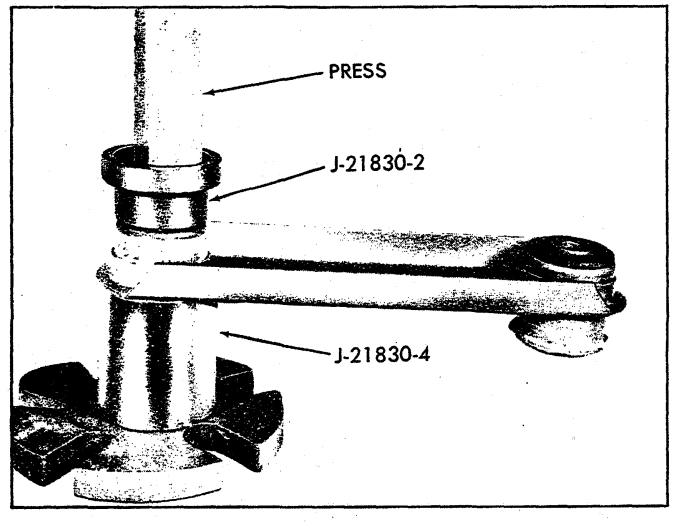


Fig. 24—Upper Control Arm Bushing Removal (Chevrolet)

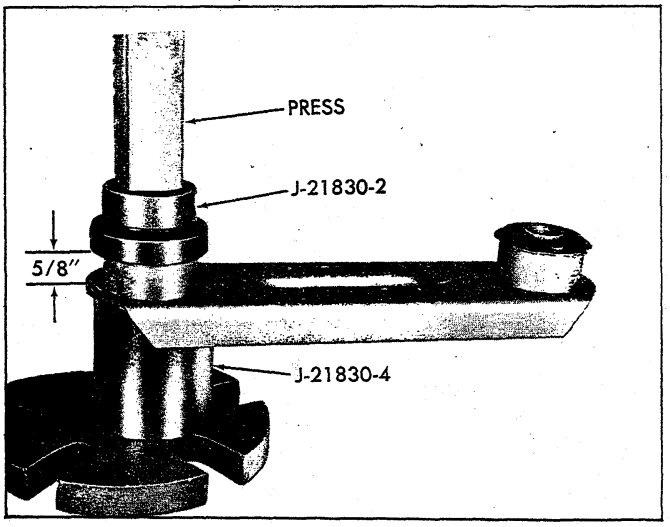


Fig. 25—Upper Control Arm Bushing Installation (Chevrolet)

2. Remove the three bolts, lock washers and nuts attaching the upper control arm bracket to the crossmember.
3. Separate the control arm bracket from the crossmember. Remove the arm from under vehicle.
4. Remove the bolt, nut and washer attaching the upper control arm to the bracket. Separate the control arm from the bracket.

Bushing Replacement

1. Remove bracket from forward end of arm.
2. Press out bushings using Tools J-21830-2 and J-21830-4 as shown in Figure 24.
3. Install new bushings using Tools J-21830-2 and J-21830-4 as shown in Figure 25. Press bushings to a depth of 5/8 inches.
4. Reinstall attaching bracket to control arm with the bracket pivot bolt nut on the outboard side of the arm.

Installation

1. Position rear of control arm into axle bracket and loosely install the pivot bolt.
2. Align the forward end of the control arm with the rear crossmember and install front bracket bolts through holes as shown in Figure 23. Raise or lower nose of carrier as required to help align bracket and crossmember.
3. Install lock washers and nuts to retain bracket in place.
4. Position vehicle so that weight is on suspension components and torque all affected parts to specifications.

Chevrolet Lower

Removal

1. Raise vehicle and remove shock absorber and spring as outlined in this section.

   NOTE: If both rear suspension lower control arms are to be removed, support the rear axle in such a manner to prevent damage to brake lines and to prevent assembly from falling.

2. Note position of control arm in forward attaching bracket and disconnect control arm at forward and rearward attaching points. Remove assembly from vehicle.

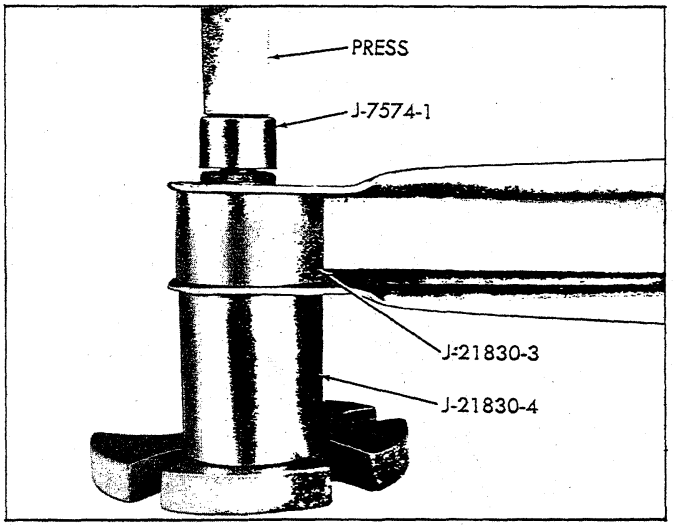


Fig. 26—Lower Control Arm Front Bushing Removal (Chevrolet)

Bushing Replacement

Lower control arm front and rear bushing assemblies are not interchangeable and require separate removal and installation procedures.

1. Replace front bushing as follows:
   a. Press out bushing using Tools J-7574-1, J-21830-3 and J-21830-4. Refer to Figure 26 for installed view of tools.
   b. Install new bushing using Tools J-7574-2, J-21830-3, and J-21830-4 as shown in Figure 27. Press until bushing is flush against control arm. Do not apply undue pressure after bushing is seated as this may distort the control arm walls.
2. Replace rear bushing as follows:
   a. Press out bushing using Tools J-21830-2, J-21830-3 and J-21830-4. Refer to Figure 28 for installed view of tools.
   b. Install new bushing using Tools J-21830-2, J-21830-3 and J-21830-4 as shown in Figure 29. Press until bushing is fully seated against control

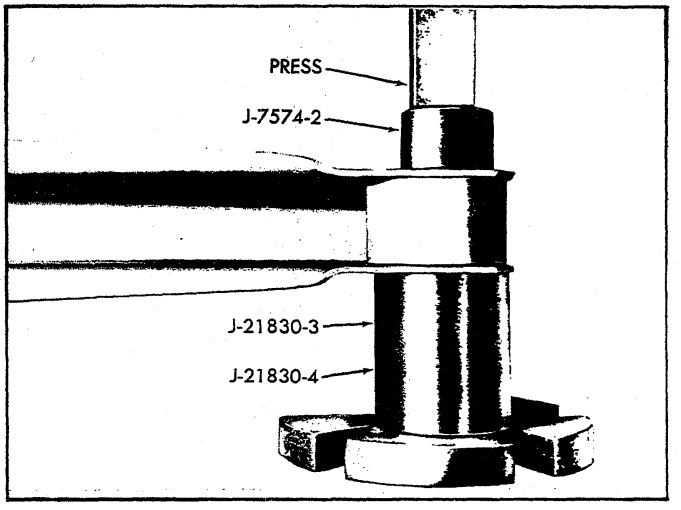


Fig. 27—Lower Control Arm Front Bushing Installation (Chevrolet)

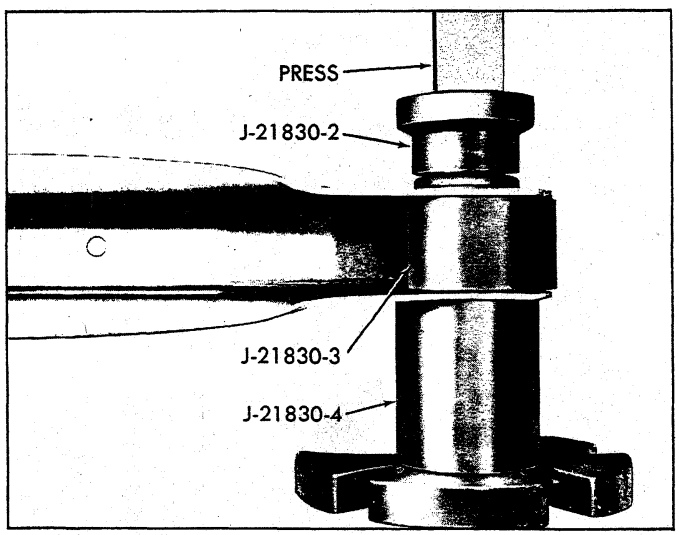


Fig. 28—Lower Control Arm Rear Bushing Removal (Chevrolet)

arm. Do not apply undue pressure after bushing is seated as this may distort the control arm walls.

Installation

1. Position the control arm between the mounting brackets and loosely install the pivot bolt retaining nuts in the proper position.
2. Install spring and shock absorber as outlined in this section.
3. Lower vehicle so that weight is placed on suspension components and torque all affected parts to specifications.

Chevelle Upper and Lower

Removal

NOTE: If both upper control arms and both lower control arms are to be removed at the same time, remove both coil springs as outlined under "Coil Spring Removal".

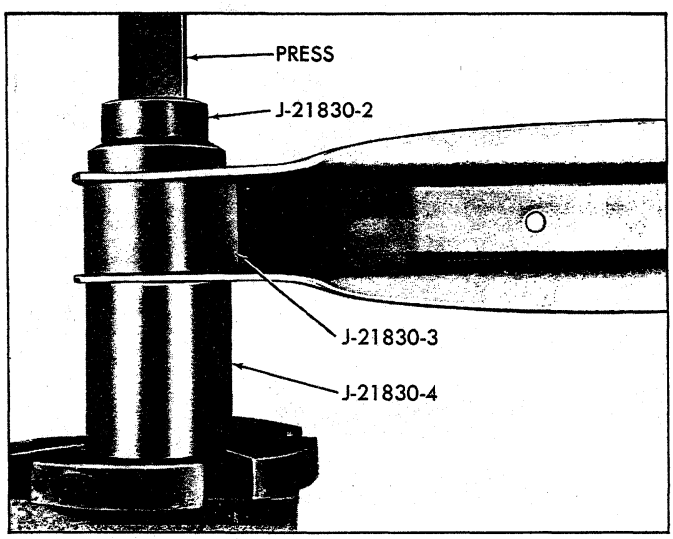


Fig. 29—Lower Control Arm Rear Bushing Installation (Chevrolet)

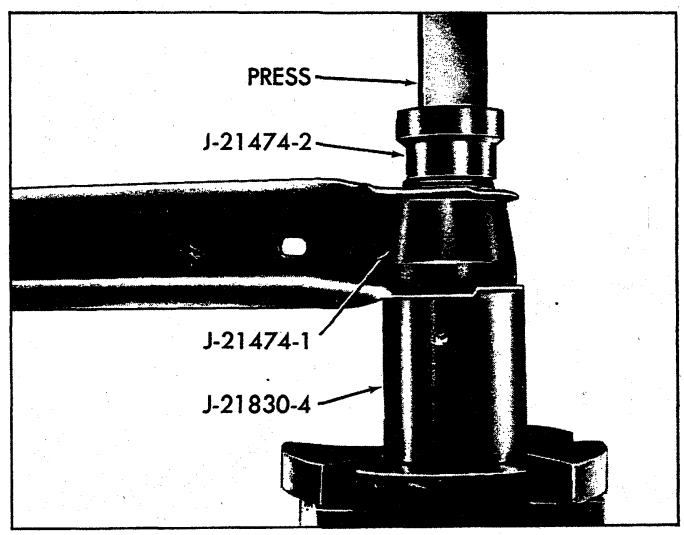


Fig. 30—Control Arm Bushing Removal (Chevelle)

1. Raise vehicle to a height that will allow axle assembly to hang freely and position supports under both frame side rails.
2. Support axle assembly with an adjustable lifting device and raise rear axle assembly until tension is relieved in control arm being removed.
3. Disconnect control arm at forward and rearward attaching points and remove from vehicle.

Bushing Replacement

The upper control arm front bushing and carrier rear bushings are of the same part number and are interchangeable. However, the lower control arm bushings are of a different rubber material and are not interchangeable with the upper bushings. Replacement procedures are indicated below.

1. Replace the upper and lower control arm bushings as follows:
   a. Press out bushing using Tools J-21474-2, J-21474-1 and J-21830-4. Refer to Figure 30 for installed view of tools.
   b. Install bushing using Tools J-21474-2, J-21474-1

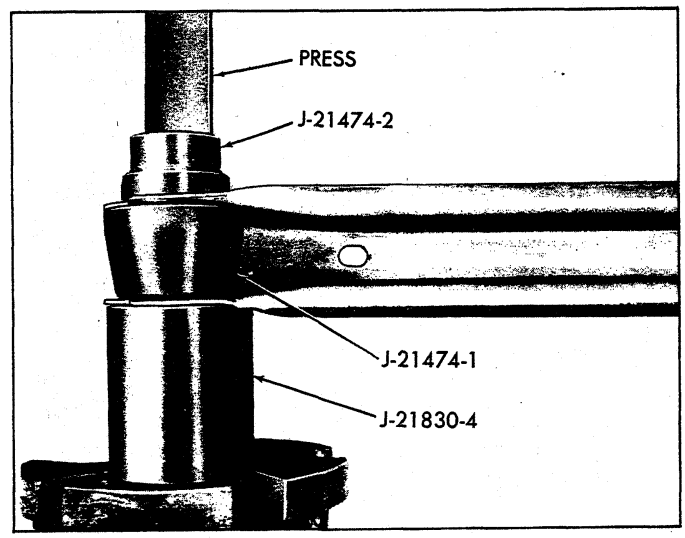


Fig. 31—Control Arm Bushing Installation (Chevelle)

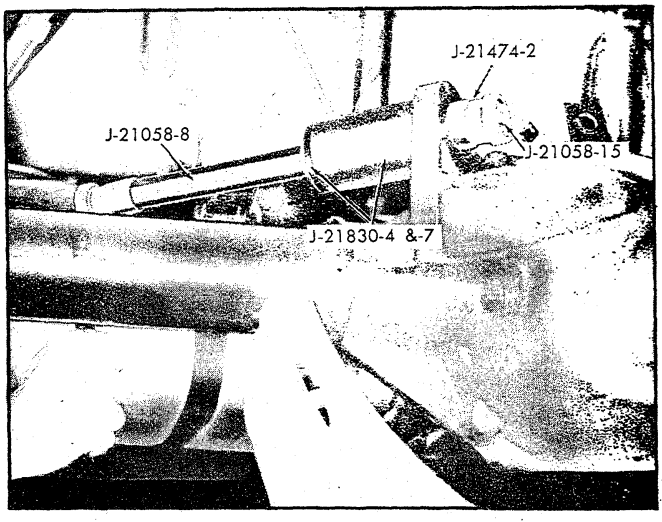


Fig. 32—Carrier Mounted Suspension Bushing (Light Duty)--(Chevelle)

and J-21830-4 as shown in Figure 31. Press until bushing is fully seated against control arm. Do not apply undue pressure after bushing is seated as this may distort the control arm.

2. Replace the carrier mounted, upper control arm rear bushing using the following procedure.

Light-Duty Carrier

a. Position Puller Adapter J-21474-2 on Puller Screw J-21058-15 then place puller screw through small end of bushing.
b. Install Receiver J-21830-4, Bridge J-21830-7, Thrust Bearing, and Nut J-21058-8 (in that order) onto puller screw. Refer to Figure 32 for installed view of tools.
c. Turn Nut J-21058-8 to remove bushing from carrier ear, making sure Remover Adapter J-21474-2 is centered and will clear hole in carrier ear.
d. Disassemble puller tools and position Installer Adapter J-21474-2 on flanged end of bushing.

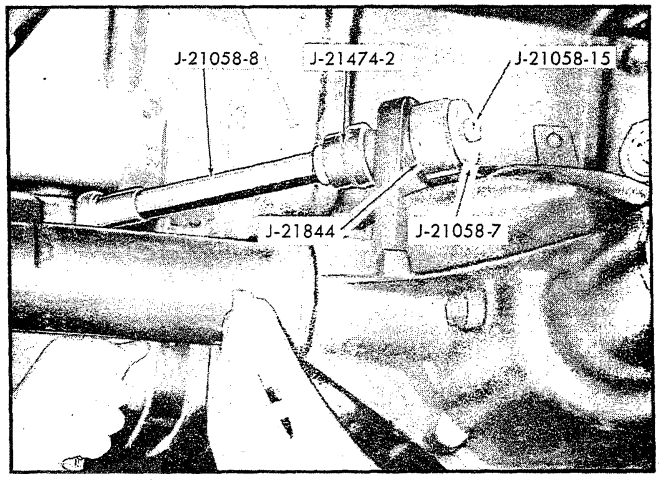


Fig. 33—Carrier Mounted Suspension Bushing Installation (Light Duty)--(Chevelle)

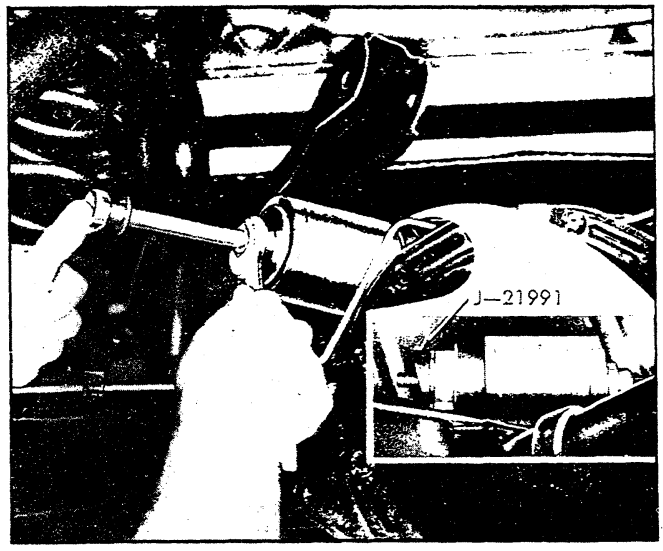


Fig. 34—Carrier Mounted Suspension Bushing Removal (Heavy Duty)--(Chevelle)

Install Puller Screw J-21058-15 through receiver so that screw head is seated against receiver. Position this assembly through inboard side of carrier ear.

e. Position bushing and Installer Adapter J-21474-2 onto puller screw with small end of bushing toward carrier ear. Refer to Figure 33 for installed view of tools.
f. Install Thrust Bearing and Nut J-21058-8 onto puller screw. Turn nut to pull bushing into carrier ear. Check position of bushing when installing to make sure bushing is properly aligned.

Heavy-Duty Carrier

a. Install a 1/2 x 20 nut on Puller Screw J-21058-15, install thrust bearing against nut. Position puller screw through Bridge and Receiver J-21830-4 and 7.
b. Position puller screw through flanged end of

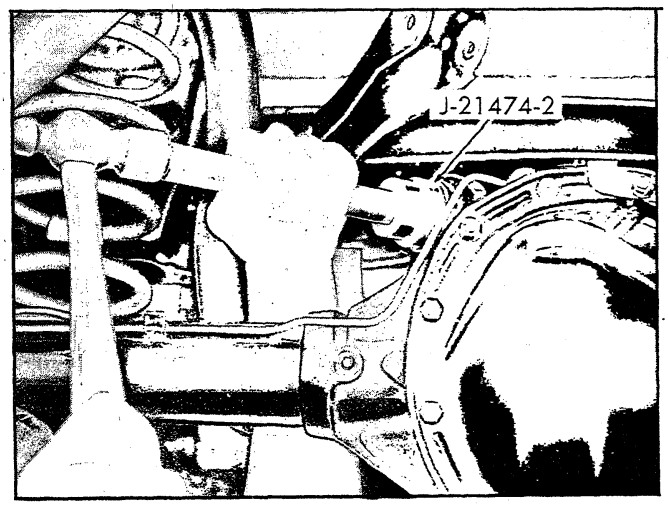


Fig. 35—Carrier Mounted Suspension Bushing Installation (Heavy Duty)--(Chevelle)

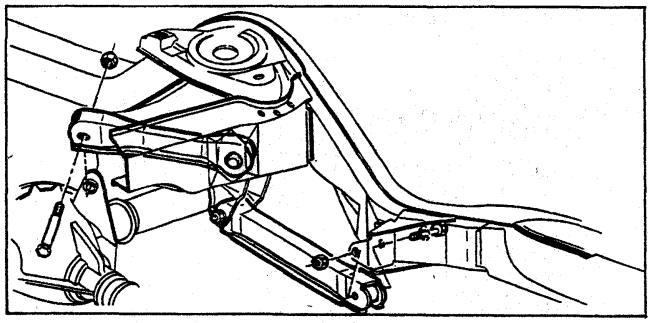


Fig. 36—Upper and Lower Control Arm Assembly (Chevelle)

bushing then install Remover Adapter J-21991 on threaded end of puller screw.

c. Align tools on carrier ear and center remover adapter on bushing. Hold head of puller screw and turn 1/2 x 20 nut to withdraw bushing from carrier ear. Refer to Figure 34 for installed view of removal tools.
d. Position Installer J-21474-2 on flanged end of new bushing and install Driver Handle J-7079-2 to opposite end of installer.
e. Position bushing in carrier ear and drive bushing until it seats against carrier. Bushing is properly seated when shoulder on bushing contacts carrier. Refer to Figure 35 for installation.

NOTE: Do not attempt to seat flange of bushing against ear of carrier. Bushing is properly installed when shoulder on bushing seats against chamfer on carrier ear.

Installation

1. Place control arm into position between the forward and rearward mounting brackets and install retaining bolts. Refer to Figure 36 for installation view of control arms.
2. Support vehicle at axle and remove supports from beneath the frame side rails.
3. Install lock washer and nut to retaining bolts and torque to specifications.

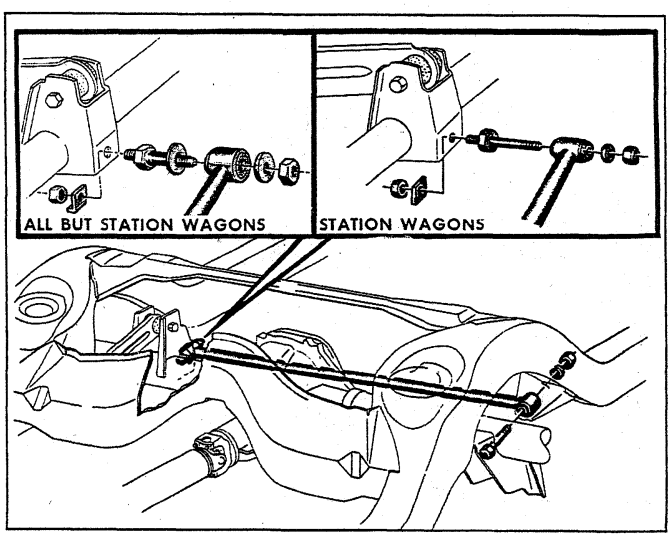


Fig. 37—Rear Suspension Tie Rod Attaching Points (Chevrolet)

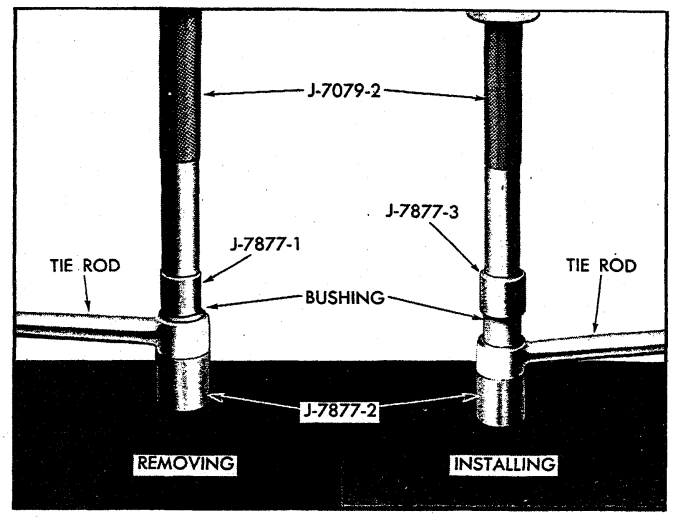


Fig. 38—Tie Rod Bushing Replacement (Chevrolet)

REAR SUSPENSION TIE ROD—CHEVROLET

Removal

1. Remove the nut, washer and bolt from the left side and the nut and washer from the stud on the right side that secure the tie rod to the brackets (fig. 37). Withdraw the rod from under the vehicle. An external shell service bushing is available for left side on all models and both right and left on station wagons and service tie rods.

   NOTE: The above operations need not be performed on a hoist. However, to provide ample working space, the use of a hoist or proper jack stand is recommended.

Bushing Replacement

The following bushing removal procedure is effective for both ends of the tie rod used on station wagons all service tie rods and the left end of the tie rod used on all models except station wagons.

1. With tie rod bushing centered over Tool J-7877-2 and with tie rod supported horizontally, press or drive bushing from rod, using Tools J-7877-1 and J-7079-2 as shown in Figure 38.
2. With tie rod centered over Tool J-7877-2 and rod supported horizontally, press or drive bushing into arm using Tools J-7877-3 and J-7079-2 as shown in Figure 38. Tool J-7877-3 should bottom on tie rod when bushing is fully installed.

Installation

1. Mount the tie rod to the axle bracket stud. Install nut and special washer but do not tighten.

   NOTE: On the tie rod used on all models except station wagons, place flanged portion of bushing against attaching bracket.

2. Install the bolt, lock washer and nut to the frame bracket (fig. 37). Do not tighten.

   NOTE: Bolt may be installed from either direction.

3. Lower vehicle to floor (if raised) and bounce rear end several times to settle bushings. Tighten affected parts to specifications.

COMPONENT PARTS REPLACEMENT (CORVETTE)

WHEEL SPINDLE AND SUPPORT (Fig. 39)

Removal

Remove wheel drive spindle as outlined previously in this section under "Wheel Bearing Adjustment".

Repairs

1. Out of 3/8" square steel bar stock, make bearing removers and use as shown in Figure 40.
2. After removing deflector, spindle inner grease seal and inner bearing race, bearing cups may be removed while spindle support is still mounted to the torque arm, by inserting remover tool and tapping cup out. New bearing cups are installed using Tool J-7817 cup installer and handle J-8092 (fig. 41).
3. To remove spindle support from torque arm, proceed as follows.
   a. Disconnect parking brake cable from actuating lever.
   b. Remove four nuts securing support to torque arm and withdraw brake backing plate and position it out of the way.
   c. Disconnect shock absorber lower eye from strut rod mounting shaft. It may be necessary to support spring outer end before disconnecting shock absorber, as shock absorber has internal rebound control.
   d. Remove cotter pin and nut from strut rod mounting shaft, then pull shaft from support and strut rod.
   e. Spindle support may then be removed and bearing cups serviced as in Step 2 above.
4. To remove drive spindle outer bearing and seal proceed as follows.
   a. Position Tool J-8331 between chamfered edge of bearing seat and inner race of bearing (fig. 42). Clamp Tool J-8331 in a vise and apply pressure to upseat bearing.

   CAUTION: Use extreme caution when positioning Tool J-8331 against machined surface of spindle. Make sure all tool imperfections such as nicks and burrs are removed from spindle contact area before applying pressure to unseat bearing.

   b. Position Tool J-8331 and spindle in an arbor press and press bearing from spindle (fig. 43).
   c. Remove outer seal and inspect for damage--replace if necessary. Outer seal must be placed on spindle before outer bearing inner race and roller assembly are installed.
   d. Pack outer bearing with a high-melting point wheel bearing lubricant and position on spindle. Large end of bearing should be toward shoulder on spindle.
   e. Press bearing on spindle using a bearing spacer and Tool J-9436 as installers, as shown in Figure 43.
5. Pack spindle inner bearing with a high-melting point wheel bearing lubricant and position bearing in spindle support - small end of bearing should be positioned inward.
6. Tap new spindle inner grease seal into seal bore and install deflector over support inner end.

Installation

1. Position support over torque arm bolts with strut rod fork toward center of vehicle and downward. Place backing plate over studs and torque nuts to specifications.
2. Connect parking brake cable to actuating lever.
3. Install drive spindle assembly as outlined previously in this section under "Wheel Bearing Adjustment".

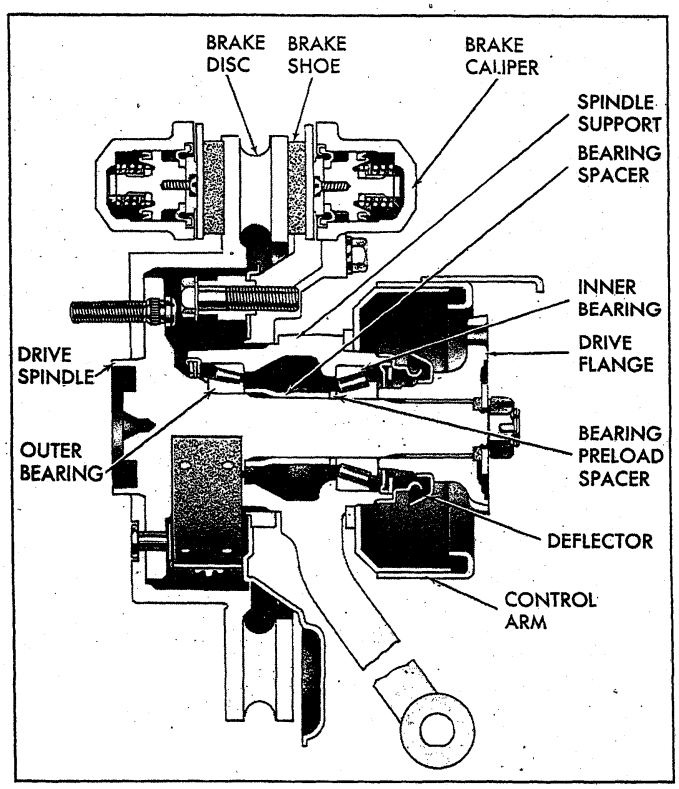


Fig. 39—Wheel Spindle and Support Cross Section (Corvette)

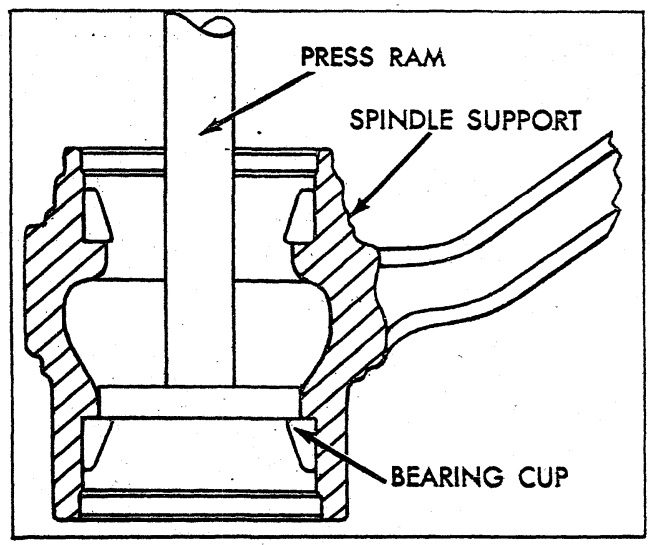


Fig. 40—Bearing Cup Remover (Corvette)

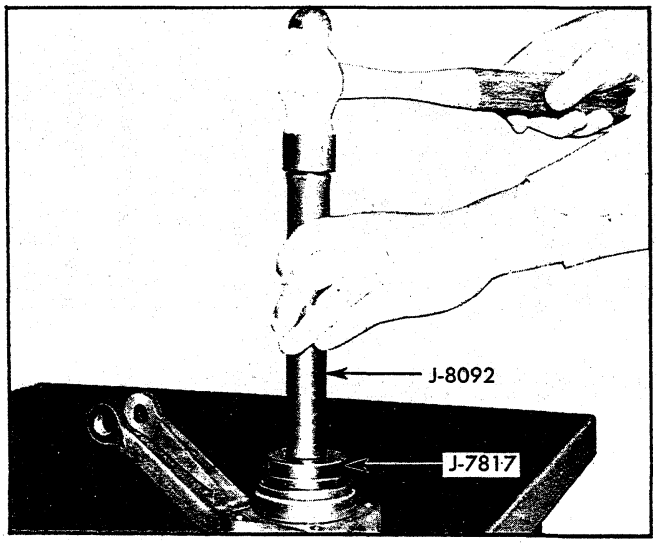


Fig. 41—Installating Spindle Bearing Cup (Corvette)

4. If new spindle support or associated parts are installed, determine correct shim size as follows.
   a. Assemble spindle to support, using a .145" shim.
   b. Check bearing adjustment and correct as necessary, following adjustment procedures previously outlined.

DIFFERENTIAL CARRIER SUPPORT BRACKET REPLACEMENT

1. Place a 1/2" thick block of wood or steel between nose of differential carrier and floor pan. This will prevent carrier from twisting upward when support bracket is disconnected.
2. Remove carrier support-to-crossmember attaching bolt.
3. Remove nuts from both bracket-to-carrier through bolts and remove bolts.
4. Assemble carrier support bracket by reversing above procedure. Torque all bolts to specifications.

SHOCK ABSORBER (Fig. 44)

Removal

1. Disconnect shock absorber upper mounting bolt.
2. Remove lower mounting nut and lock washer.
3. Slide shock upper eye out of frame bracket and pull lower eye and rubber grommets off strut rod mounting shaft.
4. Inspect grommets and shock absorber upper eye for excessive wear.

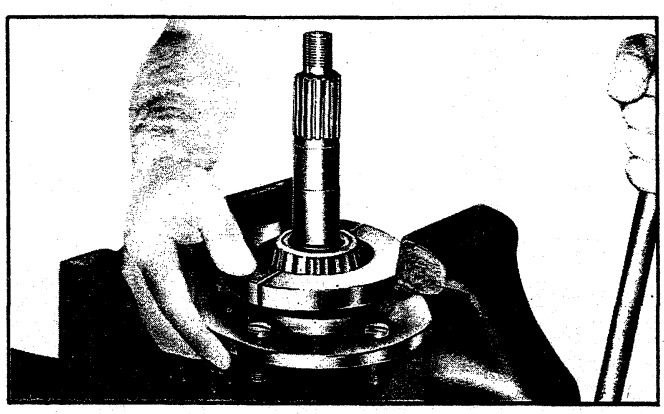


Fig. 42—Unseating Drive Spindle Outer Bearing (Corvette)

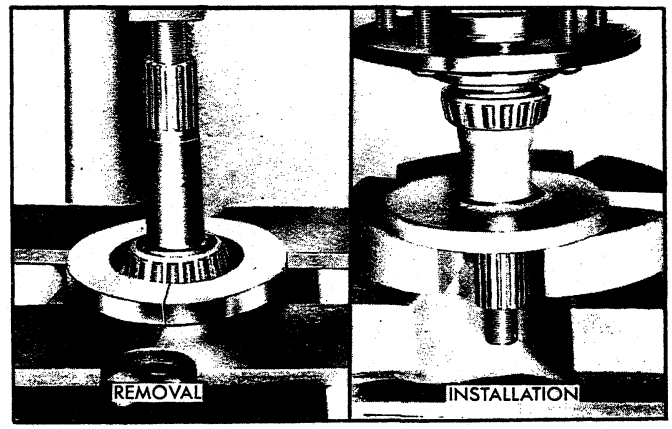


Fig. 43—Removing and Installing Drive Spindle Outer Bearing (Corvette)

Installation

1. Slide upper mounting eye into frame mounting bracket and install bolt, lock washer and nut.
2. Place rubber grommet, shock lower eye, inboard grommet, washers and nut over strut rod shaft.

   NOTE: Install washer with curve pointing inboard.

3. Torque nuts to specifications.

STRUT ROD AND BRACKET (Fig. 45)

Removal

1. Raise vehicle enough to provide working clearance.
2. Disconnect shock absorber lower eye from strut rod shaft.
3. Remove strut rod shaft cotter pin and nut. Withdraw shaft by pulling toward front of vehicle (fig. 46).

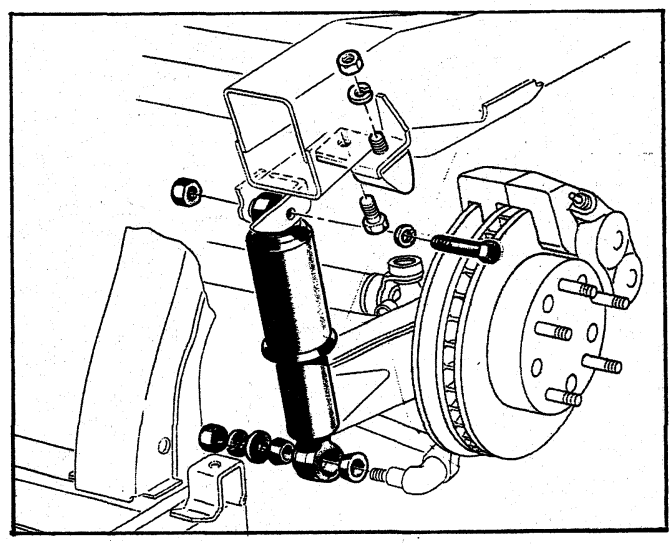


Fig. 44—Shock Absorber Installation (Corvette)

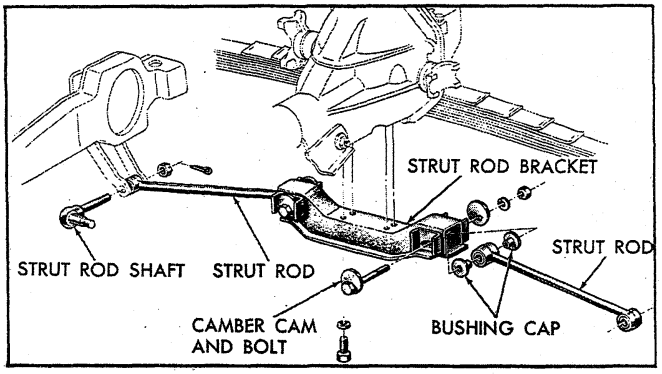


Fig. 45—Strut Rods (Corvette)

4. Mark relative position of camber adjusting cam and bracket, so they may be reassembled in same location (fig. 47).
5. Loosen camber bolt and nut. Remove four bolts securing strut rod bracket to carrier and lower bracket.
6. Remove cam bolt nut and cam and bolt assembly. Pull strut down out of bracket and remove bushing caps.
7. Inspect strut rod bushings for wear and replace where necessary. Replace strut rod if it is bent or damaged in any way.

Repairs

1. With strut rod bushing centered over Tool J-7877-2 and with strut rod supported horizontally, press or drive bushing from rod, using Tools J-7877-1 and J-7079-2 as shown in Figure 48.
2. With strut rod end centered over Tool J-7877-2 and rod supported horizontally, press or drive bushing into arm using Tools J-7877-3 and J-7079-2 as shown in Figure 48. Tool J-7877-3 should bottom on strut rod when bushing is fully installed.

Installation

1. Place bushing caps over inboard bushing and slide rod into bracket. Install cam and bolt assembly and



Fig. 46—Removing Strut Rod Shaft (Corvette)

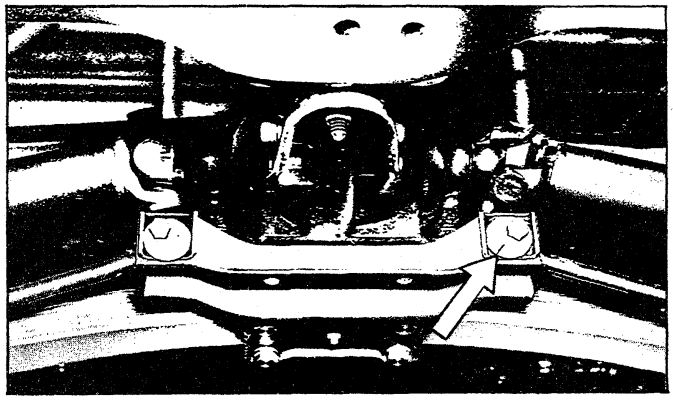


Fig. 47—Marking Camber Cam and Bracket (Corvette)

adjust cam to line up with mark on bracket. Tighten nut but do not torque at this point.
2. Raise bracket and assemble to carrier lower mounting surface. Torque bolts to specifications.
3. Raise outboard end of strut rod into spindle support fork and insert strut rod shaft into fork so that flat on shaft lines up with corresponding flat in spindle fork. Install retaining nut, but do not torque.
4. Place shock absorber lower eye and bushing over strut shaft, install washer and nut and torque to specifications.
5. Lower vehicle to floor and torque camber cam nut and strut rod shaft nut to specifications. Then install cotter pin through rod bolt.
6. Check rear wheel camber and adjust where necessary.

SPRING (Fig. 49)

Removal

1. Raise rear of vehicle and support on frame slightly forward of torque control arm pivot points. Remove wheels and tires.
2. Place floor jack under spring at link bolt, and raise spring until nearly flat.
3. Wrap 1/4" or 5/16" chain with grab hook around suspension crossmember and spring and hook chain securely with grab hook. Secure chain to spring with C clamp to prevent slipping (fig. 50).

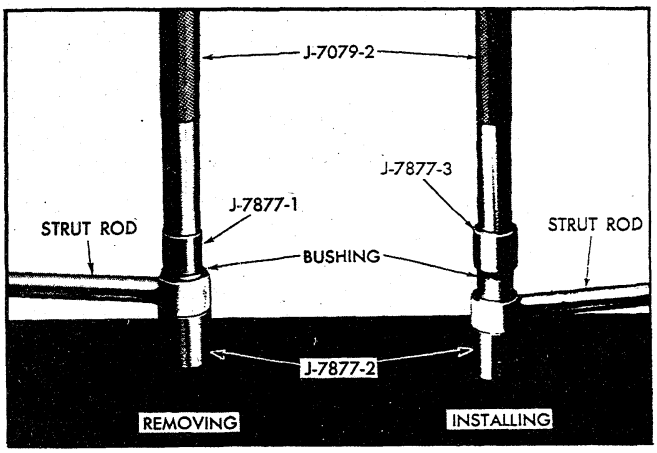


Fig. 48—Strut Rod Bushing Replacement

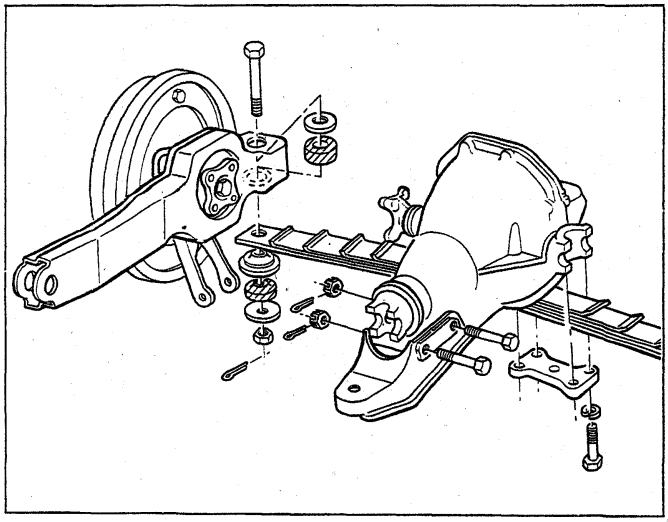


Fig. 49—Spring Mounting (Corvette)

CAUTION: Use 1/4" or 5/16" chain only with a safe grab hook for this operation. Do not use rope, wire, cable or other method of retaining spring.

4. Lower jack to free link bolt and remove link bolt cotter pin, nut and rubber cushions.
5. Support and raise spring end as in Step 2 above, remove chain when loose.
6. Carefully lower jack until spring tension is completely released.
7. Repeat Steps 2-6 on other side.
8. Remove four bolts and washers securing spring center clamp plate (fig. 51).
9. Drop spring and slide out from under vehicle (fig. 52).

Repairs

1. Clamp spring center section in vise and remove center bolt (fig. 53).
2. Release vise, remove spring and separate leaves.
3. Replace worn or damaged liners as necessary and replace any broken leaves.

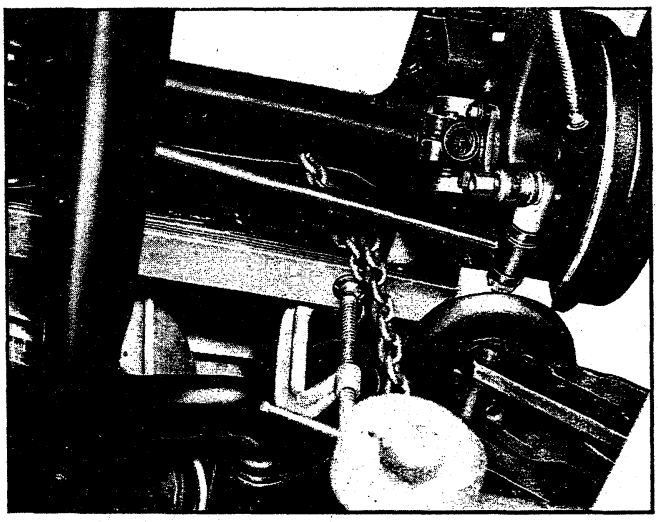


Fig. 50—Chain Installation (Corvette)

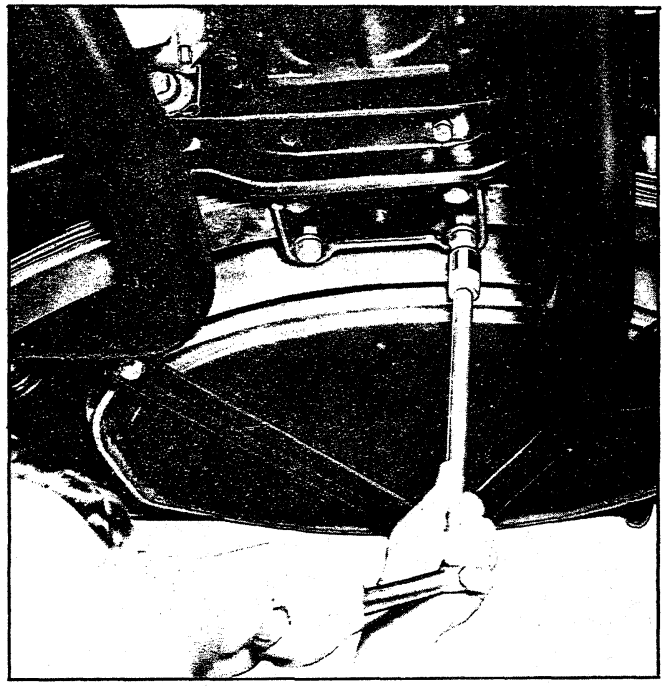


Fig. 51—Removing Clamp Plate (Corvette)

4. Replace main leaf spring cushion retainers by chiseling over flared portion until retainer may be knocked out of leaf. Place new retainers into position and flare over with a ball peen hammer or other suitable tool.
5. Insert drift into center bolt holes in leaves to align spring leaves (fig. 54). Install center bolt and tighten securely.

Installation

1. Place spring on carrier cover mounting surface, indexing center bolthead with hole in cover.
2. Place center clamp plate in position and install four bolts and washers. Tighten bolts and torque to specifications.
3. Raise spring outer end with floor jack until spring is nearly flat and secure with chain as in Step 3—Removal.
4. Lower jack, align torque control arm with spring

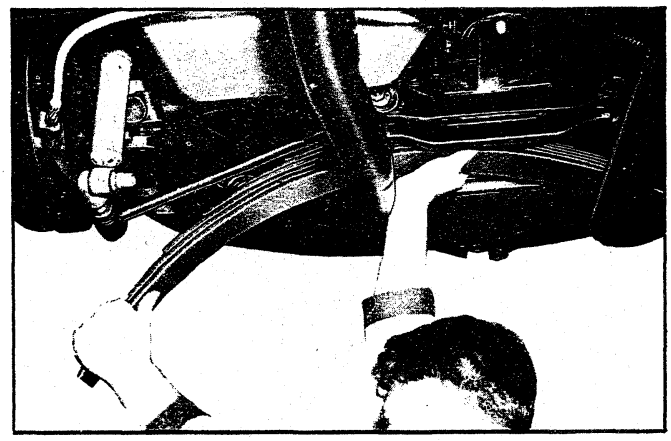


Fig. 52—Lowering Spring (Corvette)

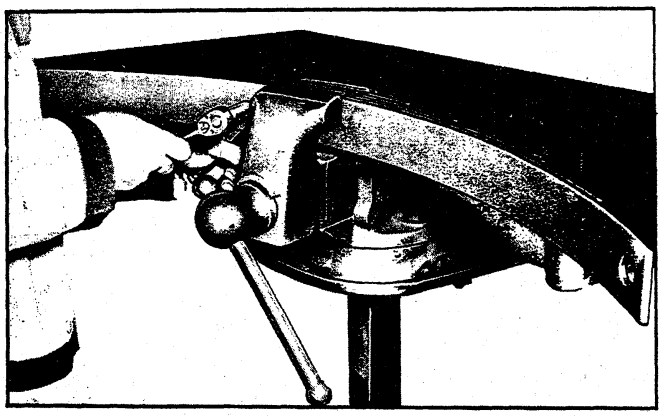


Fig. 53—Removing Center Bolt (Corvette)

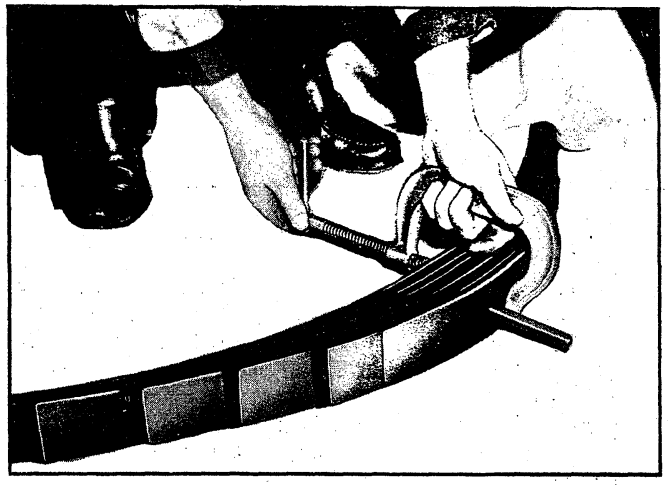


Fig. 54—Aligning Spring Leaves (Corvette)

end and insert link bolt, rubber cushions and retainers. Install castellated nut on link bolt and tighten until cotter pin hole in bolt is visible. Insert new cotter pin and bend ends around.

5. Raise spring end with jack under link bolt, and remove chain and C clamp when loose.

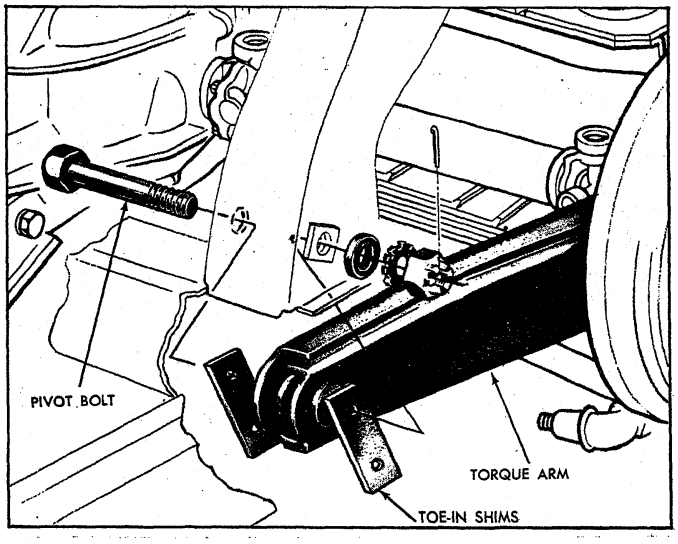


Fig. 55—Torque Control Arm (Corvette)

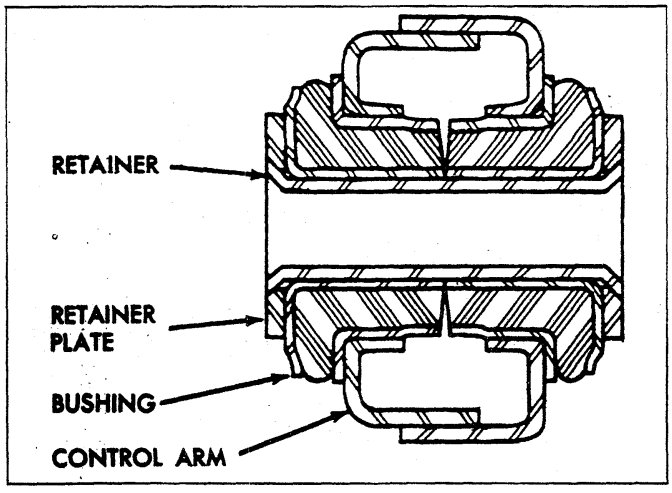


Fig. 56—Torque Control Arm Bushing Cross Section (Corvette)

6. Carefully lower jack, making sure rubber cushions remain indexed in retainers.
7. Remove jack and repeat on opposite side. Install wheels and tires, remove frame supports and lower vehicle to floor.

TORQUE CONTROL ARM (Fig. 55)

Removal

1. Disconnect spring on side torque arm is to be removed. Follow Steps 1-6, Spring-Removal.

   NOTE: If vehicle is so equipped, disconnect stabilizer shaft from torque arm - refer to "Stabilizer Shaft Replacement".

2. Remove shock absorber lower eye from strut rod shaft.
3. Disconnect and remove strut rod shaft and swing strut rod down.
4. Remove four bolts securing axle drive shaft to spindle flange and disconnect drive shaft.

   NOTE: It may be necessary to force torque arm outboard to provide clearance to drop drive shaft.

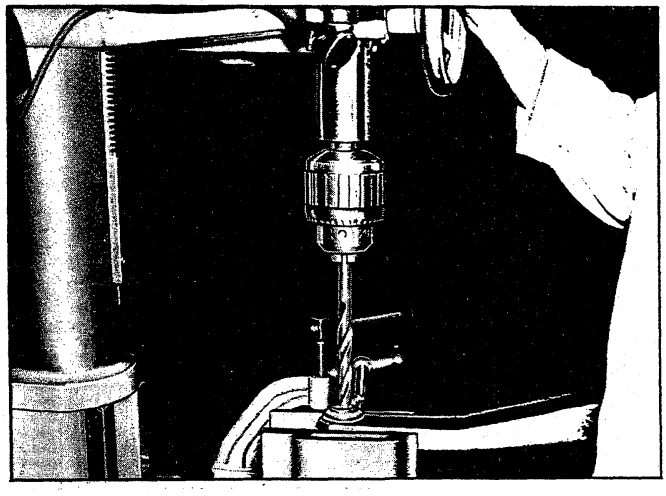


Fig. 57—Drilling Out Retainer Flare (Corvette)

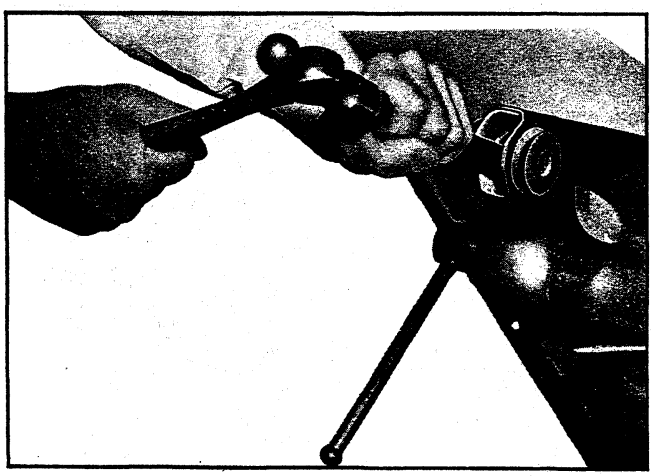


Fig. 58—Removing Bushing (Corvette)

5. Disconnect brake line at caliper and from torque arm. Disconnect parking brake cable.
6. Remove torque arm pivot bolt and toe-in shims and pull torque arm out of frame. Tape shims together and identify for correct reinstallation.

NOTE: For service operations pertaining to the spindle support assembly, refer to service operations under Wheel Spindle and Support earlier in this section.

Repairs (Fig. 56)

1. Using 11/16" drill, drill out flared end of bushing retainer (fig. 57).
2. Remove special retainer plate and tap retainer out of bushing.
3. Remove bushings by spreading them apart with a chisel and tap out of arm (fig. 58).

NOTE: If bushing diameters are severely rusted in torque arm, and arm tends to spread during removal, clamp arm in a C-clamp to prevent spreading.

4. Lightly oil new bushing diameters (not rubber portion) and start bushings squarely in arm.
5. Install Tool J-7055-1 as shown in Figure 59 and press bushings into place.
6. When bushings are fully installed, place special plate over flared portion of new bushing retainer and insert retainer into bushing.

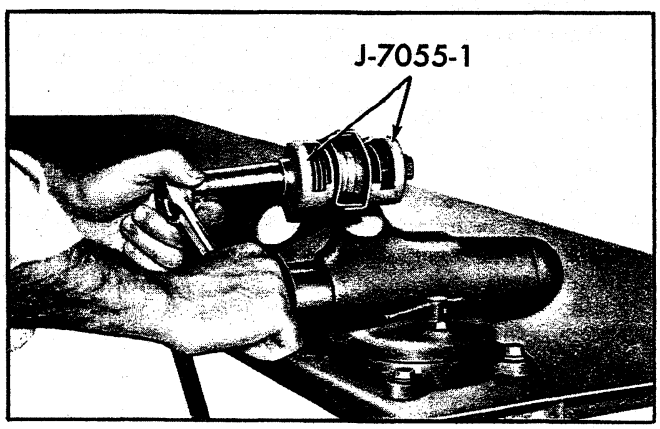


Fig. 59—Installing Bushings (Corvette)

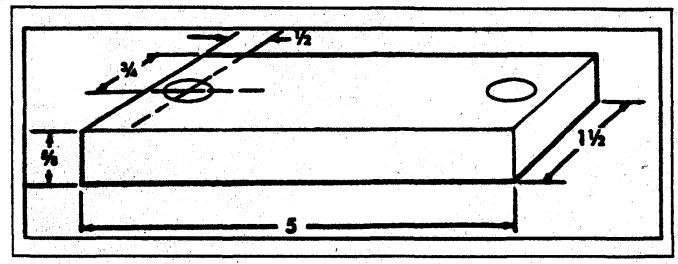


Fig. 60—Flaring Tool Back-Up Plate (Corvette)

7. Out of 5/8" thick steel plate 1-1/2" wide make flaring tool support to the dimensions shown in Figure 60 and drill clearance holes as shown for 2-1/2" bolts.
8. Place fabricated back-up plate on flared end of bushing retainer and assemble Tool J-8111-23 to plate with two 1/2" x 5" bolts. Make sure threaded hole in J-8111-23 is centered over unflared end of bushing retainer and that chamfered retainer plate is centered over retainer tube.
9. Lightly oil pointed end of J-8880-5 screw and thread into J-8111-23 until pointed end contacts bushing retainer. Continue threading J-8111-23 until retainer is flared (fig. 61).

Installation

1. Place torque arm in frame opening.
2. Place toe-in shims in original position on both sides of torque arm, install pivot bolt and tighten but do not torque at this point.
3. Raise axle drive shaft into position and install to drive flange. Torque bolts to specifications.
4. Raise strut rod into position and insert strut rod shaft so that flat lines up with flat in spindle support fork. Install nut and torque to specifications.
5. Install shock absorber lower eye and tighten nut to specifications.

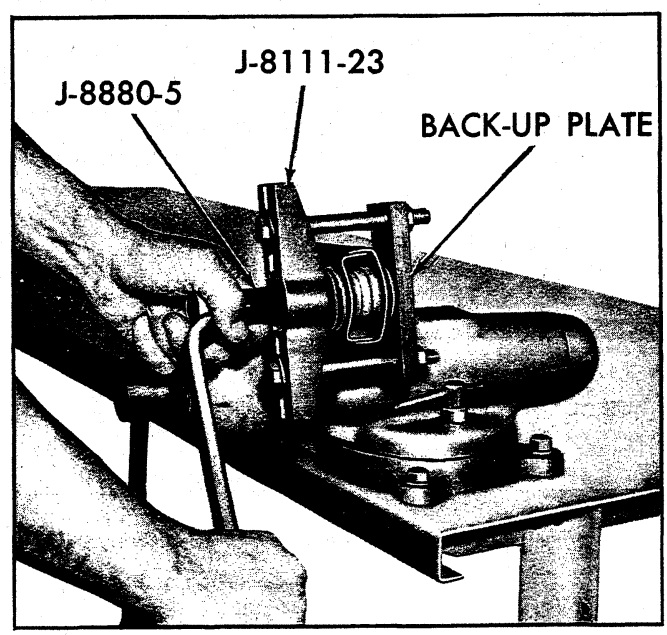


Fig. 61—Flaring Retainer (Corvette)

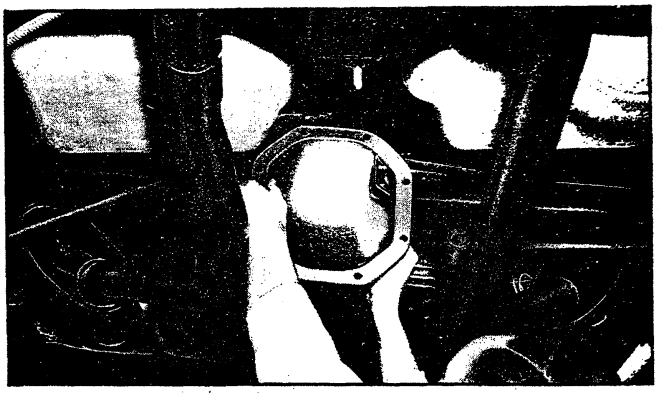


Fig. 62—Removing Crossmember (Corvette)

6. Connect spring end as outlined under Spring-Installation, Steps 3-6.

   NOTE: If vehicle is so equipped, connect stabliizer shaft to torque arm - refer to "Stabilizer Shaft Replacement".

7. Install brake line at caliper and torque arm. Bleed brakes as outlined in Section 5—Brakes.
8. Install wheel and tire and lower vehicle. Torque, torque arm pivot bolt to specifications and install cotter pin.

SUSPENSION CROSSMEMBER

Removal

1. Disconnect and remove spring as outlined under Spring-Removal.
2. Remove differential carrier assembly as outlined under Differential Carrier-Removal in this section.
3. Support crossmember, remove bolts securing crossmember isolation mounts to frame and lower crossmember (fig. 62).
4. Remove bolts securing carrier cover to crossmember.
5. Inspect rubber isolation mounts for aging and replace where necessary.

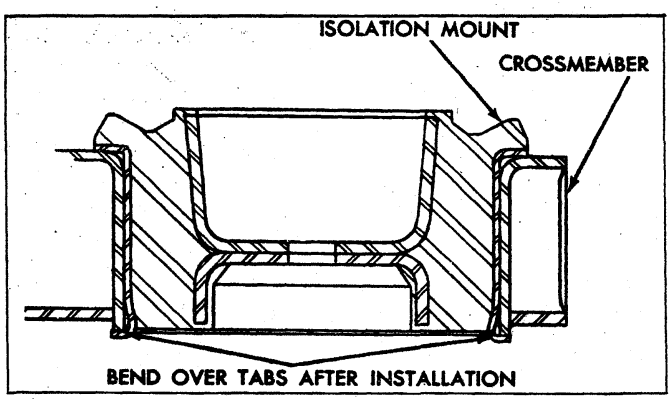


Fig. 63—Crossmember Mount Cross-Section (Corvette)

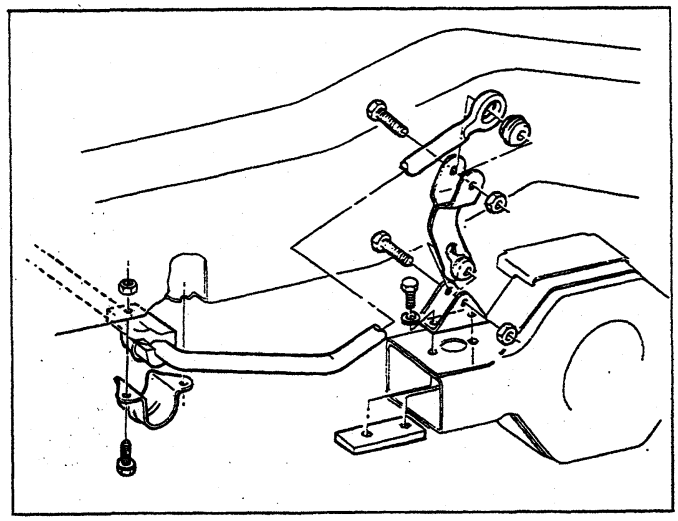


Fig. 64—Stabilizer Shaft Installation (Corvette)

Repairs—Isolation Mount

1. Bend back isolation mount tabs to allow mount removal (fig. 63).
2. Place crossmember on a suitable support and press mount out of arm using a piece of suitable size pipe or tubing on outer shell or inner insert.
3. Place new mount into position on crossmember, compress outer sleeve and press mount into place until it is fully and squarely seated.
4. After installation, bend over locking tabs.

Installation

1. Install carrier cover to crossmember and torque bolts to specifications.
2. Raise crossmember into position and install mounting bolts. Torque bolts to specifications.
3. Install differential carrier assembly as outlined under Differential Carrier-Installation in this section.
4. Install spring, wheels and tires, remove frame supports and lower vehicle.

STABILIZER SHAFT REPLACEMENT

1. Raise rear of vehicle and support at frame side rail with stand jacks.
2. Disconnect stabilizer shaft at both torque arms (fig. 64). Remove stabilizer shaft brackets from the frame and withdraw assembly from vehicle.
3. Inspect bushings for signs of deterioration, and inspect shaft for bends, breaks or other defects - do not attempt to straighten shaft - replace parts as deemed necessary.
4. Position bushings on shaft and loosely install shaft to torque arms and at frame brackets.
5. Align shaft to assume proper placement when bolts are torqued, and torque attaching bolts to specifications.

DRIVE LINE

REAR AXLE

INDEX

	Page
General Description	4-23
Chevrolet, Chevelle, Camaro and Nova	4-23
Corvette	4-23
Maintenance and Adjustments	4-23
Lubrication	4-23
Lubricant Leaks	4-23
Axle Bolts and Wheel Nuts	4-24
Rear Axle Noise Diagnosis	4-24
Gear Noise	4-26
Bearing Noise	4-26
Drive Line Backlash	4-26
Failure Analysis	4-26
Hypoid Gears	4-26
Differential Gears	4-27
Bearings	4-27
Component Parts Replacement (Chevrolet, Chevelle, Camaro and Nova)	4-27
Axle Assembly	4-27
Removal	4-27
Axle Shaft	4-27
Removal	4-27
Wheel Bolt Replacement	4-28
Oil Seal and/or Bearing Replacement	4-28
Brake Flange Plate Replacement	4-28
Installation	4-28
Pinion Flange, Dust Deflector and/or Oil Seal Replacement	4-29
Component Parts Replacement (Corvette)	4-30
Axle Driveshaft	4-30
Removal	4-30
Repairs	4-31
Installation	4-31
Pinion Flange, Dust Deflector and/or Oil Seal	4-31
Removal	4-31
Inspection	4-31
Installation	4-31
Differential Carrier	4-32
Removal	4-32
Installation	4-33
Positraction Differential Unit—On the Vehicle Check	4-33

GENERAL DESCRIPTION

CHEVROLET, CHEVELLE, NOVA AND CAMARO

The rear axle (fig. 65) is a semifloating, fabricated construction type consisting of a cast carrier with large bosses on each end into which two welded steel tubes are fitted. The carrier contains an overhung hypoid pinion and ring gear. The differential is a two pinion arrangement.

The axle housing is made up of two steel welded tubes pressed into the crossbore of the cast carrier - each tube is welded to the carrier. Welded-on brackets provide attachment points for springs, shock absorbers, and lower control arms.

The overhung hypoid drive pinion is supported by two preloaded tapered roller bearings. The pinion shaft is sealed by means of a molded, spring loaded, rubber seal. The seal is mounted on the pinion shaft flange which is splined and bolted to the hypoid pinion shaft.

The hypoid ring gear is bolted to a one-piece differential case which is supported by two preloaded tapered roller bearings.

CORVETTE

The Corvette rear axle is of the type where the differential carrier housing enclosing the differential and hypoid gears is supported on a crossmember mounted to the chassis frame. The differential is connected through universal joints to the drive shafts and wheels (fig. 66).

The internal components of the carrier are of conventional design, incorporating a hypoid gear set with an overhung pinion supported on two pre-loaded, tapered roller bearing assemblies, and a two-pinion differential assembly supported on tapered roller bearings. Pinion mounting distance adjustments are made through the use of shims, as are the differential bearing pre-load and backlash adjustments. The differential side gears drive two splined yokes which are retained laterally by snap rings located on the yoke splined end. The yokes are supported on caged needle bearings pressed into the carrier, adjacent to the differential bearings. A lip seal, pressed in outboard of the bearings, prevents oil leakage and dirt entry. The carrier cover is bolted to the carrier and provides accessibility to the internal parts. The cover incorporates two integral, reinforced mounting pads which serve as the carrier attaching point to the suspension crossmember, and an attaching point for the spring center section. The filler plug is located on the right side of the cover near the bolting flange.

All service operations allow carrier removal without removing the carrier cover. Cover removal is not necessary in any of the service procedures except in the case of complete carrier housing replacement, as the carrier and cover are serviced as an assembly.

MAINTENANCE AND ADJUSTMENTS

LUBRICANT

The lubricant level should be periodically checked and maintained at level of filler plug with a warm axle. See the lubrication section of this manual for lubricant recommendations.

Lubricant Leaks

Lubricant leaks should be checked for at the pinion flange oil seal, axle wheel bearing seals, lubricant filler plug, and carrier cover. Correction of these leaks consists of replacing the defective seals or gaskets involved as described in this section.

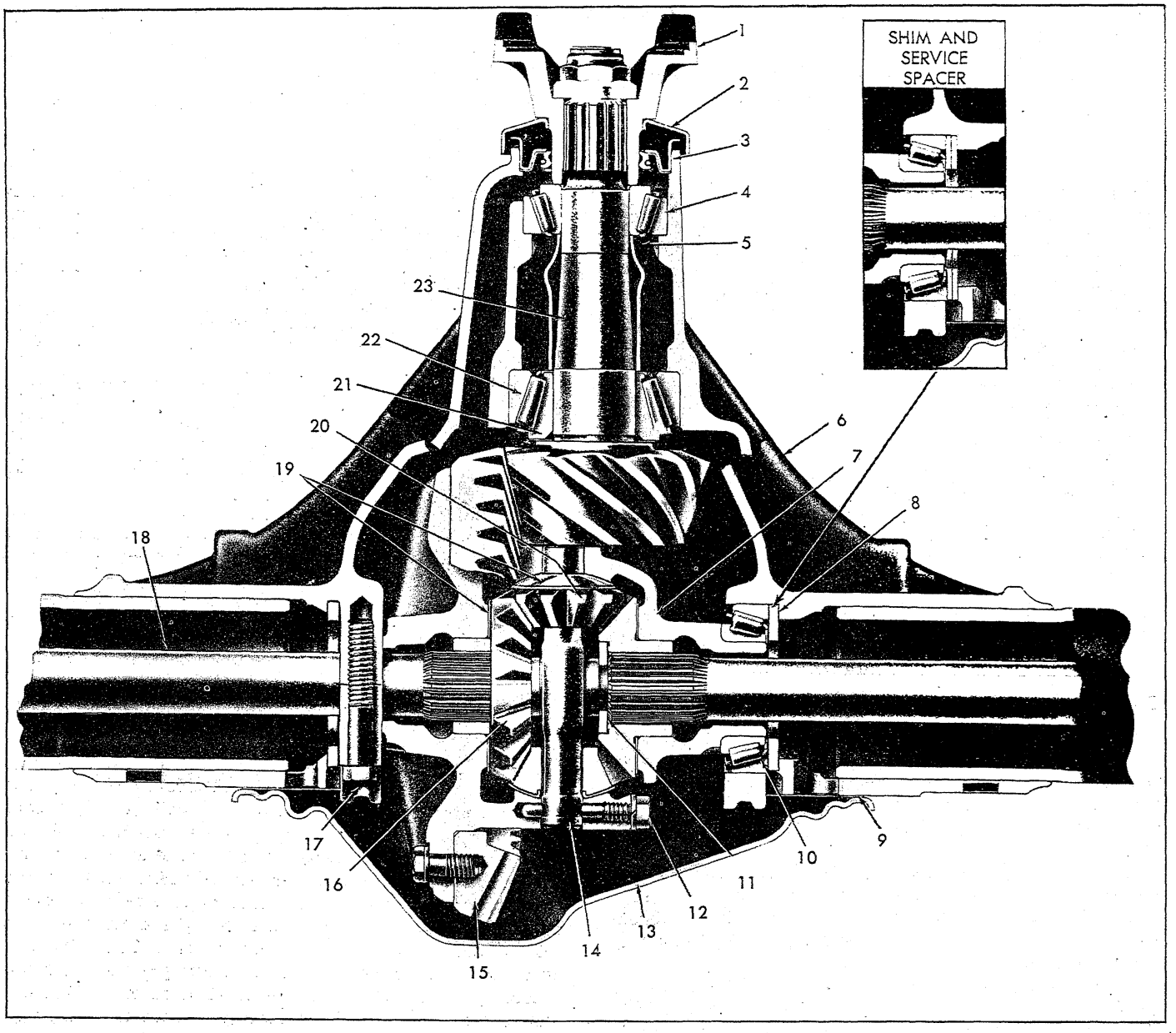


Fig. 65—Rear Axle Cross-Section (Chevrolet, Camaro, Chevelle and Nova)

1. Companion Flange
2. Deflector
3. Pinion Oil Seal
4. Pinion Front Bearing
5. Pinion Bearing Spacer
6. Differential Carrier
7. Differential Case
8. Shim
9. Gasket
10. Differential Bearing
11. "C" Lock
12. Pinion Shaft Lock Bolt
13. Cover
14. Pinion Shaft
15. Ring Gear
16. Side Gear
17. Bearing Cap
18. Axle Shaft
19. Thrust Washer
20. Differential Pinion
21. Shim
22. Pinion Rear Bearing
23. Drive Pinion

AXLE BOLTS AND WHEEL NUTS

From a safety standpoint, axle housing to rear spring bolts, wheel nuts and control arm attaching bolts should be periodically inspected for secure installation.

REAR AXLE NOISE DIAGNOSIS

Mechanical failures of the rear axle are relatively simple to locate and correct. Noise in a rear axle is a little more difficult to diagnose and repair. One of the most essential parts of rear axle service is proper diagnosis.

All rear axles are noisy to a certain degree. The action of transmitting the high engine torque through a 90° turn reducing properller shaft speed produces noise in rear axles. This point establishes the need for a line between normal and abnormal or unacceptable axle noises.

Slight axle noise heard only at a certain speed or under remote conditions must be considered normal. Axle noise

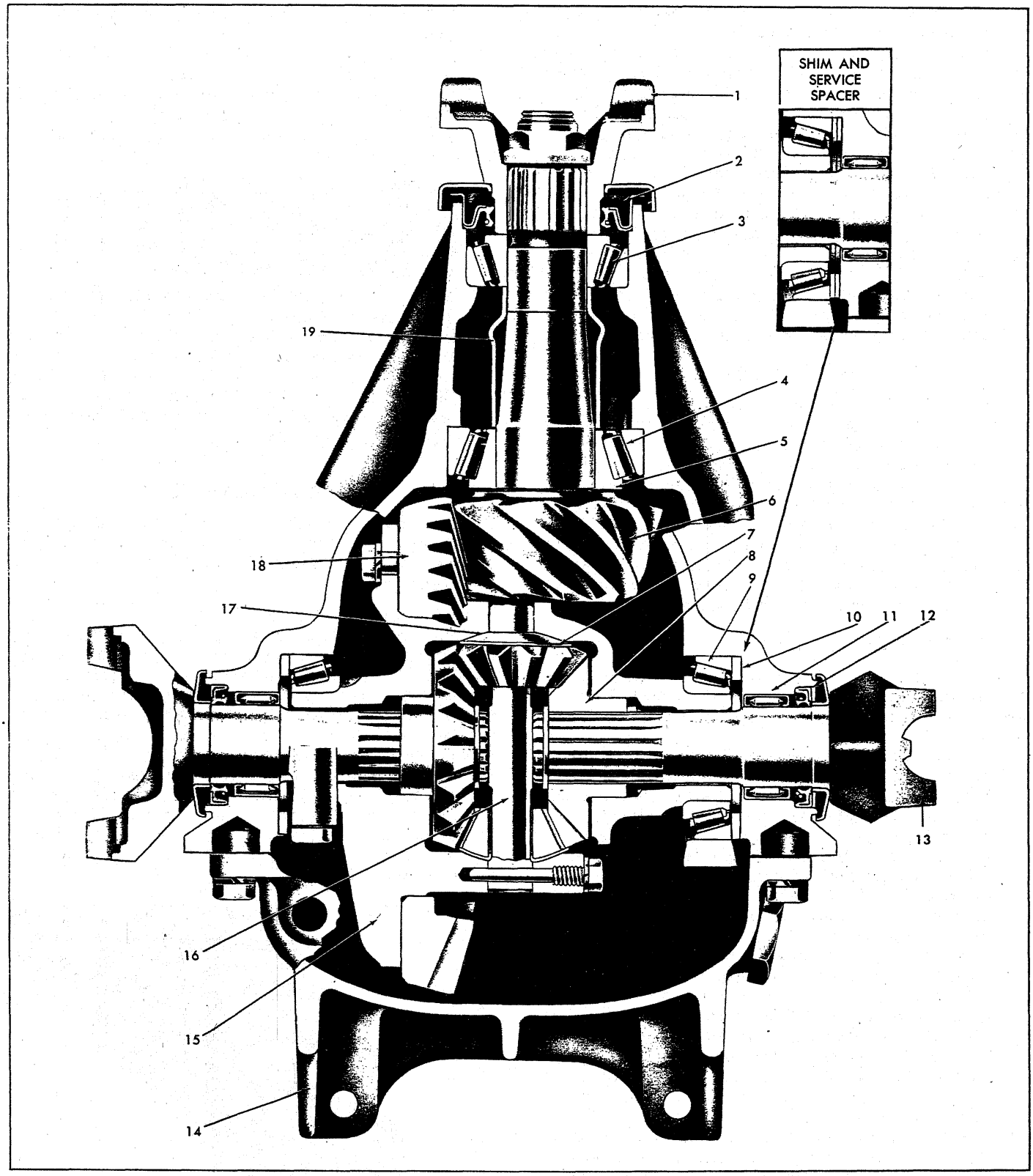


Fig. 66—Rear Axle Cross-Section (Corvette)

1. Companion Flange
2. Pinion Seal
3. Front Pinion Bearing
4. Rear Pinion Bearing
5. Pinion Shim
6. Pinion
7. Differential Pinion
8. Differential Side Gear
9. Differential Bearing
10. Differential Bearing Shim
11. Yoke Bearing
12. Yoke Bearing Seal
13. Side Gear Yoke
14. Carrier Cover
15. Differential Case
16. Differential Pinion Shaft
17. Thrust Washer
18. Ring Gear
19. Pinion Bearing Spacer

tends to "peak" at varying speeds and the noise is in no way indicative of trouble in the axle.

If noise is present in an objectionable form, loud or at all speeds, an effort should be made to isolate the noise as being in one particular unit of the vehicle. Axle noise is often confused with other noises such as tire noise transmission noise, propeller shaft vibration and universal joint noise. Isolation of the noise as in any one unit requires skill and experience. An attempt to eliminate a slight noise may baffle even the best of diagnosticians. Such practices as raising tire pressure to eliminate tire noise, listening for the noise at varying speeds and on drive, float and coast, and under proper highway conditions, turning the steering wheel from left to right to detect wheel bearing noise, will aid even the beginner in detecting alleged axle noises. Axle noises fall into two categories: gear noise and bearing noise.

GEAR NOISE

Abnormal gear noise can be recognized since it produces a cycling pitch and will be very pronounced in the speed range at which it occurs, appearing under either "drive," "float" or "coast" conditions. Gear noise tends to peak in a narrow speed range or ranges, while bearing noise will tend to remain constant in pitch. Abnormal gear noise is rare and usually originates from the scoring of the ring gear and pinion teeth as a result of insufficient or improper lubrication in new assemblies. Side gears seldom give trouble as they are used only when the rear wheels travel at different speeds.

BEARING NOISE

Defective bearings will always produce a whine that is constant in pitch and varies with vehicle speed. This fact will allow you to distinguish between bearing noise and gear noise.

1. Pinion bearing noise resulting from a bearing failure can be identified by a constant rough sound. Pinion bearings are rotating at a higher speed than differential side bearings or axle shaft bearings. This particular noise can be picked up best by testing the car on a smooth road (black top). However, care should be taken not to confuse tire noise with bearing or gear noise. If any doubt exists, tire treads should be examined for irregularities that would produce such noise.
2. Wheel bearing noise may be confused with rear axle noise. To differentiate between wheel bearings and rear axle, drive the vehicle on a smooth road at medium-low speed. With traffic permitting, turn the vehicle sharply right and left. If noise is caused by wheel bearings, it will increase in the turns because of the side loading. If noise cannot be isolated to front or rear wheel bearings, inspection will be necessary.
3. Side bearings will produce a constant rough noise of a slower nature than pinion bearings. Side bearing noise will not fluctuate in the above wheel bearing test.

DRIVE LINE BACKLASH

The following procedure may be used in determining if the amount of backlash is within limits or if the problem may be in the drive shaft or transmission.

1. Jack up one rear wheel and support axle tube with a jack stand.
2. Gently rotate raised wheel clockwise by hand until all axle assembly lash is taken up.
3. From under the vehicle scribe a line across the brake drum flange and backing plate.
4. Gently rotate wheel counter-clockwise until all axle backlash is taken up.

   CAUTION: ROTATE WHEEL ONLY FAR ENOUGH AND WITH SUFFICIENT FORCE TO TAKE UP REAR AXLE BACKLASH. DO NOT ROTATE WHEEL WITH SUFFICIENT FORCE TO CAUSE PINION FLANGE TO TURN.

5. Scribe line on backing plate directly opposite the line on the brake drum.
6. Measure distance between scribe marks on backing plate. If distance is less than 11/32" with 0-1/2" brakes or 3/8" with 11" brakes on the standard axle (10-bolt cover); 1/4" with 9-1/2" brakes or 9/32" with 11" brakes on heavy-duty axles (12-bolt cover) axle backlash is within limits.

FAILURE ANALYSIS

The most common types of rear axle failures are hypoid gear tooth scoring and fracture, differential gear fracture and/or differential bearing failure, and axle shaft bearing failure.

Hypoid Gears

Hypoid gear tooth scoring (fig. 67) is caused generally by improper break-in, incorrect lube, insufficient gear backlash or improper ring/pinion gear alignment. The scoring will progressively lead to complete erosion of the gear tooth, or gear tooth pitting and eventful fracture with possible attendant damage to bearings, if the initial scoring condition is not diagnosed in time and corrected. Hypoid gear scoring is easily recognized by it characteristic loud whine in either drive, coast or under both conditions. Another cause of hypoid tooth fracture (fig. 68) is extended overloading of the gear set which will produce fatigue fracture, or shock loading which will result in sudden failure.

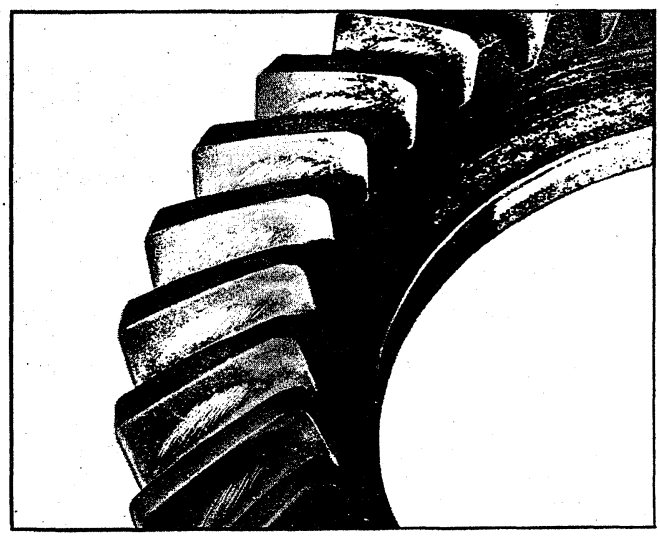


Fig. 67—Scored Hypoid Ring Gear

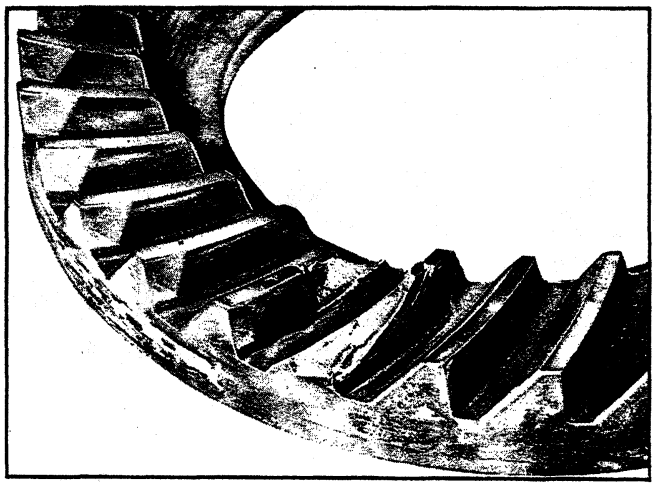


Fig. 68—Cracked Hypoid Ring Gear

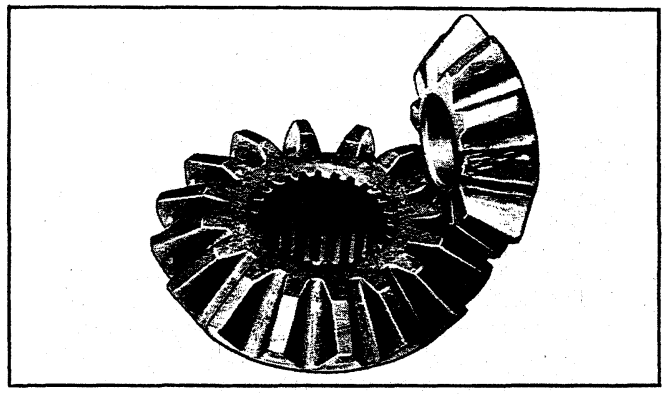


Fig. 69—Differential Gear Failure

Differential Gears

Common causes of differential gear failure are shock loading, extended overloading leading to fatigue failure, and overheating of gear thrust surfaces resulting from excessive wheel spin and consequent lubrication breakdown. Overheating will lead to seizing of thrust surfaces or tooth failure (fig. 69).

Bearings

Failure of axle tapered roller bearings is due primarily to excessive wear caused by long service or foreign materials in the oil. The second most common cause of bearing failure is too tight or too loose preload adjustment leading to spalling and eventual failure. This failure may also lead to hypoid gear scoring due to the resultant misalignment of the hypoid gear set.

COMPONENT PARTS REPLACEMENT

(Chevrolet, Chevelle, Nova and Camaro)

AXLE ASSEMBLY

Removal

1. Raise vehicle on hoist.
2. Place adjustable lifting device under axle.
3. Disconnect right and left shock absorbers from axle. On Camaro and Nova models remove lower spring pad brackets.
4. Remove propeller shaft.
5. Disconnect tie rod (if so equipped) from axle and swing upward.
6. Disconnect upper control arms from axle.
7. Remove right and left wheel and tire assembly.
8. Remove right and left brake drums.
9. Disconnect brake lines from clips on axle tubes.
10. Remove differential cover and gasket; draining lubricant.
11. Remove differential pinion lock screw, pinion shaft and axle shaft "C" locks. Reinstall pinion shaft and lock screw to retain differential gears.
12. Remove both axle shafts.
13. Remove brake backing plate retaining nuts (both sides); remove backing plates (with shoes and brake lines attached) and wire to frame. Exercise caution not to damage or bend brake lines.
14. Remove right and left lower control arm pivot bolts at axle.
15. On all models except Camaro and Nova lower axle assembly slowly until coil spring tension is released then remove axle from vehicle. For Camaro and Nova axles, shift axle assembly to clear leaf springs.
16. Reverse steps to reinstall.

AXLE SHAFT

Removal

1. Raise vehicle to desired working height and remove wheel and tire assembly and brake drum. For Camaro models equipped with rear disc brakes, remove the caliper assembly from the backing plate as outlined in Section 5 and wire up out of way. Then remove rotor.
2. Clean all dirt from area of carrier cover.
3. Drain lubricant from carrier by removing cover.
4. Remove the differential pinion shaft lock screw and the differential pinion shaft (fig. 70).
5. Push flanged end of axle shaft toward center of vehicle and remove "C" lock from button end of shaft.

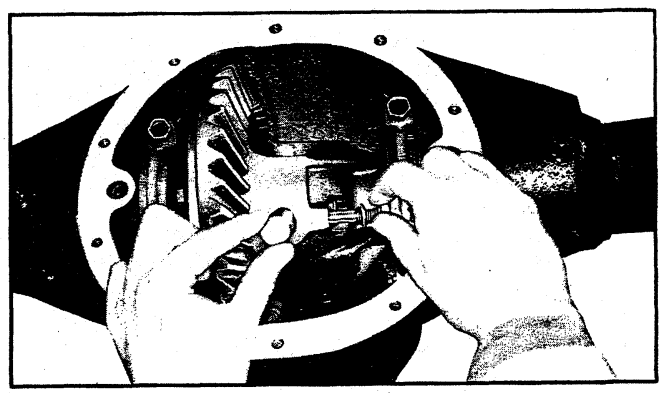


Fig. 70—Differential Pinion Shaft Removal

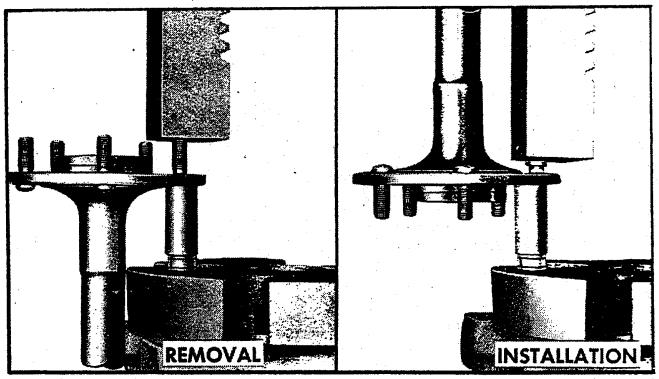


Fig. 71—Wheel Bolt Replacement

6. Remove axle shaft from housing, being careful not to damage oil seal.

Wheel Bolt Replacement

Press bolts out of axle shaft flange (as illustrated in Figure 71 and press new bolts into place, making sure that they are tight and square with flange.

Oil Seal and/or Bearing Replacement

1. Remove the oil seal by using the button end of the axle shaft - insert the button end of the shaft behind the steel case of the oil seal, then pry seal out of bore being careful not to damage housing.
2. Insert Tool J-8119 into bore and position it behind bearing so that tangs on tool engage bearing outer race. Remove bearing, using slide hammer as shown in Figure 72. Figure 73 shows a detail of axle housing outer end.
3. Lubricate new bearing with wheel bearing lubricant, and install bearing so that it bottoms against shoulder (fig. 74). To install bearing use Tool J-21491 for the Chevelle, Camaro and Nova light-duty axle and tool J-21051 for all Chevrolet models and also for Chevelle, Camaro and Nova models with heavy-duty axle.
4. Pack cavity between the seal lips with a high melting point wheel bearing lubricant; position seal on tool (Use J-21491 for the Chevelle, Camaro and Nova light-duty axle and J-21051 for all Chevrolet models and also for Chevelle, Camaro and Nova models with heavy-duty axle) and position seal in axle housing bore, tap seal into place so that it bottoms against bearing (fig. 74).

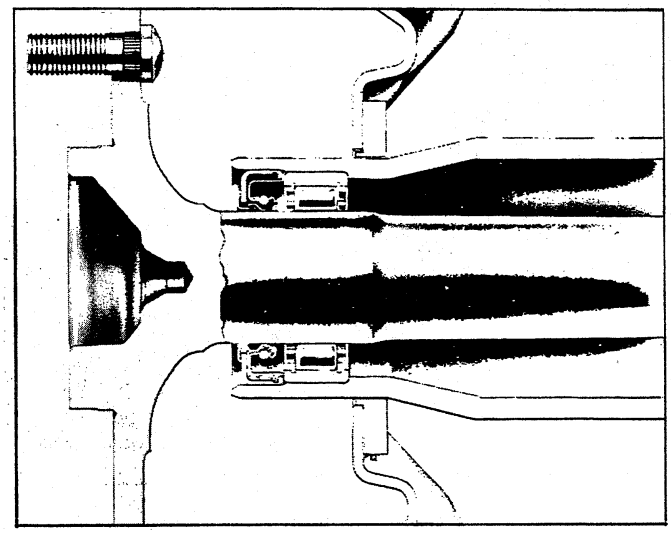


Fig. 73—Axle Housing Detail

Brake Flange Plate Replacement

1. Remove brake line at wheel cylinder inlet and disassemble brake components from flange plate. Refer to Section 5 for brake disassembly procedure.
2. Install new flange plate to axle housing and torque nuts to specifications.
4. Install brake components on flange and connect hydraulic line to wheel cylinder inlet. See Section 5 for brake assembly procedure.
5. Install axle shaft, brake drum and wheel and tire assembly.
6. Bleed and adjust brakes as outlined in Section 5.

Installation

1. Slide axle shaft into place.

   CAUTION: Exercise care that splines on end of shaft do not damage oil seal and that they engage with splines of differential side gear.

2. Install axle shaft "C" lock on button end of axle shaft and push shaft outward so that shaft lock seats in counterbore of differential side gear.
3. Position differential pinion shaft through case and pinions, aligning hole in shaft with lock screw hole. Install lock screw and torque to specifications.

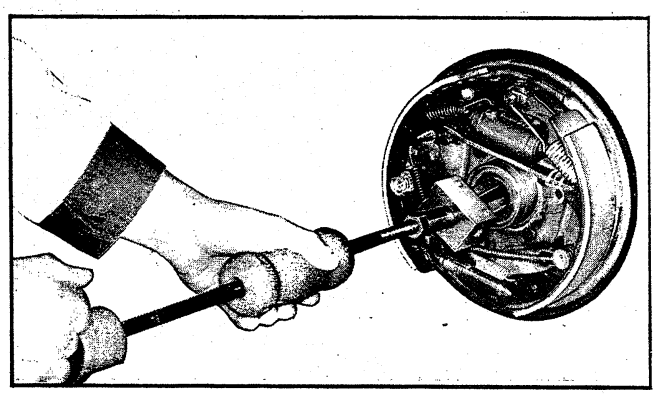


Fig. 72—Wheel Bearing Removal

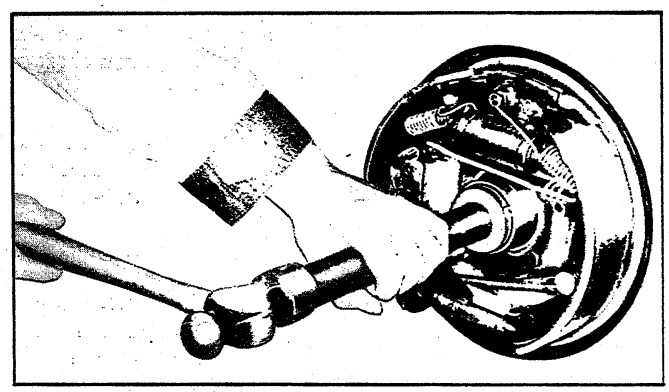


Fig. 74—Wheel Bearing and/or Oil Seal Installation

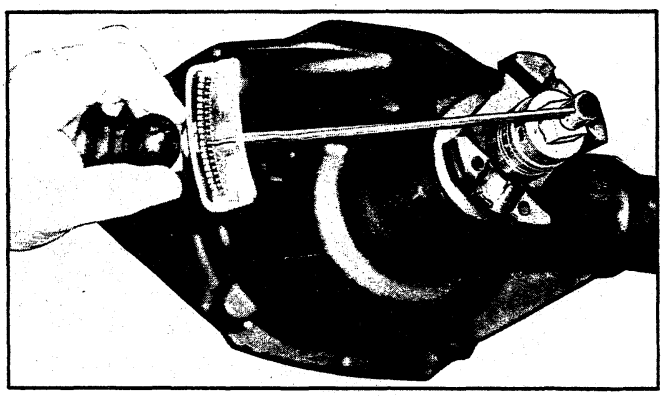


Fig. 75—Measuring Drive Pinion Bearing Preload

4. Using a new gasket, install carrier cover and torque bolts to specifications.

   CAUTION: Make sure both gasket surfaces on carrier and cover are clean before installing new gasket. Torque carrier cover bolts in a crosswise pattern to ensure uniform draw on cover gasket.

5. Fill axle with lubricant to a level even with bottom of filler hole. See Section 0 for proper lubricant.
6. Install brake drum and wheel and tire assembly.
7. Lower vehicle and test operation of axle.

PINION FLANGE, DUST DEFLECTOR AND/OR OIL SEAL

Replacement

1. Raise rear of vehicle and place stand jacks under frame side rails so that axle hangs freely to allow sufficient working room.
2. Check wheels for freedom of rotation.
3. Separate rear universal joint, tape trunnion bearings to joint, position propeller shaft to one side and tie it to frame side rail.
4. Using Tool J-5853 with Adapter J-5810 and a suitable socket on the pinion flange nut, rotate the pinion through several complete revolutions and record the torque required to keep the pinion turning (fig. 75). If flange is to be reused, mark pinion and flange for reassembly in the same relative position.

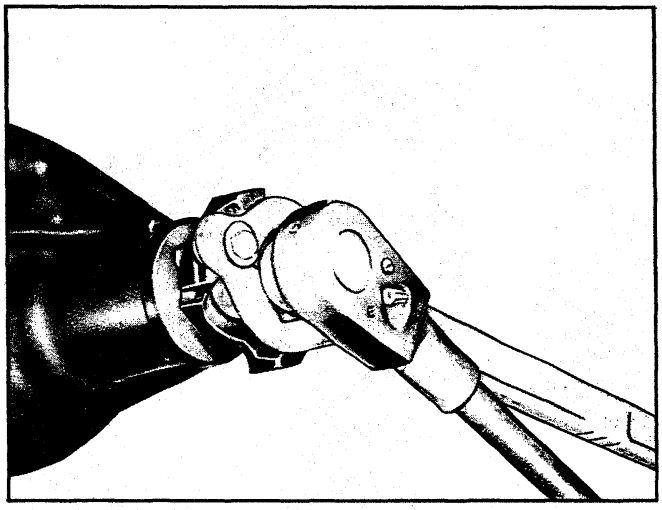


Fig. 76—Drive Pinion Nut Removal

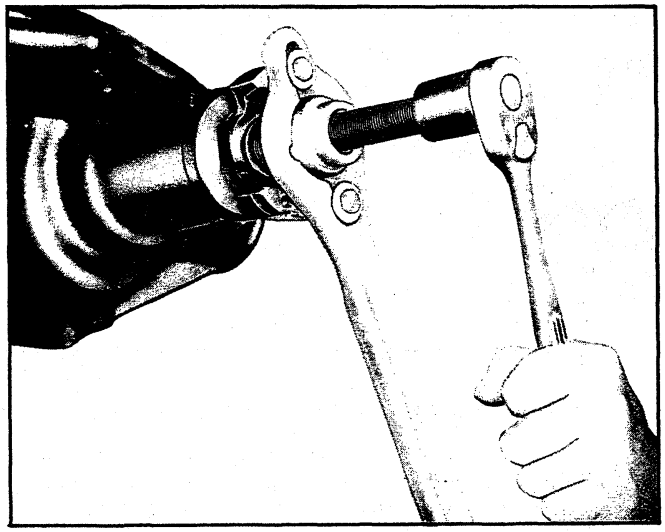


Fig. 77—Drive Pinion Flange Removal

5. Install Tool J-8614-1 on pinion flange and remove pinion flange self-locking washerfaced nut (fig. 76). (Position J-8614-1 on flange so that the four notches are toward flange.) Discard nut and use a new one upon reassembly.
6. Thread pilot end of Tool J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-1 installed as in Step 4, insert J-8614-2 into J-8614-1 and turn it 45 degrees to locked position. Remove flange by turning J-8614-3 while holding J-8614-1 (fig. 77).
7. Pry old seal out of bore, using a screw driver or a hammer and chisel.
8. Inspect pinion flange for smooth oil seal surface, worn drive splines, damaged ears, and for smoothness of bearing contact surface. Replace if necessary.
9. If deflector requires replacement, remove by tapping from flange, clean up stake points; install new deflector, and stake deflector at three new equally spaced positions.

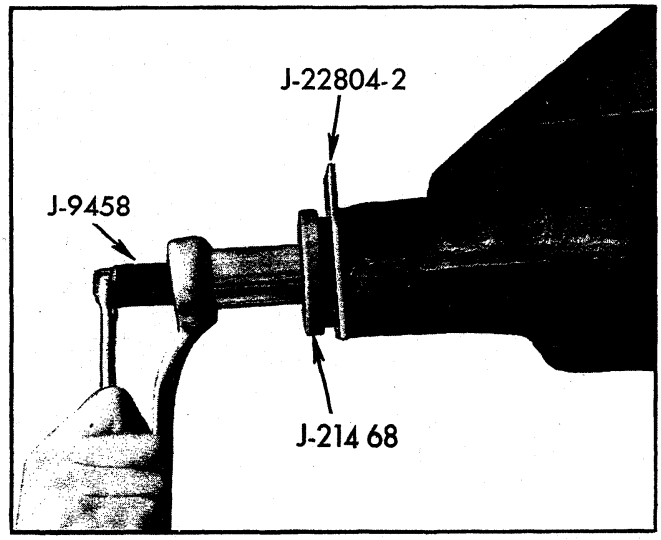


Fig. 78—Drive Pinion Flange Oil Seal Installation (Light Duty)

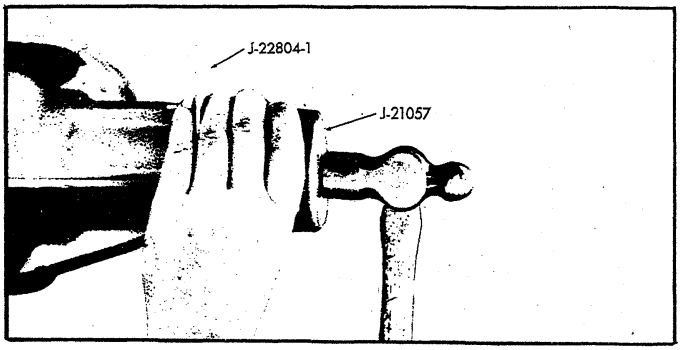


Fig. 79—Drive Pinion Flange Oil Seal Installation (Heavy Duty)

NOTE: Staking operation must be performed in such a manner that the seal operating surface is not damaged.

10. Pack the cavity between the seal lips of the pinion flange oil seal with a lithium-base extreme pressure lubricant, position seal in bore and place gauge plate J-22804-2 (Light-Duty) or J-22804-1 (Heavy-Duty) over seal and against seal flange. The gauge plate insures proper seating of seal in carrier bore.
11. Using Tool J-21468 and J-9458 for Light-Duty Axles (fig. 78) or Tool J-21057 for Heavy-Duty Axles (fig. 79), press seal into carrier bore until gauge plate is flush with the carrier shoulder and seal flange. Turn gauge plate 180° from installed position; seal must be square in carrier bore to seal properly against pinion flange.
12. Position and align pinion flange on pinion shaft using Tools J-9458 and J-8614-1. Tool J-9458-1 is threaded onto pinion shaft and nut tightened against J-9458-2 to pull flange on shaft (fig. 80). Remove J-9458 after flange is seated.

NOTE: The position of the pinion and flange was previously marked so that reinstallation may be made with flange and pinion in same relative position.

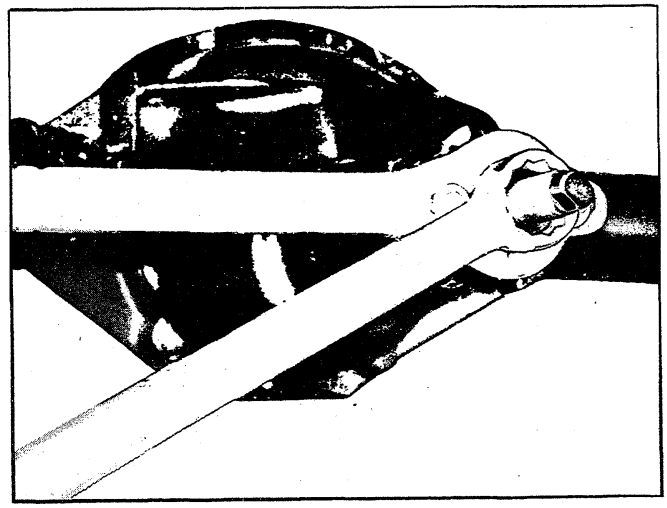


Fig. 80—Drive Pinion Flange Installation

CAUTION: Do not attempt to hammer flange onto pinion shaft. To do so will damage ring gear and pinion.

13. Pack the cavity between end of pinion splines and pinion flange with a non-hardening sealer (such as Permatex Type A) prior to installing washer and nut on pinion.
14. Install a new nut on the pinion shaft. Tighten nut to remove end play and continue alternately tightening in small increments and checking preload with torque wrench until it is the same as that recorded in Step 4.
15. Reassemble the rear universal joint, and torque "U" bolt nuts to specifications.
16. Lower vehicle to floor and road test for leaks.

COMPONENT PARTS REPLACEMENT (CORVETTE)

AXLE DRIVESHAFT—FIGURE 81

Removal

1. Disconnect inboard driveshaft trunnion from side gear yoke.

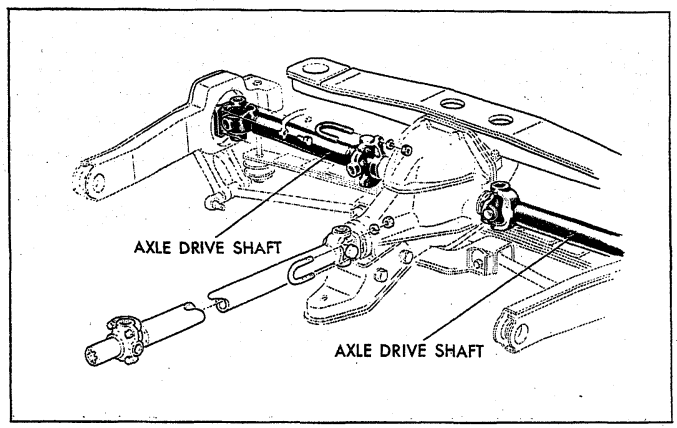


Fig. 81—Axle Driveshaft (Corvette)

2. Bend bolt lock tabs down and remove four bolts securing shaft flange to spindle drive flange (fig. 82).

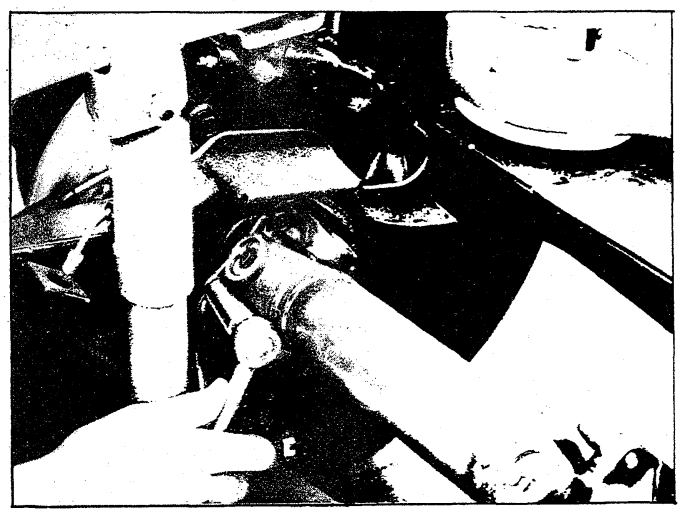


Fig. 82—Removing Driveshaft (Corvette)

3. Pry driveshaft out of outboard drive flange pilot and remove by withdrawing outboard end first (fig. 82).

Repairs

1. Remove bearing lock ring from trunnion yoke.
2. Support trunnion yoke on a piece of 1-1/4" pipe on arbor press bed.
3. Using suitable socket or rod, press trunnion down far enough to drive opposite bearing cup from yoke.
4. Remove trunnion and press other bearing cup from yoke, being careful not to drop cup or lose bearing rollers.
5. Remove trunnion and yoke from other joint in a similar manner.
6. Remove dust seals from trunnion, clean and inspect bearing rollers and trunnion. Relubricate bearings with a high-melting point wheel bearing type lubricant.

   NOTE: In addition to packing the bearings, make sure that the lubricant reservoir at the end of each trunnion is completely filled with lubricant. In filling these reservoirs, pack lubricant into the hole so as to fill from the bottom. This will prevent air pockets and ensure an adequate supply of lubricant.

7. Place new dust seals on trunnion, cavity of seal toward end of trunnion - then position Tool J-21556 over end of trunnion and into cavity portion of seal. Press seal onto trunnion until tool bottoms against trunnion (fig. 83).

   NOTE: Installation of seal is critical to proper sealing - use specified tool during installation to prevent seal distortion and to assure proper seating of seal on trunnion.

8. Partially install one bearing cup into yoke. Place trunnion in yoke and into bearing cup. Install other bearing cup and press both bearing cups into yoke, being careful to keep trunnion aligned in bearing cups.
9. Press bearing cups far enough to install lock rings, and install lock rings.

   NOTE: It may be more convenient, if necessary, to use a bench vise for removal and installation, instead of an arbor press. In this case, proceed with disassembly and assembly procedure as with an arbor press.

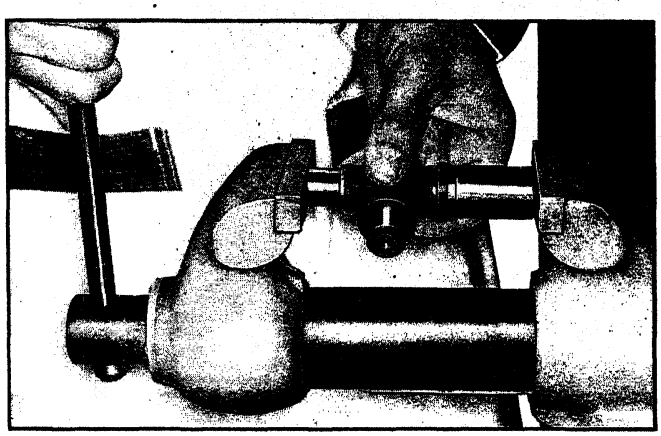


Fig. 83—"U" Joint Trunnion Seal Installation

Installation

1. Place driveshaft inboard trunnion into side gear yokes and assemble "U" bolts. Rotate yokes so that trunnion seats are phased 90° apart.
2. Install outboard drive flange into spindle drive flange pilot, position bolt lock over bolt holes and install four bolts. Torque bolts to specification and bend lock tabs flat against bolt heads.

PINION FLANGE, DUST DEFLECTOR AND/OR OIL SEAL

Removal

1. Raise vehicle and place jackstand under frame to allow wheels to hang free.
2. Place 1/2" thick block of wood or steel between carrier upper surface to rear of companion flange, and body floor. This will prevent carrier assembly from twisting upward when front support bracket is disconnected.
3. Disconnect carrier front mounting bracket bolt from frame crossmember.
4. Remove nuts from both bracket-to-carrier through bolts and remove bolts and mounting bracket.
5. Disconnect propeller shaft at transmission and at companion flange. Slide transmission yoke foreward, and lower propeller shaft down and out.
6. Mark companion flange nut and pinion relative location. This is necessary to reset original pinion bearing pre-load during reassembly of companion flange.
7. Attach J-8614-1 companion flange holder and remove flange nut and washer (fig. 84).
8. Remove companion flange by driving off with brass drift and hammer (fig. 85).
9. Using screw driver, pry oil seal out of carrier.

Inspection

Inspect companion flange splines for excessive wear or twisting and check deflector for looseness. If deflector is loose or damaged, break stake marks and remove. Install new deflector and stake in place.

Installation

1. Pack cavity between the seal lips of the pinion flange

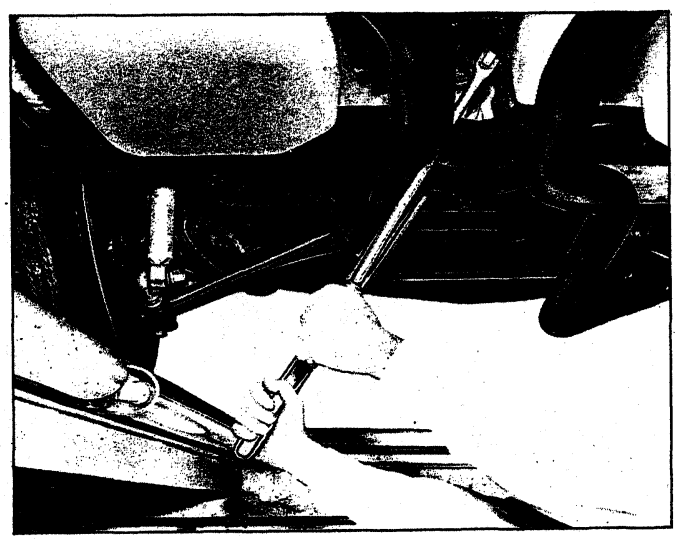


Fig. 84—Removing Companion Flange Nut

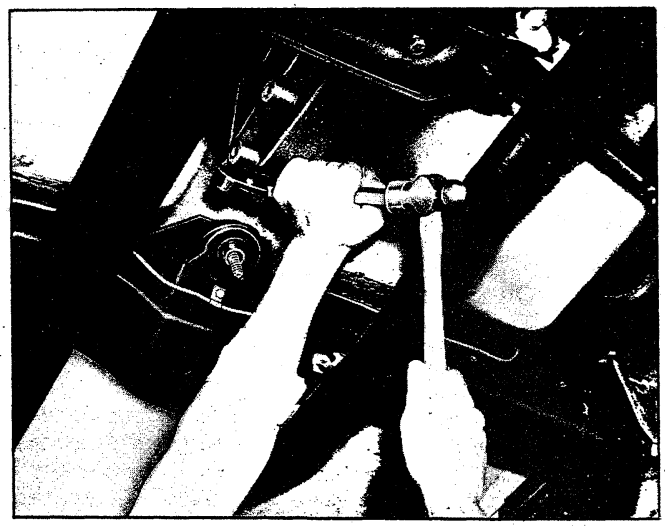


Fig. 85—Removing Companion Flange

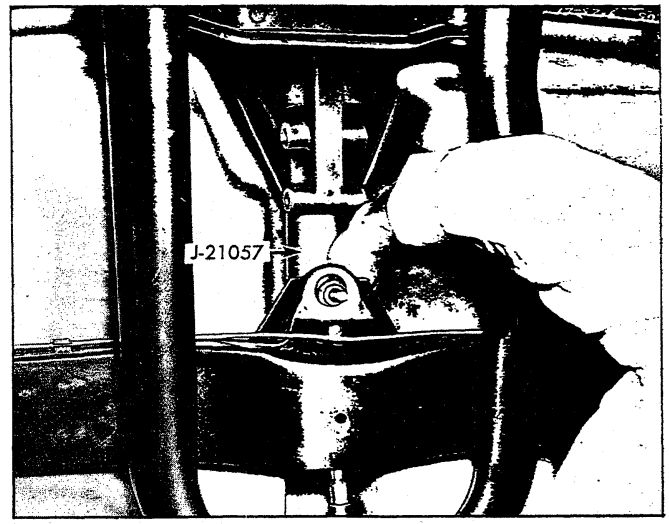


Fig. 86—Installing Pinion Oil Seal

oil seal with a Lithium base extreme pressure lubricant. Position seal in bore and place gauge plate J-22804-1 over seal and against seal flange. Gauge plate insures proper seating of seal in carrier bore.

2. Using Tool J-21057 (fig. 86), press seal into carrier bore until gauge is flush with the carrier shoulder and the seal flange. Turn gauge plate 180° from installed position; seal must be square in carrier bore to seal properly against pinion flange.
3. Lubricate companion flange splines and tap into place.
4. Install companion flange washer and nut, and tighten nut so that it lines up with mark on pinion.
5. Raise propeller shaft into position and connect to companion flange and transmission yoke.
6. Place rubber cushion on carrier front mount, and place bracket into position and loosely install rear carrier-to-bracket bolt.
7. Install front mounting nut and front carrier-to-bracket bolt. Torque all affected parts to specifications and install cotter pin to carrier bracket front bolt.

DIFFERENTIAL CARRIER

Removal

1. Disconnect spring and link bolts as outlined in Spring—Removal, in this section.
2. Disconnect axle drive shafts at carrier by removing "U" bolts securing trunnion to side gear yoke.
3. Disconnect carrier front support bracket at frame crossmember.
4. Disconnect propeller shaft at transmission and at companion flange. Slide transmission yoke forward into transmission. Drop propeller shaft down and out toward the rear.
5. Mark camber cam and bolt relative location on strut rod bracket and loosen cam bolts.
6. Remove four bolts securing bracket to carrier lower surface and drop bracket. Remove camber cam bolts and swing strut rods up and out of the way.
7. Remove eight carrier-to-cover bolts. Loosen bolts gradually to allow lubricant to drain out.
8. With mounting bolts removed, pull carrier partially out of cover, drop nose to clear crossmember and gradually work carrier down and out.

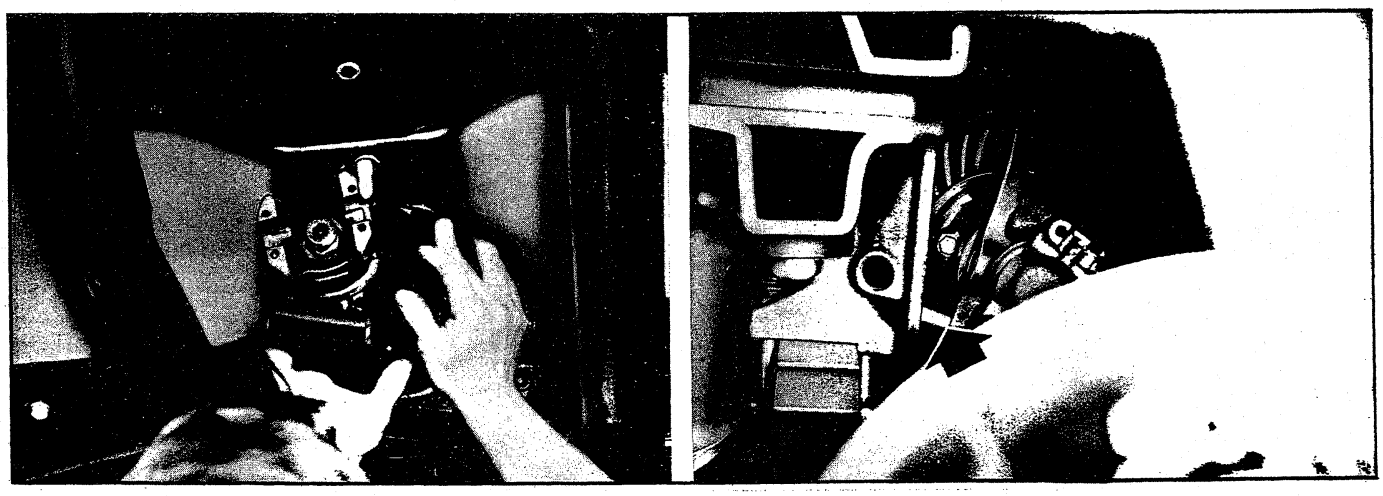


Fig. 87—Installing Carrier Assembly

Installation

1. Clean inside of carrier cover and liberally grease gasket surface. Place new gasket on cover.
2. Cut heads off two 1/2"-13 x 1-1/4" bolts and slot unthreaded end. Install these aligning studs into two below-center carrier bolt holes, one on each side.
3. Raise carrier into position aligning studs into cover (fig. 87).
4. Install carrier-to-cover bolts and tighten securely.
5. Connect propeller shaft to companion flange and transmission yoke.
6. Install rubber cushion on bracket and position to frame crossmember. Install nut and torque to specifications.
7. Raise axle drive shafts into position and assemble inboard trunnion to side gear yokes with "U" bolts.
8. Assemble strut rods to bracket and raise bracket into position under carrier. Install four bolts and torque to specifications. Move camber cams to marked location and tighten cam nuts.
9. Connect spring end link bolts as outlined under Spring—Installation, in this section.
10. Remove filler plug, located on right side of cover, and fill with hypoid lubricant to level of filler hole.
11. Lower vehicle and road test for leaks, noise and general performance.

POSITRACTION DIFFERENTIAL UNIT

The optionally available Positraction differential unit is installed in the conventional carrier to replace the standard differential unit.

Service procedures for the Positraction equipped axle are the same as on a conventional axle except for the operations listed below.

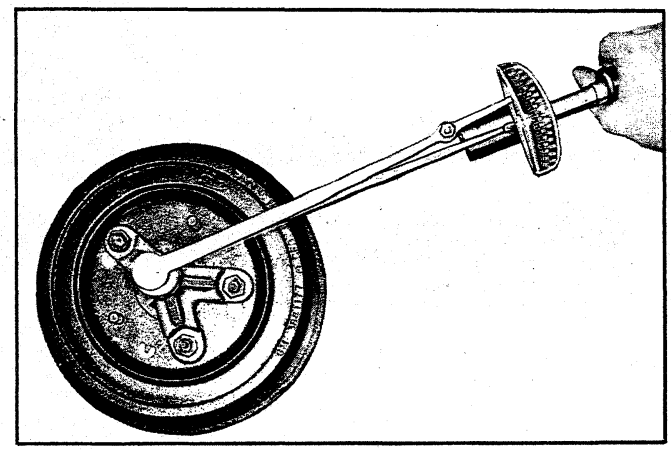


Fig. 88—Measuring Positraction Rotating Torque

On the Vehicle Check

If vehicle is equipped with a manual transmission, shift transmission into neutral.

1. Raise rear of vehicle until wheels are off the ground, remove one wheel and tire assembly.
2. Attach Adapter J-5748 to axle shaft flange and install a 1/2-13 bolt into adapter (fig. 88).
3. With wheel and tire assembly still on vehicle held firmly to prevent turning, measure torque required to rotate opposite axle shaft with a 0-150# torque wrench attached to J-5748. Torque should be 70 ft. lbs. minimum new, and no less than 40 ft. lbs. if used.

PROPELLER SHAFT AND UNIVERSAL JOINTS

	Page
General Description	4-33
Component Parts Replacement	4-33
Propeller Shaft	4-33
Removal	4-33
Repairs	4-34
Installation	4-35

GENERAL DESCRIPTION

The one-piece, exposed-type, tubular propeller shaft is used on all models (fig. 89). The cardon-type universal joints are of the extended-life design and do not require periodic maintenance. A splined front yoke on the front end of the propeller shaft extends into a splined coupling on the transmission output shaft. This slip joint permits a slight lengthening and shortening of the propeller shaft to compensate for up and down movement of the rear axle assembly. A damper is incorporated on some applications. This damper is not serviced separately--the sleeve and damper (fig. 98) must be replaced as an assembly to avoid unbalance problems. Periodic service is not needed at the spline-however, should a driveline "clunk" develop in vehicles equipped with a three-speed automatic transmission the spline should be cleaned and the spline packed with approximately one tablespoon of chassis lube (lithium soap base). A seal located in the transmission prevents the transmission from lubricating this spline.

COMPONENT PARTS REPLACEMENT

PROPELLER SHAFT

Removal

1. Raise vehicle, mark relationship of shaft to companion flange and disconnect the rear universal joint by removing trunnion bearing "U" bolts (fig. 91 or straps (fig. 92). Tape bearing cups to trunnion to prevent dropping and loss of bearing rollers.

NOTE: On Corvette models, remove trunnion "U" bolts at transmission yoke also.

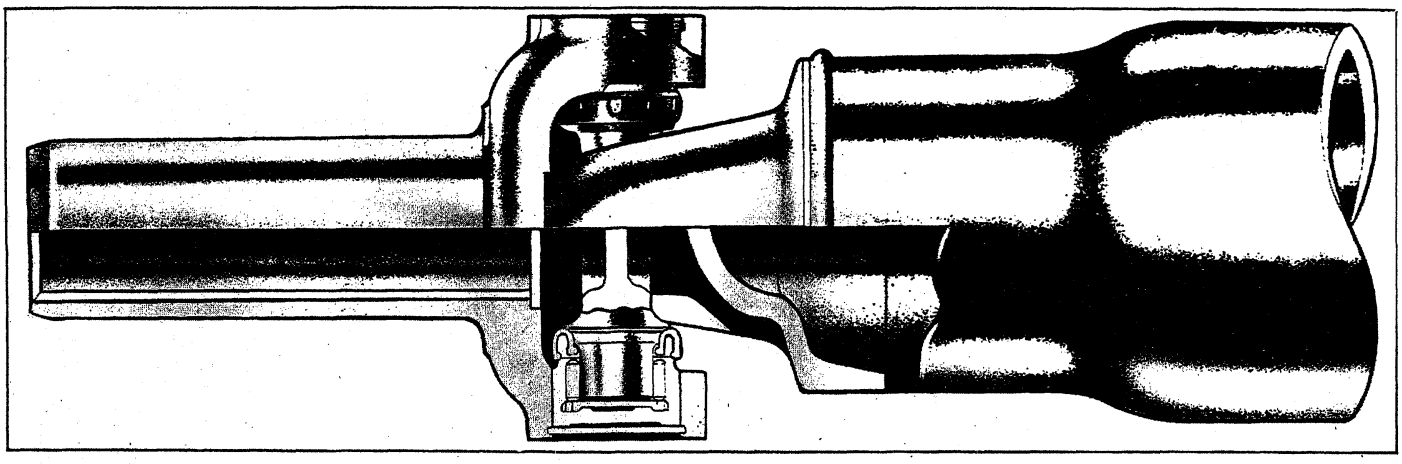


Fig. 89—Propeller Shaft Cross Section

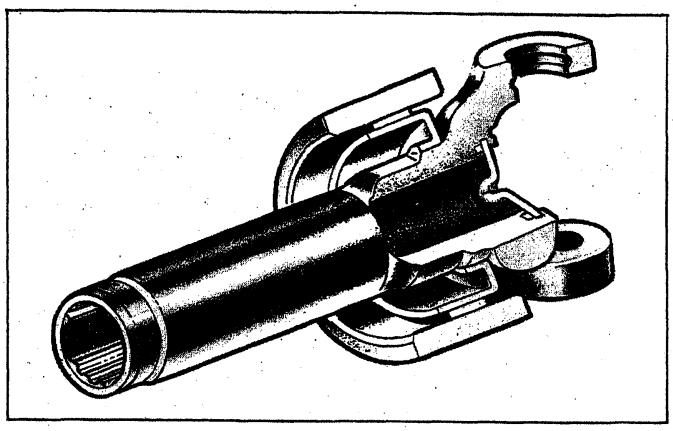


Fig. 90—Propeller Shaft Sleeve and Damper Assembly

2. Withdraw propeller shaft front yoke from transmission by moving shaft rearward, passing it under the axle housing. Watch for oil leakage from transmission output shaft housing.

Repairs

NOTE: The universal joints (fig. 93) are of the extended-life design and do not require periodic inspection or lubrication; however, when these joints are disassembled, repack bearings and lubricate reservoir at end of trunnions with high-melting point wheel bearing lubricant and replace the dust seals.

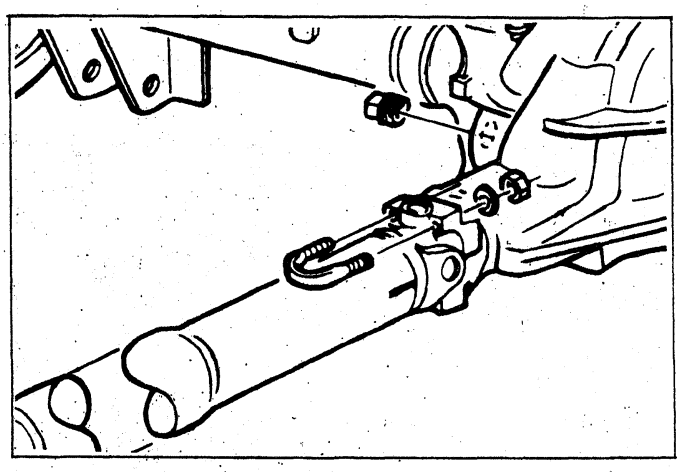


Fig. 91—Removing Propeller Shaft "U" Bolts From Companion Flange

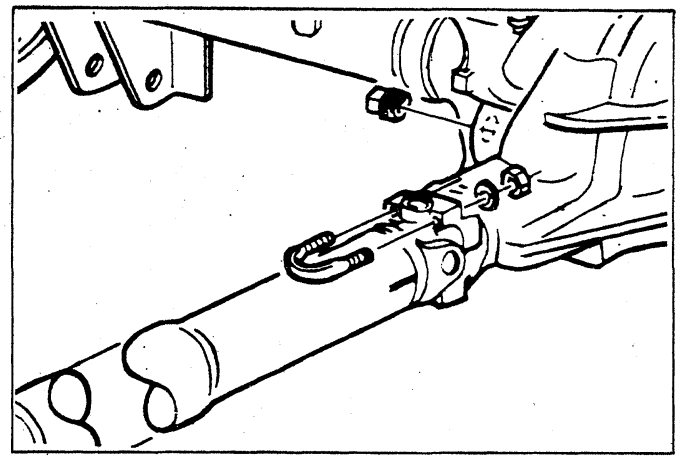


Fig. 92—Removing Propeller Shaft Strap From Companion Flange

1. Remove bearing lock rings from trunnion yoke.
2. Support trunnion yoke on a piece of 1-1/4" I.D. pipe on an arbor bed.

NOTE: Due to length of the propeller shaft it may be more convenient to use a bench vise,

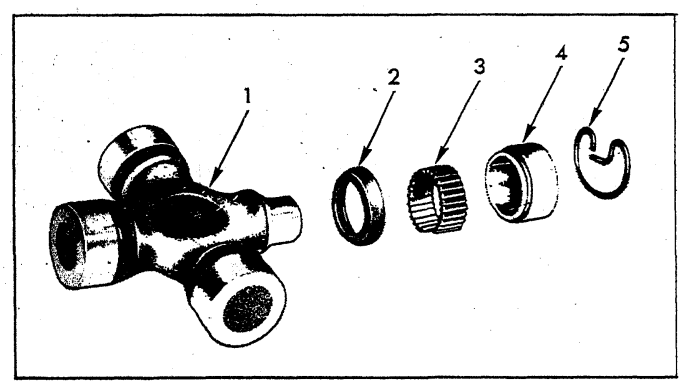
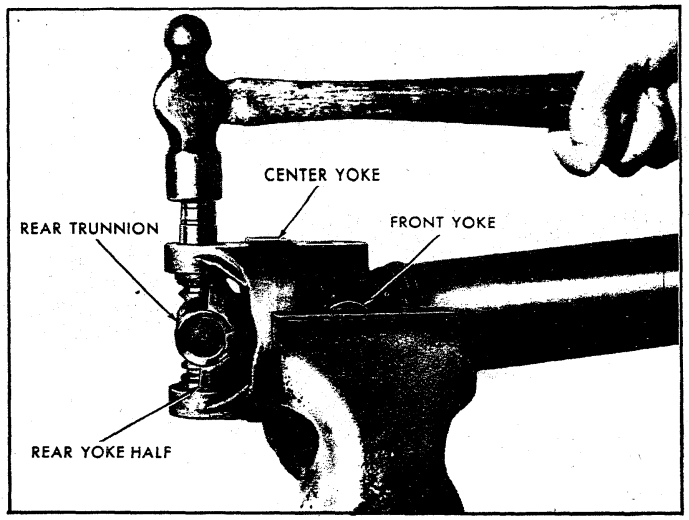


Fig. 93—Unit-Universal Joint Repair



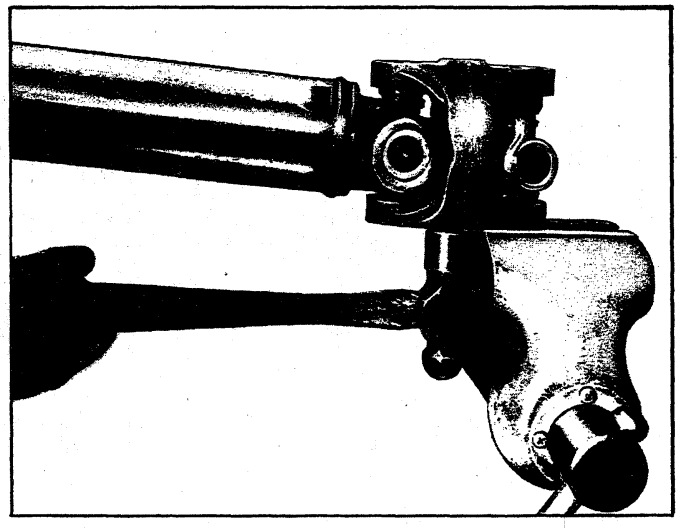


Fig. 94—Removing Bearing Cups

for removal and installation, instead of an arbor press. In this case, proceed with disassembly and assembly procedure as with an arbor press.

3. Using a suitable socket or rod, press on trunnion until bearing cup is almost out (fig. 94). Grasp cup in vise and work cup out of yoke.

   NOTE: The bearing cup cannot be fully pressed out.

4. Press trunnion in opposite direction and remove other cup as in Step #3.
5. Clean and inspect dust seals, bearing rollers, and trunnion. Relubricate bearings as indicated in Section 0.

   NOTE: In addition to packing the bearings, make sure that the lubricant reservoir at the end of each trunnion is completely filled with lubricant. In filling these reservoirs, pack lubricant into the hole so as to fill from the bottom (use of squeeze bottle is recommended). This will prevent air pockets and ensure an adequate supply of lubricant.

6. If not installing a "U" joint service kit, place new dust seals on trunnions--cavity of seal toward end of trunnion. Press seal onto trunnion exercising caution during installation to prevent seal distortion and to assure proper seating of seal on trunnion.

   NOTE: If installing seal on small size trunnion, seal installer J-21548 should be used (fig. 95).

7. Position trunnion into yoke. Partially install one bearing cup into yoke (fig. 96). Start trunnion into bearing cup. Partially install other cup. Align trunnion into cup, and press cups into yoke.
8. Install lock rings.

Installation

1. Inspect yoke seal in the transmission for leakage and replace, if necessary, as described in the transmission section.
2. Insert propeller shaft front yoke into transmission.

   NOTE: On Corvette models, install front yoke into transmission then position propeller shaft between yoke and companion flange; install "U" bolts.

3. Align propeller shaft with companion flange, using reference marks established in "Removal" procedure, connect the rear universal joint by installing "U" bolt clamps or straps over bearing trunnions - carefully torque nuts to specifications.

   NOTE: Overtorquing may cause early bearing failure.

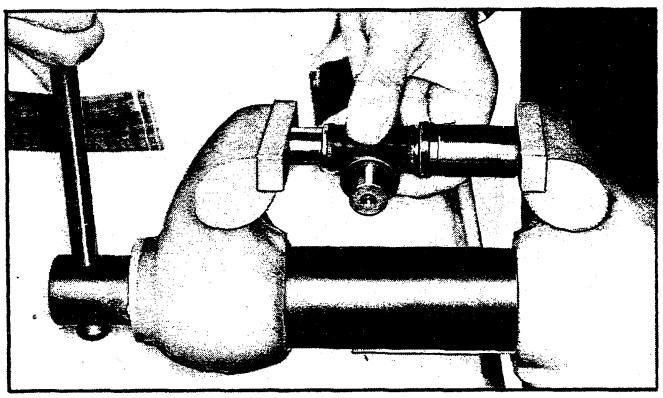


Fig. 95—"U" Joint Trunnion Seal Installatior

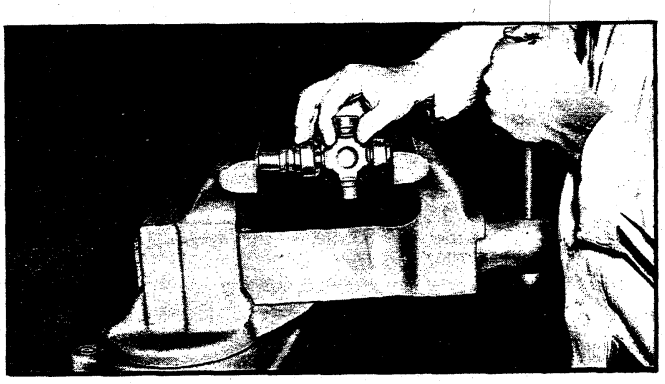


Fig. 96—Installation Bearing Cup and Trunnion

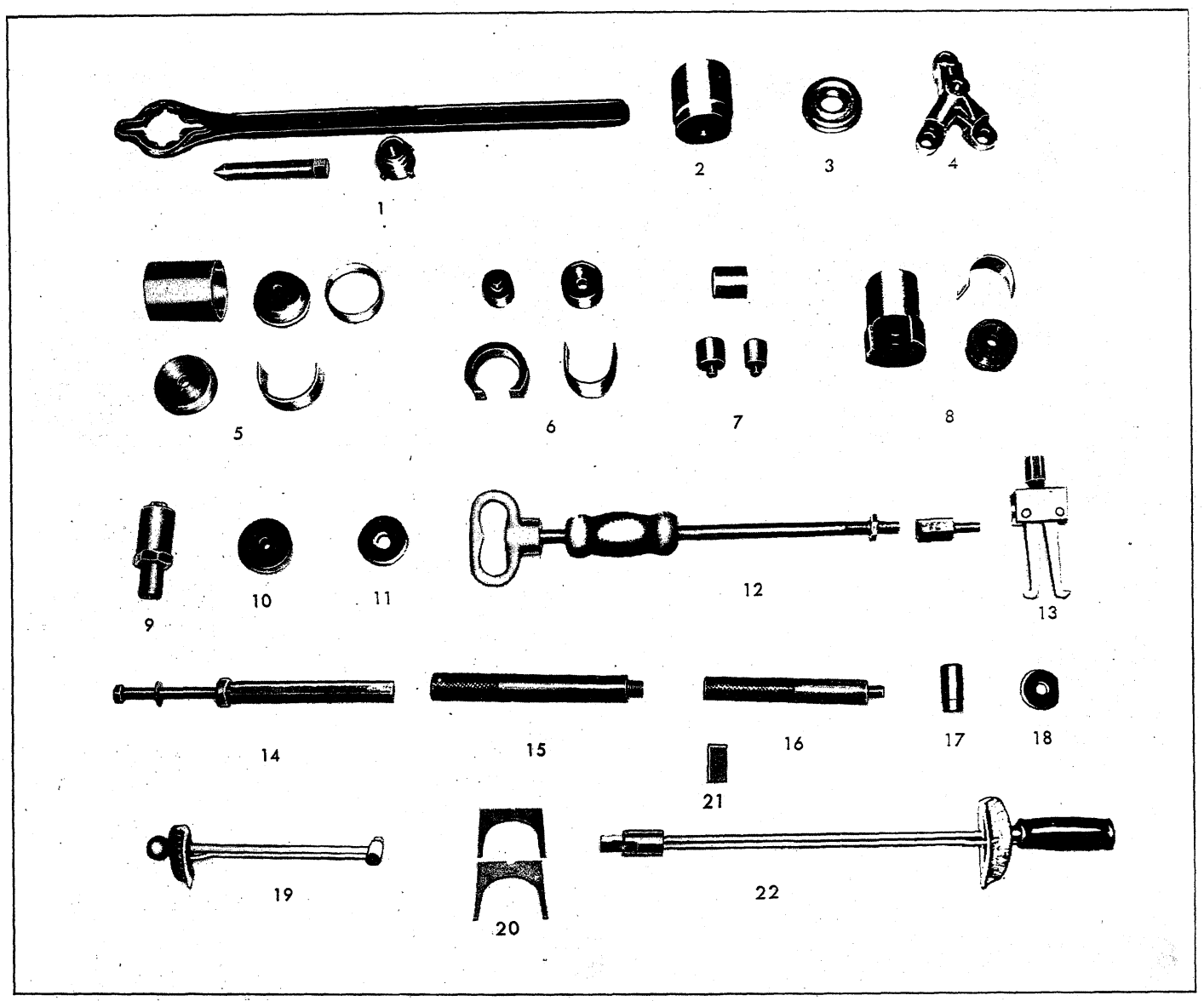


Fig. 97—Rear Suspension Special Tools (Chevrolet, Camaro, Chevelle and Nova)

1. J-8614 Companion Flange Remover--Consists of J-8614-1 Holder, J-8614-2 Nut and J-8614-3 Screw.
2. J-21057 Drive Pinion Oil Seal Installer--Heavy-Duty Axle.
3. J-21468 Drive Pinion Oil Seal Installer--Light Duty Axle--Used with J-9458.
4. J-5748 Positraction Torque Measuring Adapter.
5. J-21830 Upper and Lower Control Arm Bushing Puller--Consists of J-21830-2 Adapter, J-21830-4 Receiver, J-21830-7 Bridge--Used with J-21058-6 Spacer, and J-21830-3 Spacer
6. J-7574 Chevrolet Lower Control Arm Front Bushing Remover/Installer--Consists of J-7574-4 Receiver, J-7574-1 Remover, J-7574-2 Installer Adapter, J-7574-3 Spacer.
7. J-7877 Chevrolet Tie Rod Bushing Remover/Installer--Consists of J-7877-1 Remover Adapter, J-7877-2 Bushing Receiver, J-7877-3 Installer Adapter--Used with J-7079-2 Handle.
8. J-21474 Chevelle Control Arm Bushing Remover--Consists of J-21474-5 Receiver, J-21474-1 Spacer and J-21474-2 Adapter.
9. J-9458 Drive Pinion Oil Seal Installer--Light Duty Axle--Used with J-21468.
10. J-21051 Rear Wheel Bearing and Oil Seal Installer--Heavy Duty Axle--Used with J-7079-2.
11. J-21491 Rear Wheel Bearing and Oil Seal Installer--Light Duty Axle--Used with J-8092.
12. J-2619 Rear Wheel Bearing and Oil Seal Remover (Slide Hammer)
13. J-8119 Rear Wheel Bearing and Oil Seal Remover--Used with J-2619.
14. J-21058 Upper and Lower Control Arm Puller--Consists of J-21058-15 Screw and J-21058-8 Nut--Used with J-21830.
15. J-8092 Drive Handle--Threaded Type.
16. J-7079-2 Driver Handle--Insert Type.
17. J-21548 Propeller Shaft "U" Joint Trunnion Seal Installer.
18. J-21991 Chevelle Upper Control Arm Carrier Bushing Remover Adapter.
19. J-5853 Torque Wrench--In. lbs.
20. J-22804-1-2 Pinion Seal Gauge Plate - 1 (Heavy Duty) - (Light Duty)
21. J-5810 Torque Wrench Adapter (3/4" to 3/8")
22. J-1313 Torque Wrench--ft. lbs.
J-22553 Rear Spring Front Bushing Remover/Installer Consists of J-22553-1 Receiver, J-22553-2 Installer--Used with J-21978-1 Receiver, J-21058-8 Nut and J-21058-15 Puller Screw.

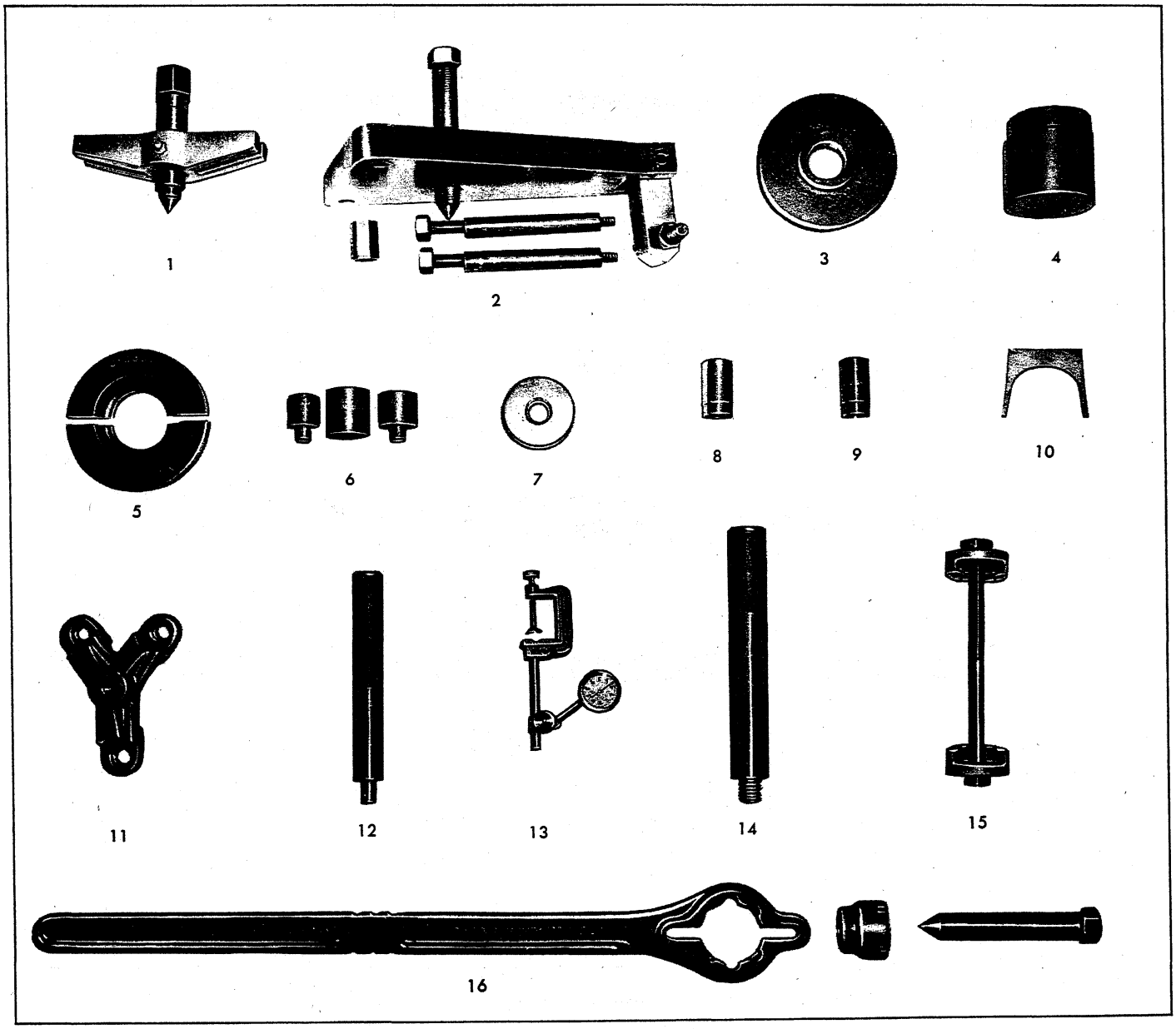


Fig. 98—Rear Suspension Special Tools (Corvette)

1.	J-8111-23	Torque Control Arm Spacer Flaring Tool
2.	J-22602	Wheel Drive Spindle Remover
3.	J-9436	Wheel Drive Spindle Outer Bearing Installer
4.	J-21057	Drive Pinion Oil Sealer Installer
5.	J-8331	Wheel Drive Spindle Outer Bearing Remover
6.	J-7877	Strut Rod Bushing Replacement Set
7.	J-7817	Wheel Drive Spindle Bearing Cup Installer
8.	J-21548	Propeller Shaft "U" Joint Trunnion Seal Installer
9.	J-21556	Axle Drive Shaft "U" Joint Trunnion Seal Installer
10.	J-22804-1	Pinion Seal Gauge Plate
11.	J-5748	Positraction Torque Measuring Adapter
12.	J-7079-2	Driver Handle (Insert Type)
13.	J-8001	Dial Indicator Set
14.	J-8092	Driver Handle (Threaded Type)
15.	J-7055-1	Torque Control Arm Bushing Installer
16.	J-8614	Rear Axle Companion Flange Holder

BRAKES

SECTION 5

CONTENTS OF THIS SECTION

	Page		Page
Duo Servo Brakes	5-1	Power Brakes	5-33
Disc Brakes	5-21	Special Tools	5-35

DUO-SERVO BRAKES

INDEX

	Page		Page
General Description	5-1	Center Cable	5-10
Maintenance and Adjustments	5-3	Rear Cables	5-10
Hydraulic Brake Fluid	5-3	Parking Brake - Corvette	5-11
Bleeding Hydraulic System	5-3	Lever Assembly	5-11
Pressure Bleeding	5-3	Front Cable	5-12
Manual Bleeding	5-5	Rear Cable	5-12
Push Rod to Main Cylinder Clearance	5-5	Brake Pedal	5-13
Hydraulic Brake Lines	5-5	Shoes and Linings	5-13
Hydraulic Brake Hose	5-5	Organic	
Hydraulic Brake Tubing	5-6	Metallic	
Brake Adjustment	5-7	Main Cylinder	5-16
Service Brake	5-7	Wheel Cylinders	5-18
Parking Brake	5-8	Anchor Pin	5-19
Component Replacement and Repairs	5-8	Front Wheel	5-19
Parking Brake - Chevrolet, Chevelle, Camaro and Nova	5-8	Rear Wheel	5-19
Pedal Assembly	5-8	Brake Drums	5-20
Front Cable	5-10	Brake Pipe Distribution and Switch Assembly	5-20
		Camaro Pressure Regulator Valve	5-21

GENERAL DESCRIPTION

All 1969 models are equipped with a split brake system. The system is designed with separate hydraulic systems for the front and rear brakes using a dual main cylinder (fig. 1 and fig. 2). If a wheel cylinder or brake line should fail at either the front or rear brake system of the vehicle, the operator can still bring the vehicle to a controlled stop.

The main cylinder has two entirely separate reservoirs and outlets in a common body casting. The front reservoir and outlet is connected to the front wheel brakes, and the rear reservoir and outlet is connected to the rear wheel brakes. Two pistons within the main cylinder receive mechanical pressure from the brake pedal push rod and transmit it through the brake lines as hydraulic pressure to the wheel cylinders. The filler cap is accessible from inside the engine compartment.

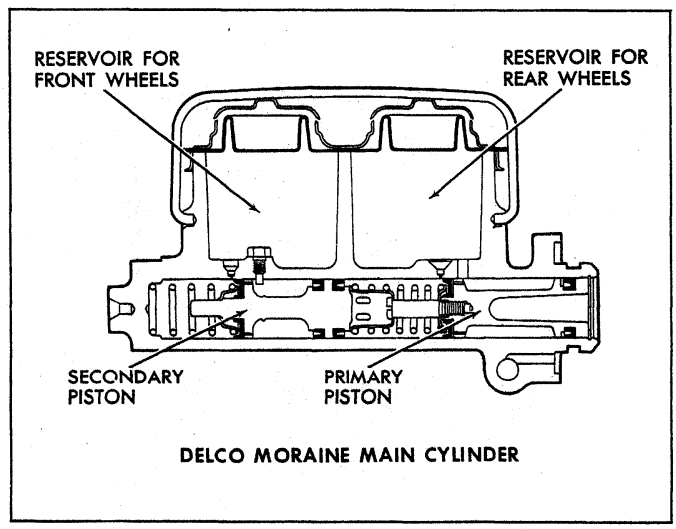


Fig. 1—Main Cylinder

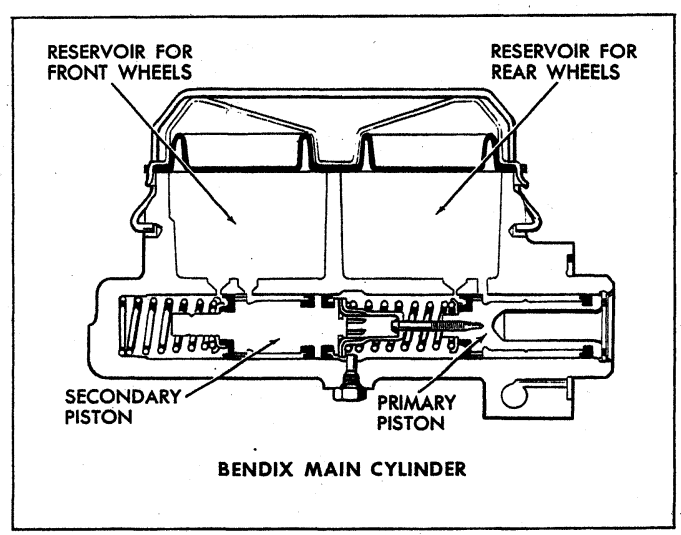


Fig. 2—Main Cylinder

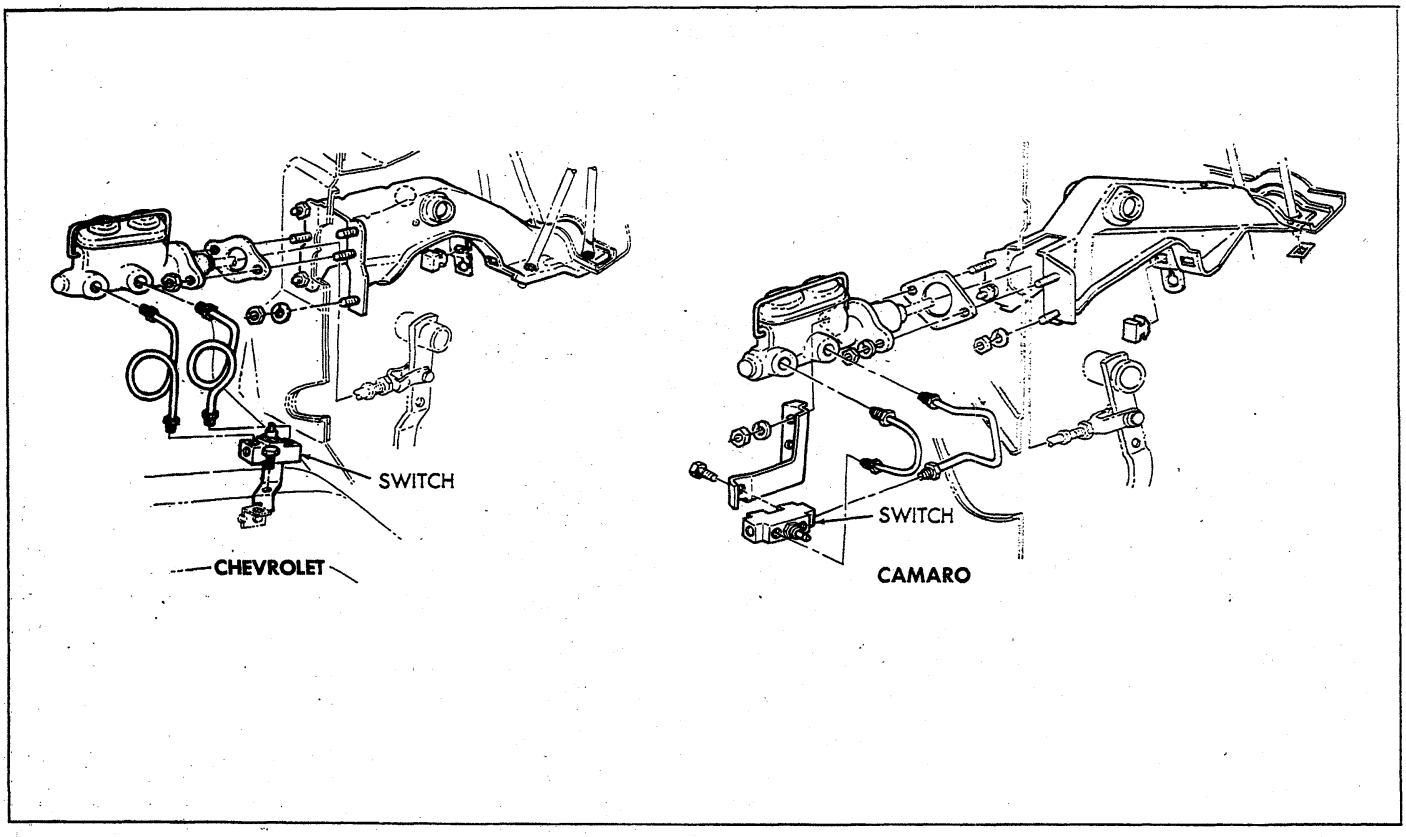


Fig. 3—Brake Pipe Distribution and Switch Assembly

A brake pipe distribution and switch assembly is mounted below the main cylinder. The front and rear hydraulic brake lines are routed from the main cylinder, through the brake pipe distribution and switch assembly, to the front and rear brakes as shown in Figure 3. The switch is wired electrically to the brake alarm indicator light on the instrument panel. If a leak in either front or rear system should occur, the pressure differential during brake application will cause the piston to compress the springs and move in the bore until it touches the electrical contact which causes the parking brake lamp on the instrument panel to light. This lamp will

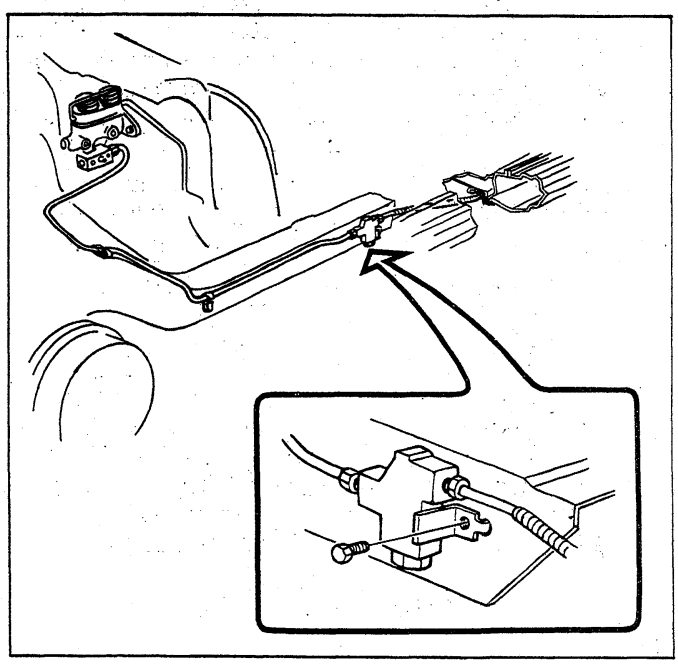


Fig. 4—Camaro Pressure Regulator Valve

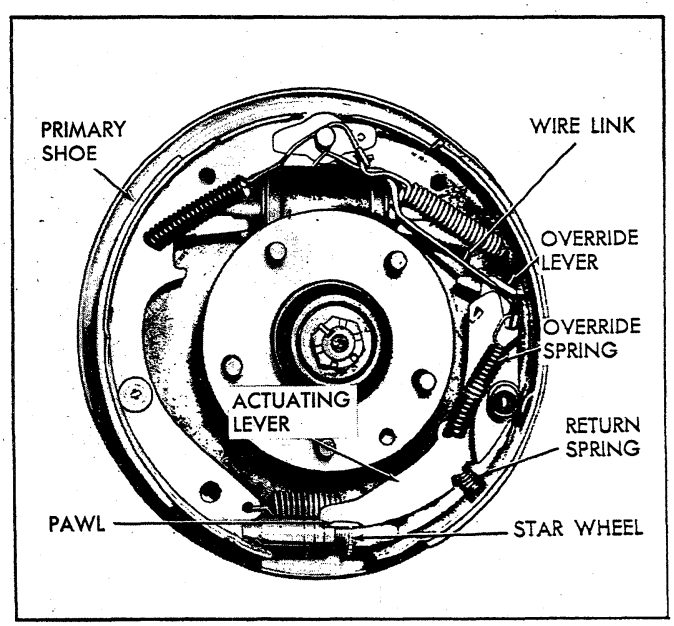


Fig. 5—Self-Adjusting Brakes

also be illuminated when the parking brake is applied.

On Camaro models equipped with 8-7/8" ring gear, the rear brake hydraulic line is routed through a pressure regulator valve mounted on the left frame side rail (fig. 4). The valve controls the hydraulic pressure to the rear brakes resulting in the correct pressure balance between the front and rear hydraulic systems.

The self-adjusting brakes (fig. 5), used on both front and rear of all models, are the Duo-Servo single anchor pin type which utilize the momentum of the vehicle to assist in the brake application. The self-energizing or self-actuating force is applied to both brake shoes at each wheel in both forward and reverse motion. The brake shoe linings are bonded to the shoes.

Wheel cylinders are the double piston type permitting even distribution of pressure to each brake shoe. To keep out dust and moisture, both ends of each wheel cylinder are sealed with a rubber boot. The wheel cylinders have no adjustments.

All models, except Corvette parking brakes have a foot operated ratchet type pedal mounted to the left of the steering column. A cable assembly connects the pedal to an intermediate cable by means of an equalizer, where the adjustment for the parking brake is incorporated. The intermediate cable attaches to the two rear cables which operate the rear service brake.

The Corvette is equipped with a ratchet-type parking brake lever located behind the console. The parking brake cable runs forward from the lever to a pulley assembly mounted on a frame crossmember, then back to an equalizer near the rear frame crossmember. A single piece rear cable passes through the equalizer and back to the rear service brakes.

MAINTENANCE AND ADJUSTMENTS

In any service operation it is extremely important that absolute cleanliness be observed. Any foreign matter in the hydraulic system will tend to clog the lines, ruin the rubber cups of the main and wheel cylinders and cause inefficient operation or even failure of the braking system. Dirt or grease on a brake lining may cause that brake to grab first on brake application and fade out on heavy brake application.

The split system consists basically of two separate brake systems. When a failure is encountered on either, the other is adequate to stop the vehicle. If one system is not functioning, it is normal for the brake pedal lash and pedal effort to substantially increase. This occurs because of the design of the master cylinder which incorporates an actuating piston for each system. When the rear system loses fluid, its piston will bottom against the front piston. When the front system loses fluid, its piston will bottom on the end of the main cylinder body. The pressure differential in one of the systems causes an uneven hydraulic pressure balance between the front and rear systems. The brake pipe distribution and switch assembly, near the main cylinder, detects the loss of pressure and illuminates the brake alarm indicator light on the instrument panel. The pressure loss is felt at the brake pedal by an apparent lack of brakes for most of the brake travel and then, when failed chamber is bottomed, the pedal will harden.

If a vehicle displays these symptoms, it is a good indication that one of the systems contains air or has failed, and it is necessary to bleed or repair the brakes.

HYDRAULIC BRAKE FLUID

Use GM Hydraulic Brake Fluid, Supreme No. 11 or equivalent when servicing brakes. This brake fluid is satisfactory for any climate and has all the qualities necessary for proper operation, such as a high boiling point to prevent vapor lock and the ability to remain fluid at low temperatures.

In the event that improper fluid has entered the system, it will be necessary to service the system as follows:

1. Drain the entire system.
2. Thoroughly flush the system with clean alcohol, 188 proof, or a hydraulic system cleaning fluid such as "Declene" or equivalent.
3. Replace all rubber parts of the system, including brake hoses.
4. Refill the system.
5. Bleed the system.

BLEEDING HYDRAULIC SYSTEM

The hydraulic brake system must be bled whenever, any line has been disconnected or air has in some way entered the system. A "spongy" pedal feeling when the brakes are applied may indicate presence of air in the system. The system must be absolutely free of air at all times. Bleeding of brake system may be performed by one of two methods—either pressure or manual.

PRESSURE BLEEDING

1. Clean all dirt from top of main cylinder and remove cylinder cover and rubber diaphragm.
2. Reduce fluid level in main cylinder until reservoirs are approximately half full.

   NOTE: Make sure brake fluid in bleeder equipment is at operating level and that the equipment is capable of exerting 30 to 50 lbs. hydraulic pressure on the brake system.

3. Install brake bleeder adapter J-22489 (fig. 6) on main cylinder. Connect hose from bleeder equipment to bleeder adapter and open release valve on bleeder equipment.
4. Install brake bleeder wrench, Tool J-21472 on bleeder valve at wheel cylinder and install one end of bleeder hose on bleeder valve (fig. 7).
5. Pour a sufficient amount of brake fluid into a transparent container to insure that end of bleeder hose will remain submerged during bleeding. Place the loose end of bleeder hose into the container. Be sure the hose end is submerged in the fluid.
6. Open wheel cylinder bleeder valve by turning Tool J-21472 counterclockwise approximately 1/3 of a turn and observe flow of fluid at end of bleeder hose.
7. Close bleeder valve tightly as soon as bubbles stop and brake fluid flows in a solid stream from the bleeder hose.
8. Remove brake bleeder wrench and bleeder hose from wheel cylinder bleeder valve.

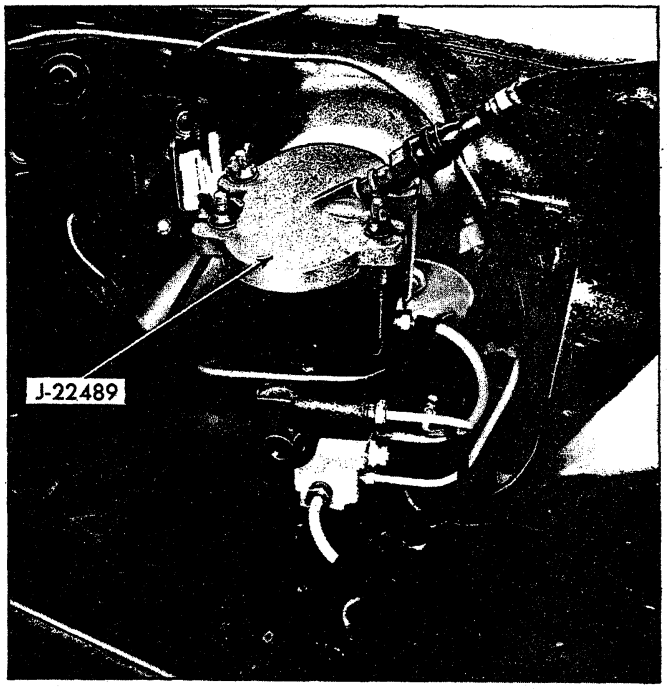


Fig. 6—Brake Bleeder Adapter J22489 Installed

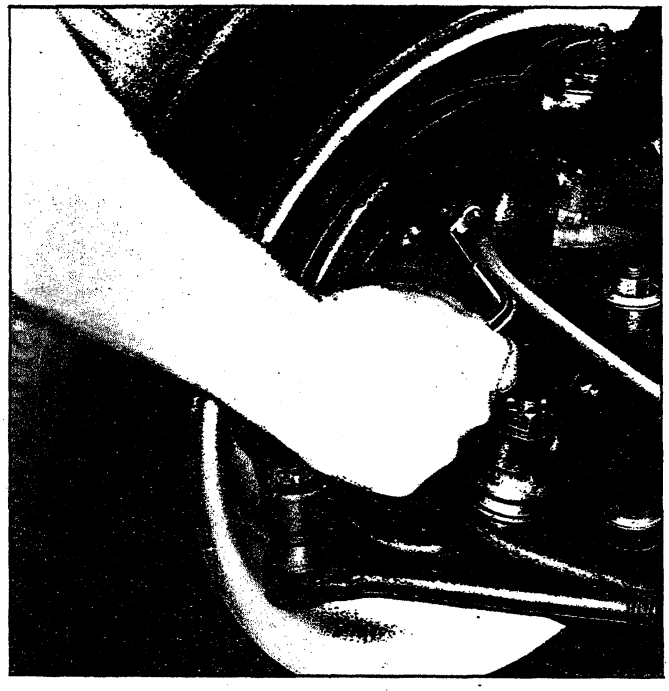


Fig. 7—Bleeding Brake Using Tool J-21472

9. Repeat Steps 4 through 8 on the remaining wheel cylinders.
10. Disconnect bleeder equipment from brake bleeder adapter cover J-22489.

    NOTE: The main cylinder on certain passenger car models is tilted upward. When removing the bleeder adapter on these models, place a clean dry cloth behind and below the cylinder to absorb any fluid spillage as the cover is removed.

11. Remove bleeder adapter J-22489. Wipe all areas dry if fluid was spilled during adapter removal.
12. Fill master cylinder reservoirs to within 1/4" of reservoir rims as shown in Figure 8.
13. Install main cylinder diaphragm and cover.

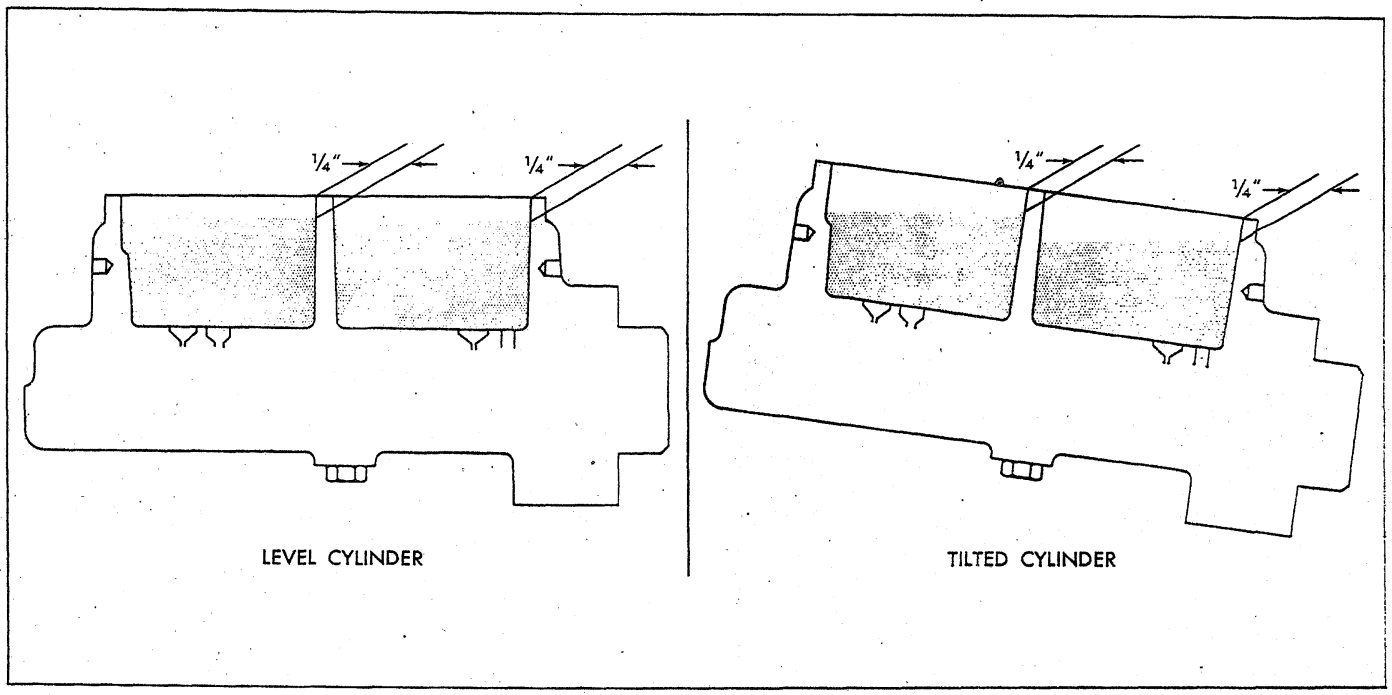


Fig. 8—Correct Main Cylinder Fluid Level

MANUAL BLEEDING

1. Clean all dirt from top of main cylinder and remove cylinder cover and rubber diaphragm.
2. Fill main cylinder reservoirs and reinstall cover.
3. Install brake bleeder wrench, Tool J-21472 on bleeder valve at wheel cylinder and install one end of bleeder hose on bleeder valve (fig. 7).
4. Pour a sufficient amount of brake fluid into a transparent container to insure that end of bleeder hose will remain submerged during bleeding. Place the loose end of bleeder hose into the container. Be sure the hose end is submerged in the fluid.

   NOTE: Carefully monitor fluid level at main cylinder during manual bleeding operations. Do not bleed enough fluid at one time to drain the reservoir completely. Replenish the reservoirs with fluid while bleeding to insure a sufficient amount of fluid is in the main cylinder at all times. To insure that outside air is not sucked back into the hydraulic system, the bleeder valve should be closed before the brake pedal reaches the floor.

5. Open wheel cylinder bleeder valve by turning Tool J-21472 counter-clockwise approximately 1/3 of a turn. Have helper slowly depress brake pedal. Just before brake pedal reaches the end of its travel, close bleeder valve and allow brake pedal to return slowly to the fully released position. Repeat this procedure until expelled brake fluid flows in a solid stream from the bleeder hose and no bubbles are present, then close bleeder valve tightly.
6. Remove brake bleeder wrench and bleeder hose from wheel cylinder bleeder valve.
7. Repeat Steps 2 through 7 on the remaining wheel cylinders.
8. Fill the main cylinder to the levels shown in Figure 8.
9. Install main cylinder diaphragm and cover.

PUSH ROD TO MAIN CYLINDER CLEARANCE

The brake pedal has a definite stop which is permanent and not adjustable. This stop consists of a rubber bumper at the release end of pedal travel. Before adjusting push rod to main cylinder clearance, make sure pedal returns to the fully released position freely and that the pedal retracting spring has not lost its tension, then proceed as follows:

1. Loosen check nut on push rod.
2. Turn push rod as required to provide correct adjustment. Movement of pedal pad before push rod contacts main cylinder pistons must be 1/16" to 1/4" (fig. 9).
3. Tighten check nut against clevis, and recheck movement.

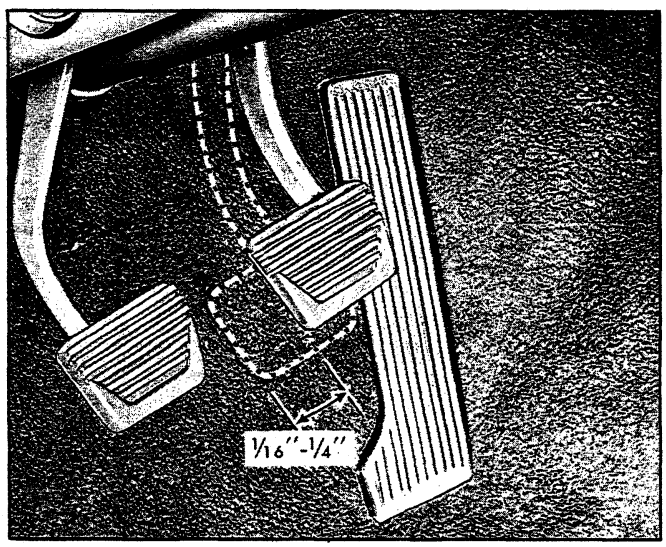


Fig. 9—Brake Pedal Free Movement

HYDRAULIC BRAKE LINES

Hydraulic Brake Hose

The flexible hoses which carry the hydraulic pressure from the steel lines to the wheel cylinders are carefully designed and constructed to withstand all conditions of stress and twist which they encounter during normal vehicle usage.

The hoses require no service other than periodic inspection for damage from road hazards or other like sources. Should damage occur and replacement become necessary, the following procedure is to be followed.

Removal

1. Separate hose from steel line by turning double flare connector out of hose fitting.
2. Remove "U" shaped retainer from hose fitting and withdraw hose from support bracket.
3. Turn hose fitting out of wheel cylinder inlet.

Replacement

1. Install new copper gasket on cylinder end of hose (male end).
2. Moisten threads with brake fluid and install hose in wheel cylinder inlet.
3. With weight of car on wheels and suspension in normal position (front wheels straight ahead) pass female end of hose through support bracket, allowing hose to seek its own position. Insert hex of hose fitting into the 12 point hole in support bracket in position which induces least twist to hose (fig. 10).

   NOTE: Do not twist hose unduly during this operation as its natural curvature is absolutely necessary to maintain proper hose-to-suspension clearance through full movement of the suspension and steering parts.

4. Install "U" shaped retainer to secure hose in support bracket.
5. Inspect by removing weight completely from wheel, turn wheels from lock to lock while observing hose position. Be sure that hose does not touch other parts at any time during suspension or wheel travel. If contact does occur, remove hose retainer and rotate the female hose end in the support bracket one or two points in appropriate direction, replace retainer, and re-inspect.
6. Place steel tube connector in hose fitting and tighten securely.
7. Bleed all brakes as outlined in this section.
8. Do not tighten male end (wheel cylinder end) once the other end is fixed. If necessary to tighten male end, disconnect hose at opposite end, then reconnect following above procedure.

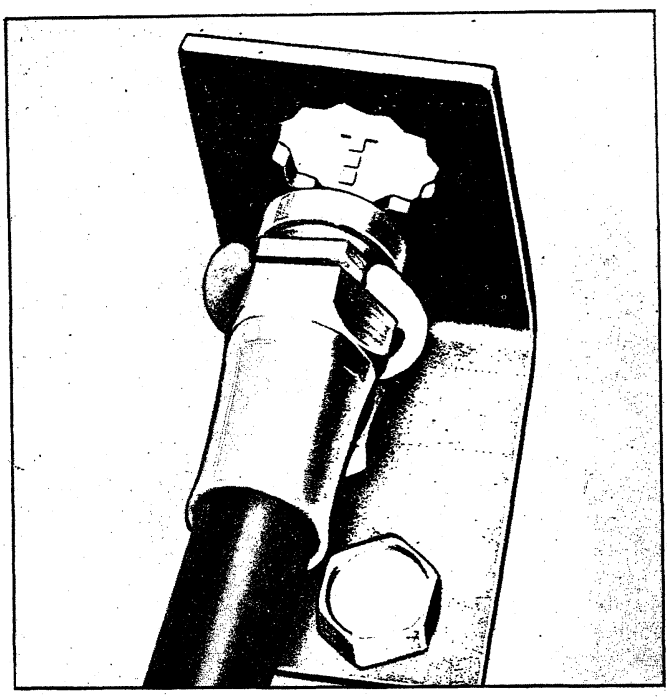


Fig. 10—Brake Line Support Bracket

Hydraulic Brake Tubing

Hydraulic brake tubing is a double layer annealed steel terne plate tubing which resists corrosion and has the physical strength to stand up under the high pressures which are developed when applying the brakes. In making up hydraulic brake pipes, it is important that the proper flaring tool be used to flare the ends of the tubing for the compression couplings. Unless the tubing is properly flared, the connections will leak and the brakes will become ineffective.

CAUTION: When necessary to replace brake tubing, always use special steel tubing which is designed to withstand high pressure and resist corrosion. Ordinary copper tubing is not satisfactory and should not be used.

This safety steel tubing must be double-lap flared at the ends in order to produce a strong leak-proof joint.

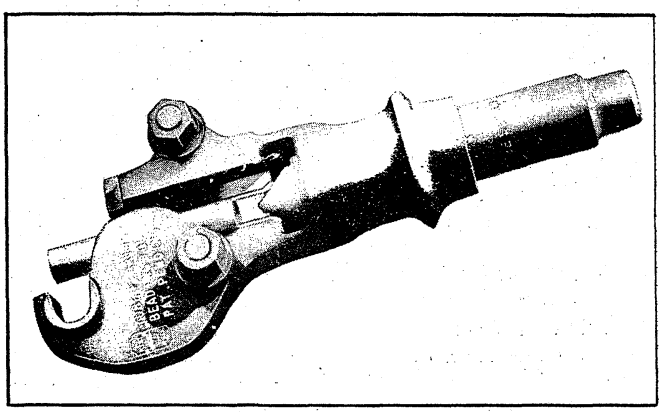


Fig. 11—Hydraulic Brake Tube

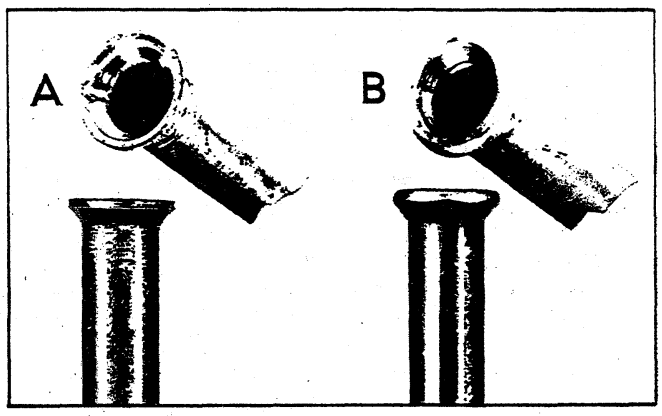


Fig. 12—Single and Double Lap Flare

The brake tube flaring Tool J-8051 (fig. 11) is used to form the double-lap flare.

Figure 12 shows two pieces of tubing, one with single-lap flare "A" and the other with double-lap flare "B". It will be noted that the single-lap flare in "A" split the tubing while the one shown in "B" is well-formed and unbroken due to the reinforcement of the double wall.

The following procedure should be followed in making up hydraulic brake pipes.

Double Lap Flaring

1. Cut the tubing to the desired length, using Tool J-8113. Square off ends of tube and ream sharp edges with reamer tool provided on the tube cutter.
2. Install compression coupling nut on tubing and dip end of tubing to be flared in hydraulic brake fluid. This lubrication results in better formation of the flare.
3. Place one-half of the die blocks in the tool body with the counterbored ends toward the ram guide. Now lay the tubing in the block with approximately 1/2" protruding beyond the end.
   Fit the other half of the block into the tool body, close the latch plate and tighten the nuts "finger tight".
4. Select the correct size upset flare punch. One end of this punch is counterbored or hollowed out to gauge the amount of tubing necessary to form a double lap flare. Slip the punch into the tool body with the gauge end toward the die blocks. Install the ram; then tap lightly until the punch meets the die blocks and they are forced securely against the stop plate (fig. 13).
5. Using the supplied wrench, draw the latch plate nut down tight to prevent the tube from slipping.

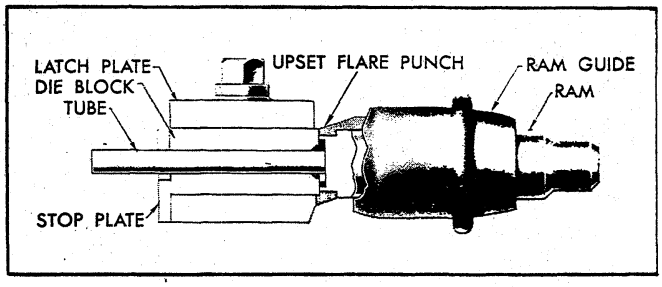


Fig. 13—Flaring Operation—Positioning Tubing

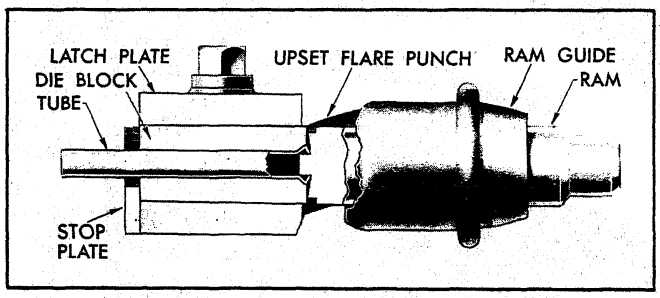


Fig. 14—Flaring Operation—First Flare

Tightening the nuts alternately, (beginning with the nut at the closed hole in the plate will prevent distortion of the plate). Remove the punch and the ram. Now reverse the punch and put it back into the tool body. Install the ram and tap it until the upset flare is complete (fig. 14). This completes the first operation. Remove the ram and the punch.

6. To complete the flare, insert the pointed finish flare punch and the ram into the tool body. Tap the ram until a good seat is formed (fig. 15).

   NOTE: The seat should be inspected at intervals during the finishing operation to avoid over-seating.

7. Blow tubing out with compressed air to remove any foreign objects.

BRAKE ADJUSTMENT

Service Brake

Although the brakes are self-adjusting, a preliminary or initial adjustment may be necessary after the brakes have been relined or replaced, or whenever the length of the adjusting screw has been changed. The final adjustment is made by using the self-adjusting feature.

1. With brake drum off, disengage the actuator from the star wheel and rotate the star wheel by spinning or turning with a small screw driver.
2. Recommended.
   a. Use special Tool J-21177; Drum-to-Brake Shoe Clearance Gauge, to check the diameter of the brake drum inner surface (fig. 16).
   b. Turn the tool to the opposite side and fit over the brake shoes by turning the star wheel until the gauge just slides over the linings (fig. 17).
   c. Rotate the gauge around the brake shoe lining surface to assure proper clearance.

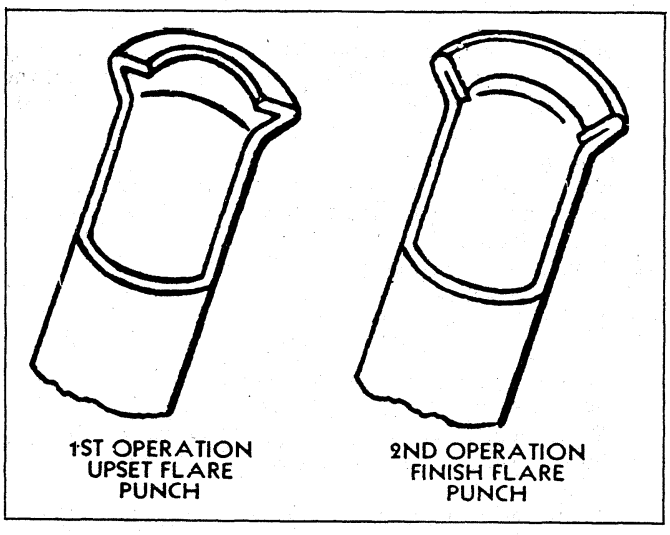


Fig. 15—Flaring Operation—First and Second Flare



Fig. 16—Using Drum-To-Brake Shoe Clearance Gauge Tool J-21177

Alternate

a. Using the brake drum as an adjustment fixture turn the star wheel until the drum slides over the brake shoes with a slight drag.
b. Turn the star wheel 1-1/4 turns to retract the shoes. This will allow sufficient lining-to-drum clearance so final adjustment may be made as described in Step 4.

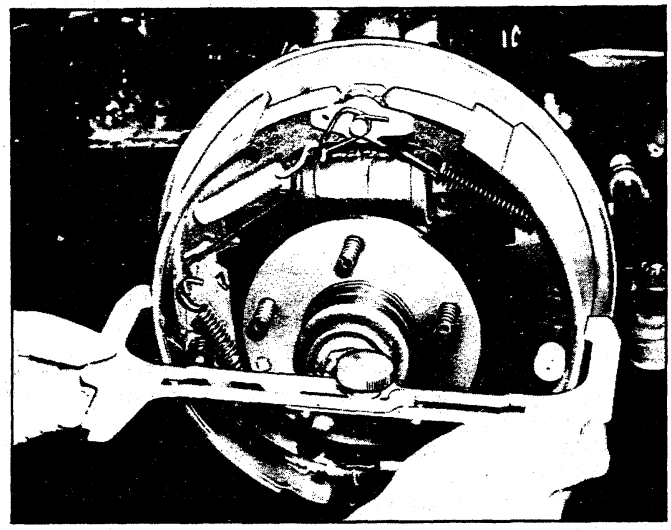


Fig. 17—Checking Brake Shoe Lining Clearance Using Tool J-21177

3. Install the drum and wheel.

   NOTE: 1: If lanced area in brake drum is knocked out, be sure all metal has been removed from brake compartment. Install new hole cover in drum to prevent contamination of the brakes.

   NOTE: 2: Make certain that drums are installed in the same position as when removed with the drum locating tang in line with the locating hole in the wheel hub (fig. 18).

4. Make final adjustment by making numerous forward and reverse stops, applying brakes with a firm pedal effort until a satisfactory brake pedal height results.

   NOTE: Frequent usage of an automatic transmission forward range to halt reverse vehicle motion may prevent the automatic adjusters from functioning, thereby inducing low pedal heights.

Parking Brake

The rear brake assemblies serve a dual purpose in that they are utilized both as a hydraulically operated service brake and also as a mechanically operated parking brake. In view of this dual purpose, the service brake must be properly adjusted as a base for parking brake adjustment; conversely the parking brake must be properly adjusted for the service brake to function as intended.

Adjustment

1. Place car on hoist, and raise hoist.
2. Apply parking brake, two notches from fully released position.
3. Loosen the equalizer forward check nut, and tighten or loosen the rear nut until a light to moderate drag is felt when rear wheels are rotated.
4. Tighten check nuts securely.
5. Fully release parking brake and rotate rear wheels; no drag should be present.



Fig. 18—Aligning Drum Tang With Wheel Hub

Inspection

If complete release of the parking brake is not obtained, unless it is forcibly returned to its released position, or if application effort is high, check parking brake assembly for free operation. If operation is sticky or a bind is experienced, correct as follows:

1. Clean and lubricate brake cables and equalizer.
2. Inspect brake assembly for straightness and alignment (replace if necessary).
3. Clean and lubricate parking brake assembly.
4. Check routing of cables for kinks or binding.
5. Lower vehicle to floor

COMPONENT REPLACEMENT AND REPAIRS

PARKING BRAKE—CHEVROLET, CHEVELLE, CAMARO (With Drum Rear) AND NOVA (Figs. 19 and 20)

Pedal Assembly

Removal

NOTE: Remove positive cable from battery to eliminate the possibility of creating short circuits under dash.

1. Place parking brake pedal in released position.
2. Remove equalizer check nut, and separate cable stud from equalizer.
3. Remove two attaching nuts from mounting studs located in engine compartment.
4. Remove front cable ball end from pedal assembly swivel.
5. Remove pedal assembly to dash brace attaching screw.
6. Remove pedal assembly by lowering rear slightly to avoid scratching dash, and pulling it out of the firewall.

Installation

1. Place pedal assembly in position with the two mounting studs protruding through the holes provided in the firewall.
2. Install and tighten pedal assembly to dash brace attaching screw.
3. Position front cable ball end into pedal assembly swivel.
4. Install and tighten two attaching nuts on mounting studs located in engine compartment.
5. Place equalizer in position on center cable and insert front cable stud through equalizer and secure with check nut.
6. Adjust parking brake as outlined under Maintenance and Adjustments in this section.
7. Connect positive battery cable.

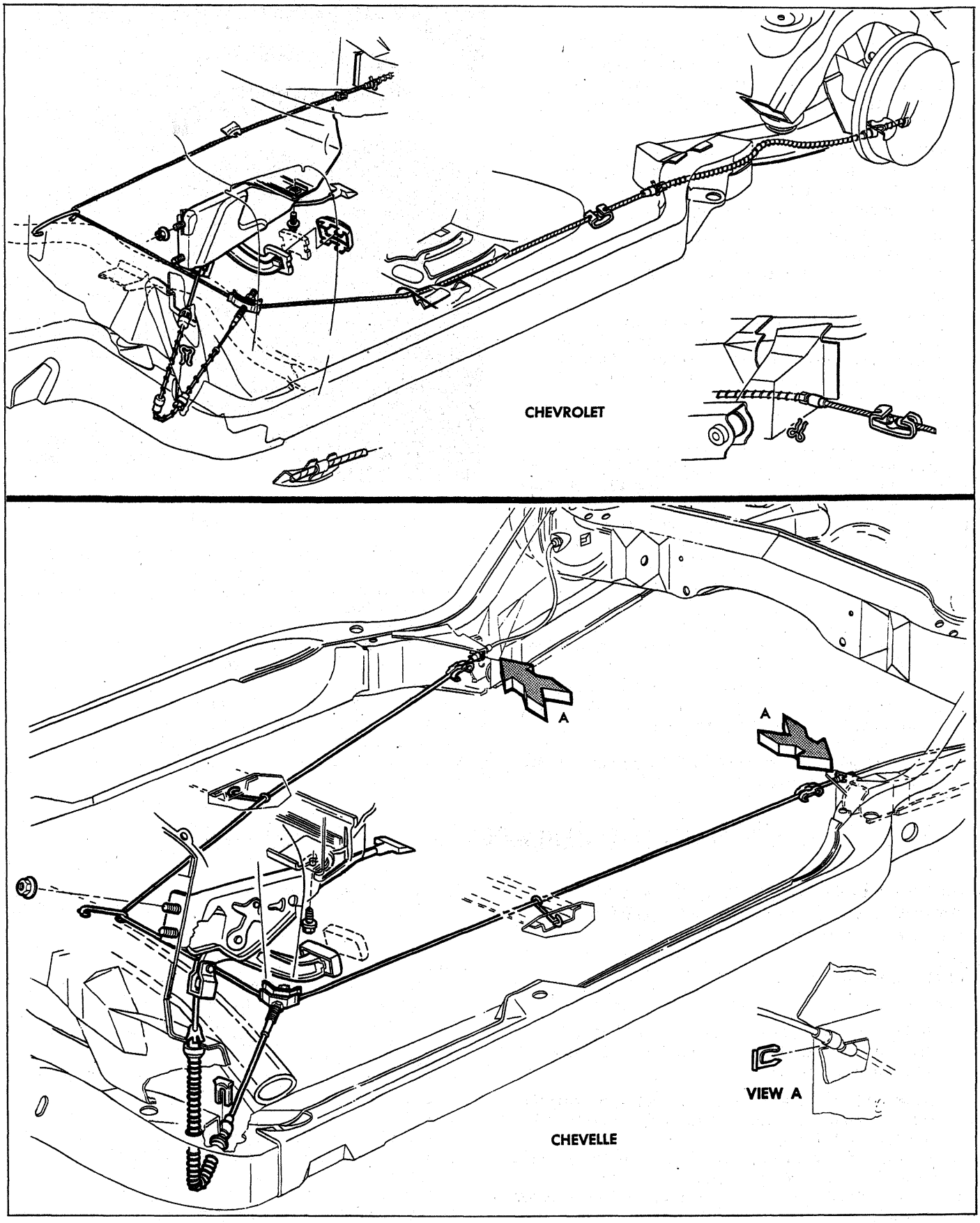


Fig. 19—Parking Brake System Chevrolet, and Chevelle

Front Cable

Removal

NOTE: Remove positive cable from battery to eliminate the possibility of creating short circuits under dash.

1. Place parking brake pedal in released position.
2. Raise vehicle on hoist.
3. Remove equalizer check nut, and separate cable stud from equalizer.
4. Remove retainer from cable assembly at inner side of frame rail.
5. Remove ball end of cable from pedal assembly swivel.
6. Compress expanded conduit locking fingers at toe pan and withdraw cable from car.
7. On Chevelle, if necessary, remove rubber tube from front cable.
8. Lower vehicle to floor.

Installation

1. On Chevelle, if necessary, replace rubber tube over front cable.
2. Position cable ball and conduit tip through cutout in firewall. Make sure conduit locking fingers are fully expanded and secured in cutout, then position cable ball into pedal assembly swivel.
3. Feed stud end of cable through frame rail and secure with retainer on inner side of frame.
4. Place one check nut on cable stud and insert stud through equalizer, (make sure center cable is in position), then place second check nut on stud.
5. Adjust parking brake as outlined in this section.
6. Connect positive battery cable.

Center Cable

Removal

1. Place parking brake pedal in released position.
2. Remove equalizer check nut and remove equalizer from cable.
3. Remove cable from cable guides.
4. Disconnect center cable from rear cables at connectors.

Installation

1. Install cable ends into rear cable connectors.
2. Place cable through equalizer and install equalizer on to front cable stud, secure with check nut. (Do not tighten.)
3. Install cable in cable guides (figs. 19 and 20).
4. Adjust parking brake as outlined in this section.

Rear Cables

Removal

1. Place parking brake pedal in released position.
2. Remove equalizer check nut and remove equalizer from cable.
3. Remove rear cable from connector.
4. Remove retainer from rear cable at frame bracket. Pull cable out of bracket.
5. Remove rear brake drum as outlined in this section.
6. Remove rear brake shoes as outlined in this section.
7. Remove cable end from parking brake actuating lever.

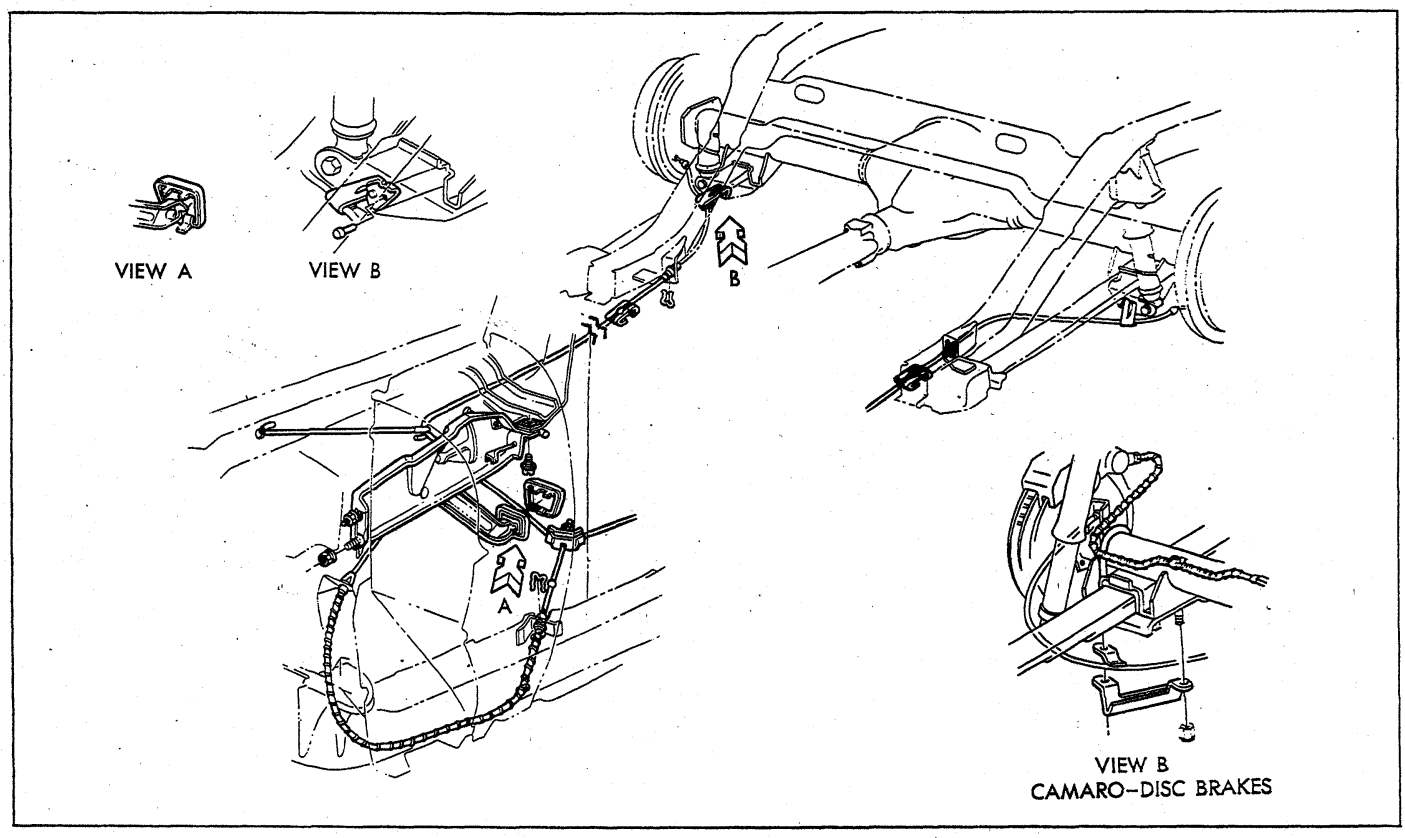


Fig. 20—Parking Brake System, Camaro and Nova

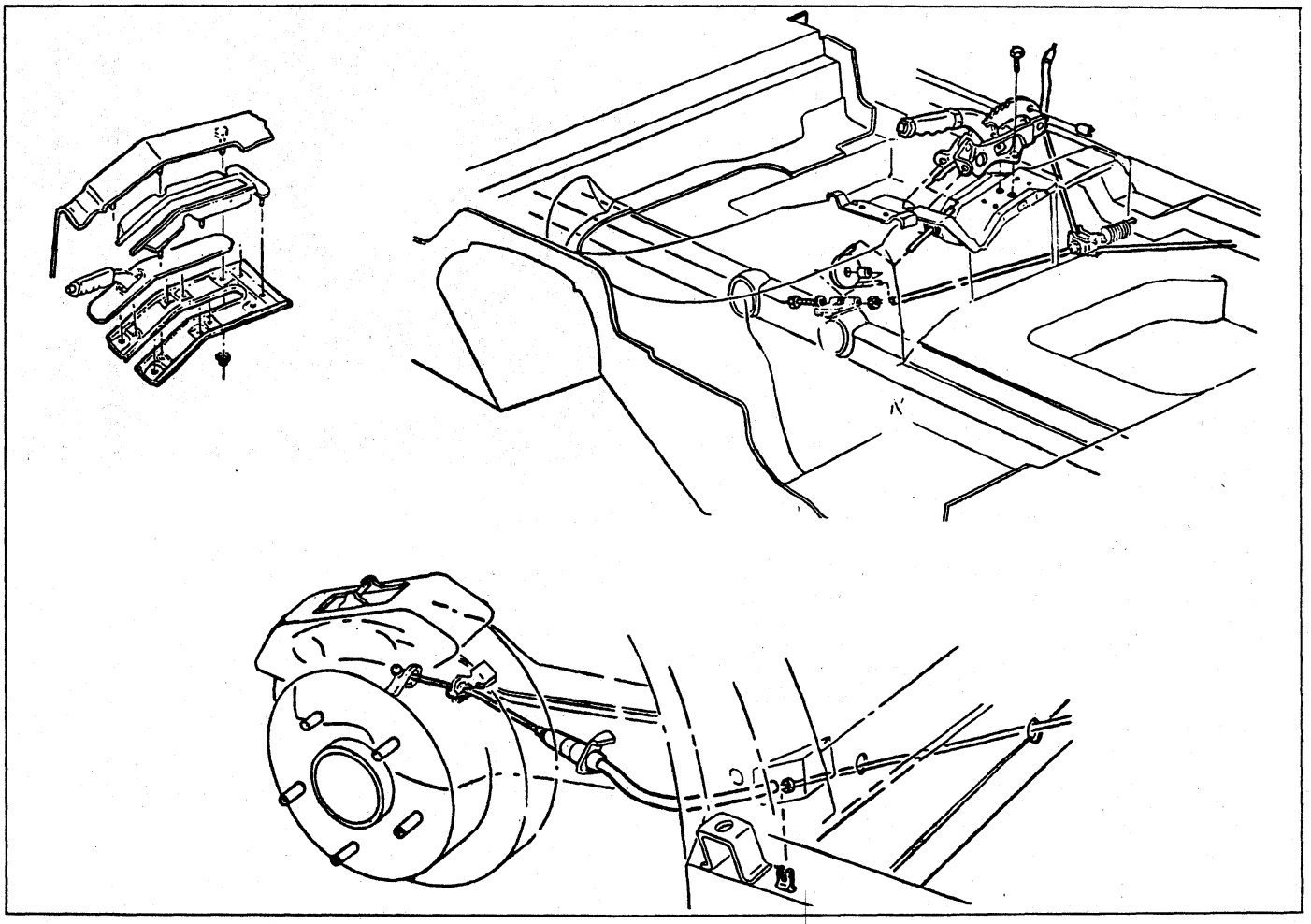


Fig. 21—Parking Brake System, Corvette

8. Compress expanded conduit locking fingers at flange plate entry hole and withdraw cable.

Installation

1. Pass end of cable and conduit tip through flange plate entry hole, making sure that conduit locking fingers all expand fully.
2. Connect cable end to actuating lever.
3. Install rear brake shoes, drum and wheel as outlined in this section.
4. Pass cable through frame bracket and install retainer.
5. Install cable end into cable connector.
6. Position equalizer on center cable and place on front cable stud, secure with check nut.
7. Make sure all center cable guides are in place and adjust parking brake as outlined in this section.

PARKING BRAKE—(Fig. 21) REAR DISC BRAKES

Lever Assembly

Removal

1. Place parking brake lever in the fully released position.
2. Raise vehicle on hoist, unhook and remove return spring.
3. Remove rear nut from cable stud at equalizer and allow front cable to hang down.
4. Lower vehicle to floor.
5. Inside vehicle, remove screws securing cover to underbody. It is necessary to push the seat cushion down as shown in Figure 22 to gain access to the lower mounting screw on each side. Remove the retainer. Lift the cover upward and to the rear to



Fig. 22—Removing or Installing Cover Lower Mounting Screw

allow seal to slide out of cover slot and remove cover.
6. Remove trim seal from lever (fig. 23).
7. Remove screw and washer securing parking brake alarm switch to side of lever assembly.
8. Remove four bolts securing lever assembly to underbody and lift lever assembly upward. Remove lever forward mounting bracket.
9. Remove front cable from lever assembly using long nose pliers as shown in Figure 24. Remove lever from vehicle.

Installation

1. Install front cable in lever assembly using long nose pliers as shown in Figure 23. Slide slack cable through hole and place lever assembly in position.
2. Place forward mounting bracket in position and secure plate and lever assembly to underbody with four mounting bolts.
3. Secure parking brake alarm switch to side of lever assembly with washer and screw (fig. 23).
4. Install trim seal on lever (fig. 23).
5. Insert the end of the trim seal into the slot in the cover and slide the cover forward and down into position.
6. Place the retainer in position. Secure retainer and cover to underbody with six screws. It is necessary to push the seat cushion down as shown in Figure 22 to gain access to the lower mounting screw hole on each side.
7. Raise vehicle on hoist.
8. Under vehicle, insert front cable stud through equalizer assembly and secure with nut.
9. Install return spring.
10. Adjust parking brake as outlined under Maintenance and Adjustments in this section.
11. Lower vehicle to floor.

Front Cable

Removal

1. Perform the complete parking brake lever removal procedure above.
2. Under vehicle, remove nut, washer, and bolt securing pulley to pulley bracket (fig. 21).

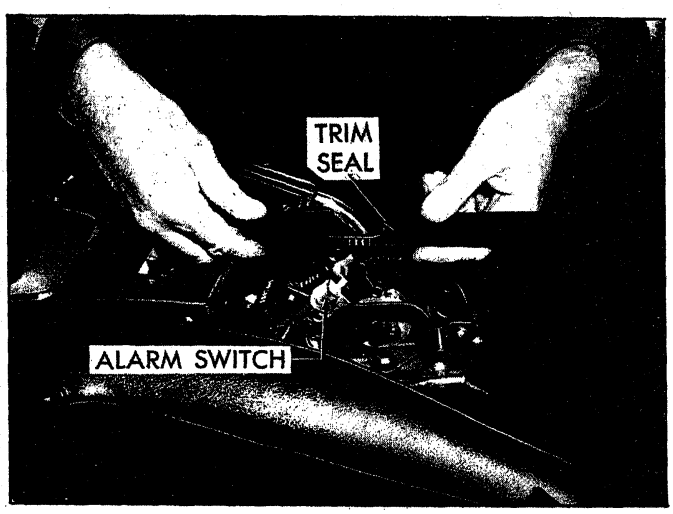


Fig. 23—Removing or Installing Trim Seal

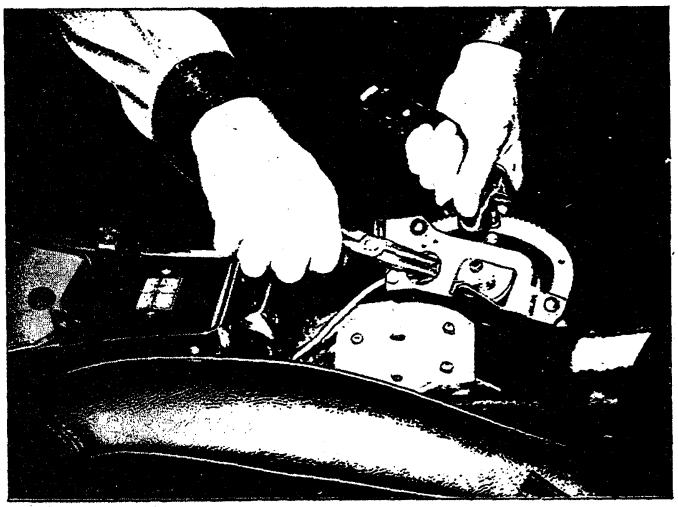


Fig. 24—Removing or Installing Front Cable

3. Remove seal grommet from underbody cable hole.
4. Pull front cable out of vehicle.

Installation

1. Install seal grommet around front cable.
2. Slide front cable into position through cable hole and work seal grommet into installed position.
3. Under vehicle, loop front cable around pulley wheel and secure pulley wheel to bracket with bolt, washer, and nut (fig. 21).
4. Perform the complete parking brake lever installation procedure above.

Rear Cable

Removal

1. Raise vehicle on hoist.
2. Remove the cable clip retainers on the back side of the frame rail from each of the rear brake cable ends.
3. Disconnect the cable at the rear wheel flange plate.
4. Remove the cable ball out of the recess in the brake lever assembly clevis.
5. Disconnect the cables at the equalizer connector and remove the cables.

Installation

1. Attach the rear cable balls on the rear cable ends to the rear wheel recess in the brake lever assembly clevis.
2. Attach the cable assembly to the rear wheel flange plate.
3. Connect the cable assemblies along the frame rail area.
4. Insert the cable end through the equalizer and attach to the equalizer connector.
5. Adjust as outlined under Maintenance and Adjustments.
6. Lubricate the cables and all moving parts for trouble-free operation--see Lubrication, Section 0.
7. Lower vehicle to floor.

NOTE: Camaro cable adjustment with rear disc brake is the same as with standard brakes.

Brake Shoes

Refer to parking brake shoe service procedures under Disc Brakes in this section.

Brake Pedal (Fig. 25)

Removal

NOTE: Refer to Section 1A for removal of air conditioning components if necessary.

1. Disconnect clutch pedal return spring (manual transmission models only).
2. Disconnect clutch push rod at pedal.
3. Disconnect brake pedal return spring on manual brake cars.
4. Disconnect brake pedal from main cylinder push rod by removing retainer and clevis pin.
5. Corvette only:
   a. Remove steering column from vehicle as outlined in Section 9.
   b. Support main cylinder from inside engine compartment and remove four support brace nuts.
   c. Remove four nuts and bolts securing support plate to bracket and remove support plate.
   d. Remove two screws securing bracket to underside of instrument panel and lower bracket and pedals to floor.
6. Remove retainer from right side of pedal pivot shaft.
7. Slide clutch pedal assembly to the left and remove from support brace.
8. Withdraw brake pedal and all nylon bushings.

Inspection

1. Clean all metal parts with a good nontoxic cleaning solvent.
2. Wipe nylon bushings clean with a clean cloth.

CAUTION: Nylon bushings should not be treated with cleaning agent of any nature.

3. Inspect all nylon bushings for wear and damage.
4. Inspect mating surface of bushings for wear and damage--replace parts as required.

Installation

1. Lubricate and install nylon bushings on pedal pivot shaft, right side of support brace cutout, and through both ends of brake pedal bore.
2. Chevrolet, Nova and Corvette: Position brake pedal return spring on pedal arm and place pedal assembly in support brace. Index return spring in support brace cutout.
3. Chevelle and Camaro: Place pedal assembly in support brace.
4. Slide pedal pivot shaft through support brace and brake pedal bore.
5. Install retainer to right side of pedal pivot shaft.
6. Corvette only:
   a. Install bracket with pedal assemblies to underside of instrument panel with two screws.
   b. Install support plate on bracket with four bolts and nuts.
   c. Place main cylinder in position and install four bracket and cylinder mounting bolts; secure entire assembly with four nuts.
   d. Install steering column in vehicle as outlined in Section 9.
7. Install brake pedal return spring on manual brake cars.
8. On manual transmission models, connect clutch pedal push rod to pedal bracket and install retainer. Install clutch pedal return spring.
9. Adjust brake pedal free travel as outlined in this section. Adjust stoplight switch as outlined in Section 6Y. Adjust clutch pedal travel as outlined in Section 7.

SHOES AND LININGS

NOTE: If brake drums are worn severely, it may be necessary to retract the adjusting screw.

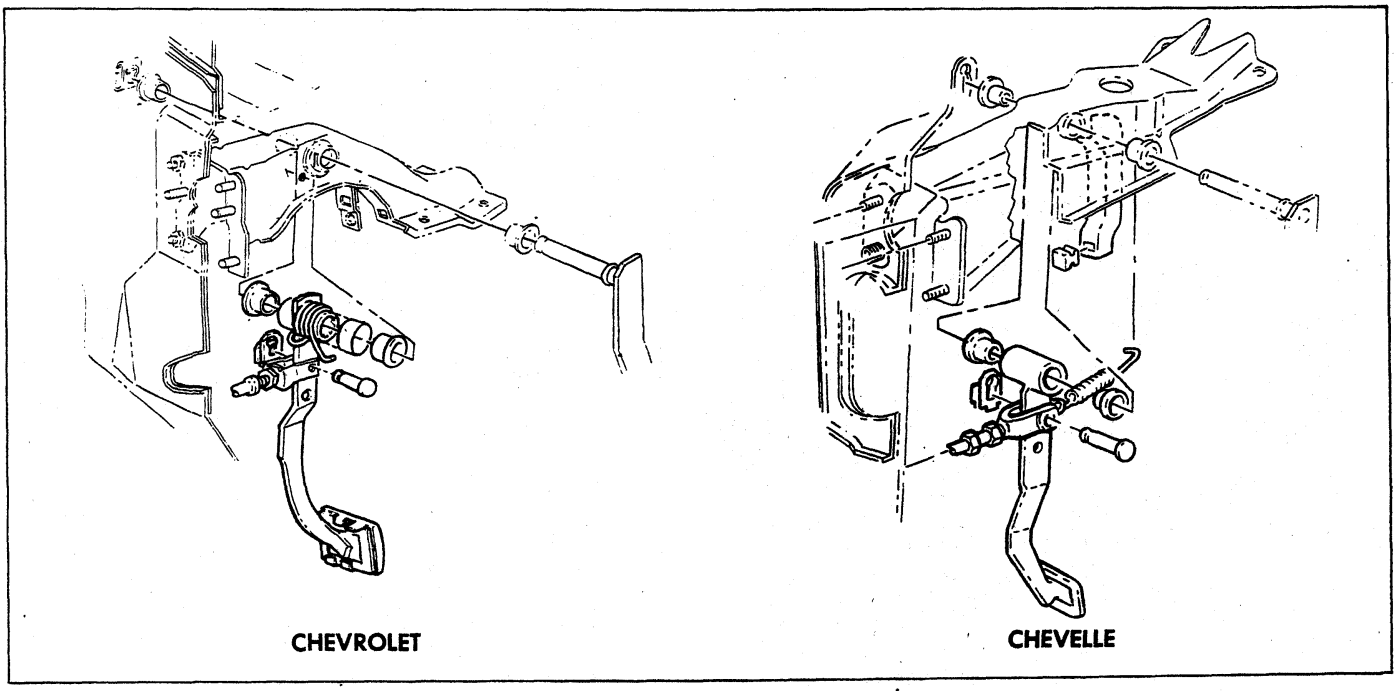


Fig. 25—Brake Pedal Installation

To gain access to the adjusting screw star wheel, knock out the lanced area in the web of the brake drum using a chisel or similar tool. Release the actuator from the star wheel by lifting with a small screw driver and back off the star wheel with a second screw driver (press down on the handle to retract shoes).

CAUTION: After knocking out the metal, be sure to remove it from the inside of the drum and clean all metal from the brake compartment. A new hole cover must be installed when drum is reinstalled.

Removal

1. Raise car on hoist.
2. Loosen check nuts at parking brake equalizer sufficiently to remove all tension from brake cable.
3. Remove brake drums.

   NOTE: Since there are wheel cylinder piston stops to prevent pistons from leaving cylinders, it is not necessary to install wheel cylinder clamps when brake shoes are removed; however, brake pedal must not be depressed while drums are removed.

4. Unhook brake shoe pull back springs from anchor pin and link end, using Tool J-8049 (fig. 26).
5. Remove the actuator return spring and link.
6. Remove hold-down pins and springs (fig. 27).
7. Remove the actuator assembly.

   NOTE: The actuator, pivot and override spring are an assembly. It is not recommended that they be disassembled for service purposes, unless they are broken. It is much easier to assemble and disassemble the brakes by leaving them intact.

8. Separate the brake shoes by removing adjusting screw and spring.

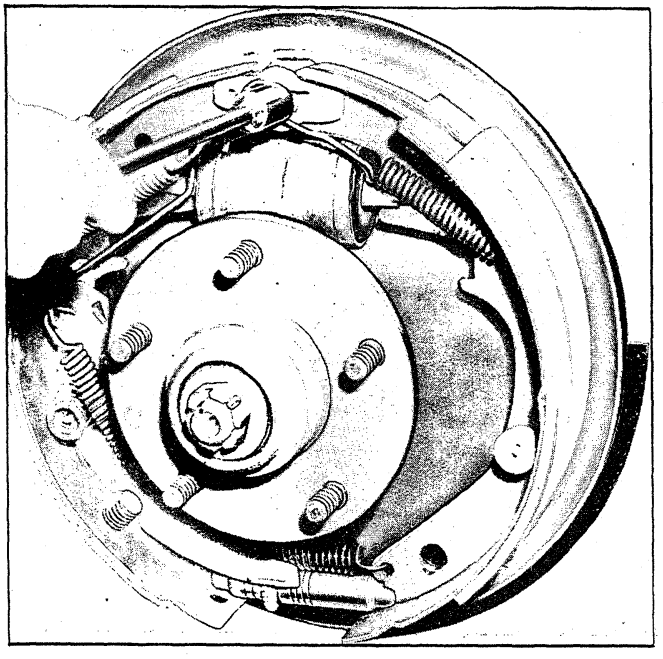


Fig. 26—Unhooking Pull Back Spring

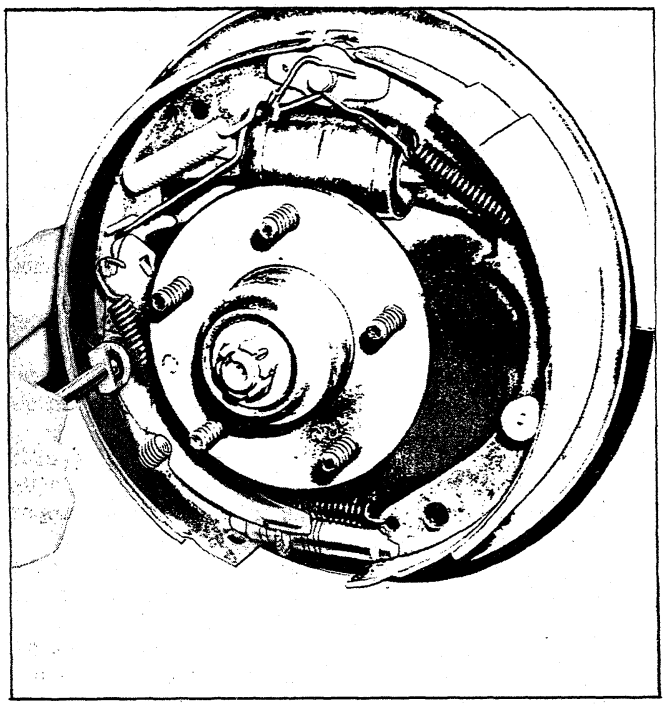


Fig. 27—Removing Hold Down Spring and Pins

9. Remove parking brake lever from secondary brake shoe (rear only).

Inspection

1. Clean all dirt out of brake drum using care to avoid getting dirt into front wheel bearings. Inspect drums for roughness, scoring or out-of-round. Replace or recondition drums as required.
2. Inspect wheel bearings and oil seal, and replace any necessary parts.
3. On Chevrolet only:
   Carefully pull lower edges of wheel cylinder boots away from cylinders and note whether interior is wet with brake fluid. Excessive fluid at this point indicates leakage past piston cups and a need for wheel cylinder overhaul or replacement.

   NOTE: A slight amount of fluid is nearly always present and acts as lubricant for the piston.

4. Check cylinders with internal boots by carefully pulling a small part of the boot out of the cylinder. Note whether interior is wet with brake fluid. Excessive fluid at this point indicates leakage past piston cups and a need for wheel cylinder overhaul or replacement.
5. Check all brake flange plate attaching bolts to make sure that they are tight. Clean all rust and dirt from shoe contact faces on flange plate (fig. 28), using fine emery cloth.

Installation

CAUTION: Make certain to install recommended shoe and lining assemblies. Otherwise, serious fade or failure may occur.

1. Inspect new linings and make certain there are no nicks or burrs on bonding material on shoe edge where contact is made with brake flange plate or on any of the contact surfaces.

NOTE: Keep hands clean while handling brake shoes. Do not permit oil or grease to come in contact with linings.

2. If working on rear brakes, lubricate parking brake cable.
3. On rear brakes only, lubricate fulcrum end of parking brake lever and the bolt with brake lube, then attach lever to secondary shoe with bolt, spring washer, lock washer and nut. Make sure that lever moves freely.
4. Put a light coat of lubriplate on pads, backing plate and the threads of the adjusting screw.

   CAUTION: BE CAREFUL TO KEEP LUBRICANT OFF FACINGS.

5. Before installation make certain the adjusting screw is clean and lubricated properly.

   NOTE: Loose adjustment may occur from an adjusting screw that is not properly operating. If the lubrication in the adjusting screw assembly is contaminated or destroyed, the adjusting screw should be thoroughly cleaned and lubricated.

6. Connect brake shoes together with adjusting screw spring, then place adjusting screw, socket and nut in position.

   CAUTION: Make sure the proper adjusting screw is used ("L" for left side of vehicle, "R" for right side of vehicle). The star wheel should only be installed with the star wheel nearest to the secondary shoe and the adjusting screw spring inserted to prevent interference with the star wheel.

7. On rear wheels connect parking brake cable to lever.
8. Secure the primary brake shoe (short lining--faces forward) first with the hold-down pin and spring using a pair of pliers. Engages shoes with the wheel cylinder connecting links.
9. Install and secure the actuator assembly and secondary brake shoe with the hold-down pin and spring using a pair of needle nose pliers. On rear wheels position parking brake strut and strut spring.
10. Install guide plate over anchor pin.
11. Install the wire link.

    NOTE: Do not hook the wire link over the anchor pin stud with the regular spring hook tool. This may damage the cylinder boot seals. Fasten the wire link to the actuator assembly first, then place over the anchor pin stud by hand while holding the adjuster assembly in the full down position.

12. Install actuator return spring.

    NOTE: Do not pry actuator lever to install return spring. Ease it in place using the end of a screw driver or other suitable flat tool.

13. If old brake pull back (return) springs are nicked, distorted or if strength is doubtful, install new springs.
14. Hook springs in shoes using Tool J-8049 by installing the primary spring from the shoe over the anchor pin and then spring from secondary shoe over the wire link end.
15. After completing installation, make certain the actuator lever functions easily by hand operating the self-adjusting feature (fig. 29).
16. Follow the above procedure for all wheels.
17. Adjust the service brakes and parking brake as outlined under "Maintenance and Adjustments" in this section.
18. Install drum, wheel and tire and lower vehicle to floor.

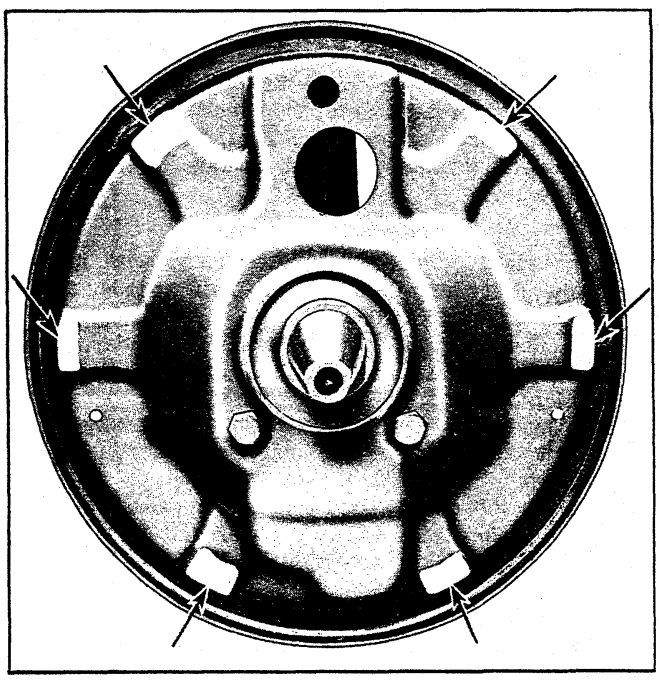


Fig. 28—Backing Plate Contact Surfaces

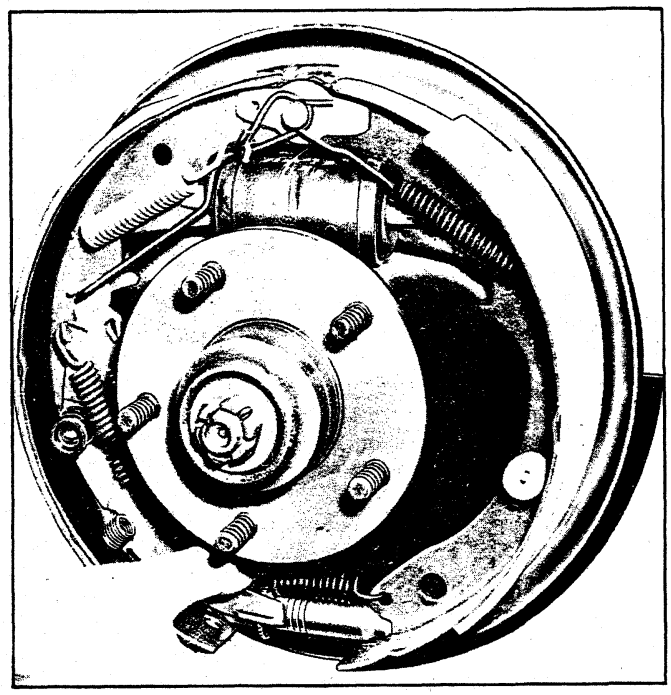


Fig. 29—Checking Operation of Actuating Lever

Model	Source	Brake Type	Main Cylinder Code	Secondary Piston Identification
Chevrolet	Delco Moraine	Manual-Drum Power - Drum	AT	2 Rings or Grooves
	Bendix	Power- Drum	AT	1 Ring or 2 Grooves
All Passenger Cars except Chevrolet	Delco Moraine	Manual-Drum Power - Drum	BS	1 Ring or Groove
Corvette	Delco Moraine	Manual-Disc Power Disc	DC	5 Rings or Grooves
		Power-Disc	PG	1 Ring or Groove
Chevrolet	Delco Moraine	Power-Disc	TA	2 Rings or Grooves
Chevelle			BA	6 Rings or Grooves
Camaro Nova	Delco Moraine	Power-Disc	US	3 Rings or Grooves

Brake Main Cylinder Identification

MAIN CYLINDER

Dual Main Cylinder Component Replacement

The dual main cylinder used on 1969 passenger cars is designed and built to satisfy individual brake system displacement requirements for each vehicle line. Therefore, it is necessary that correct parts be used when replacing either complete main cylinder assemblies or the component pistons of these assemblies.

There are two sources for dual main cylinders used on 1969 vehicles: Delco Moraine and Bendix. The Bendix unit can be readily identified by a 'Secondary Piston Stop' bolt on the bottom of the casting. Delco Moraine main cylinders has a stop bolt on the inside (See Figures 1 and 2).

The length of the secondary pistons in these main cylinders is a critical factor in the displacement capabilities of a particular main cylinder. These secondary pistons are coded, using rings or grooves in the shank or center section of the piston. Refer to the chart above for proper identification.

The primary pistons are of two types. One has a deep socket for the push rod and the other a very shallow socket.

It is mandatory that replacement pistons be identical to the original piston. This can be verified by checking the identification marks on the secondary piston and the socket contour of the push rod end of the primary piston.

When servicing the Delco Moraine dual master cylinder, follow the rules below when replacing either complete master cylinder or the component pistons of the cylinder. It is equally important to use only the correct service parts when servicing a main cylinder.

1. The two-letter identification stamp on the end of the master cylinder indicates the displacement capabilities of that particular cylinder. Master cylinders should only be replaced with another cylinder bearing the same two-letter identification.
2. The length of the component pistons in the master cylinders are critical factors in displacement capabilities of a particular master cylinder. These pistons are coded, using rings or grooves in the shank of the piston. It is mandatory that when pistons are replaced, the replacing piston must contain the same identification marks and the same contour at the push rod end as the piston which is removed.
3. Delco Moraine dual master cylinders, used with drum-type brakes, contain a rubber check valve and check valve spring in each outlet boss. When the car is equipped with disc brakes on the front and drum brakes on the rear, the dual master cylinder will have a check valve and spring in the outlet boss for the rear brakes. No check valve is required for disc brakes, and, therefore, the outlet boss to the front brakes will not contain a check valve and spring.

Removal

1. Wipe main cylinder and lines clean with a clean cloth. Place dry cloths below main cylinder area to absorb any fluid spillage.
2. Disconnect hydraulic lines at main cylinder. Cover line ends with clean lint-free material to prevent foreign matter from entering the system.
3. Disconnect the push rod from the brake pedal.
4. Unbolt and remove the main cylinder from the firewall.
5. Remove the main cylinder mounting gasket and boot.
6. Remove the main cylinder cover and dump out the fluid. Pump the remaining fluid from the cylinder by depressing the push rod.

Disassembly (Fig. 30)

1. Clamp main cylinder in a bench vice.
2. Remove push rod retainer.
3. Remove secondary piston stop bolt from bottom of front fluid reservoir.

4. Remove the snap ring retainer and primary piston assembly. Remove the secondary piston, piston spring, and retainer by blowing air through the stop bolt hole. (If no air is available, a piece of wire may be used. Bend approximately 1/4 inch of one end into a right angle, hook the secondary piston and pull it out.)
5. Position main cylinder in vice with outlet holes facing up.
6. Drill a 13/64 inch hole through both check valve seats.
7. Tap out both seats using a 1/4 - 20 tap.
8. Install a spare brake line tube nut in the outlet hole. Place a flat washer on a one inch screw (threaded to screw into tapped hole), and thread screw into threaded hole in tube seat. Hold the screw to keep it from turning and back out the tube nut. This will remove the tube seat.
9. Repeat Step 8 above on second tube seat.
10. Remove the check valves and springs from the cavities beneath the tube seats.
11. Remove the primary seal, primary seal protector, and secondary seals from the secondary piston. Remove the piston extension screw securing the primary piston spring to the primary piston. Remove the spring retainer, primary seal, primary seal protector, and secondary seal from the primary piston.

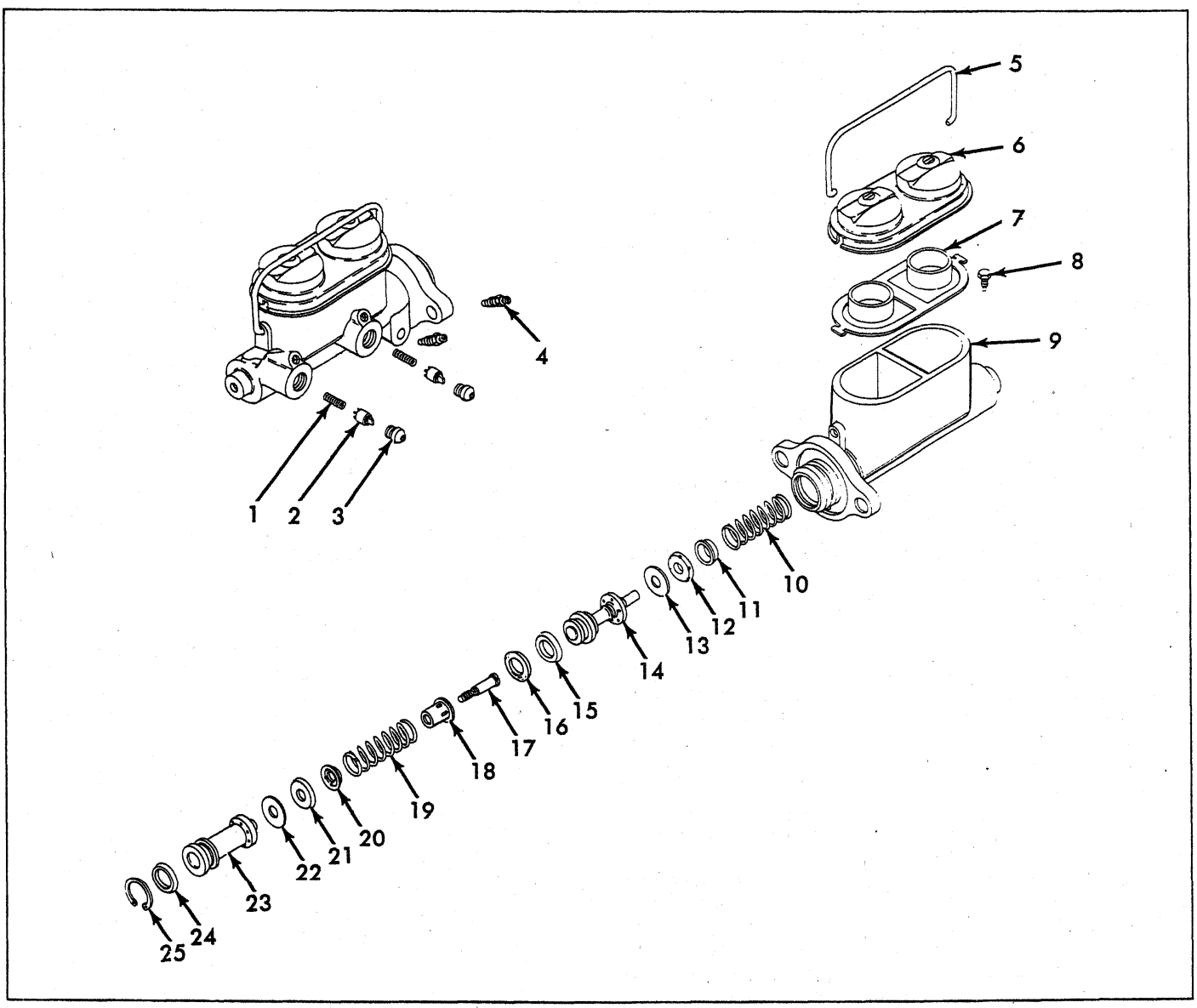


Fig. 30—Main Cylinder for Drum Type Brakes—Exploded View

1. Spring
2. Check Valve
3. Valve Seat
4. Bleeder Valve
5. Bail Wire
6. Cover
7. Diaphragm
8. Stop Screw
9. Body
10. Spring
11. Retainer
12. Seal
13. Seal Protector
14. Primary Piston
15. Seal
16. Seal
17. Piston Extension Screw
18. Secondary Piston Stop
19. Spring
20. Spring Retainer
21. Seal
22. Seal Protector
23. Secondary Piston
24. Seal
25. Retaining Ring

Cleaning and Inspection

1. Remove main cylinder casting from vise and inspect the bore for corrosion, pits, and foreign matter. Be sure that the outlet ports are clean and free of brass cuttings from the tube seat removal operation.
2. Inspect the fluid reservoirs for foreign matter. Check the bypass and compensating ports to the cylinder bore to insure that they are not restricted. Do not use wire to check ports.

   NOTE: Before washing parts, hands must be clean. Do not wash hands in gasoline or oil before cleaning parts. Use soap and water only.

3. Use Declene or equivalent to clean all metal parts thoroughly. Immerse parts in the cleaning fluid and brush with hair brush to remove foreign matter. Blow out all passages, orifices, and valve holes. Air dry the parts and place on clean paper or lint-free clean cloth.

   NOTE: Be sure to keep parts clean until reassembly. Rewash parts, if there is any occasion to doubt cleanliness.

4. Check pistons for scratches or other visual damage; replace if necessary.

Assembly (Fig. 30)

Use care when reassembling the main cylinder check valves. Improper assembly of the check valve seats will result in distortion of the seats. If this occurs, there will be no check valve action and a loss of brake pedal travel will result; the pedal will have to be pumped one or more times before actual car braking occurs.

1. Place the main cylinder in a vice with the outlet holes facing up. Place the check valve springs in the outlet holes. Be sure the springs are seated in the bottom of the holes. Place new rubber check valves over the springs, being careful not to displace the springs from the spring seats.
2. Place new brass tube seats in the outlet holes. Be sure seats are not cocked as this would cause burrs to be turned up as the tube seats are pressed in. Thread a spare brake line tube nut into the outlet hole and turn the nut down until the tube seat bottoms. Remove the tube nut and check the outlet hole for loose burrs, which might have been turned up when the tube seat was pressed down. Repeat this process to bottom the second seat.
3. Put new secondary seals in the two grooves in the end of the secondary piston assembly. The seal which is nearest the end will have its lips facing toward that end. The seal in the second groove should have its lips facing toward the portion of the secondary piston which contains the small compensating holes.
4. Assemble a new primary seal protector and primary seal over the end of the secondary piston with the flat side of the seal seats against the seal protector, and the protector against the flange of the piston which contains the small compensating holes.
5. Assemble the new secondary seal into the groove on the push rod end of the primary piston. The lips of this seal should face toward the small compensating holes in the opposite end of the primary piston.
6. Assemble the new primary seal protector and primary seal on the end of the primary piston with the flat side of the seal seated against the seal protector, and the protector against the flange on the piston which contains the compensating holes.
7. Assemble the spring retainer in one end of the primary piston spring and the secondary piston stop in the other end. Place the end of the spring over the end of the primary piston with the spring retainer seats inside of the lips of the primary seal.
8. Remove all cleaning liquid from the threaded hole in the primary piston. Place the piston extension screw down through the secondary piston stop and the primary spring retainer and screw it into the primary piston until it bottoms out.
9. Coat the bore of the master cylinder with clean brake fluid. Coat the primary and secondary seals on the secondary piston with clean brake fluid. Insert the secondary piston spring retainer into the secdary piston spring. Place the retainer and spring down over the end of the secondary piston until the retainer locates inside of the lips of the primary cup.
10. Hold the master cylinder with the open end of the bore down. Push the secondary piston into the bore until the spring seats against the closed end of the bore.
11. Position the master cylinder in a vise with the open end of the bore up. Coat the primary and secondary seal on the primary piston with clean brake fluid. Push the primary piston assembly, spring end first, into the bore of the master cylinder. Hold the piston down and snap the lock ring into position in the small grooves in the I.D. of the bore.
12. Push the primary piston down to move the secondary piston forward far enough to clear the stop screw hole in the bottom of the front fluid reservoir. Install the stop screw.
13. Install reservoir diaphragm in the reservoir cover and install the cover on the main cylinder. Push ball wire into position to secure the reservoir cover.

Installation

1. Assemble the push rod through the push rod retainer, if it has been disassembled.
2. Push the retainer over the end of the main cylinder. Assemble new boot over push rod and press it down over the push rod retainer. Slide new mounting gasket into position.
3. Secure the main cylinder to the firewall with mounting bolts.
4. Connect the push rod clevis to the brake pedal with pin and retainer.
5. Connect the brake lines to the main cylinder.
6. Fill the main cylinder reservoirs to the levels shown in Figure 7. Bleed the brake system as outlined in this section.
7. If necessary, adjust the brake pedal free play as outlined in this section.

WHEEL CYLINDER (Fig. 31)

The wheel cylinder boots should be removed from a cylinder body only when they are visibly damaged or leaking fluid. Wheel cylinders having torn, cut, or heat-cracked boots should be completely overhauled.

Removal

1. Place car on hoist.
2. Remove wheel and tire assembly. Back off brake adjustment, if necessary, and remove drum.
3. Disconnect brake system hydraulic line from cylinder.
4. Remove brake shoe pull back springs.
5. Remove screws securing wheel cylinder to flange plate. Disengage cylinder push rods from brake shoes and remove cylinder.

NOTE: On Chevrolet, it is necessary to remove the anchor pin which holds the front wheel cylinder to flange plate to remove the front wheel cylinder.

Disassembly

1. Remove boots from cylinder ends with pliers and discard boots.
2. Remove and discard pistons and cups.

Inspection and Cleaning

NOTE: Staining is not to be confused with corrosion. Corrosion can be identified as pits or excessive bore roughness.

1. Inspect cylinder bore. Check for staining and corrosion. Discard cylinder if corroded.
2. Polish any discolored or stained area with crocus cloth by revolving the cylinder on the cloth supported by a finger. Do not slide the cloth in a lengthwise manner under pressure.

NOTE: Before washing parts, hands must be clean. Do not wash hands in gasoline or oil before cleaning parts. Use soap and water to clean hands.

3. Wash the cylinder and metal parts in Declene or equivalent.
4. Shake excess cleaning fluid from the cylinder. Do not use a rag to dry the cylinder as lint from the rag cannot be kept from the cylinder bore surfaces.
5. Check piston for scratches or other visual damage; replace if necessary.

Assembly (Fig. 31)

1. Lubricate the cylinder bore and counterbore with clean brake fluid and insert spring-expander assembly.
2. Install new cups with flat surface toward outer ends of cylinder. Be sure cups are lint and dirt free before insertion. Do not lubricate cups prior to assembly.

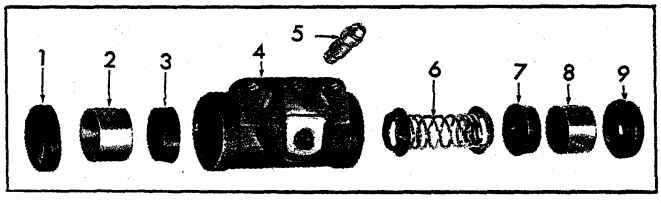


Fig. 31—Chevelle Wheel Cylinder—Exploded View

1. Push Rod Boot
2. Piston
3. Piston Cup
4. Housing
5. Fluid
6. Spring
7. Piston Cup
8. Piston
9. Push Rod Boot

3. Install new Durex pistons into cylinder with flat surfaces toward center of cylinder. Do not lubricate pistons before installation.
4. Press new boots into cylinder counterbores by hand. Do not lubricate boots prior to installation.

Installation

1. Position wheel cylinder to brake flange plate. Install screws and tighten securely.

NOTE: On Chevrolet front wheels, mount front wheel cylinders to the brake flange plate by installing the threaded anchor pin through the wheel cylinder housing and tighten to 130 ft. lb. To secure, peen over the flat washer on the anchor pin.

2. Replace all push rods and pull back springs.
3. Connect hose or line to wheel cylinder.

NOTE: If replacing front wheel cylinder, connect hose and inspect installation as outlined in "Hydraulic Brake Hose Replacement".

4. Install drum and wheel.
5. Bleed brakes as outlined in this section.
6. Lower vehicle to floor.

ANCHOR PIN

Front Wheel

1. Place car on hoist.
2. Remove wheel and drum as outlined in this section.
3. Remove brake shoe pull back springs, link and guide plate.
4. Disengage anchor pin lock and remove anchor pin by turning counter-clockwise.
5. Place new lock plate on anchor pin and pass pin through the hole in flange plate and screw into tapped hole in spindle support.
6. Torque pin to 130 ft. lb. and lock by peening over washer tabs.
7. Install brake shoe guide plate, link and pull back springs.
8. Adjust brakes, install drum and wheel as outlined in this section and lower vehicle. Test brake operation.

Rear Wheel

Two type anchor pins are used in production for the rear wheels. The riveted type is not serviced and if failure or damage should occur to either the anchor pin or flange plate, both parts will have to be replaced and the threaded type anchor pin used.

Threaded Type

1. Place car on hoist.
2. Remove wheel and drum as outlined in this section.
3. Remove brake shoe pull back springs, link and guide plate.
4. Remove anchor pin retaining nut and washer and remove pin from flange plate.
5. Position anchor pin to flange plate, install lock washer and nut, and torque pin to 80 ft. lb.
6. Install brake shoe guide plate, link and pull back springs.
7. Adjust brakes and install drum and wheel as outlined in this section and lower vehicle.
8. Test brake operation.

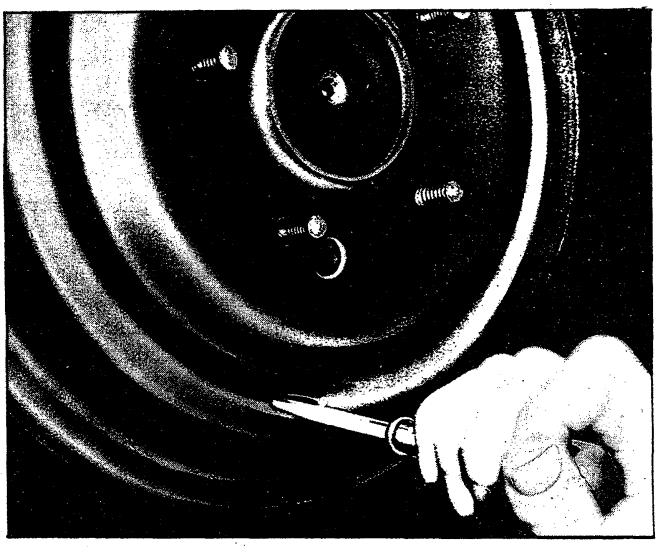


Fig. 32—Brake Drum Access Hole

BRAKE DRUMS

Front brake drums are the demountable type; that is, they can be removed without removing the hub. Rear brake drums are demountable and may be removed without removing the axle shaft.

A lanced "knock out" area (fig. 32) is provided in the web of the brake drum for servicing purposes in the event retracting of the brake shoes is required in order to remove the drum.

A small screw driver or hooked wire may be inserted to disengage the automatic adjuster actuating lever so the star wheel may be turned.

Removal

1. Place car on hoist.
2. Remove wheel and tire assembly, back off brake adjustment if necessary and remove drum.

Inspection and Reconditioning

Whenever brake drums are removed they should be thoroughly cleaned and inspected for cracks, scores, deep grooves, and out-of-round. Any of these conditions must be corrected since they can impair the efficiency of brake operation and also can cause premature failure of other parts.

Smooth up any slight scores by polishing with fine emery cloth. Heavy or extensive scoring will cause excessive brake lining wear and it will probably be necessary to rebore in order to true up the braking surface.

An out-of-round drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action.

A drum that is more than .008" out-of-round on the diameter will result in rough brake application and should be rebored. Out-of-round, as well as taper and wear can be accurately measured with an inside micrometer fitted with proper extension rods.

If drum is to be rebored for use with standard size brake facings which are worn very little, only enough metal should be removed to obtain a true smooth braking surface.

If drum has to be rebored more than .020" over the standard diameter, it should be rebored to .060" diameter oversize and the brake facing should be replaced with .030" oversize facings.

A brake drum must not be rebored more than .060" over the maximum standard diameter, (since Chevrolet brake facings are not furnished larger than .030" oversize and will not work efficiently in drums bored more than .060") removal of more metal will effect dissipation of heat.

Brake drums may be refinished either by turning or grinding. Best brake performance is obtained by turning drums with a very fine feed. To insure maximum lining life, the refinished braking surface must be smooth and free from chatter or tool marks, and run-out must not exceed .005" total indicator reading.

Cleaning

New brake drums in parts stock are given a light coating of rust proofing oil to prevent the formation of rust on the critical braking surfaces during the time that the drums are in storage.

This rust proofing oil must be carefully removed before the drum is placed in service to prevent any of this oil from getting on the brake shoe facings, which might cause an extreme brake grab condition.

It is recommended that a suitable volatile, non-toxic, greaseless type solvent be used to clean the oil from the braking surface of the new brake drums before they are placed in service to insure the cleanest possible surface.

Gasoline or kerosene should not be used as there is danger that a portion of the diluted oil substance may be left on the braking surface that may later cause difficulty.

Installation

1. Make brake adjustment as outlined in this section.
2. Install brake drum, aligning tang with wheel hub (fig. 18).
3. Install wheel and tire assembly and lower vehicle.
4. Make final brake adjustment as outlined in this section and check brake operation.

NOTE: The brake pressure differential warning switch is non-adjustable, non-serviceable valve. If defective it must be replaced.

BRAKE PIPE DISTRIBUTION AND SWITCH ASSEMBLY (Fig. 3)

Removal

1. Disconnect battery cable.
2. Disconnect electrical lead from switch assembly.
3. Place dry rags below the switch to absorb any fluid spilled during removal of switch.
4. Disconnect four hydraulic lines from connections at switch. If necessary, loosen line connections at main cylinder to loosen lines. Cover open line ends with clean, lint-free material to prevent foreign matter from entering the system.
5. Remove mounting screw and remove switch from vehicle.

Installation

1. Make sure new switch is clean and free of dust and lint. If any doubt exists, wash switch in Declene, or equivalent, and dry with air.
2. Place switch in position and secure to bracket with mounting screw.

3. Remove protective material from open hydraulic brake lines and connect lines to switch. If necessary, tighten brake line connections at main cylinder.
4. Connect switch electrical lead.
5. Connect battery cable.
6. Bleed the brake systems as outlined in this section.

CAMARO PRESSURE REGULATOR VALVE

NOTE: The pressure regulator valve is a non-adjustable, non-serviceable valve. If defective it must be replaced.

Removal (Fig. 4)

1. Place dry rags below valve to absorb any fluid spilled during removal of valve.
2. Disconnect hydraulic brake lines from both sides of switch. Cover open line ends with clean, lint-free material to prevent foreign matter from entering the system.
3. Remove mounting screw and remove switch from vehicle.

Installation

1. Make sure new valve is clean and free of dust and lint. If any doubt exists, wash valve in Declene, or equivalent, and dry with air.
2. Place valve in position and secure to frame side rail with mounting screw.
3. Remove protective material from open hydraulic brake lines and connect lines to each side of valve.
4. Bleed brake system as outlined in this section.

BRAKE WARNING LIGHT CHECKING PROCEDURE

1. Disconnect wire from switch terminal and use a jumper to connect wire to a good ground.
2. Turn ignition key to "ON". Warning lamp should light. If lamp does not light bulb is burned out or electrical circuit is defective. Replace bulb or repair electrical circuit as necessary.
3. When warning lamp lights, turn ignition switch off. Disconnect jumper and reconnect wire to switch terminal.

TESTING WARNING LIGHT SWITCH

1. Raise vehicle on hoist and attach a bleeder hose to a rear brake bleed screw and immerse other end of hose in a container partially filled with clean brake fluid. Be sure master cylinder reservoirs are full.
2. Turn ignition switch to "ON". Open bleed screw while a helper applies heavy pressure to brake pedal. Warning lamp should light. Close bleed screw before helper releases pedal.
3. Attach bleeder hose to front brake bleed screw and repeat above test. Again warning lamp should light. Turn ignition switch off.
4. Lower vehicle to floor.

NOTE: If warning lamp does not light during Steps 2 and 3, but does light when a jumper is connected to ground, warning light switch is defective. Do not attempt to disassemble switch. A defective switch must be replaced with a new switch assembly.

NOTE: Caution should be taken to prevent air from entering hydraulic system during checks on switch.

The recommended checking interval should be 24 months or 24,000 miles, any time major brake work is done or any time a customer complains of excessive pedal travel.

4 WHEEL DISC BRAKES

INDEX

	Page
General Description	5-21
Maintenance and Adjustments	5-23
Bleeding Hydraulic System	5-23
Parking Brake Adjustment	5-23
Component Replacement and Repairs	5-23
Brake Shoes	5-23
Brake Caliper	5-24
Brake Disc	5-25
Main Cylinder	5-27
Parking Brake Shoes	5-27

GENERAL DESCRIPTION

Four wheel disc brakes are standard equipment on the 1969 Corvette and optional equipment on Camaro. The Corvette may also be equipped with heavy duty disc brakes which include optional front calipers, shoes, linings, and rear pressure regulator valve. This heavy duty option is used in conjunction with a vacuum power unit.

The disc brake (figs. 33 and 34) consists of a fixed caliper, splash shield, mounting bracket and rotating disc. The caliper assembly contains four pistons and two shoe and lining assemblies. A seal and dust boot are installed on each piston, with a piston spring in the caliper cylinder bore beneath each piston. A retaining pin extends through each caliper half and both shoes to hold the shoes and linings in position in the caliper. On

Corvette heavy duty disc brakes, two retaining cotter pins are used at each end of the caliper to secure the shoes and linings. Machined surfaces within the caliper prevent the shoe and lining assembly from rotating with the brake disc when pressure is applied.

The disc, which has a series of air vent louvers to provide cooling, is mounted on the front wheel-hub. The caliper straddles the disc and mounts on a mounting bracket attached to the steering knuckle or rear axle flange.

The Corvette heavy duty option includes a pressure regulator valve mounted in the rear brake line just below the main cylinder downstream from the distributor switch. The valve regulates the hydraulic pressure to the rear brakes resulting in simultaneous braking balance between the front and rear brake systems. This valve guards against premature lock-up of rear wheels when brakes are applied.

Maintenance, adjustment, and service operations which are not included in this section are the same as for the Duo-Servo type brakes.

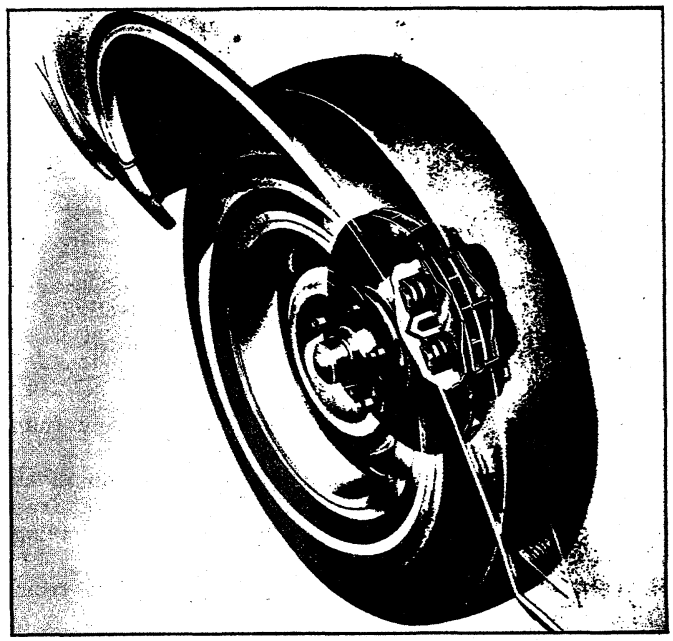


Fig. 33—Delco Moraine Disc Brake

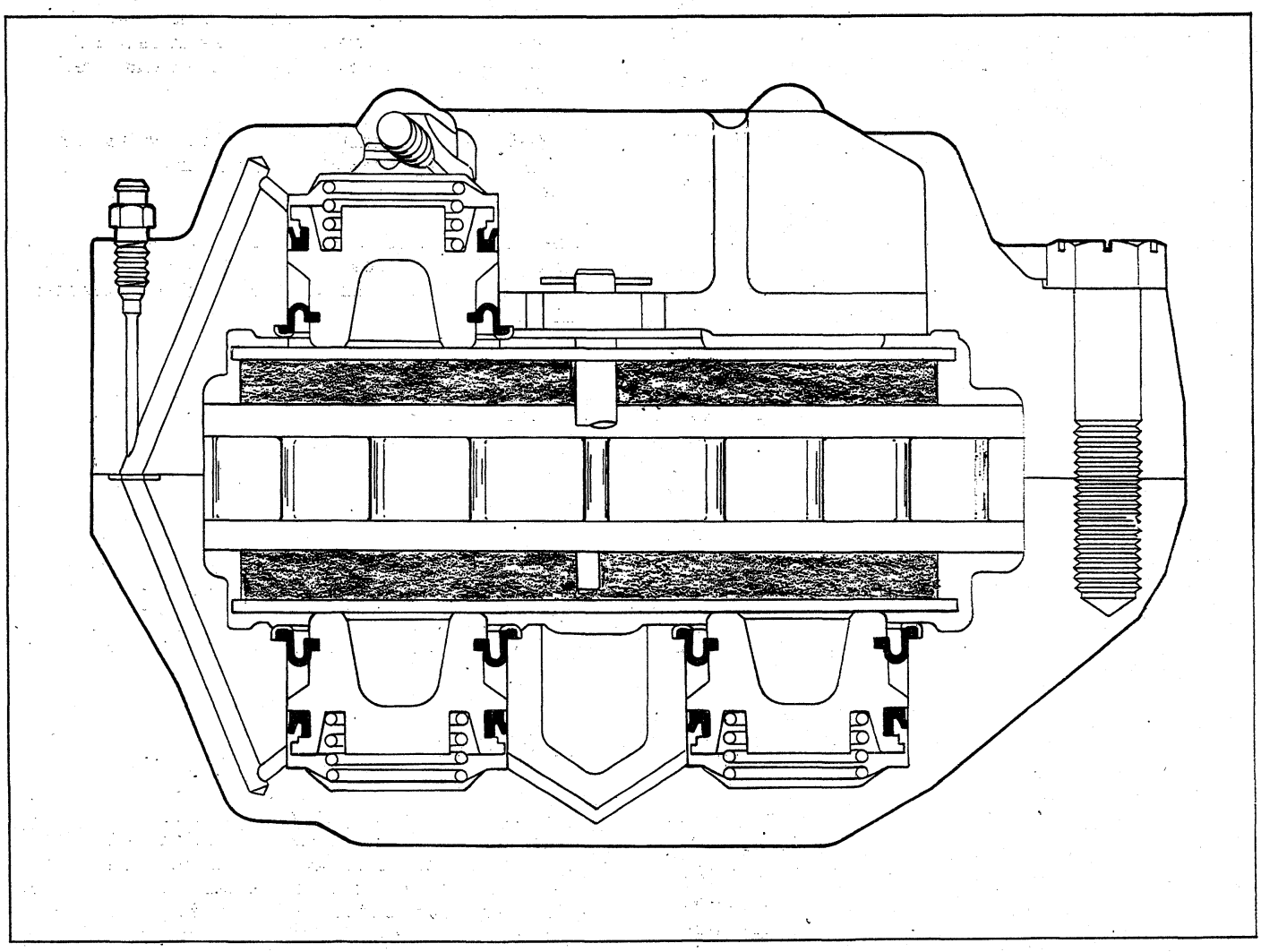


Fig. 34—Disc Brake—Cutaway View

MAINTENANCE AND ADJUSTMENTS

BLEEDING HYDRAULIC SYSTEM

The operation of bleeding the disc brake hydraulic system is the same as for Duo-Servo system outlined in the front of this section. Note the exceptions below and refer to bleeding procedures under Duo-Servo brakes.

1. When pressure bleeding equipment is used, the correct pressure setting for bleeding disc brakes is 10-20 lbs.
2. The front calipers contain one bleeder valve. The rear calipers on Corvette contain two bleeder valves (one inboard and one outboard) which necessitates the removal of the rear wheels for bleeding.
3. Tapping the caliper with a rawhide mallet as the fluid is flowing out may assist in obtaining a good bleeding job.
4. Never reuse brake fluid that has been drained from the hydraulic system, when bleeding the brakes.

PARKING BRAKE

Adjustment

1. Place car on hoist and raise.
2. Remove rear wheels.
3. Loosen brake cables at the equalizer until the parking brake levers move freely to the "off" position with slack in the cables.
4. Turn the disc until the adjusting screw can be seen through the hole in the disc.
5. Insert an adjusting tool or screw driver through the hole in the disc and tighten the adjusting screw by moving your hand away from the floor on both the left and right sides (fig. 35).

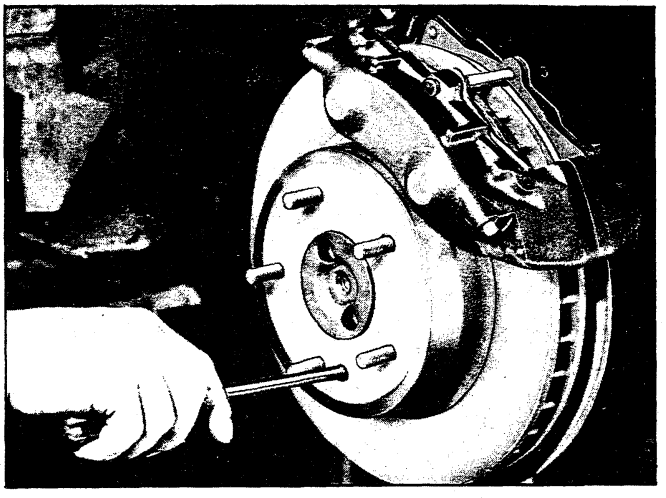


Fig. 35—Adjusting Parking Brake Shoe

6. Tighten until the disc will not move, then back off six (6) to eight (8) notches.
7. Apply the parking brake two (2) notches from inside the car.
8. Tighten the brake cables at the equalizer to produce a light drag with the wheels mounted.
9. Fully release the parking brake and rotate the rear wheels. No drag should be evident with the parking brake released.
10. Lower vehicle to floor.

COMPONENT REPLACEMENT AND REPAIRS

BRAKE SHOES

Shoes with bonded linings should be replaced when the lining is worn to approximately 1/16 inch of thickness. Shoes with linings retained by rivets should be replaced when the lining is worn to approximately .020" thickness over the rivet heads.

Removal

1. Siphon 2/3 of the brake fluid from the main cylinder reservoirs.

   CAUTION: If fluid is not removed, insertion of the new full thickness lining will force the pistons back into the housing displacing fluid into the master cylinder. This will cause the main cylinder to overflow. Do not drain the reservoirs completely or air will be pumped into the system.

2. Place car on hoist and raise.
3. Remove wheels.
4. Remove and discard the cotter pin from the inboard end of the shoe retaining pin and slide out the retaining pin. On Corvette with heavy duty disc brakes, two retaining pins must be removed, one on each end of the caliper assembly.
5. Remove the inboard shoe by pulling up.
6. Insert new shoe with lining into position. Use a putty knife to push each piston back as the shoe is inserted as shown in Figure 36.

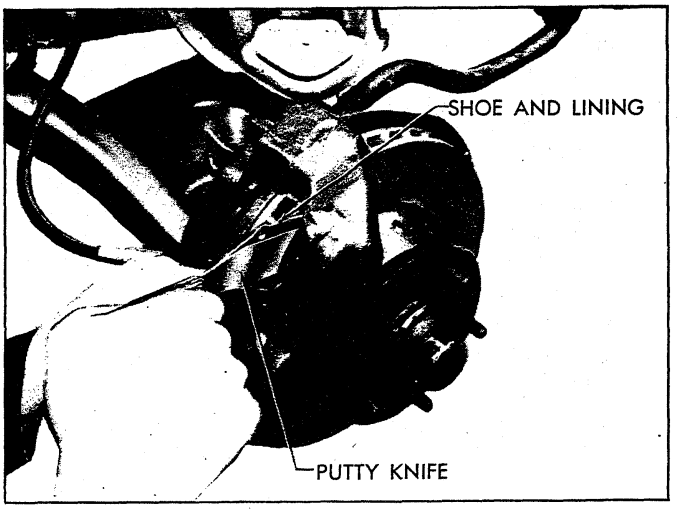


Fig. 36—Replacing Shoe and Lining Assembly

7. Replace the outboard shoe as described above. When both caliper shoes have been replaced, install the shoe retaining pin through outboard caliper half, outboard shoe, inboard shoe, and inboard caliper half. Insert a new 3/32 x 5/8 plated cotter pin through the retaining pin and bend back ends of cotter pin. (On Corvette heavy duty front caliper, install two retaining cotter pins, one at each end of the caliper.)
8. Repeat above procedure at each wheel where shoes are to be replaced.
9. Refill main cylinder to fluid level shown in Figure 8. If necessary, bleed brake system as outlined in this section.
10. Install wheels and lower vehicle.

CAUTION: Do not move car until a firm pedal is obtained.

BRAKE CALIPER

Removal

1. Place car on hoist.
2. Remove wheel.
3. On front caliper, disconnect the brake hose at brake line support bracket. On rear caliper, disconnect the brake tubing from the inboard caliper. Tape the open tube or line end to prevent foreign matter from entering the system.
4. Pull cotter pin from end of shoe assembly retaining pin. Remove the pin and shoe assembly from the caliper. Two retaining pins must be removed on heavy duty Corvette front calipers. Identify the inboard and outboard shoe if they are to be reused. Remove the end of brake hose at bracket by removing U-shaped retainer from the hose fitting and withdrawing the hose from bracket.
5. Remove the caliper assembly from the mounting bracket by removing two hex head bolts.

Disassembly (Fig. 37)

1. Clean exterior of caliper with Declene, or equivalent. Remove brake hose from front caliper.
2. Pull cotter pin from end of shoe assembly retaining pin. Remove the pin and shoe assembly from the caliper. Two retaining pins must be removed on heavy duty Corvette front calipers. Identify the inboard and outboard shoe if they are to be reused.
3. Separate the caliper halves by removing the two large bolts. Remove the two small "O" rings from the cavities around the fluid transfer holes in the two ends of the caliper halves.
4. To free the piston boots so that the pistons may be removed, push the piston down into the caliper as far as it will go. Insert a screw driver blade under the inner edge of the steel ring in the boot, and using the piston as a fulcrum, pry the boot from its seat in the caliper half.

   CAUTION: Use care not to puncture seal when removing pistons from caliper.

5. Remove the pistons and piston springs from the caliper half. Remove the boot and seal from their grooves in the piston.

Cleaning and Inspection

1. Clean all metal parts using Declene, or equivalent. Remove all traces of dirt and grease. Do not use mineral base solvents to clean brake parts.
2. Using an air hose, blow out all fluid passages in the caliper halves, making sure that there is no dirt or foreign material blocking any of these passages.
3. Discard all rubber parts. Boots, seals, and "O" rings should be replaced with new service kit parts.
4. Carefully inspect the piston bores in the caliper halves. They must be free of scores and pits. A scored or otherwise damaged bore will cause leaks and unsatisfactory brake operation. Replace the caliper half if either bore is damaged to the extent that polishing with very fine crocus cloth will not restore it.
5. Check the fit of the piston in the bore using a feeler gauge. Clearance should be as follows:

2 1/16 inch Bore	.0045 to .010
1 7/8 inch Bore	.0045 to .010
1 3/8 inch Bore	.0035 to .009

If the bore is not damaged, and the clearance exceeds either of the upper limits, a new piston will be required.

Assembly

1. Assemble the seal in the groove in the piston which is closest to the flat end of the piston. The lip on the seal must face toward the large end of the piston. Be sure lips are in the piston groove and do not extend over the step in the end of the groove.
2. Place the spring in the bottom of the piston bore.
3. Lubricate the seal with clean brake fluid.
4. Install the piston assembly in the bore using applicable piston ring compressor Tool J-22639, 22629 or 22591 as shown in Figure 38. Use care not to damage the seal lip as piston is pressed past the edge of the bore.
5. Assemble the boot in the groove of the piston closest to the concave end of the piston. The fold in the boot must face toward the end of the piston with the seal on it.
6. Depress the pistons and check that they slide smoothly into the bore until the end of the piston is flush with the end of the bore. If not, recheck piston assembly and location of the piston spring and the seal.
7. Position applicable boot seal installer Tool J-22592, J-22628, or J-22638 over the piston and seat the steel boot retaining, ring evenly in the counterbore as shown in Figure 39. The boot retaining ring must be flush or below the machined face of the caliper. Any distortion or uneven seating could allow contaminating and corrosive elements to enter the bore.
8. Position the "O" rings in the small cavities around the brake fluid transfer holes in both ends of the outboard caliper halves. Lubricate the hex head bolts with Delco Brake Lube or dip in clean brake fluid. Fit caliper halves together and secure with bolts.

Installation

1. Carefully mount the assembled caliper over the edge of the disc. Use a putty knife to depress pistons so that the caliper can be lowered into position on the disc (fig. 40). Use care to prevent damage to boots on the edge of the disc as the caliper is mounted.
2. Secure the caliper to the mounting bracket with two hex head bolts. Refer to torque specifications in rear of manual for correct torque values.

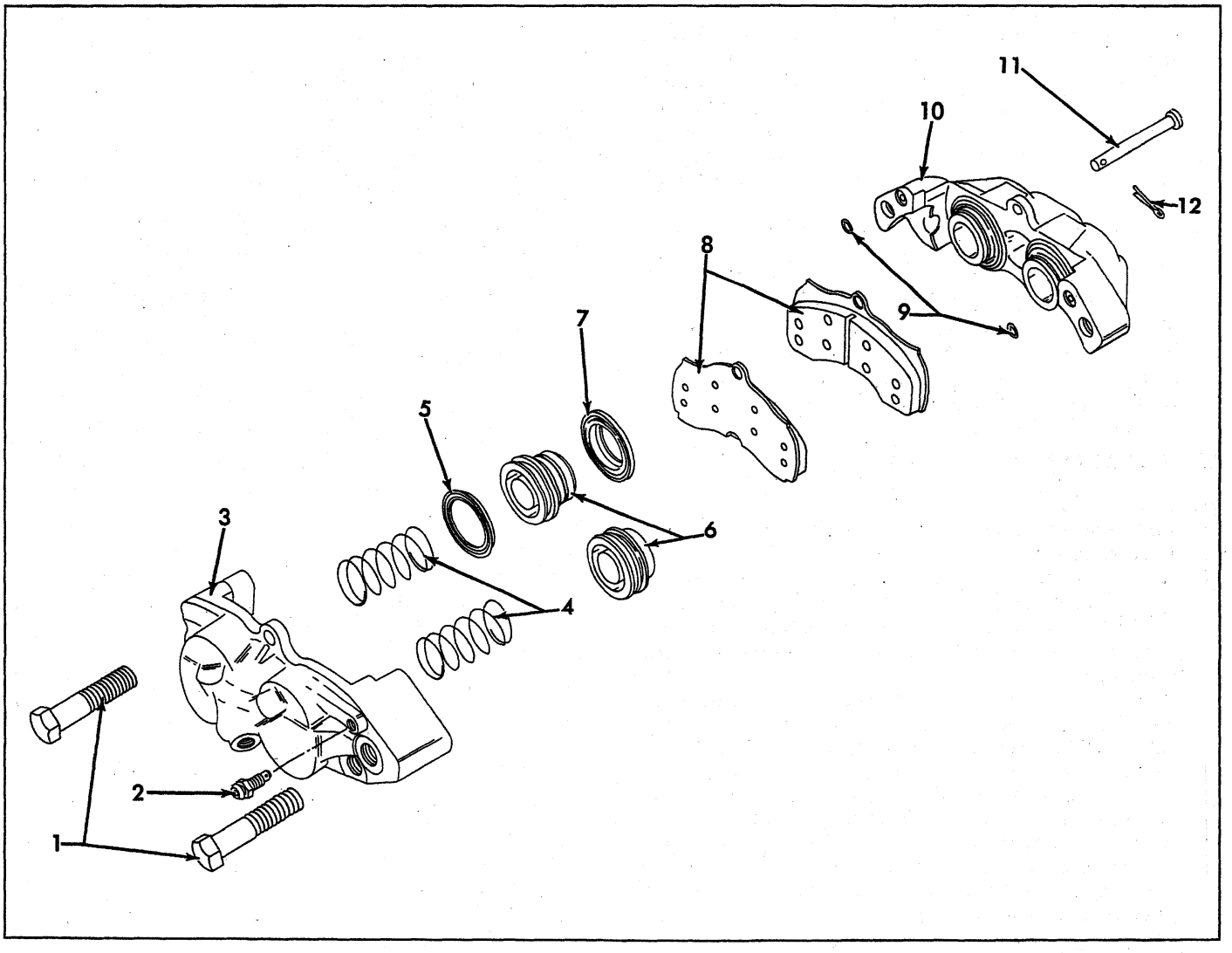


Fig. 37—Caliper Assembly—Exploded View

1. Caliper Bolts
2. Bleeder Valve
3. Caliper Half
4. Piston Spring
5. Seal
6. Piston
7. Piston Boot
8. Brake Shoes
9. "O" Rings
10. Caliper Half
11. Retaining Pin
12. Cotter Pin

CAUTION: If replacing old shoe assemblies, be sure to get the shoes in the same position from which they were removed.

3. Install the shoe and lining assemblies as outlined in this section.
4. Place a new copper gasket on the male end of the front wheel brake hose. Install brake hose in the calipers. With the wheels straight ahead, pass the female end of the brake hose through the support bracket.
5. Make sure the tube seat is clean and connect the break line tube nut to the caliper. Tighten securely.
6. Allowing the hose to seek a normal position, without twist, insert hex of the hose fitting into the 12-point hole in the support bracket and secure it in place with the "U"-shaped retainer. Turn the steering geometry from lock to lock while observing the hose. Check that the hose does not touch other parts at any time during suspension or geometry travel. If contact does occur, remove the "U"-shaped retainer and rotate the end of the hose in the support bracket one or two points in a direction which will eliminate hose contact. Reinstall the retainer and recheck for hose contact. If it is satisfactory, place the steel tube connector in the hose fitting and tighten securely.
7. If rear brake caliper is being serviced, connect brake line to caliper.
8. Bleed brakes as outlined in this section.
9. Install wheels and lower vehicle.

CAUTION: Do not move car until a firm pedal is obtained.

BRAKE DISC

Servicing of the disc brakes is extremely critical due to tolerances required in machining of the brake disc to insure proper brake operation.

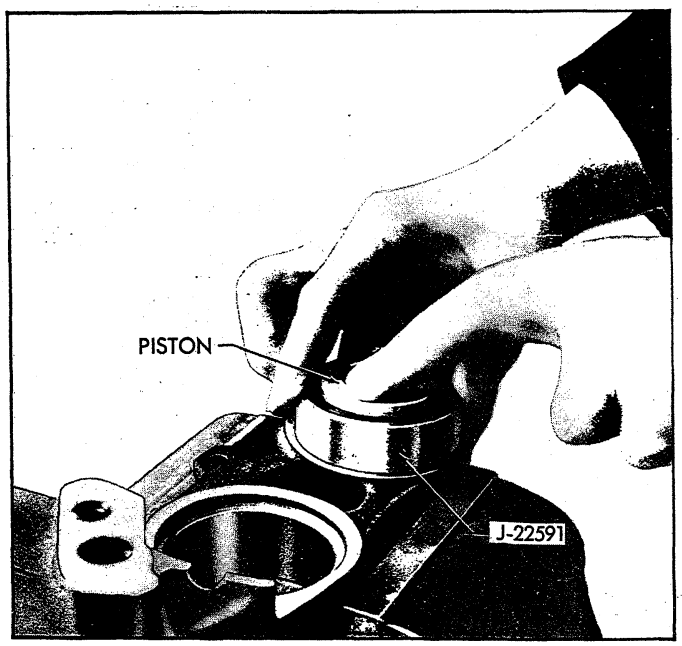


Fig. 38—Installing Piston in Caliper Bore Using Tool J-22591

Manufacturing tolerance for flatness and parallelism of the brake disc is held to .0005" while lateral runout of the brake disc surfaces cannot exceed .002" total indication reading. Excessive lateral runout of the brake disc will cause a "knocking back" of the pistons, which will create increased pedal travel and vibration when the brakes are applied. The finish of the frictional surfaces must be maintained at 30-50 micro inches.

In view of the foregoing close tolerances, machining of the discs is not recommended.

It has been found that, once a wear pattern has been established, disc brakes are less susceptible to scoring

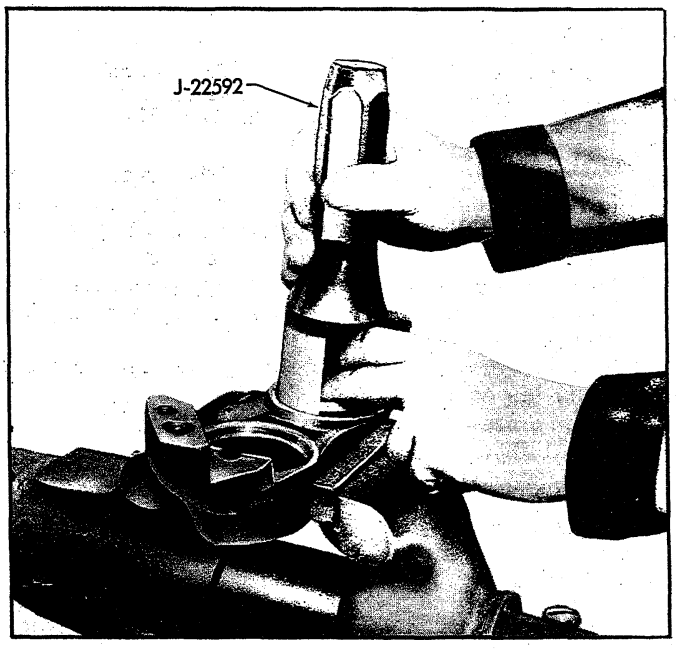


Fig. 39—Installing Boot Seal in Caliper Using Tool J-22592

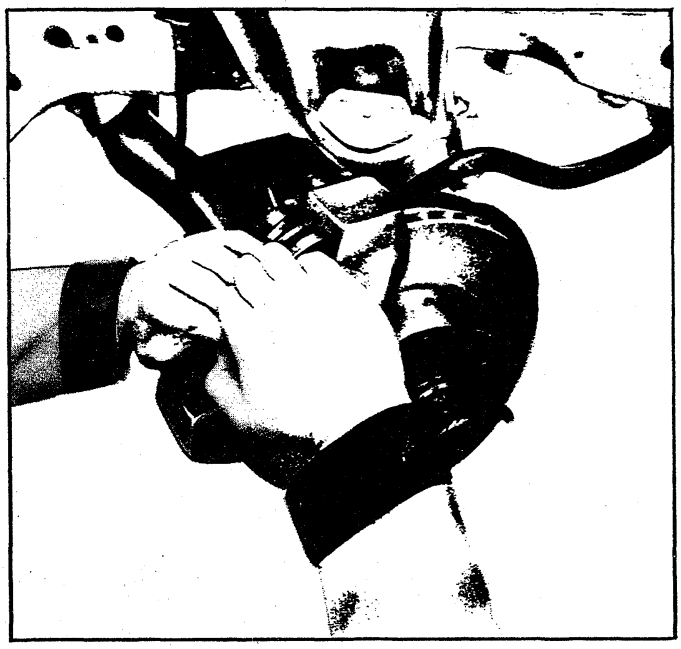


Fig. 40—Installing Caliper on Disc

problems than are drum brakes. Disc surface scoring imperfections less than .015 in depth have negligible effect on disc brake operation.

When the total disc thickness is less than 1.215, it should be replaced. Disc thickness less than this could permit the shoes to come out of contact with the shoe abutments and cause malfunction.

FRONT HUB

Removal

1. Raise vehicle on hoist.
2. Remove wheel and tire assembly.
3. Remove brake caliper as outlined in this section.
4. Remove hub and disc as an assembly on Corvette following removal procedure in Section 3. On Camaro the disc can be removed as any standard brake drum.

Disassembly and Assembly

On Corvette, drill out the rivets attaching the disc to the hub.

When reassembling the disc to the hub it is unnecessary to rivet the two assemblies. The lug nuts will supply ample retention. When checking runout after the rivets have been removed it will be necessary to install the lug nuts.

Installation

1. Follow removal procedure in reverse.
2. Bleed the system as outlined in this section.
3. Install wheel and tire assemblies and lower vehicle.

REAR HUB

Removal

1. Raise vehicle on hoist.
2. Remove wheel and tire.
3. Remove brake caliper as outlined in this section.
4. On Corvette, drill out rivets attaching the disc to the

axle spindle. On Camaro, remove as any standard brake drum.

5. Follow the same procedure as in front hub for reassembling the disc.

CAUTION: BE SURE THE EMERGENCY BRAKE ADJUSTING HOLES OF THE SPINDLE AND DISC ARE IN ALIGNMENT.

Installation

1. Follow removal procedure in reverse.
2. Bleed the system as outlined in this section.
3. Install wheel and tire assemblies and lower vehicle.

Checking Procedure (Fig. 41)

Front

Place car on hoist and raise. Tighten the adjusting nut of the wheel bearing until all play has been removed. It should be just loose enough to allow the wheel to turn. Clamp a dial indicator to the caliper so that its button contacts the disc at a point about 1 inch from the outer edge. When the disc is turned, the indicator reading should not exceed .002 inches. If runout exceeds this amount the hub and disc assembly should be replaced. Due to the close tolerances involved it is not recommended that the front discs be machined or serviced separately.

After checking the runout, readjust the wheel bearings as outlined in Section 3 of this manual.

Rear

Check the rear wheel bearing end play, as outlined in Section 4 of this manual. Then dial indicate the disc face. If lateral runout of the disc exceeds the bearing end play by .002 inches, the disc should be replaced.

MAIN CYLINDER

The service operations for the main cylinder are the same as for Duo-Servo main cylinder. Refer to service procedures under Duo-Servo Brakes.

PARKING BRAKE SHOES (Fig. 42)

Removal

1. Remove tire and wheel assemblies and brake disc as outlined in this section.
2. Remove retractor spring at the top of the shoes. Remove hold down springs on primary and secondary shoes.
3. Remove shoes by pulling them away from the anchor pin.
4. Remove the adjusting screw spring and adjusting screw from the shoes.

Installation

1. Put light coat of lubriplate or equivalent on pads, backing plate, and the threads of the adjusting screw.
2. Attach adjusting screw spring to the bottom hole in each shoe.
3. Insert the star wheel between the shoes. (On left hand brakes, the star wheel goes next to the rear shoe; on right hand brakes, the star wheel goes next to the forward shoe).
4. Install the shoes on the backing plate by spreading them and placing them around the anchor pin.
5. Install the hold down springs on the hold down nails.
6. Install retractor spring on one shoe and stretch to other shoe.

CAUTION: Make sure that the lever assembly which spreads the shoe is located so that the notches on the lever fit against the shoes.

7. Install disc and caliper as outlined in this section.
8. Bleed brakes as outlined in this section.
9. Adjust the parking brake as outlined in this section.
10. Install wheels and lower vehicle.

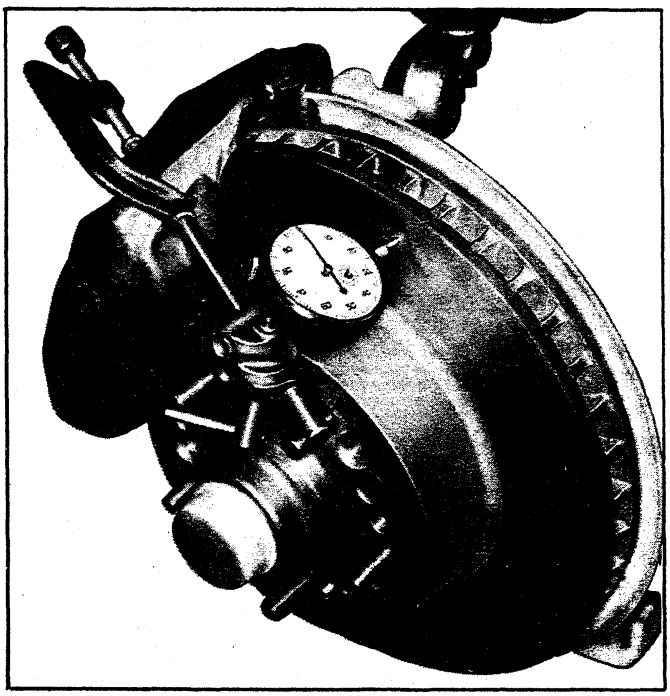


Fig. 41—Dial Indicating Disc for Runout

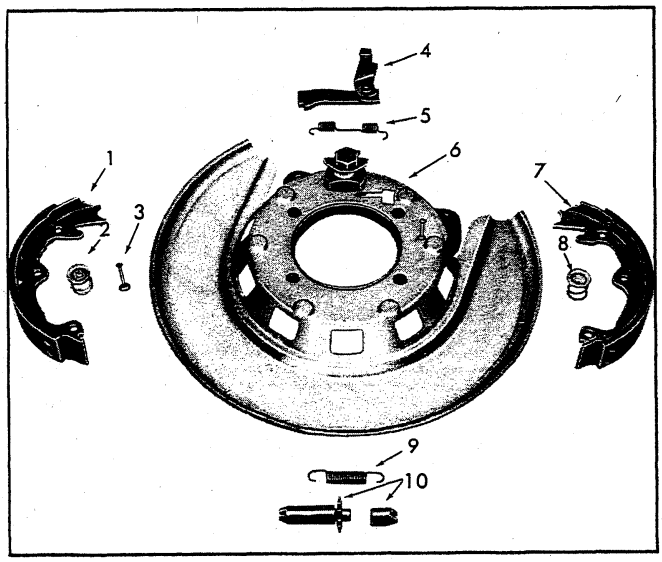


Fig. 42—Exploded View of Parking Brake Shoes

1. Parking Brake Shoe
2. Hold Down Spring and Cap
3. Hold Down Pin
4. Actuating Lever
5. Retractor Spring
6. Backing Plate
7. Parking Brake Shoe
8. Hold Down Spring and Cap
9. Adjusting Screw Spring
10. Adjusting Screw Assembly

NOTE: When replacing the parking brake shoes, it is necessary to "break in" the new shoes in the following manner. (Brakes should be adjusted before beginning.)

CORVETTE

1. Count the number of notches required to pull 40 lbs. on the parking brake handle. (Pull scale on the second finger notch).
2. Release the brake and drive the vehicle at 30 m.p.h.
3. Apply the parking brake the same number of notches gained in Step 1.
4. Maintain 30 m.p.h. for 1/4 mile and then release the brake.

CAMARO

1. Count the number of notches required to push 50 lbs. on the parking brake pedal (push scale on the pedal pad.)
2. Release the brake and drive the vehicle at 30 m.p.h.
3. Apply the parking brake the same number of notches gained in Step 1.
4. Maintain 30 m.p.h. for 1/4 mile and then release the brake.

DISC FRONT BRAKES

INDEX

	Page		Page
General Description	5-29	Brake Shoes	5-29
Maintenance and Adjustments	5-29	Brake Caliper	5-31
Bleeding System	5-29	Brake Rotor	5-33
Component Replacement and Repair	5-29	Main Cylinders	5-16

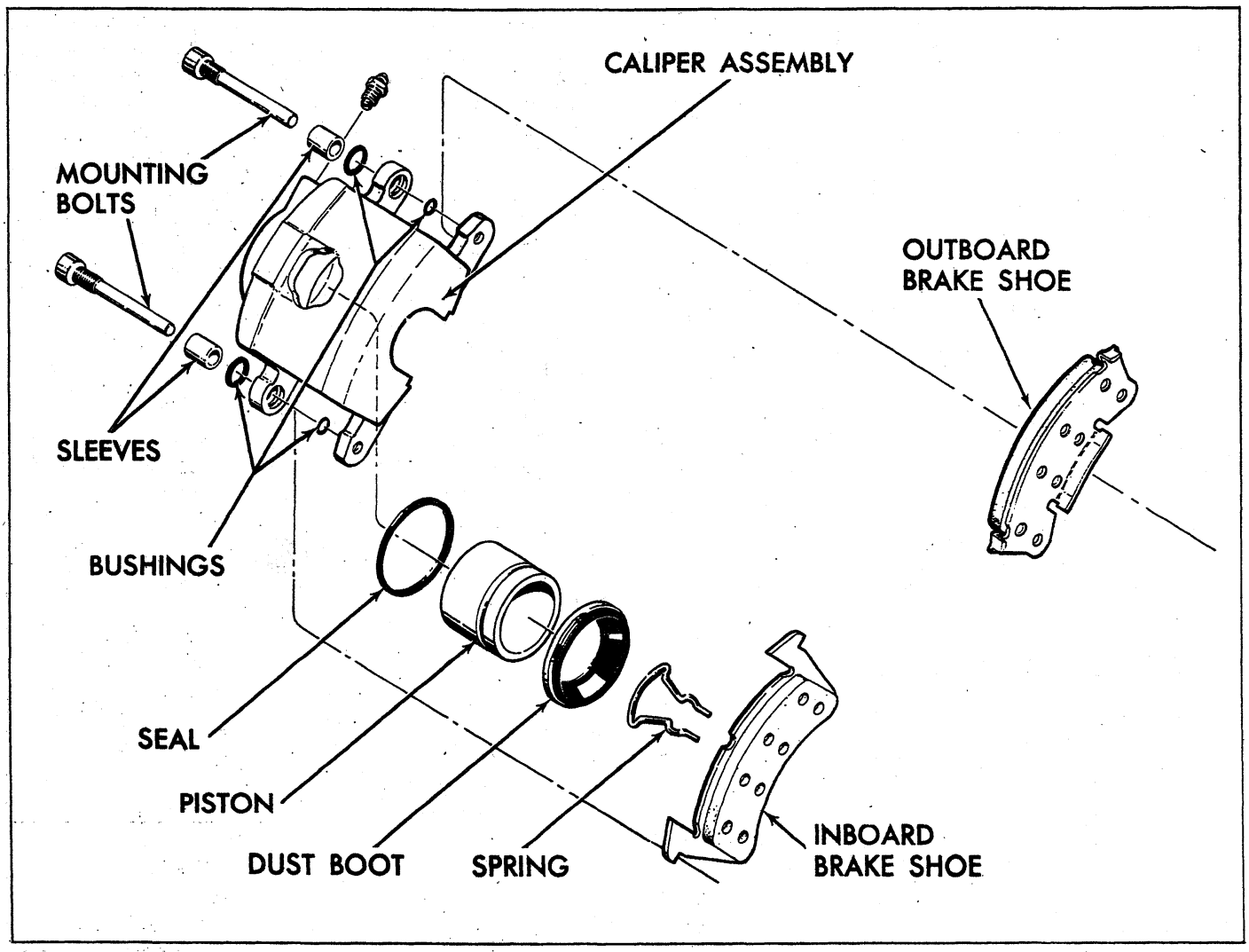


Fig. 43—Single Piston Caliper—Explode

GENERAL DESCRIPTION

A new single piston, sliding caliper front disc brake system is offered as optional equipment on Chevrolet, Chevelle, Nova and Camaro. This same brake system is standard equipment on some models. This system includes a pressure metering valve in the front brake system. This valve meters the hydraulic pressure to the front brakes so as to obtain simultaneous application of the front and rear brakes.

The single piston sliding caliper assembly (fig. 43) utilizes a one piece housing design with the inboard side bored for a single piston. A seal within the cylinder bore provides a hydraulic seal between the piston and cylinder wall.

When the brake pedal is depressed, hydraulic pressure forces the piston against the inner surface of the disc. This force causes the caliper to slide inboard, on four bushings, forcing the outer brake shoe and lining assembly against the outer surface of the disc (fig. 44).

Maintenance and adjustments not included in this section are the same as for Duo-Servo type brakes.

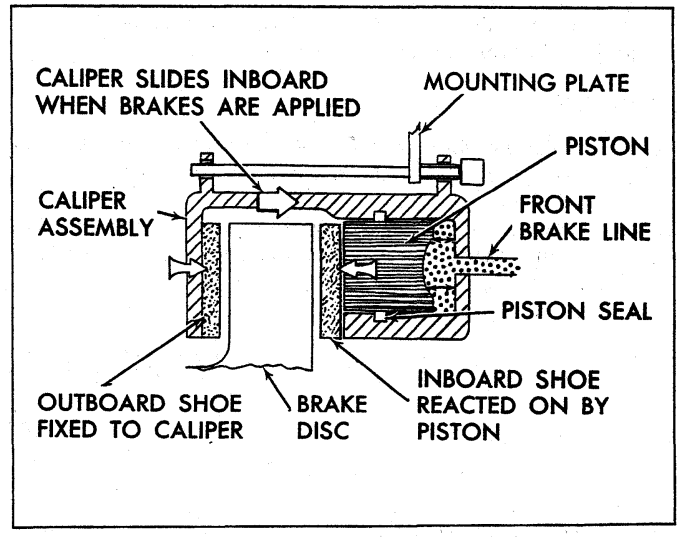


Fig. 44—Theory of Operation

MAINTENANCE AND ADJUSTMENTS

BLEEDING SYSTEM

The operation of bleeding the front disc brake hydraulic system is the same as for the 4 wheel disc brake system outlined in the beginning of that section. Note the exception below and refer to bleeding procedures under Duo-Servo brakes.

The spring loaded end of the pressure metering valve (fig. 45) must be depressed while bleeding. This can be done by depressing and holding in the plunger in the end of the valve either by hand, or by clamping.

COMPONENT REPLACEMENT AND REPAIR

BRAKE SHOE AND LINING REPLACEMENT

The brake linings should be inspected any time that the wheels are removed. Check both ends of the outboard shoe by looking in at each end of the caliper. This is the point at which the highest rate of wear normally occurs. At the same time, check the lining thickness on the inboard shoe by looking down through the inspection hole in the top of the caliper. The shoes should be replaced when the lining is worn to approximately .020 inch thickness over the rivet heads.

Removal

1. Remove main cylinder cover and observe brake fluid level in front reservoir. If reservoir is more than 1/3 full, siphon the necessary amount out to bring the level to 1/3 full. (This step is taken to avoid reservoir overflow when the caliper piston is pushed back into its bore.) Discard the brake fluid removed. Never reuse brake fluid.
2. Raise the vehicle and remove the front wheels.
3. Push the piston back into its bore.. This can be accomplished by using a "C" clamp as shown in Figure 47.
4. Remove the two mounting bolts which attach the caliper to the support as shown in Figure 46.

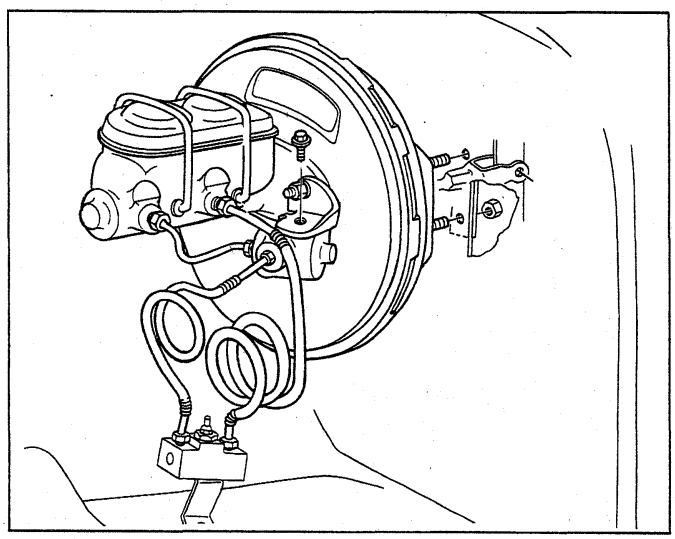


Fig. 45—Pressure Regulator Valve

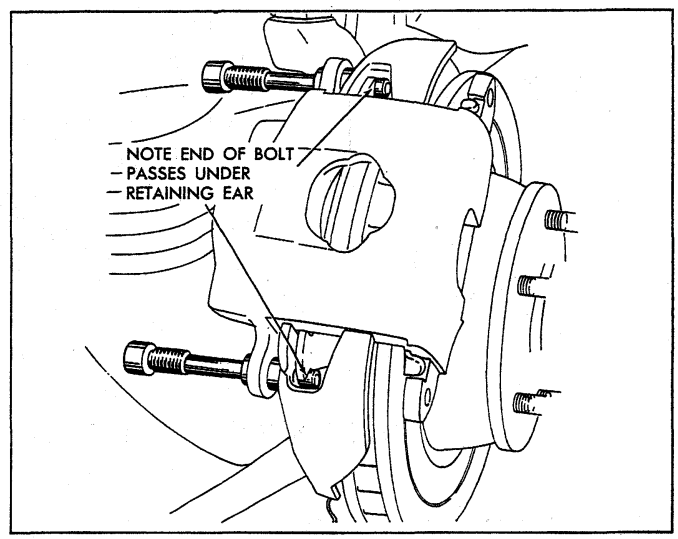


Fig. 46—Caliper Removal and Installation

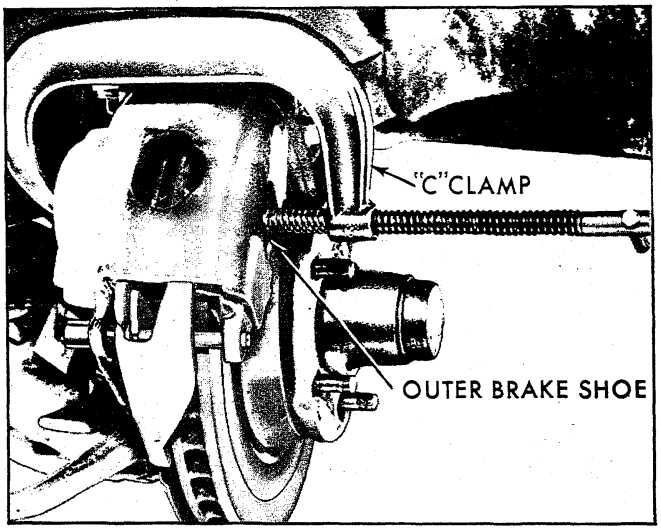


Fig. 47—"C" Clamp Installed for Removal Aid

5. Lift the caliper off the disc.
6. Remove the inboard shoe. Dislodge the outboard shoe and position the caliper on the front suspension arm so that the brake hose will not support the weight of the caliper.
7. Remove the shoe support spring from the piston.
8. Remove the two sleeves from the inboard ears of the caliper.
9. Remove the four rubber bushings from the grooves in each of the caliper ears.

Cleaning and Inspection

1. Thoroughly clean the holes and the bushing grooves in the caliper ears and wipe any dirt from the mounting bolts.

   NOTE: Do not use abrasives on the bolts since this may damage the plating. If the bolts are damaged or corroded, they should be replaced.

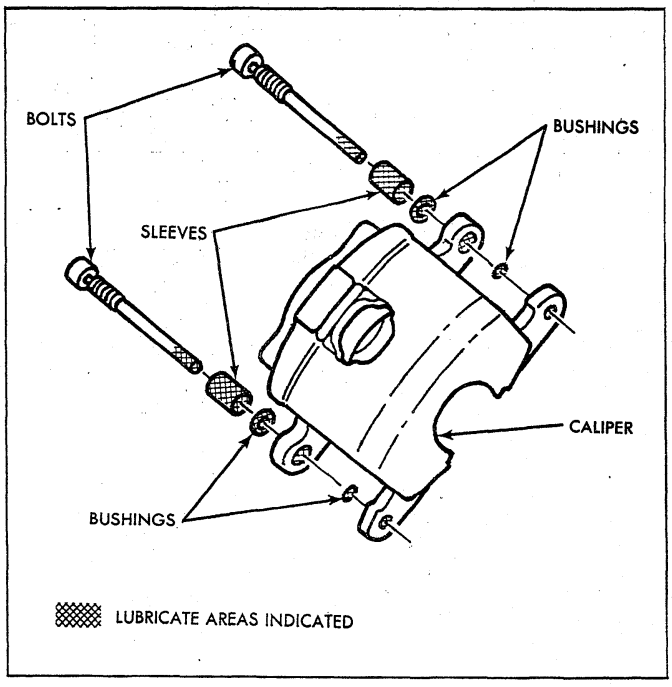


Fig. 48—Lubrication Points

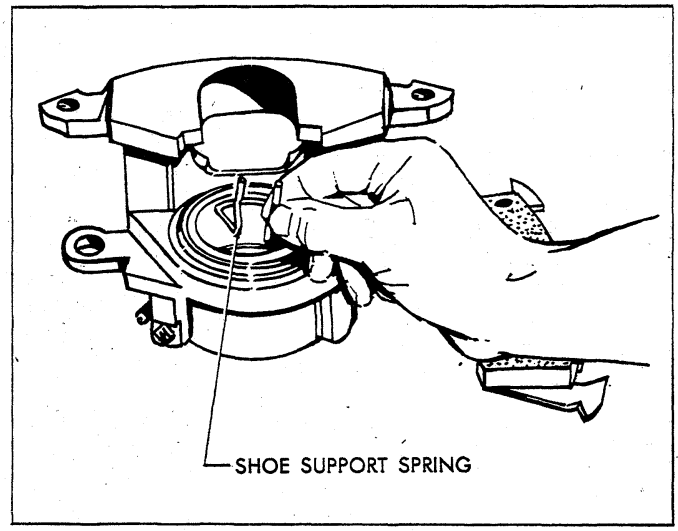


Fig. 49—Installing Support Spring

2. Examine the inside of the caliper for evidence of fluid leakage. If leakage is noted, the caliper should be overhauled.
3. Wipe the inside of the caliper clean, including the exterior of the dust boot. Check the boot for cuts, cracks or other damage.

   NOTE: Do not use compressed air to clean the inside of the caliper. This may cause the dust boot to become unseated.

Installation

1. Lubricate new sleeves, new rubber bushings, the bushing grooves and the end of the mounting bolts using Delco Moraine Silicone Lube or its equivalent (fig. 48).
2. Install the new rubber bushings in the caliper ears.
3. Install the new sleeves to the inboard ears of the caliper.

   NOTE: Position the sleeve so that the end toward the shoe and lining assembly is flush with the machined surface of the ear.

4. Install the shoe support spring in the center of the piston cavity as shown in Figure 49.
5. Position inboard shoe in caliper so that the spring ends centrally contact the shoe edge. Initially this will place the shoe on an angle (upper edge up). Push upper edge down until the shoe lays flat against the caliper (fig. 50). When properly sealed, the ends of the spring will not extend more than 0.100 inch beyond the metal part of the brake shoe.
6. Position the outboard shoe in the caliper with the ears at the top of the shoe over the caliper ears and the tab at the bottom of the shoe engaged in the caliper cutout.
7. With both shoes installed, lift up the caliper and rest the bottom edge of the outboard lining on the outer edge of the brake disc to make sure there is no clearance between the tab at the bottom of the outboard shoe and the caliper abutment.
8. Using a 1/4 x 1 x 2-1/2 inch metal bar to bridge the

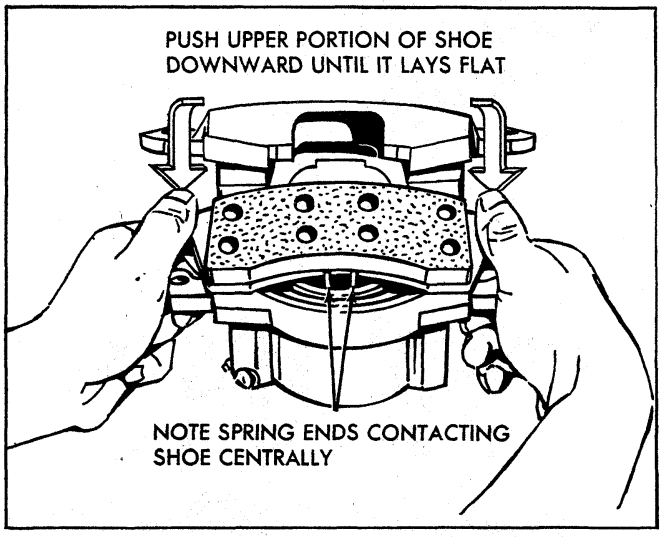


Fig. 50—Installing Shoe to Caliper

caliper cutout, clamp the outboard shoe to the caliper using a "C" clamp as shown in Figure 51.

NOTE: Use a clean "C" clamp to avoid contamination of the brake lining and do not use excessive force which could deform the lining face.

9. Using vice-grip pliers, as shown in Figure 51 bend both upper ears of the outboard shoe over the caliper until the clearance between the shoe ear and the caliper (measured at both the edge and side of the caliper) is 0.005 inch or less.
10. Remove the "C" clamp and position the caliper over the brake disc, lining up the hole in the caliper ears with the holes in the mounting bracket.

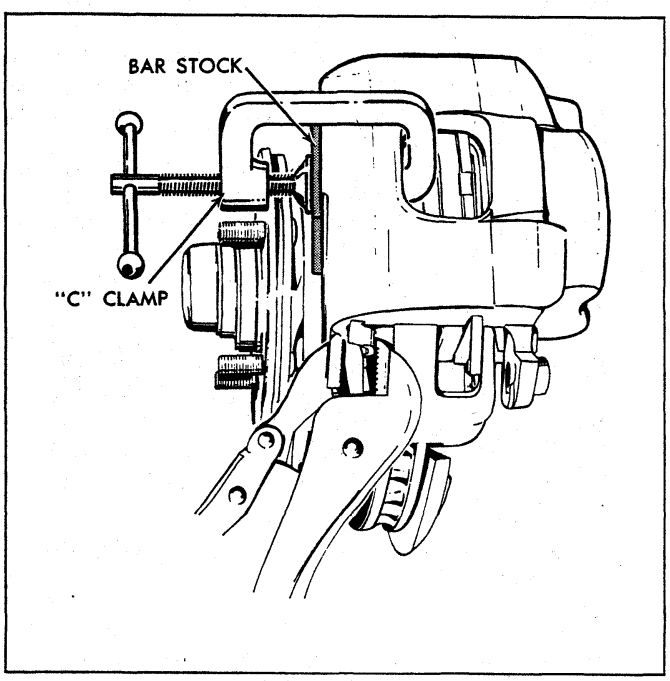


Fig. 51—Fitting Shoe to Caliper

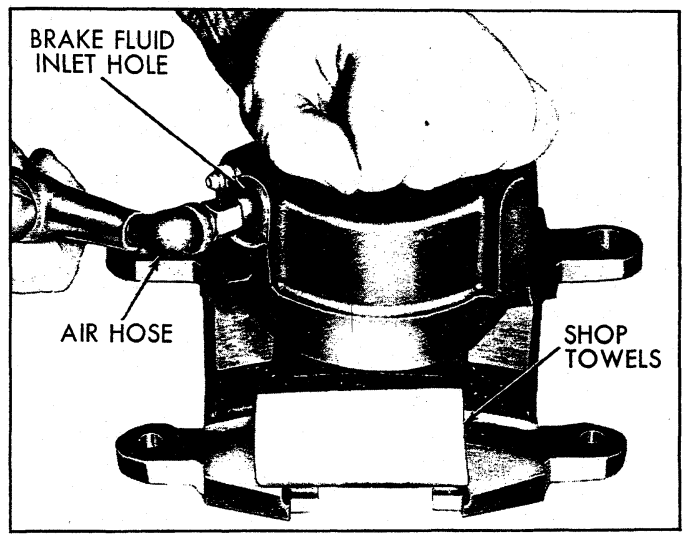


Fig. 52—Removing Piston from Caliper

NOTE: Make sure that the brake hose is not twisted or kinked.

11. Start the caliper to mounting bracket bolts through the sleeves in the inboard caliper ears and the mounting bracket, making sure that the ends of the bolts pass under the retaining ears on the inboard shoe (fig. 46).
12. Push the mounting bolts through to engage the holes in the outboard ears. Then thread the mounting bolts into the mounting bracket.
13. Torque the mounting bolts to 30-40 ft. lbs.
14. Reinstall the front wheel and lower the vehicle.
15. Add brake fluid to the master cylinder reservoir to bring the fluid level up to within 1/4 inch of the top.

NOTE: Before moving the vehicle, pump the brake pedal several times to make sure that it is firm. Do not move vehicle until a firm pedal is obtained.

CALIPER OVERHAUL

1. Disconnect the hose from the steel brake line and cap or tape the fittings to prevent dirt from entering the line or hoses.
2. Remove the U-shaped retainer from the hose fitting.
3. Withdraw the hose from the frame support bracket and remove the caliper with the hose attached.

Disassembly

1. Clean the exterior of the caliper using denatured alcohol or equivalent and place on a clean work surface.
2. Remove the brake hose from the caliper and discard the copper gasket.
3. Drain the brake fluid from the caliper.
4. Using clean shop towels, pad the interior of the caliper and remove the piston by directing compressed air into the caliper inlet hole (fig. 52).

NOTE: Use just enough air pressure to ease the piston out of the bore. Do not blow piston out of the bore.

CAUTION: DO NOT PLACE THE FINGERS IN FRONT OF THE PISTON IN AN ATTEMPT TO

CATCH OR PROTECT IT WHEN APPLYING COMPRESSED AIR. THIS COULD RESULT IN SERIOUS INJURY.

5. Using a screw driver and caution so as not to scratch the piston bore, pry the dust boot out of the caliper piston bore.
6. Using a small piece of wood or plastic remove the piston seal from its groove in the caliper piston bore.

   NOTE: Do not use a metal tool of any kind for this operation as it may damage the bore.

7. Remove the bleeder valve from the caliper.

Cleaning and Inspection

NOTE: The dust boot, piston seal, rubber bushings and sleeves are to be replaced each time that the caliper is over-hauled. Discard these parts - do not bother to clean and inspect them.

1. Clean all parts (other than those mentioned above) in Declene or its equivalent. Use dry, filtered, compressed air to dry parts and blow out all passages in the caliper and bleeder valve.

   NOTE: The use of lubricated shop air will leave a film of mineral oil on the metal parts. This may damage rubber parts when they come in contact after reassembly.

2. Check the mounting bolts for corrosion or other damage. Do not attempt to clean up the bolts. If they appear corroded - replace them.
3. Carefully examine the outside surface of the piston for scoring, nicks, corrosion and worn or damaged chrome plating. If any surface defects are detected, replace the piston.

   NOTE: The piston outside diameter is the primary sealing surface in the caliper assembly. It is manufactured and plated to close tolerances. Refinishing by any means or the use of any abrasive is not an acceptable practice.

4. Check the bore in the caliper for the same defects as the piston. The piston bore, however, is not plated and stains or minor corrosion can be polished with crocus cloth.

   NOTE: Do not use emery cloth or any other form of abrasive and thoroughly clean the caliper after the use of crocus cloth. If the bore cannot be cleaned up in this manner, replace the caliper.

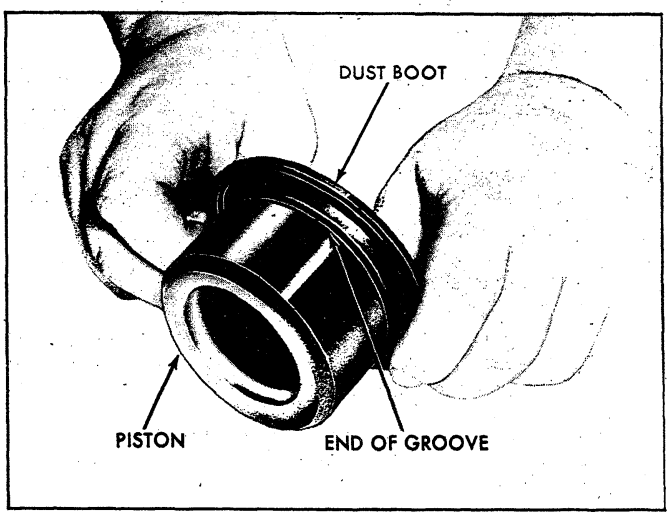


Fig. 53—Installing Boot to Piston

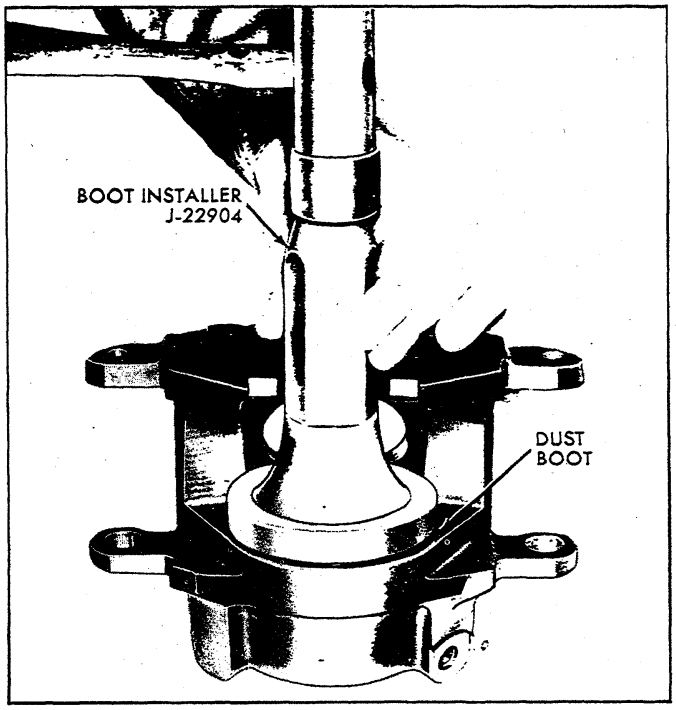


Fig. 54—Installing Boot to Caliper

Reassembly

1. Lubricate the caliper piston bore and the new piston seal with clean brake fluid. Position the seal in the caliper bore groove.
2. Lubricate the piston with clean brake fluid and assemble a new boot into the groove in the piston so that the fold faces the open end of the piston as shown in Figure 53.
3. Insert the piston into the caliper bore using care not to unseat the seal and force (50 to 100 pounds force required) the piston to the bottom of the bore.
4. Position the dust boot in the caliper counterbore and seat using boot installer Tool J-22904 as shown in Figure 54.

   NOTE: Check the boot installation to make sure that the retaining ring moulded into the boot is not bent and that the boot is installed below the caliper face and evenly all around. If the boot is not fully installed, dirt and moisture may enter the bore and cause damage or corrosion.

5. Install the brake hose in the caliper inlet using a new copper gasket.

Installation

NOTE: Installation of the caliper and mounting parts (rubber bushings, sleeves, bolts, and shoe and lining assemblies) is the same as for:

Brake Shoes and Linings - Installation (Pages 29 through 31 of this insert) except for the steps given below.

1. Connect the brake hose to the brake line at the frame bracket.
2. Bleed the calipers using the method outlined in the 4 wheel disc brake section.

ROTOR SERVICING

Servicing of the brake rotor is extremely critical since accurate control of the rotor tolerances is necessary to insure proper brake operation. For this reason, machining of the rotor is not recommended. A rotor that does not meet specifications should be discarded and replaced with a new rotor.

Lateral runout is the movement of the rotor from side to side as it rotates. This could also be described as "rotor wobble". The movement of the rotor from side to side in the lateral plane causes the brake shoe and lining to knock the piston back into its bore. This results in additional pedal travel required and a vibration during the braking action.

Variations in rotor thickness or parallelism, cause pedal vibration as well as front end vibration during brake applications. When rotor thickness is less than 1.215 inch on Chevrolet and .965 on all other vehicles it should be replaced.

The surface finish of the rotor is held to 30-50 micro inches. Control of the rubbing surface finish is necessary to avoid pulling or grabbing during brake application and also to extend lining life. Light scoring of the rotor surfaces not exceeding 0.015 inch in depth, however, which may result from normal use is not detrimental to brake operation.

CHECKING LATERAL RUNOUT

Tighten the wheel bearing adjusting nut until all of the play is out of the bearing. It should be just loose enough to allow the wheel to turn. Fasten a dial indicator to some portion of the suspension so that the point of the stylus contacts the rotor face approximately one inch from the rotor edge. Set the dial at zero and move the rotor one complete rotation, checking the indicator as the rotor moves. The total indicator reading should not exceed 0.002 inch. After checking the runout, readjust the wheel bearing.

CHECKING PARALLELISM

To check for parallelism, measure the thickness of the rotor at four or more points around the circumference of the rotor. All measurements must be made at the same distance in from the edge of the rotor. Total variation in thickness must not exceed 0.0005 inch.

POWER BRAKES

INDEX

	Page
General Description	5-33
Maintenance and Adjustments	5-33
Inspection	5-33
Lubrication	5-33
Bleeding Instructions	5-34
Air Cleaner Service	5-34
Component Replacement	5-34
Power Brake Cylinder	5-34
Removal	5-34
Disassembly and Assembly	See Overhaul Manual
Installation	5-34

GENERAL DESCRIPTION

The Power Brake Unit is a self-contained hydraulic and vacuum unit, utilizing manifold vacuum and atmosphere pressure for its power.

This unit permits the use of a low brake pedal as well as less pedal effort than is required with the conventional (nonpower) hydraulic brake system. Only two external line connections are necessary - one a vacuum connection from manifold to check valve located on front shell; the other, a hydraulic connection from the main cylinder outlet directly into the hydraulic system. The unit is mounted on the engine side of the fire wall and directly connected to the brake pedal.

MAINTENANCE AND ADJUSTMENTS

INSPECTIONS

1. Check vacuum line and vacuum line connections as well as vacuum check valve in front shell of power unit for possible vacuum loss.
2. Inspect all hydraulic lines and connections at the wheel cylinders and main cylinder for possible hydraulic leaks.
3. Check brake assemblies for scored drums, grease or brake fluid on linings, worn or glazed linings, and make necessary adjustments.
4. Check brake fluid level in the hydraulic reservoirs. The reservoirs should be filled to the levels shown in Figure 8.
5. Check for loose mounting bolts at main cylinder and at power section.
6. Check air cleaner filter in power piston extension and replace filter if necessary.
7. Check brake pedal for binding and misalignment between pedal and push rod.

LUBRICATION

The power brake unit is lubricated at assembly and

needs no further lubrication other than maintaining normal reservoir fluid level. The reservoir should be filled as described in this section.

BLEEDING INSTRUCTIONS

The power system may be bled manually or with a pressure bleeder as outlined in this section. Use only GM Supreme 11 Brake Fluid or equivalent. Do not use the power assist while bleeding. The engine should not be running and the vacuum reserve should be reduced to zero by applying the brake several times before starting the bleeding procedure.

AIR CLEANER SERVICE

Servicing of the air cleaner is recommended and the element replaced when restriction becomes severe enough to affect power brake response. At any other time, if cleaning of the filter is felt necessary, it should be shaken free of dirt or washed in soap and water and thoroughly dried.

COMPONENT REPLACEMENT

POWER BRAKE CYLINDER

Removal

1. Remove vacuum hose from vacuum check valve.
2. Disconnect hydraulic lines at main cylinder.
3. Disconnect push rod at brake pedal assembly.
4. Remove nuts and lock washers securing power unit to fire wall, and remove power unit from engine compartment.

CHEVELLE

Manual Transmission

1. Remove main cylinder from power unit.
2. Remove vacuum line from vacuum check valve.
3. From inside vehicle remove nuts and lock washers securing power unit to fire wall.
4. Push brake pedal to floor. This will push power unit away from fire wall. With pedal on the floor adequate clearance between the brake pedal-to-push rod pivot pin and the clutch rod is obtained for removal of the pin.
5. Remove clip from pin. Remove power unit from vehicle.
6. To install, reverse Steps 1-5.

Repair procedures for the power cylinder are outlined in the Brake Section of the Overhaul Manual - for service of the main cylinder refer to applicable portion of "Standard Brakes" in this manual.

Installation

1. Mount the power brake assembly in place and install the attaching nuts and lock washers.
2. Attach vacuum line to check valve.
3. Secure hydraulic lines to main cylinder.
4. Attach push rod to brake pedal assembly, and check operation of stop light.
5. Bleed brakes as outlined in this section.

CAUTION: After replacing the unit on the vehicle, start the engine and allow vacuum to build up before applying the brake.

SPECIAL TOOLS

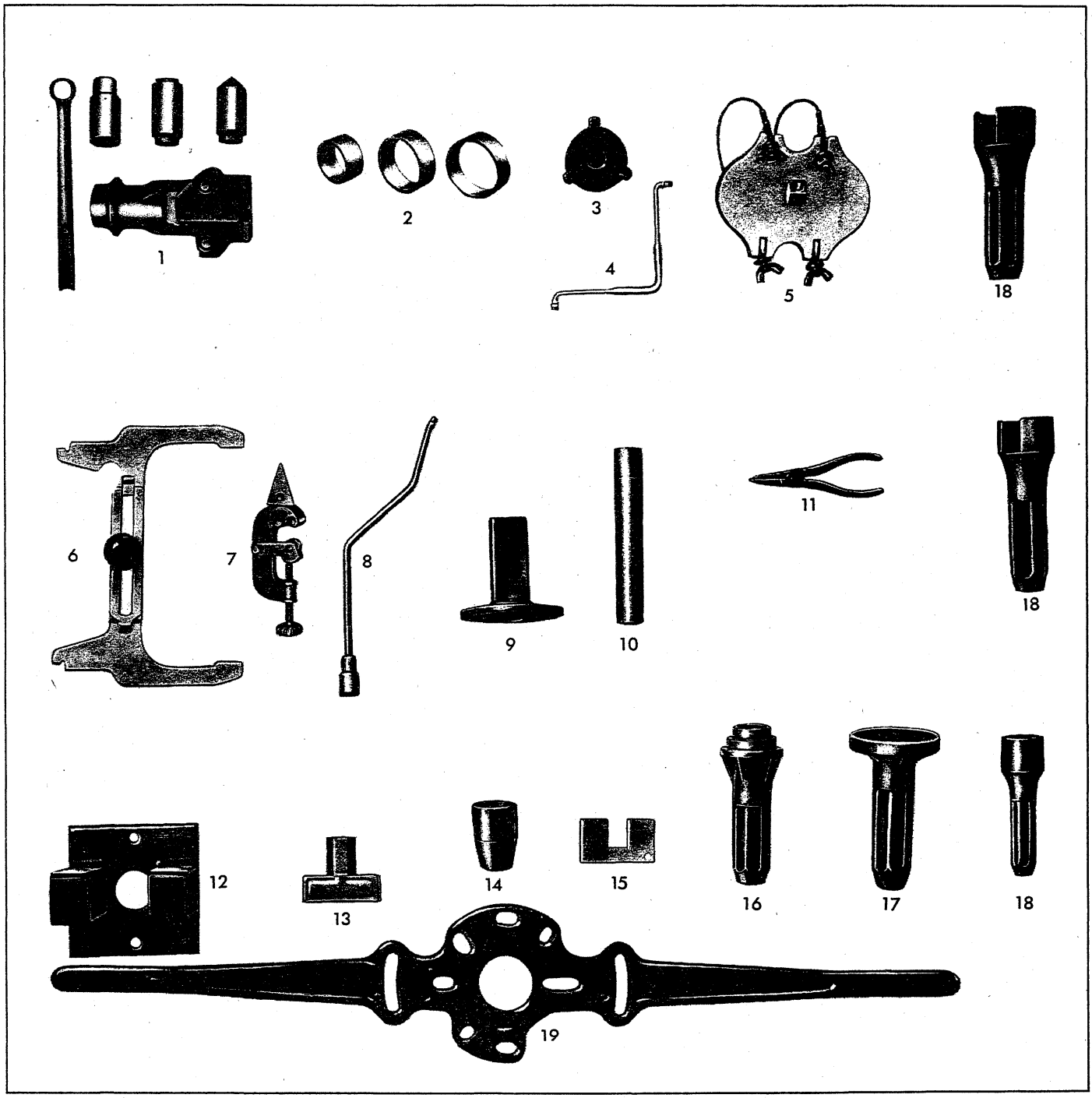


Fig. 55—Special Tools

1. J-8051 Brake Tube Flaring Tool
2. J-22591 - J-22629 - J-22639 Piston Ring Compressor
3. J-21524 Power Piston Remover and Installer
4. J-21472 Brake Bleeder Wrench
5. J-22489 Pressure Bleeder Adapter
6. J-21177 Drum to Shoe Clearance Gauge
7. J-8113 Brake Tube Cutter
8. J-8049 Brake Spring Remover and Installer
9. J-22805 Vacuum Power Cylinder Holding Fixture
10. J-21601 Power Brake Retainer Installer
11. J-4880 Truarc Pliers
12. J-22893 Brake Vacuum Booster Separating Adapter
13. J-22839 Front Plate Holding Fixture
14. J-22733 Seal Installer Protector
15. J-7723-01 Push Rod Height Gauge
16. J-22677 Vacuum Power Cylinder Seal Installer
17. J-22904 Dust Boot Installer
18. J-22592 - J-22628 - J-22638 Boot Seal Installer
19. J-9504 Vacuum Power Cylinder Spanner Wrench

SECTION 6
ENGINE

CONTENTS OF THIS SECTION

	Page
Engine Tune Up	6-1
Engine Mechanical (In Line)	6-14
Engine Mechanical (V8)	6-26
Torque Sequence	6-43
Special Tools	6-44

ENGINE TUNE UP

INDEX

	Page
General Description	6-1
Mechanical Checks and Adjustments	6-1
Spark Plug Removal	6-1
Test Compression	6-1
Service and Install Spark Plugs	6-2
Service Ignition System	6-2
Service Battery and Battery Cables	6-4
Service Delcotron and Regulator	6-5
Service Fan Belt	6-5
Service Manifold Heat Valve	6-5
Tighten Manifold	6-5
Service Fuel Lines and Fuel Filter	6-5
Service Cooling System	6-5
Check and Adjust Accelerator Linkage	6-6
Service Crankcase Ventilation	6-6
Service Air Injection Reactor System	6-6
Choke Adjustment	6-7
Instrument Check-Out	6-8
Instrument Hook-Up	6-8
Check and Adjust Dwell	6-8
Check Dwell Variation	6-8
Check and Adjust Timing	6-9
Adjust Idle Speed and Mixture	6-9
Additional Checks and Adjustments	6-9
Testing Crankcase Ventilation Valve	6-9
Cylinder Balance Test	6-9
Testing Cranking Voltage	6-11
Battery	6-11
Ignition	6-11
Carburetor	6-12
Fuel Pump	6-12
Cooling System	6-12
Cylinder Head Torque and Valve Adjustment	6-12

GENERAL DESCRIPTION

The engine tune up is important to the modern automotive engine with its vastly improved power and performance. The higher compression ratios, improved electrical systems and other advances in design, make today's engines more sensitive and have a decided effect on power, performance and fuel consumption.

It is seldom advisable to attempt a tune up by correction of one or two items only. Time will normally be saved and more lasting results assured if the technician will follow a definite and thorough procedure of analysis and correction of all items affecting power, performance and economy.

The tune up will be performed in two parts. The first part will consist of visual and mechanical checks and adjustments; the second part will consist of an instrument checkout that can be performed with any one of the units of service equipment available for this purpose. Always follow the instructions provided by the manufacturer of the particular equipment to be used.

Additional checks and adjustments are included in the latter part of this section for use as required. Many of these operations can be used to isolate and correct trouble located during the tune up. Where conditions are uncovered requiring major corrective action, refer to the appropriate section of this manual or the Passenger Car Chassis Overhaul Manual for detailed service information.

Typical illustrations and procedures are used except where specific illustrations or procedures are necessary to clarify the operation. Illustrations showing bench operations are used for clarification, however, all operations can be performed on the vehicle.

MECHANICAL CHECKS AND ADJUSTMENTS

Spark Plug Removal

Remove any foreign matter from around spark plugs by blowing out with compressed air, then disconnect wires and remove plugs.

Test Compression (Fig. 1)

The compression check is important because an engine with low or uneven compression cannot be tuned successfully. It is essential that improper compression be corrected before proceeding with the engine tune up.

1. Remove air cleaner and block throttle and choke in wide open position.
2. Hook up starter remote control cable and insert compression gauge firmly in spark plug port.

CAUTION: Whenever the engine is cranked

remotely at the starter, with a special jumper cable or other means, the primary distributor lead must be disconnected from the negative post on the coil and the ignition switch must be in the "ON" position. Failure to do this will result in a damaged grounding circuit in the ignition switch.

3. Crank engine through at least four compression strokes to obtain highest possible reading.
4. Check and record compression of each cylinder.
5. If one or more cylinders read low or uneven, inject about a tablespoon of engine oil on top of pistons in low reading cylinders (through spark plug port). Crank engine several times and recheck compression.
   - If compression comes up but does not necessarily reach normal, rings are worn.
   - If compression does not improve, valves are burnt, sticking or not seating properly.
   - If two adjacent cylinders indicate low compression and injecting oil does not increase compression, the cause may be a head gasket leak between the cylinders. Engine coolant and/or oil in cylinders could result from this defect.

NOTE: If a weak cylinder cannot be located with the compression check, see "Cylinder Balance Test" under "Additional Checks and Adjustments" in this section.

Service and Install Spark Plugs (Fig. 2)

1. Inspect each plug individually for badly worn electrodes, glazed, broken or blistered porcelains and replace plugs where necessary. Refer to spark plug diagnosis information presented in Section 6Y for an analysis of plug conditions.
2. Clean serviceable spark plugs thoroughly, using an abrasive-type cleaner such as sand blast. File the center electrode flat.
3. Inspect each spark plug for make and heat range. All plugs must be of the same make and number.
4. Adjust spark plug gaps to specifications using a round feeler gauge.

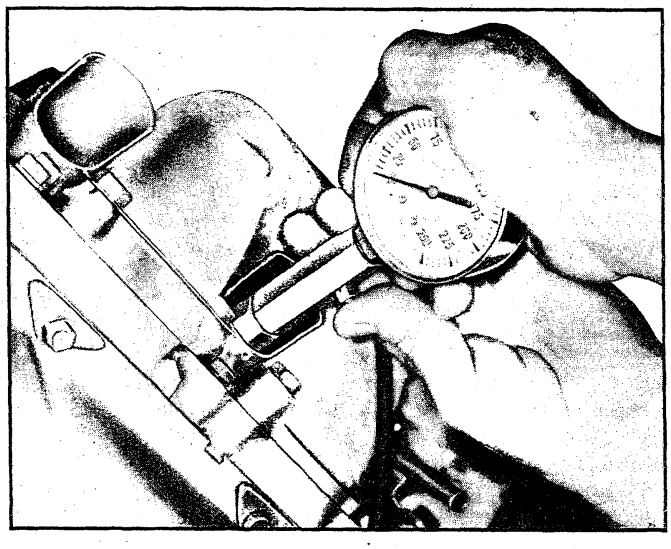


Fig. 1 - Checking Compression

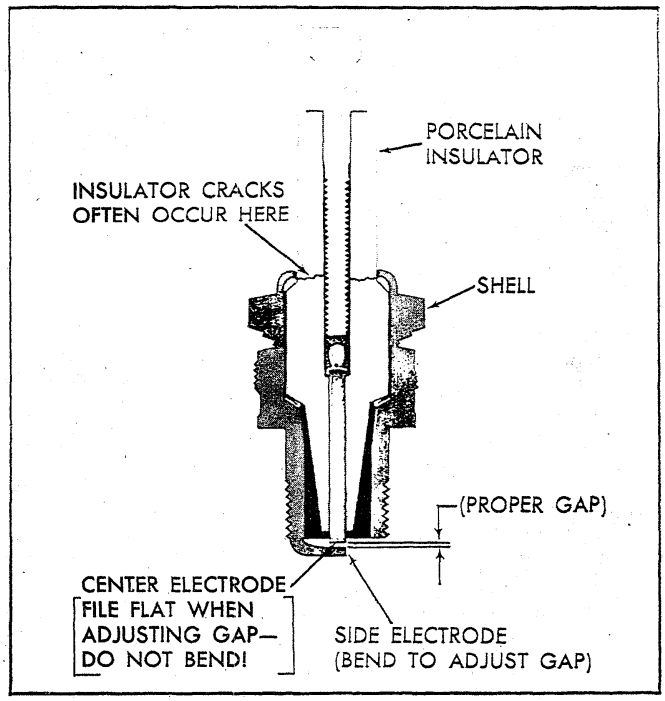


Fig. 2 - Spark Plug Detail

CAUTION: Never bend the center electrode to adjust gap. Always adjust by bending ground or side electrode.

5. If available, test plugs with a spark plug tester.
6. Inspect spark plug hole threads and clean before installing plugs. Corrosion deposits can be removed with a 14 mm. x 1.25 SAE spark plug tap (available through local jobbers) or by using a small wire brush in an electric drill. (Use grease on tap to catch chips.)

CAUTION: Use extreme care when using tap to prevent cross threading. Also crank engine several times to blow out any material dislodged during cleaning operation.

7. Install spark plugs with new gaskets and torque to specifications.

NOTE: The following are some of the greatest causes of unsatisfactory spark plug performance.

- Installation of plugs with insufficient torque to fully seat the gasket.
- Installation of the plugs using excessive torque which changes gap settings.
- Installation of plugs on dirty gasket seal.
- Installation of plugs into corroded spark plug hole threads.

8. Connect spark plug wiring.

Service Ignition System (Fig. 3)

1. Remove distributor cap, clean cap and inspect for cracks, carbon tracks and burned or corroded terminals. Replace cap where necessary.

2. Clean rotor and inspect for damage or deterioration. Replace rotor where necessary.
3. Replace brittle, oil soaked or damaged spark plug wires. Install all wires to proper spark plug. Proper positioning of spark plug wires in supports is important to prevent cross-firing.
4. Tighten all ignition system connections.
5. Replace or repair any wires that are frayed, loose or damaged.

Magnetic Pulse(Breakerless) Distributor

There are no moving parts in the ignition pulse amplifier, and the distributor shaft and bushings have permanent type lubrication, therefore no periodic maintenance is required for the magnetic pulse ignition system. Refer to Section 6Y for an analysis of problems and/or repair procedures encountered on the Transistorized (Magnetic Pulse) ignition system.

Standard (Breaker Point) Distributor (Figs. 4 or 5)

1. Check the distributor centrifugal advance mechanism by turning the distributor rotor in a clockwise direction as far as possible, then releasing the rotor to see if the springs return it to its retarded position. If the rotor does not return readily, the distributor must be disassembled and the cause of the trouble corrected.
2. Check to see that the vacuum spark control operates freely by turning the movable breaker plate counterclockwise to see if the spring returns to its retarded position. Any stiffness in the operation of the spark control will affect the ignition timing. Correct any interference or binding condition noted.
3. Examine distributor points and clean or replace if necessary.
   - Contact points with an overall gray color and only slight roughness or pitting need not be replaced.
   - Dirty points should be cleaned with a clean point file.

     Use only a few strokes of a clean, fine-cut contact file. The file should not be used on other metals and should not be allowed to become greasy or dirty. Never use emery cloth or sandpaper to clean contact points since particles will embed and cause arcing and rapid burning of points. Do not attempt to remove all roughness nor dress the point surfaces down smooth. Merely remove scale or dirt.
   - Clean cam lobe with cleaning solvent, lubricate cam lobe with "Delco Remy Cam and Ball Bearing Lubricant" or its equivalent and rotate cam lubricator wick 1/2 turn.
   - Replace points that are burned or badly pitted.

NOTE: Where prematurely burned or badly pitted points are encountered, the ignition system and engine should be checked to determine the cause of trouble so it can be eliminated. Unless the condition causing point burning or pitting is corrected, new points will provide no

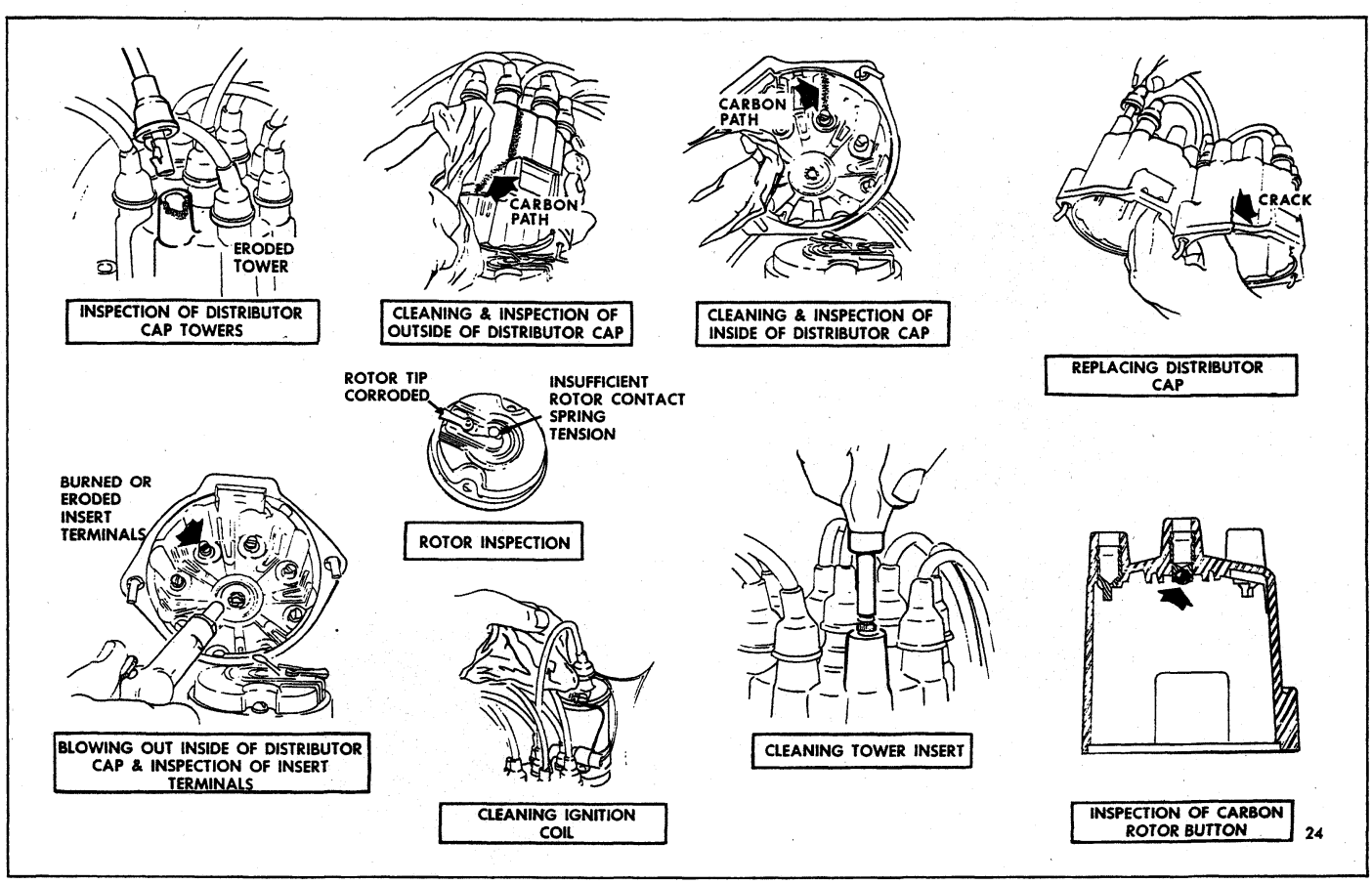


Fig. 3—Cleaning and Inspecting Distributor Cap, Rotor, and Coil

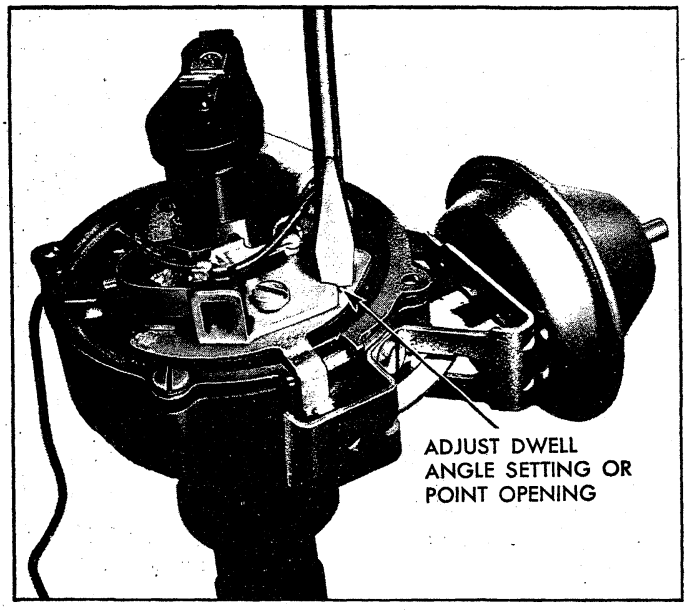


Fig. 4—Distributor (In Line)

better service than the old points. Refer to Section 6Y for an analysis of point burning or pitting.

- Check point alignment (fig. 6) then, adjust distributor contact point gap to .019" (new points) or .016" (used points). Breaker arm rubbing block must be on high point of lobe during adjustment.

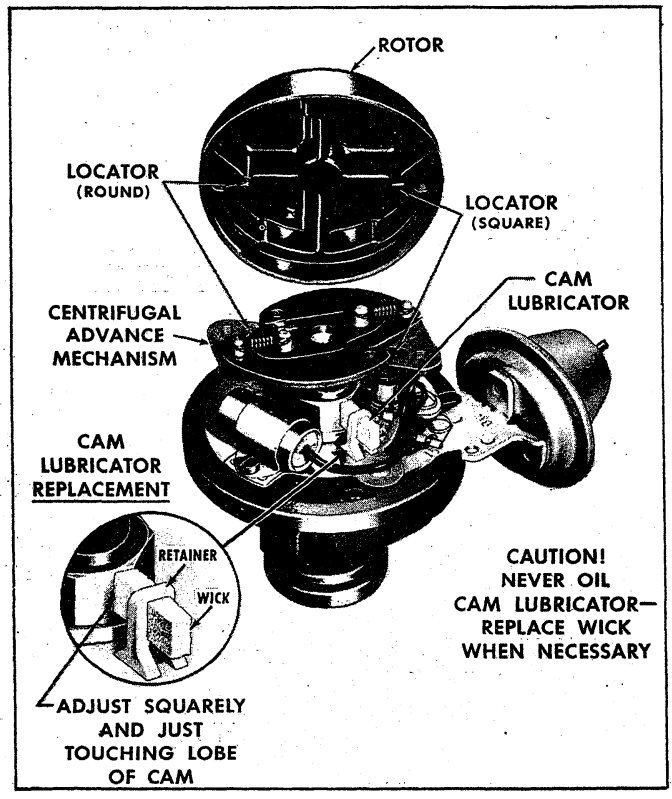


Fig. 5—Distributor (V-8)

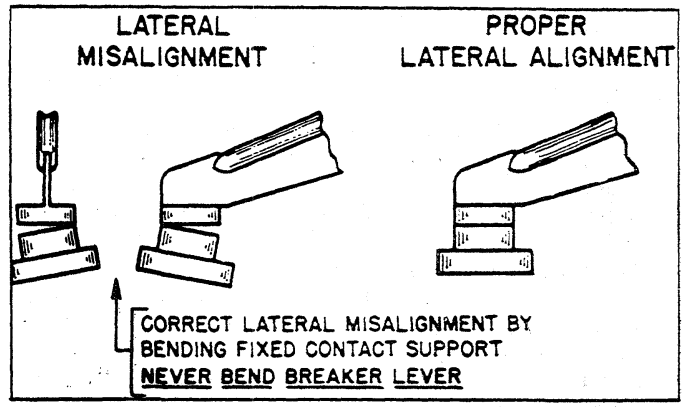


Fig. 6—Point Alignment

NOTE: If contact points have been in service, they should be cleaned with a point file before adjusting with a feeler gauge.

- Check distributor point spring tension (contact point pressure) with a spring gauge hooked to breaker lever at the contact and pull exerted at 90 degrees to the breaker lever. The points should be closed (cam follower between lobes) and the reading taken just as the points separate. Spring tension should be 19-23 ounces. If not within limits, replace.

  Excessive point pressure will cause excessive wear on the points, cam and rubber block. Weak point pressure permits bouncing or chattering, resulting in arcing and burning of the points and an ignition miss at high speed.

4. Install rotor and distributor cap. Press all wires firmly into cap towers.

Service Battery and Battery Cables

1. Measure the specific gravity of the electrolyte in each cell (fig. 7). If it is below 1.230 (corrected to

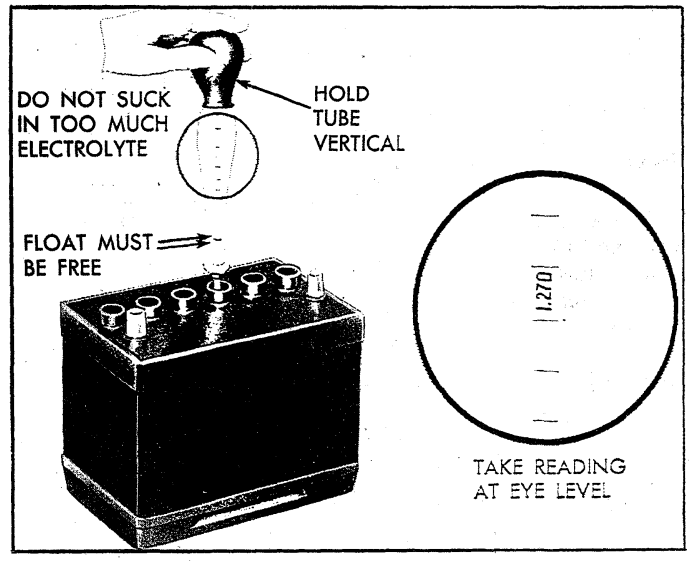


Fig. 7—Testing Specific Gravity of Battery

80°F.) recharge with a slow rate charger, or if desired, further check battery.

2. Connect a voltmeter across the battery terminals and measure the terminal voltage of the battery during cranking (disconnect the coil primary lead at the negative terminal during this check to prevent engine from firing). If the terminal voltage is less than 9.0 volts at room temperature, approximately 80° ± 20°F., the battery should be further checked. See Section 6Y for further tests.
3. Inspect for signs of corrosion on battery, cables and surrounding area, loose or broken carriers, cracked or bulged cases, dirt and acid, electrolyte leakage and low electrolyte level. Fill cells to proper level with distilled water or water passed through a "demineralizer".

   The top of the battery should be clean and the battery hold-down bolts properly tightened. Particular care should be taken to see that the top of the battery is kept clean of acid film and dirt. When cleaning batteries, wash first with a dilute ammonia or soda solution to neutralize any acid present and then flush off with clean water. Keep vent plugs tight so that the neutralizing solution does not enter the cell. The hold-down bolts should be kept tight enough to prevent the battery from shaking around in its holder, but they should not be tightened to the point where the battery case will be placed under a severe strain.

   To insure good contact, the battery cables should be tight on the battery posts. Oil battery terminal felt washer. If the battery posts or cable terminals are corroded, the cables should be cleaned separately with a soda solution and wire brush. After cleaning and before installing clamps, apply a thin coating of petrolatum to the posts and cable clamps to help retard corrosion.

   If the battery has remained undercharged, check for loose or defective fan belt, defective Delcotron, high resistance in the charging circuit, oxidized regulator contact points, or a low voltage setting.

   If the battery has been using too much water, the voltage output is too high.

Service Delcotron and Regulator

The Delcotron and regulator tests during tune up consist of the above battery tests; the condition of the battery indicating further tests and adjustments as outlined in Section 6Y.

Service Belts (Fig. 8)

Inspect belt condition.

Check and adjust if necessary for correct tension of belt, as follows:

- Using a strand tension gauge, check the belt tension.
- Adjust belt until the specified tension is reached. (See Tune Up Chart.)

Service Manifold Heat Valve (Figs. 9 or 10)

Check manifold heat control valve for freedom of operation. If shaft is sticking, free it up with GM Manifold Heat Control Solvent or its equivalent.

NOTE: Tap shaft end to end to help free it up.

Tighten Manifold

Tighten intake manifold bolts to specifications in the sequence outlined on Torque Sequence Chart (Fig. 1T).

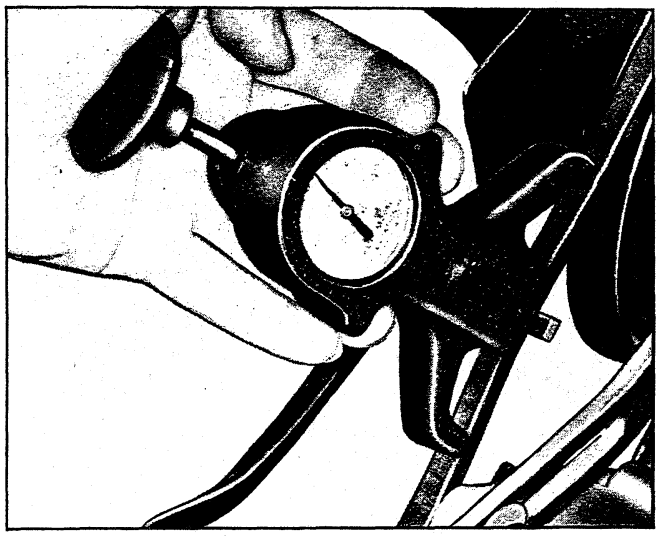


Fig. 8—Checking Fan Belt Tension

A slight leak at the intake manifold destroys engine performance and economy.

Service Fuel Lines and Fuel Filter

1. Inspect fuel lines for kinks, bends or leaks and correct any defects found.
2. Inspect filter and replace if plugged.

NOTE: Refer to Section 8 for the correct fabrication and replacement procedure of fuel lines.

Service Cooling System

1. Inspect cooling system for leaks, weak hoses, loose hose clamps and correct coolant level, and service as required.

NOTE: A cooling system pressure test, as described in "Additional Checks and Adjustments" in this section, may be performed to detect internal or external leaks within the cooling system.

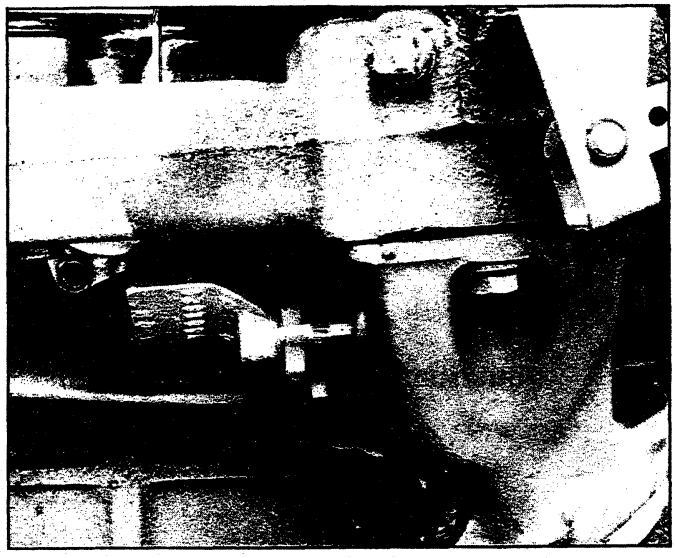


Fig. 9—Manifold Heat Control Valve (In-Line)

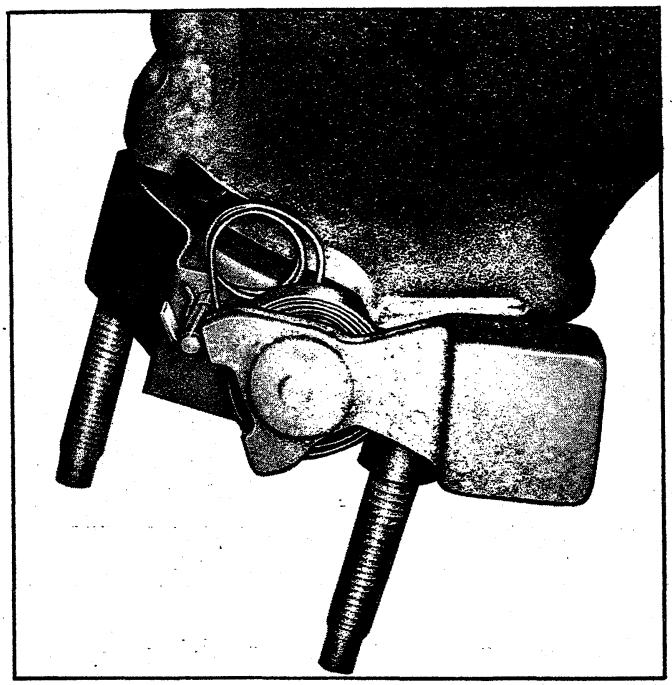


Fig. 10—Manifold Heat Control Valve (V-8)

Check and Adjust Accelerator Linkage

1. Disconnect control linkage at carburetor throttle lever.
2. Hold carburetor throttle lever in wide position.
3. Pull control linkage to wide open position. (On vehicles equipped with automatic transmission, pull through detent).
4. Adjust control linkage to freely enter hole in carburetor throttle lever.

   NOTE: Accelerator linkage is outlined in detail in Section 6M.

5. Connect control linkage at throttle lever.

Service Crankcase Ventilation (Fig. 11)

All engines have "Closed Positive" ventilation systems utilizing manifold vacuum to draw fumes and contaminating vapors into the combustion chamber where they are burned. Since it affects every part of the engine, crankcase ventilation is an important function and should be understood and serviced properly.

In the "Closed Positive" ventilation system, air is drawn through the engine, (through a regulating valve) into the manifold, drawing crankcase vapors and fumes with it to be burned. This ventilation system draws the clean air from the carburetor air cleaner and has a nonvented oil filler cap.

1. Ventilation valve may be checked as outlined under "Additional Checks and Adjustments".
2. Inspect for deteriorated or plugged hoses.
3. Inspect all hose connections.
4. On "Closed Positive" ventilation systems, remove flame arrestor if equipped and wash in solvent then dry with compressed air.

Service Air Injection Reactor System

Inspect air injection reactor system for evidence of leaks, deteriorated hoses, cracked air manifolds or tubes

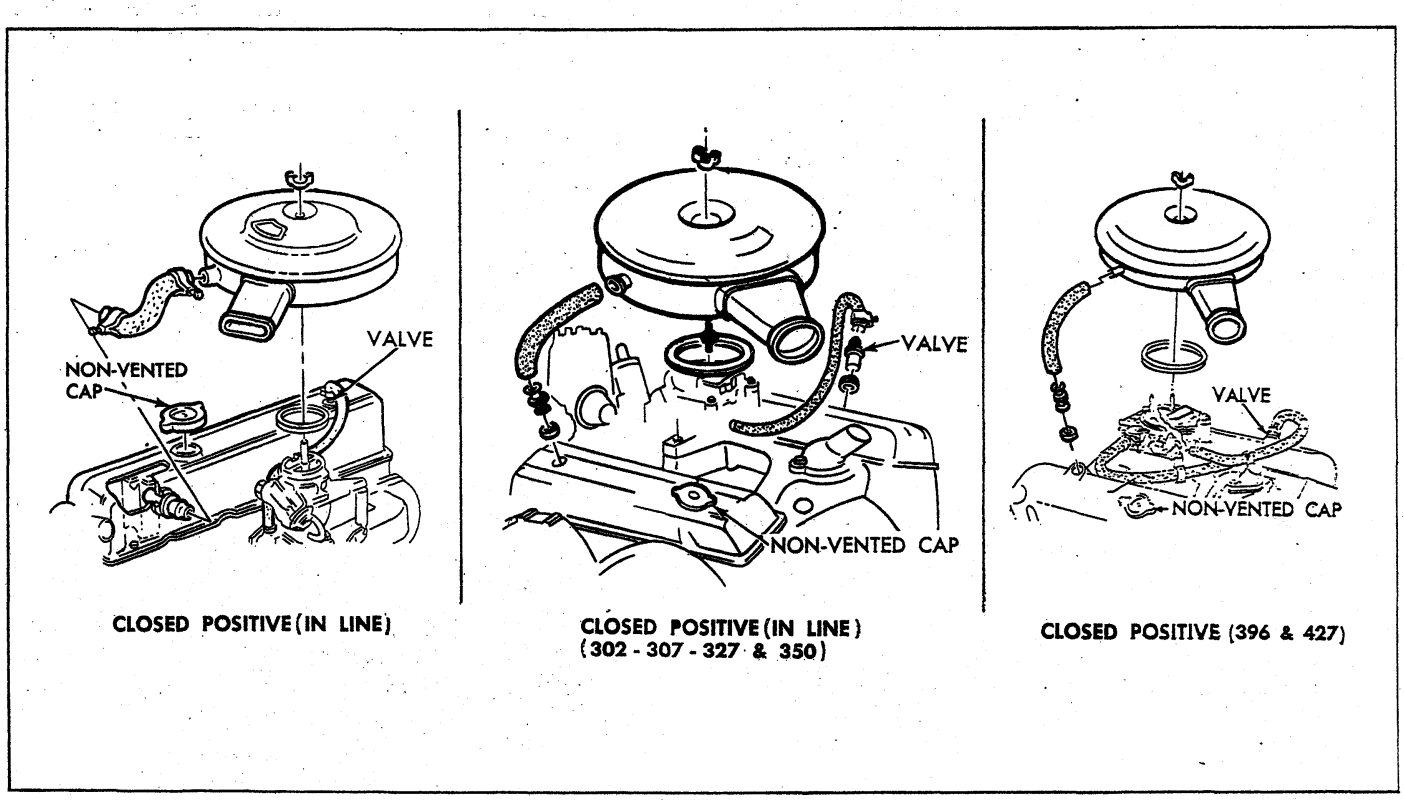


Fig. 11—Crankcase Ventilation Systems

and loose hose clamps. Inspect air injection pump belt condition and tension. Make all necessary repairs as outlined in "Section 6T".

Because of the relationship between "Engine Tune Up" and "Unburned Exhaust Gases", the condition of Engine Tune Up should be checked whenever the Air Injection Reactor System seems to be malfunctioning. Particular care should be taken in checking items that affect fuel-air ratio such as the crankcase ventilation system, the carburetor and the carburetor air cleaner. Carburetors and distributors for engines with the Air Injection Reactor System and Controlled Combustion System are designed, particularly, for these engines; therefore, they must not be interchanged with or replaced by a carburetor or distributor designed for different applications.

Service Choke Assemblies

The passenger car automatic choke assemblies (fig. 12) are shown in their relative installed position when the choke is in fully applied (choke ON--choke rod hitting stop) position. The arrows show the direction the coils and rods move when closing the choke valve.

Choke Adjustment with Remote Choke (Fig. 13)

1. Remove air cleaner and check to see that choke valve and rod move freely.
2. Disconnect choke rod at choke lever.
3. Check choke adjustment as follows:

   On all engines except L6 and two barrel V8 engines, hold choke valve closed and push rod downward to contact stop. The top of rod should be even with bottom of hole in choke lever.

   On L6 and two barrel V8 engines, hold choke valve closed and pull rod upward to end of travel. The bottom of rod should be even with top of hole in choke lever.
4. If necessary, adjust rod length by bending rod at offset. (Bend must be such that rod enters choke lever hole freely and squarely.)
5. Connect rod at choke lever and install air cleaner.

Choke Adjustment with Manual Choke

1. Remove air cleaner.
2. Push hand choke knob in to within 1/8" of instrument panel.

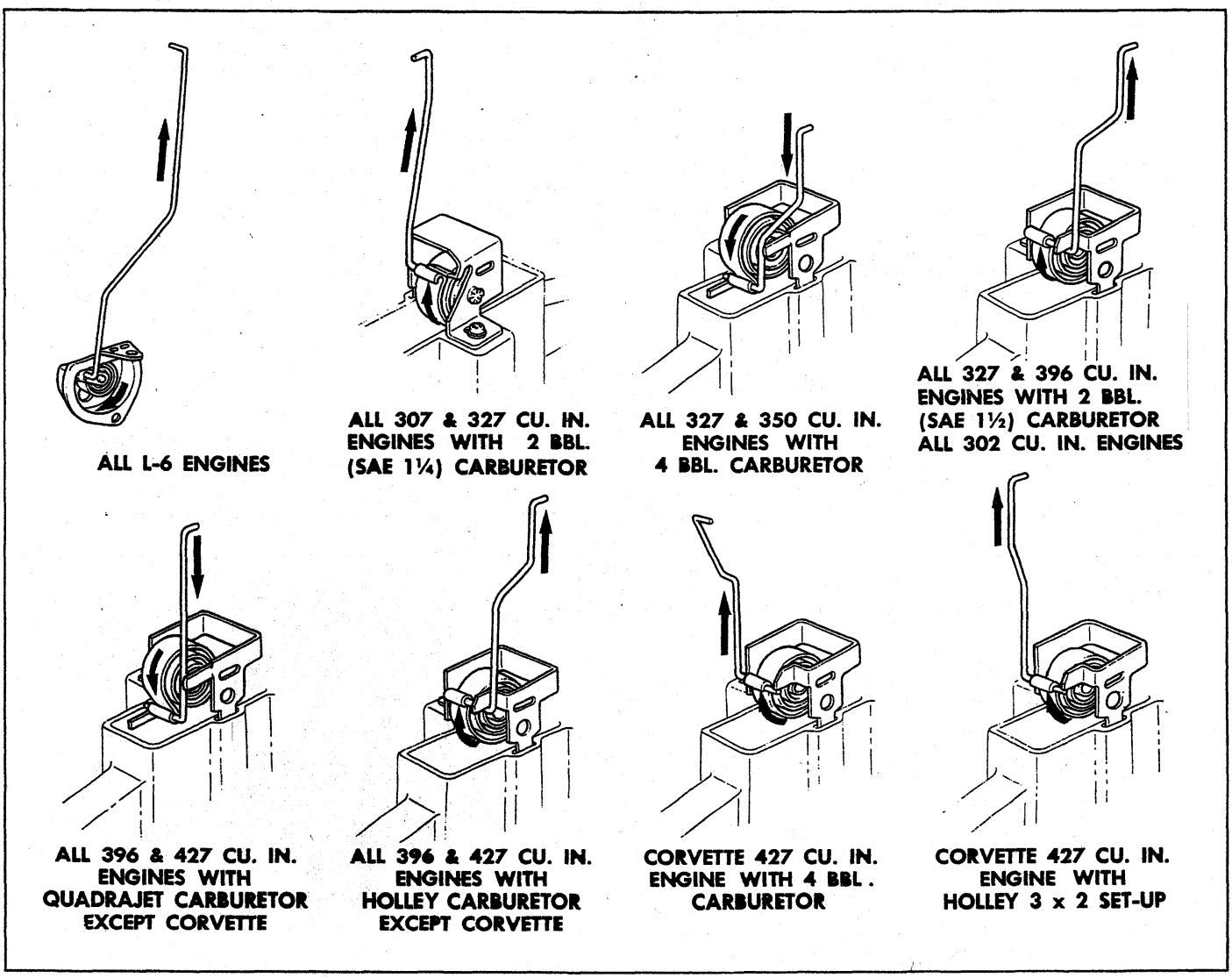


Fig. 12—Carburetor Automatic Choke Assemblies

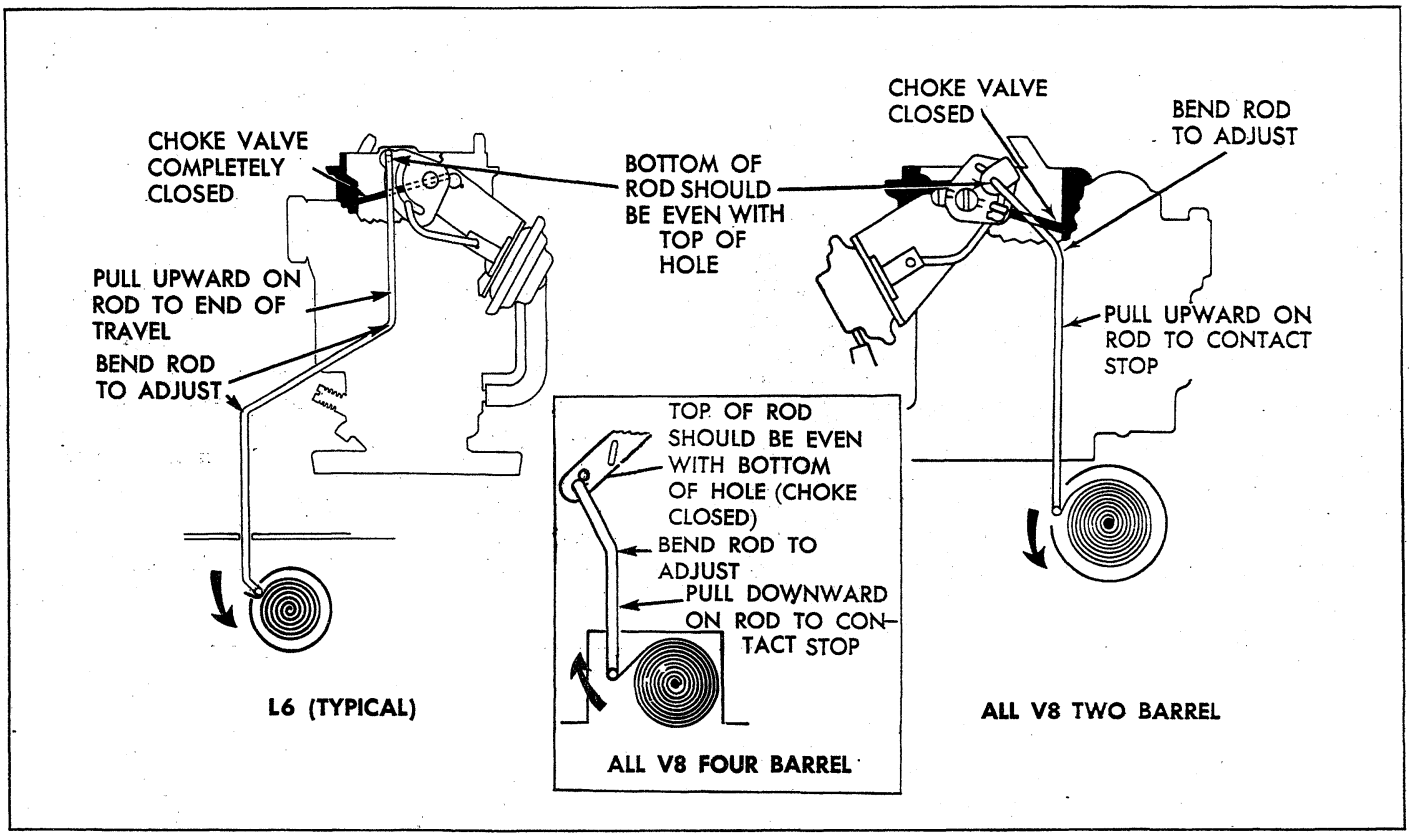


Fig. 13—Automatic Choke Adjustment

3. Loosen choke cable at carburetor bracket and adjust cable through the clip until the choke valve is wide open.
4. Tighten cable clamp at carburetor bracket and check operation of choke valve to ensure full closed and wide open positions.

INSTRUMENT CHECK-OUT

Instrument Hook Up

Connect vacuum gauge, dwell meter, tachometer and timing light as recommended by the manufacturer of the equipment being used.

Check and Adjust Dwell

1. Start engine then check ignition dwell.
2. If dwell is not within specifications, adjust dwell as follows:

V8 ENGINES

- With engine running at idle, raise the adjustment screw window and insert an Allen wrench in the socket of the adjusting screw (fig. 14).
- Turn the adjusting screw as required until a dwell reading of 30° is obtained. A 2° variation is allowable for wear.
- Close access cover fully to prevent the entry of dirt into the distributor.

NOTE: If a dwell meter is not available, turn adjusting screw clockwise until engine starts to misfire, then turn screw one-half turn in the opposite direction to complete adjustment.

IN LINES ENGINES

- Remove distributor cap and recheck point setting.

If dwell is still not within specifications check the distributor as outlined in Section 6Y.

Check Dwell Variation

Slowly accelerate engine to 1500 rpm and note dwell

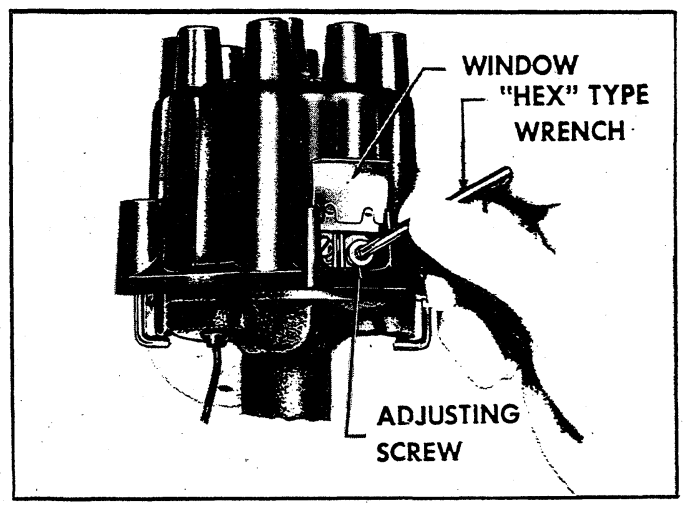


Fig. 14—Setting Point Dwell

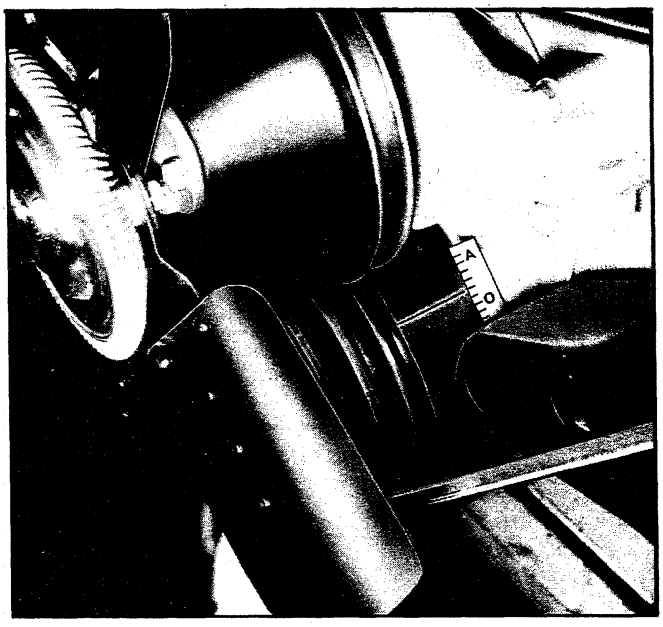


Fig. 15—Ignition Timing Marks

reading. Return engine to idle and note dwell reading. If dwell variation exceeds specifications, check for worn distributor shaft, worn distributor shaft bushing or loose breaker plate.

Check and Adjust Ignition Timing (Fig. 15)

1. Disconnect the distributor spark advance hose and plug the vacuum source opening.
2. Start engine and run at idle speed (see tune up chart).
3. Aim timing light at timing tab.

   NOTE: The markings on the tabs are in 2° increments (the greatest number of markings on the "A" side of the "O"). The "O" markings is TDC of #1 cylinder and all BTDC settings fall on the "A" (advance) side of the "O".

4. Adjust the timing by loosening the distributor clamp and rotating the distributor body as required, then tighten the clamp.
5. Stop engine and remove timing light and reconnect the spark advance hose.

Adjust Idle Speed and Mixture (Fig. 16)

1. As a preliminary adjustment, turn idle mixture screws lightly to seat and back out 3 turns.

   CAUTION: Do not turn idle mixture screw tightly against seat or damage may result.

2. With engine running at operating temperature (Air cleaner installed, pre-heater valve and choke valve wide open); adjust idle speed screw to bring idle speed to specified rpm (automatic transmission in drive, manual transmission in neutral).

   NOTE: On air conditioning vehicles, turn air conditioning "OFF" or "ON" in accordance to instructions on Decal.

3. Adjust idle mixture screw to obtain highest steady idle speed. Adjust idle speed screw to recommended rpm on "DECAL" (Fig. 17).

   NOTE: Idle speed adjustment for engines with idle solenoid is as follows: Adjust idle speed to 500 rpm L6 and 600 rpm V8 by adjusting solenoid plunger hex only (Fig. 18). Disconnect wire at solenoid and observe idle speed. De-energizing the solenoid allows the throttle lever to seat against the carburetor idle screw. Adjust the carburetor idle screw as necessary to obtain 400 rpm.

4. Adjust mixture screw in to obtain a 20 rpm drop (lean roll).
5. Adjust mixture screw out 1/4 turn.
6. Repeat Steps 4 and 5 for second mixture screw (if so equipped).
7. Readjust speed screw if necessary to specified idle rpm.

ADDITIONAL CHECKS AND ADJUSTMENTS

Testing Crankcase Ventilation Valve (Fig. 19)

1. Connect tachometer and vacuum gauge as for idle speed and mixture adjustment.
2. Set parking brake, start engine and adjust idle speed and mixture.
3. Disconnect ventilation hose at valve, block opening of valve and read engine rpm change.
4. A change of less than 50 rpm indicates a plugged ventilation valve - replace the valve (fig. 20).

Cylinder Balance Test (Fig. 21)

It is often difficult to locate a weak cylinder. A compression test, for example, will not locate a leaky intake manifold, a valve not opening properly due to a worn camshaft, or a defective spark plug.

With the cylinder balance test, the power output of one cylinder may be checked against another, using a set of grounding leads. When the power output of each cylinder is not equal, the engine will lose power and run roughly.

Perform a cylinder balance test as follows:

1. Connect the tachometer and vacuum gauge.
2. Start engine and run at 1500 rpm.
3. Ground large clip of grounding leads and connect individual leads to all spark plugs except the pair being tested.

Divide the firing order in half and arrange one half over the other. The cylinders to be tested together appear one over the other.

L4 Firing Order

1-3-4-2 = 1-3 = 1-4, 3-2
4-2

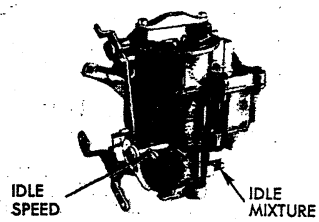
L6 Firing Order

1-5-3-6-2-4 = 1-5-3 = 1-6, 5-2, 3-4
6-2-4

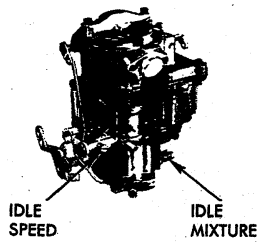
V8 Firing Order

1-8-4-3-6-5-7-2 = 1-8-4-3 = 1-6, 8-5, 4-7, 3-2
6-5-7-2

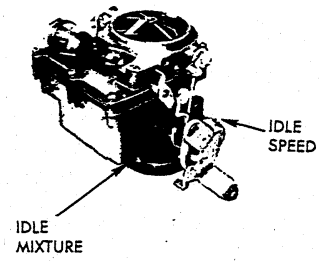
ROCHESTER M



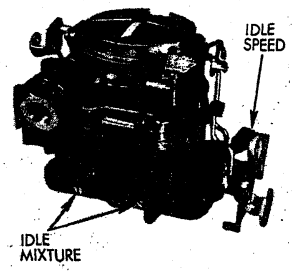
ROCHESTER MV



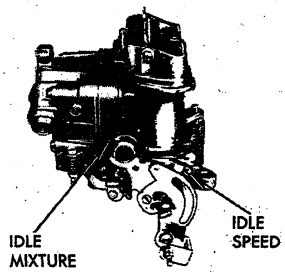
ROCHESTER 2GV



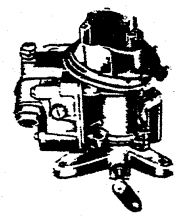
ROCHESTER 2GV (1-½)



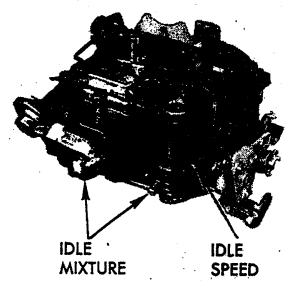
HOLLEY 2300C (PRIMARY)



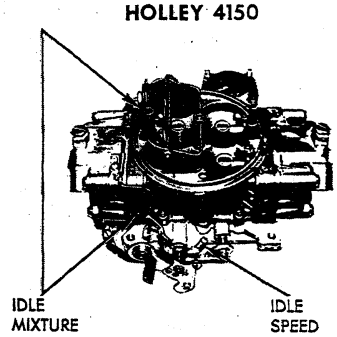
HOLLEY 2300 (SECONDARY)



ROCHESTER 4MV



HOLLEY 4150



APPLICATION / CARBURETOR		Chevrolet	Chevelle	Chevy Nova	Camaro	Corvette	IN LINE			V-8																			
							153	230	250	302	307	327		350			396				427								
							90	140	155	290	200	210	235	300	350	370	265	325	350	375	335	390	400	425	430	435			
ROCH M				3			3																						
ROCH MV		1	2	3	4			2 3 4	1 2 3 4																				
ROCH 2GV(SAE 1¼)			2	3	4						2 3	4																	
ROCH 2GV(SAE 1½)		1											1				1												
ROCH 4MV		1	2	3	4	5								123 45	5			2 4	2 3 4		1	1 5						
HOLLY 2300	C Prim.					5																	5			5			
	Sec.					5																	5			5			
HOLLY 4150		1	2	3	4	5				4						5				2 3 4				1	1 5				

Fig. 16—Idle Speed and Mixture Screws

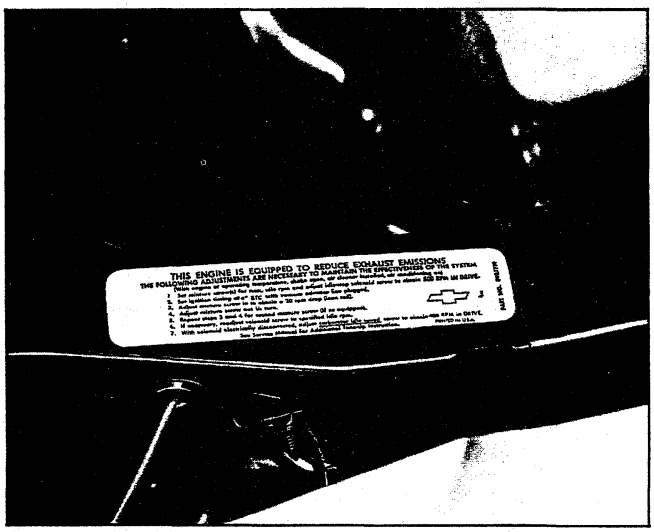


Fig. 17—Tune-Up Decal

4. Operate engine on each pair of cylinders in turn and note engine rpm and manifold vacuum for each pair. A variation of more than 1 inch of vacuum or 40 rpm between pairs of cylinders being tested indicates that the cylinders are off balance.

Battery

The battery should be checked with special testing equipment and to the equipment manufacturers specifications. See Section 6Y for complete information on battery tests.

Ignition

The following additional ignition checks may be made with any of several pieces of equipment available for uncovering the source of engine difficulties. The specific operating instructions of the equipment manufacturer should be followed:

- Cranking voltage
- Ignition switch
- Distributor resistance
- Secondary resistance
- Ignition output and secondary leakage

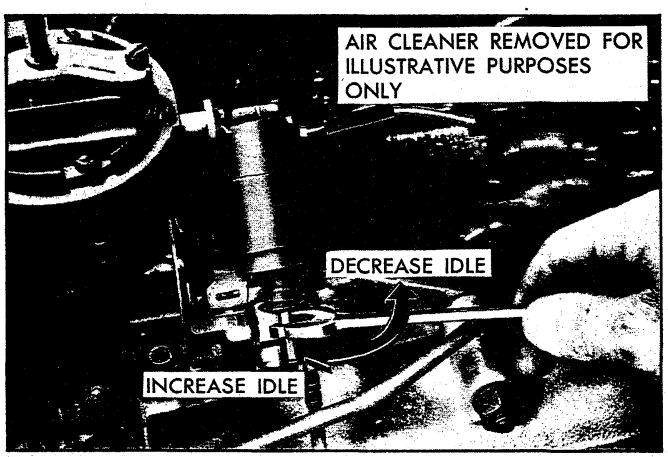


Fig. 18—Adjusting Idle Solenoid

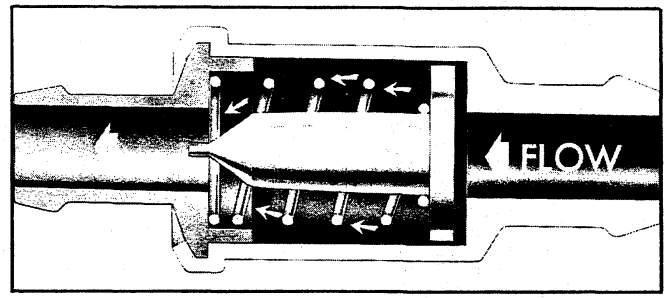


Fig. 19—Crankcase Ventilation Valve

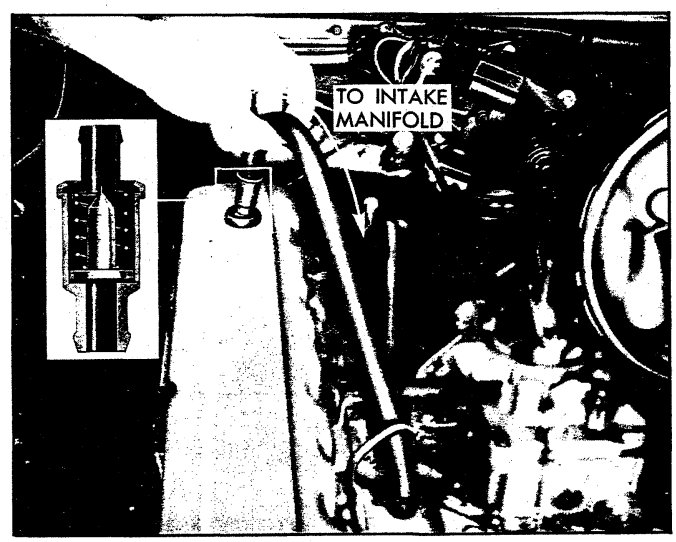


Fig. 20—Installing P.C.V. Valve

Cranking Voltage (Fig. 22)

1. Disconnect coil primary lead at the coil negative terminal to prevent engine from firing during cranking.

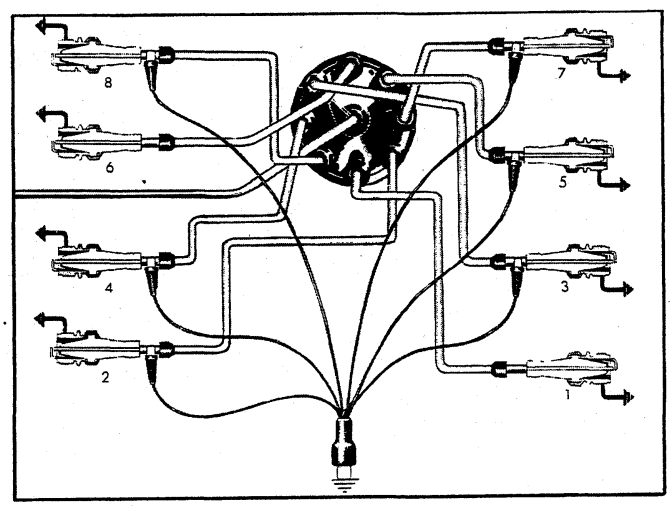


Fig. 21—Cylinder Balance Test

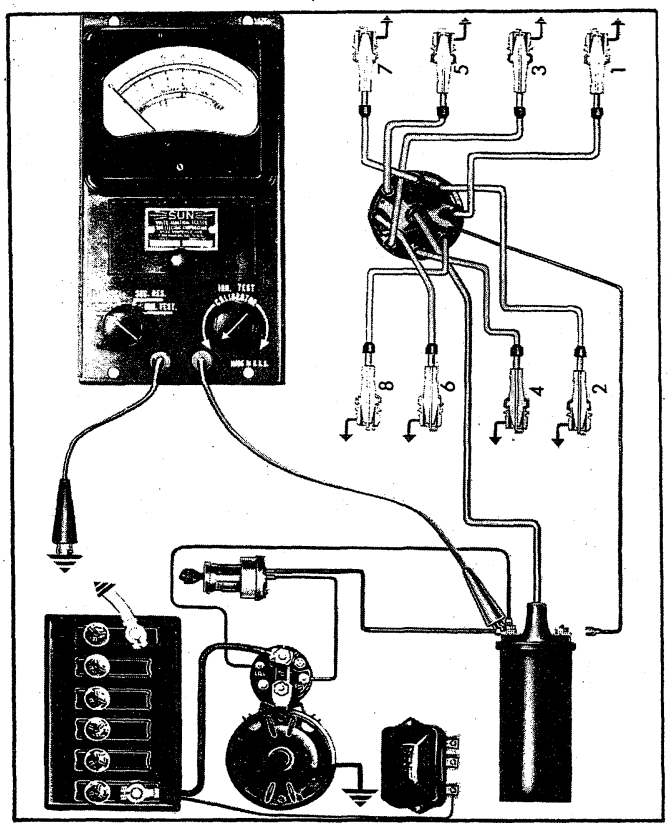


Fig. 22—Testing Cranking Voltage

2. Connect voltmeter between primary terminal of coil (resistance wire side) and ground.
3. Operate starting motor.
   a. If voltage is 9 volts or more and cranking speed is satisfactory, the battery, starter, cables, starter switch and ignition circuit to coil (by-passing resistance wire) are in good condition.
   b. If below 9 volts, check circuit until difficulty is located.

      Meter reading below specification--Weak battery; defective cables, connections, switch or starter; defective ignition circuit to coil.

      Cranking speed below normal--Excessive resistance in cables or starting motor; excessive mechanical drag in engine.

      Uneven cranking speed--Uneven compression, defective starter or starter drive.

Ignition Switch

With voltmeter connected as described for the Cranking Voltage Test, turn ignition switch to ON. Voltage should drop to 5 to 7 volts as current is now passing through high resistance wire connected between ignition switch and (+) positive terminal of coil. If battery voltage of 12 volts is obtained, the starter solenoid is by-passing the high resistance wire connected between ignition switch and (+) positive terminal of coil, thus the starter solenoid is not functioning properly to bypass the ignition resistance wire or the ignition circuit is incorrectly wired.

NOTE: The voltage drop (12 to 5-7 volts) will only take place when the points are closed. If the points are open, the path through the resistance wire will not be completed.

Distributor Resistance

Use equipment as directed by manufacturer. Excessive resistance in primary circuit must be eliminated before continuing with test procedure.

Secondary Resistance

Use equipment as directed by manufacturer.

- Uniform "normal readings" as specified by manufacturer indicate all secondary circuit components are in good condition.
- If all readings are "below normal," check for corroded coil tower terminal, poorly connected or broken coil wire, center cap electrode or rotor tip burned, or an open secondary in coil.
- If readings are "higher than normal" at two or more plugs adjacent in firing order, cross firing is occurring in distributor cap or between spark plug cables concerned.
- If meter reads off scale to left, the coil polarity is reversed. Check for reversed coil primary wires, wrong coil or reversed vehicle battery connections.

Ignition Output and Secondary Leakage

Use equipment as directed by manufacturer.

- GOOD readings indicate both ignition output and secondary insulation are good.
- If all readings are BAD or if ignition test calibrator cannot be adjusted to Set Line, check for high resistance in primary circuit, defective distributor points, coil or condenser.
- If readings are BAD when certain plug wires are lifted off, check for cracks or carbon tracks in distributor cap or defective insulation on those plug wires being lifted off.

Carburetor

Refer to Section 6M to perform adjustments such as idle vent, float level, pump rod and secondary valve.

Fuel Pump

If the owner has complained of poor high speed performance, the fuel pump may be at fault. Too low a pump pressure or volume will cause a high speed "miss" because of lack of fuel delivered to the carburetor, while too high a pressure will cause carburetor flooding. Check fuel pump as outlined in Section 6M.

Cooling System

The following test may be performed with pressure testing equipment available commercially for this purpose. This test provides an excellent means of detecting internal or external leaks within the cooling system.

1. Remove radiator cap.
2. Apply a test pressure of 3 pounds higher than the radiator cap (fig. 23). i.e. 18 pounds for a 15 pound cap.
3. If the pressure will not hold, there is either an internal or external leak in the system.

Cylinder Head Torque and Valve Adjustment

Retorquing the cylinder head bolts is not necessary unless a gasket has been replaced, or a leak is suspected. Valve lash must always be adjusted after the head has been torqued.

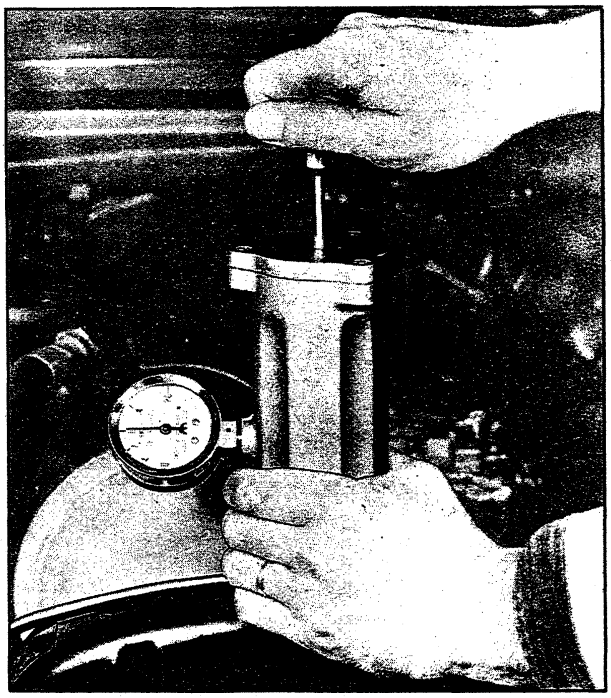


Fig. 23—Cooling System Pressure Check

Before adjusting the valve lash, it is extremely important that the engine be thoroughly warmed up to normalize the expansion of all parts. This is very important because during the warm-up period, the valve clearances will change considerably.

Hydraulic

1. After the engine has been normalized, remove rocker arm covers and gaskets.

   CAUTION: Do not pry rocker arm cover loose. Gaskets adhering to cylinder head and rocker arm cover may be sheared by bumping end of rocker arm cover rearward with palm of hand or a rubber mallet.

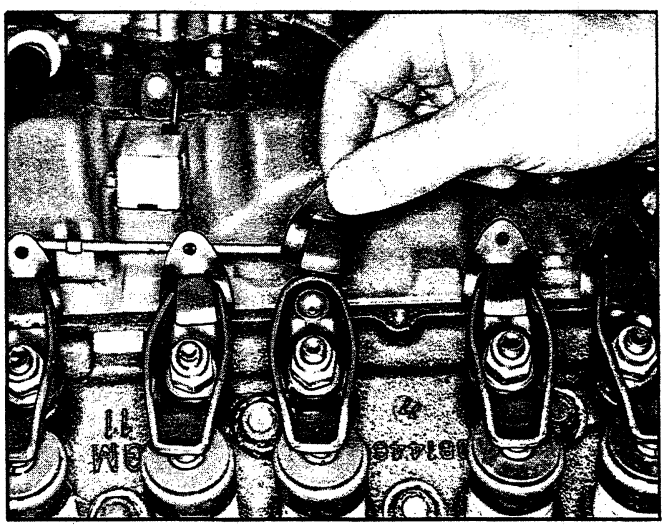


Fig. 24—Oil Deflector Clips Installed

2. With the engine running at idle, back off valve rocker arm nut until the valve rocker arm starts to clatter.
3. Turn rocker arm nut down slowly until the clatter just stops. This is the zero lash position.
4. Turn nut down 1/4 additional turn and pause 10 seconds until engine runs smoothly. Repeat additional 1/4 turns, pausing 10 seconds each time, until nut has been turned down 1 full turn from the zero lash position.

   NOTE: This 1 turn preload adjustment must be done slowly to allow the lifter to adjust itself to prevent the possibility of interference, between the inlet valve head and top of piston, which might result in internal damage and/or bent push rods. Noisy lifters should be replaced.

5. Repeat Steps 2, 3 and 4 to adjust the rest of the valves.
6. Clean gasket surfaces on cylinder heads and rocker arm covers with degreaser then install rocker arm covers, using new gaskets, and torque bolts to specifications.

Mechanical

1. Normalize the engine.
2. Remove rocker arm covers and gaskets.

   CAUTION: Do not pry rocker arm cover loose. Gaskets adhering to cylinder head and rocker arm cover may be sheared by bumping end of rocker arm cover rearward with palm of hand or a rubber mallet.

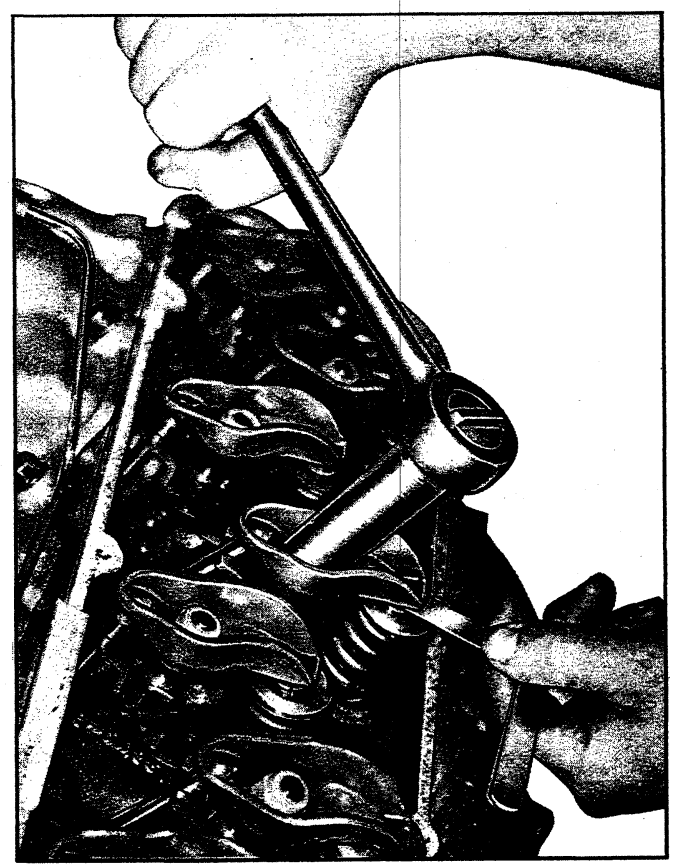


Fig. 25—Valve Adjustment (Mechanical)

3. Use a socket wrench on self-locking rocker arm stud nut and adjust as needed to obtain valve lash (see tune up chart) measured between rocker arm and valve stem with a leaf type feeler gauge (Fig. 25).
4. Stop engine, clean gasket surfaces on cylinder heads and rocker arm covers with degreaser then install rocker arm covers, using new gaskets, and torque bolts to specifications.

ENGINE MECHANICAL

IN-LINE ENGINES

INDEX

	Page
General Description	6-14
Component Replacement and Adjustment	6-14
Engine Assembly	6-14
Removal	6-14
Installation	6-15
Manifold Assembly	6-16
Removal	6-16
Installation	6-16
Rocker Arm Cover	6-16
Removal	6-16
Installation	6-16
Valve Mechanism	6-16
Removal	6-16
Installation and Adjustment	6-16
Valve Lifters	6-17
Locating Noisy Lifters	6-17
Removal	6-17
Installation	6-17
Valve Stem Oil Seal and/or Valve Spring	6-18
Replacement	6-18
Cylinder Head Assembly	6-18
Removal	6-18
Installation	6-18
Oil Pan	6-19
Removal	6-19
Installation	6-19
Oil Pump	6-20
Removal	6-20
Installation	6-20
Oil Seal (Rear Main)	6-20
Replacement	6-20
Crankshaft Pulley and Hub	6-21
Removal	6-21
Installation	6-21
Torsional Damper	6-21
Removal	6-21
Installation	6-21
Crankcase Front Cover	6-22
Removal	6-22
Installation	6-22
Oil Seal (Front Cover)	6-22
Replacement	6-22
Camshaft	6-22
Measuring Lobe Lift	6-22
Removal	6-23
Installation	6-23
Timing Gears	6-24
Replacement	6-24
Flywheel	6-24
Removal	6-24
Installation	6-24
Engine Mounts	6-24
Replacement (Front)	6-25
Replacement (Rear)	6-25

GENERAL DESCRIPTION

The In Line engines (fig. 1L) covered in this section are the 153 cu. in. L4, the 230 and 250 cu. in. L6, regardless of which passenger vehicle they are used in.

This section covers the removal and installation of engine assemblies; the removal, installation and adjustment of some sub-assemblies and replacement of some components. For service to all components and sub-assemblies (after removal) and removal of some sub-assemblies, refer to Section 6 of the Chassis Overhaul Manual.

Because of the interchangeability and similarity of many engine sub-assemblies and engine parts, regardless of which passenger vehicle they are used in, typical illustrations and procedures are used except where specific illustrations or procedures are necessary to clarify the operation. Although illustrations showing bench operations are used, most single operations, when not part of a general overhaul, should be performed (if practical) with the engine in the vehicle.

COMPONENT REPLACEMENT AND ADJUSTMENT

ENGINE ASSEMBLY

Removal

1. Drain cooling system and engine oil.
2. Remove air cleaner and disconnect battery cables at battery.
3. Remove hood hinge front bolts, loosen the rear bolts. Swing hood up and install Tool J-22382-1.
4. Remove radiator and radiator shroud as outlined in Section 13.
5. Remove fan blade and pulley as outlined in Section 6K.
6. Disconnect wires at:
   - Starter Solenoid
   - Delcotron
   - Temperature Switch

- Oil Pressure Switch
- Coil

7. Disconnect:
   - Accelerator linkage at manifold bellcrank.
   - Exhaust pipe at manifold flange.
   - Fuel line (from tank) at fuel pump.
   - Vacuum line to power brake unit at manifold (if so equipped).
8. Remove power steering pump and lay aside (if so equipped).
9. Raise vehicle.
10. Remove propeller shaft.

NOTE: If plug for propeller shaft opening in transmission is not available, drain transmission.

11. Disconnect:
    - Shift linkage at transmission.
    - Speedometer cable at transmission.
12. On synchromesh equipped vehicles, disconnect clutch linkage at cross-shaft then remove cross-shaft engine bracket.
13. Connect lifting device or chain to engine lift brackets.
14. Raise engine to take weight off front mounts and remove front mount thru bolts.
15. Remove rear mount to crossmember bolts.
16. Raise engine to take weight off rear mount, then remove crossmember.

NOTE: On Chevrolet vehicles it will be necessary to remove mount from transmission before crossmember can be removed.

NOTE: On Camaro vehicles it is not necessary to completely remove the crossmember. Remove crossmember bolts and slide back.

17. Remove engine-transmission assembly from vehicle as a unit.
18. Remove transmission (and clutch):

Synchromesh Transmission

a. Remove clutch housing cover plate screws.
b. Remove bolts attaching the clutch housing to engine block then remove transmission and clutch housing as a unit.

NOTE: Support the transmission, as the last mounting bolt is removed, and as it is being pulled away from the engine (to prevent damage to clutch disc).

c. Remove starter and clutch housing rear cover.
d. Loosen clutch mounting bolts a turn at a time (to prevent distortion of clutch cover) until the spring pressure is released. Remove all bolts, clutch disc and pressure plate assembly.

Automatic Transmission

a. Lower engine, secured by the hoist, and support engine on blocks.
b. Remove starter and converter housing underpan.
c. Remove flywheel-to-converter attaching bolts.
d. Support transmission on blocks.
e. Remove transmission-to-engine mounting bolts.
f. With the hoist attached, remove blocks from the engine only and slowly guide the engine from the transmission.

19. Mount engine in stand.

Installation

1. Attach lifting device or chain to engine lift brackets and remove engine from engine stand.
2. Install transmission (and clutch):

Synchromesh Transmission

a. Install the clutch on flywheel as outlined in Section 7.
b. Install clutch housing front cover and starter.
c. Install transmission and clutch housing as outlined in Section 7.
d. Install clutch housing cover screws and tighten securely.

Automatic Transmission

a. Position engine adjacent to the transmission and align the converter with the flywheel.
b. Bolt transmission to engine, then raise engine and transmission assembly and install flywheel to converter attaching bolts.
c. Install converter housing underpan and starter.

3. Tilt and lower engine and transmission assembly into the chassis as a unit, guiding engine to align front mounts with frame supports.
4. Install front mount through bolts.
5. Raise engine enough to install rear crossmember, then install crossmember, install rear mount and lower engine.
6. Remove lifting device and torque all mount bolts to specifications.
7. On synchromesh equipped vehicles, install clutch cross shaft engine bracket, then adjust and connect clutch as outlined in Section 7.
8. Connect:
   - Speedometer cable.
   - Shift linkage at transmission.
9. Install propeller shaft.
10. Lower hoist and remove vehicle.
11. Connect:
    - Power steering pump lines (if disconnected).
    - Vacuum line to power brake unit (if disconnected).
    - Fuel line at fuel pump.
    - Exhaust pipe at manifold flange.
    - Accelerator linkage at manifold bellcrank.
12. Connect wires at:
    - Coil
    - Oil pressure switch
    - Temperature switch
    - Delcotron
    - Starter solenoid
13. Install pulley, fan blade and fan belt as outlined in Section 6K.
14. Install radiator and shroud as outlined in Section 13.
15. Remove hood prop tool and install front hinge bolts. Adjust hood as outlined in Section 11.
16. Connect battery cables.
17. Fill with coolant, engine oil and transmission oil, then start engine and check for leaks.
18. Perform necessary adjustments and install air cleaner.

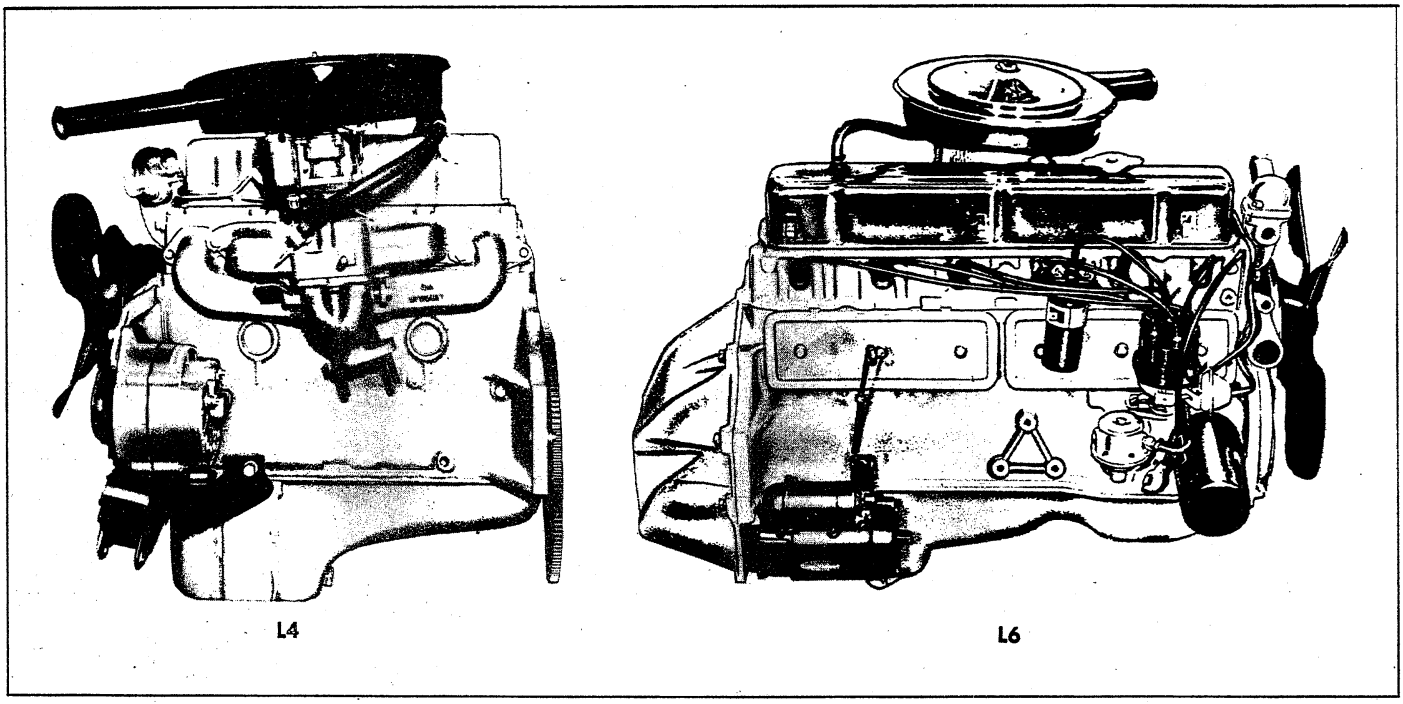


Fig. 1L - In Line Engines (Typical)

MANIFOLD ASSEMBLY

Removal

1. Remove air cleaner.
2. Disconnect both throttle controls at bellcrank and remove throttle return spring.
3. Disconnect fuel and vacuum lines at carburetor. Disconnect choke cable on L4 engines.
4. Disconnect crankcase ventilation hose at rocker arm cover.
5. Disconnect exhaust pipe at manifold flange and discard packing.
6. Remove manifold attaching bolts and clamps then remove manifold assembly and discard gaskets.
7. Check for cracks in manifold castings.
8. If necessary to replace either intake or exhaust manifolds, separate them by removing one bolt and two nuts at center of assembly. Reassemble manifolds using a new gasket. Tighten finger tight and torque to specifications after assembly to cylinder head. Transfer all necessary parts.

Installation

1. Clean gasket surfaces on cylinder head and manifolds.
2. Position new gasket over manifold end studs on head and carefully install the manifold in position making sure the gaskets are in place.
3. Install bolts and clamps while holding manifold in place with hand.
4. Torque bolts to specifications.

   NOTE: On L6 engines center bolt and end bolt torque differ.

5. Connect exhaust pipe to manifold using a new packing.
6. Connect crankcase ventilation hose at rocker arm cover.
7. Connect fuel and vacuum lines at carburetor.
8. On L4 engines connect choke cable and adjust as outlines in Section 6M.
9. Connect throttle controls at bellcrank and install throttle return spring.
10. Install air cleaner, start engine, check for leaks and adjust carburetor idle speed and mixture.

ROCKER ARM COVER

Removal

1. Disconnect crankcase ventilation hose(s) at rocker arm cover.
2. Remove air cleaner.
3. Disconnect temperature wire from rocker arm cover clips.
4. Remove rocker arm cover.

Installation

1. Clean gasket surfaces on cylinder head and rocker arm cover with degreaser then, using a new gasket, install rocker arm cover and torque bolts to specifications.
2. Connect temperature wire at rocker arm cover clips.
3. Install air cleaner.
4. Connect crankcase ventilation hoses.

VALVE MECHANISM

Removal

1. Remove rocker arm cover as outlined.
2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods.

   NOTE: Place rocker arms, rocker arm balls and push rods in a rack so they may be reinstalled in the same location.

Installation and Adjustment

NOTE: Whenever new rocker arms and/or

rocker arm balls are being installed, coat bearing surfaces of rocker arms and rocker arm balls with Molykote or its equivalent.

1. Install push rods. Be sure push rods seat in lifter socket.
2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until all lash is eliminated.
3. Adjust valves when lifter is on base circle of camshaft lobe as follows:
   a. Mark distributor housing, with chalk, at each cylinder position (plug wire) then disconnect plug wires at spark plugs and coil and remove distributor cap and plug wire assembly (if not previously done).
   b. Crank engine until distributor rotor points to number one cylinder position and breaker points are open. Both valves on number one cylinder may now be adjusted.
   c. Back out adjusting nut until lash is felt at the push rod then turn in adjusting nut until all lash is removed. This can be determined by checking push rod side play while turning adjusting nut (fig. 2L). When play has been removed, turn adjusting nut in one full additional turn (to center lifter plunger).
   d. Adjust the remaining valves, one cylinder at a time, in the same manner.
4. Install distributor cap and spark plug wire assembly.
5. Install rocker arm cover as outlined.
6. Adjust carburetor idle speed and mixture.

VALVE LIFTERS

Hydraulic valve lifters very seldom require attention. The lifters are extremely simple in design readjustments are not necessary, and servicing of the lifters requires only that care and cleanliness be exercised in the handling of parts.

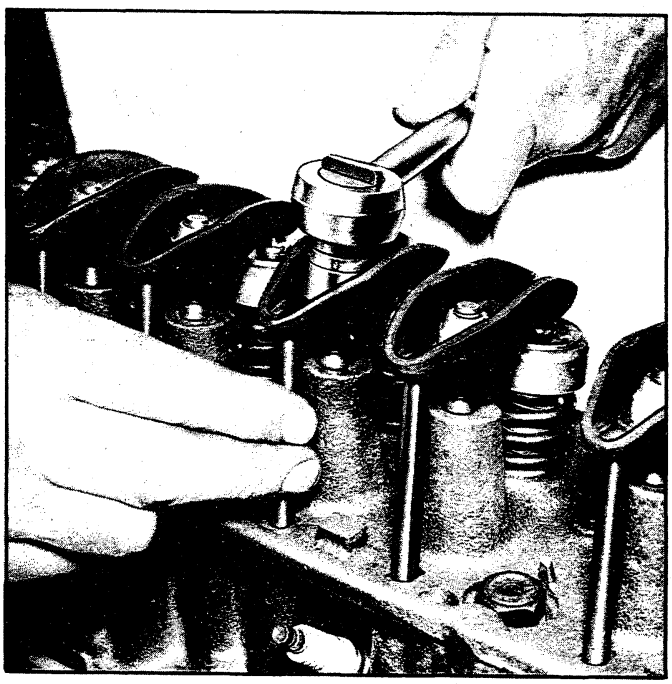


Fig. 2L - Valve Adjustment

Locating Noisy Lifters

Locate a noisy valve lifter by using a piece of garden hose approximately four feet in length. Place one end of the hose near the end of each intake and exhaust valve with the other end of the hose to the ear. In this manner, the sound is localized making it easy to determine which lifter is at fault.

Another method is to place a finger on the face of the valve spring retainer. If the lifter is not functioning properly, a distinct shock will be felt when the valve returns to its seat.

The general types of valve lifter noise are as follows:

1. Hard Rapping Noise--Usually caused by the plunger becoming tight in the bore of the lifter body to such an extent that the return spring can no longer push the plunger back up to working position. Probable causes are:
   a. Excessive varnish or carbon deposit causing abnormal stickiness.
   b. Galling or "pickup" between plunger and bore of lifter body, usually caused by an abrasive piece of dirt or metal wedging between plunger and lifter body.
2. Moderate Rapping Noise--Probable causes are:
   a. Excessively high leakdown rate.
   b. Leaky check valve seat.
   c. Improper adjustment.
3. General Noise Throughout the Valve Train--This will, in almost all cases, be a definite indication of insufficient oil supply, or improper adjustment.
4. Intermittent Clicking--Probable causes are:
   a. A microscopic piece of dirt momentarily caught between ball seat and check valve ball.
   b. In rare cases, the ball itself may be out-of-round or have a flat spot.
   c. Improper adjustment.

In most cases where noise exists in one or more lifters all lifter units should be removed, disasssmbled, cleaned in a solvent, reassembled, and reinstalled in the engine. If dirt, varnish, carbon, etc. is shown to exist in one unit, it more than likely exists in all the units, thus it would only be a matter of time before all lifters caused trouble.

Removal

1. Remove valve mechanism as outlined.
2. Mark distributor housing, with chalk, at each cylinder position (plug wire) then disconnect plug wires at spark plugs and coil and remove distributor cap and plug wire assembly.
3. Crank engine until distributor rotor points to number one position, then disconnect distributor primary lead at coil and remove distributor.
4. Remove push rod covers (discard gaskets).
5. Remove valve lifters.

   NOTE: Place valve lifters in a rack so they may be reinstalled in the same location.

Installation

1. Install valve lifters.

   NOTE: Whenever new valve lifters are being installed, coat foot of valve lifters with Molykote or its equivalent.

2. Install push rod covers, using new gaskets, and torque bolts to specifications.
3. Install distributor, positioning rotor to number one cylinder position, then connect primary lead at coil.

4. Install and adjust valve mechanism as outlined.
5. Adjust ignition timing and carburetor idle speed and mixture.

VALVE STEM OIL SEAL AND/OR VALVE SPRING

Replacement

1. Remove rocker arm cover as outlined.
2. Remove spark plug, rocker arm and push rod on the cylinder(s) to be serviced.
3. Apply compressed air to the spark plug hole to hold the valves in place.

   NOTE: A tool to apply air to the cylinder is available through local jobbers or may be manufactured. In manufacturing this Tool a AC-46N Spark Plug or its equivalent is recommended. This will make the Tool universal for all Chevrolet engines. Chisel the spark plug as shown, then drive the porcelain out of the plug by tapping the center electrode against a hard block. Using a 3/8" pipe tap, cut threads in the remaining portion of the spark plug and assemble as shown (fig. 3L).

4. Using Tool J-5892 to compress the valve spring, remove the valve locks, valve cap, valve shield and valve spring and damper (fig. 4L).
5. Remove the valve stem oil seal.
6. To replace, set the valve spring and damper, valve shield and valve cap in place. The close coiled end of the spring is installed against the cylinder head. Compress the spring with Tool J-5892 and install oil seal in the lower groove of the stem, making sure the seal is flat and not twisted.

   NOTE: A light coat of oil on the seal will help prevent twisting.

7. Install the valve locks and release the compressor tool, making sure the locks seat properly in the upper groove of the valve stem.

   NOTE: Grease may be used to hold the locks in place while releasing the compressor tool.

8. Install spark plug, using a new gasket, and torque to specifications.
9. Install and adjust valve mechanism as outlined.

CYLINDER HEAD ASSEMBLY

Removal

1. Remove manifold assembly as outlined.
2. Remove valve mechanism as outlined.
3. Drain cooling system (block).
4. Remove fuel and vacuum line from retaining clip at water outlet then disconnect wires from temperature sending units.
5. Disconnect upper radiator hose at water outlet housing and battery ground strap at cylinder head.
6. Remove coil (L6 engines only).
7. Remove cylinder head bolts, cylinder head and gasket. Place cylinder head on two blocks of wood to prevent damage.

Installation

CAUTION: The gasket surfaces on both the head and the block must be clean of any foreign matter and free of nicks or heavy scratches. Cylinder bolt threads in the block and threads on the cylinder head bolt must be cleaned. (Dirt will affect bolt torque.) Do not use gasket sealer on composition steel asbestos gasket.

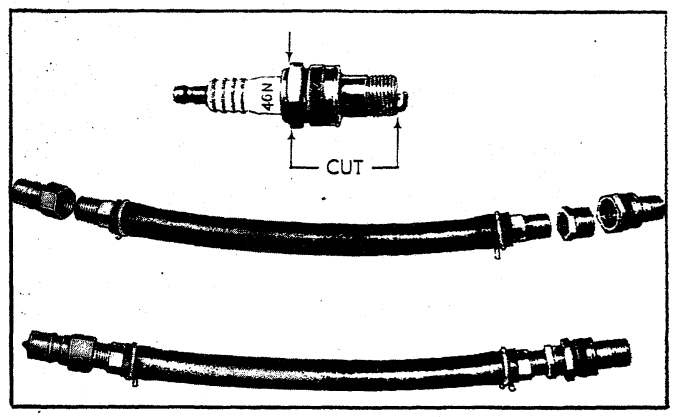


Fig. 3L - Air Adapter Tool

1. Place the gasket in position over the dowel pins with the bead up.
2. Carefully guide cylinder head into place over dowel pins and gasket.
3. Coat threads of cylinder head bolts with sealing compound and install finger tight.
4. Tighten cylinder head bolts a little at a time in the sequence shown on the torque sequence chart until the specified torque is reached.
5. Install coil (if removed).
6. Connect upper radiator hose and engine ground strap.
7. Connect temperature sending unit wires and install fuel and vacuum lines in clip at water outlet.
8. Fill cooling system.
9. Install manifold assembly as outlined.
10. Install and adjust valve mechanism as outlined.

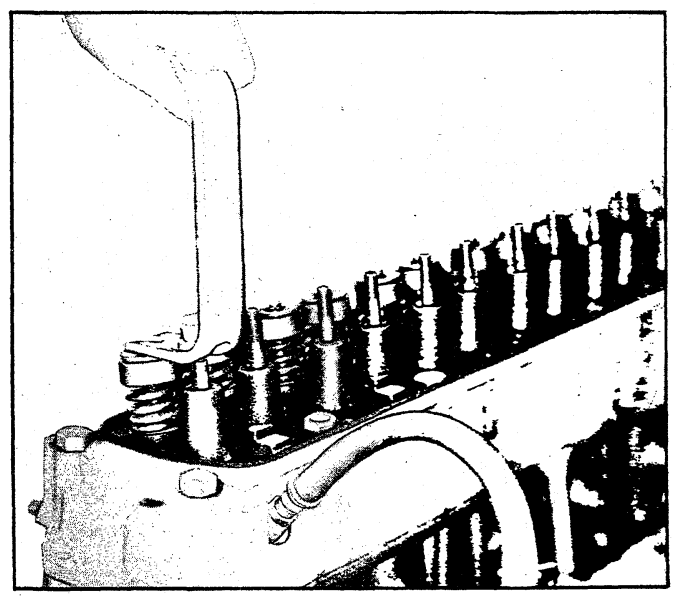


Fig. 4L - Compressing Valve Spring

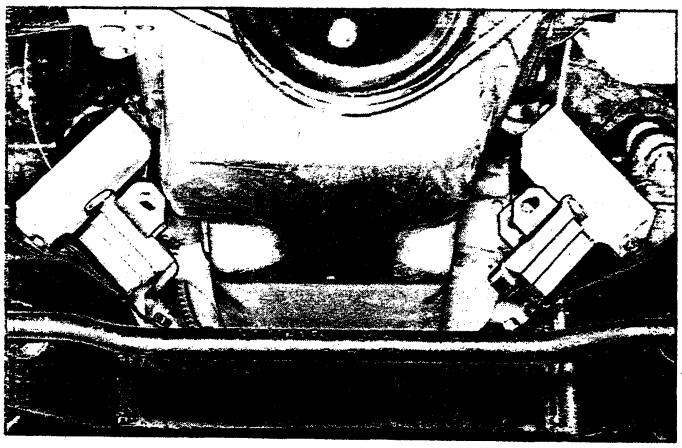


Fig. 5L—Engine Blocked for Pan Removal

NOTE: Do not install rocker arm cover.

11. Start engine and allow warm up then retorque cylinder head as outlined in Step 4 and readjust valves as outlined under Engine Tune Up.

OIL PAN

Removal

Chevrolet, Camaro and Nova

1. Disconnect battery positive cable.
2. Remove through bolts from engine front mounts.
3. Remove upper radiator mounting panel or side mount bolts.
4. Place a piece of heavy cardboard between fan blade and radiator.
5. Raise vehicle then drain engine oil.
6. Disconnect and remove starter.
7. On vehicles equipped with automatic transmission, remove converter housing underpan.
8. Disconnect steering rod at idler lever then swing steering linkage for oil pan clearance.
9. Rotate crankshaft until timing mark on torsional damper is at 6:00 o'clock position.
10. On Chevrolet and Camaro, use a suitable jack (and a block of wood to prevent damaging oil pan), raise engine enough to insert 2" x 4" wood blocks under engine mounts (fig. 5L), then lower engine onto blocks.
11. On Chevrolet, remove oil pan and discard gaskets and seals.
12. On Camaro, remove oil pan retaining screws and lower pan. Remove the two bolts securing the oil pump assembly and the one nut securing the intake pipe and screen to block. Remove the oil pump and pan and discard gaskets and seals.
13. On Nova remove hood hinge front bolts, loosen rear bolts and swing hood up to install Tool J-22382-1. Connect cantilever hoist or chain fall and raise engine approximately 2".
14. On Nova remove left engine mount and frame bracket. Remove oil pan by lowering it slightly and then rolling it into opening created by removal of left engine mount until oil pan is cleared. Tilt front of pan upward and remove by pulling pan down and to the rear of vehicle. Discard gaskets and seals.

Chevelle (With Manual Transmission)

1. Remove engine from vehicle as outlined.
2. Place engine on jack stands, one at each front mount and one at transmission extension.

   CAUTION: Leave engine lift attached to engine. Do not remove all weight of engine from engine lift.

3. Remove starter.
4. Remove oil pan and discard gaskets and seals.

Chevelle (With Automatic Transmission)

1. Disconnect battery positive cable on battery.
2. Remove radiator upper mounting panel and place a piece of heavy cardboard between the fan and radiator.
3. Disconnect starter brace at starter and disconnect and plug fuel line at fuel pump.
4. Raise vehicle on hoist and drain engine oil.
5. Remove converter housing under pan and splash shield.
6. Remove inboard starter bolt and loosen outboard starter bolt. Swing starter outboard to gain adequate clearance to remove oil pan.
7. Rotate crankshaft until timing mark on torsional damper is at 6:00 o'clock position.
8. Remove the both engine mount "through" bolts.
9. Raise front of engine until motor mounts separate from frame brackets. Remove the right motor mount from the engine and install two bolts in the mount holes. Continue raising engine until a 4-1/2" block of wood can be inserted on the right side between the bolts and frame bracket and a 4" block on the left side between mount and frame (fig. 5L).
10. Remove retaining bolts and lower pan, remove front main bearing cap and remove oil pan from vehicle. Discard gaskets and seals.

Installation

1. Thoroughly clean all gasket sealing surfaces.

   NOTE: Use a new pan gasket set. Do not use sealer.

2. Install rear seal in rear main bearing cap.
3. Install front seal on crankcase front cover pressing tips into holes provided in cover.
4. Install side gaskets on cylinder block (fig. 6L).
5. Complete installation as follows:

Chevrolet, Camaro and Nova

a. If crankshaft was rotated while pan was off, place timing mark at 6:00 o'clock position.
b. On Chevrolet, install oil pan and torque bolts to specifications.
c. On Camaro, raise oil pump and pan into position. Install oil pump and pick-up and torque attaching bolts to specifications. Install oil pan screws and torque to specifications.
d. On Nova install pan by tilting front upward on its side and inserting into the space on the left of engine. Roll pan under engine and then upward and install pan bolt. Torque pan bolts to specifications.
e. On Nova install left engine mount and frame bracket. Lower engine and remove engine hoist.
f. On Nova remove Tool J-22382-1 and install hood hinge bolts. Align hood hinges to original positions and tighten to specifications.
g. Using a suitable jack (and a block of wood to

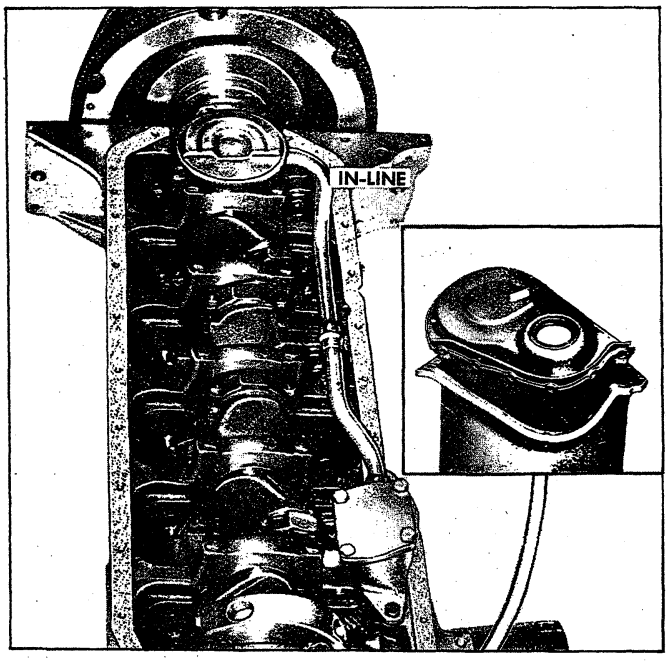


Fig. 6L—Pan Gaskets and Seals

prevent damaging oil pan) raise engine enough to remove 2" x 4" wood blocks, then lower engine.

h. On vehicles equipped with automatic transmission install converter housing underpan, then connect transmission cooler lines.
i. Install and connect starter.
j. Lower vehicle and install fan blades as outlined in Section 6K.
k. Connect upper and lower radiator hoses.
l. Install through bolts in engine front mounts.
m. Connect battery positive cable.
n. Fill radiator with coolant and fill engine with oil, then start engine and check for leaks.

Chevelle (With Manual Transmission)

a. Install oil pan and torque bolts to specifications.
b. Install starter.
c. Install engine as outlined.

Chevelle (With Automatic Transmission)

a. If crankshaft was rotated while pan was off, place timing mark at 6:00 o'clock position.
b. Place oil pan under engine, align main bearing upper half and install bearing cap. Torque bolts to specifications.
c. Install oil pan and torque bolts to specifications.
d. Raise engine and remove blocks. Install right motor mount and lower engine. Install front mount "through" bolts and torque bolts to specifications.
e. Install inboard starter bolts and torque both bolts to specifications.
f. Install converter housing underpan and splash shield.
g. Lower vehicle and fill engine with oil.
h. Connect starter brace and fuel line at pump.
i. Install radiator upper mounting panel.
j. Connect battery positive cable.

OIL PUMP

Removal

1. Remove oil pan as outlined.
2. Remove two flange mounting bolts, pickup pipe bolt, then remove pump and screen as an assembly.

Installation

1. Align oil pump drive shafts to match with distributor tang, then install oil pump to block positioning flange over distributor lower bushing. Use no gasket.

   NOTE: Oil pump should slide easily into place, if not, remove and reposition slot to align with distributor tang.

2. Install oil pan using new gaskets and seals as outlined.

OIL SEAL (REAR MAIN)

Replacement

The rear main bearing oil seal can be replaced (both halves) without removal of the crankshaft.

NOTE: Always replace the upper and lower seal as a unit. Install with the lip facing toward the front of the engine.

1. With the oil pan and oil pump removed, remove the rear main bearing cap.
2. Remove oil seal from the annular tang by prying from the bottom with a small screw driver (fig. 7L).
3. Lubricate the lip of a new seal with engine oil. Keep oil off the parting line surface as this is treated with glue. Insert seal in cap and roll it into place with finger and thumb, using light pressure so seal tangs at parting line do not cut bead on back of seal.
4. To remove the upper half of the seal, use a small hammer to tap a brass pin punch on one end of seal until it protrudes far enough to be removed with pliers (fig. 8L).



Fig. 7L—Removing Oil Seal (Lower Half) Typical

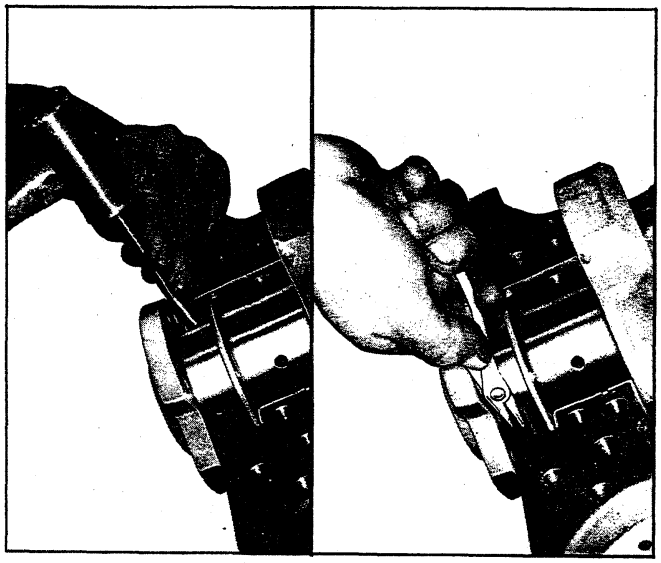


Fig. 8L—Removing Oil Seal (Upper Half) Typical

NOTE: Always wipe crankshaft surface clean before installing a new seal.

5. Lubricate the lip of a new seal with engine oil. Keep oil off the parting line surface.
   Gradually push with a hammer handle, while turning crankshaft, until seal is rolled into place. (Similar to installing a main bearing.) Be careful that seal tangs at parting line do not cut bead on back of seal. Use sealer at parting line on cap half of seal and cylinder block in seal area (fig. 9L).
6. Install the rear main bearing cap (with new seal) and torque to specifications.

CRANKSHAFT PULLEY AND HUB (Nova with L4 Engine)

Removal

1. Drain radiator and disconnect upper and lower radiator hoses at radiator.

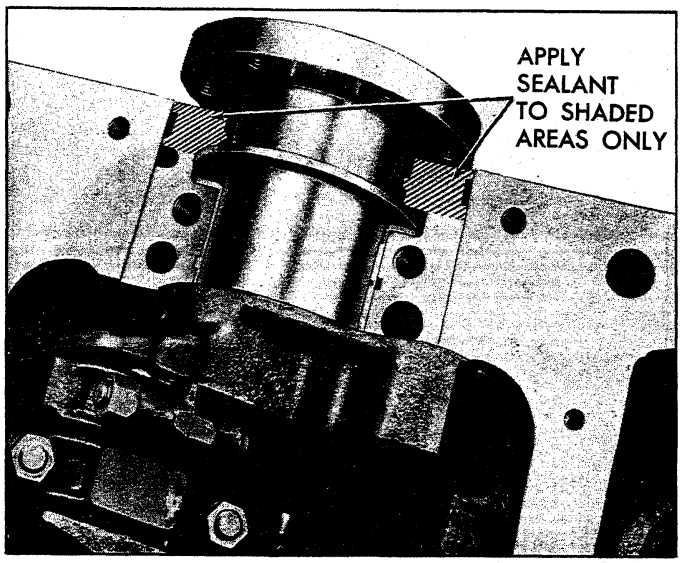


Fig. 9L—Sealing Bearing Cap

2. Remove radiator core as outlined in Section 13.
3. Remove fan belt. Remove crankshaft pulley from pulley hub.
4. Install puller Tool J-6978 to pulley hub with two 3/8" x 2" and one 5/16" x 2" bolts and remove hub then remove puller tool.

Installation

1. Coat oil seal contact area on hub with engine oil position hub over crankshaft and key and start hub into position with a mallet. Using Tool J-5590 drive onto crankshaft until it bottoms against crankshaft gear.

   NOTE: Crankshaft extends slightly through hub and a tool is necessary to drive hub completely into bottomed position.

2. Install pulley onto hub.

   NOTE: There are two 3/8" holes and one 5/16" hole that must be matched on hub in order to properly position timing mark.

3. Install fan belt and adjust using strand tension gauge.
4. Install radiator as outlined in Section 13.

TORSIONAL DAMPER

Removal

1. Remove radiator core, as outlined in Section 13.
2. Remove fan belt and (if so equipped) accessory drive pulley and belt.
3. Install Tool J-6978 to damper and turn puller screw to remove damper (fig. 10L). Remove tool.

Installation

1. Coat front cover oil seal contact area of damper with engine oil.

   CAUTION: It is necessary to use installer Tool J-22197 to prevent the inertia weight section from walking off the hub during installation of damper.

2. Attach damper installer Tool J-22197 to damper. Tighten fingers of tool to prevent weight from moving (fig. 11L).
3. Position damper on crankshaft and drive into position, using J-5590, until it bottoms against crankshaft gear (fig. 11L). Remove installer tool.
4. Install fan belt and adjust using strand tension gauge.

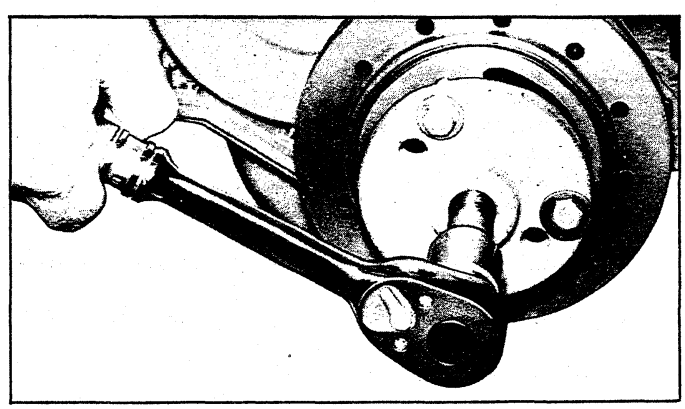


Fig. 10L—Removing Torsional Damper

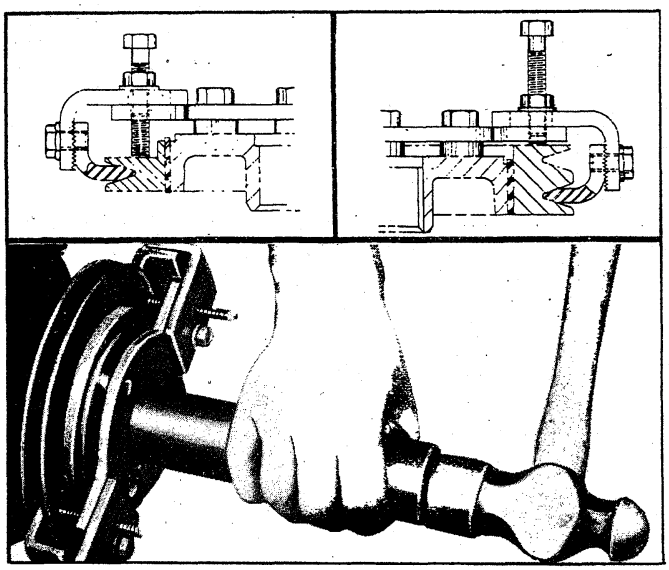


Fig. 11L—Installing Torsional Damper

5. If so equipped, install accessory drive pulley and belt.
6. Install radiator core as outlined in Section 13.
7. Fill cooling system and check for leaks.

CRANKCASE FRONT COVER

Removal

1. Remove oil pan as outlined.
2. Remove crankshaft pulley and hub or torsional damper as outlined.
3. Remove crankcase front cover attaching bolts, remove cover and gasket.

Installation

1. Clean gasket surfaces on block and crankcase front cover.
2. Install centering Tool J-966 or Tool J-21742 in crankcase front cover seal (fig. 12L).
3. Coat the gasket with gasket sealer and place in position on cover, then install crankcase front cover to block and torque bolts to specifications.
4. Remove centering tool.

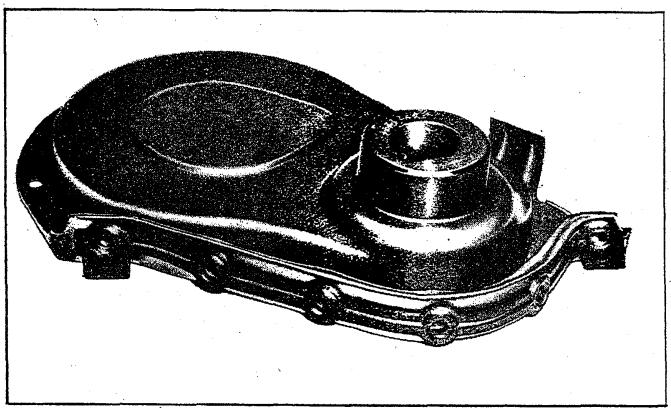


Fig. 12L—J-23042 Centering Tool in Cover

NOTE: It is important that centering tool be used to align crankcase front cover so that crankshaft hub or torsional damper installation will not damage seal and to position seal evenly around the balancer or hub surface.

5. Install crankshaft hub and/or torsional damper as outlined.
6. Install oil pan with new gaskets and seals as outlined.

OIL SEAL (FRONT COVER)

Replacement

With Cover Removal

1. With cover removed, pry old seal out of cover from the front with screw driver being careful not to distort cover.
2. Install new seal so that open end of the seal is toward the inside of cover and drive it into position with Tool J-995 (fig. 13L).

CAUTION: Support cover at sealing area. (Tool J-971 may be used as support.)

Without Cover Removal

1. With crankshaft pulley and hub or torsional damper removed, pry old seal out of cover from the front with a large screw driver, being careful not to damage the seal surface on the cover.
2. Install new seal so that open end of seal is toward the inside of cover and drive it into position with Tool J-8340 (fig. 14L).

CAMSHAFT

Measuring Lobe Lift

NOTE: Procedure is similar to that used for checking valve timing. If improper valve operation is indicated, measure the lift of each

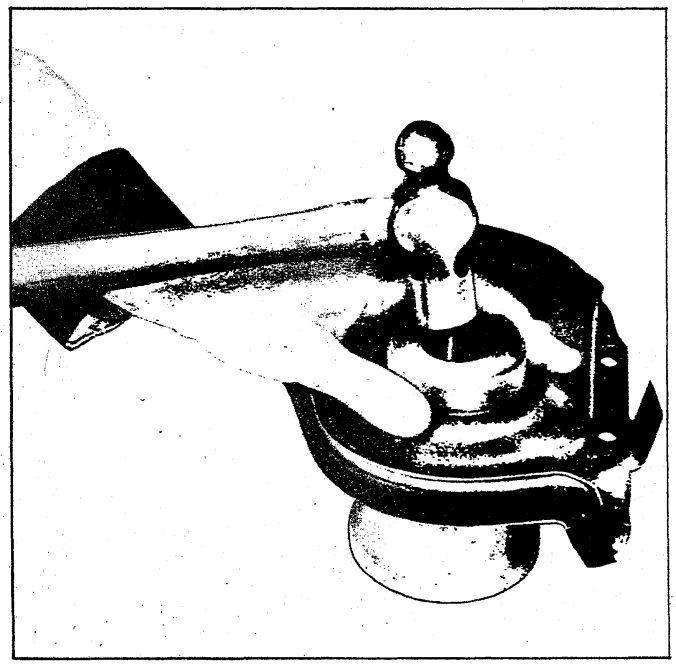


Fig. 13L—Installing Oil Seal (Cover Removed)

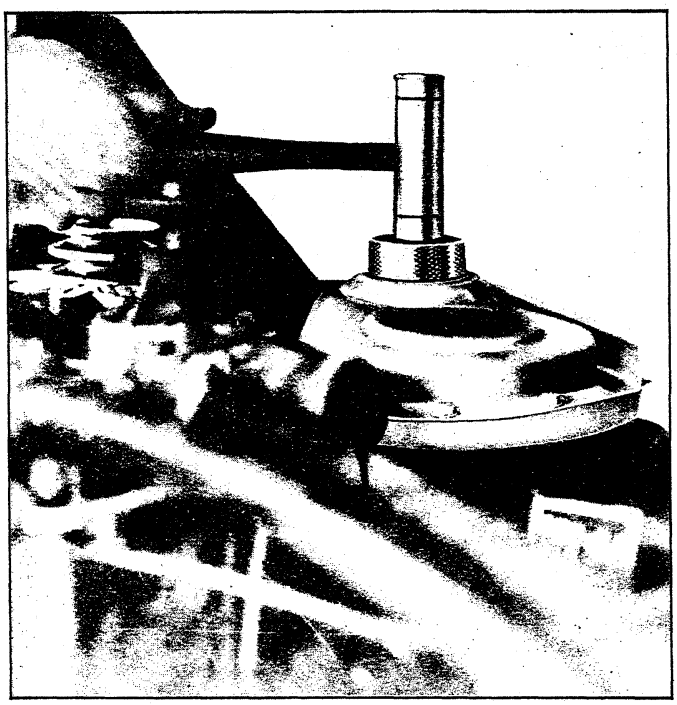


Fig. 14L—Installing Oil Seal (Cover Installed)

push rod in consecutive order and record the readings.

1. Remove valve mechanism as outlined.
2. Position indicator with ball socket adapter (Tool J-8520) on push rod (fig. 15L).
3. Rotate the crankshaft slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the push rod will be in its lowest position.

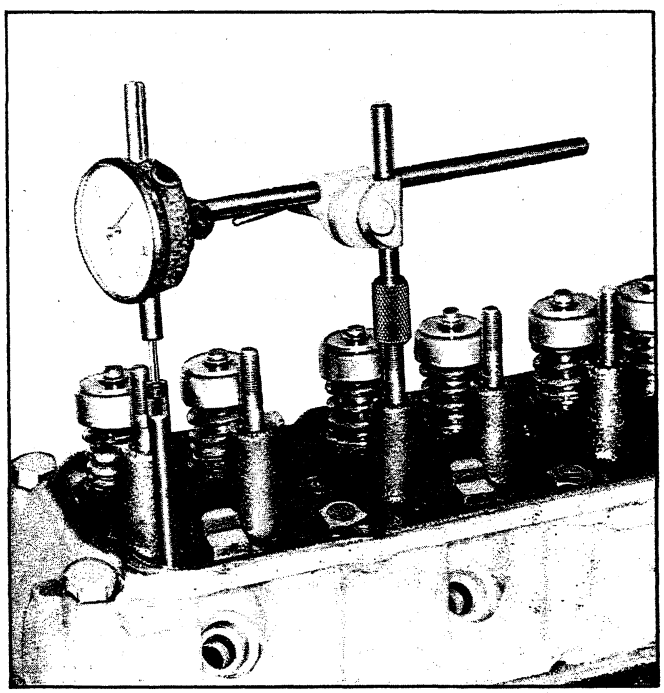


Fig. 15L—Measuring Camshaft Lobe Lift

4. Set dial indicator on zero, then rotate the crankshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until the push rod is in the fully raised position.

   CAUTION: The primary distributor lead must be disconnected from the negative post on the coil and the ignition switch must be in the ON position. Failure to do this will result in a damaged grounding circuit in the ignition switch.

5. Compare the total lift recorded from the dial indicator with specifications.
6. Continue to rotate the crankshaft until the indicator reads zero. This will be a check on the accuracy of the original indicator reading.
7. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
8. Install and adjust valve mechanism as outlined.

Removal (Camaro)

1. Remove engine and proceed as outlined in the Chassis Overhaul Manual.

Removal (Except Camaro)

1. Remove valve lifters as outlined.
2. Remove crankcase front cover as outlined.
3. Remove radiator as outlined in Section 13.
4. Remove grille as outlined in Section 13.
5. Remove fuel pump as outlined in Section 6M.
6. Align timing gear marks then remove the two camshaft thrust plate bolts by working through holes in the camshaft gear (fig. 16L).
7. Remove the camshaft and gear assembly by pulling it out through the front of the block.

   NOTE: Support camshaft carefully when removing so as not to damage camshaft bearings.

Installation

1. Install the camshaft and gear assembly in the engine block, being careful not to damage camshaft bearings or camshaft.
2. Turn crankshaft and camshaft so that the valve timing marks on the gear teeth will line up (fig. 16L).

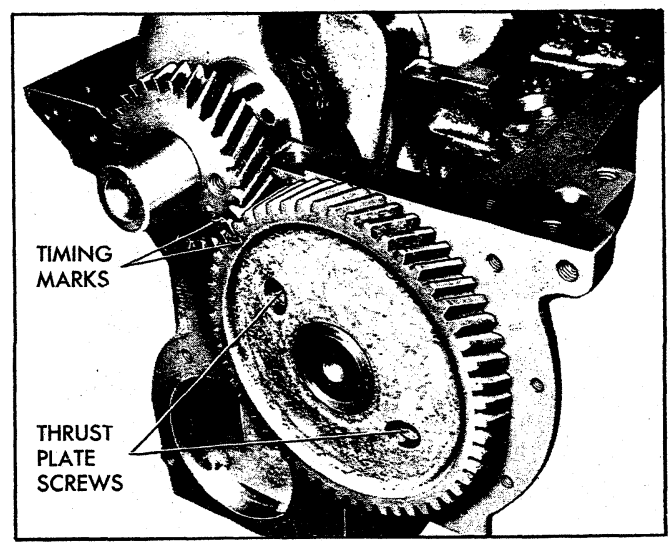


Fig. 16L—Timing Gear Marks

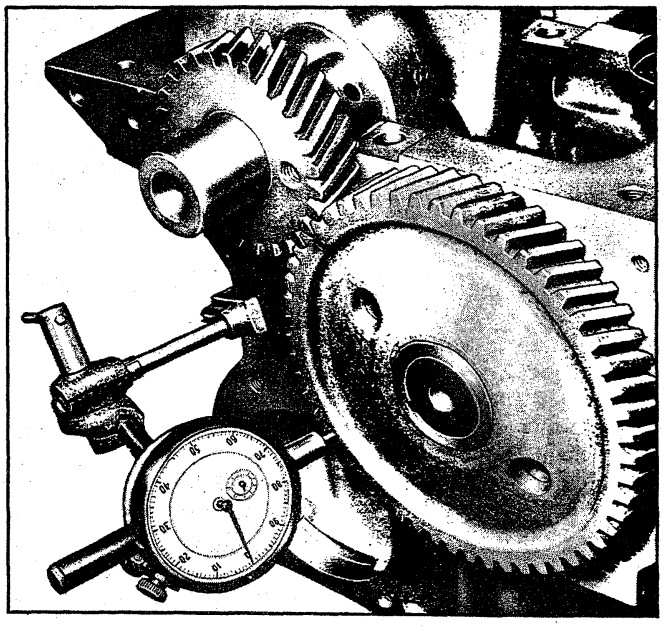


Fig. 17L—Checking Camshaft Gear Runout

Push camshaft into position. Install camshaft thrust plate-to-block bolts and torque to specifications.

3. Check camshaft and crankshaft gear run out with a dial indicator (fig. 17L). The camshaft gear run out should not exceed .004" and the crankshaft gear run out should not exceed .003".
4. If gear run out is excessive, the gear will have to be removed and any burrs cleaned from the shaft or the gear will have to be replaced.
5. Check the backlash between the timing gear teeth with a dial indicator (fig. 18L). The backlash should not be less than .004" nor more than .006".
6. Install fuel pump as outlined in Section 6M.

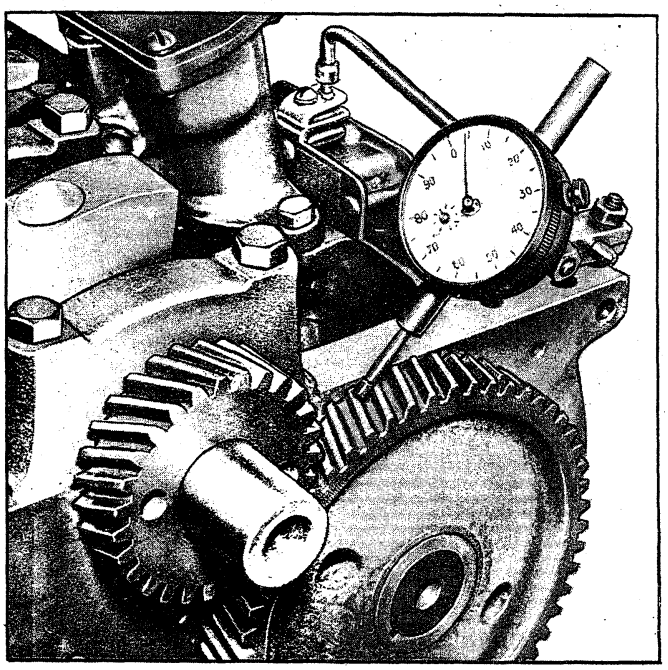


Fig. 18L—Checking Timing Gear Backlash

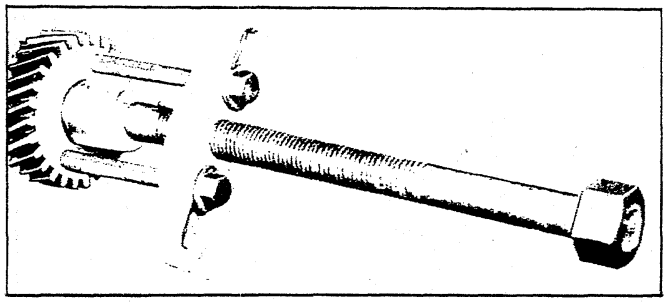


Fig. 19L—Removing Crankshaft Gear

7. Install grille as outlined in Section 13.
8. Install crankcase front cover as outlined.
9. Install radiator as outlined in Section 13.
10. Install valve lifters as outlined.

TIMING GEARS

Replacement

With camshaft removed, crankshaft gear may be removed using Tool J-8105 (fig. 19L). To install crankshaft gear use Tool J-5590 (fig. 20L). For camshaft gear replacement, refer to Section 6, "Camshaft Disassembly" of the Overhaul Manual.

FLYWHEEL

Removal

With transmission and/or clutch housing and clutch removed from engine, remove the flywheel.

Installation

1. Clean the mating surfaces of flywheel and crankshaft to make certain there are no burrs.
2. Install flywheel on crankshaft and position to align dowel hole of crankshaft flange and flywheel (fig. 21L).

   NOTE: On Automatic Transmission equipped engines, the flywheel must be installed with the flange collar to transmission side (fig. 21L).

3. Install bolts and torque to specifications.

ENGINE MOUNTS

Engine mounts (fig. 22L) are the non-adjustable type

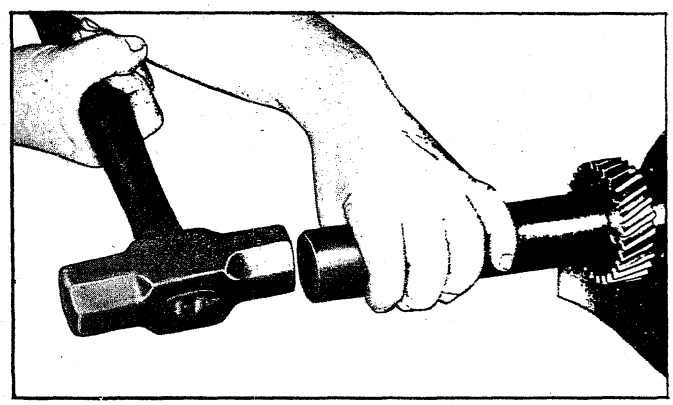


Fig. 20L—Installing Crankshaft Gear

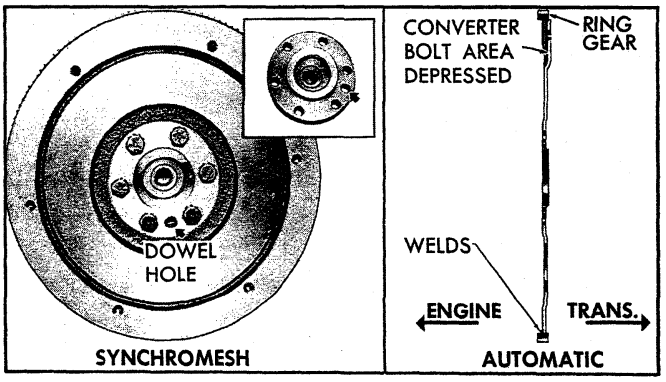


Fig. 21L—Flywheel Installation (Typical)

and seldom require service. Broken or deteriorated mounts should be replaced immediately, because of the added strain placed on other mounts and drive line components.

Front Mount Replacement

Chevrolet, Chevelle, and Camaro

1. Remove nut, washer, spacer then engine mount through-bolt.
2. Raise engine to release weight from mount.
3. Remove mount, stop bracket and frame bracket assembly from crossmember, then remove stop bracket and mount from frame bracket.
4. Install stop bracket and new mount on frame bracket, then install assembly on crossmember.
5. Lower engine, install through-bolt and tighten all mount bolts to specified torques.

Nova

1. Remove nut, washer and engine mount through-bolt.
2. Raise engine to release weight from mount.
3. Remove bracket-to-mount bolt, then remove mount.
4. Install new mount on bracket.
5. Lower engine, install through-bolt and tighten all mount bolts to specified torques.

Rear Mount Replacement

Chevrolet

1. Remove crossmember-to-mount bolts.
2. Raise transmission to release weight from mount.
3. Remove mount-to-transmission bolts, then remove mount and spacer.
4. Install spacer and new mount on transmission.
5. While lowering transmission, align and start crossmember-to-mount bolts.
6. Lower transmission and tighten all mounting bolts to specified torques.

Chevelle and Camaro

1. Remove crossmember-to-mount bolts.
2. Raise transmission to release weight from mount.
3. Remove mount-to-transmission bolts, then remove mount.

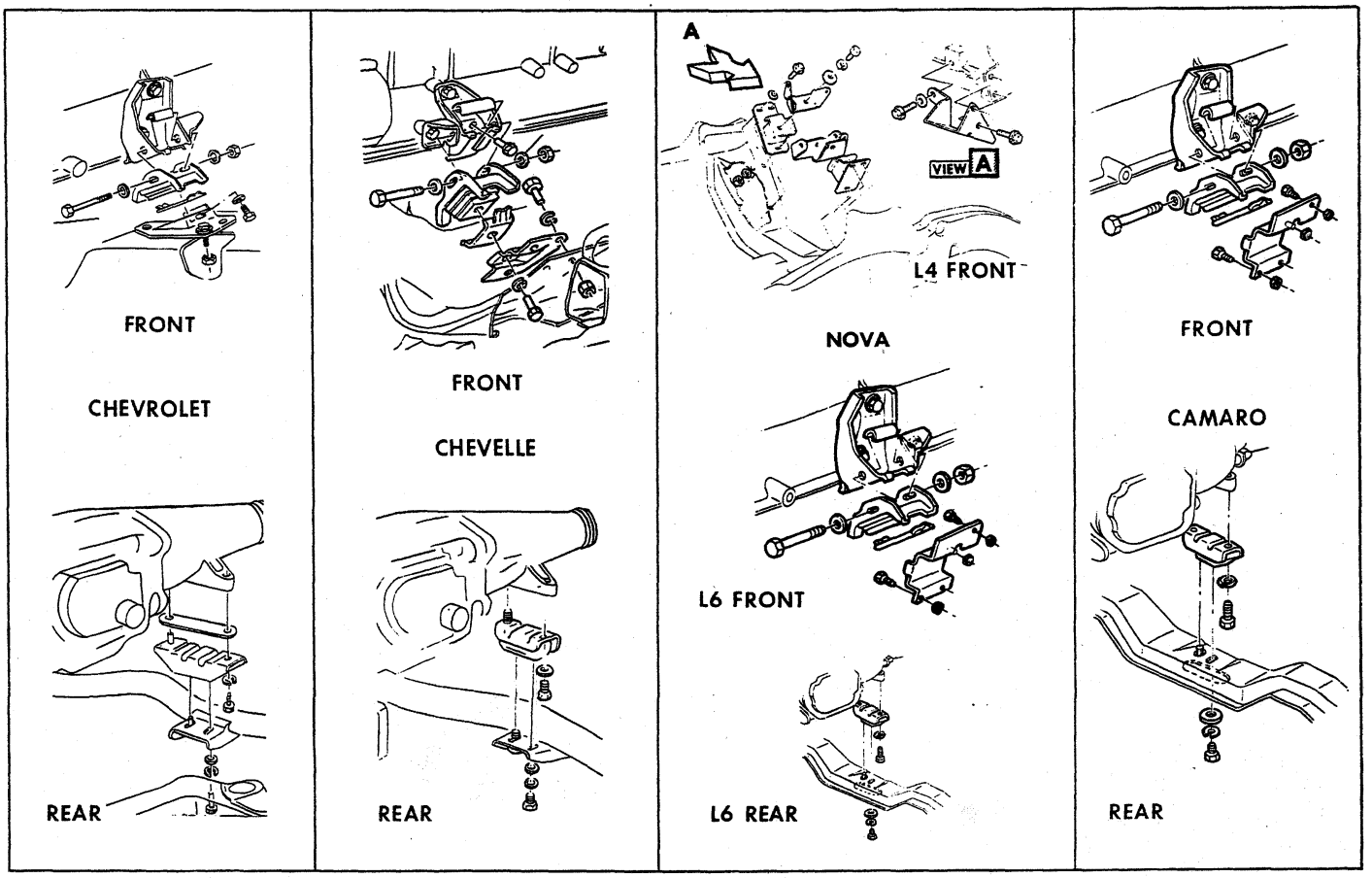


Fig. 22L—Engine Mounts

4. Install new mount on transmission.
5. While lowering transmission align and start crossmember-to-mount bolts.
6. Lower transmission and tighten all mounting bolts to specified torques.

Nova

1. Remove crossmember-to-mount bolts.
2. Raise transmission to release weight from mount.
3. Remove mount-to-transmission bolts, then remove mount.
4. Install new mount on transmission.
5. While lowering transmission align and start crossmember-to-mount bolts.
6. Lower transmission and tighten all mounting bolts to specified torques.

ENGINE MECHANICAL

V-8 ENGINES

INDEX

	Page
General Description	6-26
Component Replacement and Adjustment	6-26
Engine Assembly	6-26
Removal	6-26
Installation	6-28
Intake Manifold	6-28
Removal	6-28
Installation	6-28
Exhaust Manifold	6-29
Removal	6-29
Installation	6-29
Rocker Arm Cover	6-29
Removal	6-29
Installation	6-29
Valve Mechanism	6-29
Removal	6-29
Installation and Adjustment	6-29
Valve Lifters	6-30
Locating Noisy Lifters (Hydraulic)	6-30
Removal	6-31
Installation	6-31
Valve Stem Oil Seal and/or Valve Spring	6-31
Replacement	6-31
Cylinder Head Assembly	6-32
Removal	6-32
Installation	6-32
Oil Pan	6-32
Removal	6-32
Installation	6-34
Oil Pump	6-34
Removal	6-34
Installation	6-35
Oil Seal (Rear Main)	6-35
Replacement	6-35
Torsional Damper	6-36
Removal	6-36
Installation	6-36
Crankcase Front Cover	6-37
Removal	6-37
Installation	6-37
Oil Seal (Front Cover)	6-37
Replacement	6-37
Timing Chain and/or Sprockets	6-38
Replacement	6-38
Camshaft	6-39
Measuring Lobe Lift	6-39
Removal	6-40
Installation	6-40
Flywheel	6-40
Removal	6-40
Installation	6-41
Engine Mounts	6-41
Replacement (Front)	6-41
Replacement (Rear)	6-41

GENERAL DESCRIPTION

The V8 engines (fig. 1V) covered in this section are the 302, 307, 327, 350, 396, and 427 cu. in. engines, regardless of which passenger vehicle they are used in.

This section covers the removal and installation of engine assemblies; the removal, installation and adjustment of some sub-assemblies and replacement of some components. For service to all components and sub-assemblies (after removal) and removal of some sub-assemblies, refer to Section 6 of the Chassis Overhaul Manual.

Because of the interchangeability and similarity of many engines, engine sub-assemblies and engine parts, regardless of which passenger vehicle they are used in, typical illustrations and procedures are used except where specific illustrations or procedures are necessary to clarify the operation. Although illustrations showing bench operations are used, most single operations, when not part of a general overhaul, should be performed (if practical) with the engine in the vehicle.

COMPONENT REPLACEMENT AND ADJUSTMENT

ENGINE ASSEMBLY

Removal

1. Drain cooling system and engine oil.
2. Remove air cleaner and disconnect battery cables at battery.
3. Remove hood hinge front bolts, loosen the rear bolts. Swing hood up and install Tool J-22382-1.
4. Remove radiator and shroud as outlined in Section 13.
5. Remove fan blade and pulley as outlined in Section 6K.

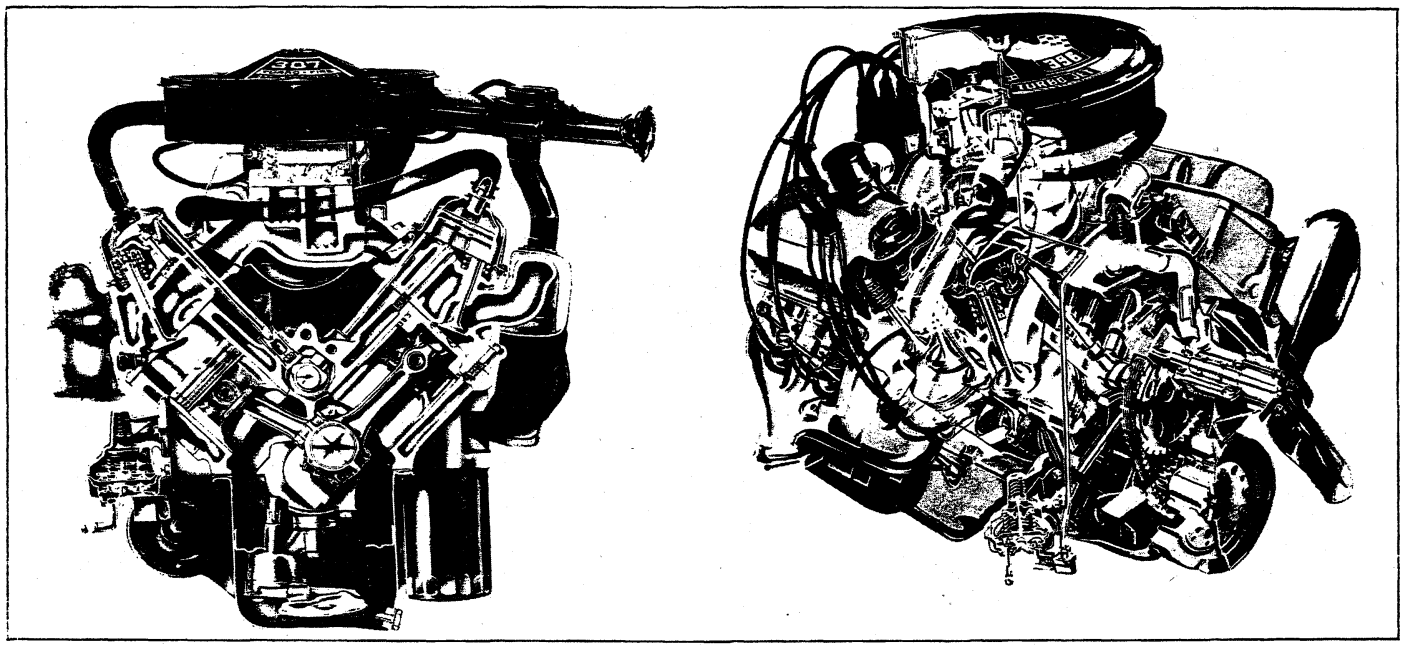


Fig. 1V - V8 Engines (Typical)

6. Disconnect wires at:
   - Starter solenoid
   - Delcotron
   - Temperature switch
   - Oil pressure switch
   - Coil
7. Disconnect:
   - Accelerator linkage at pedal lever.
   - Exhaust pipes at manifold flanges.
   - Vacuum line to power brake unit at manifold (if so equipped).
   - Fuel line (from tank) at fuel pump.
   - Engine cooler lines (if so equipped).
   - Oil pressure gauge line (if so equipped).
8. Remove power steering pump with hoses attached and lay aside.
9. Raise vehicle on hoist.
10. Remove propeller shaft.

NOTE: If plug for propeller shaft opening in transmission is not available, drain transmission.

11. Disconnect:
    - Shift linkage at transmission.
    - Speedometer cable at transmission.
    - Transmission cooler lines (if so equipped).
12. On synchromesh equipped vehicles, disconnect clutch linkage at cross-shaft then remove cross-shaft at frame bracket.
13. Connect lifting device or chain to engine lift brackets.
14. Raise engine to take weight off front mounts and remove front mount thru bolts.
15. Remove rear mount to crossmember bolts.
16. Raise engine to take weight off rear mount, then remove crossmember.

NOTE: On Chevrolets it will be necessary to remove mount from transmission before crossmember can be removed.

NOTE: On Camaro models it is not necessary to completely remove the crossmember. Remove crossmember bolts and slide crossmember back.

17. Remove engine-transmission assembly from vehicle as a unit.
18. Remove transmission (and clutch):

Synchromesh Transmission

a. Remove clutch housing cover plate screws.
b. Remove bolts attaching the clutch housing to engine block then remove transmission and clutch housing as a unit.

NOTE: Support the transmission as the last mounting bolt is removed, and as it is being pulled away from the engine (to prevent damage to clutch disc).

c. Remove starter and clutch housing rear cover plate.
d. Loosen clutch mounting bolts a turn at a time (to prevent distortion of clutch cover) until the spring pressure is released. Remove all bolts, clutch disc and pressure plate assembly.

Automatic Transmission

a. Lower engine, secured by the hoist, and support engine on blocks.
b. Remove starter and converter housing underpan.
c. Remove flywheel-to-converter attaching bolts.
d. Support transmission on blocks.
e. Remove transmission-to-engine mounting bolts.
f. With the hoist attached, remove blocks from the engine only and slowly guide the engine from the transmission.

19. Mount engine in stand.

Installation

1. Attach lifting device or chain to engine lift brackets and remove engine from engine stand.
2. Install transmission (and clutch):

Synchromesh Transmission

a. Install the clutch on flywheel as outlined in Section 7.
b. Install clutch housing rear cover and starter.
c. Install transmission and clutch housing as outlined in Section 7.
d. Install clutch housing cover screws and tighten securely.

Automatic Transmissions

a. Position engine adjacent to the transmission and align the converter with the flywheel.
b. Bolt transmission to engine, then raise engine and transmission assembly and install flywheel to converter attaching bolts.
c. Install converter housing underpan and starter.

3. Tilt and lower engine and transmission assembly into the chassis as a unit, guiding engine to align front mounts with frame supports.
4. Install front mount thru bolts.
5. Raise engine enough to install rear crossmember, then install crossmember, install rear mount and lower engine.
6. Remove lifting device and torque all mount bolts to specifications.
7. On synchromesh equipped vehicles, install clutch cross-shaft engine bracket, then adjust and connect clutch as outlined in Section 7.
8. Connect:
   - Speedometer cable.
   - Shift linkage at transmission.
   - Transmission cooler lines (if so equipped).
9. Install propeller shaft.
10. Lower hoist and remove vehicle.
11. Connect:
   - Vacuum line to power brake unit (if so equipped).
   - Exhaust pipes at manifold flanges.
   - Accelerator linkage at pedal lever.
   - Fuel line at fuel pump.
   - Engine cooler lines (if so equipped).
   - Oil pressure gauge lines (if so equipped).
12. Connect wires at:
   - Coil
   - Oil pressure switch
   - Temperature switch
   - Delcotron
   - Starter soleniod
13. Install power steering pump.
14. Install pulley, fan blade and fan belt as outlined in Section 6K.
15. Install radiator and shroud as outlined in Section 13.
16. Remove hood prop tool and install front hinge bolts. Adjust hood as outlined in Section 11.
17. Connect battery cables.
18. Fill with coolant, engine oil and transmission oil, then start engine and check for leaks.
19. Perform necessary adjustments and install air cleaner.

INTAKE MANIFOLD

Removal

1. Drain radiator and remove air cleaner.
2. Disconnect:
   - Battery cables at battery.
   - Upper radiator and heater hose at manifold.
   - Accelerator linkage at pedal lever.
   - Fuel line at carburetor.
   - Wires at coil (both sides) and temperature sending switch.
   - Power brake hose at carburetor base or manifold.
   - Spark advance hose at distributor.
   - Crankcase ventilation hoses (as required).
3. Remove distributor cap and mark rotor position with chalk. Remove distributor clamp and distributor, then position distributor cap rearward clear of manifold.
4. Remove delcotron upper bracket.
5. Remove coil and bracket.
6. Remove manifold-to-head attaching bolts, then remove manifold (with carburetor on) from engine and discard gaskets and seals.
7. If manifold is to be replaced, transfer:
   - Carburetor and carburetor mounting studs.
   - Water outlet and thermostat (use new gasket).
   - Heater hose adapter.
   - Choke coil.

Installation

1. Clean gasket and seal surfaces of manifold, cylinder heads and block.
2. Install manifold end seals on block as shown (fig. 2V).
3. Install side gaskets on cylinder heads using sealing compound around water passages (fig. 2V).
4. Install manifold bolts, and torque to specifications in

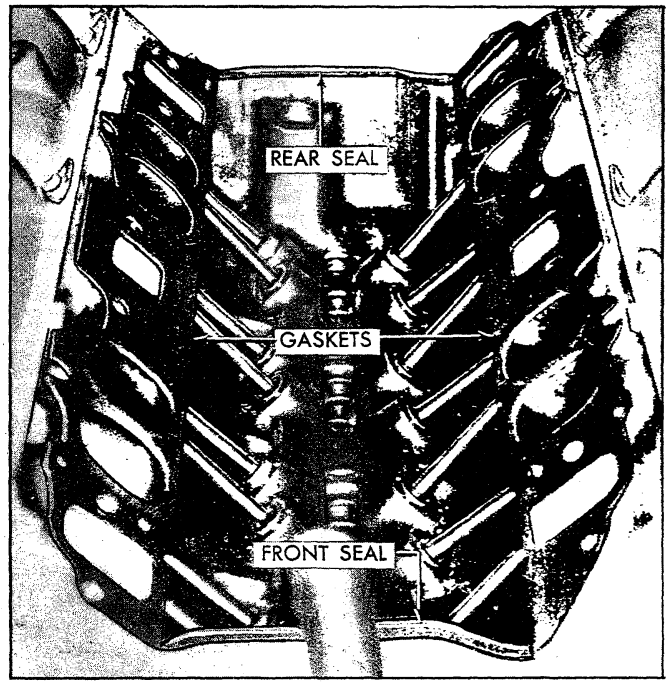


Fig. 2V—Intake Manifold Gasket and Seal Location

the sequence outlined on the Torque Sequence Chart.
5. Install coil.
6. Install distributor with the rotor pointing at the chalk mark, then install distributor cap.

NOTE: If the crankshaft has been rotated while the distributor was removed, time distributor to number 1 cylinder as outlined in Section 6Y.

7. Install delcotron upper bracket. Adjust belt tension and torque attaching bolts to specifications. Connect:
   - Battery cables at battery.
   - Upper radiator and heater hose at manifold.
   - Accelerator linkage at pedal lever.
   - Fuel line at carburetor.
   - Wires at ignition coil (both sides).
   - Power brake hose at carburetor base or manifold.
   - Spark advance hose at distributor.
   - Crankcase ventilation hoses (as required).

   Fill with coolant, start engine, check for leaks and adjust timing and carburetor idle speed and mixture.

EXHAUST MANIFOLD

Removal

NOTE: If equipped with "Air Injection Reactor System", remove air manifold and tubes as outlined in Section 6T.

1. Disconnect battery ground cable.
2. Remove air cleaner pre-heater air stove.
3. Remove exhaust manifold flange nuts, then lower exhaust pipe assembly (hang exhaust pipe from frame with wire).
4. Remove end bolts then remove center bolts and remove manifold from engine.

Installation

1. Clean mating surfaces on manifold and head, then install manifold in position with center bolts.
2. Install end bolts and snug all manifold bolts.
3. Torque center bolts to specifications, then torque end bolts to specifications.
4. Using a new flange gasket install exhaust pipe to manifold flange.
5. Connect the battery ground cable.
6. Install air cleaner pre-heater.
7. Start engine and check for leaks.

ROCKER ARM COVER

Removal

1. Remove air cleaner.
2. Disconnect crankcase ventilation hoses (as required).
3. Disconnect temperature wire from rocker arm cover clips.
4. Remove rocker arm cover.

CAUTION: DO NOT pry rocker arm cover loose. Gaskets adhering to cylinder head and rocker arm cover may be sheared by bumping end of rocker arm cover rearward with palm of hand or a rubber mallet.

Installation

1. Clean gasket surfaces on cylinder head and rocker arm cover with degreaser then, using a new gasket, install rocker arm cover and torque bolts to specifications.
2. Connect crankcase ventilation hoses (if disconnected).
3. Connect temperature wire at rocker arm cover clips.
4. Install air cleaner.

VALVE MECHANISM

Removal

1. Remove rocker arm covers as outlined.
2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods.

NOTE: Place rocker arms, rocker arm balls and push rods in a rack so they may be reinstalled in the same location.

Installation and Adjustment

NOTE: Whenever new rocker arms and/or rocker arm balls are being installed, coat bearing surfaces of rocker arms and rocker arm balls with Molykote or its equivalent.

1. Install push rods. Be sure push rods seat in lifter socket.
2. Install rocker arms, rocker arm balls and rocker arm nuts.
3. Adjust valves when lifter is on base circle or camshaft lobe as follows:

With Hydraulic Valve Lifters

a. Crank engine until mark on torsional damper lines up with center or "0" mark on the timing tab and the engine is in the number 1 firing position. This may be determined by placing fingers on the number 1 cylinder valve as the mark on the damper comes near the "0" mark on the front cover. If the valves are not moving, the engine is in the number 1 firing position. If the valves move as the mark comes up to the timing tab, the engine is in number 6 firing position and crank-

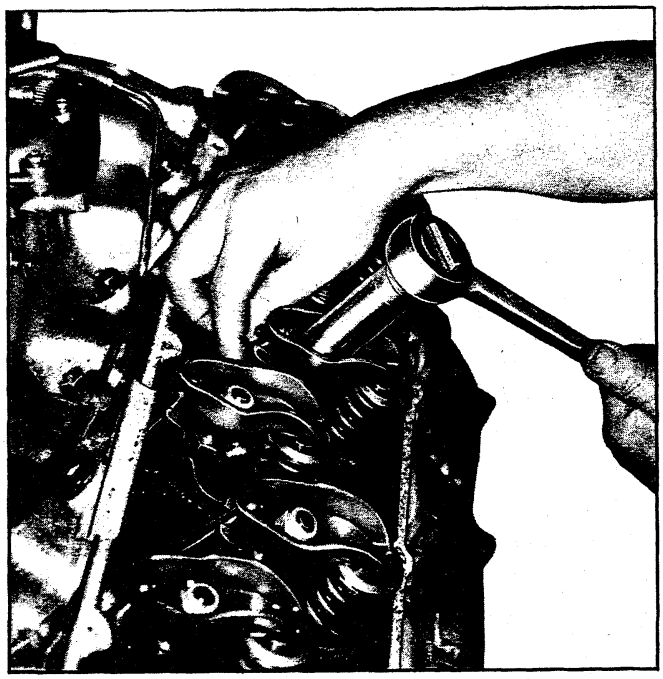


Fig. 3V—Valve Adjustment (Hydraulic)

shaft should be rotated one more revolution to reach the number 1 position.

b. Valve adjustment is made by backing off the adjusting nut (rocker arm stud nut) until there is play in the push rod and then tighten nut to just remove all push rod to rocker arm clearance. This may be determined by rotating push rod with fingers as the nut is tightened (fig. 3V). When push rod does not readily move in relation to the rocker arm, the clearance has been eliminated. The adjusting nut should then be tightened an additional 1 turn to place the hydraulic lifter plunger in the center of its travel. No other adjustment is required.

c. With the engine in the number 1 firing position as determined above, the following valves may be adjusted.
   Exhaust - 1, 3, 4, 8
   Intake - 1, 2, 5, 7

d. Crank the engine one revolution until the pointer "0" mark and torsional damper mark are again in alignment. This is number 6 firing position. With the engine in this position the following valve may be adjusted.
   Exhaust - 2, 5, 6, 7
   Intake - 3, 4, 6, 8

With Mechanical Valve Lifters

a. Crank engine until mark on torsional damper lines up with center or "0" mark on the timing tab and the engine is in the number 1 firing position. This may be determined by placing fingers on the number 1 cylinder valve as the mark on the damper comes near the "0" mark on the front cover. If the valves are not moving, the engine is in the number 1 firing position. If the valves move as the mark comes up to the timing tab, the engine is in number 6 firing position and crankshaft should be rotated one more revolution to reach the number 1 position.

b. With the engine in the number 1 firing position as determined above, adjust the following valves to specifications with a feeler gauge (fig. 4V).
   Exhaust - 4, 8
   Intake - 2, 7

c. Turn crankshaft 1/2 revolution (180°) clockwise and adjust the following valve to specifications with a feeler gauge.
   Exhaust - 3, 6
   Intake - 1, 8

d. Turn crankshaft 1/2 revolution (180°) clockwise until the pointer "0" mark and torsional damper mark are again in alignment. This is number 6 firing position. With the engine in this position, adjust the following valves to specifications with a feeler gauge.
   Exhaust - 5, 7
   Intake - 3, 4

e. Turn crankshaft 1/2 revolution (180°) clockwise and adjust the following valves to specifications with a feeler gauge.
   Exhaust - 1, 2
   Intake - 5, 6

f. Readjust valves (hot and running) as outlined under "Engine Tune Up".

4. Install rocker arm covers as outlined.

5. Adjust carburetor idle speed and mixture.

VALVE LIFTERS

Hydraulic valve lifters very seldom require attention. The lifters are extremely simple in design, readjustments are not necessary, and servicing of the lifters requires only that care and cleanliness be exercised in the handling of parts.

Locating Noisy Lifters (Hydraulic)

Locate a noisy valve lifter by using a piece of garden hose approximately four feet in length. Place one end of the hose near the end of each intake and exhaust valve with the other end of the hose to the ear. In this manner, the sound is localized making it easy to determine which lifter is at fault.

Another method is to place a finger on the face of the valve spring retainer. If the lifter is not functioning properly, a distinct shock will be felt when the valve returns to its seat.

The general types of valve lifter noise are as follows:

1. Hard Rapping Noise--Usually caused by the plunger becoming tight in the bore of the lifter body to such an extent that the return spring can no longer push the plunger back up to working position. Probable causes are:
   a. Excessive varnish or carbon deposit causing abnormal stickiness.
   b. Galling or "pick-up" between plunger and bore of lifter body, usually caused by an abrasive piece of

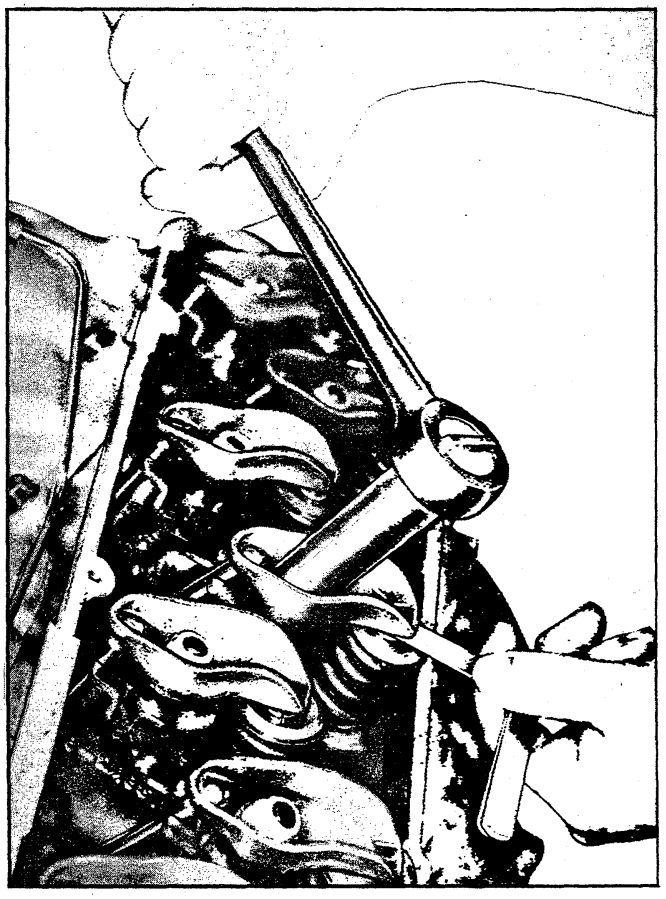


Fig. 4V—Valve Adjustment (Mechanical)

dirt or metal wedging between plunger and lifter body.

2. Moderate Rapping Noise--Probable causes are:
   a. Excessively high leakdown rate.
   b. Leaky check valve seat.
   c. Improper adjustment.
3. General Noise Throughout the Valve Train--This will, in almost all cases, be a definite indication of insufficient oil supply, or improper adjustment.
4. Intermittent Clicking--Probable cases are:
   a. A microscopic piece of dirt momentarily caught between ball seat and check valve ball.
   b. In rare cases, the ball itself may be out-of-round or have a flat spot.
   c. Improper adjustment.

In most cases where noise exists in one or more lifters all lifter units should be removed, disassembled, cleaned in a solvent, reassembled, and reinstalled in the engine. If dirt, corrosion, carbon, etc. is shown to exist in one unit, it more than likely exists in all units, thus it would only be a matter of time before all lifters caused trouble.

Removal

1. Remove intake manifold as outlined.
2. Remove valve mechanism as outlined.
3. Remove valve lifters.

   NOTE: Place valve lifters in a rack so they may be reinstalled in the same location.

Installation

1. Install valve lifters.

   NOTE: Whenever new valve lifters are being installed coat foot of valve lifters with Molykote or its equivalent.

2. Install intake manifold as outlined.
3. Install and adjust valve mechanism as outlined.

VALVE STEM OIL SEAL AND/OR VALVE SPRING

Replacement

1. Remove rocker arm cover(s) as outlined.
2. Remove spark plug, rocker arm and push rod on the cylinders to be serviced.
3. Apply compressed air to the spark plug hole to hold the valves in place.

   NOTE: A tool to apply air to the cylinder is available through local jobbers or may be manufactured. In manufacturing this Tool an AC-46N Spark Plug or its equivalent is recommended. This will make the Tool universal for all Chevrolet engines. Chisel the spark plug as shown, then drive the porcelain out of the plug by tapping the center electrode against a hard block. Using a 3/8" pipe tap, cut threads in the remaining portion of the spark plug and assemble as shown (fig. 5V).

4. Using Tool J-5892 to compress the valve spring, remove the valve locks, valve cap, and valve spring and damper (fig. 6V).
5. Remove valve stem oil seal.
6. Remove as follows:

302, 307, 327 and 350 cu. in. Engines

a. To replace, set the valve spring and damper, valve shield and valve cap in place. The close coiled end of the spring is installed against the cylinder head.

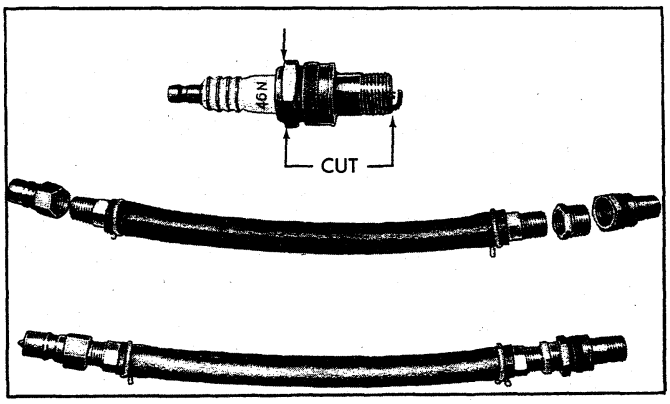


Fig. 5V—Air Adaptor Tool

b. Compress the spring with Tool J-5892 and install oil seal in the lower groove of the stem, making sure the seal is flat and not twisted.

NOTE: A light coat of oil on the seal will help prevent twisting.

c. Install the valve locks and release the compressor tool making sure the locks seat properly in the upper groove of the valve stem.

NOTE: Grease may be used to hold the locks in place while releasing the compressor tool.

396 and 427 cu. in. Engines

a. Install new valve stem oil seal (coated with oil) in position over valve guide.

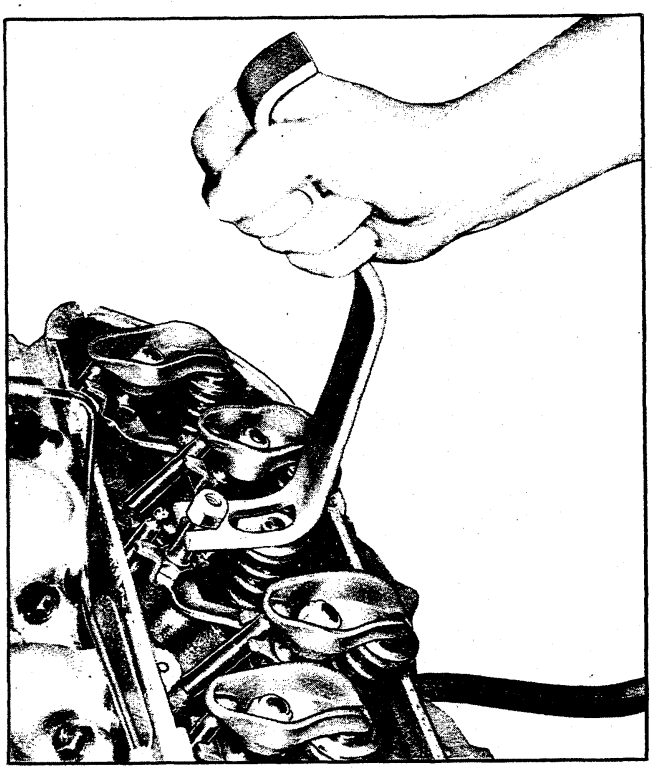


Fig. 6V—Compressing Valve Spring

b. Set the valve spring and damper and valve cap in place.
c. Compress the spring with Tool J-5892 and install the valve locks, then release the compressor tool, making sure the locks seat properly in the groove of the valve stem.

NOTE: Grease may be used to hold the locks in place while releasing the compressor tool.

7. Install spark plug, using a new gasket, and torque to specifications.
8. Install and adjust valve mechanism as outlined.

CYLINDER HEAD ASSEMBLY

Removal

1. Remove intake manifold as outlined.
2. Remove exhaust manifolds as outlined.
3. Remove valve mechanism as outlined.
4. Drain cooling system (block).
5. Remove cylinder head bolts, cylinder head and gasket. Place cylinder head on two blocks of wood to prevent damage.

Installation

CAUTION: The gasket surfaces on both the head and the block must be clean of any foreign matter and free of nicks or heavy scratches. Cylinder bolt threads in the block and threads on the cylinder head bolt must be cleaned. (Dirt will affect bolt torque.)

1. On engines using a STEEL gasket, coat both sides of a new gasket with a good sealer, spread the sealer thin and even. One method of applying the sealer that will assure the proper coat is with the use of a paint roller. Too much sealer may hold the beads of the gasket away from the head or block.

CAUTION: Use no sealer on engines using a composition STEEL ASBESTOS gasket.

2. Place the gasket in position over the dowel pins with the bead up.
3. Carefully guide cylinder head into place over dowel pins and gasket.
4. Coat threads of cylinder head bolts with sealing compound and install finger tight.
5. Tighten cylinder head bolts a little at a time in the sequence shown on the torque sequence chart until the specified torque is reached.
6. Install the exhaust manifold as outlined.
7. Install the intake manifold as outlined.
8. Install and adjust the valve mechanism as outlined.

OIL PAN

Removal

Chevrolet, Camaro, Nova and Chevelle
(Except 396 cu. in. Engine or Manual Transmission)

1. Disconnect battery positive cable.
2. Remove distributor cap from distributor (to prevent breaking cap when engine is raised).
3. Remove radiator upper mounting panel (all except Chevrolet). On Chevrolet models remove six radiator support bolts. This will allow radiator to move up and down freely in later steps.
4. On 396 and 427 cu. in. engine models, place a piece of heavy cardboard between the radiator and fan blade to avoid damage from contact when engine is raised.
5. Raise vehicle on hoist and drain engine oil.
6. Disconnect exhaust pipes or crossover pipe.
7. On vehicles equipped with automatic transmission, remove converter housing under pan and splash shield.
8. Disconnect steering idler lever at the frame and swing steering linkage down for oil pan clearance.
9. Rotate crankshaft until timing mark on torsional damper is at 6:00 o'clock position.
10. Disconnect starter brace at starter. Remove inboard starter bolt and loosen outboard starter bolt. Starter can now be swung outboard to gain adequate clearance to remove oil pan.
11. On Chevelle, remove the full pump and plug fuel line from gas tank.
12. Remove the "through" bolts from the engine front mounts.
13. On all except Nova and Camaro 307, 327 and 350 cu. in. engines, use a suitable jack and a block of wood (to avoid pan damage) and raise the engine.
14. On Nova and Camaro 302, 327 and 350 cu. in. engines use Tool J-8105 and J-21058-12 and raise engine (fig. 7V).

NOTE: Remove tip (punch out pin) and remove yoke from bolt of Tool J-8105. Insert bolt portion of Tool J-8105 through hole in forward portion of frame. Install yoke portion of tool on bolt. Place Tool J-21058-12 over end of bolt. Once the tool is assembled on the vehicle in this manner, screw bolt until end of Tool J-21058-12 contacts the engine torsional damper. Engine is raised by continuing to turn the bolt.

15. Engine should be raised until wood blocks of 4" on Chevrolet, 2" on Nova and Camaro and 3" on Chevelle can be inserted under engine mounts. Lower engine until supported by blocks (Fig. 8V).
16. Remove oil pan bolts and remove oil pan. Discard used gaskets and seals.

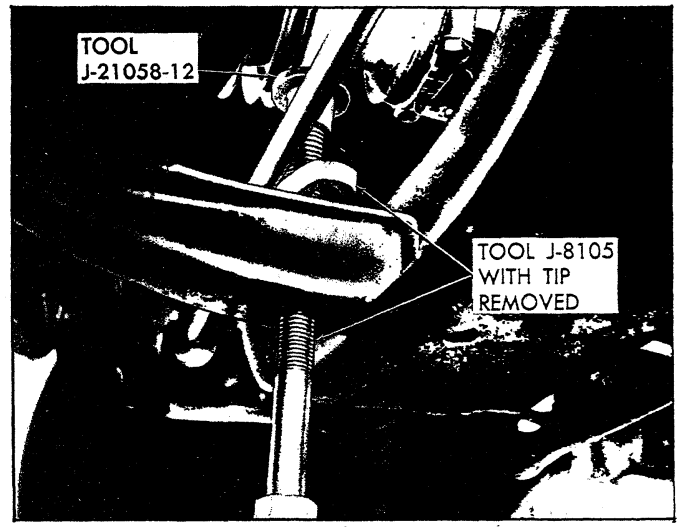


Fig. 7V—Raising Engine with Tool J-8105 and J-21058-12

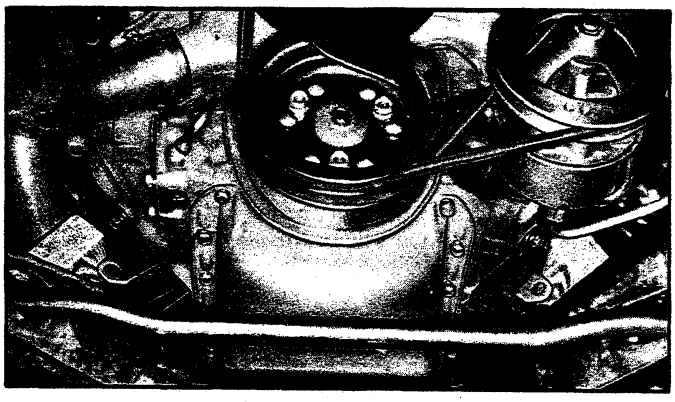


Fig. 8V—Engine Blocked for Oil Pan Removal

Chevelle (396 cu. in. Engine or Manual Transmission)

1. Disconnect battery positive cable.
2. Remove air cleaner, dipstick, and disconnect distributor cap from distributor (to prevent breaking cap when engine is raised).
3. Remove radiator shroud and upper mounting panel. This will allow radiator to move up and down freely in later steps.
4. On 396 cu. in. engine models, place a piece of heavy cardboard between the radiator and fan blade to avoid damage from contact when engine is raised.
5. Disconnect engine ground straps at engine. On 307 and 350 cu. in. engines remove fuel pump and plug line from tank.
6. Disconnect accelerator control cable from engine.
7. Place a hook fabricated from steel strap stock and formed as shown in fig. 9V and suitable chain (approximately 4 feet long) over cowl (fig. 10V). Install a bolt through holes in hook and center link of chain.
8. Raise vehicle on hoist, drain oil and remove oil filter on 307 and 350 cu. in. engines.
9. Disconnect starter brace at starter. Remove inboard starter bolt and loosen outboard starter bolt. Starter can now be swung outboard to gain adequate clearance to remove oil pan.
10. Remove prop shaft and plug rear of transmission.
11. On all floor shift manual transmission models, remove 2 bolts securing shift lever to linkage. On all other models disconnect transmission linkage at transmission.
12. Disconnect speedometer cable and back-up lamp switch connector.
13. On manual transmission vehicles disconnect clutch cordon shaft at frame. On automatic transmission vehicles, disconnect cooler lines, detent cable, rod or switch wire, and modulator pipe.
14. Remove crossmember bolts and place jack under engine. Raise engine and move crossmember toward rear of vehicle.
15. On engines with single exhaust, remove crossover pipe. On engines with dual exhaust disconnect exhaust pipes.
16. Remove flywheel housing cover. Remove transmission attaching bolts and remove transmission. On manual transmission models remove flywheel housing and throwout bearing.

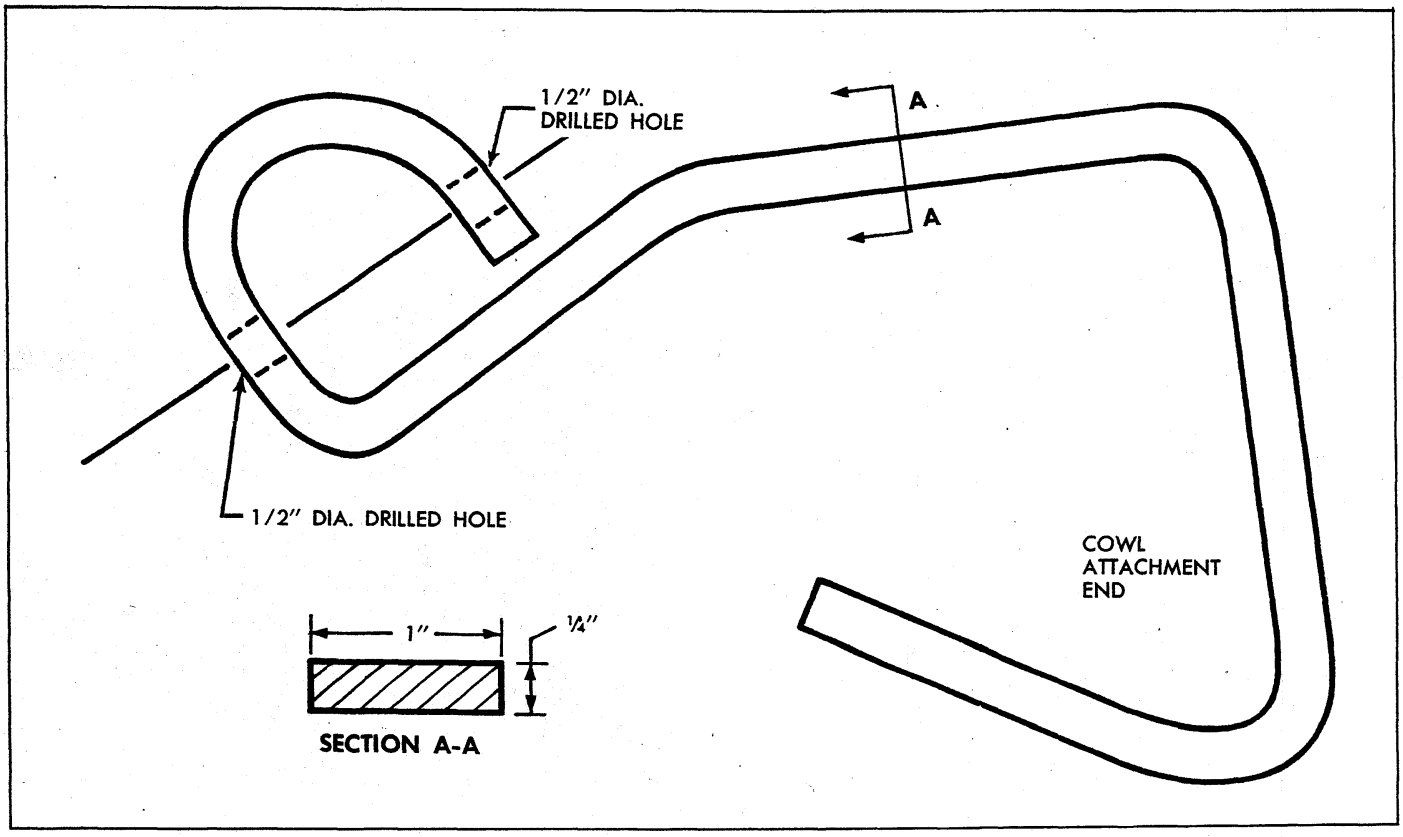


Fig. 9V—Full Size Template of Fabricated Strap

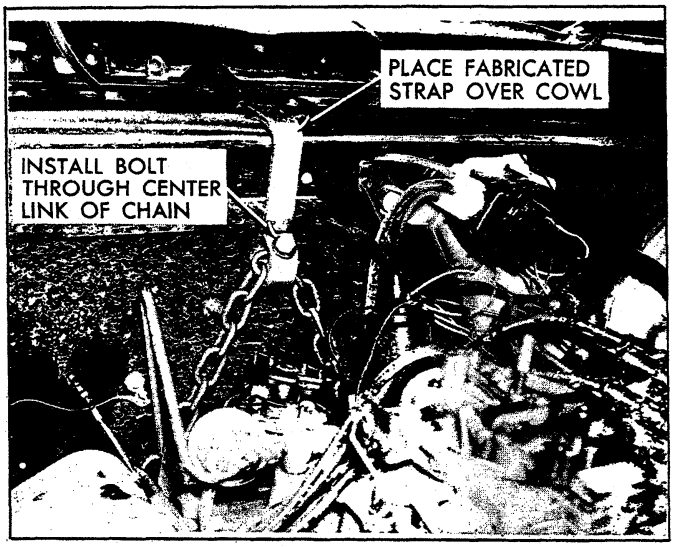


Fig. 10V—Install Strap Over Cowl

17. Remove engine mount through bolts.
18. Raise rear of engine approximately 4 inches. Attach each end of chain to engine using bell housing bolts (manual transmission) or transmission mounting bolts (automatic transmission). Lower engine jack and move to front of engine.
19. Raise front of engine and insert 2" blocks of wood under front engine mounts (fig. 8V).
20. Rotate crankshaft until timing mark on torsional damper is at 6:00 o'clock position.
21. Remove oil pan bolts and remove oil pan. Discard used gaskets and seals.

Corvette

1. Disconnect battery positive cable and remove engine oil dipstick and tube.
2. Raise vehicle on hoist and drain engine oil.
3. Disconnect steering linkage idler at frame and lower the linkage.
4. Remove oil pan bolts and remove oil pan. Discard used gaskets and seals.

Installation

1. Thoroughly clean all gasket sealing surfaces.
2. If crankshaft was rotated while oil pan was off, place timing mark at 6:00 o'clock position.
3. Using new gaskets, install side gasket on pan rails using gasket sealer as a retainer.
4. Install front and rear pan seals, making sure their ends butt with side gaskets.
5. Install oil pan and torque retaining bolts to specifications.
6. Raise engine, remove wood blocks and lower engine onto front mounts.
7. Complete installation as follows:

Chevrolet, Camaro, Nova and Chevelle (Except 396 cu. in. Engine or Manual Transmission)

a. Install engine front mount "through" bolts and torque to specifications.
b. Install inboard starter bolt and connect starter brace, torque bolt to specifications.
c. On Chevelle install fuel pump. Torque bolts to specifications and connect fuel line.
d. Connect steering idler arm and torque bolts to specifications.
e. On vehicles equipped with automatic transmissions install converter under pan and splash shield.
f. Connect exhaust pipes or crossover pipe.
g. Lower vehicle and fill engine with oil.
h. Install radiator upper mounting panel (except Chevrolet). On Chevrolet models install six radiator support bolts.
i. Install distributor cap on distributor and connect battery positive cable.

Chevelle (396 cu. in. Engine or Manual Transmission)

a. Support rear of engine with jack and remove support chain. Lower engine and install front mount through bolts. Torque bolts to specifications.
b. On manual transmission vehicles install flywheel housing and throw out bearing. Install flywheel housing cover and transmission. Torque attaching bolts to specifications.
c. On Automatic transmission vehicles install transmission and converter under pan. Torque attaching bolts to specifications.
d. On engines with single exhaust install crossover pipe. On engines with dual exhaust connect exhaust pipes.
e. Install crossmember and remove engine jack. Torque bolts to specifications.
f. On manual transmission vehicles connect clutch cordon shaft and adjust clutch. On automatic transmission vehicles connect cooler lines detent cable, rod or switch wire, and modulator pipe.
g. Connect speedometer cable and back-up lamp switch connector.
h. On floorshift manual transmission models, install shift lever to linkage. On all other models connect transmission shift linkage to transmission.
i. Remove transmission extension plug and install prop shaft.
j. Install inboard starter bolt and connect starter brace, torque bolts to specifications.
k. Install oil filter on 307 and 350 cu. in. engines. Lower vehicle and fill engine with oil.
l. Remove support hook with chain and connect accelerator cable.
m. Connect engine ground straps. Install fuel pump (307 and 350 cu. in. engines), torque bolts to specifications and connect fuel line.
n. Install radiator shroud and upper mounting panel.
o. Install distributor cap on distributor and install air cleaner and engine dipstick.
p. Connect battery positive cable.

Corvette

a. Connect steering linkage idler and torque attaching bolts to specifications.
b. Lower vehicle and install engine oil dipstick and tube.
c. Fill engine with oil and connect battery positive cable.

OIL PUMP

Removal

1. Remove oil pan as outlined.
2. Remove pump to rear main bearing cap bolt and remove pump and extension shaft.

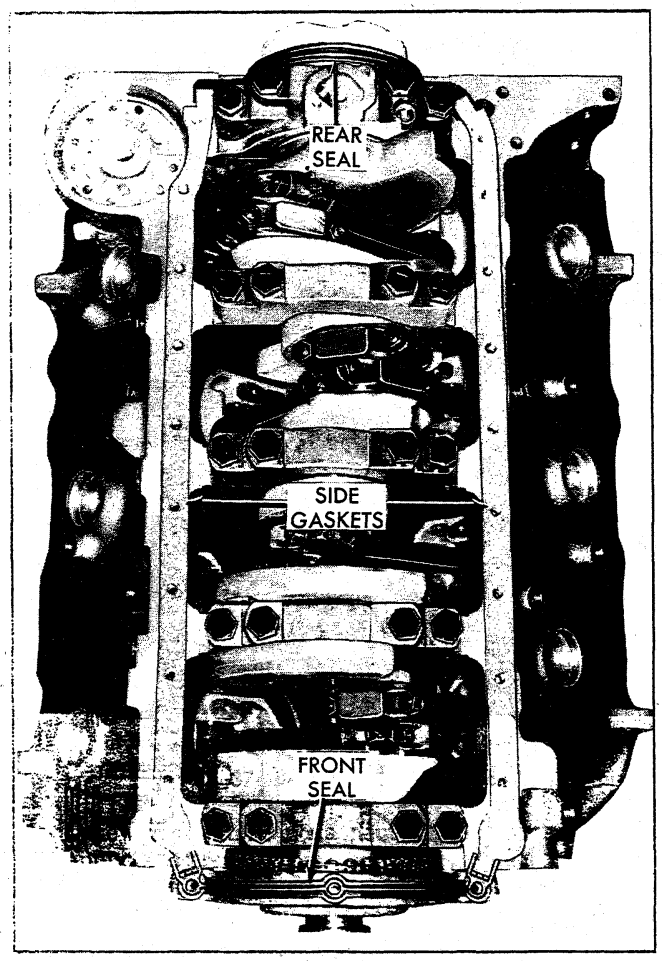


Fig. 11V—Oil Pan Gasket and Seal Location

Installation

1. Assemble pump and extension shaft to rear main bearing cap, aligning slot on top end of extension shaft with drive tang on lower end of distributor drive shaft.
2. Install pump to rear bearing cap bolt and torque to specifications.

   NOTE: Installed position of oil pump screen is with bottom edge parallel to oil pan rails.

3. Install oil pan as outlined.

OIL SEAL (REAR MAIN)

Replacement

The rear main bearing oil seal can be replaced (both halves) without removal of the crankshaft.

NOTE: Always replace the upper and lower seal as a unit. Install with the lip facing toward the front of the engine.

1. With the oil pan and oil pump removed, remove the rear main bearing cap.
2. Remove oil seal from the annulor tang by prying from the bottom with a small screw driver (fig. 12V).
3. Lubricate the lip of a new seal with engine oil. Keep oil off the parting line surface as this is treated with glue. Insert seal in cap and roll it into place with finger and thumb, using light pressure so seal tangs at parting line do not cut bead on back of seal.
4. To remove the upper half of the seal, use a small hammer to tap a brass pin punch on one end of seal until it protrudes far enough to be removed with pliers (fig. 13V).

   NOTE: Always wipe crankshaft surface clean before installing a new seal.

5. Lubricate the lip of a new seal with engine oil. Keep oil off the parting line surface. Gradually push with a hammer handle, while turning crankshaft, until seal is rolled into place. (Similar to installing a main bearing.) Be careful that seal tangs at parting



Fig. 12V—Removing Oil Seal (Lower Half)

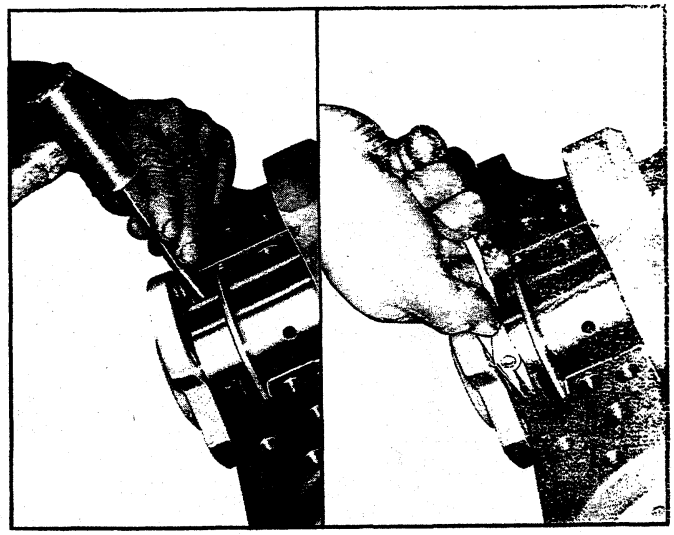


Fig. 13V—Removing Oil Seal (Upper Half)

line do not cut bear on back of seal. Use sealer at parting line on cap half of seal and seal area of cylinder block (fig. 14V)

6. Install the rear main bearing cap (with new seal) and torque to specifications.

TORSIONAL DAMPER

Removal

1. Remove fan belt, fan and pulley as outlined in Section 6K.
2. Remove the radiator and shroud as outlined in Section 13.

   NOTE: If additional operations such as camshaft removal are not being performed, the radiator will not have to be removed on Chevrolets and Corvettes equipped with 396 and 427 cu. in. engines.

3. On Corvettes equipped with 427 cu. in. engines, remove engine front mount through-bolts and raise front of engine enough for torsional damper to clear frame crossmember.
4. Remove accessory drive pulley, then remove torsional damper retaining bolt (if so equipped).
5. Install Tool J-6978 to torsional damper and turn puller screw to remove damper from crankshaft (fig. 15V).
6. Remove tool.

Installation

CAUTION: It is necessary to use installer tool to prevent the inertia weight section from walking off the hub during installation of damper.

307, 327 and 350 cu. in. Engines
(Except 302 and 350 (350 & 370 HP) cu. in. Engines)

1. Coat front cover seal contact area (on torsional damper) with engine oil.
2. Attach damper installer Tool J-22197 to damper. Tighten fingers of tool to prevent weight from moving (fig. 16V).
3. Position damper on crankshaft and drive into position until it bottoms against crankshaft sprocket. (fig. 16V). Remove installer tool.
4. Install accessory drive pulley.
5. Install radiator and shroud as outlined in Section 13.
6. Install fan pulley and fan as outlined in Section 6K.
7. Install fan belt and adjust to specifications using strand tension gauge.

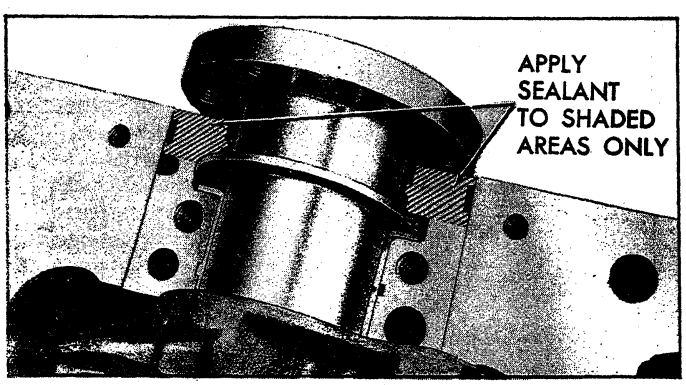


Fig. 14V—Sealing Bearing Cap

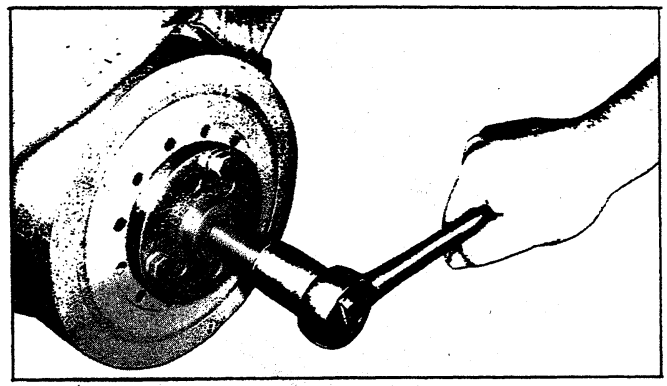


Fig. 15V—Removing Torsional Damper

8. Fill cooling system, start engine and check for leaks.

396 and 427 cu. in. Engines

1. Coat front cover seal contact area (on damper) with engine oil.
2. Place damper in position over key on crankshaft.
3. Using Tool J-21058 pull damper onto crankshaft (fig. 17V).

   NOTE: If engine or radiator has not been removed from the vehicle a 1/2"-20 x 5" bolt and a 1/2"-20 nut may be used in place of the bolt and nut of Tool J-21058.

   CAUTION: Install bolt in crankshaft with sufficient thread engagement (min. 1/2").

4. Remove tool from crankshaft.
5. Install damper retaining bolt and torque to specifications, then install accessory drive pulley.
6. Install radiator and shroud as outlined in Section 13.
7. Install fan pulley and fan as outlined in Section 6K.
8. Install fan belt and adjust to specifications using strand tension gauge.

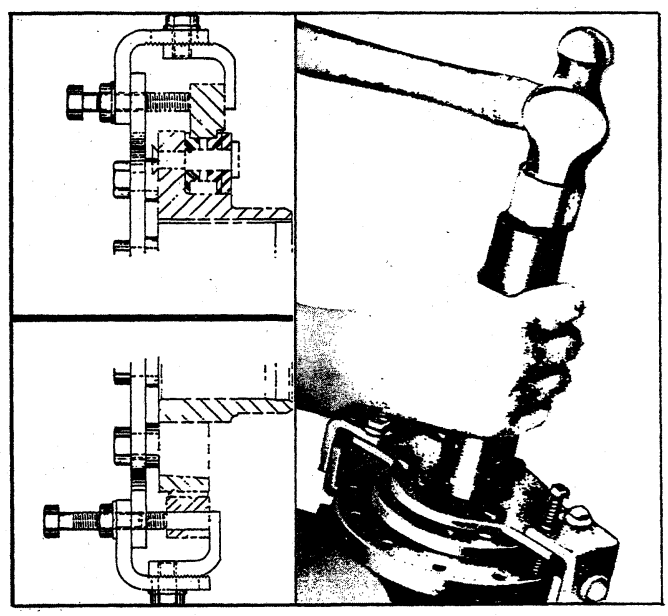


Fig. 16V—Installing Torsional Damper
(302, 307, 327 and 350)

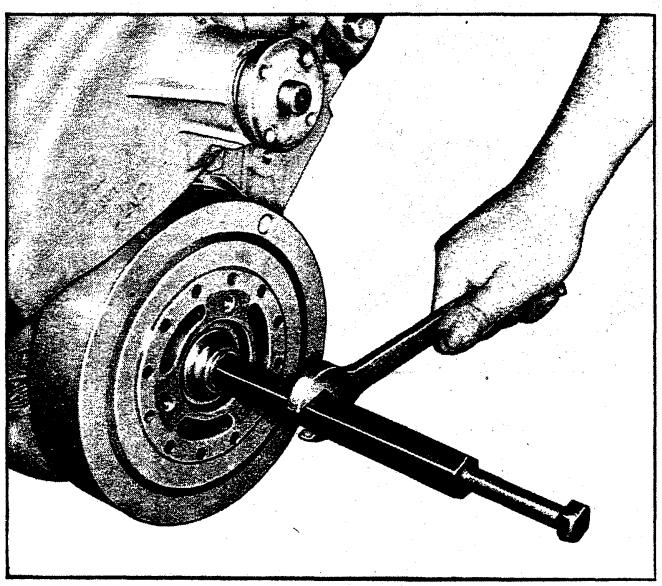


Fig. 17V—Installing Torsional Damper (396 and 427)

9. On Corvettes, lower engine and install front mount through-bolts.
10. Fill cooling system, start engine and check for leaks.

302 and 350 (350 & 370 HP) cu. in. Engines

Install damper as outlined for 396 and 427 cu. in. engines, using a 7/16"-20 x 5" bolt and nut in place of the bolt and nut furnished with J-21058.

CRANKCASE FRONT COVER

Removal

1. Remove oil pan as outlined.
2. Remove torsional damper as outlined.
3. Remove water pump as outlined in Section 6K.
4. Remove crankcase front cover attaching bolts and remove front cover and gasket, then discard gasket.

Installation

1. Make certain that cover mounting face and cylinder block front face are clean and flat.
2. Coat the oil seal with engine oil and using a new cover gasket, coated with gasket sealer, install cover and gasket over dowel pins and cylinder block.
3. Install cover screws and torque bolts to specifications.
4. Install water pump as outlined in Section 6K.
5. Install torsional damper as outlined.
6. Install oil pan as outlined.

OIL SEAL (FRONT COVER)

Replacement

With Cover Removal

1. With cover removed, pry old seal out of cover from the front with a large screw driver.
2. Install new seal so that open end of the seal is toward the inside of cover and drive it into position with Tool J-995 on 302, 307, 327 and 350 cu. in. engines (fig. 18V) or Tool J-22102 on 396 and 427 cu. in. engines (fig. 19V).

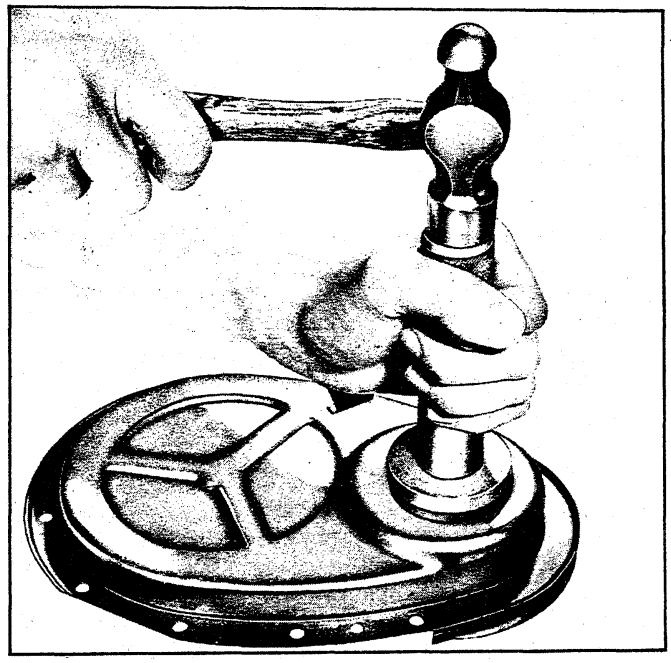


Fig. 18V—Installing Oil Seal (Cover Removed) 302, 307, 327 and 350

CAUTION: Support cover at sealing area to avoid distorting cover.

Without Cover Removal

1. With torsional damper removed, pry old seal out of cover from the front with a large screw driver, being careful not to damage the surface on the crankshaft.
2. Install new seal so that open end of seal is toward the inside of cover and drive it into position with Tool J-8340 on 302, 307, 327 and 350 cu. in. engines (fig. 20V) or Tool J-22102 on 396 and 427 cu. in. engines (fig. 21V).

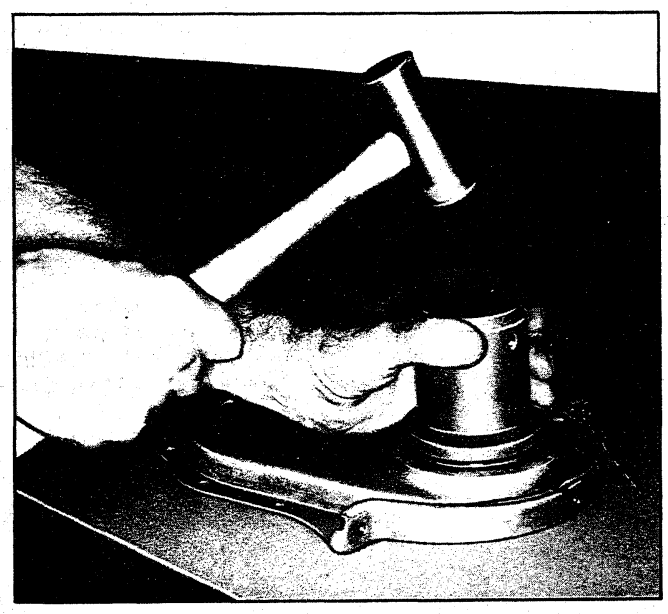


Fig. 19V—Installing Oil Seal (Cover Removed) 396 and 427

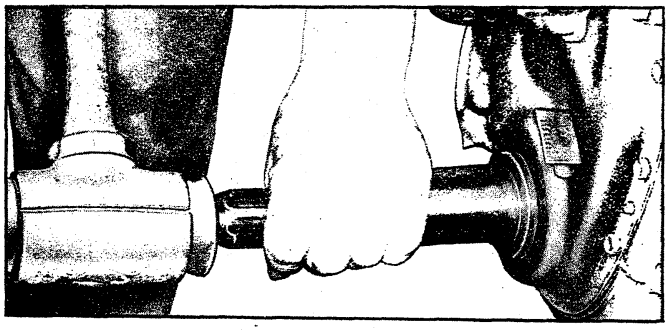


Fig. 20V—Installing Oil Seal (Cover Installed 302, 307, 327 and 350

TIMING CHAIN AND/OR SPROCKETS

Replacement

1. Remove torsional damper and crankcase front cover as outlined.
2. Crank engine until marks on camshaft and crankshaft sprockets are in alignment (fig. 22V).
3. Remove three camshaft sprocket to camshaft bolts.
4. Remove camshaft sprocket and timing chain together.

   NOTE: Sprocket is a light press fit on camshaft. To dislodge, tap lightly on lower edge of camshaft sprocket with a plastic hammer.

5. If crankshaft sprocket is to be replaced, remove sprocket using Tool J-5825 on 302, 307, 327 and 350 cu. in. engines (fig. 23V), or Tool J-1619 on 396 and 427 cu. in. engines (fig. 24V). Install new sprocket using Tool J-5590 on 302, 307, 327 and 350 cu. in. engines (fig. 25V) or Tool J-21058 on 396 and 427 cu. in. engines (fig. 26V).

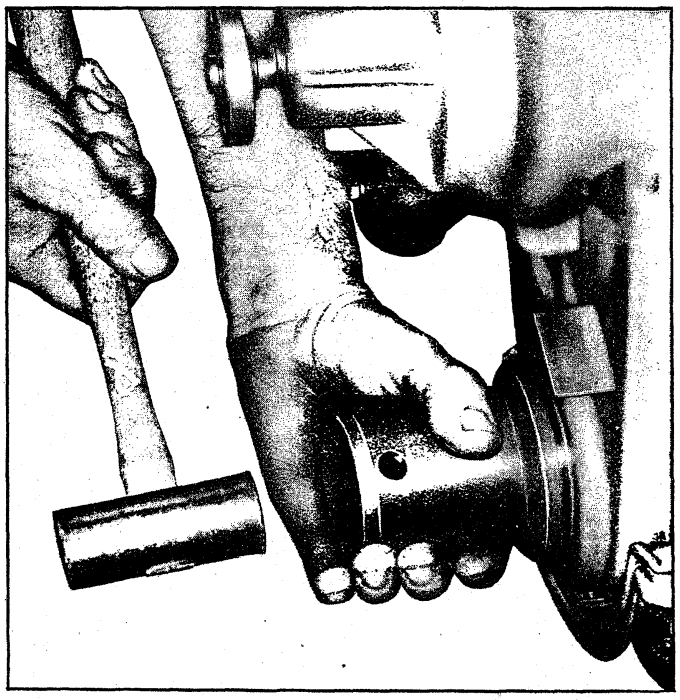


Fig. 21V—Installing Oil Seal (Cover Installed) 396 and 427

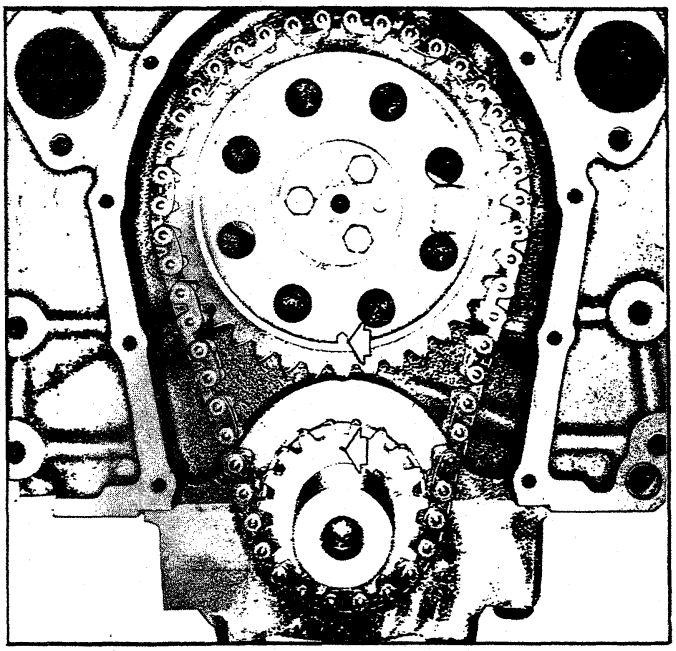


Fig. 22V—Timing Sprocket Marks

6. Install timing chain on camshaft sprocket. Hold the sprocket vertical with the chain hanging below, and orient to align marks on camshaft and crankshaft sprockets (fig. 22V).
7. Align dowel in camshaft with dowel hole in camshaft sprocket and install sprocket on camshaft (fig. 27V).

   NOTE: Do not attempt to drive cam sprocket on shaft as welsh plug at rear of engine can be dislodged.

8. Draw camshaft sprocket onto camshaft, using the three mounting bolts. Torque to bolt specifications.
9. Lubricate timing chain with engine oil.
10. Install crankcase front cover and torsional damper as outlined.

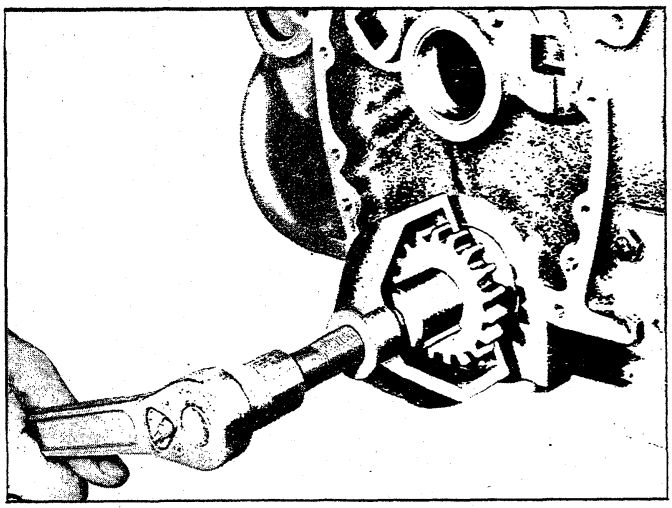


Fig. 23V—Removing Crankshaft Sprocket (302, 307, 327 and 350)

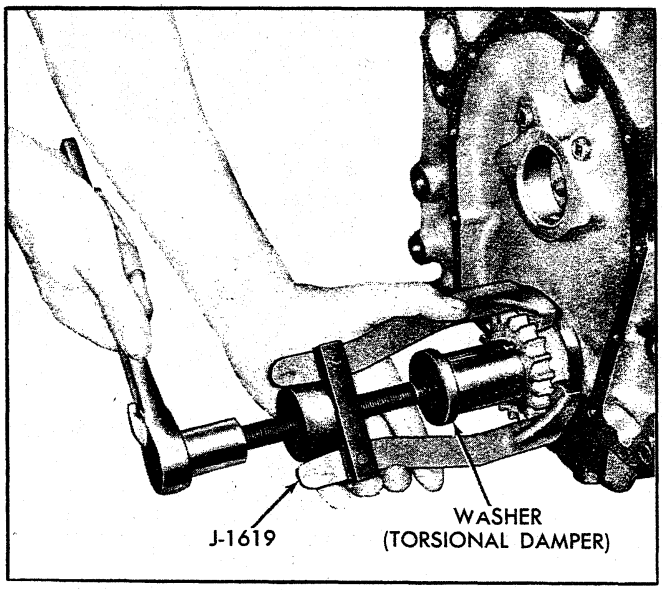


Fig. 24V—Removing Crankshaft Sprocket (396 and 427)

CAMSHAFT

Measuring Lobe Lift

NOTE: Procedure is similar to that used for checking valve timing. If improper valve operation is indicated, measure the lift of each push rod in consecutive order and record the readings.

1. Remove valve mechanism as outlined.
2. Position indicator with ball socket adapter (Tool J-8520) on push rod (fig. 28V).
3. Rotate the crankshaft damper slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the push rod will be in its lowest position.
4. Set dial indicator on zero, then rotate the damper slowly, or attach an auxiliary starter switch and "bump" the engine over, until the push rod is in the fully raised position.

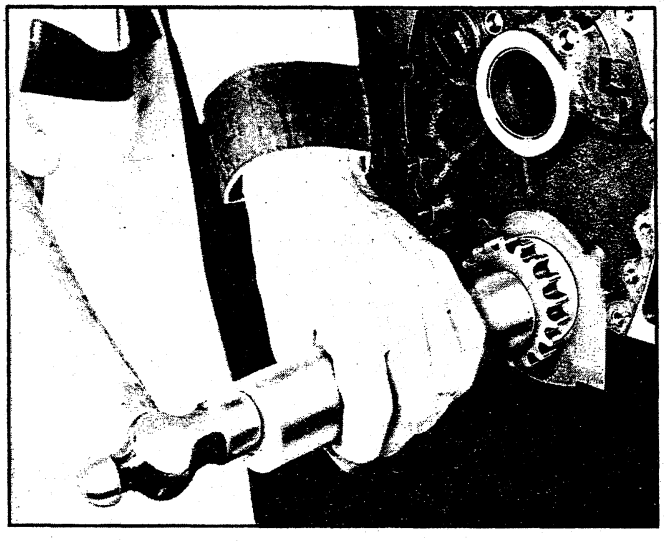


Fig. 25V—Installing Crankshaft Sprocket (302, 307, 327 and 350)

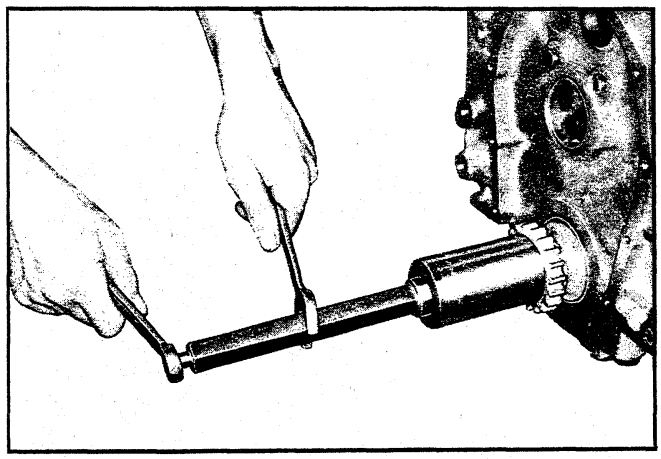


Fig. 26V—Installing Crankshaft Sprocket (396 and 427)

CAUTION: The primary distributor lead must be disconnected from the negative post on the coil and the ignition switch must be in the on position. Failure to do this will result in a damaged grounding circuit in the ignition switch.

5. Compare the total lift recorded from the dial indicator with specifications.

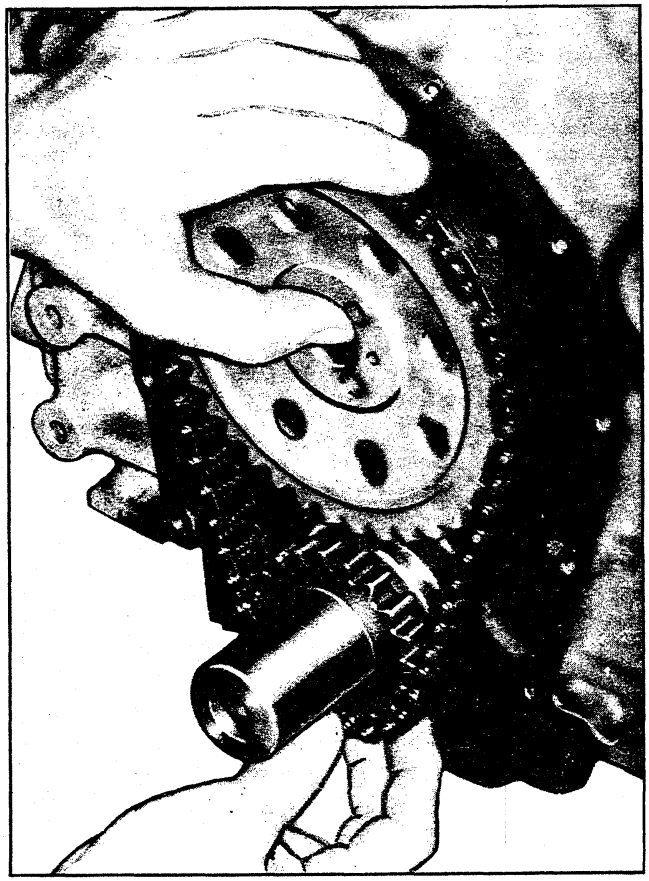


Fig. 27V—Installing Timing Chain

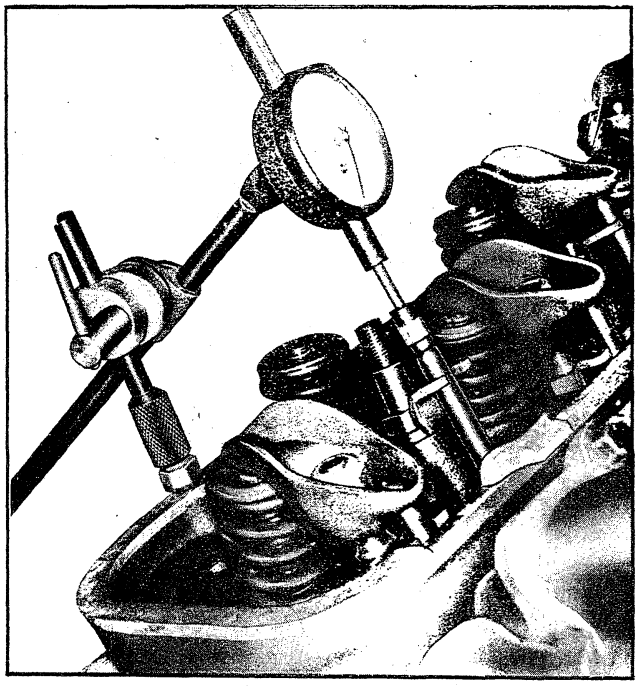


Fig. 28V—Measuring Camshaft Lobe Lift

6. Continue to rotate the crankshaft until the indicator reads zero. This will be a check on the accuracy of the original indicator reading.
7. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
8. Install and adjust valve mechanism as outlined.

Removal

1. Remove valve lifters as outlined.
2. Remove crankshaft front cover as outlined.
3. Remove grille as outlined in Section 13 (except Camaro and Nova).
4. On Camaro and Nova remove both front mount through bolts and remove the right motor mount. Lower engine on frame.
5. On Camaro and Nova remove the two center and one lower bolts securing the hood catch support to the grille and radiator support to provide camshaft removal clearance.
6. Remove fuel pump and push rod as outlined in Section 6M.

CAUTION: ALL CAMSHAFT JOURNALS ARE THE SAME DIAMETER AND CARE MUST BE USED IN REMOVING CAMSHAFT TO AVOID DAMAGE TO BEARINGS.

7. Remove camshaft sprocket to camshaft bolts then remove sprocket and timing chain together.

NOTE: Sprocket is a tight fit on camshaft. If sprocket does not come off easily, a light blow on the lower edge of the sprocket (with a plastic mallet) should dislodge the sprocket.

8. Install two 5/16" - 18" x 4" bolts in camshaft bolt holes then remove camshaft (fig. 29V).

Installation

NOTE: Whenever a new camshaft is installed

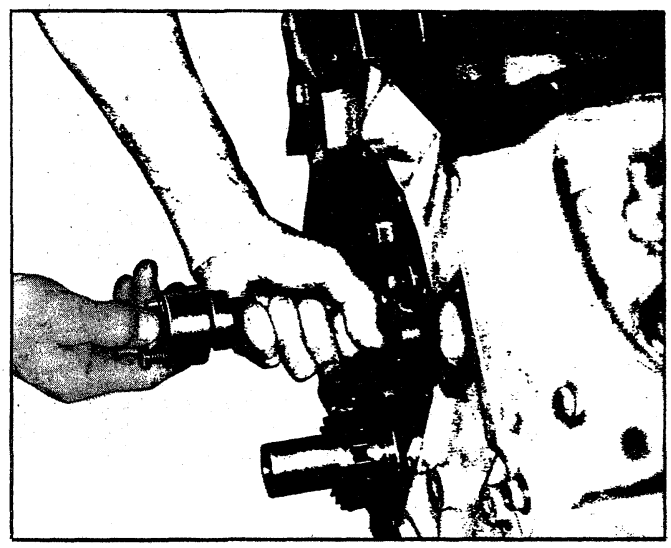


Fig. 29V—Removing Camshaft

coat camshaft lobes with Molykote or its equivalent.

1. Lubricate camshaft journals with engine oil and install camshaft.
2. Install timing chain on camshaft sprocket. Hold the sprocket vertical with the chain hanging down, and orient to align marks on camshaft and crankshaft sprockets. Refer to Figure 22V.
3. Align dowel in camshaft with dowel in hole in camshaft sprocket then install sprocket on camshaft. Refer to Figure 27V.
4. Draw the camshaft sprocket onto camshaft using the mounting bolts. Torque to specifications.
5. Lubricate timing chain with engine oil.
6. Install fuel pump push rod as outlined in Section 6M.
7. Install grille as outlined in Section 13.
8. Install crankcase front cover as outlined.
9. Install valve lifters as outlined.

FLYWHEEL

Removal

With transmission and/or clutch housing and clutch removed from engine, remove the flywheel.

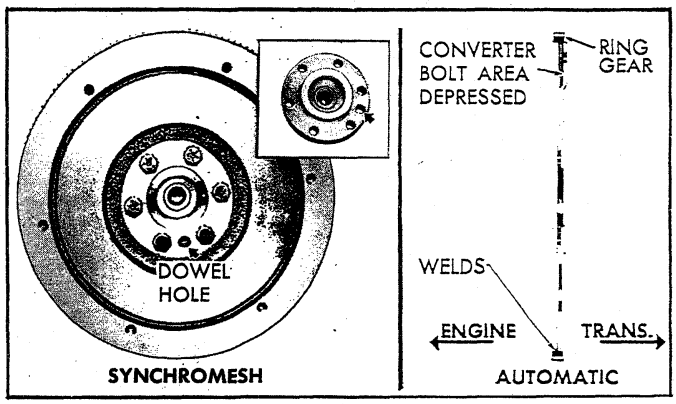


Fig. 30V—Flywheel Installation (Typical)

Installation

1. Clean the mating surfaces of flywheel and crankshaft to make certain there are no burrs.
2. Install flywheel on crankshaft and position to align dowel hole of crankshaft flange and flywheel (fig. 30V).

   NOTE: On Automatic Transmission equipped engines, the flywheel must be installed with the flange collar to transmission side (fig. 30V).

ENGINE MOUNTS

Engine mounts are the non-adjustable type and seldom require service. Broken or deteriorated mounts should be replaced immediately, because of the added strain placed on other mounts and drive line components.

Front Mount Replacement

1. Remove nut, washer and engine mount through-bolt.
2. Raise engine to release weight from mount.
3. Remove mount from engine.
4. Install new mount on engine.
5. Lower engine, install through-bolt and tighten all mount bolts to specified torques.

Rear Mount Replacement

1. Remove crossmember-to-mount bolts.
2. Raise transmission to release weight from mount.
3. Remove mount-to-transmission bolts, then remove mount (and spacer on Chevrolets).
4. Install new mount (and spacer on Chevrolets) on transmission.
5. While lowering transmission, align and start crossmember-to-mount bolts.

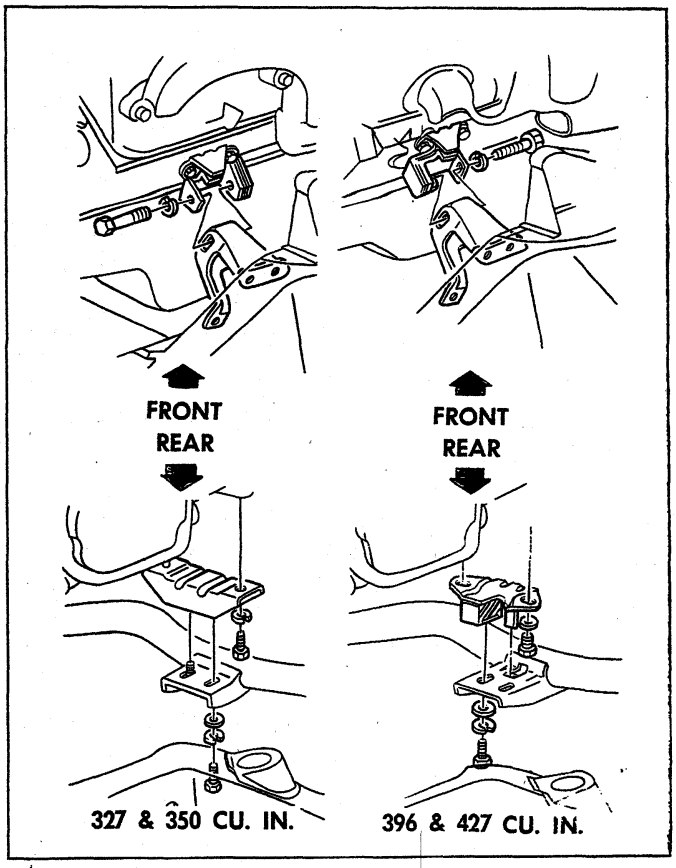


Fig. 31V—Chevrolet Engine Mounts

6. Lower transmission and tighten all mounting bolts to specified torques.

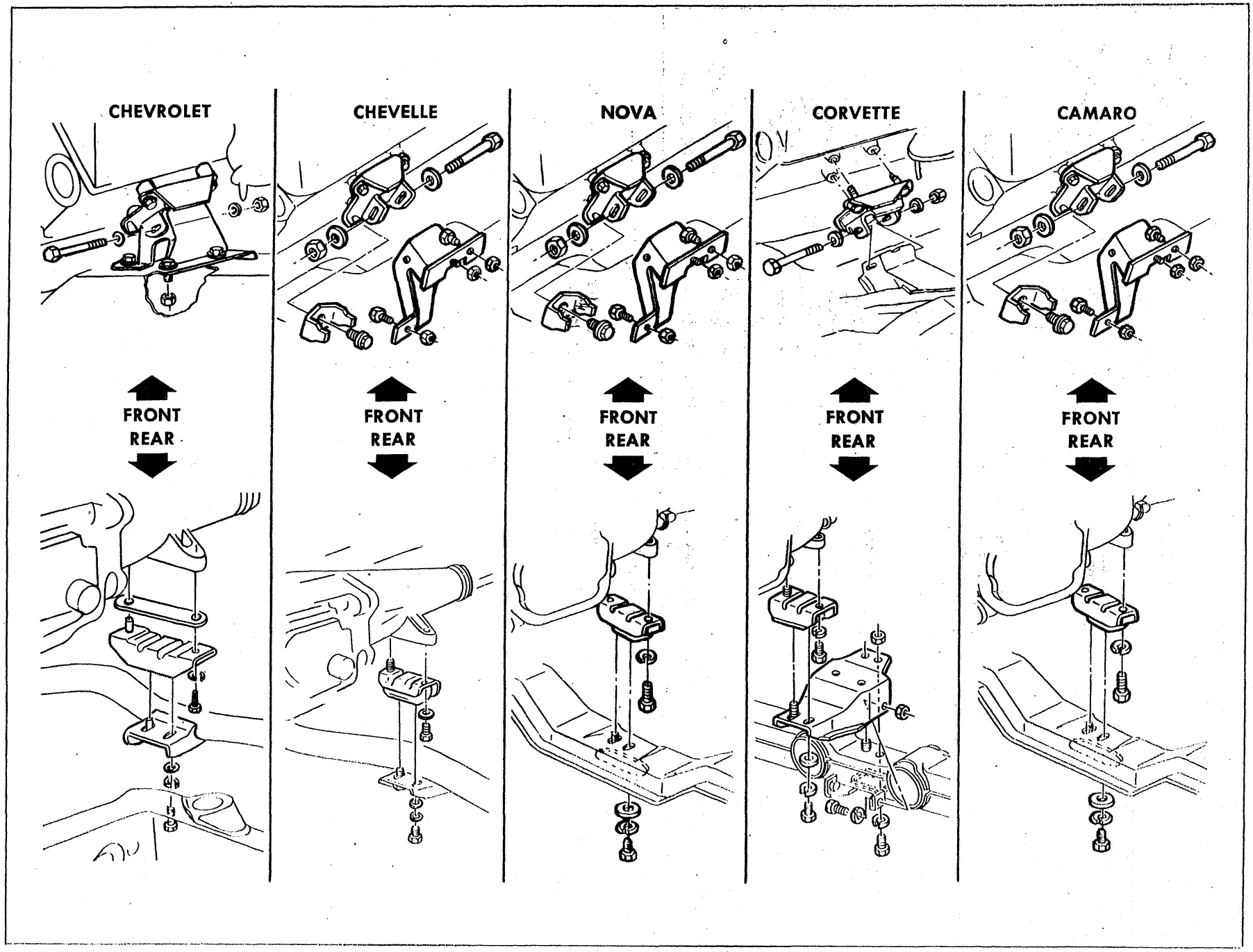
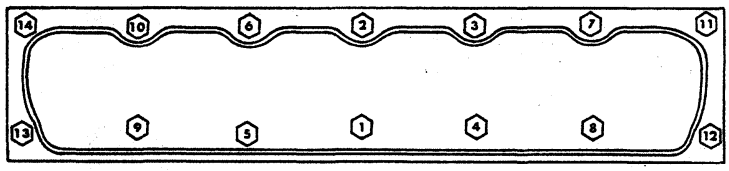
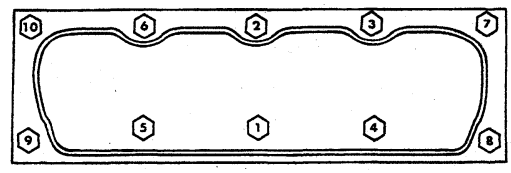


Fig. 32V.— Engine Mounts

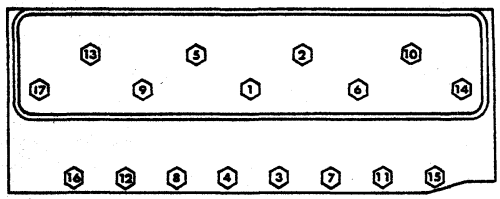
CYLINDER HEAD TORQUE SEQUENCE



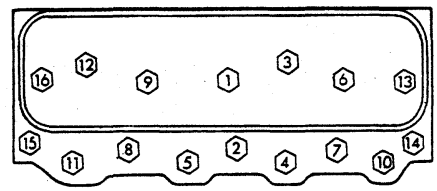
L6



L4



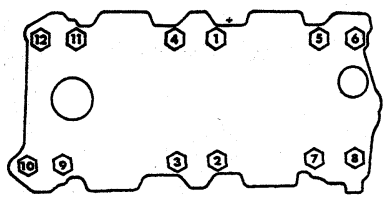
V8—302—307—327 & 350



V8-396 & 427

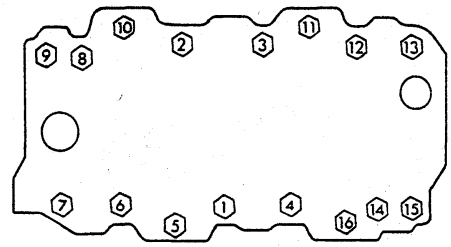
INTAKE MANIFOLD TORQUE SEQUENCE

FRONT



V8—302—307—327 & 350

FRONT



V8-396 & 427

Fig. 1T—Torque Sequence

SPECIAL TOOLS

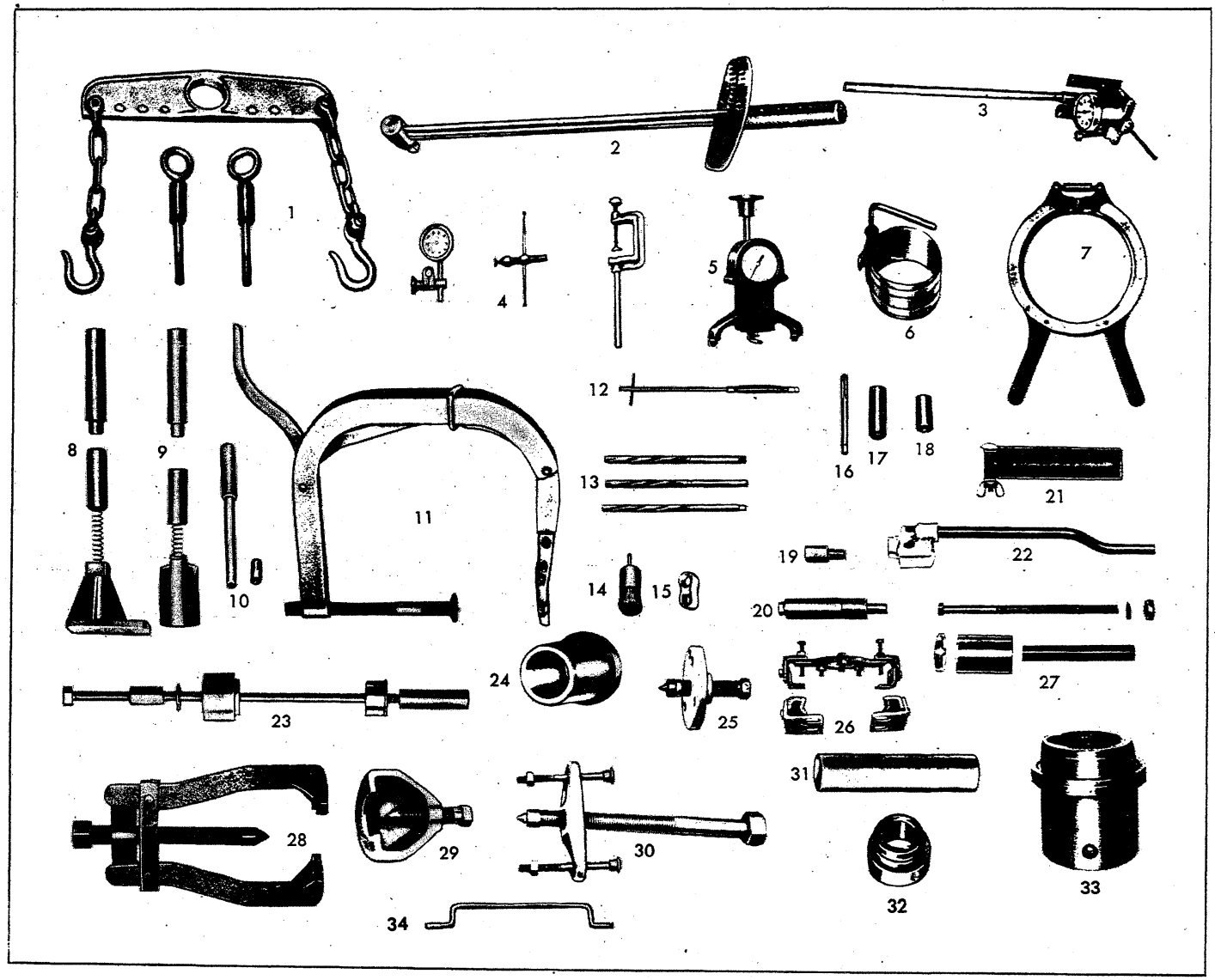


Fig. 2T - Engine Special Tools

1. J-4536 Engine Lift Kit
2. J-1264 (0-200 ft. lb.) Torque Wrench
   J-8058 (0-50 ft. lb.)
   J-5853 (0-100 in. lb.)
3. J-8087 Indicator Set (Cylinder Bore)
4. J-8001 Indicator Set (Universal)
5. J-7316 Belt Tension Gauge
6. J-8037 Piston Ring Compressor
7. J-8020 (3 9/16") Piston Ring Expander
   J-8021 (3 7/8")
   J-8032 (4")
   J-22249 (3 15/16")
   J-22147 (4 3/32")
   J-22250 (4 1/4")
8. J-6994 Piston Pin Assembly Tool
9. J-9510 Piston Pin Assembly Tool
10. J-5239 (3/8") Connecting Rod Guide Set
    J-6305 (11/32")
11. J-8062 Valve Spring Compressor
12. J-8101 Valve Guide Cleaner
13. J-5830 (11/32") Valve Guide Reamer Set
    J-7049 (3/8")
14. J-8089 Carbon Removing Brush
15. J-5860 Cylinder Head Bolt Wrench
16. J-5715 (.003") Rocker Arm Stud Reamer
    J-6036 (.013")
17. J-6880 Rocker Arm Stud Installer
18. J-5802 Rocker Arm Stud Remover
19. J-9534 Distributor Lower Bushing Remover
20. J-9535 Distributor Lower Bushing Installer
21. J-22144 Oil Pick-up Screen Installer
22. J-8369 Oil Pick-up Screen Installer
23. J-6098 Cam Bearing Tool
24. J-0971 Camshaft Gear Support
25. J-6978 Torsional Damper Puller
26. J-22197 Torsional Damper Installer
27. J-21058 Torsional Damper and Sprocket Installer
28. J-1619 Crankshaft Sprocket Puller
29. J-5825 Crankshaft Sprocket Puller
30. J-8105 Crankshaft Gear Puller
31. J-5590 Crankshaft Sprocket or Gear Installer
32. J-23042 Crankcase Cover Centering Gauge
33. J-22102 Crankcase Cover Tool & Seal Installer
34. J-22382-1 Open Hood Safety Stop

SECTION 6K
ENGINE COOLING

INDEX

	Page
General Description	6K-1
Maintenance and Adjustments	6K-1
Coolant Level	6K-1
Coolant System Checks	6K-1
Periodic Maintenance	6K-2
Cleaning	6K-2
Reverse Flushing	6K-2
Radiator	6K-2
Cylinder Block and Cylinder Head	6K-2
Hot Water Heater	6K-3
Fan Belt	6K-3
Adjustment	6K-3
Thermostat	6K-3
Replacement	6K-3
Water Pump	6K-3
Removal	6K-3
Installation	6K-3

GENERAL DESCRIPTION

All Chevrolet passenger cars have pressure type engine cooling systems with thermostatic control of coolant circulation. The cooling system is sealed by a pressure type radiator filler cap.

The pressure type radiator filler cap (fig. 1) is designed to operate the cooling system at higher than atmospheric pressure. The higher pressure raises the boiling point of the coolant which increases the efficiency of the radiator.

The radiator filler cap contains a pressure relief valve and a vacuum relief valve. The pressure relief valve is held against its seat by a spring which when compressed, allows excessive pressure to be relieved out the radiator overflow.

The vacuum valve is also held against its seat by a spring which when compressed, opens the valve relieving the vacuum created when the system cools off.

The cooling systems water pump is of the centrifugal vane impeller type. The bearings are permanently lubricated during manufacture and are seated to prevent the loss of lubricant or the entry of dirt and water. The pump requires no care other than to make certain the air vent at the top of the housing and the drain holes in the bottom do not become plugged with dirt or grease.

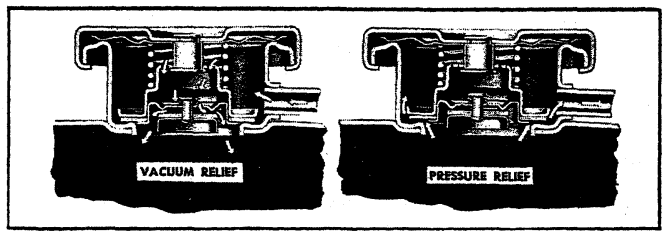


Fig. 1—Pressure Radiator Cap

Removal and installation of the water pump is covered in this section. Overhaul procedures of the water pump assemblies are covered in Section 6K of the Passenger Chassis Overhaul Manual. For radiator service refer to Section 13 of this manual. Radiator fan shroud replacement is covered in Section 11 of this manual.

MAINTENANCE AND ADJUSTMENTS

Coolant Level

The radiator coolant level should only be checked when the engine is cool, particularly on cars equipped with air conditioning. If the radiator cap is removed from a hot cooling system, serious personal injury may result.

The cooling system fluid level should be maintained one inch below the bottom of the filler neck of the downflow radiator when cooling system is cold, or at the bottom of the filler neck when the system is warm. Coolant level in crossflow radiators should be maintained three inches below the bottom of the filler neck when the system is cold. It is very important that the correct fluid level be maintained. The sealing ability of the radiator cap is affected when the cooling level is too high.

All passenger car cooling systems are pressurized with a 15# pressure cap which permits safe engine operation at cooling temperatures of up to 247°F.

When the radiator cap is removed or loosened, the system pressure drops to atmospheric, and the heat which had caused water temperature to be higher than 212°F, will be dissipated by conversion of water to steam. Inasmuch as the steam may form in the engine water passages, it will blow coolant out of the radiator upper hose and top tank, necessitating coolant replacement. Engine operating temperatures higher than the normal boiling point of water are in no way objectionable so long as the coolant level is satisfactory when the engine is cool.

Upon repeated coolant loss, the pressure radiator cap and seat should be checked for sealing ability. Also, the cooling system should be checked for loose hose connections, defective hoses, gasket leaks, etc.

Coolant System Checks

1. Test for restriction in the radiator, by warming the engine up and then turning the engine off and feeling

the radiator. The radiator should be hot at the top and warm at the bottom, with an even temperature rise from bottom to top. Cold spots in the radiator indicate clogged sections.

2. Water pump operation may be checked by running the engine while squeezing the upper radiator hose. A pressure surge should be felt. Check for a plugged vent-hole in pump.

   NOTE: A defective head gasket may allow exhaust gases to leak into the cooling system. This is particularly damaging to the cooling system as the gases combine with the water to form acids which are harmful to the radiator and engine.

3. To check for exhaust leaks into the cooling system, drain the system until the water level stands just above the top of the cylinder head, then disconnect the upper radiator hose and remove the thermostat and fan belt. Start the engine and quickly accelerate several times. At the same time note any appreciable water rise or the appearance of bubbles which are indicative of exhaust gases leaking into the cooling system.

Periodic Maintenance

It is the owner's responsibility to keep the freeze protection at a level commensurate with the area in which the vehicle will be operated. Regardless of climate, system protection should be maintained at least to 0°F., to provide adequate corrosion protection. When adding solution due to loss of coolant for any reason or in areas where temperatures lower than -20°F. may occur, a sufficient amount of an ethylene glycol base coolant that meets GM Specification 1899-M should be used.

Every two years the cooling system should be serviced by flushing with plain water, then completely refilled with a fresh solution of water and a high-quality, inhibited (permanent-type) glycol base coolant meeting GM Specification 1899-M and providing freezing protection at least to 0°F. At this time, also add GM Cooling System Inhibitor and Sealer or equivalent. In addition, Cooling System Inhibitor and Sealer should be added every fall thereafter. GM Cooling System Inhibitor retards the formation of rust or scale and is compatible with aluminum components.

NOTE: Alcohol or methanol base coolants or plain water are not recommended for your engine at any time.

Two common causes of corrosion are: (1) air suction--Air may be drawn into the system due to low liquid level in the radiator, leaky water pump or loose hose connections; (2) exhaust gas leakage--Exhaust gas may be blown into the cooling system past the cylinder head gasket or through cracks in the cylinder head and block.

Cleaning

A good cleaning solution should be used to loosen the rust and scale before reverse flushing the cooling system. There are a number of cleaning solutions available and the manufacturer's instructions with the particular cleaner being used should always be followed.

An excellent preparation to use for this purpose is GM Cooling System Cleaner. The following directions for cleaning the system applies only when this type cleaner is used.

1. Drain the cooling system including the cylinder block and then close both drain plugs.
2. Remove thermostat and replace thermostat housing.
3. Add the liquid portion (No. 1) of the cooling system cleaner.
4. Fill the cooling system with water to a level of about 3 inches below the top of the overflow pipe.
5. Cover the radiator and run the engine at moderate speed until engine coolant temperature reaches 180 degrees.
6. Remove cover from radiator and continue to run the engine for 20 minutes. Avoid boiling.
7. While the engine is still running, add the powder portion (No. 2) of the cooling system cleaner and continue to run the engine for 10 minutes.
8. At the end of this time, stop the engine, wait a few minutes and then open the drain cocks or remove pipe plugs. Also remove lower hose connection.

   CAUTION: Be careful not to scald your hands.

   NOTE: Dirt and bugs may be cleaned out of the radiator air passages by blowing out with air pressure from the back of the core. Do not bend radiator fins.

Reverse Flushing

Reverse flushing should always be accomplished after the system is thoroughly cleaned as outlined above. Flushing is accomplished through the system in a direction opposite to the normal flow. This action causes the water to get behind the corrosion deposits and force them out.

Radiator

1. Remove the upper and lower radiator hoses and replace the radiator cap.
2. Attach a lead-away hose at the top of the radiator.
3. Attach a new piece of hose to the radiator outlet connection and insert the flushing gun in this hose.
4. Connect the water hose of the flushing gun to a water outlet and the air hose to an air line.
5. Turn on the water and when the radiator is full, turn on the air in short blasts, allowing the radiator to fill between blasts of air.

   CAUTION: Apply air gradually as a clogged radiator will stand only a limited pressure.

6. Continue this flushing until the water from the lead-away hose runs clear.

Cylinder Block and Cylinder Head

1. With the thermostat removed, attach a lead-away hose to the water pump inlet and a length of new hose to the water outlet connection at the top of the engine.

   NOTE: Disconnect the heater hose and cap connections at engine when reverse flushing engine.

2. Insert the flushing gun in the new hose.
3. Turn on the water and when the engine water jacket is full, turn on the air in short blasts.
4. Continue this flushing until the water from the lead-away hose runs clear.

Hot Water Heater

1. Remove water outlet hose from heater core pipe.
2. Remove inlet hose from engine connection.
3. Insert flushing gun and flush heater core. Care must be taken when applying air pressure to prevent damage to the core.

Fan Belt

Adjustment

1. Loosen bolts at Delcotron mounting.
2. Pull Delcotron away from engine until desired tension reading is obtained with a strand tension gauge. Refer to Engine Tune-Up Specifications.
3. Tighten all Delcotron bolts securely.

Radiator Cap

The radiator cap should be washed with clean water and pressure checked at regular tune-up intervals. Inspect rubber seal on cap for tears or cracks. Install radiator cap on tester (fig. 2). If the pressure cap will not hold pressure or does not release at the proper pressure, replace the cap.

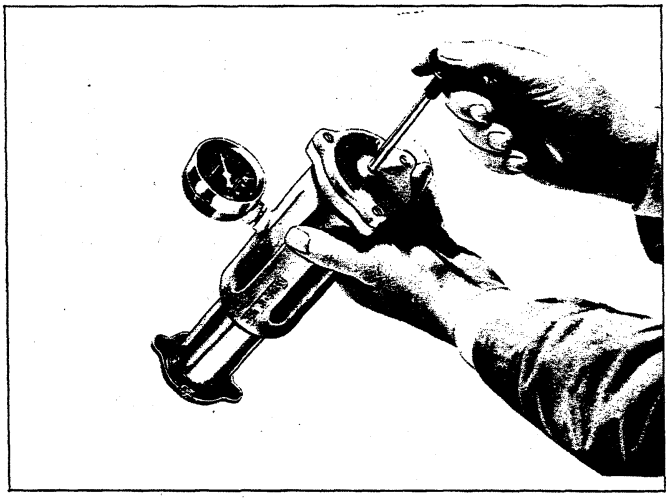


Fig. 2—Pressure Checking Radiator Cap

Thermostat

The 195° thermostat consists of a restriction valve actuated by a thermostatic element. This is mounted in the housing at the cylinder head water outlet above the water pump. Thermostats are designed to open and close at predetermined temperatures and if not operating properly should be removed and tested as follows.

Replacement

1. Remove radiator to water outlet hose.
2. Remove thermostat housing bolts and remove water outlet and gasket from thermostat housing (fig. 3).
3. Inspect thermostat valve to make sure it is in good condition.
4. Place thermostat in hot water 25° above the temperature stamped on the thermostat valve.
5. Submerge the valve completely and agitate the water thoroughly. Under this condition the valve should open fully.



Fig. 3—Replacing Thermostat

6. Remove the thermostat and place in water 10° below temperature indicated on the valve.
7. With valve completely submerged and water agitated thoroughly, the valve should close completely.
8. If thermostat checks satisfactorily, re-install, using a new housing gasket.
9. Refill cooling system.

Water Pump

Removal

1. Drain radiator and break loose the fan pulley bolts.
2. Disconnect heater hose, lower radiator hose and by pass hose (as required) at water pump.
3. Remove Delcotron upper brace (V8 only), loosen swivel bolt, and remove fan belt.
4. Remove fan blade assembly attaching bolts, fan and pulley.

   NOTE: Thermostatic fan clutches must be kept in an "in-car" position. When removed from the car the assembly should be supported so that the clutch disc remains in a vertical plane to prevent silicone fluid leakage.

5. Remove pump to cylinder block bolts and remove pump and old gasket from engine.

   NOTE: On in line engines, pull the pump straight out of the block first, to avoid damage to impeller.

Installation

1. Install pump assembly on cylinder block then, using a new sealer-coated pump-to-block gasket, tighten bolts to specifications.
2. Install pump pulley and fan on pump hub and tighten bolts to specifications.

   NOTE: A guide stud (5/16"-24 bolt with the head removed) installed in one hole of the fan

hub will aid in aligning hub, pulley and fan. Remove stud after starting the remaining three bolts.

3. Connect hoses and fill cooling system.
4. Install Delcotron upper brace (V8 only), and install fan belt.
5. Adjust fan belt to specifications as previously outlined.
6. Start engine and check for leaks.

SECTION 6M
ENGINE FUEL

CONTENTS OF THIS SECTION

	Page		Page
Carburetors	6M-1	Fuel Pumps	6M-17
Air Cleaners	6M-13	Special Tools	6M-18

CARBURETORS

INDEX

	Page		Page
General Description	6M-1	Additional Adjustments	6M-4
Service Procedures	6M-1	Removal	6M-5
Preliminary Checks	6M-1	Test Before Installation	6M-5
Idle Speed and Mixture Adjustment	6M-1	Installation	6M-5
Fast Idle Adjustment	6M-3	Fuel Filter Maintenance	6M-5
Choke Adjustment	6M-3	Choke Coil Replacement	6M-7
Float Adjustment	6M-4	Throttle Linkage Adjustment	6M-8

GENERAL DESCRIPTION

Various carburetors (fig. 1c) are used with Chevrolet, Chevelle, Chevy II, Camaro and Corvette passenger vehicles. These carburetors are designed to meet the particular requirements of engine, transmissions and vehicles. Therefore, carburetors that look alike are not always interchangeable. (Refer to carburetor part number and/or specifications.)

Because many service procedures for the various carburetors are similar, typical illustrations and procedures are used except where specific illustrations or procedures are necessary to clarify the operation.

This section covers removal, installation and adjustments (on engine) of carburetors. Also covered in this section are maintenance procedures for choke coils, throttle linkage and fuel filters. For carburetor overhaul procedures and additional adjustments (bench), refer to Section 6M of the Overhaul Manual under the carburetor being serviced.

Specifications for carburetors are located in the back of this manual.

SERVICE PROCEDURES

Preliminary Checks

1. Thoroughly warm-up engine. If the engine is cold, allow to run for at least 15 minutes.
2. Inspect torque of carburetor to intake manifold bolts and intake manifold to cylinder head bolts to exclude the possibility of air leaks.
3. Inspect manifold heat control valve (if used) for freedom of action and correct spring tension.

Adjust Idle Speed and Mixture (Fig. 1c)

1. As a preliminary adjustment, turn idle mixture screw slightly to seat and back out 3 turns.

   CAUTION: Do not turn idle mixture screw tightly against seat or damage may result.

2. With engine running at operating temperature (air cleaner installed, pre-heater valve and choke valve wide open); adjust idle speed screw to bring idle speed to specified rpm (automatic transmission in drive, manual transmission in neutral).

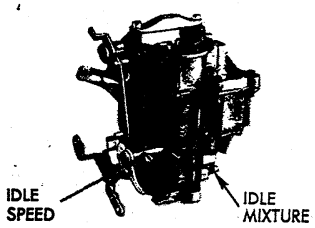
   NOTE: On air conditioned vehicles, turn air conditioning "OFF" except 390 and 400 h.p. Corvette engines where idle speed is set with air conditioning "ON".

3. Adjust idle mixture screw to obtain highest steady idle speed. Adjust idle speed screw to recommended rpm on "Decal" (Fig. 2c).

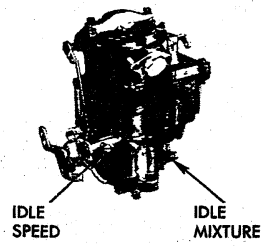
   NOTE: Idle speed adjustment for engines with idle solenoid is as follows: adjust idle speed to specifications by adjusting solenoid plunger hex only. Disconnect wire at solenoid and observe idle speed. Deenergizing the solenoid allows the throttle lever to seat against the carburetor idle screw. Adjust the carburetor idle screw as necessary to obtain the specified r.p.m. (Fig. 3C).

4. Adjust mixture screw in to obtain a 20 rpm drop (lean roll).
5. Adjust mixture screw out 1/4 turn.
6. Repeat Steps 4 and 5 for second mixture screw (if so equipped).
7. Readjust speed screw if necessary to specified idle rpm.

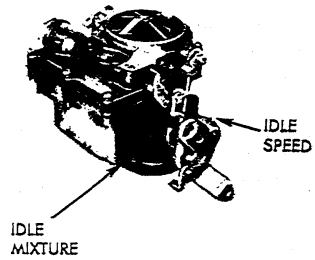
ROCHESTER M



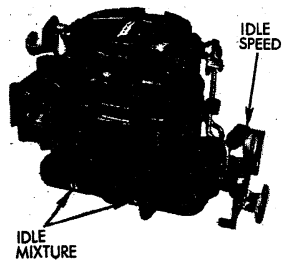
ROCHESTER MV



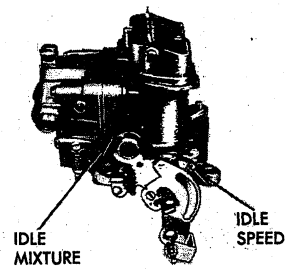
ROCHESTER 2GV



ROCHESTER 2GV (1-½)



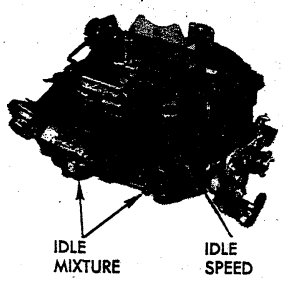
HOLLEY 2300C (PRIMARY)



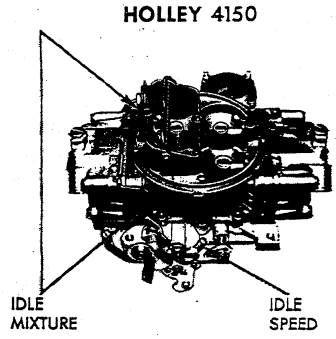
HOLLEY 2300, (SECONDARY)



ROCHESTER 4MV



HOLLEY 4150



APPLICATION ▶ / CARBURETOR ▼		Chevrolet	Chevelle	Chevy Nova	Camaro	Corvette	IN LINE			V-8																					
							153	230	250	302	307	327		350			396				427										
							90	140	155	290	200	210	235	300	350	370	265	325	350	375	335	390	400	425	430	435					
ROCH M				3			3																							
ROCH MV		1	2	3	4			2 3 4	1 2 3 4																					
ROCH 2GV(SAE 1¼)			2	3	4						2 3	4																		
ROCH 2GV(SAE 1½)		1											1				1													
ROCH 4MV		1	2	3	4	5								123 45	5			2 4	2 3 4		1	1 5								
HOLLY 2300	C Prim.					5																	5			5				
	Sec.					5																	5			5				
HOLLY 4150		1	2	3	4	5				4						5				2 3 4				1	5					

Fig. 1C—Carburetors



Fig. 2C—Tune-Up Decal

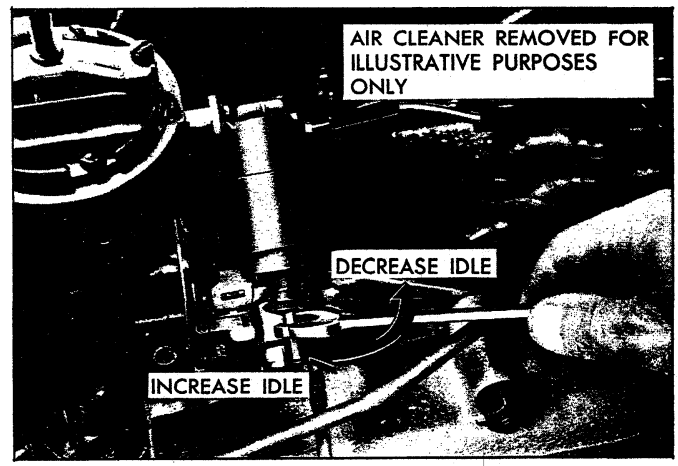


Fig. 3C—Adjusting Idle Solenoid

Fast Idle Adjustment

Rochester M, 4MV and Holley

With fast idle lever on high step of cam and choke valve open (engine warm) set fast idle to give specified engine rpm. Adjust screw on Rochester 4MV and bend fast idle lever on Rochester M and Holley.

Choke Adjustment

With Remote Choke (Fig. 2c)

1. Remove air cleaner and check to see that choke valve and rod move freely.
2. Disconnect choke rod at choke lever.
3. Check choke adjustment as follows:

On all engines except L6 and 2 barrel V8 engines, hold choke valve closed and push rod downward to contact stop. The top of rod should be even with bottom of hole in choke lever.

On L6 and 2 barrel V8 engines, hold choke valve closed and pull rod upward to end of travel. The

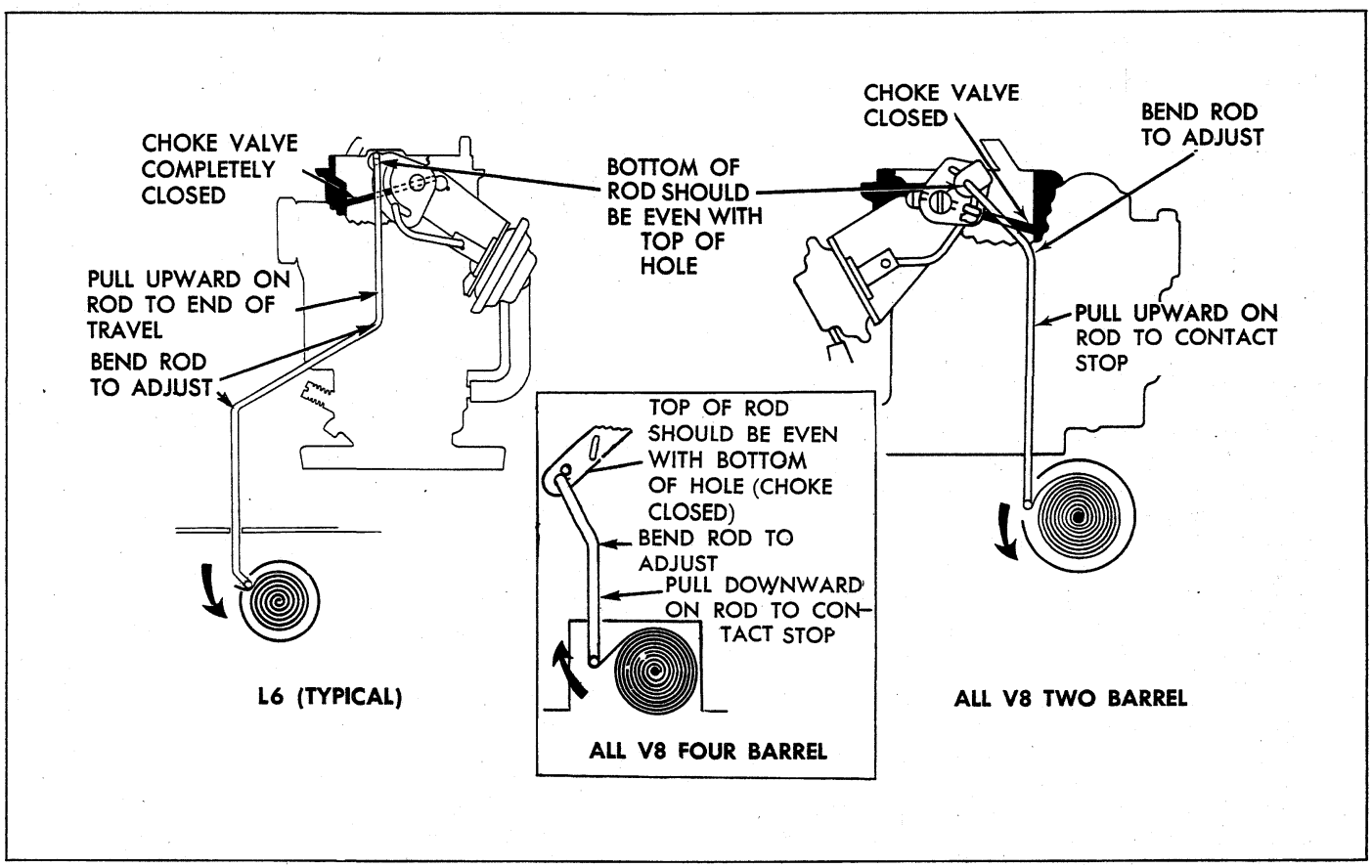


Fig. 4C—Remote Choke Adjustment

bottom of rod should be even with top of hole in choke lever.

4. If necessary, adjust rod length by bending rod at offset bend. (Bend must be such that rod enters choke lever hole freely and squarely).
5. Connect rod at choke lever and install air cleaner.

With Manual Choke (Rochester M)

1. Remove air cleaner.
2. Push hand choke knob in to within 1/8" of instrument panel.
3. Loosen choke cable clamp at carburetor bracket and adjust cable through the clip until the choke valve is wide open.
4. Tighten cable clamp at carburetor bracket and check operation of choke valve to ensure full closed and wide open positions.
5. Install air cleaner.

Float Adjustment

Holley (Model 4150 Center Inlet & Model 2300)

1. Remove air cleaner then remove the fuel level sight plugs (fig. 3c).
2. With parking brake on, and transmission in neutral, start the engine and allow it to idle.
3. With the car on a level surface, the fuel level should be on a level with the threads at the bottom of the sight plug port (plus or minus 1/32 inch).

   NOTE: No float drop adjustment is required on this carburetor.

4. If necessary to adjust (either or both bowls), loosen inlet needle lock screw and turn the adjusting nut clockwise to lower or counter-clockwise to raise fuel level, then tighten lock screw.

   NOTE: 1/6 turn of adjusting nut equals approximately 1/16" fuel level change.

5. Allow a minute for fuel level to stabilize, and recheck the level at sight plug.
6. Readjust, if necessary, until proper level is obtained, and install sight plug and air cleaner.

   NOTE: To assure proper secondary float level setting it is advisable to accelerate primary throttles slightly and hand operate secondary throttle. This assures a stabilized secondary fuel level.

Vacuum Break Adjustment

1. Remove air cleaner assembly from vehicle. On vehicles with 'Therm AC' air cleaner, plug the sensor's vacuum take-off port.
2. Start engine or install a vacuum source such as J-23309 to vacuum diaphragm vacuum tube.
3. Remove choke rod from choke lever and install a rubber band to the lever in such a manner as to react on the lever in a direction to close the choke blade (Fig. 6C).
4. Slowly open accelerator until choke closes (choke will not fully close due to the vacuum break link's reaction on it) and idle is determined by high step of fast idle cam. Release accelerator.
5. With idle determined by fast idle cam and vacuum break link acting on the choke lever, insert specified gauge (hold vertical) between the carburetor air horn and choke blade (Fig. 6C).

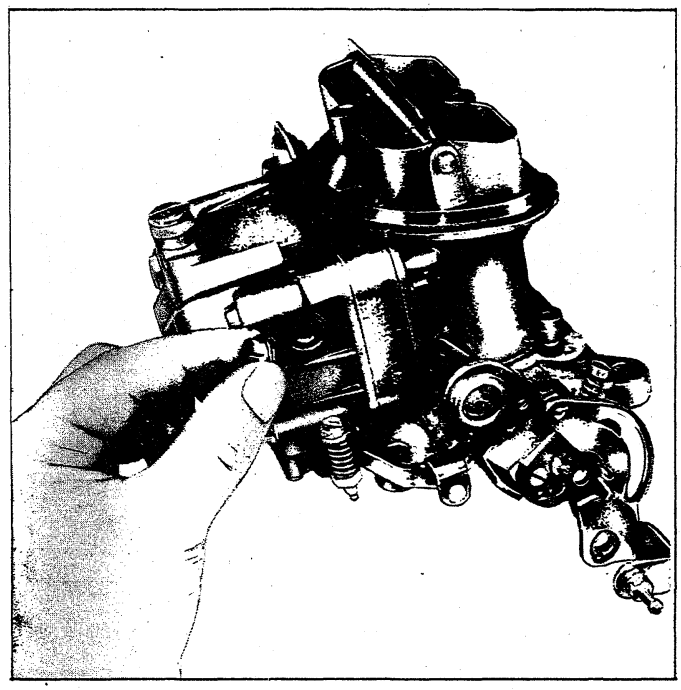


Fig. 5C—Fuel Level Sight Plug

6. Adjust vacuum break setting as necessary by bending rod or tang.

Additional Adjustments

The following adjustments may be made without removing the carburetor from the engine. For procedure refer to Section 6M of the Overhaul Manual under the carburetor being serviced.

Rochester MV

- Float
- Idle Vent
- Choke Rod (Fast Idle)
- Choke Vacuum Break
- Choke Unloader

Rochester 2GV (1¼ and 1½)

- Float
- Accelerator Pump
- Idle Vent
- Choke Rod (Fast Idle)
- Choke Vacuum Break
- Choke Unloader

Rochester 4MV

- Float
- Accelerator Pump
- Idle Vent
- Air Valve
- Choke Rod
- Choke Vacuum Break
- Choke Unloader
- Secondary Throttle Lockout
- Secondary Opening
- Secondary Closing

Holley 2300 and 4150

- Float
- Air Vent Valve
- Accelerator Pump
- Choke Vacuum Break
- Choke Unloader

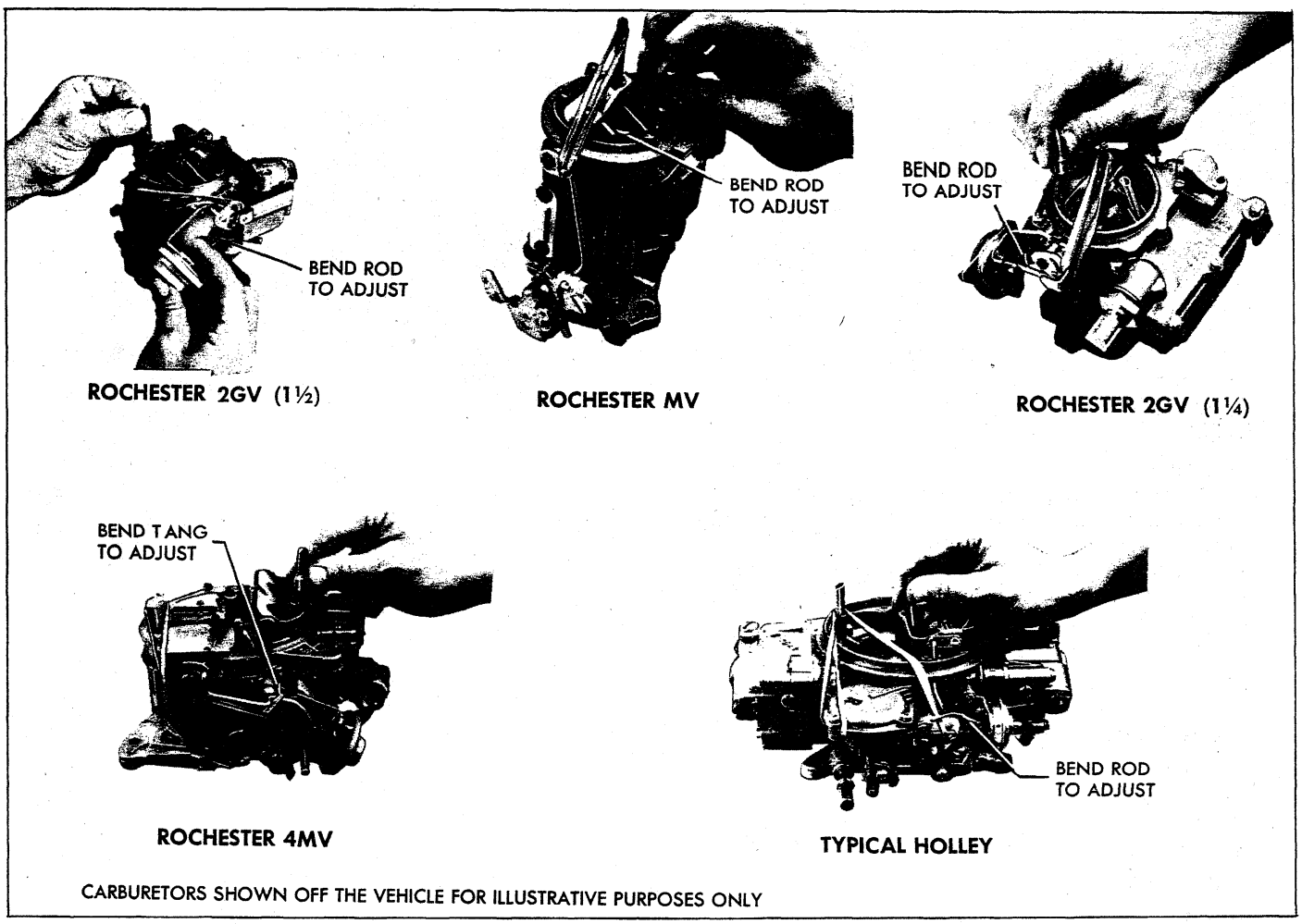


Fig. 6C—Vacuum Break Adjustment

Removal

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by the presence of dirt, water, or other foreign matter in the carburetor. To aid in diagnosing the cause of the complaint, the carburetor should be carefully removed from the engine without draining the fuel from the bowl. The contents of the fuel bowl may then be examined for contamination as the carburetor is disassembled.

1. Remove air cleaner and gasket.
2. Disconnect fuel and vacuum lines from carburetor.
3. Disconnect choke rod or choke cable.
4. Disconnect accelerator linkage.
5. If equipped with Automatic transmission, disconnect TV linkage.
6. Remove carburetor attaching nuts and/or bolts and remove carburetor.

Test Before Installation

It is good shop practice to fill the carburetor bowl before installing the carburetor. This reduces the strain on the starting motor and battery and reduces the possibility of backfiring while attempting to start the engine. A fuel pump clamped to the bench, a small supply of fuel and the necessary fittings enable the carburetor to be filled and the operation of the float and intake needle and seat to be checked. Operate the throttle several times and check the discharge from the pump jets before installing the carburetor.

Installation

1. Be certain throttle body and intake manifold sealing surfaces are clean.
2. Install new carburetor to manifold flange gasket (if required).
3. Install carburetor over manifold studs.
4. Start vacuum and fuel lines at carburetor.
5. Install attaching nuts and/or bolts and tighten securely.
6. Tighten fuel and vacuum lines.
7. Connect and adjust accelerator and TV linkage.
8. Connect choke rod.
9. Install air cleaner, adjust idle speed and mixture per decal.

Fuel Filter Maintenance

1. Disconnect fuel line connection at inlet fuel filter nut.
2. Remove inlet fuel filter nut from carburetor with a 1" box wrench or socket.
3. Remove filter element and spring (fig. 7c and fig. 8c).
4. Check bronze element for restriction by blowing on cone end; element should allow air to pass freely.

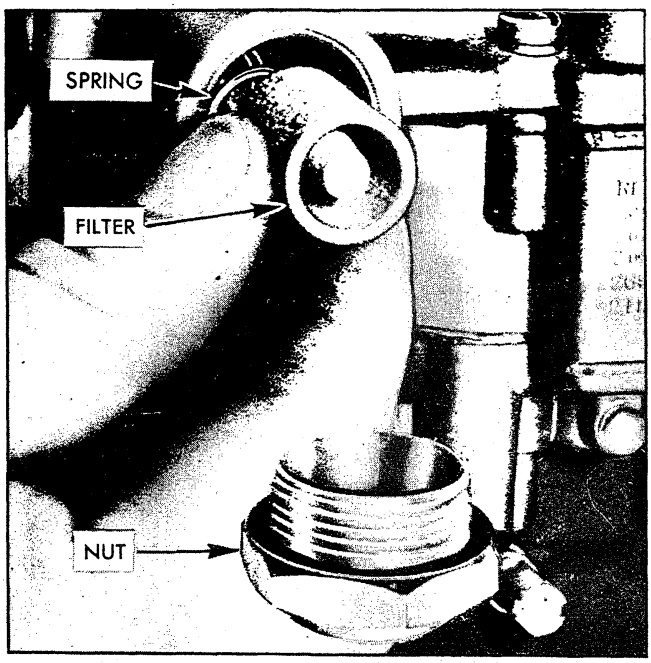


Fig. 7C—Fuel Filter (Bronze Type)

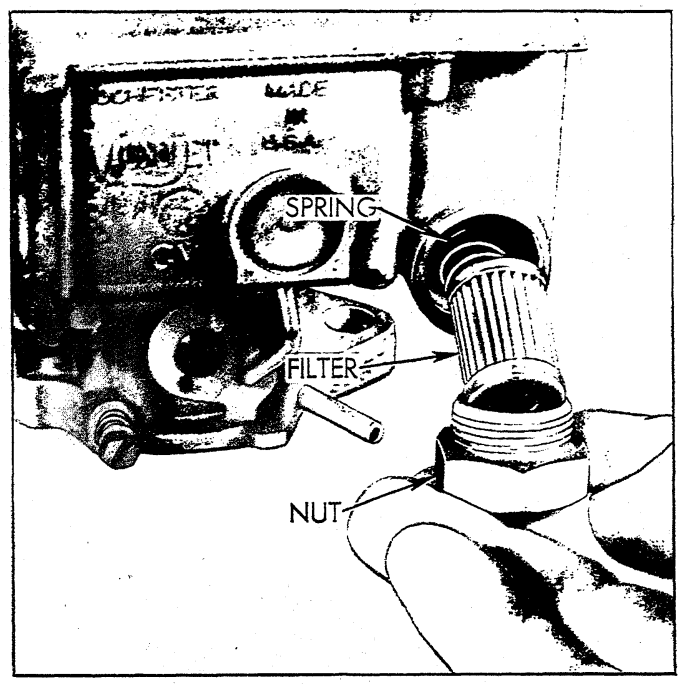


Fig. 8C—Fuel Filter (Paper Type)

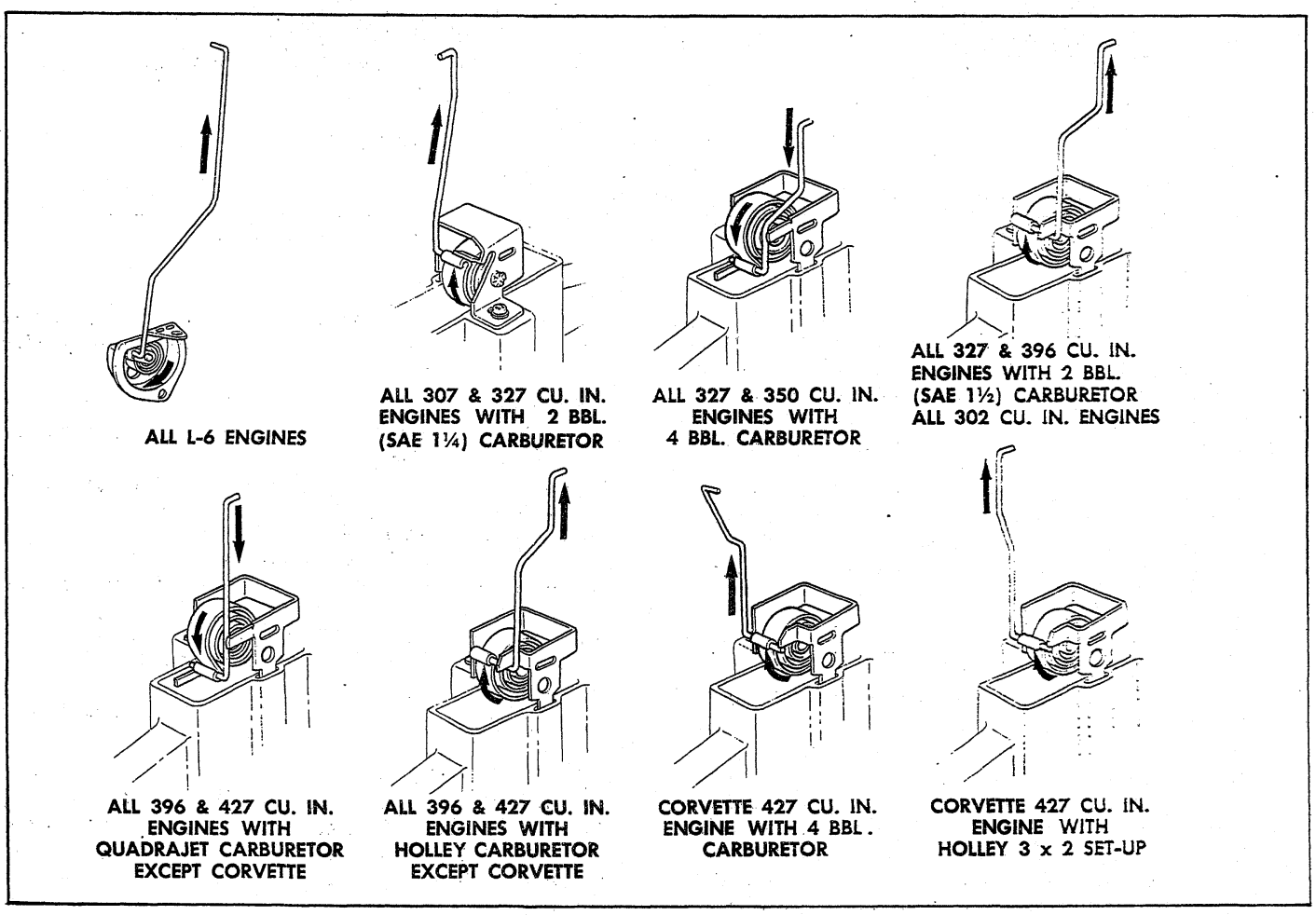


Fig. 9C—Carburetor Automatic Choke Assemblies

5. Check paper element by blowing on fuel inlet end. If filter does not allow air to pass freely, replace element. No attempt should be made to clean filters.

   NOTE: Element should be replaced if plugged or if flooding occurs. A plugged filter will result in a loss of engine power or rough (pulsating) engine feel, especially at high engine speeds.

6. Install element spring, and install element in carburetor. Bronze filters must have small section of cone facing out.
7. Install new gasket on inlet fitting nut and install nut in carburetor and tighten securely.
8. Install fuel line and tighten connector.

   NOTE: Filter element should be replaced every 12 months or 12,000 miles, whichever occurs first.

Automatic Choke Coil Assemblies

The passenger car automatic choke assemblies (fig. 9C) are shown in their relative installed position when the choke is in fully applied (choke ON--choke rod hitting stop) position. The arrows show the direction the coils and rods move when closing the choke valve.

Choke Coil Replacement

L6 Engines (Fig. 10c)

1. Remove air cleaner and disconnect choke rod upper clip.
2. Remove bolts attaching choke coil to manifold, and remove choke coil and choke rod as an assembly.
3. Disconnect choke rod from choke coil.
4. Connect choke rod to new choke coil and install assembly on manifold.
5. Install bolts and tighten securely.
6. Adjust and connect choke rod as outlined.
7. Start and warm-up the engine then check operation of choke and install air cleaner.

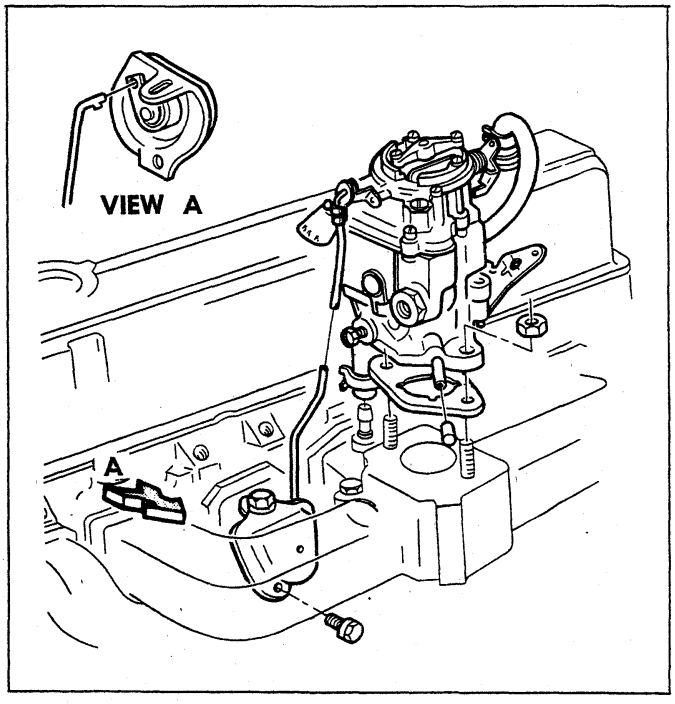


Fig. 10C—Choke Coil - L6 Engine

V8 Engines (Fig. 11c)

1. Remove air cleaner and disconnect choke rod upper clip.
2. Remove choke coil as follows:

   WITH ROCHESTER 2GV CARBURETOR
   - Remove the choke coil shield by prying with a screw driver in the cut out provided and then remove the choke rod.
   - Remove bracket and choke coil assembly.

   WITH ROCHESTER 4MV AND HOLLEY CARBURETORS
   - Remove the choke coil shield by prying with a screw driver in the cut out provided then lift shield carefully over rod.
   - Remove choke rod, bracket screw and choke coil assembly.

3. Install a new choke coil assembly being sure the locating tab is in the forward hole of the intake manifold and install mounting screw.
4. Complete installation as follows:

   WITH ROCHESTER 2GV CARBURETOR
   - Check that the choke rod eye of the coil is below the stop tab on the bracket and install the choke rod and adjust if necessary.
   - Install the choke coil shield over the choke coil and move shield to best fit along manifold.

   WITH ROCHESTER 4MV AND HOLLEY CARBURETORS
   - Install the choke rod and adjust as necessary (without choke coil shield installed).
   - Disconnect choke rod upper end and lower choke coil shield over choke rod and install over choke coil.
   - Move shield to best fit along manifold and connect upper end of choke rod.

5. Be sure choke valve moves freely from full open to full closed position.
6. Start and warm up the engine and check operation of the choke.
7. Install the air cleaner.

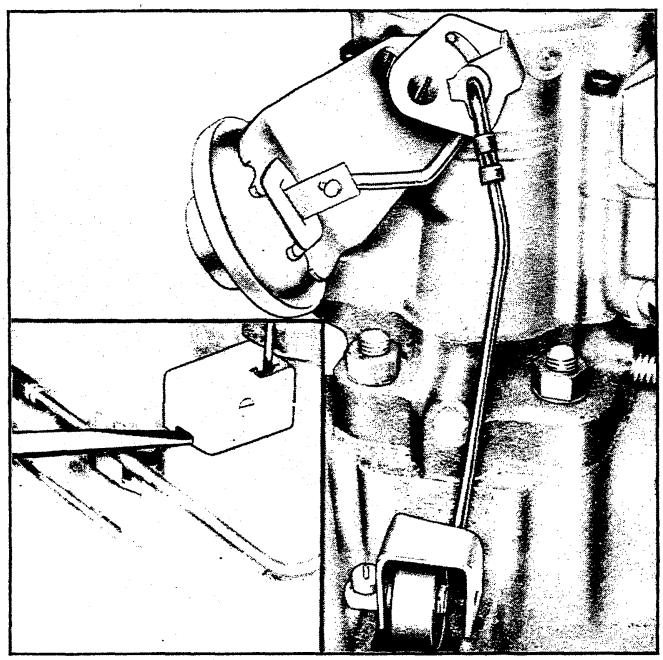


Fig. 11C—Choke Coil - V8 Engine

Idle Solenoid Replacement Removal

1. Remove engine air cleaner.
2. Disconnect electrical connector at solenoid.
3. Loosen solenoid bracket clamp bolt and remove solenoid.

Installation

1. Install solenoid in bracket so that it does not contact throttle lever.
2. Set the carburetor in the closed throttle position with the choke off.
3. Start engine and set idle to specifications (refer to tune-up decal) using the carburetor's low idle speed screw.
4. With solenoid energized and solenoid plunger screw out two turns from being fully bottomed in plunger, slide solenoid into bracket so that the plunger just slightly contacts the carburetor lever. Tighten the bracket strap to secure the solenoid in place.
5. Back out carburetor low idle speed screw approximately one turn (counter-clockwise). The low idle speed screw will be reset in the last step outlined on engine decal.

Corvette 3 x 2 Holley

Secondary Carburetor Closing Rod Adjustment

1. Start engine and allow to warm-up (choke in fully opened position).
2. Disconnect closing rod ends from each secondary carburetor. Set idle to specifications. Turn off engine.
3. With clevis pin bottomed in primary carburetor throttle slot, adjust rear secondary carburetor closing rod so that it falls short of entering the rear secondary throttle lever hole by 1/2 a rod diameter. Install rod and secure with special clip.
4. Next, adjust forward secondary carburetor closing rod so that it just enters the forward secondary throttle level hole. Install rod and secure with special clip.

When the adjustment is completed the clevis pin will be at a point just above the bottom of the primary throttle slot, thus insuring that there is freedom in the linkage and a positive secondary throttle closure (Fig. 12C).

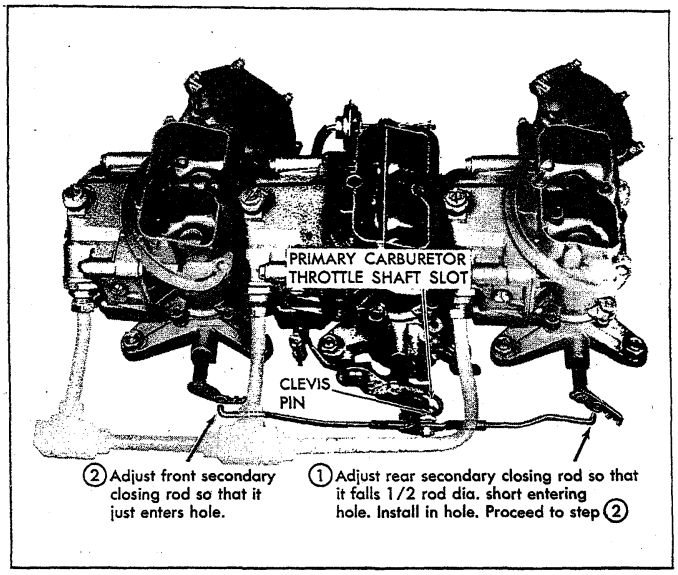


Fig. 12C—Secondary Closing Rod Adjustment

Throttle Linkage Adjustment

1. Disconnect throttle rod swivel at throttle lever on carburetor.

   NOTE: Cable controls do not require adjustment except Corvette. TV controls used with cable throttle linkages are adjusted same as Step 5.

2. Corvette only: hold accelerator pedal to floor against stop. Move carburetor throttle lever to wide open position. Tighten cable clamp bolt to 45 in. lbs. of torque.
3. On automatic transmission equipped vehicles disconnect TV rod at throttle lever.
4. Hold carburetor throttle in wide open position, push throttle rod rearward (to position accelerator pedal at the floor mat) and adjust swivel to just enter hole in throttle lever.
5. Connect swivel to throttle lever and install accelerator return spring.
6. On vehicles equipped with automatic transmission hole throttle lever in full open position, pull TV rod to full detent position and adjust TV rod to just enter hole on throttle lever, and connect TV rod at throttle lever.

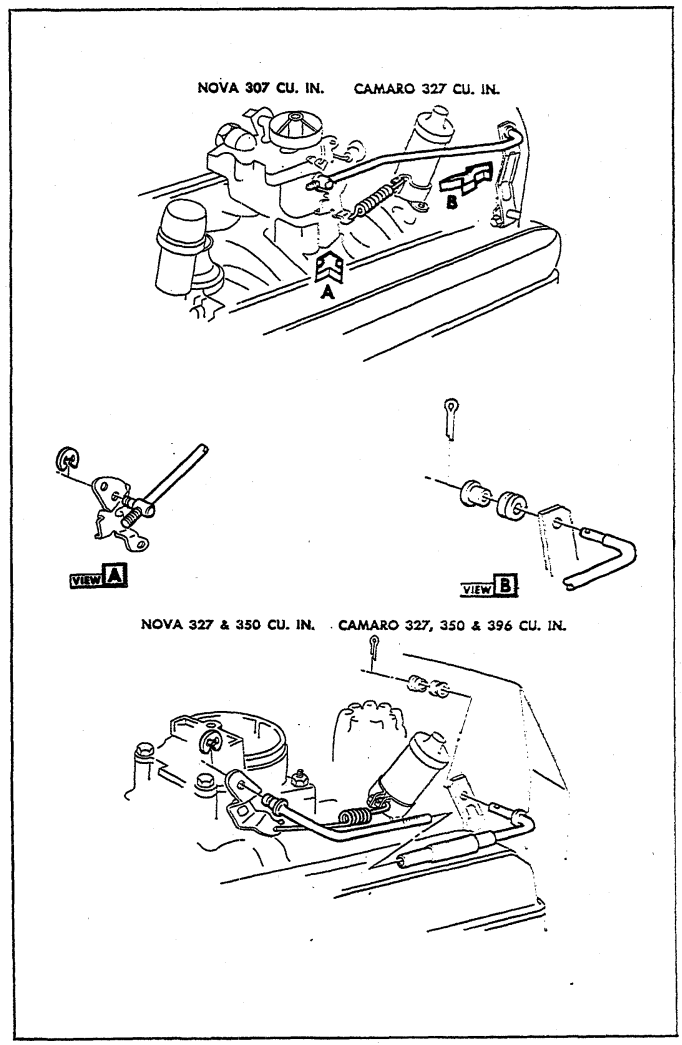
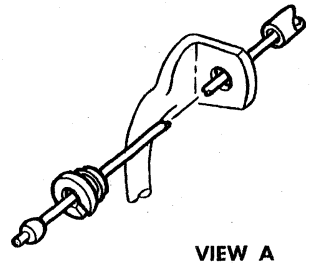
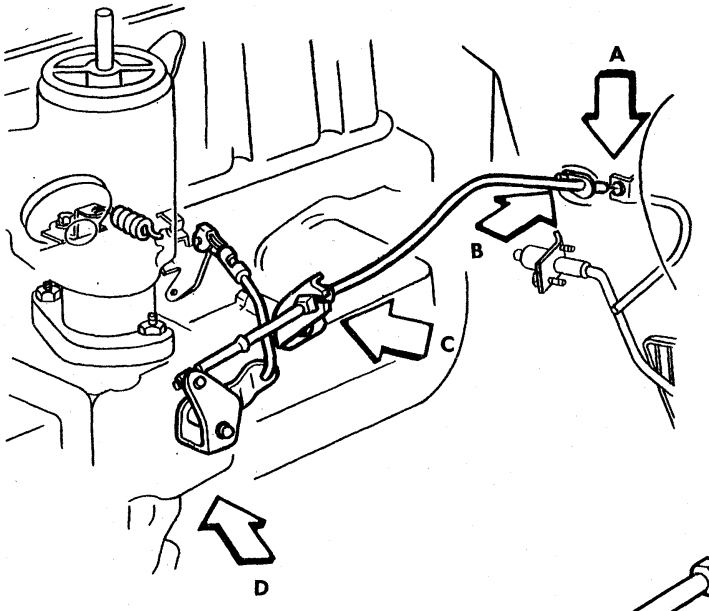


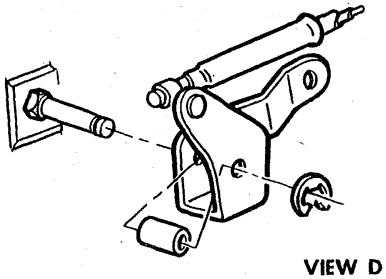
Fig. 13C—Throttle Linkage - Nova and Camaro V8



VIEW A

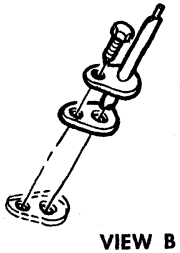
CHEVELLE, NOVA & CAMARO





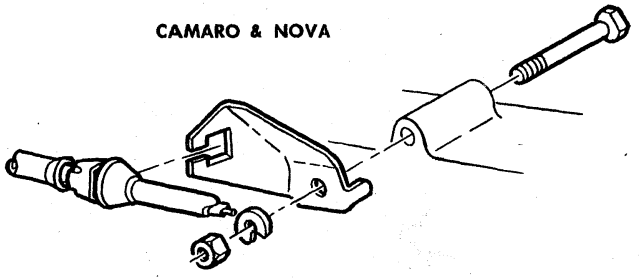
VIEW D

CHEVELLE & CAMARO



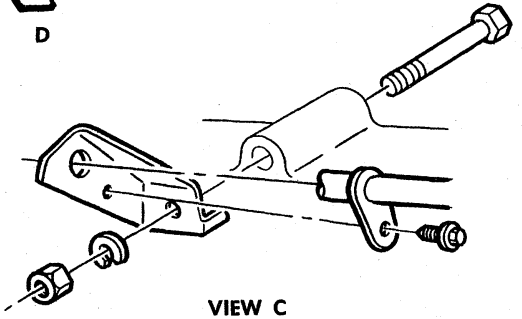
VIEW B

CAMARO & NOVA



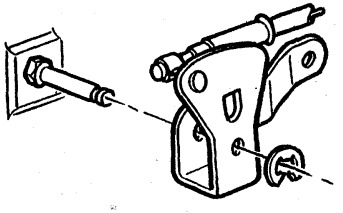
VIEW C

CHEVELLE & CAMARO



VIEW C

NOVA



VIEW D

NOVA

Fig. 14C—Throttle Linkage - Chevelle, Nova and Camaro L-6

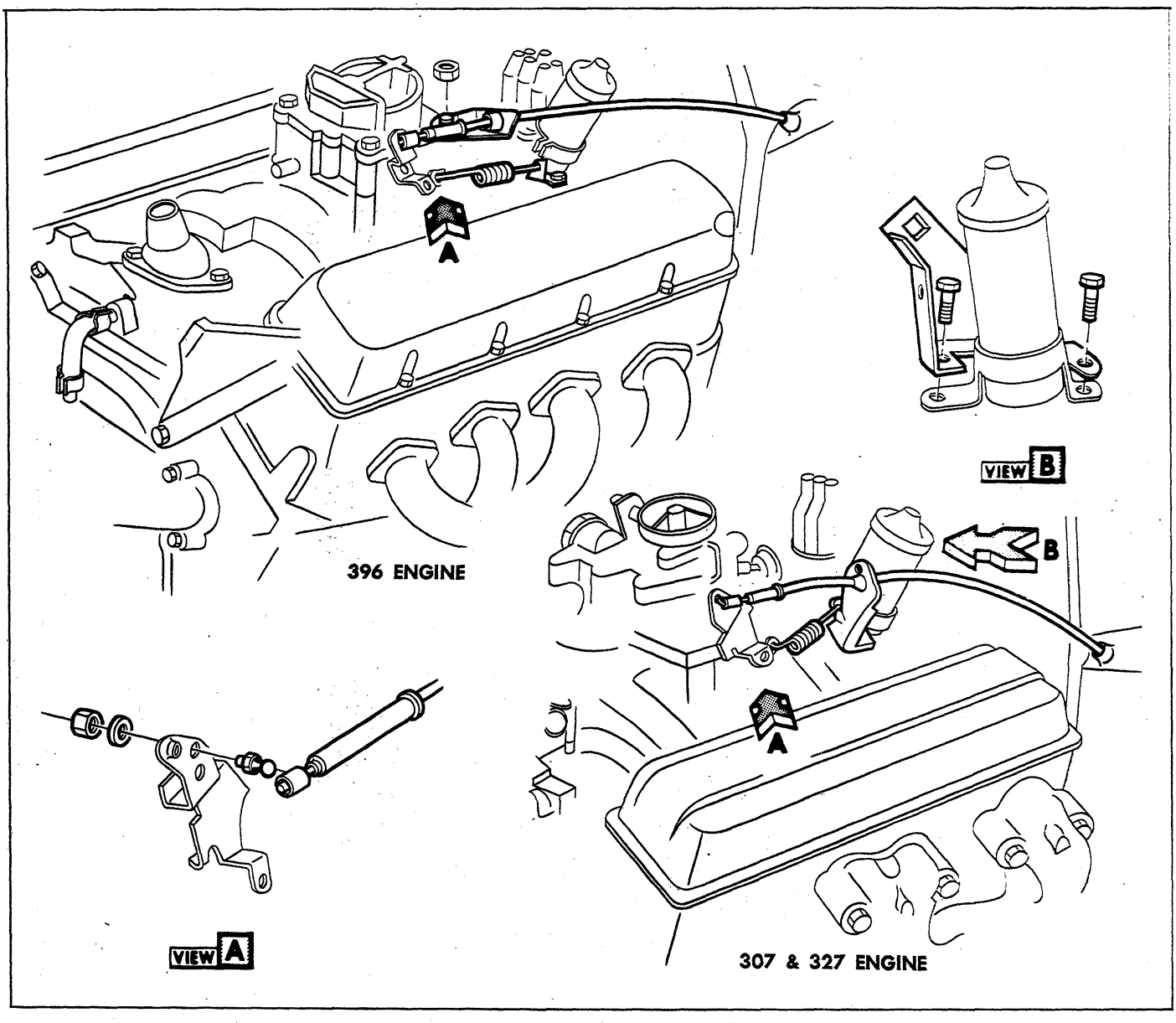
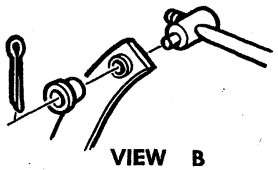
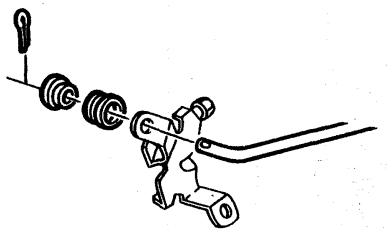


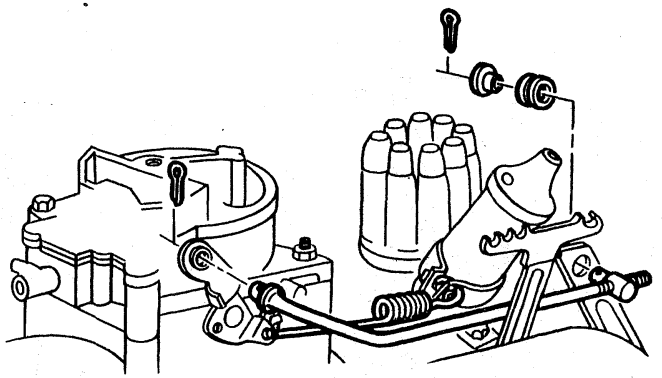
Fig. 15C—Throttle Linkage Chevelle V8



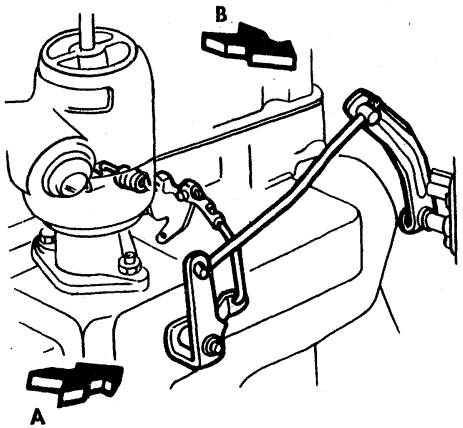
VIEW B



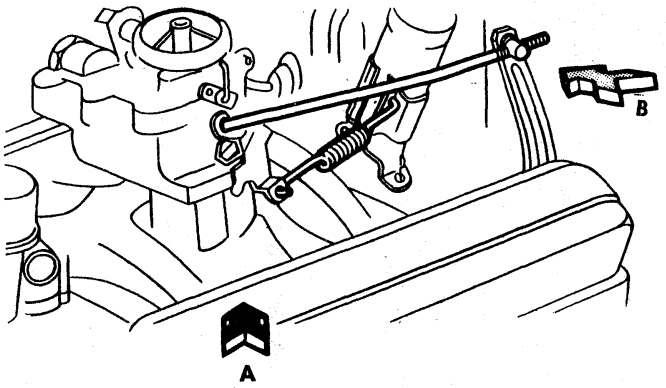
VIEW A



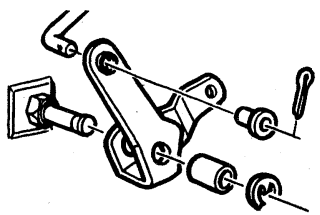
V-8 ENGINE 396-427 ACCELERATOR CONTROLS



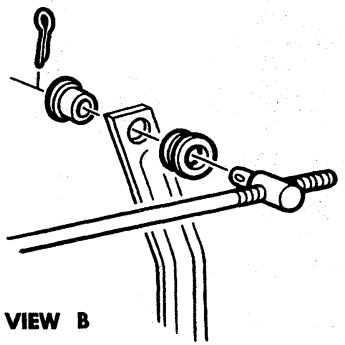
L-6 ENGINE



V-8 ENGINE (EXCEPT 396 & 427 CU. IN.)



VIEW A



VIEW B

Fig. 16C—Throttle Linkage Chevrolet

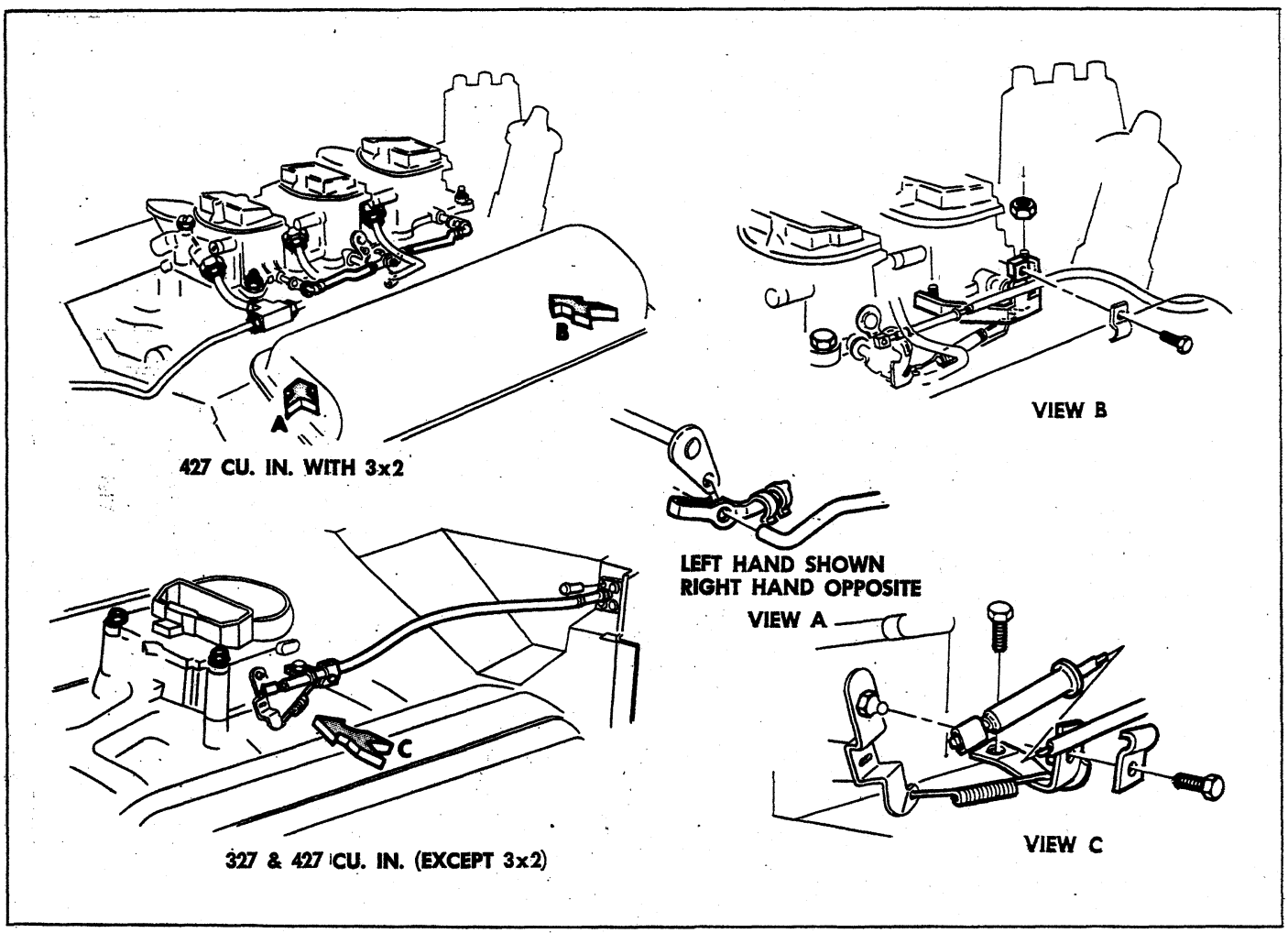


Fig. 17C—Throttle Linkage Corvette

AIR CLEANERS

INDEX

	Page
General Description	6M-13
Service Procedures	6M-13
Polyurethane Element	6M-13
Maintenance	6M-13
Oil Wetted Paper Element	6M-13
Maintenance	6M-13
Thermostatically Controlled Air Cleaner	6M-14
Testing	6M-14
Replacement	6M-14

GENERAL DESCRIPTION

Air cleaners on all models operate primarily to remove dust and dirt from the air that is taken into the carburetor and engine. The air cleaner is also effective in reducing engine air inlet noise.

Three basic types of air cleaners are used on 1969 Chevrolet vehicles. They are the oiled paper, oiled paper with polyurethane band, and the wire mesh with polyurethane band.

On most automatic transmission equipped vehicles an automatic air inlet temperature control device is used. Air temperature is automatically controlled by a thermostatic valve which selects warmed air from the heat stove and/or cooler air from the engine compartment.

The oiled paper filters used in most air cleaner assemblies have both ends of the paper element bonded with plastisol sealing material. Oil on the paper causes the element to become discolored by a small amount of dirt that does not necessarily indicate that the element is plugged or reduced in efficiency. It is advisable to rotate the air cleaner element 180° at 12,000 miles and to replace the air cleaner element every 24,000 miles. The preceding maintenance operations should be performed more often when subject to dusty or otherwise adverse driving conditions.

SERVICE PROCEDURES

POLYURETHANE ELEMENT

Maintenance

1. Remove cover wing nut, cover and filter element.
2. Visibly check the element for tears or rips and replace if necessary.
3. Clean all accumulated dirt and grime from air cleaner bottom and cover. Discard air horn to air cleaner gaskets.
4. Remove support screen from element and wash element in kerosene or mineral spirits; then squeeze out excess solvent (fig. 3A).

   NOTE: Never use a hot degreaser or any solvent containing acetone or similar solvent.

5. Dip element into light engine oil and squeeze out excess oil.

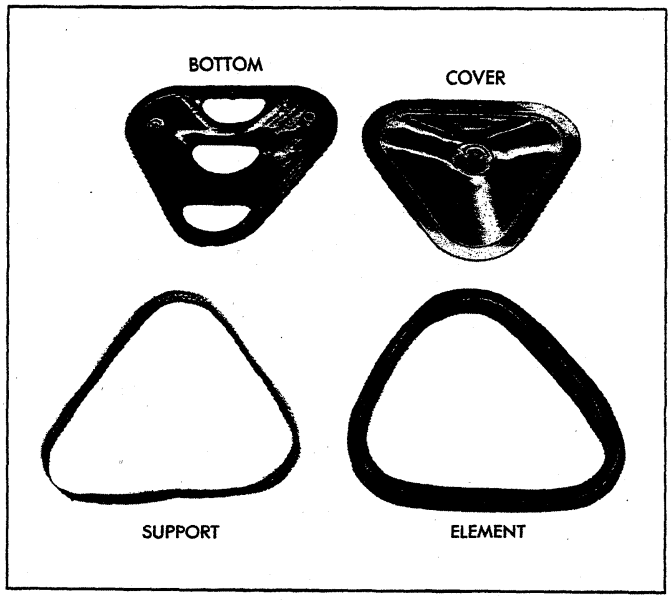


Fig. 1A—Polyurethane Element Air Cleaner

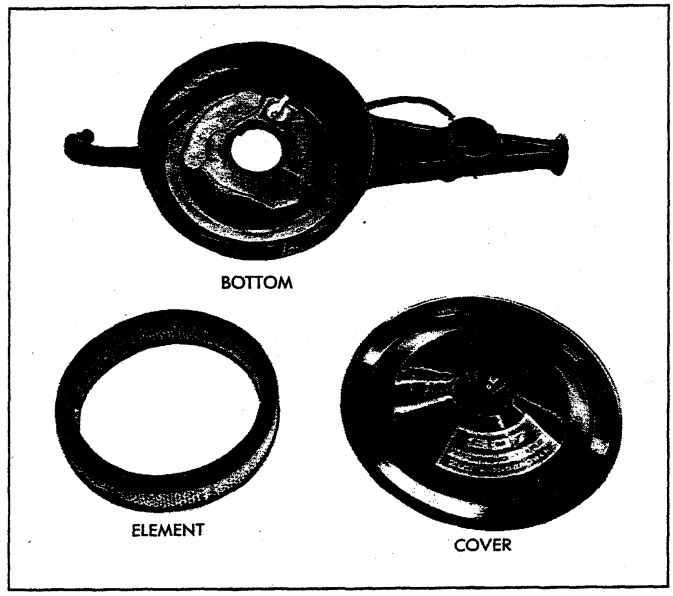


Fig. 2A—Paper Element Air Cleaner

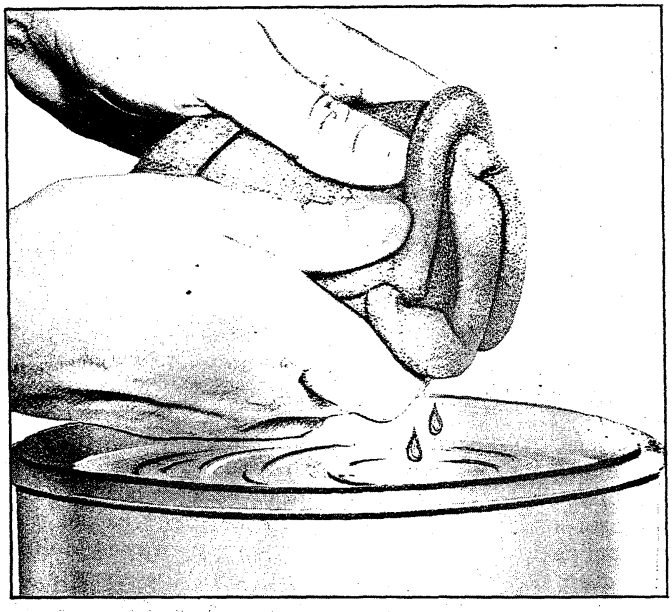


Fig. 3A—Cleaning Polyurethane Element

NOTE: Never shake, swing or wring the element to remove excess oil or solvent as this may tear the polyurethane material. Instead, "squeeze" the excess from the element.

6. Install element on screen support (fig. 4A).
7. Using new gaskets, replace air cleaner body over carburetor air horns.
8. Replace the element in the air cleaner. Care must be taken that the lower lip of the element is properly placed in the assembly and that the filter material is not folded or creased in any manner that would cause an imperfect seal. Take the same precautions when replacing the cover that the upper lip of the element is in proper position.
9. Replace cover and wing nut.

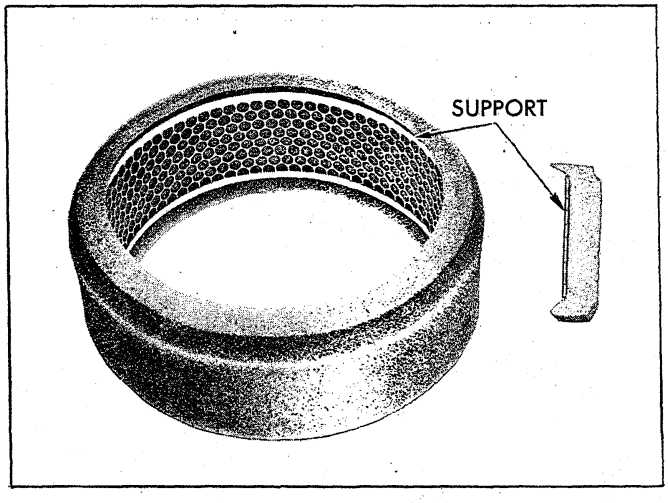


Fig. 4A—Polyurethane Support

OIL WETTED PAPER ELEMENT

Replacement

1. Remove wing nut, washer and cover.
2. Remove paper element and discard.
3. Remove bottom section of air cleaner and gasket on air horn of carburetor. Discard air horn gasket.
4. Clean bottom section of air cleaner and cover pieces thoroughly, to remove dust and grime.

   NOTE: Do not submerge bottom section of thermostatic air cleaners in solvent.

5. Check air cleaner cover seal for tears or cracks.
6. Install a new gasket on carburetor air horn and set bottom section of air cleaner on carburetor.
7. Install new paper element on bottom section of air cleaner with either end up.

   NOTE: Plastisol seal is the same material on both ends.

8. Install cover, washer and wing nut.

Cleaning

1. Remove air cleaner element as previously outlined.
2. Inspect top and bottom seals for deformation or cracking. These surfaces must be smooth and uniform.
3. Inspect element for punctures or splits by looking through the element towards a light bulb.
4. Tap element on smooth flat surface to dislodge dirt particles being careful not to damage element. Compressed air can be used to clean element if done very gently and opposite the flow of air to the carburetor.
5. Internal portions of air cleaner cover and bottom should be clean. If washed with solvent surfaces should be dried thoroughly.

   NOTE: Do not submerge bottom section of thermostatic air cleaners in solvent.

6. Install air cleaner element as previously outlined.

THERMOSTATICALLY CONTROLLED AIR CLEANER

This system is designed to improve carburetor operation and engine warm-up characteristics. It achieves this by keeping the air entering the carburetor at a temperature of at least 100°F or more.

The thermostatic air cleaner system includes a temperature sensor, a vacuum motor and control damper assembly mounted in the air cleaner, vacuum control hoses, manifold heat stove and connecting pipes. The vacuum motor is controlled by the temperature sensor. The vacuum motor operates the air control damper assembly to regulate the flow of hot air and under hood air to carburetor. The hot air is obtained from the heat stove on the exhaust manifold (Fig. 5A).

Inspection

Visual

1. Check for proper, secure connections of heat pipe and hoses.
2. Check for kinked or deteriorated hoses. Repair or replace as required.

Operational

1. Remove air cleaner cover and install temperature gauge (Tool J-22973) as close as possible to sensor (Fig. 7A).

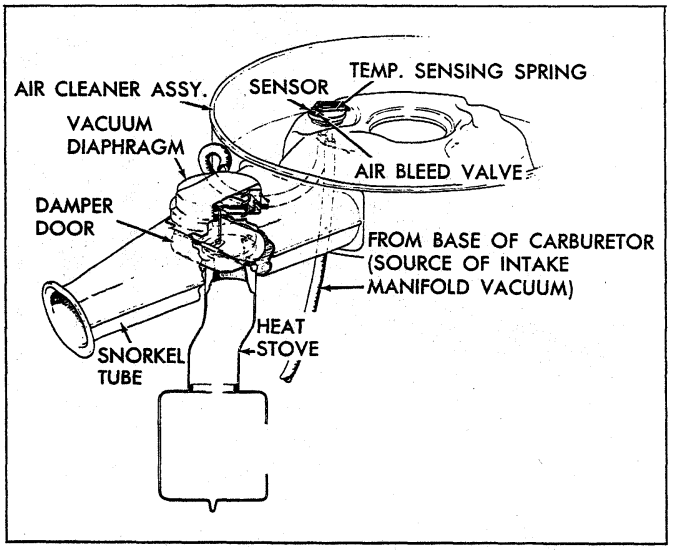


Fig. 5A—Thermostatically Controlled Air Cleaner

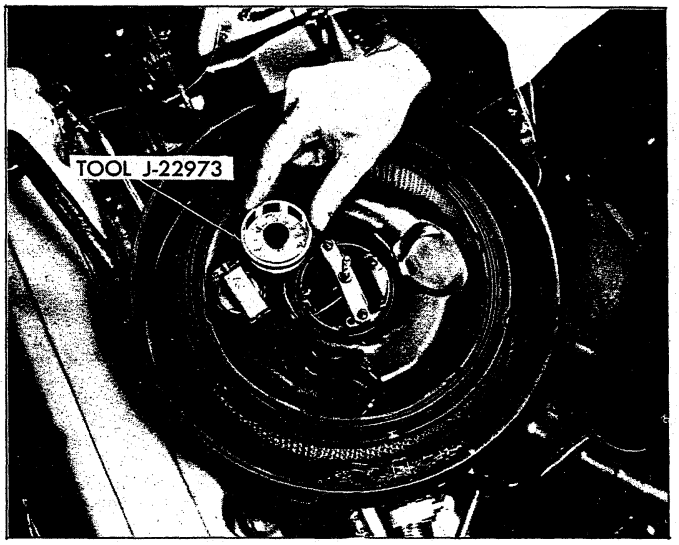


Fig. 7A—Installing Temperature Gauge

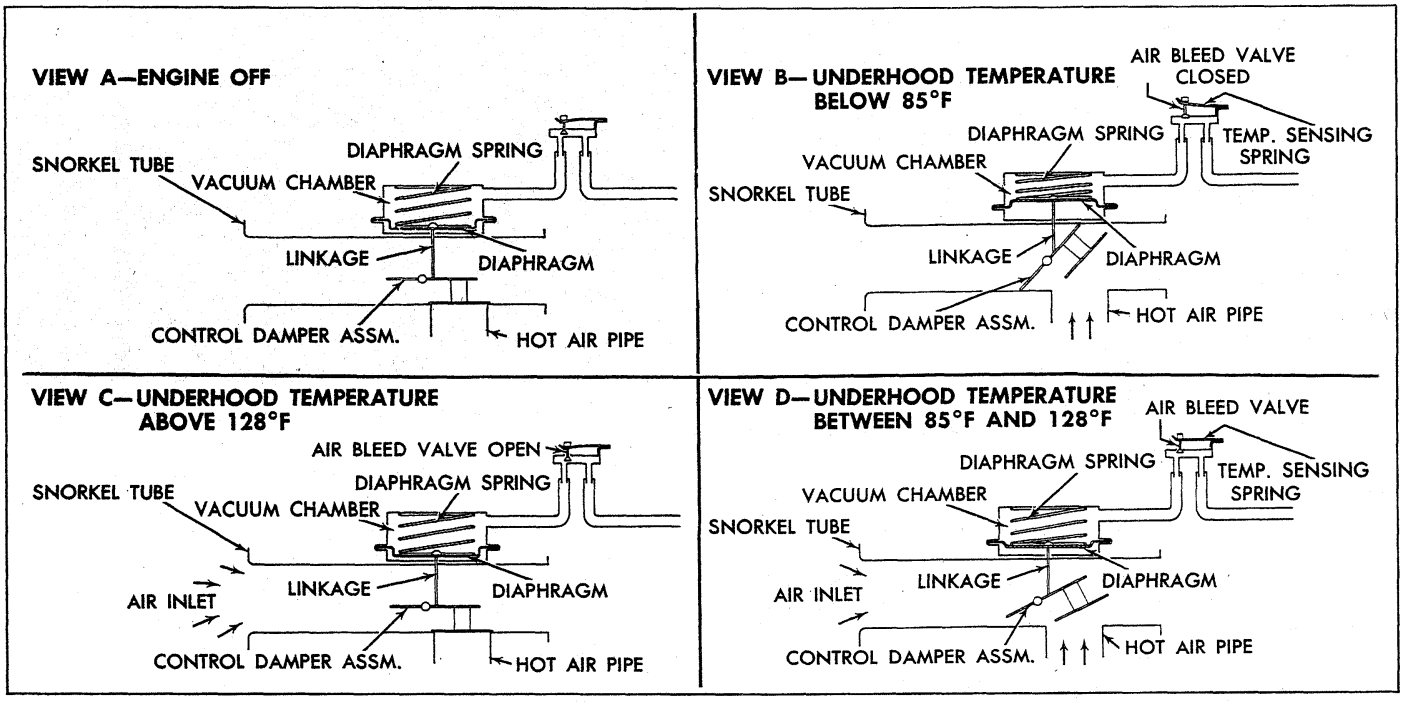


Fig. 6A—Operational Diagrams

Reinstall cover without wing nut. If vehicle has been in recent operation and temperature at sensor unit is above 85°F, remove air cleaner assembly and let it cool to below 85°F. Reinstall air cleaner assembly and cover. Do not install wing nut.

2. With the engine "Off", observe damper door position through snorkel opening. If position of snorkel makes observation difficult use the aid of a mirror. At this point damper door should be in such a position that the heat stove passage is covered (snorkel passage open). If not, check for binds in linkage.
3. Start and idle engine. Observe damper door position through snorkel. If ambient air temperatures are below 85°F, the damper door should close off snorkel passage when engine is initially started. When damper door begins to open (opening snorkel passage), remove air cleaner cover and observe thermometer reading. It should be between 85°F and 115°F.
4. If damper door opens before 85°F, replace sensor unit.
5. If damper door does not open at correct temperature continue with the following vacuum motor check:
   a. Turn off engine. Disconnect diaphragm assembly vacuum hose at sensor unit. Damper door should completely close heat stove passage at this point. If not, check linkage for a binding condition.
   b. Apply at least 9 in. Hg. of vacuum to diaphragm assembly through hose disconnected at sensor unit. This can be done by mouth. Damper door should completely close snorkel passage when vacuum is applied. If not check to see if linkage is hooked up correctly and for a vacuum leak.

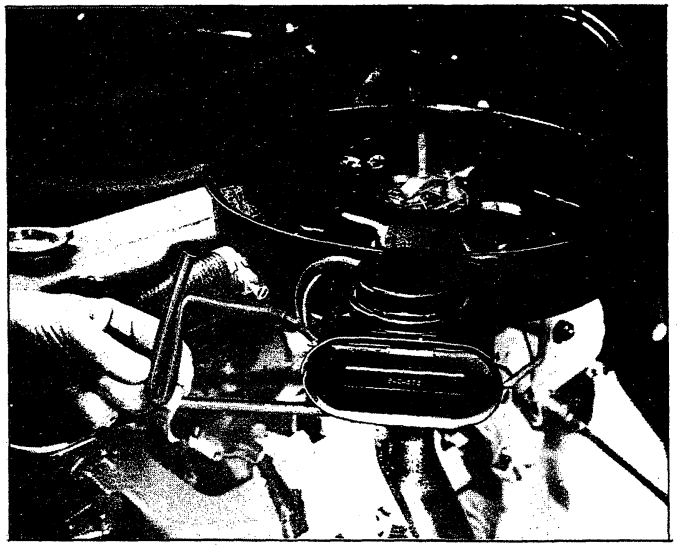


Fig. 8A—Checking Vacuum Diaphragm

c. With vacuum applied, bend or clamp hose to trap vacuum in diaphragm assembly (Fig. 8A). Damper door should remain in position (closed snorkel passage). If it does not, there is a vacuum leak in diaphragm assembly. Replace diaphragm assembly.

6. If vacuum motor check is found satisfactory, replace sensor unit.

Vacuum Motor Replacement

Removal

1. Remove air cleaner from engine.
2. Drill out spot welds fastening vacuum motor retaining strap to snorkel tube.
3. Remove vacuum motor by lifting and unhooking linkrod from damper door.

Replacement

1. Drill 7/64" hole in snorkel tube at center of vacuum motor retaining strap (fig. 9A).
2. Connect vacuum motor linkage to damper door. Fasten retaining strap to air cleaner with sheet metal screw.
3. Replace air cleaner on engine and check operation of vacuum motor and control damper assembly.

Temperature Sensor Replacement

Removal

1. Remove air cleaner from engine and disconnect vacuum hoses at sensor.

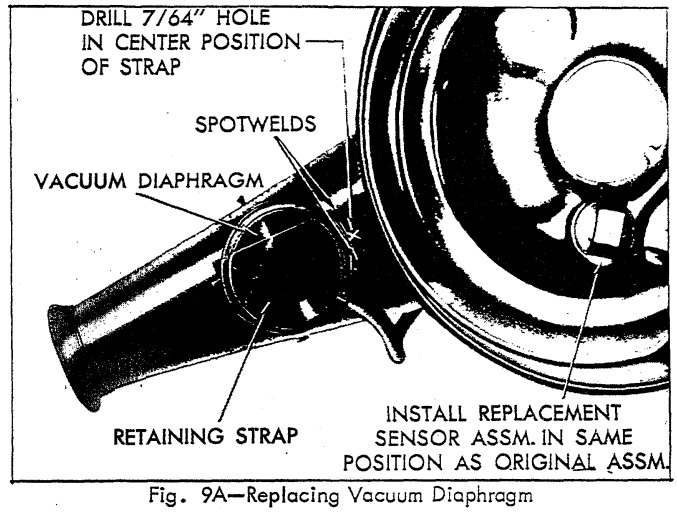


Fig. 9A—Replacing Vacuum Diaphragm

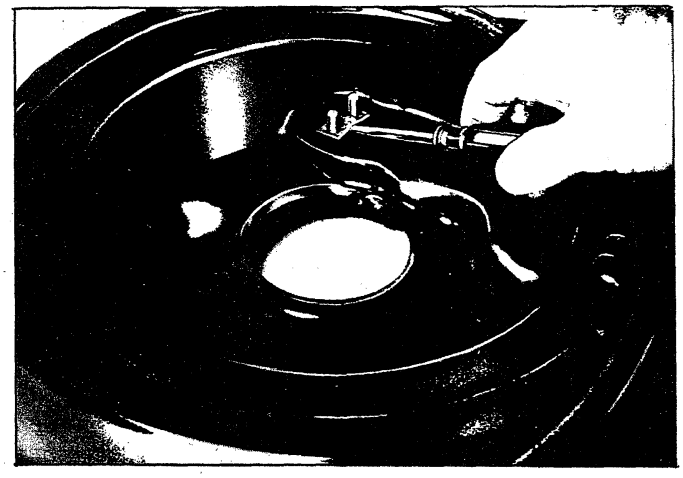


Fig. 10A—Removing Sensor Unit

2. Pry up tabs of sensor retaining clip (Fig. 10A).

NOTE: Observe position of sensor, new sensor must be installed in this same position.

3. Remove clip and sensor from air cleaner.

Replacement

1. Install sensor and gasket assembly in air cleaner in position as noted above.
2. Press retaining clip on sensor. Support the sensor on its sides to prevent damage to the control mechanism to the center.
3. Install air cleaner on engine and connect vacuum hoses.

FUEL PUMP

INDEX

	Page		Page
General Description	6M-17	Test	6M-17
Service Procedures	6M-17	Removal	6M-17
Inspection	6M-17	Installation	6M-17

GENERAL DESCRIPTION

The fuel pump (fig. 1P) used on all Chevrolet vehicles covered in this manual is the diaphragm type. The pump is actuated by an eccentric located on the engine camshaft. On in-line engines, the eccentric actuates the rocket arm. On V-8 engines, a push rod (located between the camshaft eccentric and fuel pump) actuates the pump rocker arm. Because of design, this pump is serviced as an assembly only.

SERVICE PROCEDURES

Inspection

The fuel pump should be checked to make sure the mounting bolts and inlet and outlet connections are tight.

Test

Always test pump while it is mounted on the engine and be sure there is gasoline in the tank.

The line from the tank to the pump is the suction side of the system and the line from the pump to the carburetor is the pressure side of the system. A leak on the pressure side, therefore, would be made apparent by dripping fuel, but a leak on the suction would not be apparent except for its effect of reducing volume of fuel on the pressure side.

1. Tighten any loose line connections and look for bends or kinks in lines.
2. Disconnect fuel pipe at carburetor. Disconnect distributor to coil primary wire so that engine can be cranked without firing. Place suitable container at end of pipe and crank engine a few revolutions. If little or no gasoline flows from open end of pipe then fuel pipe is clogged or pump is inoperative. Before removing pump disconnect fuel pipe at gas tank and outlet pipe and blow through them with an air hose to make sure they are clear. Reconnect pipes and retest while cranking engine.

   CAUTION: Whenever the engine is cranked remotely at the starter, with a special jumper cable or other means, the primary distributor lead must be disconnected from the negative post on the coil and the ignition switch must be in the "ON" position. Failure to do this will result in a damaged grounding circuit in the ignition switch.

3. If fuel flows from pump in good volume from pipe at carburetor, check fuel delivery pressure to be certain that pump is operating within specified limits as follows:
   a. Attach a fuel pump pressure test gauge to disconnect end of pump to carburetor pipe.
   b. Run engine at approximately 450-1,000 rpm (on gasoline in carburetor bowl) and note reading on pressure gauge.
   c. If pump is operating properly the pressure will be within specifications and will remain constant at speeds between 450-1,000 rpm. If pressure is too low, too high, or varies significantly at different speeds, the pump should be replaced.

Removal

1. Disconnect fuel inlet and outlet pipes at fuel pump.
2. Remove fuel pump mounting bolts and remove pump and gasket.
3. On V8 engines, if push rod is to be removed, remove pipe plug and push rod (396 and 427 cu. in. engines), and fuel pump adapter and gasket and push rod 302, 307, 327 and 350 cu. in. engines).

Installation

1. On V8 engines, if fuel pump push rod has been removed, install push rod and pipe fitting or fuel pump adapter using gasket sealer on gasket or pipe fitting.
2. Install fuel pump using a new gasket and tighten securely. Use sealer on fuel pump mounting bolt threads.

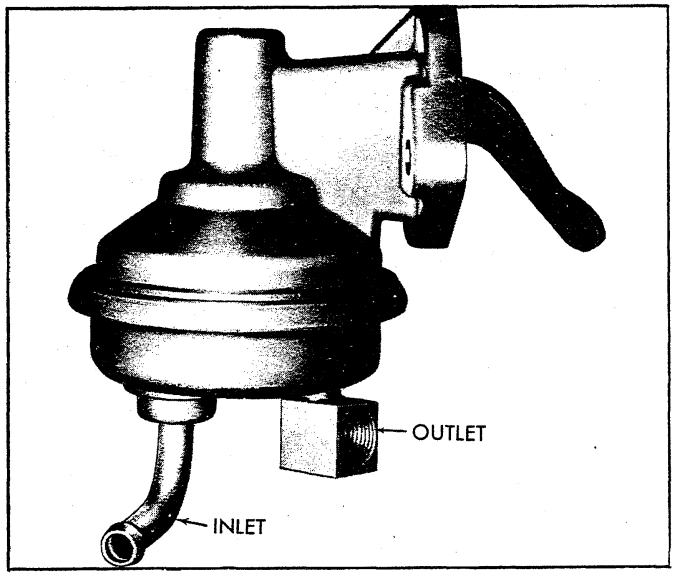


Fig. 1P—Fuel Pumps (Non-Serviceable)

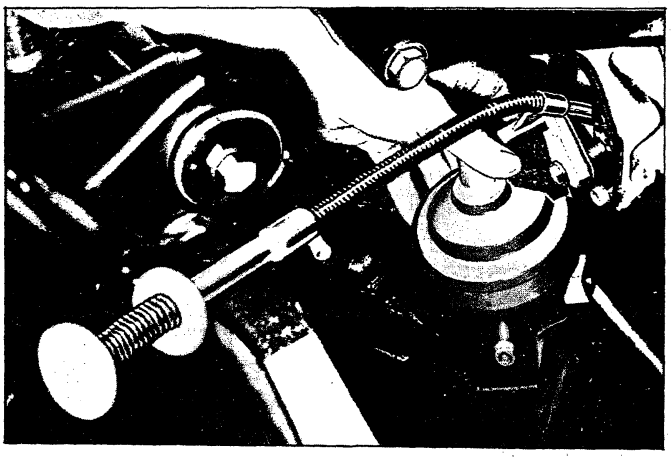


Fig. 2P—Installing 302, 307, 327 and 350 V8 Engine Fuel Pumps

NOTE: On V8 engines, a pair of mechanical fingers or heavy grease may be used to hold fuel pump push rod up while installing fuel pump (fig. 2P).

3. Connect fuel pipes to pump.
4. Start engine and check for leaks.

SPECIAL TOOLS

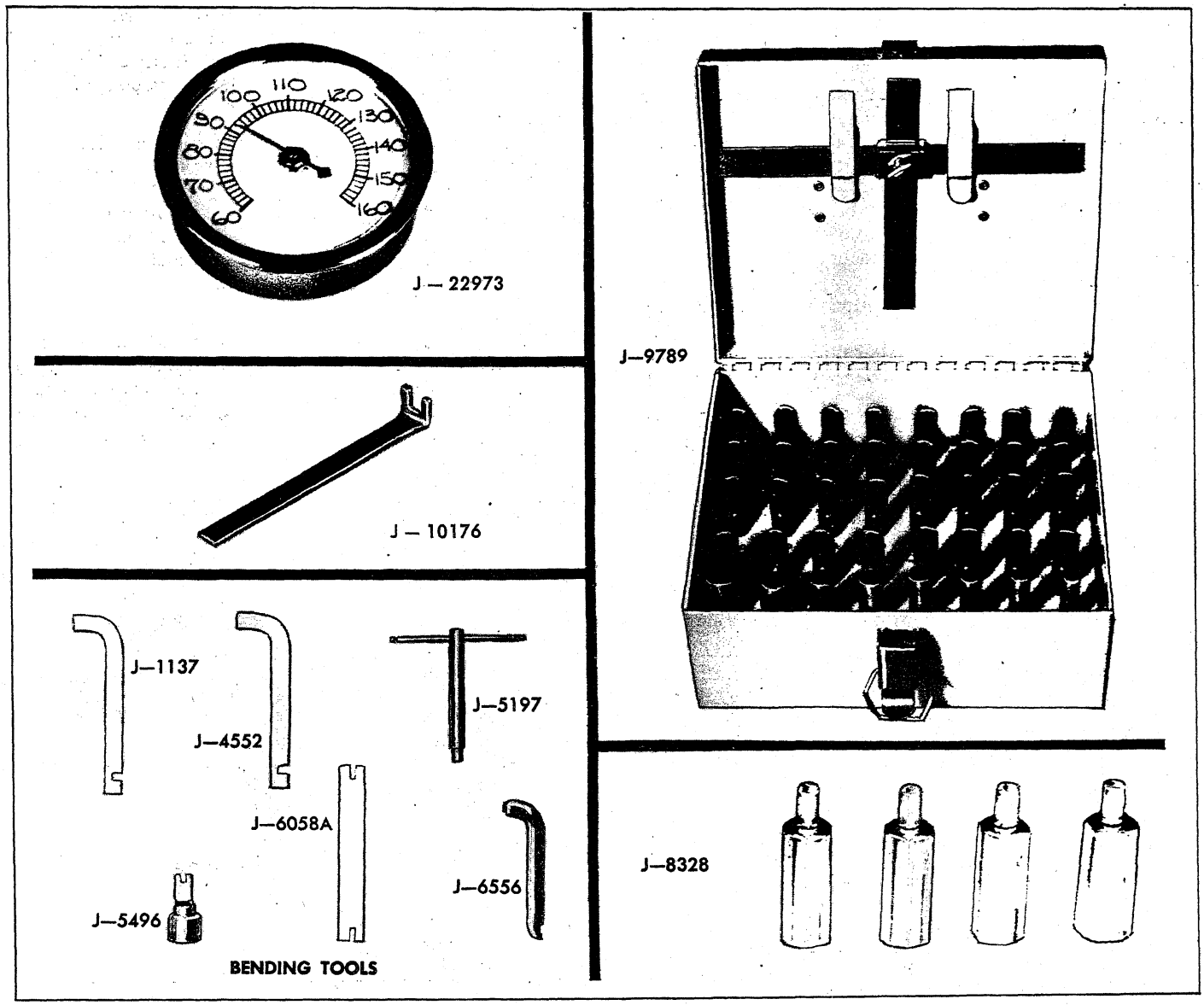


Fig. 1T—Engine Fuel Special Tools

SECTION 6T

AIR INJECTION REACTOR SYSTEM

INDEX

	Page
General Description	6T-1
Maintenance Procedures	6T-2
Drive Belt	6T-2
Inspection	6T-2
Adjustment	6T-2
Replacement	6T-3
Pump Pulley	6T-3
Replacement	6T-3
Air Manifold, Hose and Tube	6T-4
Inspection	6T-4
Replacement	6T-4
Check Valve(s)	6T-5
Inspection	6T-5
Replacement	6T-5
Diverter Valve	6T-5
Inspection	6T-5
Replacement	6T-5
Air Injection Tube	6T-6
Inspection	6T-6
Replacement	6T-6
Air Injection Pump	6T-6
Inspection	6T-6
Pressure Relief Valve Replacement	6T-6
Special Tools	6T-6

GENERAL DESCRIPTION

The Air Injection Reactor (A.I.R.) System (fig. 1), used on Chevrolet passenger car engines consists of: the air injection pump (with necessary brackets and drive attachments), air injection tubes (one for each cylinder), an air diverter valve, check valves (one for in-line engines, two for V8 engines) and air manifold assemblies, tubes and hoses necessary to connect the various components (fig. 2).

Carburetors and distributors for engines with the A.I.R. System are designed, particularly, for these engines; therefore they should not be interchanged with or replaced by a carburetor or distributor designed for engines without the A.I.R. System.

The air injection pump (fig. 3) with an integral filter, compresses the air and injects it through the air manifolds, hoses and injection tubes into the exhaust system in the area of the exhaust valves. The fresh air ignites and burns the unburned portion of the exhaust gases in the exhaust system, thus minimizing exhaust contaminations.

The diverter valve (fig. 4) when triggered by a sharp increase in manifold vacuum, shuts off the injected air

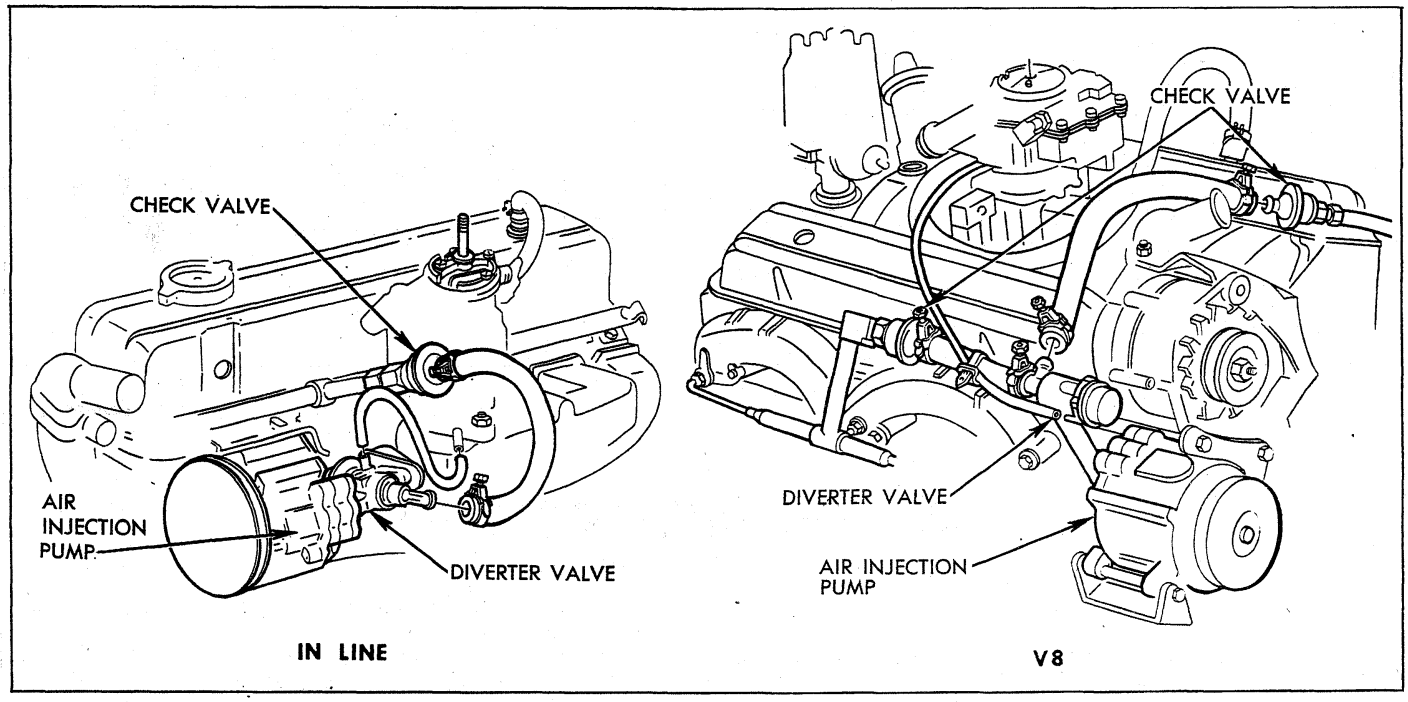


Fig. 1-Air Injection Reactor System

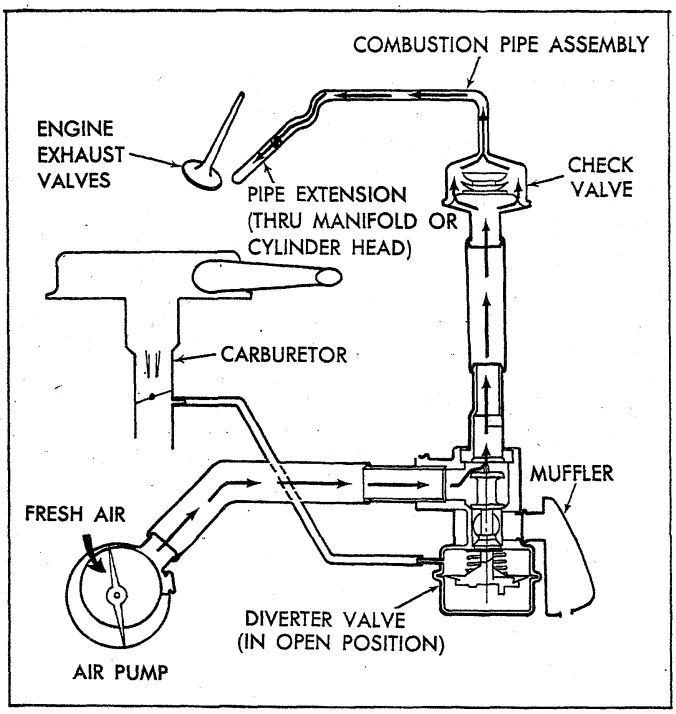


Fig. 2—Schematic of A.I.R. System

to the exhaust port areas and prevents backfiring during this richer period.

On engine overrun the total air supply is dumped through the muffler on the diverter valve. At high engine speeds the excess air is dumped through the pressure relief valve which is incorporated in the diverter valve.

The check valve(s) prevent exhaust gases from entering and damaging the air injection pump, as back flow can occur even under normal operating conditions.

When properly installed and maintained, the A.I.R. System will effectively reduce exhaust emissions. However, if any A.I.R. component or any engine component that operates in conjunction with the A.I.R. System should malfunction, the exhaust emissions might be increased.

Because of the relationship between "Engine Tune Up" and "Unburned Exhaust Gases", the condition of the Engine Tune Up should be checked whenever the A.I.R. System seems to be malfunctioning. Particular care should be taken in checking items that affect fuel-air ratio such as the crankcase ventilation system, the carburetor and the carburetor air cleaner.

Because of the similarity of many parts, typical illustrations and procedures are used except where specific illustrations or procedures are necessary to clarify the operation.

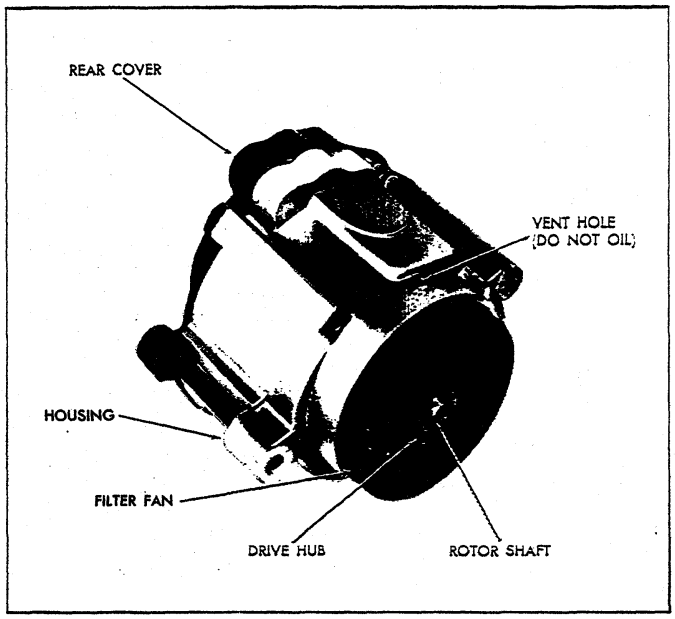


Fig. 3—Air Injection Pump

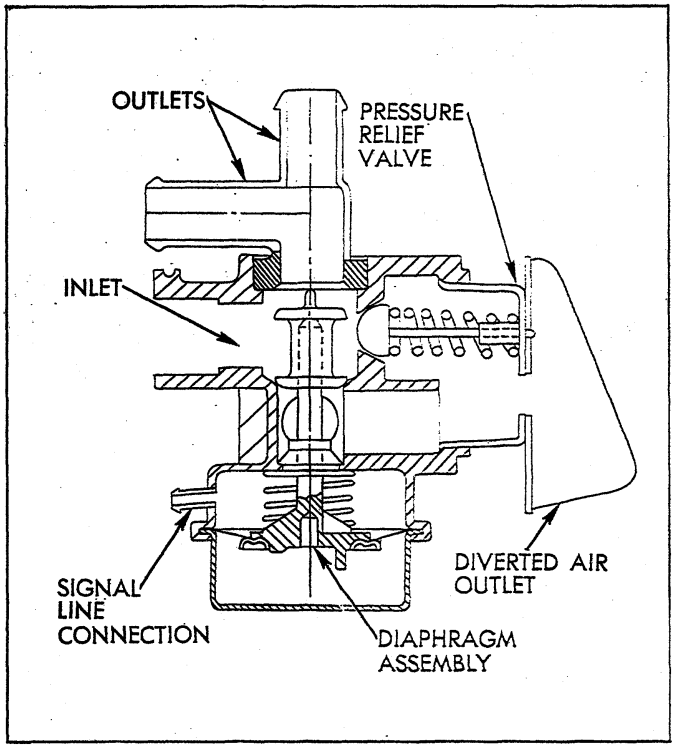


Fig. 4—Diverter Valve (Typical)

MAINTENANCE PROCEDURES

DRIVE BELT

Inspection

- Inspect drive belt for wear, cracks or deterioration and replace if required.
- Inspect belt tension and adjust if below 50 lbs. using a strand tension gauge.

Adjustment

- Loosen pump mounting bolt and pump adjustment bracket bolt.
- Move pump or Delcotron until belt is tight (55 ± 5 lb. used belt or 75 ± 5 lb. new belt using a strand tension gauge) then tighten adjustment bracket bolt and mounting bolt (fig. 5).

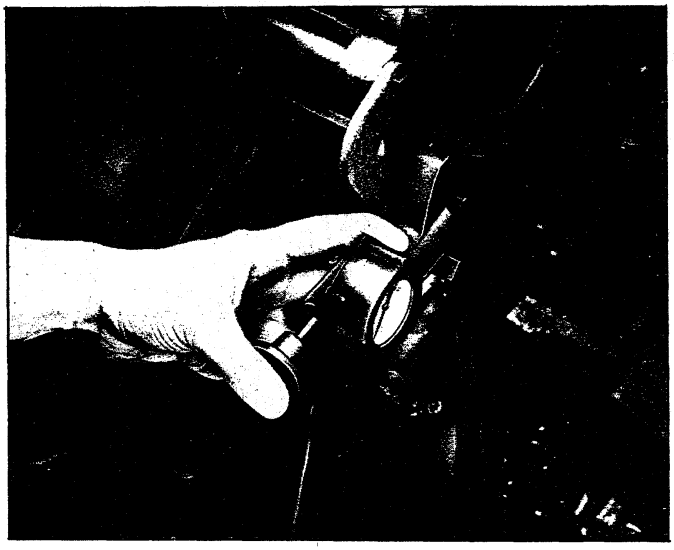


Fig. 5—Checking A.I.R. Pumps Belt Tension

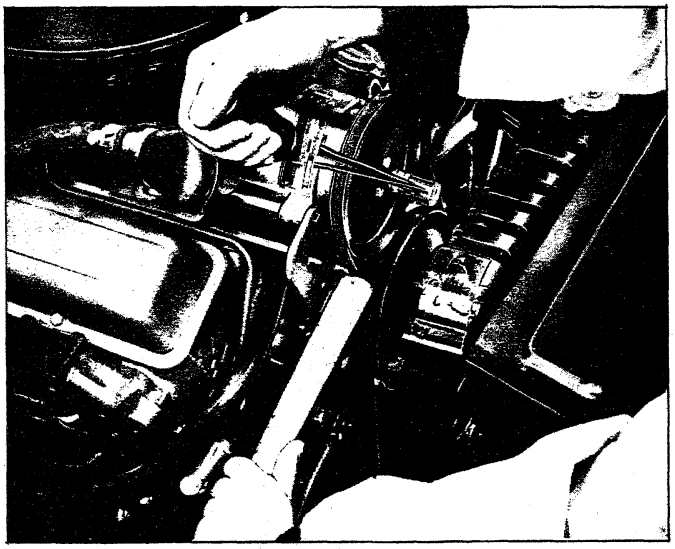


Fig. 6—Tightening Pump Pulley Bolts

CAUTION: Do not pry on the pump housing. Distortion of the housing will result in extensive damage to the Air Injection Pump.

Replacement

- Loosen pump mounting bolt and pump adjustment bracket bolt then swing pump until drive belt may be removed.
- Install a new drive belt and adjust as outlined above.

PUMP PULLEY

Replacement

- Hold pump pulley from turning by compressing drive belt then loosen pump pulley bolts.
- Remove drive belt as outlined above then remove pump pulley.
- Install pump pulley with retaining bolts hand tight.
- Install and adjust drive belt as outlined above.
- Hold pump pulley from turning by compressing drive belt then torque pump pulley bolts to 25 ft. lbs. (fig. 6).
- Recheck drive belt tension and adjust if required.

PUMP FILTER

Replacement

- Remove drive belt and pump pulley as previously outlined.
- Pry loose outer disc of filter fan.
- Pull remaining portion of filter off with pliers (fig. 8).

NOTE: Care should be taken to prevent fragments from entering the air intake hole.

- Install the new filter by drawing it on with the pulley and pulley bolts (fig. 9). Do not attempt to install a filter by hammering it on or pressing it on.

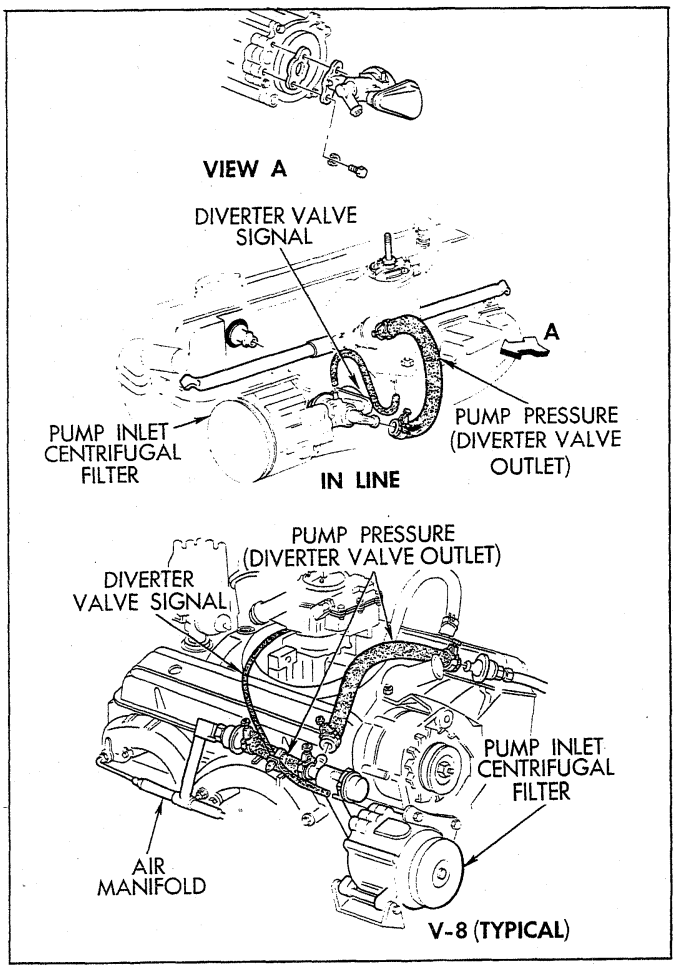


Fig. 7—Air Manifold, Hose and Tube Routing

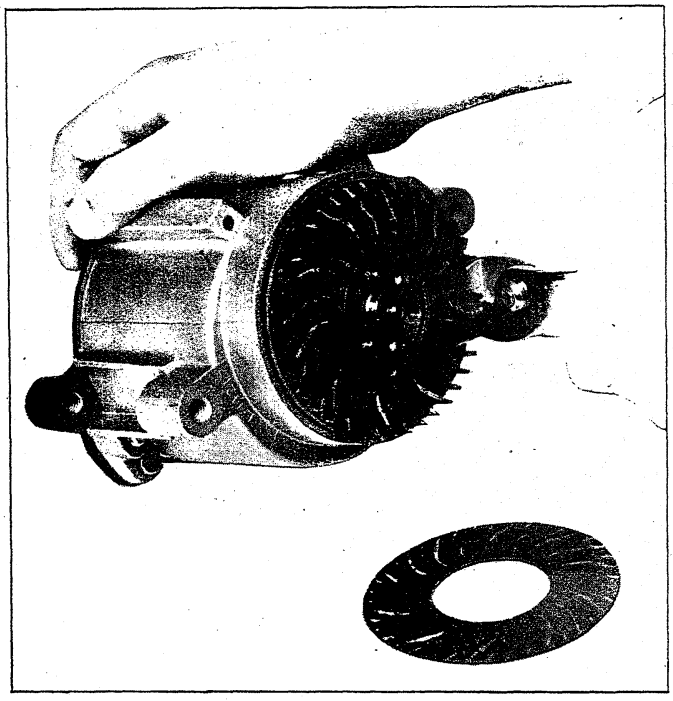


Fig. 8—Removing Centrifugal Filter

- Draw the filter down evenly by alternately torquing the bolts. Make certain that the outer edge of the filter slips into the housing. The slight amount of interference with the housing bore is normal.

NOTE: A new filter may squeal upon initial operation until its O.D. sealing lip has worn in.

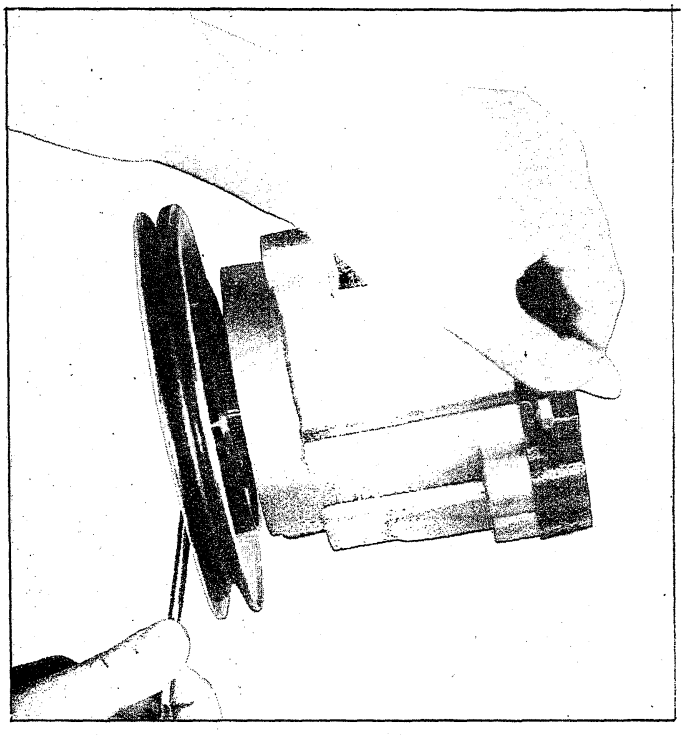


Fig. 9—Installing Centrifugal Filter

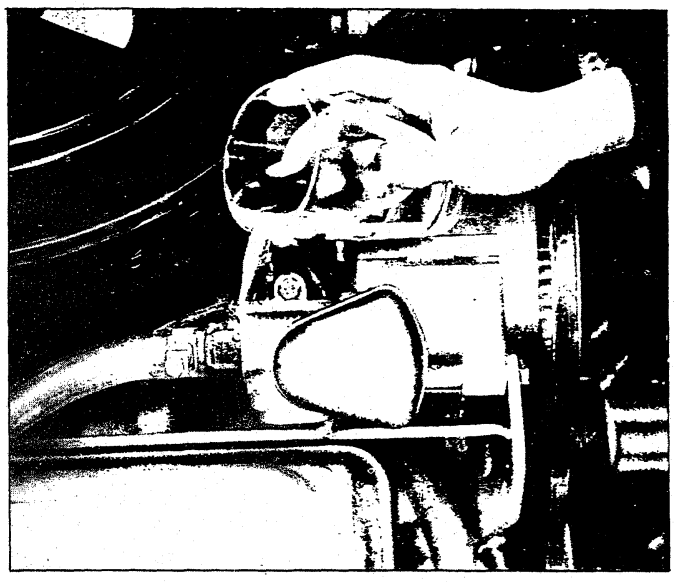


Fig. 10—Checking for Leaks with a Soapy Water Solution

AIR MANIFOLD, HOSE AND TUBE

Inspection

- Inspect all hoses for deterioration or holes.
- Inspect all tubes for cracks or holes.
- Check all hose and tube connections.
- Check all tube and hose routing. Interference may cause wear.
- If leak is suspected on the pressure side of the system or any tubes and/or hoses have been disconnected on the pressure side, the connections should be checked for leaks with a soapy water solution. With the pump running, bubbles will form if a leak exists (fig. 10).

Replacement

- To replace any hose and/or tube, note routing then remove hose(s) and/or tube(s) as required.

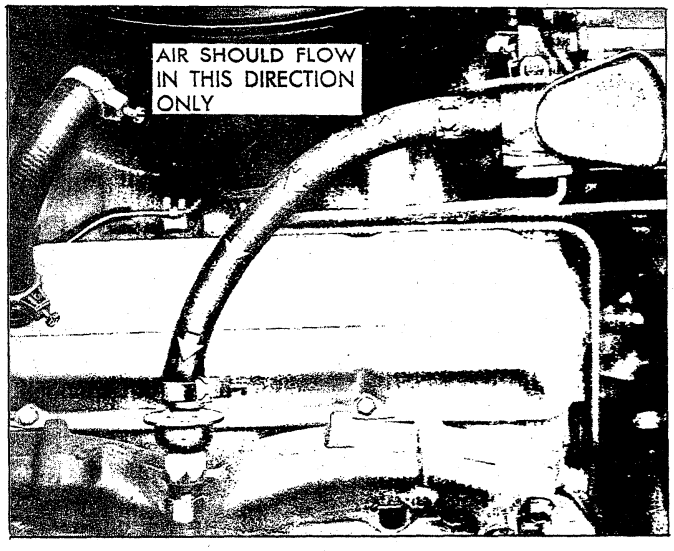


Fig. 11—Air Flow Through Check Valve

CAUTION: The 1/4" pipe threads at the cylinder head (In Line) or exhaust manifold (V8) are a straight pipe thread. Do not use a .1/4" tapered pipe tap. The hoses of the A.I.R. System are a special material to withstand high temperature. No other type hose should be substituted.

- Install new hose(s) and/or tube(s), routing them as when removed.
- Tighten all connections.

NOTE: Use anti seize compound on threads of the air manifold to exhaust manifold or cylinder head connections.

CHECK VALVE

Inspection

- The check valve should be inspected whenever the hose is disconnected from the check valve or whenever check valve failure is suspected. (A pump that had become inoperative and had shown indications of having exhaust gases in the pump would indicate check valve failure.)
- Orally blow through the check valve (toward air manifold) then attempt to suck back through check valve. Flow should only be in one direction (toward the air manifold) (fig. 11).

Replacement

- Disconnect pump outlet hose at check valve. Remove check valve from air manifold, being careful not to bend or twist air manifold (fig. 12).

DIVERTER VALVE

Inspection

- Check condition and routing of all lines especially the signal line. All lines must be secure, without crimps and not leaking.
- Disconnect signal line at valve. A vacuum signal must be available with engine running (fig. 13).

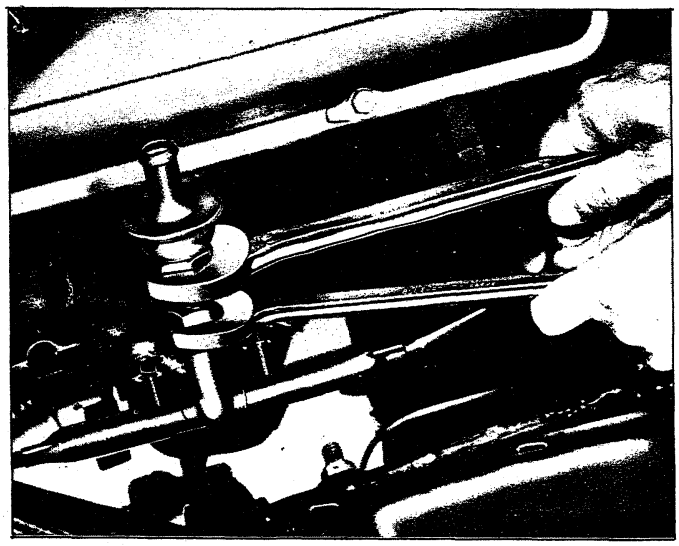


Fig. 12—Removing Check Valve

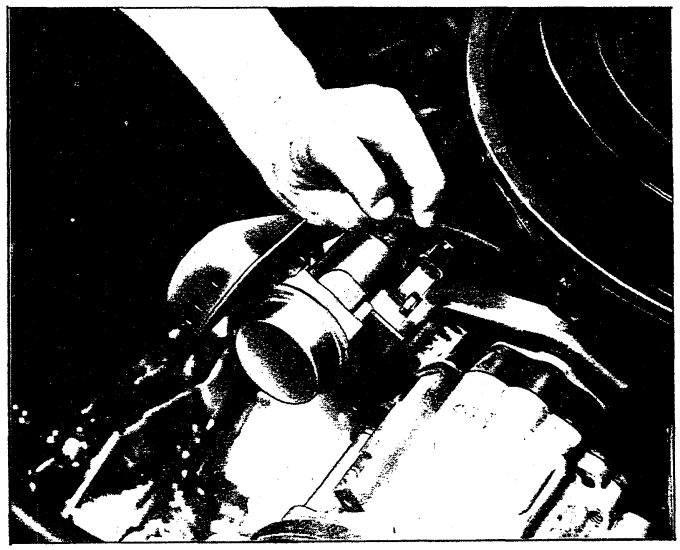


Fig. 13—Checking for Vacuum Signal at Diverter Valve

- With engine stabilized at idle speed, no air should be escaping through the muffler. Manually open and quickly close the throttle, a momentary blast of air should discharge through muffler for at least one second (fig. 14).
- Defective valves should be replaced.

CAUTION: Diverter valves although sometimes similar in appearance are designed to meet particular requirements of various engines, therefore, be sure to install the correct valve.

Replacement

- Disconnect vacuum signal line. Disconnect valve exhaust hose(s).
- Remove diverter valve from pump or elbow.
- Install diverter valve to pump or elbow with new

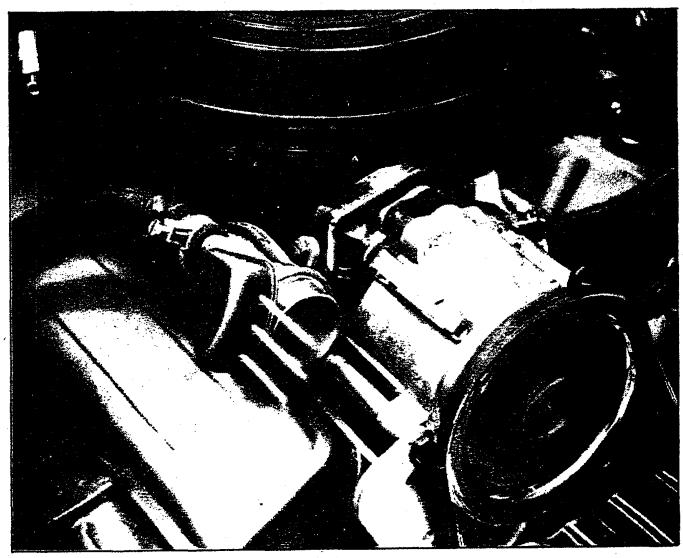


Fig. 14—Momentary Blast of Air Through Diverter Valve During Engine Over-Run

gasket. Torque valve attaching screws to 85 in. lbs.
- Install outlet and vacuum signal lines and check system for leaks.

AIR INJECTION TUBE

Inspection (Fig. 15)

- There is no periodic service or inspection for the air injection tubes, yet on In Line engines whenever the cylinder head is removed or on V8 engines whenever the exhaust manifolds are removed, inspect the air injection tubes for carbon build up and warped or burnt tubes.
- Remove any carbon build up with a wire brush.
- Warped or burnt tubes must be replaced.

Replacement

- On In Line engines remove carbon from tubes and using penetrating oil, work tubes out of cylinder head.
- On V8 engines clamp exhaust manifold in a vise, remove carbon from tubes and using penetrating oil, work tubes out of manifold.
- Install new tubes in cylinder head or manifold.

AIR INJECTION PUMP

Inspection

Accelerate engine to approximately 1500 RPM and observe air flow from hose(s). If air flow increases as engine is accelerated, pump is operating satisfactorily. If air flow does not increase or is not present, proceed as follows:

- Check for proper drive belt tension.
- Check for a leaky pressure relief valve. Air may be heard leaking with the pump running.

NOTE: The A.I.R. System is not completely noiseless. Under normal conditions noise rises in pitch as engine speed increases. To determine if excessive noise is the fault of the Air Injection Reactor System, operate the engine with the pump drive belt removed. If excessive noise does not exist with the belt removed proceed as follows:

- Check for a seized Air Injection Pump.
- Check hoses, tubes, air manifolds and all connections for leaks and proper routing.
- Check air injection pump for proper mounting.

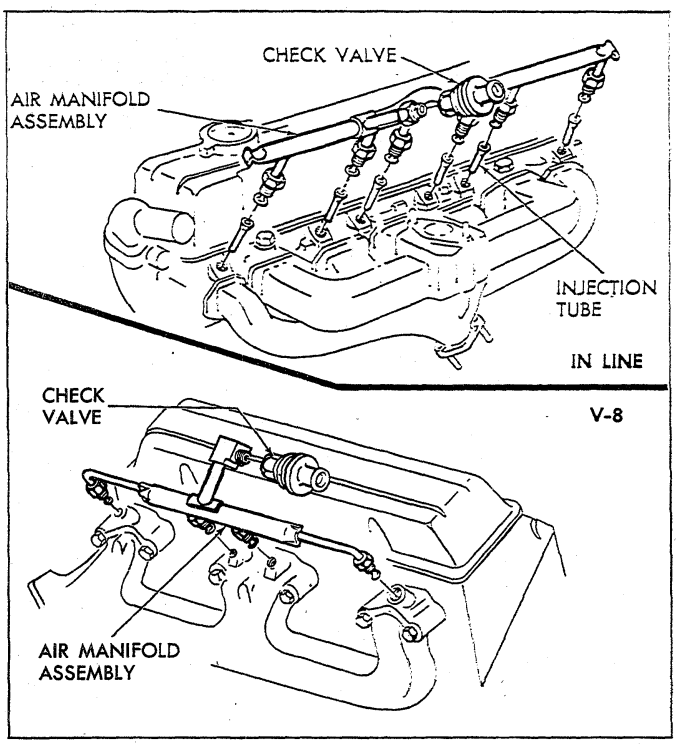


Fig. 15—Air Injection Tubes (Typical)

- If none of the above conditions exist and the air injection pump has excessive noise remove and replace pump unit.

Replacement

- Disconnect the hoses at the pump.
- Remove pump pulley as outlined.
- Remove pump mounting bolts and remove pump.
- Install pump with mounting bolts loose.
- Install pump pulley as outlined.
- Install and adjust belt as outlined
- Connect the hoses at the pump.
- Tighten mounting bolts securely.

Pressure Relief Valve Replacement

NOTE: The pressure relief valve is incorporated in the diverter valve. The complete unit must be replaced to correct a malfunction of the relief valve.

SECTION 6Y
ENGINE ELECTRICAL
CONTENTS OF THIS SECTION

	Page		Page
Battery	6Y-1	Ignition System	6Y-19
Charging System - 1D Series Delcotron	6Y-7	Starting System	6Y-31
Charging System - 10SI Series Delcotron	6Y-15	Special Tools	6Y-33

BATTERY
INDEX

	Page		Page
General Description	6Y-1	Charging Procedures	6Y-4
Periodic Service	6Y-2	Slow Charging	6Y-4
Common Causes of Failure	6Y-2	Fast Charging	6Y-4
Level Indicator	6Y-2	Emergency Boost Charging	6Y-4
Electrolyte Level	6Y-3	Test Procedures	6Y-4
Water Usage	6Y-3	Visual Inspection	6Y-4
Cleaning	6Y-3	Instrument	6Y-4
Cables	6Y-3	Full Charge Hydrometer Test	6Y-5
Carrier and Holddown	6Y-3	Specific Gravity Readings	6Y-5
Safety Precautions	6Y-3	Installing Battery	6Y-5

GENERAL DESCRIPTION

The battery (fig. 1b) is made up of a number of separate elements, each located in an individual cell in a hard rubber case. Each element consists of an assembly of positive plates and negative plates containing dissimilar active materials and kept apart by separators. The elements are immersed in an electrolyte composed of dilute sulfuric acid. Plate straps located on the top of each element connect all the positive plates and all the negative plates into groups. The elements are connected in series electrically by connectors that pass directly through the case partitions between cells. The battery top is a one-piece cover of hard rubber construction. The cell connectors, by-passing through the cell partitions, connect the elements along the shortest practical path (fig. 2b).

With the length of the electrical circuit inside the Battery reduced to a minimum, the internal voltage drop is decreased resulting in improved performance, particularly during engine cranking at low temperatures.

The hard, smooth one-piece cover greatly reduces the tendency for corrosion to form on the top of the battery. The cover is bonded to the case with sealing compound that forms an air tight seal between the cover and case.

Protection for the Battery charging circuit (10 gauge wire) is provided by a pigtail lead which is a fusible link off the battery positive cable (14 gauge wire). This lead is an integral part of the Battery cable assembly and servicing requires replacing the complete cable assembly.

A battery generally has two classifications of ratings: (1) a 20 hour rating at 80 F and, (2) a cold rating at 0 F

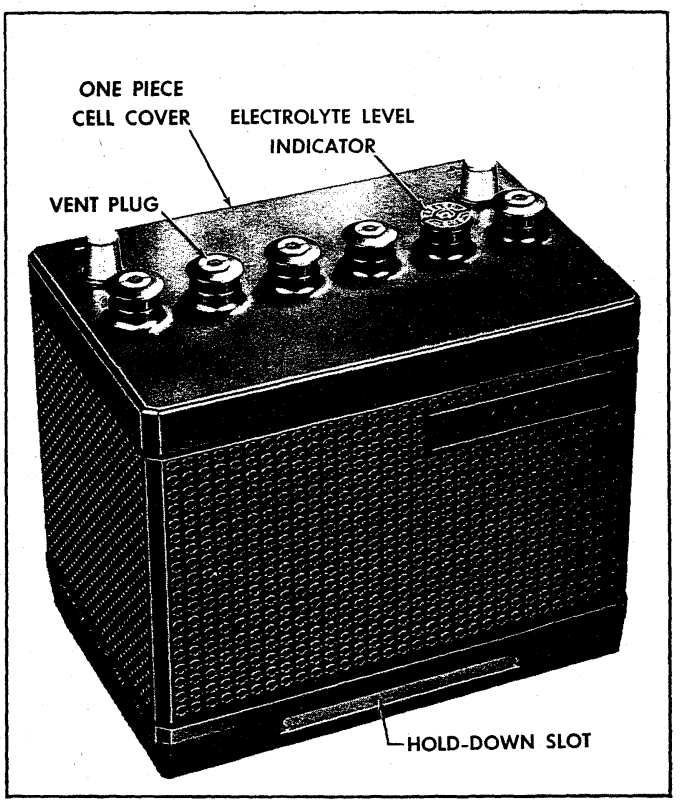


Fig. 1b—Energizer

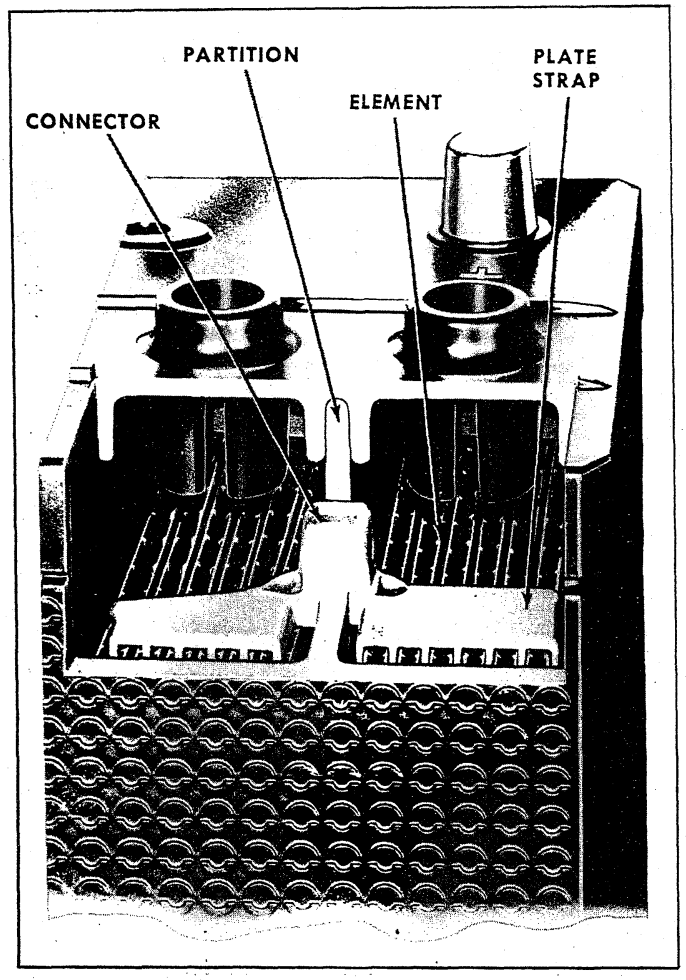


Fig. 2b—Internal View of Energizer

which indicates the cranking load capacity. The Ampere-Hour rating found on batteries was based on the 20 hour rating. That is, a battery capable of furnishing three (3) amperes for 20 hours while maintaining a specified average individual cell voltage would be classified as a 60 ampere hour battery (e.g. 3 amperes x 20 hours = 60 A.H.) a PWR (Peak Watt Rating) has been developed as a measure of the Energizer's cold cranking ability. The numerical rating is embossed on each case at the base of the Energizer. This value is determined by multiplying the max. current by the max. voltage. The PWR should not be confused with the ampere hour rating since two batteries with the same ampere hour rating can have quite different watt ratings. For battery replacement, a unit of at least equal power rating must be selected.

PERIODIC SERVICING

Since the Battery is a perishable item which requires periodic servicing, a good maintenance program will insure the longest possible Battery life.

COMMON CAUSES OF FAILURE

If the Battery tests good but fails to perform satisfactorily in service for no apparent reason, the following are some of the more important factors that may point to the cause of the trouble.

1. Vehicle accessories inadvertently left on overnight to cause a discharge condition.
2. Slow speed driving of short duration, to cause an undercharged condition.
3. A vehicle electrical load exceeding the generator capacity.
4. Defect in the charging system such as high resistance, slipping fan belt, faulty generator or voltage regulator.
5. Battery abuse, including failure to keep the Battery top clean, cable clamps and posts clean and tight, and improper addition of water to the cells.

LEVEL INDICATOR

The Battery features an electrolyte level indicator, which is a specially designed vent plug with a transparent rod extending through the center (fig. 3b). When the electrolyte is at the proper level, the lower tip of the rod is immersed, and the exposed top of the rod will appear very dark; when the level falls below the tip of the rod, the top will glow.

The indicator reveals at a glance if water is needed, without the necessity of removing the vent plugs (fig. 4b).

The Level Indicator is used in only one cell (second cell cap from positive Battery post) because when the electrolyte level is low in one cell, it is normally low in all cells. Thus when the indicator shows water is needed, check the level in all six cells.

An alternate method of checking the electrolyte level is to remove the vent plug and visually observe the electrolyte level in the vent well. The bottom of the vent well features a split vent which will cause the surface of the electrolyte to appear distorted when it makes contact. The electrolyte level is correct when the distortion first appears at the bottom of the split vent (fig. 5b).

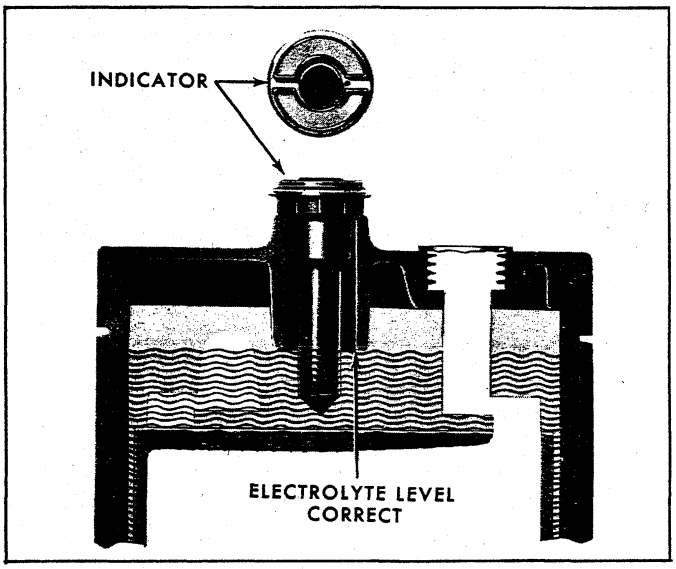


Fig. 3b—Electrolyte at Proper Level

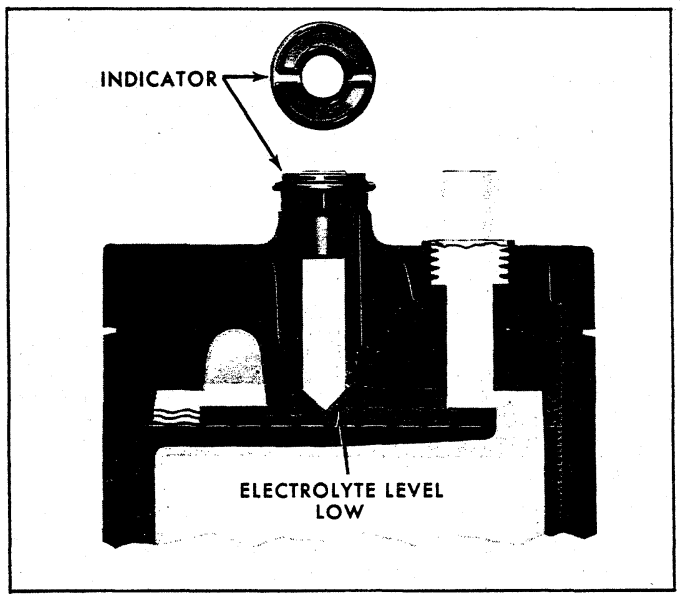


Fig. 4b—Electrolyte at Low Level

ELECTROLYTE LEVEL

The electrolyte level in the Battery should be checked regularly. In hot weather, particularly during trip driving, checking should be more frequent because of more rapid loss of water. If the electrolyte level is found to be low, then colorless, odorless, drinking water should be added to each cell until the liquid level rises to the split vent located in the bottom of the vent well. DO NOT OVERFILL because this will cause loss of electrolyte resulting in poor performance, short life, and excessive corrosion.

CAUTION: During service only water should be added to the Battery, not electrolyte.

The liquid level in the cells should never be allowed to drop below the top of the plates, as the portion of the plates exposed to air may be permanently damaged with a resulting loss in performance.

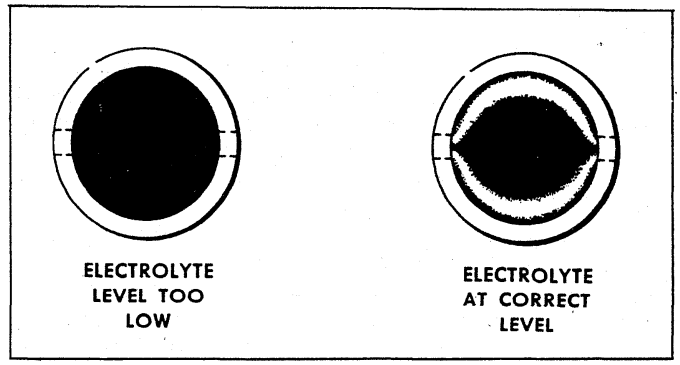


Fig. 5b—View Inside Vent Well

WATER USAGE

Excessive usage of water indicates the Battery is being overcharged. The most common causes of overcharge are high Battery operating temperatures, too high a voltage regulator setting, poor regulator ground wire connection. Normal Battery water usage is approximately one to two ounces per month per battery.

CLEANING

The external condition of the Battery should be checked periodically for damage or for the presence of dirt and corrosion. The top of the Battery should be kept clean. An accumulation of acid film and dirt may permit current to flow between the terminals, which will slowly discharge the Battery. For best results when cleaning the top of Batteries, wash first with a diluted ammonia or a soda solution to neutralize any acid present; then flush with clean water. Care must be taken to keep vent plugs tight, so that the neutralizing solution does not enter the cells.

CABLES

To insure good electrical contact, the cables should be clean and tight on the Energizer posts. If the posts or cable terminals are corroded, the cables should be disconnected and the terminals and clamps cleaned separately with a soda solution and a wire brush. After cleaning and installing clamps, apply a thin coating of petroleum jelly on the cable clamps to retard corrosion.

CARRIER AND HOLD-DOWN

The Battery carrier and hold-down should be clean and free from corrosion before installing the Battery. The carrier should be in a sound mechanical condition so that it will support the Battery securely and keep it level.

To prevent the Battery from shaking in its carrier, the hold-down bolts should be tight (60-80 in. lbs.). However, the bolts should not be tightened to the point where the Battery case or cover will be placed under a severe strain.

BATTERY SAFETY PRECAUTIONS

When Batteries are being charged, an explosive gas mixture forms in each cell. Part of this gas escapes

through the holes in the vent plugs and may form an explosive atmosphere around the Battery itself if ventilation is poor. This explosive gas may remain in or around the Battery for several hours after it has been charged. Sparks or flames can ignite this gas causing an internal explosion which may shatter the Battery.

The following precautions should be observed to prevent an explosion:

1. Do not smoke near Batteries being charged or which have been very recently charged.
2. Do not break live circuits at the terminals of Batteries because a spark usually occurs at the point where a live circuit is broken. Care must always be taken when connecting or disconnecting booster leads or cable clamps on fast chargers. Poor connections are a common cause of electrical arcs which cause explosions.

BATTERY CHARGING PROCEDURES

There are three methods of recharging Batteries. They differ basically in the length of time the battery is charged and the rate at which charging current is supplied. One is the Slow Charge method, the second is the Fast Charge method, and the third is the Emergency Boost Charge method.

Before recharging a Battery by any method, the electrolyte level must be checked and adjusted if necessary.

SLOW CHARGING

The Slow Charge method supplies the Battery with a relatively low current flow for a relatively long period of time. This is the only method that will bring the Battery to a full state of charge.

The Slow Charge method consists of charging at approximately a 4 ampere rate for 24 hours or more if necessary to bring the Battery to full charge. A fully charged condition is reached when the cells are gassing freely and three corrected specific gravity readings taken at hourly intervals show no increase.

FAST CHARGING

The Fast Charge method supplies current to the Battery at a 40 to 50 ampere rate for a 1-1/2 hour period of time. If the electrolyte temperature reaches 125°F before the 1-1/2 hour period is completed, the Battery must be taken off charge temporarily, or the charging rate reduced to avoid damage to the Battery.

Although a Battery cannot be brought to a fully charged condition during Fast Charge, it can be substantially recharged or "boosted". In order to bring the Battery to a fully charged condition, the charging cycle must be finished by the Slow Charge method.

EMERGENCY BOOST CHARGING

In cases where the Battery is not sufficiently charged to crank the engine, an emergency boost charge may be applied as a temporary expedient in order to crank the engine. The Emergency Boost Charge method consists of charging at a 40 to 50 ampere rate for a period of one-half hour.

It should be particularly noted that the Emergency Boost Charge will not necessarily restore the Battery to a useful state of charge for continued service. After an emergency boost charge, failure to charge the Battery further, either by a long uninterrupted driving period or by the Fast Charge or Slow Charge method, may result in failure to crank the engine the next time cranking is attempted. A Battery should never be condemned on the basis of failure to crank the engine after an emergency boost charge. Although an emergency boost charge may put enough energy into the Battery to crank the engine once, further charging usually is necessary in order to create a sufficient reserve to crank a second and third time.

12 VOLT BATTERY SUGGESTED CHARGING RATES

(100 Amp-hr or Less Capacity)

TYPE OF CHARGE	LENGTH OF TIME	CHARGING RATE
Boost Charge for Light Load Test	20 Minutes	50 Amps
Slow Charge	24 Hours	4 Amps
Fast Charge	1-1/2 Hours	40-50 Amps
Quick Boost	30 Minutes	40-50 Amps
Dry Charge Warm-up Boost	10 Minutes	15 Amps

BATTERY TESTING PROCEDURES

Testing procedures are used to determine whether the Battery is (1) good and usable, (2) requires recharging or (3) should be replaced. Analysis of Battery conditions can be accomplished by performing a visual inspection, Instrument Test and the full charge hydrometer test.

1. VISUAL INSPECTION

The first step in testing the Battery should be a visual inspection, which very often will save time and expense in determining Battery condition.

- Check the outside of the Battery for a broken or cracked case or a broken or cracked cover. If any damage is evident, the Battery should be replaced.
- Note the electrolyte level. Levels that are too low or too high may cause poor performance, as covered in the section entitled "Periodic Servicing".
- Check for loose cable connections, and for evidence of corrosion as covered in section entitled "Periodic Servicing". Correct as required before proceeding with tests.

2. INSTRUMENT TEST

A number of suppliers have approved testing equipment available. These testers have a programmed test procedure consisting of a series of timed discharge and charge events, requiring approximately 2 to 3 minutes, that will determine the condition of the Battery with a high degree of accuracy. When using these testers, the procedure recommended by the tester manufacturer

should be followed. Batteries should not be charged prior to testing as doing so may alter the test results. If a tester is not available for testing, the "Specific Gravity Cell Comparison Test" may be used or an alternate method, but with a sacrifice in testing accuracy.

NOTE: New energizers which have become completely discharged over a relatively long period of time, such as during vehicle storage, should be tested by the hydrometer method. Energizers discharged to this degree cannot be accurately tested using equipment requiring load capability comparison tests.

3. FULL CHARGE HYDROMETER TEST

This test should be used only on Batteries which test good with testing equipment or "Specific Gravity Cell Comparison Test" but which subsequently fail in service.

- Remove the Battery from the vehicle, and adjust the electrolyte level as necessary, by adding colorless, odorless, drinking water.
- Fully charge the Battery at the Slow Charging rate as covered in the section entitled "Battery Charging".
- Measure the specific gravity of the electrolyte in each cell and interpret as follows:

  Hydrometer Reading Less Than 1.230—Full charge hydrometer readings less than 1.230 corrected for temperature indicate the Battery is defective and should be replaced.

  Hydrometer Readings Above 1.310—Full charge hydrometer readings above 1.310 corrected for temperature indicate that the cells have been improperly filled (activation) or improperly serviced. Poor service and short Battery life will result.

SPECIFIC GRAVITY READINGS

A hydrometer can be used to measure the specific gravity of the electrolyte in each cell.

The hydrometer measures the percentage of sulphuric acid in the battery electrolyte in terms of specific gravity. As a battery drops from a charged to a discharged condition, the acid leaves the solution and enters the plates, causing a decrease in specific gravity of electrolyte. An indication of the concentration of the electrolyte is obtained with a hydrometer.

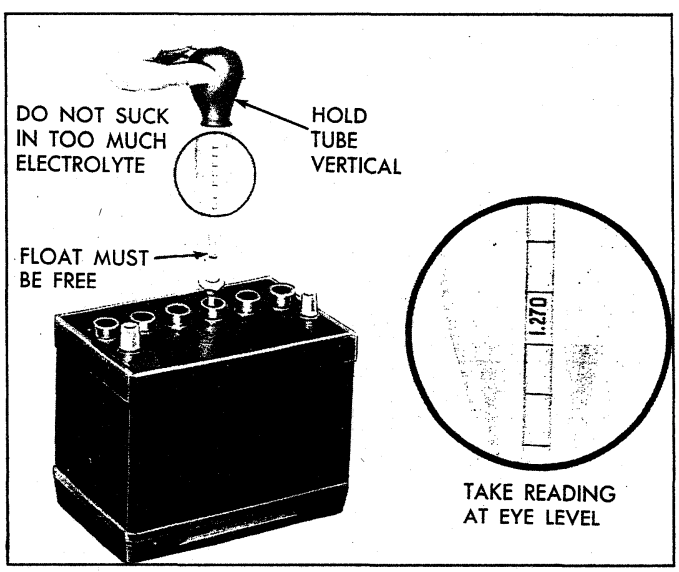


Fig. 6b—Checking Specific Gravity

When using a hydrometer, observe the following points:

1. Hydrometer must be clean, inside and out, to insure an accurate reading.
2. Hydrometer readings must never be taken immediately after water has been added. The water must be thoroughly mixed with the electrolyte by charging for at least 15 minutes at a rate high enough to cause vigorous gassing.
3. If hydrometer has built-in thermometer, draw liquid into it several times to insure correct temperature before taking reading.
4. Hold hydrometer vertically and draw in just enough liquid from battery cell so that float is free floating. Hold hydrometer at eye level so that float is vertical and free of outer tube, then take reading at surface of liquid. Disregard the curvature where the liquid rises against float stem due to surface tension.
5. Avoid dropping battery fluid on car or clothing as it is extremely corrosive. Any fluid that drops should be washed off immediately with baking soda solution.

The specific gravity of the electrolyte varies not only with the percentage of acid in the liquid but also with temperature. As temperature increases, the electrolyte expands so that the specific gravity is reduced. As temperature drops, the electrolyte contracts so that the specific gravity increases. Unless these variations in specific gravity are taken into account, the specific gravity obtained by the hydrometer may not give a true indication of the concentration of acid in the electrolyte.

A fully charged Battery will have a specific gravity reading of approximately 1.270 at an electrolyte temperature of 80°F. If the electrolyte temperature is above or below 80°F, additions or subtractions must be made in order to obtain a hydrometer reading corrected to the 80°F standard. For every 10° above 80°F, add four specific gravity points (.004) to the hydrometer reading. Example: A hydrometer reading of 1.260 at 110°F would be 1.272 corrected to 80°F, indicating a fully charged Battery. For every 10° below 80°F, subtract four points (.004) from the reading. Example: A hydrometer reading of 1.272 at 0°F would be 1.240 corrected to 80°F, indicating a partially charged Battery.

Specific Gravity Cell Comparison Test—This test may be used when an instrumental tester is not available. To perform this test measure the specific gravity of each cell, regardless of state of charge, and interpret the results as follows:

- If specific gravity readings show a difference between the highest and lowest cell of .050 (50 points) or more, the Battery is defective and should be replaced.

INSTALLING BATTERIES

To install a Battery properly, it is important to observe the following precautions:

- Connect grounded terminal of Battery last to avoid short circuits which may damage the electrical system.
- Be sure there are not foreign objects in the carrier, so that the new Battery will rest properly in the bottom of the carrier.

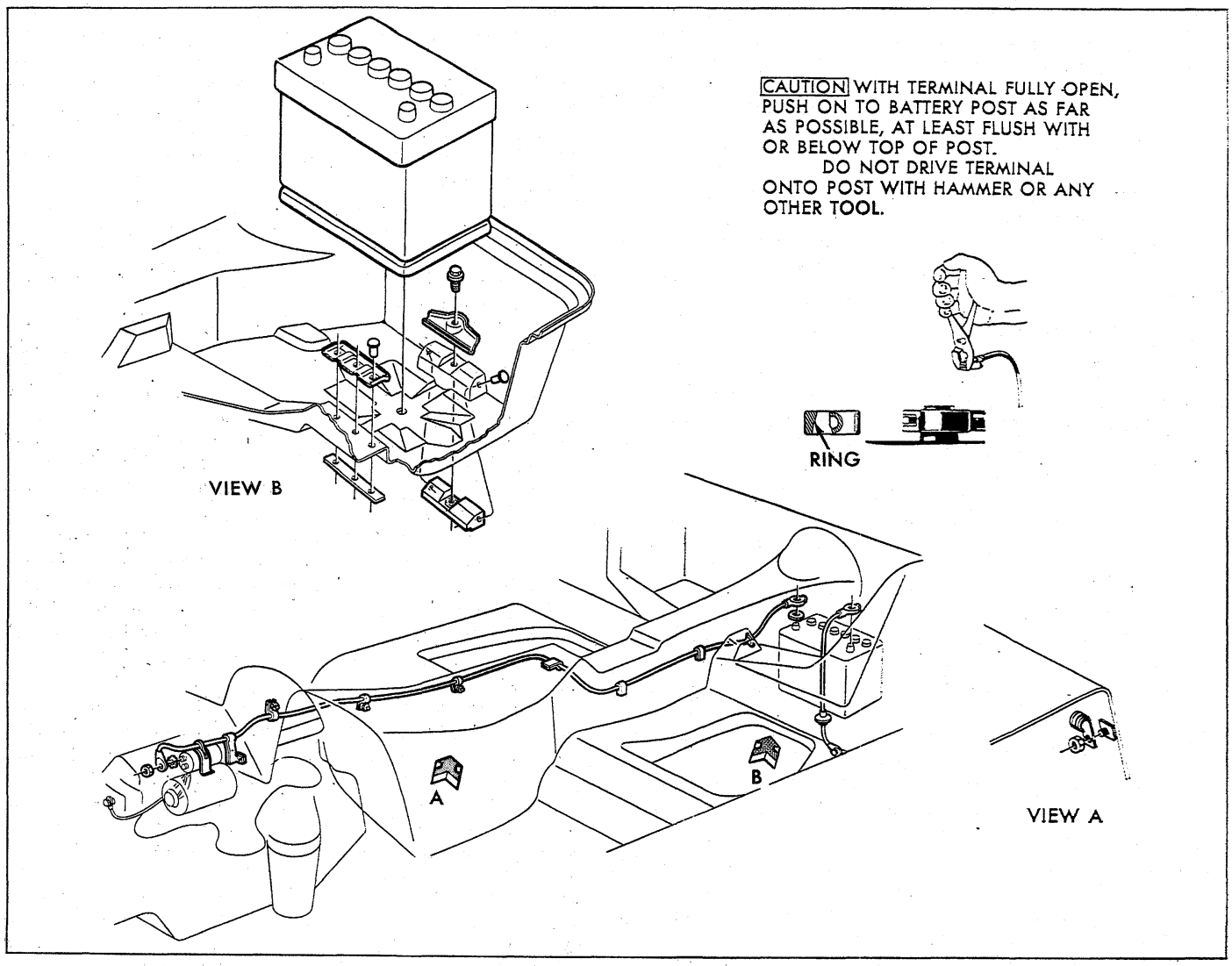


Fig. 7b—Battery Installation

- Tighten the hold-down evenly until snug (60-80 in. lbs.). Do not draw down tight enough to distort or crack the case or cover.
- Be sure the cables are in good condition and the terminal clamps are clean and tight. Make sure the ground cable is clean and tight at engine block or frame.
- Check polarity to be sure the Battery is not reversed with respect to the generating system.
- Oil the battery terminal felt washer.
- Do not drive cable terminals onto post with hammer or other tools.

REPLACEMENT (Fig. 7b)

1. Disconnect Battery negative and positive cables.
2. Disconnect Battery vent covers from vent plugs (Corvette).
3. Remove Battery hold-down clamp bolt and clamp.
4. Remove Battery from tray and transfer vent cover to replacement Battery (Corvette).
5. Position new Battery, which has been properly activated, in the Battery tray.
6. Install Battery clamp and bolt.

   NOTE: Recommended hold-down bolt torque is 60-80 lbs.

7. Connect Battery vent covers to vent plugs (Corvette).
8. Connect Battery positive and negative cables.

CAUTION: To insure good contact the Battery cables should be tight on the Battery posts. Oil the Battery terminal felt washer. If the Battery posts or cable terminals are corroded, the cables should be cleaned separately with a soda solution and a wire brush. Do not file, ream or otherwise remove ridge from inside clamp. It is required to insure good "pushing" contact with the post. After cleaning and installing clamps, apply a thin coating of petrolatum to the posts and cable clamps to help retard corrosion. See Figure 7b for correct installation of cable terminal clamps. Cable terminals should not be open beyond position shown or permanent set and loose connections will result.

CHARGING SYSTEMS
5.5" SERIES 1D DELCOTRON SYSTEM
INDEX

	Page
General Description	6Y-7
Maintenance and Adjustments	6Y-8
Static Checks	6Y-9
System Condition Test	6Y-9
Adjusting Regulator Voltage	6Y-9
Delcotron Output Test	6Y-10
Delcotron Diode and Field Test	6Y-10
Indicator Lamp-Initial Field Excitation Circuit Tests	6Y-11
Field Circuit Resistance Wire Checks	6Y-12
Field Relay Checks and Adjustment	6Y-12
Other Harness Checks	6Y-13
Service Operations	6Y-13
Generator	6Y-13
Removal and Installation	6Y-13
Pulley Replacement	6Y-13
Double Contact Regulator	6Y-14

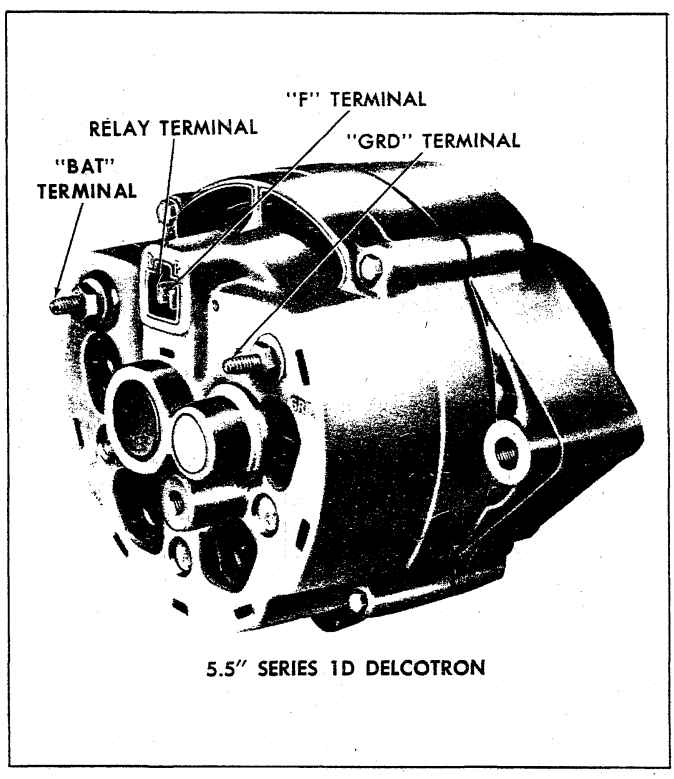
GENERAL DESCRIPTION

The Series 10 Delcotron continuous output A.C. generator (fig. 1c) consists of two major parts, a stator and a rotor. The stator is composed of a large number of windings assembled on the inside of a laminated core that is attached to the generator frame. The rotor revolves within the stator on bearings located in each end frame. Two brushes are required to carry current through the two slip rings to the field coils wound concentric with the shaft of the rotor. Six rectifier diodes are mounted in the slip ring end frame and are joined to the stator windings at three internally located terminals.

Diodes are mounted in heat sinks to provide adequate heat dissipation. The six diodes replace the separately mounted rectifier as used in other types of application. The diodes change the Delcotron A.C. current to D.C. current.

The function of this regulator in the charging system is to limit the generator voltage to a pre-set value by controlling the generator field current. The double contact regulator has an internal field relay unit. The relay unit allows the telltale lamp to light (as a bulb check) with the ignition key on and engine not running. When the engine is started and the generator begins to charge, the indicator light goes out indicating that the system is operating normally.

The double-contact regulator assembly (fig. 2c) consists of a double contact voltage regulator unit and a field relay unit. This unit uses two sets of contact points on



5.5" SERIES 1D DELCOTRON

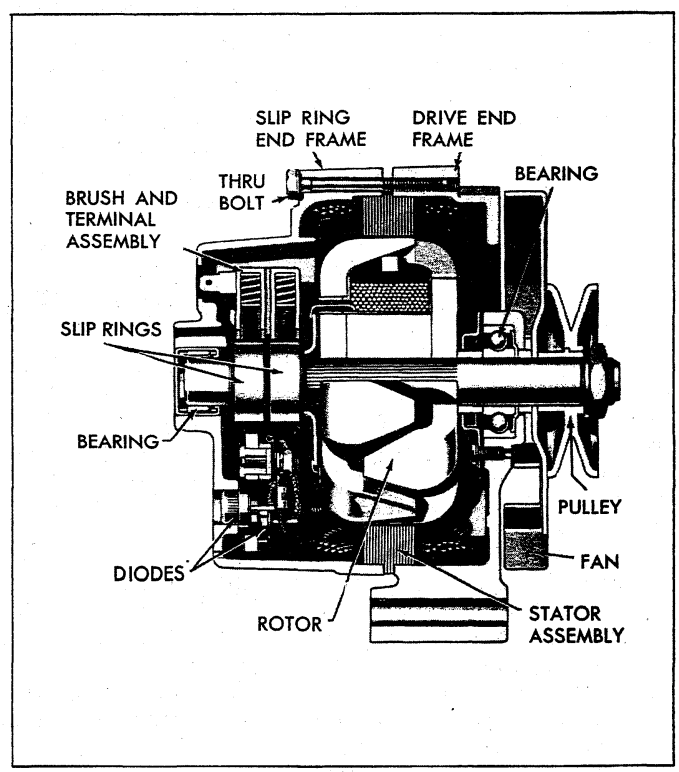


Fig. 1C—5.5" Series 1D Delcotron

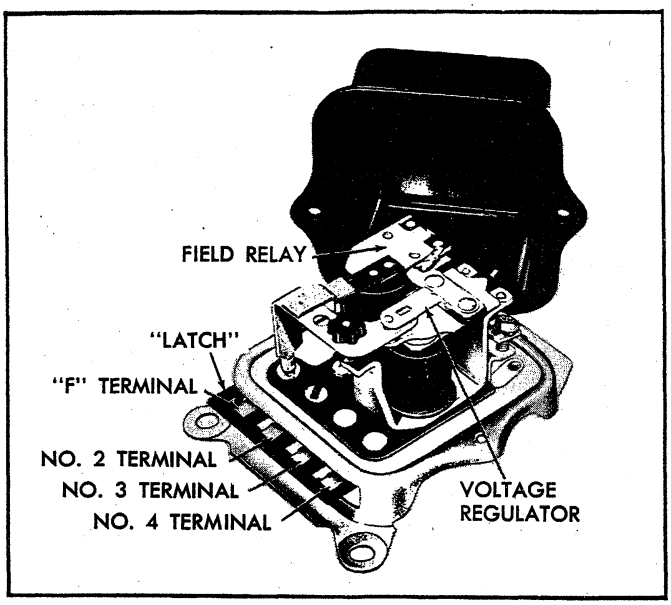


Fig. 2C—Voltage Regulator

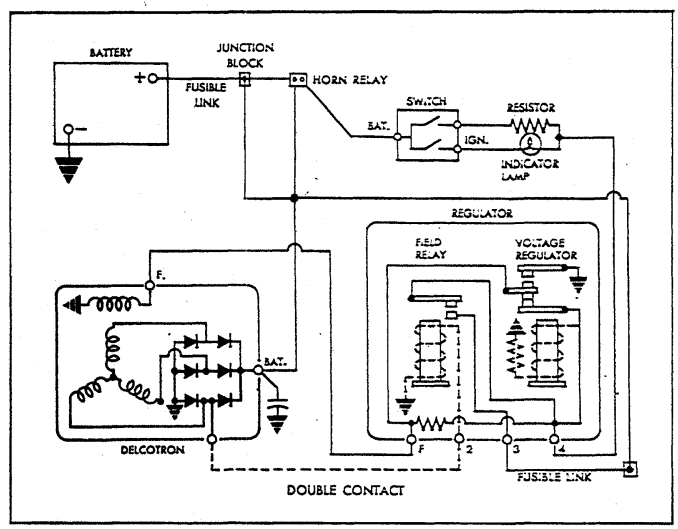


Fig. 3c—Voltage Regulator Circuitry

the voltage regulator unit to obtain desired field excitation under variable conditions. An internal circuit wiring diagram of the double contact regulator is shown in Figure 3c.

Engine compartment wiring harness incorporates several fusible links. Each link is identified with its gauge size. A fusible link is a length of special wire (normally four wire gauges smaller than the circuit it is protecting) used in wiring circuits that are not normally fused, such as the ignition circuit. The same size wire with a hypalon insulation must be used when replacing a fusible link. The links are:

1. The pigtail lead at the battery positive cable (except Corvette) is a 14 gauge, brown fusible link protecting the 10 gauge battery charging circuit. This wire is an integral part of the battery cable assembly and servicing requires replacing the complete battery cable assembly. On Corvette models this link is installed as a molded splice at the solenoid "Bat" terminal and servicing requires splicing in a new link.
2. A 16 gauge black fusible link is located at the horn relay to protect all unfused wiring of 12 gauge or larger. It is installed as a molded splice and servicing requires splicing in a new link.
3. The generator warning light and field circuitry (16 gauge wire) is protected by a fusible link (20 gauge orange wire) used in the "battery feed to voltage regulator #3 terminal" wire. The link is installed as a molded splice in the generator and forward lamp harness and is serviced by splicing in a new 20 gauge wire as required.
4. The ammeter circuit on all models is protected by two orange, 20 gauge wire fusible links installed as molded splices in the circuit at the junction block or the solenoid "Bat" terminal (Corvette only) and at the horn relay. Each link is serviced by splicing in a new 20 gauge wire as required.

MAINTENANCE AND ADJUSTMENTS

At regular intervals, inspect the terminals for corrosion and loose connections, and the wiring for frayed insulation. Check mounting bolts for tightness. Check the drive belt for alignment, proper tension and wear. Because of the higher inertia and load capacity of the rotor used in A.C. generators, PROPER BELT TENSION is more critical than on D.C. generators.

Since the Delcotron and its companion regulator are designed for use on negative polarity systems only, the following precautions must be observed. Failure to observe these precautions may result in serious damage to the charging system.

1. When installing a battery, always make absolutely sure the ground polarity of the battery, generator and regulator is the same.
2. When connecting a booster battery, make certain to connect the correct battery terminals together.
3. When connecting a charger to the battery, connect the correct charger leads to the battery terminals.
4. Never operate the generator on an uncontrolled open circuit. Make absolutely certain all connections in the circuit are secure.
5. Do not short across or ground any of the terminals on the generator or regulator.
6. Do not attempt to polarize the generator.
7. Do not disconnect lead at generator without first disconnecting battery ground cable.

Trouble in the A.C. charging system (Fig. 4c) will usually be indicated by one or more of the following conditions:

1. Faulty indicator lamp or ammeter operation.
2. An undercharged battery (usually evidenced by slow cranking speeds).

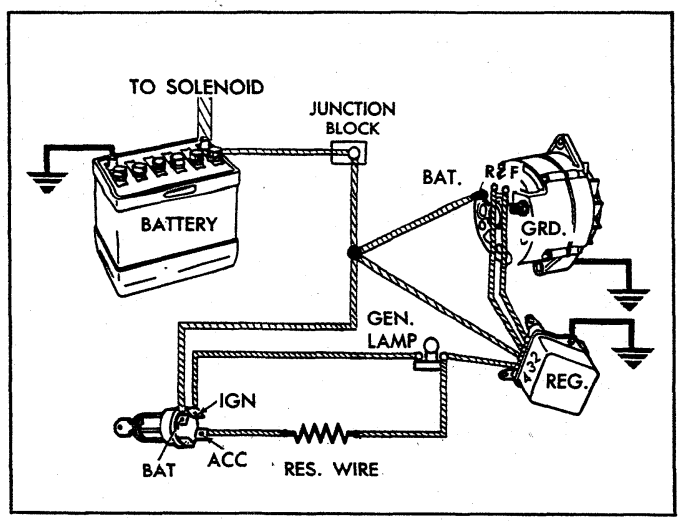


Fig. 4c—Typical Wiring Diagram

3. An overcharged battery (usually evidenced by excessive battery water usage).
4. Excessive generator noise or vibration.

STATIC CHECKS

Before making any electrical checks, perform the following static checks:

1. Check for loose fan belt.
2. Check for defective battery. (Refer to Battery.)
3. Inspect all connections, including the slip-on connectors at the regulator and Delcotron.

NOTE: Do not short field to ground to check if generator is charging since this will seriously damage the charging system.

CHARGING SYSTEM CHECKS (ALL EXCEPT CORVETTE)

SYSTEM CONDITION TEST

This test is used to indicate the overall condition of the charging system (both good and defective) and to isolate the malfunctioning unit if the system is defective.

1. With ignition off, perform the prescribed Static Checks outlined in this section. Then set hand brake and shift transmission into neutral.
2. Connect a voltmeter from junction block relay to ground at regulator base.

CAUTION: Be sure meter clip does not touch a resistor or terminal extension under regulator.

3. Connect a tachometer on engine.
4. Models equipped with indicator Lamp: Turn ignition switch on "ON" position and check indicator lamp. If lamp fails to glow, perform appropriate tests and corrections (Indicator Lamp Circuit Tests) before continuing.

   Models equipped with Ammeter: Turn ignition switch to "ACC" with an accessory on and check ammeter. If ammeter fails to read discharge, check ammeter circuit before continuing.
5. Models equipped with Indicator Lamp: If lamp glows, start the engine and run it at 1500 rpm or above. Check indicator lamp. If lamp fails to go out, perform appropriate test and corrections (Indicator Lamp Circuit Test) before continuing.

   Models equipped with Ammeter: If ammeter reads discharge, start the engine and observe ammeter. If meter fails to move toward charge (from original position), perform appropriate test and corrections (Field Circuit Tests) before continuing.

   NOTE: At this point a field circuit has been established and any other problem will lie in generator or regulator.
6. Turn on high-beam headlights and heater blower motor to high speed, run engine at or above 1500 rpm (for a few minutes, if necessary) and read the voltage on meter.

   NOTE: Voltage will not greatly exceed 12-1/2 volts until the battery develops a surface charge, a few minutes generally, unless the battery is severely discharged or is hot.

   If reading is:
   a. 12-1/2 volts or more, turn off electrical loads, stop engine and proceed to Step 7.
   b. Less than 12-1/2 volts, perform "Delcotron Output Test—Ammeter Method."
      (1) Delcotron tests bad—remove and repair Delcotron, then repeat Step 6.
      (2) Delcotron tests good - disconnect regulator connector, remove regulator cover and reconnect the connector. Then repeat Step 6 and turn voltage adjusting screw (fig. 5c) to raise setting to 12-1/2 volts. Turn off loads, stop engine and proceed to Step 7. If 12-1/2 volts cannot be obtained, install a new regulator and repeat Step 6.

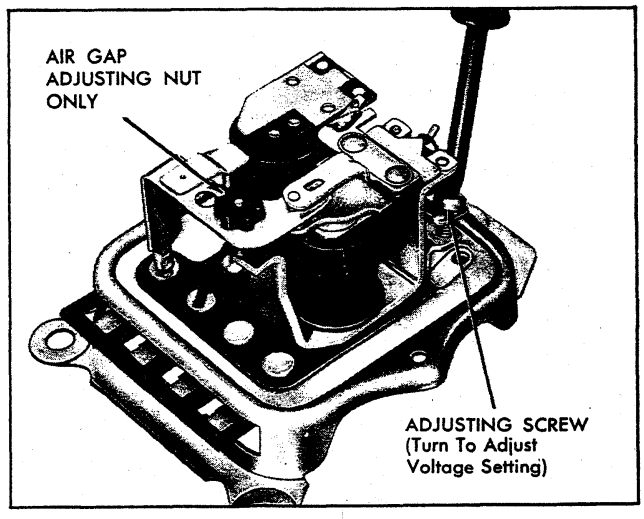


Fig. 5c—Adjusting Voltage Setting

Adjusting Regulator Voltage

7. Connect a 1/4 ohm-25 watt fixed resistor (purchased commercially) into the charging circuit at the junction block as shown in Figure 6c.

   NOTE: Between both leads and the terminal.

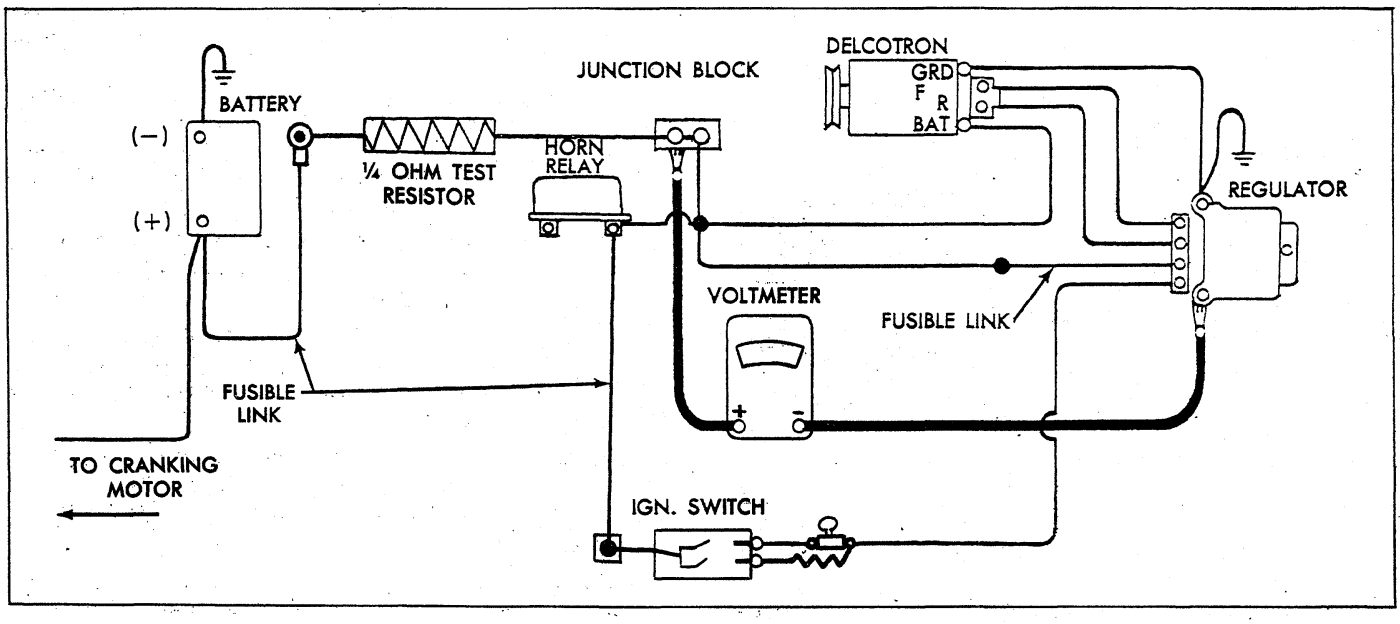


Fig. 6c—Voltage Setting Test Connections

8. Run engine at 1500 rpm or above for at least 15 minutes of warm-up, then cycle regulator voltage control (by disconnecting and re-connecting regulator connector) and read voltage.

   If voltage is 13.5 to 15.2 the regulator is okay.

   If voltage is not within 13.5 to 15.2 volts, leave engine running at 1500 rpm or above and:

   a. Disconnect four terminal connector and remove regulator cover. Then re-connect four terminal connector and adjust voltage to 14.2 to 14.6. (Refer to Step 6 and fig. 5c.)
   b. Disconnect four terminal connector and reinstall regulator cover, then reinstall connector.
   c. Continue running engine at 1500 rpm for 5-10 minutes to re-establish regulator internal temperature.
   d. Cycle regulator voltage by disconnecting and re-connecting regulator connector. Read voltage. A reading between 13.5 and 15.2 indicates a good regulator.

CAUTION: Be sure four terminal regulator connector is disconnected when removing or installing cover. This is to prevent regulator damage by short circuits.

DELCOTRON OUTPUT TEST

Ammeter Method ((Fig. 7c)

1. Disconnect the battery ground cable at the battery.
2. Disconnect the red wire at Delcotron battery terminal and connect an ammmeter in series between the wire and terminal.
3. Connect a voltmeter from battery terminal to a good ground on the generator.
4. Disconnect the F-R terminal connector at the Delcotron.
5. Connect the jumper wire between Delcotron "F" and battery terminals.
6. Connect the battery ground cables at the battery.

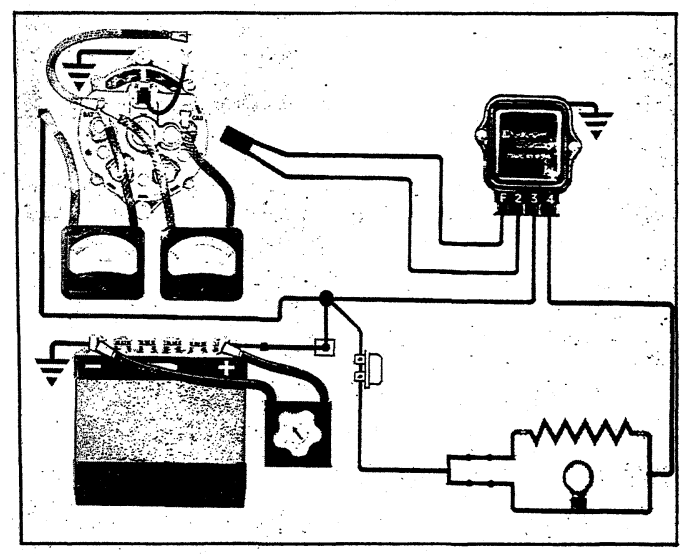


Fig. 7c—Ammeter Method Test Connections

7. Connect an adjustable carbon pile across the battery posts.
8. Start the engine and slowly bring the speed to 1500 RPM and at the same time adjust the carbon pile load to hold the voltage at 14 volts.
9. Read the amperage and compare with a specifications chart.
10. Turn off ignition, disconnect battery ground cable, and remove all test equipment.
11. If the Delcotron meets the test specifications, the problem is not in the generator.
12. If the Delcotron fails to meet the test specifications, remove it and perform bench tests and make repair needed.

DELCOTRON DIODE AND FIELD TEST (Fig. 8c)

NOTE: These tests will indicate good, shorted or open field or shorted diode but will not indi-

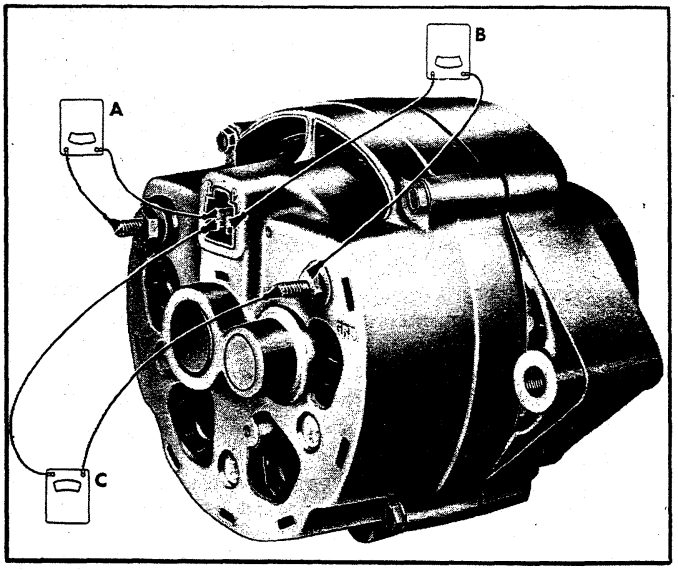


Fig. 8c—Delcotron Diode and Field Test

cate a failed open diode. If output was low and following tests show good, refer to service operations to determine cause and repair.

1. Disconnect battery ground cable at battery.
2. Positive diodes (Test A) connect an ohmmeter between "R" terminal and "BAT" terminal and note reading, then reverse the leads at same terminals and note this reading. Meter should read high resistance in one direction and low in the other.
3. Negative diodes (Test B) connect ohmmeter between "R" terminal and "GRD" and note reading, then reverse the leads and note this reading. Meter should read high in one direction and low in the other.

NOTE: A high or low reading in both directions indicates a defective diode.

4. Open Field or Grounded Stator Check:
   a. Connect an ohmmeter from "F" terminal to "GRD" terminal stud and note reading on the lowest range scale. Meter should read 7 to 20 ohms.
   b. If meter reads zero or excessively high resistance, the Delcotron is faulty.
5. If above tests indicate a defective Delcotron, remove and completely check Delcotron as outlined under "Service Operations".

INDICATOR LAMP/INITIAL FIELD EXCITATION CIRCUIT TESTS (Fig. 9c)

On standard models the indicator lamp circuit provides initial field excitation (causing lamp to glow). The light is cancelled by closing the field relay which applies battery voltage to both sides of bulb (bulb goes out).

The indicator light should glow when ignition switch is "ON" and go out almost immediately when engine starts.

Ammeter equipped vehicles use the same initial field excitation and control circuits as the indicator lamp except the lamp is omitted. The continuity tests on both type vehicles can be made as follows:

If Lamp Fails to Go Out, or if Ammeter Shows Discharge the Possible Causes are:

1. Faulty bulb or bulb socket.
2. Faulty ammeter.
3. An open circuit in wiring, regulator, or field.
4. A shorted positive diode—(may also cause glow with ignition switch "OFF").

TEST AS FOLLOWS:

1. Disconnect connector from regulator and turn ignition switch to "ON". Connect a test lamp from con-

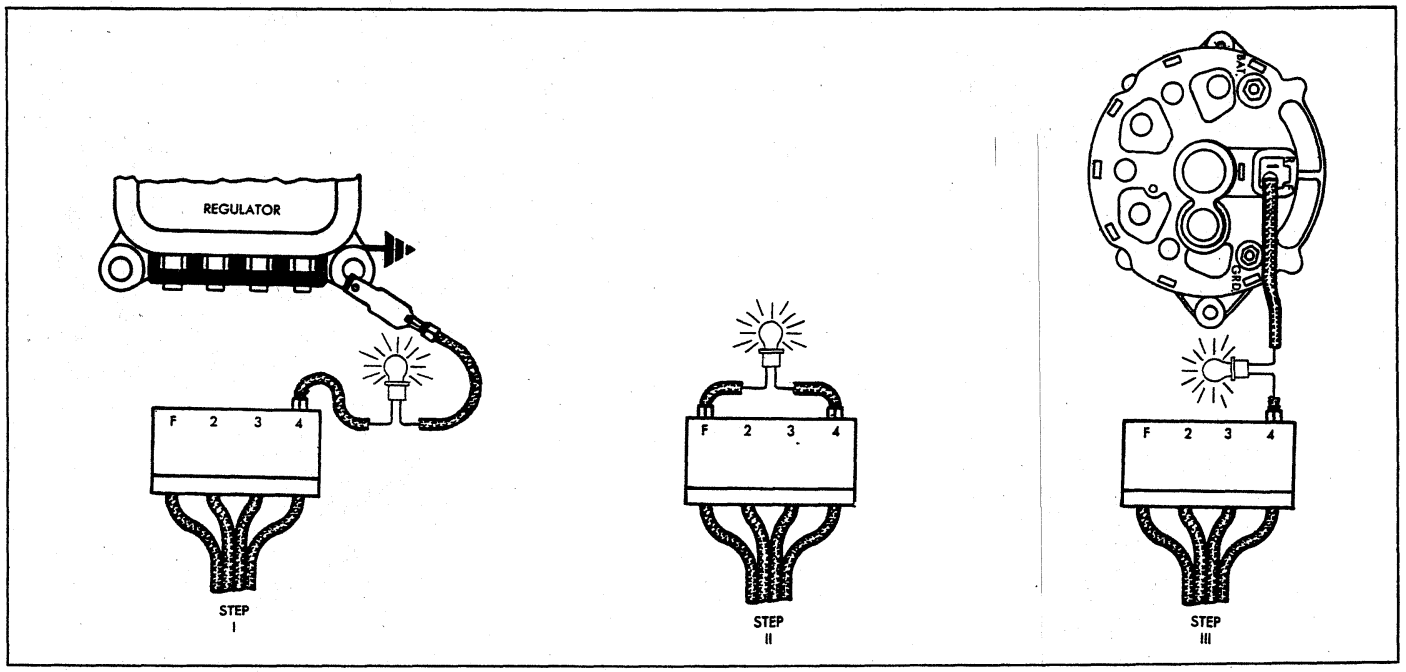


Fig. 9c—Initial Field Excitation Circuit Tests

nector terminal "4" to ground (fig. 9c Step 1) and note test lamp.

a. Lamp fails to glow—check for faulty bulb, socket or open circuit between switch and regulator connector. Repair as needed.
b. Light goes on—failure is in regulator, Delcotron, or wire between "F" terminals on regulator and Delcotron. Go to Step 2.

2. Disconnect lamp lead at ground end and connect between connector "F" and "4" terminals (fig. 9c, Step 2), and note lamp:
   a. Test Lamp glows—problem is in regulator. An open circuit in regulator or relay is stuck closed. See "Service Operations" for repair.
   b. Fails to glow—problem is in wire between "F" terminals on generator and regulator or in field windings. Go to Step 3.
3. Disconnect test lamp at connector "F" terminal and connect to "F" terminal on Delcotron (fig. 9c, Step 3), and note lamp:
   a. Lamp glows—an open circuit in wire between "F" terminals—correct as needed.
   b. Fails to glow—Delcotron field has open circuit, see "Service Operations" to repair.

If Lamp Fails to Go Out, or if Ammeter Shows Discharge the Possible Causes are:

1. Loose drive belt—adjust as necessary.
2. Faulty field relay—(see relay test and adjustment).
3. Defective Delcotron—(see Delcotron output test).
4. At normal idle—parallel resistance wire open (see Resistance test). On ammeter models the initial field excitation wire to "ACC" terminal is open.
5. Switch off—positive diode shorted (see Diode test).

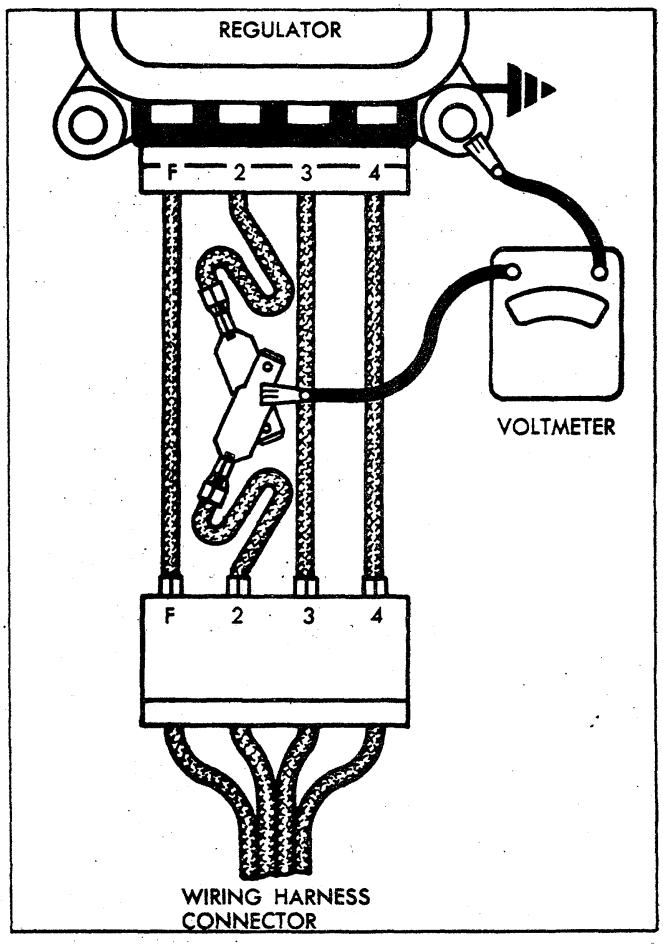


Fig. 10c—Testing Field Relay

FIELD CIRCUIT RESISTANCE WIRE CHECKS

The resistance wire is an integral part of the ignition harness. However, the resistance wire is not solderable; it must be spliced with a crimp-type connector. It is rated at 10 ohms, 6.25 watts minimum.

The check for an open resistor or field excitation wire (connected to the ignition switch "ACC" terminal) is as follows:

1. Connect a test lamp from the wiring harness connector terminal "4" to ground as shown in Figure 9c (Step 1).
2. Turn the ignition switch to the "ON" position and note test bulb.
   a. Test lamp glows—resistance is O.K.
   b. Test lamp does not glow—the resistor is open circuited—note also that dash lamp does not glow during this test because series resistance of the 2 bulbs causes amperage to be too low.

FIELD RELAY CHECKS AND ADJUSTMENT

To check for a faulty relay proceed as follows:

1. Connect a voltmeter into the system at the regulator No. 2 terminal to ground (fig. 10c).

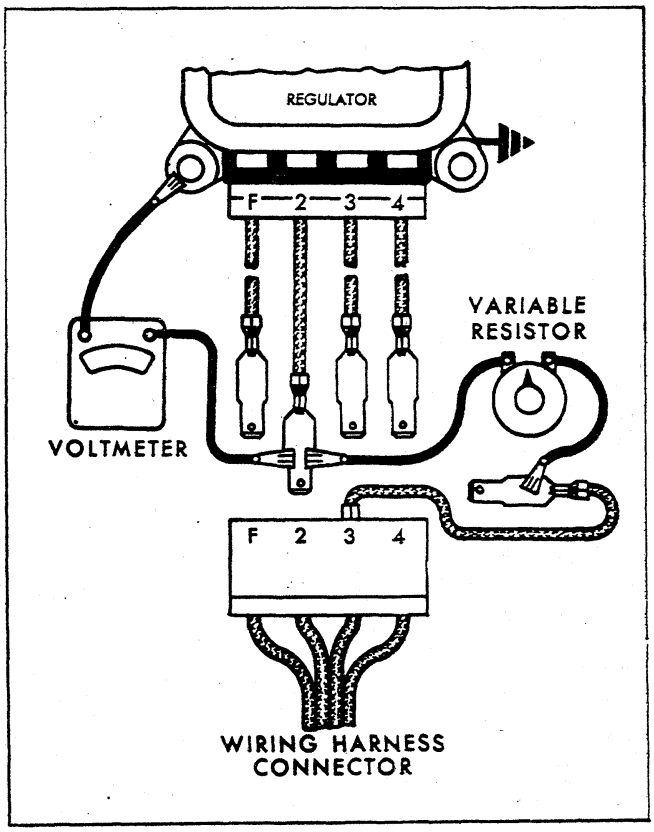


Fig. 11c—Field Relay Closing Voltage Test

2. Operate the engine at fast idle (1500 to 2000 rpm) and observe voltmeter reading.
3. If voltmeter shows zero voltage at regulator, check circuit between No. 2 terminal on regulator to "R" terminal on Delcotron.
4. If voltage at regulator exceeds closing voltage specification and light remains on, regulator field relay is faulty (Refer to specifications). Check and adjust regulator as follows:

CLOSING VOLTAGE ADJUSTMENT

1. Make connections as shown in Figure 11c using a 50 ohm variable resistor.

   NOTE: This gives us a variable resistance in series from a hot lead to the relay coil.

2. Turn resistor to "open" position.
3. Turn ignition switch off.
4. Slowly decrease resistance and note closing voltage of the relay. Adjust by bending heel iron in the manner illustrated in Figure 14c.

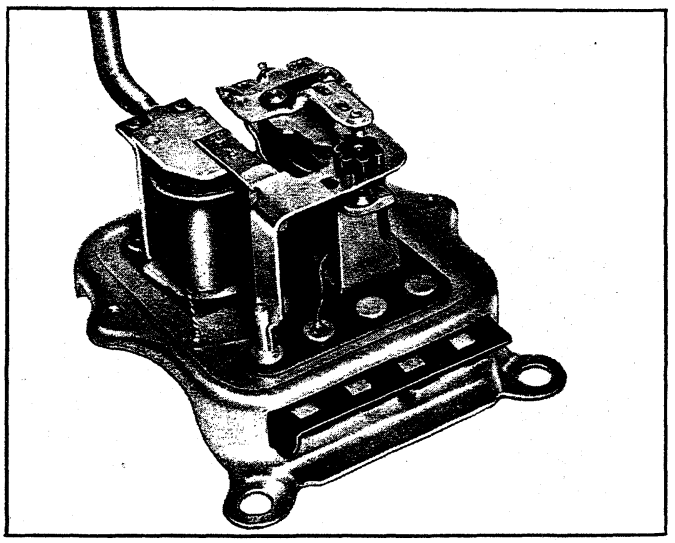


Fig. 12c—Adjusting Field Relay Closing Voltage

OTHER HARNESS CHECKS

Other wires in the charging system harness need be checked for continuity by use of an ohmmeter or a test light (12 Volt). Connect the test so the wire in question is in series in the test circuit.

SERVICE OPERATIONS

DELCOTRON

Removal and Installation

1. Disconnect the battery cables at battery.
2. Disconnect wiring leads at Delcotron.
3. Remove generator brace bolt, then detach drive belt (belts).
4. Support the generator and remove generator mount bolt and remove from vehicle.
5. Reverse the removal procedure to install then adjust drive belt(s).

Pulley Replacement

Single Groove Pulley

1. Place 15/16" box wrench on retaining nut and insert a 5/16" allen wrench into shaft to hold shaft while removing nut (fig. 13c).

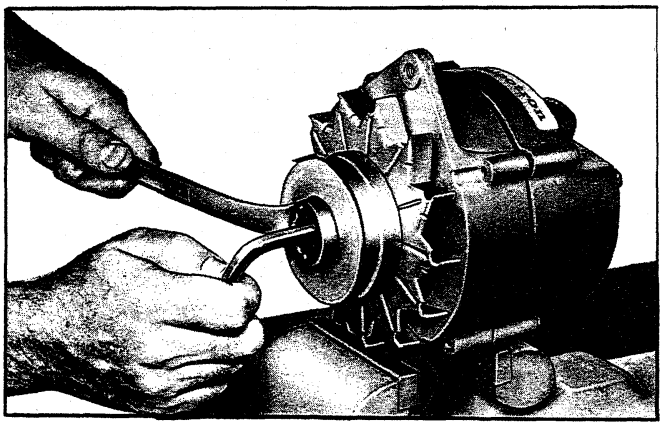


Fig. 13c—Pulley Removal

2. Remove washer and slide pulley, fan and spacer from shaft.
3. Reverse Steps 1 and 2 to install, use a torque wrench with a crow-foot adapter (instead of box wrench) and torque the nut to 50 ft. lbs. (fig. 14c).

Double Groove Pulley

1. Place a 15/16" socket (with wrench flats on the drive end or use Adapter J-21501 and a box wrench) on retaining nut, insert a 5/16" allen wrench through socket and adapter into hex on shaft to hold the shaft while removing the nut.

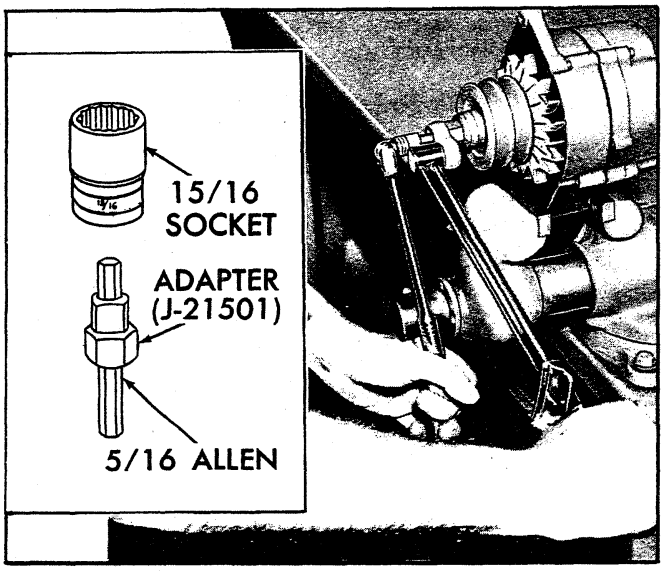


Fig. 14c—Torquing Pulley Nut

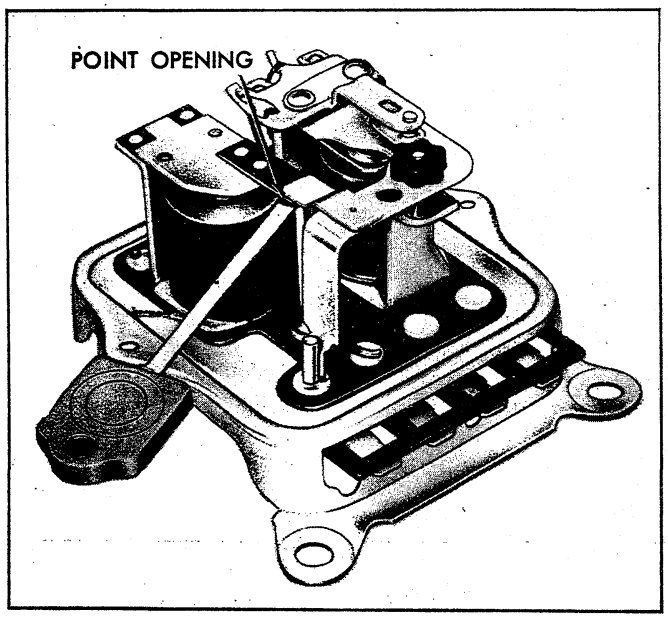


Fig. 15c—Checking Field Relay Point Opening

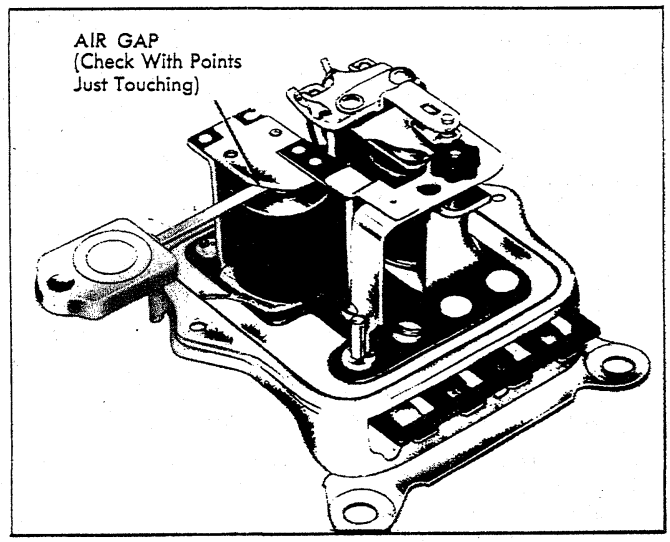


Fig. 16c—Checking Field Relay Air Gap

2. Remove washer and slide pulley, fan and spacer from shaft.
3. To install, slide spacer, fan, pulley and washer on shaft and start the nut.
4. Use the socket and adapter with a torque wrench and tighten nut to 50 ft. lbs. torque.

DOUBLE CONTACT REGULATOR

While most regular adjustments are made on the vehicle as outlined under "Maintenance and Adjustments", the regulator may be removed for field relay point and air gap adjustment. However, voltage regulating contacts should never be cleaned as they are made of special material that may be destroyed by cleaning with any abrasive material.

NOTE: A sooty or discolored condition of the contacts is normal after a relatively short period of operation.

Removal and Installation

To remove the regulator assembly, disconnect the battery ground cable and the wiring harness connector at the regulator, then remove the screws securing the regulator to the vehicle.

Electrical settings must be checked and adjusted after making mechanical adjustments. Before installing regulator cover, make sure the rubber gasket is in place on the regulator base.

Mechanical Adjustments

NOTE: Only an approximate voltage regulator air gap setting should be made by the "feeler gauge" method.

Field Relay Adjustment

1. Point Opening: The point opening is checked as illustrated in Figure 15c. If adjustment is necessary, carefully bend the armature stop.
2. Air Gap: Check the air gap with the points just touching (fig. 16c). The air gap normally need not be adjusted. If the point opening and closing voltages are within specifications, the relay will operate satisfactorily even though the air gap may not be exactly according to specifications. If adjustment is necessary, bend the flat contact spring.

10-SI SERIES DELCOTRON SYSTEM

INDEX

	Page
General Description	6Y-16
Operating Principles	6Y-16
Charging Circuit Checks	6Y-16
Static Checks	6Y-17
Indicator Lamp Circuit	6Y-17
Undercharged Energizer Condition	6Y-17
Overcharged Energizer Condition	6Y-17
Generator Output Test	6Y-18
Service Operations	6Y-13
Delcotron Replacement -- Refer to 5.5" Delcotron	6Y-13
Pulley Replacement -- Refer to 5.5" Delcotron	6Y-13

GENERAL DESCRIPTION

The 10-SI Series Delcotron generator illustrated in Figure 1D features a solid state regulator that is mounted inside the generator slip ring end frame. All regulator components are enclosed into a solid mold, and this unit along with the brush holder assembly is attached to the slip ring end frame. The regulator voltage setting never needs adjusting, and no provision for adjustment is provided.

No periodic adjustments or maintenance of any kind are required on the entire generator assembly.

The generator rotor bearings contain a supply of lubricant sufficiently adequate to eliminate the need for periodic lubrication. Two brushes carry current through the two slip rings to the field coil mounted on the rotor, and under normal conditions will provide long periods of attention-free service.

The stator windings are assembled on the inside of a laminated core that forms part of the generator frame. A rectifier bridge connected to the stator windings contains six diodes, and electrically changes the stator a.c. voltages to a d.c. voltage which appears at the generator output terminal. Generator field current is supplied through a diode trio which also is connected to the stator windings. A capacitor, or condenser, mounted in the end frame protects the rectifier bridge and diode trio from high voltages, and suppresses radio noise.

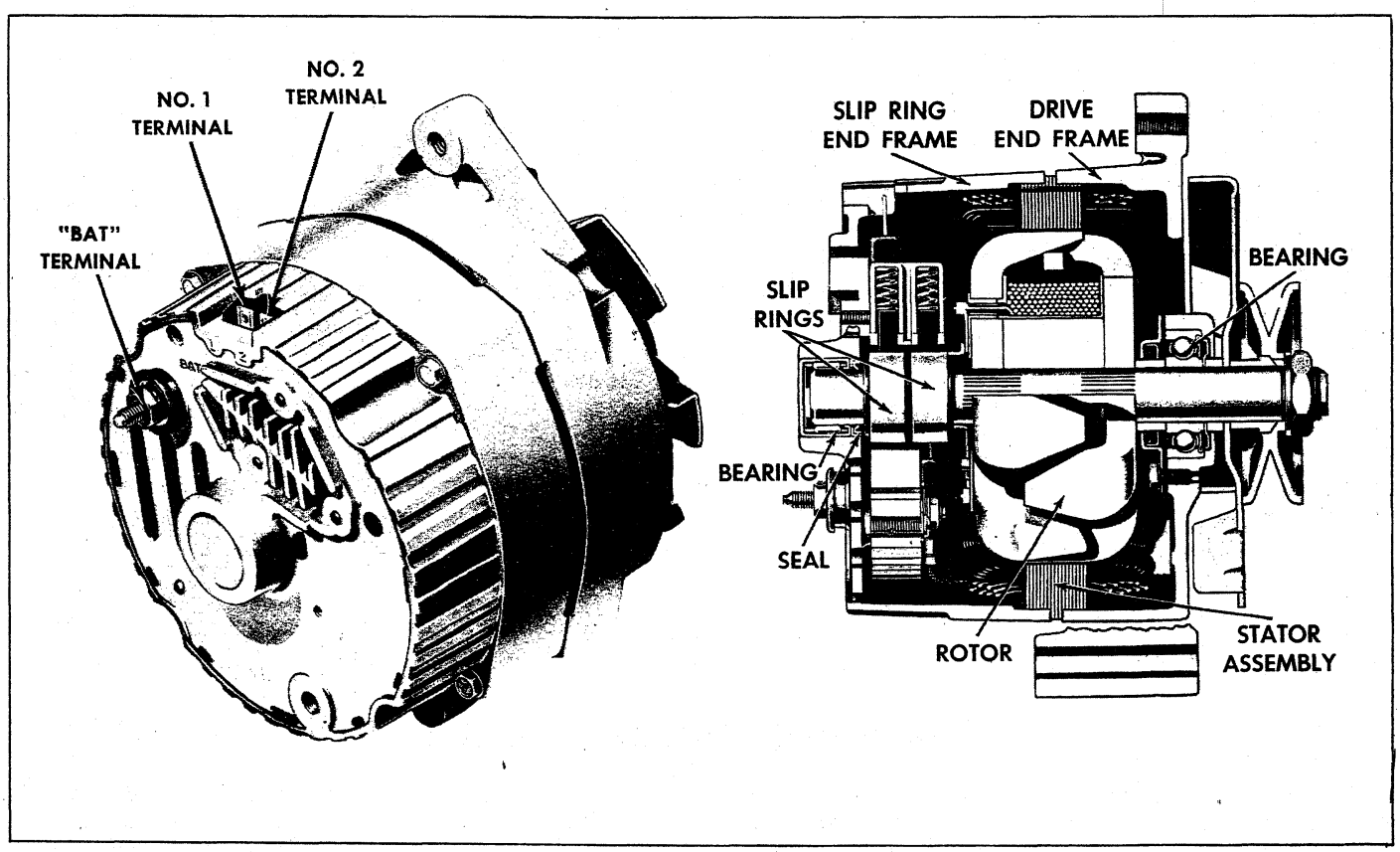


Fig. 1D—10-SI Series Delcotron

OPERATING PRINCIPLES

A typical wiring diagram is illustrated in Figure 2D. The basic operating principles are explained as follows.

When the switch is closed, current from the energizer flows to the generator No. 1 terminal, through resistor R1, diode D1, and the base-emitter of transistor TR1 to ground, and then back to the battery. This turns on transistor TR1, and current flows through the generator field coil and TR1 back to the energizer. The resistor in the ignition circuit reduces total circuit resistance to provide higher field current for initial voltage build-up when the engine starts.

With the generator operating, a.c. voltage is generated in the stator windings, and the stator supplies d.c. field current through the diode trio, the field, TR1, and then through the grounded diodes in the rectifier bridge back to the stator. Also, the six diodes in the rectifier bridge change the stator a.c. voltages to a d.c. voltage which appears between ground and the generator "BAT" terminal. As generator speed increases, current is provided for charging the energizer and operating electrical accessories.

The No. 2 terminal on the generator is always connected to the energizer, but the discharge current is limited to a negligible value by the high resistances of R2 and R3. As the generator speed and voltage increase, the voltage between R2 and R3 increases to the point where zener diode D2 conducts. Transistor TR2 then turns on and TR1 turns off. With TR1 off, the field current and system voltage decrease, and D2 then blocks current flow, causing TR1 to turn back on. The field current and system voltage increase, and this cycle then repeats many times per second to limit the generator voltage to a pre-set value.

Capacitor C1 smooths out the voltage across R3, resistor R4 prevents excessive current through TR1 at high temperatures, and diode D3 prevents high-induced-voltages in the field windings when TR1 turns off.

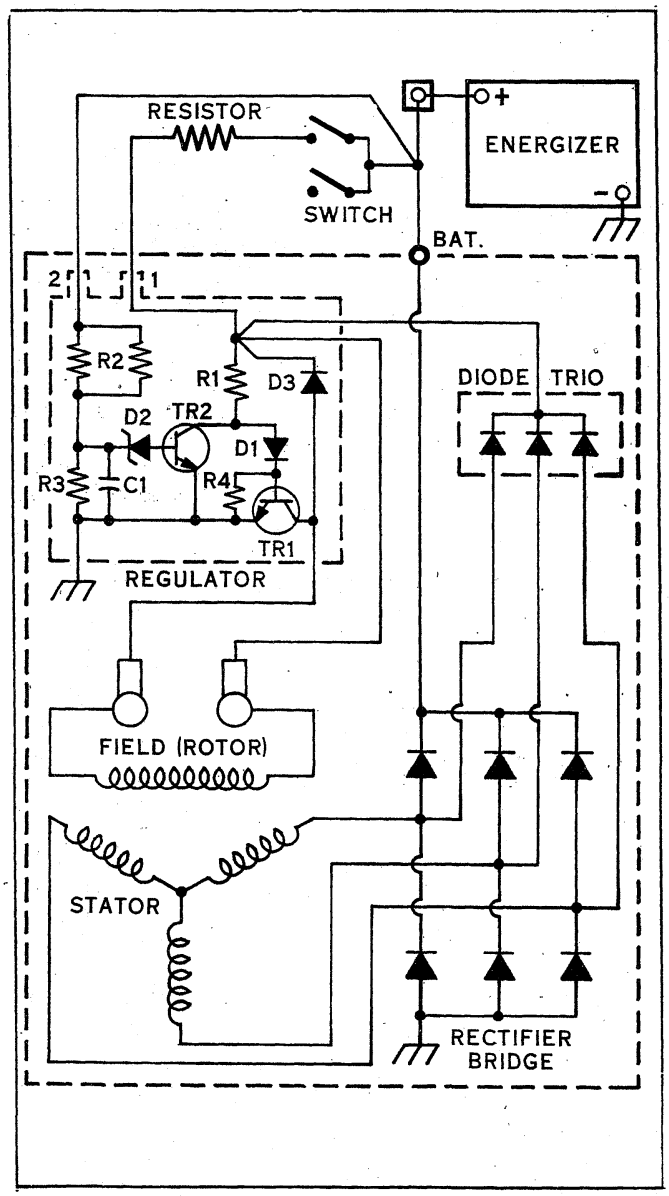


Fig. 2D—Integral Charging System Circuitry

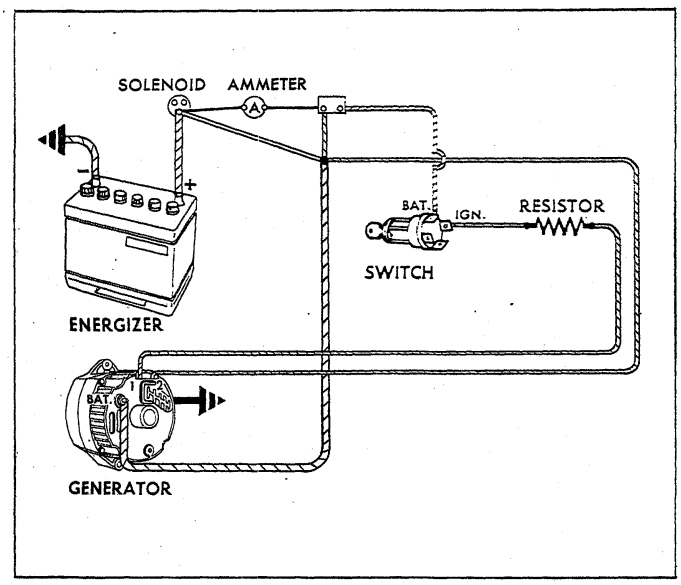


Fig. 3D—Basic Wiring Diagram

CHARGING CIRCUIT CHECKS

Most charging system troubles show up as an undercharged or overcharged battery. Since the battery itself may be defective, it should be checked first to determine its condition. Also, in the case of an undercharged battery, check for battery drain caused by grounds or by accessories being left on.

A basic wiring diagram showing lead connections is presented in Figure 3D. The following precautions must be observed when working on the charging circuit. Failure to observe these precautions will result in serious damage to the electrical equipment.

- Do not polarize the generator.

- Do not short across or ground any of the terminals in the charging circuit except as specifically instructed in these procedures.
- Never operate the generator with the output terminal open circuited.
- Make sure the generator and Energizer are of the same ground polarity.
- When connecting a charger or a booster Energizer to the vehicle Energizer, connect negative to negative and positive to positive.

STATIC CHECK

Before making any electrical checks, visually inspect all connections, including slip-on connectors, to make sure they are clean and tight. Inspect all wiring for cracked, frayed or broken insulation. Be sure generator mounting bolts are tight and unit is properly grounded. Check for loose fan belt.

UNDERCHARGED ENERGIZER CONDITION CHECK

This condition, as evidenced by slow cranking and low specific gravity readings, can be caused by one or more of the following conditions even though the ammeter may be operating normally.

1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.
2. Check the drive belt for proper tension.
3. Check energizer. Test is not valid unless energizer is good and fully charged.
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the slip connectors at the generator and firewall, and the cable clamps and battery posts.
5. With ignition switch "on" connect a voltmeter from generator "BAT" terminal to ground. A zero reading indicates an open between voltmeter connection and Energizer. Also, disconnect wiring harness at generator No. 1 and No. 2 terminals, and connect voltmeter from No. 1 harness terminal to ground. A zero reading indicates an open between voltmeter connection and Energizer. Reconnect harness to No. 1 and No. 2 terminals.

   NOTE: If previous Steps 1 through 5 check satisfactorily, check Delcotron generator as follows:

6. Connect a voltmeter in the circuit at the "BAT" terminal of the generator.
7. Operate engine at moderate speed (approximately 1500-2000 rpm) and turn on electrical loads (high beam headlights, windshield wiper, heater or A/C blower, radio, etc.).

   NOTE: Without sufficient electrical load to demand maximum Delcotron output the following voltage check is invalid.

8. Observe Voltmeter reading:
   a. If reading is 12.8 volts or more, generator is not defective. Turn off electrical loads, stop engine and disconnect test equipment. Recheck steps 1 thru 5.

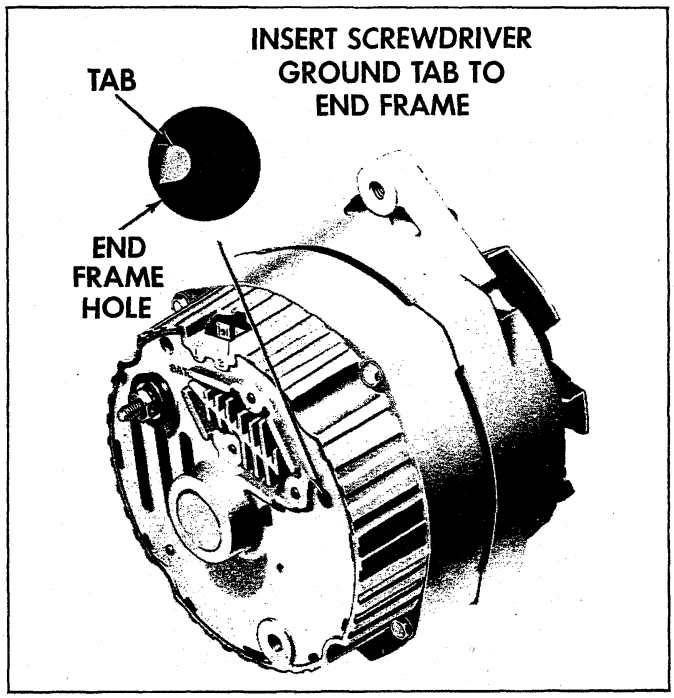


Fig. 4D—Delcotron End View

   b. If reading is less than 12.8 volts, ground field winding by inserting a screwdriver into the test hole in the end frame (fig. 4D).

CAUTION: TAB IS WITHIN 3/4 INCH OF CASTING SURFACE. DO NOT FORCE SCREWDRIVER DEEPER THAN ONE INCH INTO END FRAME.

   (1) If voltage increases (13 volts and above) regulator unit is defective. Replace regulator, as described in Section 6Y, Chassis Overhaul Manual. Repeat Steps 7 and 8 after new regulator unit is installed.
   (2) If voltage does not increase significantly, generator is defective. Check the field winding, diode trio, rectifier bridge and stator as covered in Section 6Y, Chassis Overhaul Manual and repair as required.

9. Turn off electrical loads, shut off engine and disconnect all test equipment, if not previously done.

OVERCHARGED ENERGIZER CONDITION CHECK

1. Determine Energizer or battery condition. Test is not valid if Energizer is not good and fully charged.
2. Connect a voltmeter from generator No. 2 terminal to ground. If reading is zero, No. 2 lead circuit is open, which will cause an overcharged condition.
3. If Energizer and No. 2 lead circuit check good, but an obvious overcharge condition exists as evidenced by excessive Energizer water usage, proceed as follows:
   a. Separate end frames as covered in Delcotron "Disassembly" section in the Chassis Overhaul Manual.
   b. Connect ohmmeter using lowest range scale from brush lead clip to end frame as shown in Step 1, Figure 5D, then reverse lead connections.

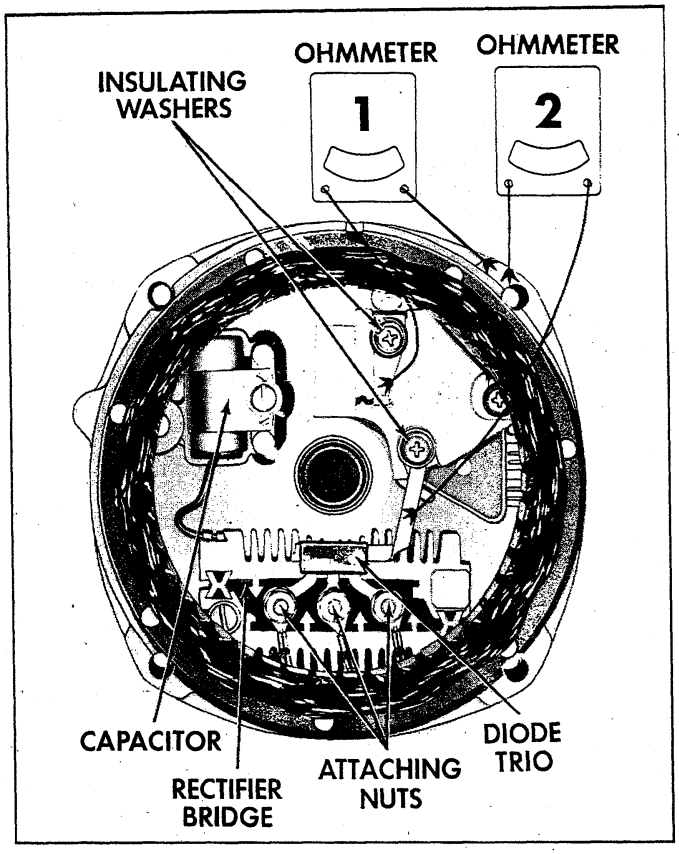


Fig. 5D—Slip Ring End Frame

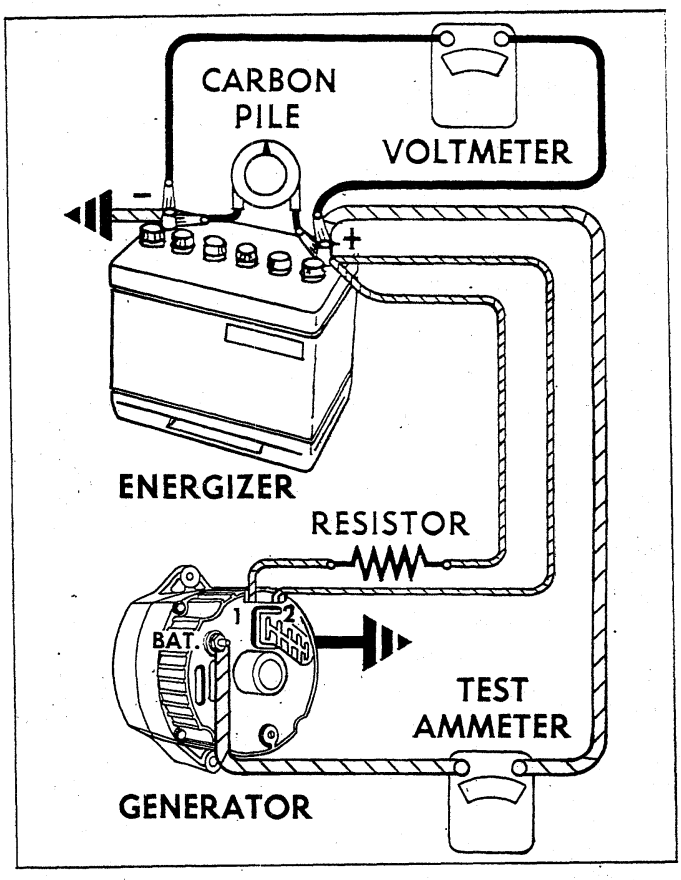


Fig. 6D—Generator Output Test

c. If both readings are zero, either the brush lead clip is grounded, or regulator is defective.
d. A grounded brush lead clip can result from omission of insulating washer (Fig. 5), omission of insulating sleeve over screw, or damaged insulating sleeve. Remove screw to inspect sleeve. If satisfactory, replace regulator as covered under heading of "GENERATOR REPAIR" in the Chassis Overhaul Manual.

GENERATOR OUTPUT TEST

To check the generator in a test stand, proceed as follows:

1. Make connections as shown in Figure 6D, except leave the carbon pile disconnected. Use a fully charged Energizer or battery, and a 10 ohm resistor rated at six watts or more between the generator No. 1 terminal and the Energizer.
2. Slowly increase the generator speed and observe the voltage.
3. If the voltage is uncontrolled with speed and increases above 16 volts, check for a grounded brush lead clip as covered under heading of "OVERCHARGED ENERGIZER", Step 3. If not grounded, replace the regulator.

NOTE: The Energizer must be fully charged when making this check.

4. Connect the carbon pile as shown.
5. Operate the generator at moderate speed as required and adjust the carbon pile as required to obtain maximum current output.
6. If output is within ten percent of rated output as stamped on generator frame, generator is good.
7. If output is not within ten percent of rated output, ground generator field (Fig. 4D).
8. Operate generator at moderate speed and adjust carbon pile as required to obtain maximum output.
9. If output is within ten percent of rated output, replace regulator as covered in "Regulator Replacement" section.
10. If output is not within ten percent of rated output, check the field winding, diode trio, rectifier bridge and stator as previously covered.

IGNITION SYSTEMS

INDEX

	Page
General Description	6Y-19
Maintenance and Adjustments	6Y-20
Breaker Point System	6Y-20
Breakerless System	6Y-20
Ignition Coil Check	6Y-20
Spark Plugs	6Y-20
Service Operations	6Y-20
Distributor Contact Points	6Y-20
Cleaning	6Y-20
Replacement	6Y-21
Setting Dwell Angle	6Y-22
Distributor Condenser	6Y-23
Performance Diagnosis	6Y-23
Replacement	6Y-24
Distributor	6Y-24
Breaker Point Type	6Y-24
Removal	6Y-24
Disassembly	6Y-24
Cleaning and Inspection	6Y-26
Assembly	6Y-26
Installation	6Y-27
Breakerless	6Y-27
Removal	6Y-27
Disassembly	6Y-27
Installation	6Y-28
Off-Engine Test	6Y-28
Coil Replacement	6Y-28
Pulse Amplifier	6Y-29
Disassembly	6Y-29
Component Checks	6Y-29
Assembly	6Y-30
Spark Plugs	6Y-30
Cleaning and Regapping	6Y-30
Installation	6Y-31

GENERAL DESCRIPTION

There are two ignition systems available on 1969 vehicles. The breaker point type which is continued as the regular production system and the optional (Corvette only) transistor controlled breakerless ignition system (magnetic pulse type). The transistor ignition system features a specially designed distributor, ignition pulse amplifier, and a special coil. Two resistance wires are also used in the circuit; one as a ballast between the coil negative terminal and ground, while the other resistance wire provides a voltage drop for the engine run circuit and is by-passed at cranking. The other units in the system (the ignition switch, spark plugs, and battery) are of standard design. The distributor and control unit (ignition pulse amplifier) are shown in Figure 1i and 2i.

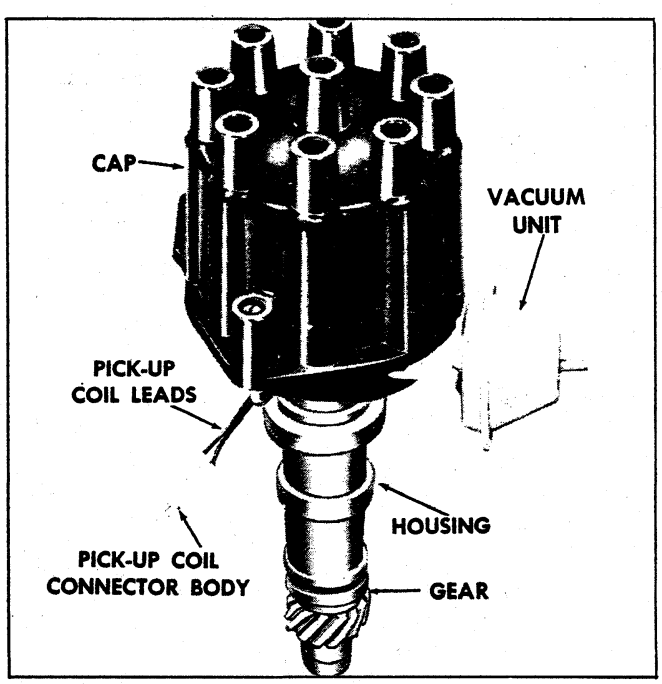


Fig. 1i—Magnetic Pulse Distributor

Although the external appearance of the distributor resembles a standard distributor, the internal construction is quite different. As shown in the exploded view (fig. 16i) an iron timer core replaces the conventional breaker cam. The timer core has the same number of equally-spaced projections, or vanes as engine cylinders.

The timer core rotates inside a magnetic pickup assembly, which replaces the conventional breaker plate, contact point set, and condenser assembly. The magnetic pickup assembly consists of a ceramic permanent magnet, a pole piece, and a pickup coil. The pole piece is a steel plate having equally spaced internal teeth, one tooth for each cylinder of the engine.

The magnetic pickup assembly is mounted over the main bearing of the distributor housing, and is made to rotate by the vacuum control unit, thus providing vacuum advance. The timer core is made to rotate about the shaft by conventional advance weights, thus providing centrifugal advance.

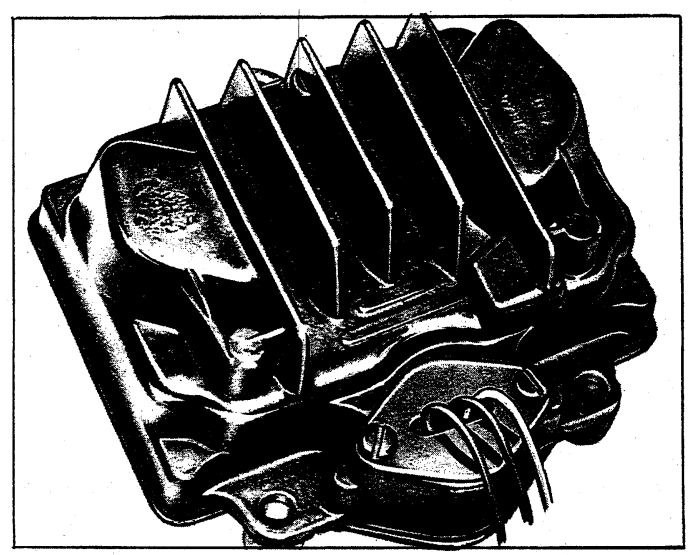


Fig. 2i—Ignition Pulse Amplifier Unit

MAINTENANCE AND ADJUSTMENTS

PERIODIC MAINTENANCE

BREAKER POINT SYSTEM

The distributor breaker points and spark plugs are the only ignition system components that require periodic service. The remainder of the ignition system requires only periodic inspection to check operation of the units, tightness of the electrical connections, and condition of the wiring. When checking the coil, test with a reputable tester.

Breaker type distributors are equipped with cam lubricator and should have the wick replaced at the same time contact point set is replaced. It is not necessary to lubricate the breaker cam when using a cam lubricator. Do not attempt to lubricate the wick - Replace when necessary. When installing a new wick, adjust its position so the end of the wick just touches the lobe of the breaker cam.

Distributor shaft lubrication is accomplished by a reservoir of lube around the mainshaft in the distributor body.

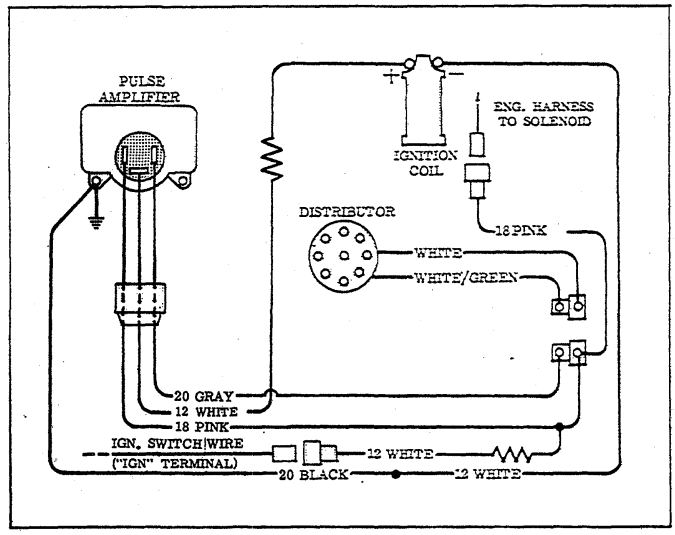


Fig. 3i—Breakerless Ignition System

BREAKERLESS SYSTEM

Since there are no moving parts in the ignition pulse amplifier unit mounted forward of the radiator bulkhead, and the distributor shaft and bushings have permanent type lubrication, no periodic maintenance is therefore required for the breakerless ignition system. The distributor lower bushing is lubricated by engine oil through a splash hole in the distributor housing, and a housing cavity next to the upper bushing contains a supply of lubricant which will last between overhaul periods. At time of overhaul, the upper bushing may be lubricated by removing the plastic seal and then adding SAE 20 oil to the packing in the cavity. A new plastic seal will be required since the old one will be damaged during removal.

Tachometer readings for test purposes can be made on the primary circuit of the breakerless ignition system in the same manner as on the conventional ignition system, however before attempting to connect a test tachometer into the primary circuit check with your instrument supplier to insure that satisfactory readings can be obtained and the breakerless system will not be damaged by the tachometer that is to be used.

IGNITION COIL CHECK (BREAKERLESS)

The ignition coil primary can be checked for an open condition by connecting an ohmmeter across the two primary terminals with the battery disconnected. Primary resistance at 75° F. should be between .35 and .55 ohm. An infinite reading indicates the primary is open. For the engine to run but miss at times, the primary open may be of the intermittent type.

The coil secondary can be checked for an open by connecting an ohmmeter from the high tension center tower to either primary terminal. To obtain a reliable reading, a scale on the ohmmeter having the 20,000 ohm value within, or nearly within, the middle third of the scale should be used. Secondary resistance at 75° F. should be between 8,000 and 12,500 ohms. If the reading is infinite, the coil secondary winding is open.

A number of different types of coil testers are available from various test equipment manufacturers. When using these testers, follow the procedure recommended by the tester manufacturer.

NOTE: Make sure the tester will properly check this special coil.

SPARK PLUGS

Should be removed, inspected, cleaned and regapped at tune-up. Defective plugs should be replaced, see Servicing of Units Off the Vehicle.

SERVICE OPERATIONS

DISTRIBUTOR CONTACT POINTS

Cleaning

Dirty contact points should be dressed with a few strokes of a clean, fine-cut contact file. The file should not be used for other metals and should not be allowed to become greasy or dirty. Never use emery cloth to clean contact points. Contact surfaces, after considerable use, may not appear bright and smooth, but this is not necessarily an indication that they are not functioning satisfactorily. Do not attempt to remove all roughness nor dress the point surfaces down smooth; merely remove scale or dirt.

Badly burned or pitted contact points should be replaced and the cause of trouble determined so it can be eliminated. High resistance or loose connections in the condenser circuit, oil or foreign materials on the contact surfaces, improper point adjustment or high voltages may cause oxidized contact points. Check for these con-

ditions where burned contacts are experienced. An out-of-balance condition in the ignition system, often the result of too much or too little condenser capacity, is indicated where point pitting is encountered.

Replacement

Four and Six Cylinder Engine Distributor

1. Release distributor cap hold-down screws, remove cap and place it out of work area.
2. Remove rotor.
3. Pull primary and condenser lead wires from contact point quick disconnect terminal (fig. 4i).
4. Remove contact set attaching screw, lift contact point set from breaker plate.
5. Clean breaker plate of oil smudge and dirt.
6. Place new contact point assembly in position on breaker plate, install attaching screw.

   CAUTION: Carefully wipe protective film from point set prior to installation.

   NOTE: Pilot on contact set must engage matching hole in breaker plate.

7. Connect primary and condenser lead wires to quick disconnect terminal on contact point set.
8. Check and adjust points for proper alignment and breaker arm spring tension (fig. 5i). Use an aligning tool to bend stationary contact support if points need alignment.

   NOTE: The contact point pressure must fall within specified limits. Weak tension will cause chatter resulting in arcing and burning of the points and an ignition miss at high speed, while excessive tension will cause undue wear of the contact points, cam and rubbing block. Breaker arm spring tension should be 19-23 ounces. The contact point pressure should be checked with a spring gauge. The scale should be hooked to the breaker lever and the pull exerted at 90 degrees to the breaker lever as shown in Figure 5i. The reading should be taken just as the points separate. The pressure can be adjusted by bending the breaker lever spring. If the pressure is excessive, it can be decreased by pinching the spring carefully. To increase pressure, the lever must be removed from the distributor so the spring can be bent away from the lever. Avoid excessive spring distortion.

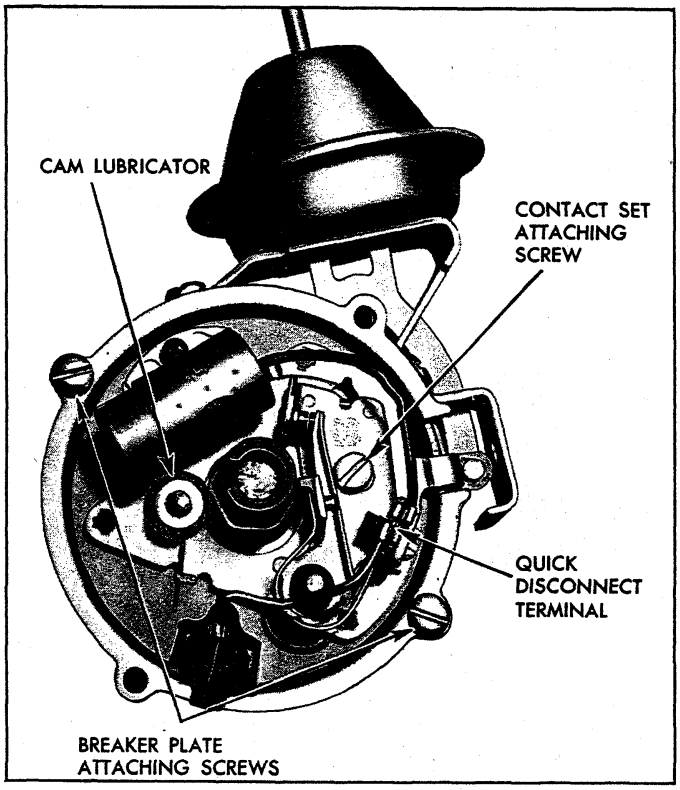


Fig. 4i—Breaker Plate and Attaching Parts

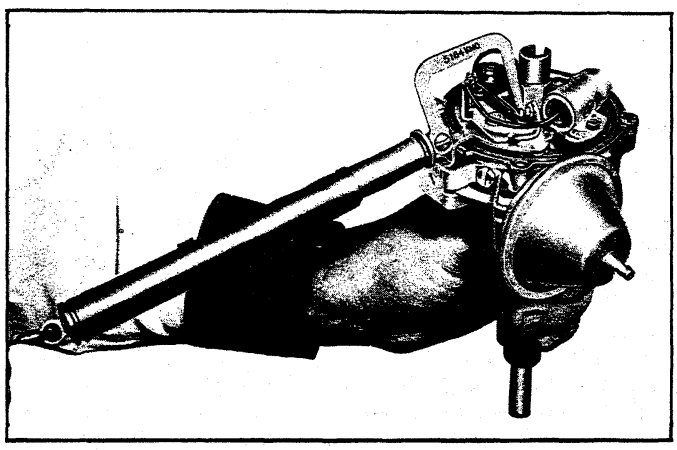


Fig. 5i—Checking Breaker Arm Spring Tension

9. Set point opening (.019" for new points.)
10. Reinstall rotor, position and lock distributor cap to housing.
11. Start engine and test dwell and ignition timing.

Eight Cylinder Engine Distributor

1. The contact point set is replaced as one complete assembly and only dwell angle requires adjustment after replacement. Breaker lever spring tension and point alignment are factory set.
2. Remove the distributor cap by placing a screw driver in the slot head of the latch, press down and turn 1/4 turn in either direction.
3. Remove the two attaching screws which hold the base of the contact set assembly in place.
4. Remove the primary and condenser leads from their nylon insulated connection (fig. 6i) in contact set.
5. Reverse Steps 2, 3 and 4 to install new contact set.

   CAUTION: Install the primary and condenser leads as shown in Figure 6i. Improper installation will cause lead interference between the cap, weight base and breaker advance plate.

6. If car has 20,000 to 25,000 miles (or sooner if desired) the cam lubricator wick (fig. 7i) should be changed. Using long nosed pliers squeeze assembly together at base and lift out. Remove all old lubricant from cam surface. Replace in same manner.

   NOTE: End of cam lubricant wick should be adjusted to just touch cam lobes. Over lubrication of cam resulting in grease on contact points

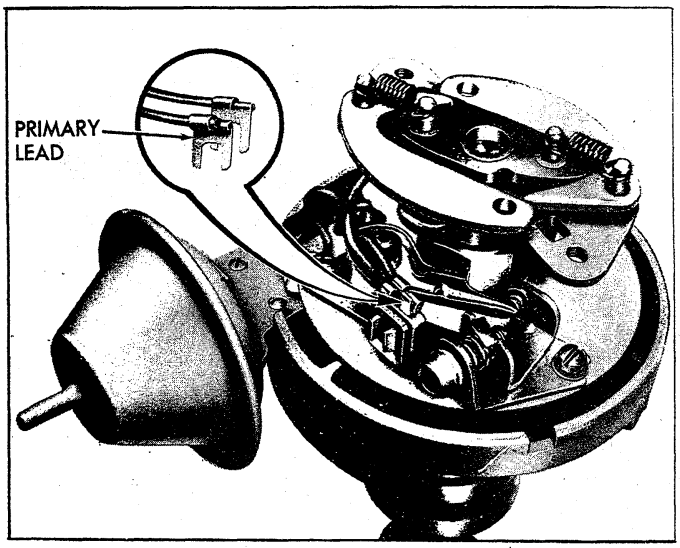


Fig. 6i—Distributor Lead Arrangements

can be caused by cam lubrication wick bearing too hard against cam surface. A correctly adjusted cam lubricator wick will provide adequate lubrication for cam. Do not apply additional grease to cam surface.

7. Start engine and check point dwell and ignition timing.

Setting Dwell Angle

Four and Six Cylinder Engine Distributors

The point opening of new points can be checked with a feeler gauge, but the use of a feeler gauge on rough or uncleaned used points is not recommended since accurate mechanical gauging cannot be done on such points (fig. 8i).

Contact points must be set to the proper opening. Points set too close may tend to burn and pit rapidly. Points with excessive separation tend to cause a weak spark at high speed. Proper point setting for all models are:

.019" for new points
.016" for used points

New points must be set to the larger opening as the rubbing block will wear down slightly while seating to the cam. Contact points should be cleaned before adjusting if they have been in service.

To adjust contact point opening:

1. If necessary, align points (fig. 9i) by bending the fixed contact support. Do not bend the breaker lever. Do not attempt to align used points; replace them where serious misalignment is observed. Use an aligning tool if available.
2. Turn or crank the distributor shaft until the breaker arm rubbing block is on the high point of the cam lobe. This will provide maximum point opening.
3. Loosen the contact support lock screw.
4. Use a screw driver (fig. 10i) to move the point support to obtain .019" opening for new points and a .016" opening for used points.
5. Tighten the contact support lock screw and recheck the point opening.

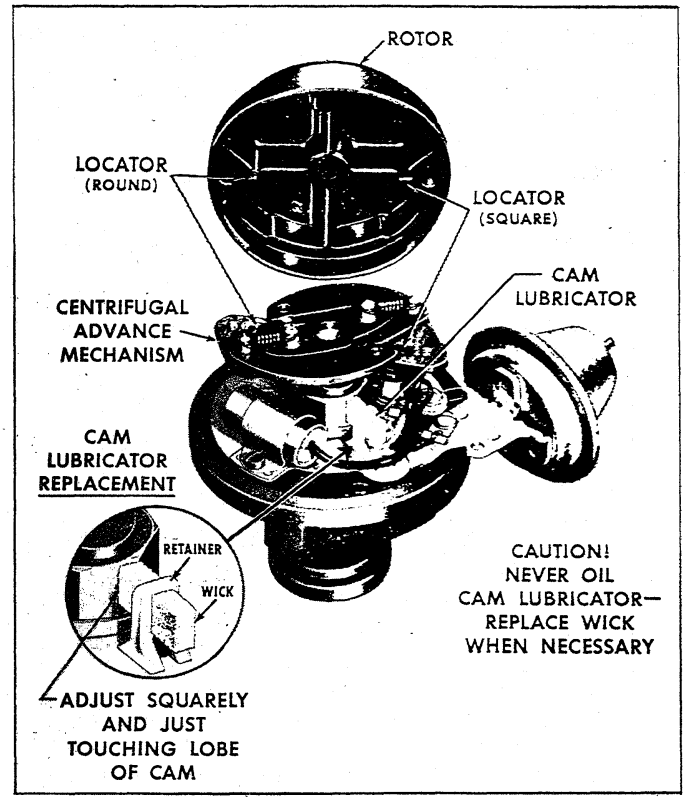


Fig. 7i—Top View of Distributor

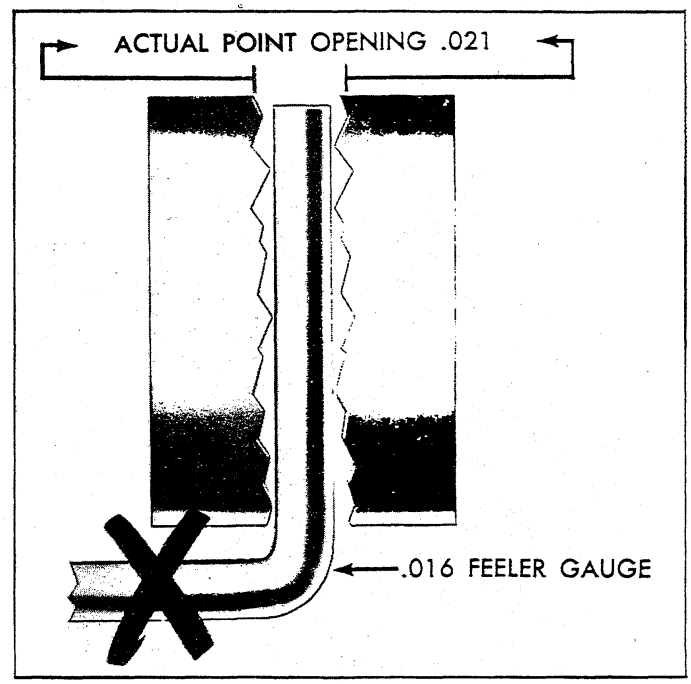


Fig. 8i—Inaccurate Gauging of Rough Points

6. After checking and adjusting the contact point opening to specifications, the cam angle or dwell should be checked with a dwell angle meter if such equipment is available (see Specifications for proper dwell

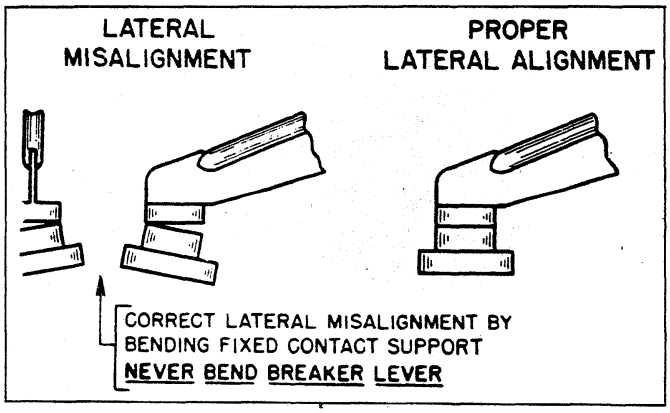


Fig. 9i—Alignment of Points

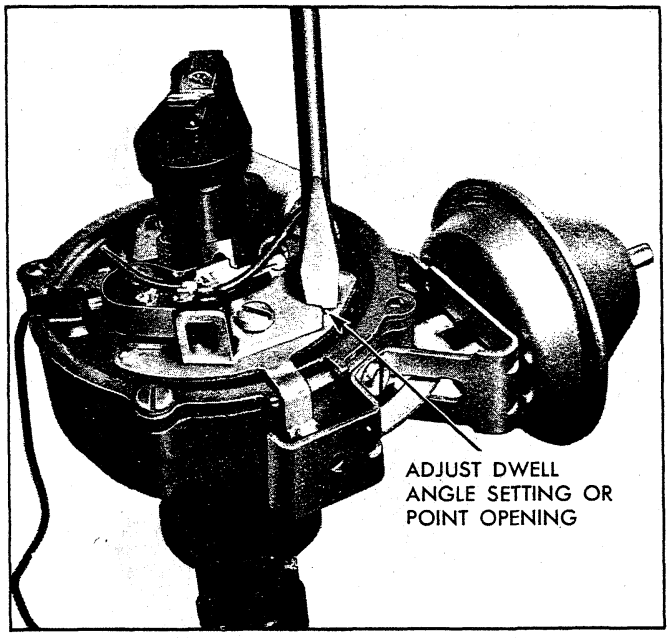


Fig. 10i—Setting Point Opening

angle). If the cam angle is less than the specified minimum, check for defective or misaligned contact points or worn distributor cam lobes. The variation in cam angle readings between idle speed and 1750 engine rpm should not exceed 3°. Excessive variation in this speed range indicates wear in the distributor.

NOTE: Cam angle readings taken at speeds above 1750 engine rpm may prove unreliable on some cam angle meters.

Eight Cylinder Engine Distributor

On the Vehicle

With the engine running at idle and operating temperatures normalized, the dwell is adjusted by first raising the window provided in the cap and inserting a "Hex" type wrench into the adjusting screw head (fig. 11i).

1. Preferrred Method - Turn the adjusting screw until the specified dwell angle is obtained as measured in degrees (28° to 32°, 30° preferred) by a dwell angle meter.

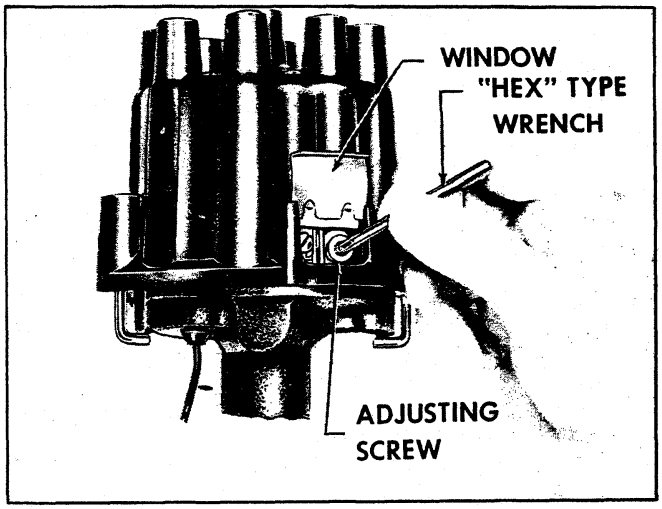


Fig. 11i—Adjusting Dwell Angle

2. Alternate Method - Turn adjusting screw in (clockwise) until the engine begins to misfire, then turn screw 1/2 turn in the opposite direction (counter-clockwise). This will give the approximate dwell angle required. (Use only when meter is not available.)

Off the Vehicle

1. Distributor Test Method:
   a. With the distributor mounted on a distributor testing machine, connect the dwell meter to the distributor primary lead.
   b. Turn the adjusting screw (fig. 11i) to set the dwell angle to 30 degrees.
2. Test Light Method:
   a. With the distributor mounted in a vise, connect a testing lamp to the primary lead.
   b. Rotate the shaft until one of the circuit breaker cam lobes is under the center of the rubbing block of the breaker lever.
   c. Turn the adjusting screw clockwise (fig. 11i) until the lamp lights, then give the wrench 1/2 turn in the opposite direction (counter-clockwise) to obtain the proper dwell angle.

DISTRIBUTOR CONDENSER

Performance Diagnosis

The following four factors affect condenser performance and, each factor must be considered in making any condenser test.

1. Breakdown - A failure of the insulating material. A direct short between the metallic elements of the condenser. This prevents any condenser action.
2. Low Insulating Resistance (Leakage) - Low insulation resistance prevents the condenser from holding a charge. All condensers are subject to leakage which, up to a certain limit, is not objectionable.
3. High Series Resistance - Excessive resistance in the condenser circuit due to broken strands in the condenser leak or to a defective connection. This will cause burned points and ignition failure upon initial starts and at high speeds.

4. Capacity - Capacity is determined by the area of the metallic elements and the insulating and impregnating materials.

For a complete check of the condenser, use a tester which will check for all of the above conditions. Follow the instructions given by the manufacturer of the test equipment. Condenser capacity should be 18-:23 microfarads.

Replacement

Four and Six Cylinder Engine Distributor (Fig. 4i)

1. Release distributor cap hold-down screws, remove cap and place it out of the work area.
2. Remove rotor.
3. Disconnect condenser lead wire from contact point quick-disconnect terminal.
4. Remove condenser attaching screw, lift condenser from breaker plate and wipe breaker plate clean.
5. Install new condenser using reverse of procedure outlined above.

Eight Cylinder Engine Distributor

1. Remove distributor cap.
2. Loosen condenser lead attaching screw (fig. 6i) and lift out condenser lead clip.
3. Remove screw holding condenser bracket to breaker plate and slide condenser from bracket.
4. To replace condenser reverse the above procedure.

NOTE: Make sure that new condenser lead is installed in proper position (fig. 6i).

DISTRIBUTOR (BREAKER POINT TYPE)

Removal

1. On radio equipped Corvettes, remove ignition shield from over distributor and coil. One bolt is accessible from top of shield, the other two are at rear of shield, facing firewall.
2. Release the distributor cap hold-down screws, remove the cap and place it clear of the work area.

NOTE: If necessary, remove secondary leads from the distributor cap after first marking the cap tower for the lead to No. 1 cylinder. This will aid in the reinstallation of leads in the cap.

3. Disconnect the distributor primary lead from the coil terminal.
4. Scribe a realignment mark on the distributor bowl and engine in line with the rotor segment.
5. Disconnect vacuum line to distributor and tachometer drive cable (Corvette). Remove the distributor hold-down bolt and clamp and remove the distributor from the engine. Note position of vacuum advance mechanism relative to the engine.

CAUTION: Avoid rotating the engine with the distributor removed as the ignition timing will be upset.

Disassembly

It is advisable to place the distributor in a distributor testing machine or synchroscope prior to disassembly. When mounting distributors for tests, first secure the gear in the test drive mechanism, then push the distribu-

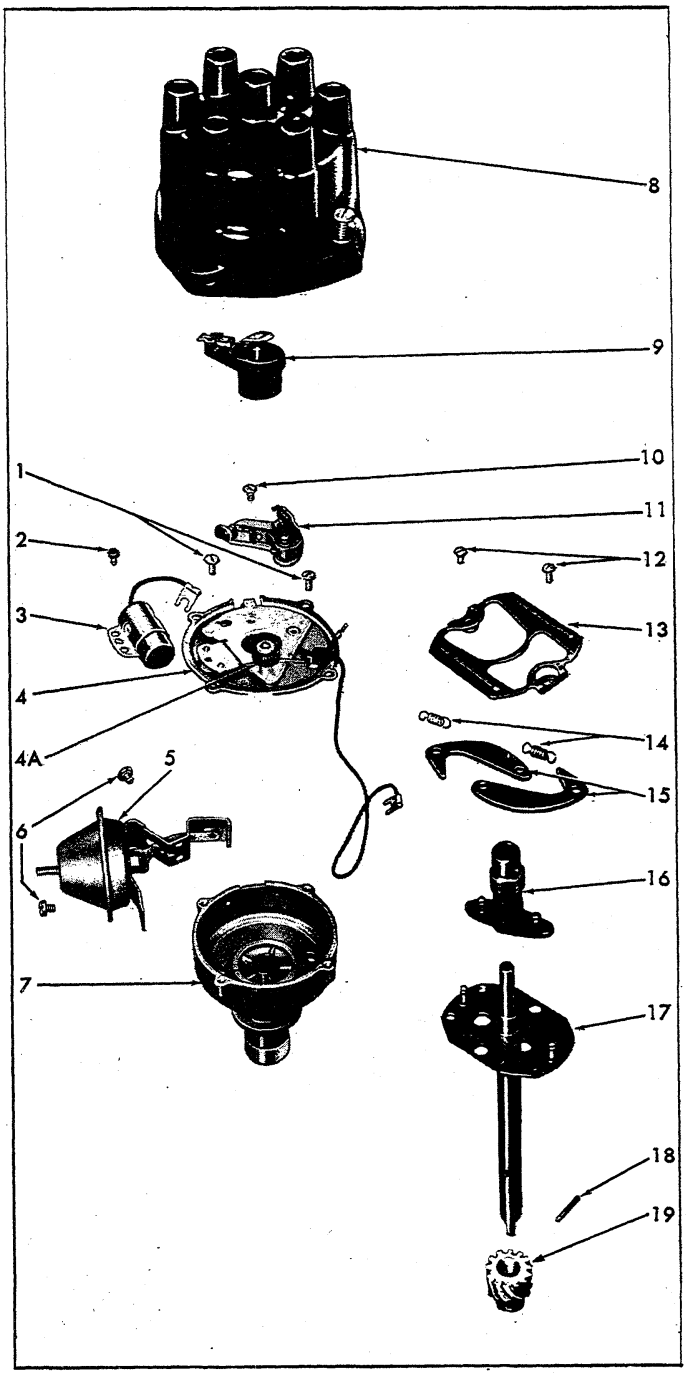


Fig. 12i—L-6 Distributor - Exploded View

1. Breaker Plate Attaching Screws
2. Condenser Attaching Screws
3. Condenser
4. Breaker Plate Assembly
4a. Cam Lubricator
5. Vacuum Control Assembly
6. Vacuum Control Attaching Screws
7. Housing
8. Cap
9. Rotor
10. Contact Point Attaching Screw
11. Contact Point Assembly
12. Weight Cover Attaching Screws
13. Weight Cover
14. Weight Springs
15. Advance Weights
16. Cam Assembly
17. Main Shaft Assembly
18. Roll Pin
19. Drive Gear

tor housing downward toward the gear to take up any end play between the gear and the housing.

NOTE: When testing distributors that have their lower shaft support bushing located in the engine block (6 cylinder engines), a special adapter should be used to insure the shaft will run true in its housing.

Test the distributor for variation of spark, correct centrifugal and vacuum advance and condition of contacts. This test will give valuable information on distributor condition and indicate parts replacement which may be necessary. Check the area on the breaker plate just beneath the contact points. A smudgy line indicates that oil or crankcase vapors have been present between the points.

Four and Six Cylinder Engines

Refer to Figure 12i.

1. Remove the rotor.
2. Remove the vacuum control assembly retaining screws, detach the unit from the distributor housing.
3. Disconnect the primary and condenser leads from the contact point quick disconnect terminal, remove the contact point set attaching screw, condenser attaching screw. Remove the point set and condenser from the breaker plate.
4. Remove the breaker plate attaching screws, remove the breaker plate from the distributor housing (fig. 12i).

   NOTE: Do not disassemble breaker plate any further.

5. Remove the roll pin retaining the driven gear to the mainshaft, slide the gear from the shaft.
6. Slide the cam and mainshaft from the distributor housing.
7. Remove the weight cover and stop plate screws, remove the cover, weight springs, weights and slide cam assembly from the mainshaft.

V-8 Engines

Refer to Figure 13i.

1. Remove the rotor.

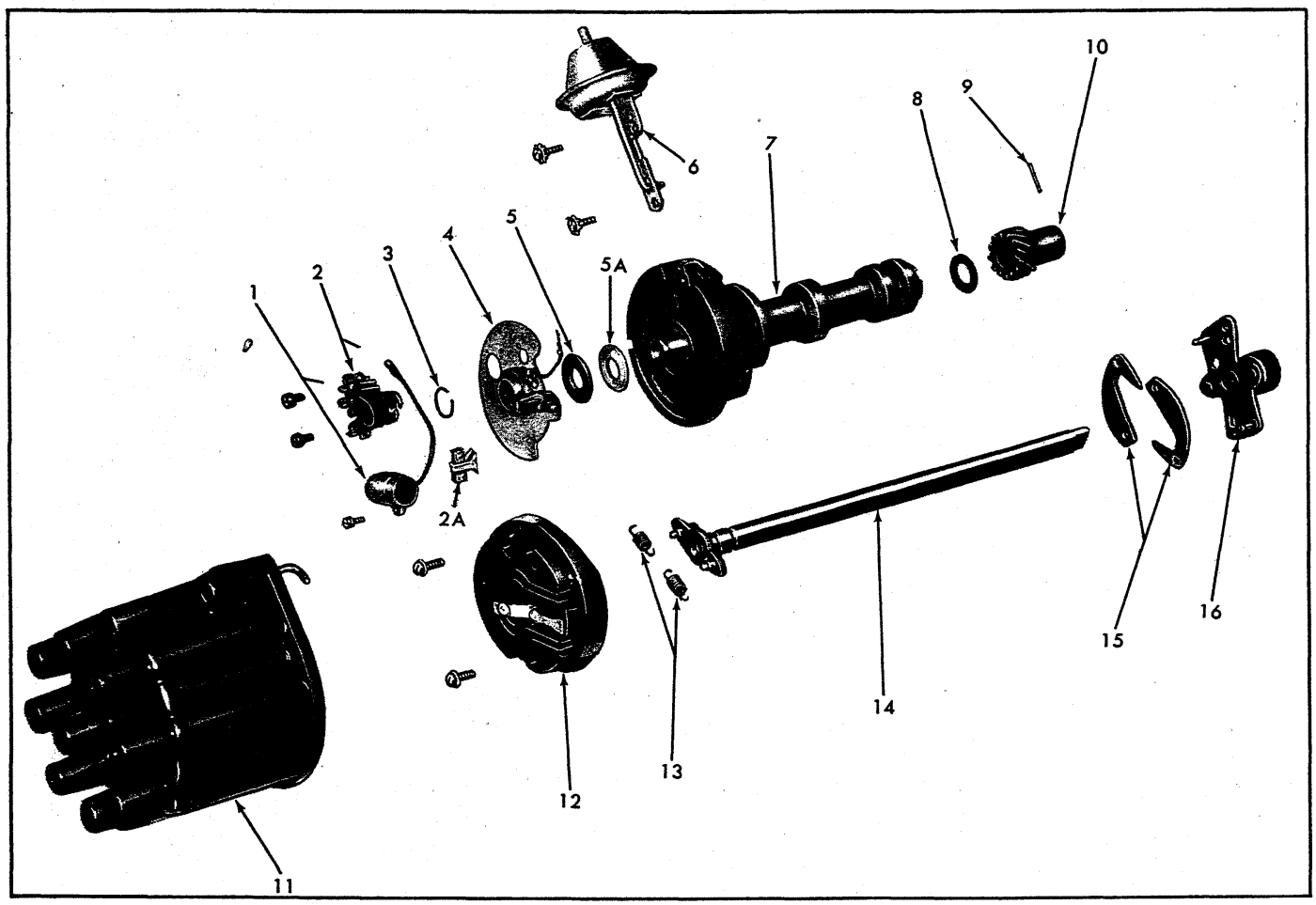


Fig. 13i—V-8 Distributor (Typical) - Exploded View

1. Condenser
2. Contact Point Assembly
2a. Cam Lubricator
3. Retaining Ring
4. Breaker Plate
5. Felt Washer
5a. Plastic Seal
6. Vacuum Advance Unit
7. Housing
8. Shim Washer
9. Drive Gear Pin
10. Drive Gear
11. Cap
12. Rotor
13. Weight Springs
14. Mainshaft
15. Advance Weights
16. Cam Weight Base Assembly

2. Remove both weight springs and advance weights.
3. Remove roll pin retaining driven gear to distributor shaft, slide the gear and spacers from the shaft. Remove tachometer drive gear on Corvette models.
4. Before sliding the distributor shaft from the housing, check for and remove any burrs on the shaft. This will prevent damage to the seals and bushing still positioned in the housing.
5. Slide the distributor mainshaft and cam-weight base assembly from the housing.
6. Remove vacuum advance mechanism retaining screws, remove the vacuum advance assembly.
7. Remove the spring retainer, remove the breaker plate assembly from the distributor housing. Remove the contact point and condenser from the breaker plate. Remove the felt washer and plastic seal located beneath the breaker plate.

Cleaning and Inspection

1. Wash all parts in cleaning solvent except cap, rotor, condenser, breaker plate assembly and vacuum control unit. Degreasing compounds may damage insulation of these parts or saturate the lubricating felt in the case of the breaker plate assembly.
2. Inspect the breaker plate assembly for damage or wear and replace if necessary.
3. Inspect the shaft for wear and check its fit in the bushings in the distributor body. If the shaft or bushings are worn, the parts should be replaced.
4. Mount the shaft in "V" blocks and check the shaft alignment with a dial gauge. The run-out should not exceed .002".
5. Inspect the advance weights for wear or burrs and free fit on their pivot pins.
6. Inspect the cam for wear or roughness. Then check its fit on the end of the shaft. It should be absolutely free without any roughness.
7. Inspect the condition of the distributor points. Dirty points should be cleaned and badly pitted points should be replaced. (See Distributor Contact Points.)
8. Test the condenser for series resistance, microfarad capacity (.18 to .23) and leakage or breakdown, following the instructions given by the manufacturer of the test equipment used.
9. Inspect the distributor cap and spark plug wires for damage and replace if necessary.

Assembly

Four and Six Cylinder Engine

Refer to Figure 12i for Exploded View of Distributor.

1. Replace cam assembly to mainshaft.

   NOTE: Lubricate top end of shaft with Delco can and ball bearing grease or equivalent prior to replacing.

2. Install governor weights on their pivot pins, replace weight springs. Install weight cover and stop plate.
3. Lubricate mainshaft and install it in distributor housing.
4. Install distributor driven gear to mainshaft and insert attaching roll pin. Check to see that shaft turns freely.
5. Install breaker plate assembly in the distributor body and attach retaining screws.
6. Attach condenser and contact point set in proper location with appropriate attaching screws.

   NOTE: Contact point set pilot must engage matching hole in breaker plate. Connect primary and condenser leads to contact set quick-disconnect terminal.

7. Attach vacuum control assembly to distributor housing.
8. Check and adjust contact point opening and alignment (See setting and alignment of points.)
9. Check breaker lever spring tension which should be 19-23 ounces. (See contact point replacement.)

V-8 Assembly—(Fig. 13i)

1. Fill housing lubricating cavity with proper compound, press in new plastic seal and install felt washer.
2. Replace the vacuum advance unit, install the breaker plate in housing and install the spring retainer on the upper bushing.
3. Lubricate and slide weight cam over mainshaft and install weights and spring (fig. 14i).
4. Insert mainshaft into housing, indexing it with drive gear and washers. Install tachometer drive gear on Corvette models.
5. Slide distributor drive gear shims and gear over shaft and install new pin. Tap new pin through gear and mainshaft. Check shaft for free rotation.

   NOTE: Mainshaft end clearance should be .002"-.007". Add or remove shims as necessary.

6. Install contact point set and condenser to breaker plate. Connect leads as shown in Figure 6i.

   NOTE: Contact point spring tension is factory-set above specifications to assure ease of final adjustment. Correct tension is 19-23 oz.

7. Install rotor to cam assembly, indexing round and square pilot holes.

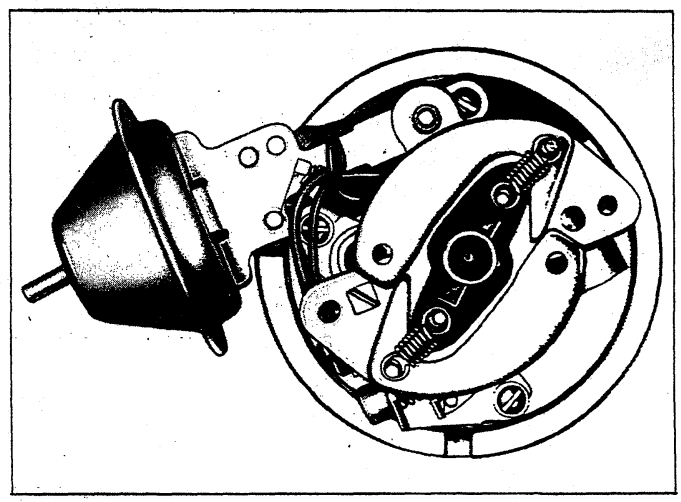


Fig. 14i—Advance Weights Installed

Installation—Engine Not Disturbed (All Models)

1. Turn the rotor about 1/8 turn in a clockwise direction past the mark previously placed on the distributor housing to locate rotor.
2. Push the distributor down into position in the block with the housing in a normal "installed" position (fig. 15i).

   NOTE: It may be necessary to move rotor slightly to start gear into mesh with camshaft gear, but rotor should line up with the mark when distributor is down in place.

3. Tighten the distributor clamp bolt snugly and connect vacuum line. Connect primary wire to coil terminal and install cap. Also install spark plug and high tension wires if removed.

   NOTE: It is important that the spark plug wires be installed in their proper location in the supports.

4. Time ignition as previously described under Tune-Up in Section 6.

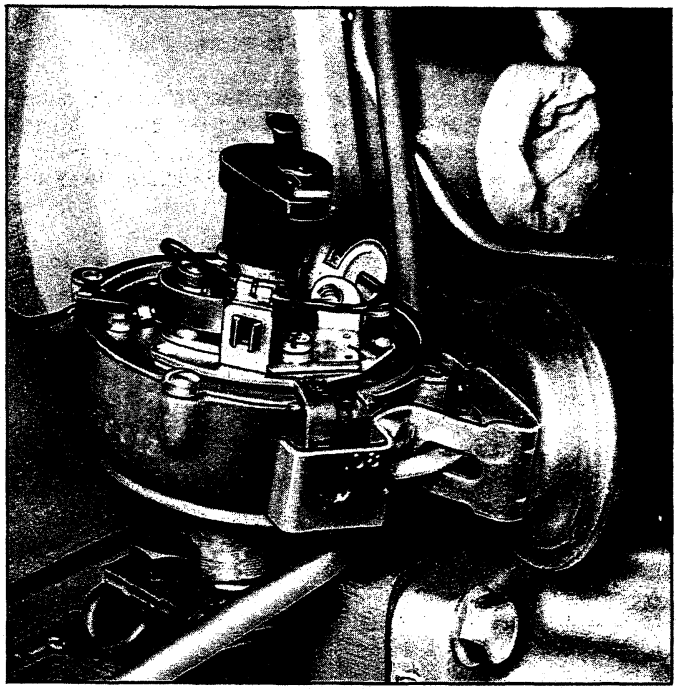


Fig. 15i—Six Cylinder Engine Distributor

Installation—Engine Disturbed (All Models)

1. Locate No. 1 piston in firing position by either of two methods described below.
   a. Remove No. 1 spark plug and, with finger on plug hole, crank engine until compression is felt in the No. 1 cylinder. Continue cranking until timing mark on crankshaft pulley lines up with timing tab attached to engine front cover.
   b. Remove rocker cover (left bank on V-8 engines) and crank engine until No. 1 intake valve closes and continue to crank slowly about 1/3 turn until timing mark on pulley lines up with timing tab.
2. Position distributor to opening in block in normal installed attitude (fig. 15i), noting position of vacuum control unit.
3. Position rotor to point toward front of engine (with distributor housing held in installed attitude), then turn rotor counter-clockwise approximately 1/8 turn more toward left cylinder bank and push distributor down to engine camshaft. It may be necessary to rotate rotor slightly until camshaft engagement is felt.
4. While pressing firmly down on distributor housing, kick starter over a few times to make sure oil pump shaft is engaged. Install hold-down clamp and bolt and snug up bolt.
5. Turn distributor body slightly until points just open and tighten distributor clamp bolt.
6. Place distributor cap in position and check to see that rotor lines up with terminal for No. 1 spark plug.
7. Install cap, check all high tension wire connections and connect spark plug wires if they have been removed. It is important that the wires be installed in their location in the supports.

   NOTE: The brackets are numbered to show the correct installation. Wires must be installed as indicated to prevent cross firing.

8. Connect vacuum line to distributor and distributor primary wire to coil terminal.
9. Start engine and set timing as described under Tune-Up in Section 6.

DISTRIBUTOR BREAKERLESS (MAGNETIC PULSE)

Removal (Corvette)

1. If vehicle is equipped with radio, remove three bolts securing ignition shield over distributor and coil. One bolt is accessible from the top of shield, the other two are at rear of shield, facing firewall.
2. Disconnect tachometer drive cables from distributor housing.
3. Disconnect pickup coil leads at connector.
4. Remove distributor cap.
5. Crank engine so rotor is in position to fire No. 1 cylinder and timing mark on harmonic balancer is indexed with pointer.
6. Remove vacuum line from distributor.
7. Remove distributor clamping screw and hold-down clamp.
8. Remove distributor and distributor-to-block gasket. It will be noted that the rotor will rotate as the distributor is pulled out of the block. Mark the relationship of the rotor and the distributor housing after removal so that the rotor can be set in the same position when the distributor is being installed.

Disassembly (Fig. 16i)

NOTE: If a distributor is being disassembled for replacement of the stationary magnetic pick-up assembly only, it will be necessary to perform only Steps 3, 4, 5, 7, 8, 9, and 12 of the service procedure listed below.

1. Remove screws securing rotor and remove rotor.
2. Remove centrifugal weight springs and weights.

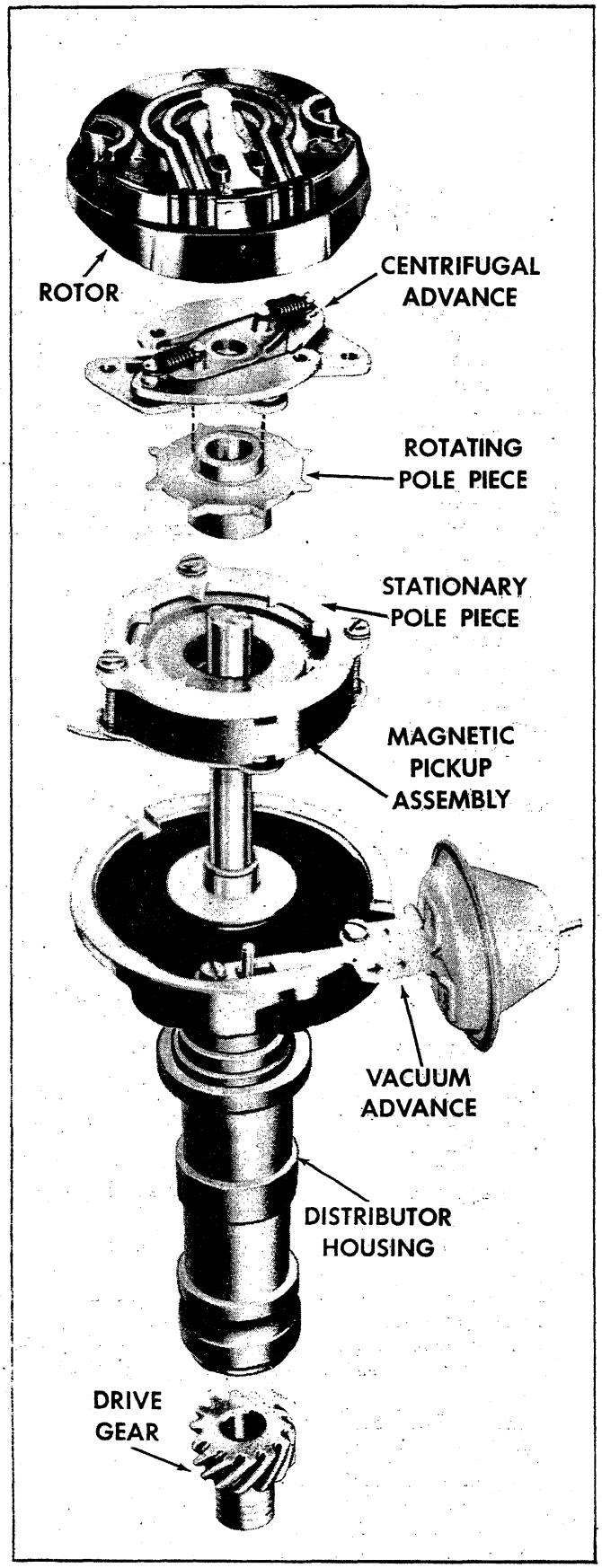


Fig. 16i—Magnetic Pulse Distributor Components

3. Remove the tachometer drive gear from the distributor (Corvette only).
4. Remove roll pin, then remove distributor drive gear and washer.

   CAUTION: To prevent damage to the permanent magnet, support drive gear when driving out roll pin.
5. Remove drive shaft assembly.
6. Remove centrifugal weight support and timer core from drive shaft.
7. Remove connector from pickup coil leads.
8. Remove retaining ring which secures magnetic core support plate to distributor shaft bushing in housing.
9. As a unit, remove the entire magnetic pickup assembly from the distributor housing.
10. Remove brass washer and felt pad.
11. Remove vacuum advance unit.
12. To reassemble distributor, perform the above steps in reverse order.

Installation (Corvette)

1. Check to see that the engine is at firing position for No. 1 cylinder (timing mark on harmonic balancer indexed with pointer).
2. Position a new distributor-to-block gasket on the block.
3. Before installing distributor, index rotor with housing as noted when distributor was removed. Install distributor in block so that vacuum diaphragm faces approximately 45° forward on the right side of the engine and the rotor points toward contact in cap for No. 1 cylinder.
4. Replace distributor clamp leaving screw loose enough to allow distributor to be turned for timing adjustment.
5. Install spark plug wires in distributor cap. Place wire for No. 1 cylinder in tower (marked on old cap during assembly) then install remaining wires clockwise around the cap according to the firing order (1-8-4-3-6-5-7-2).
6. Attach distributor to coil primary wires.
7. Replace distributor cap.
8. Adjust timing and then fully tighten distributor clamp screw.
9. Attach vacuum line to distributor.
10. Connect tachometer drive cables to distributor body.
11. Replace ignition shields.

DISTRIBUTOR OFF-ENGINE TEST

The distributor's centrifugal and vacuum advance can be checked in a distributor testing machine or synchroscope specially adapted or designed to accommodate this type distributor. However, since this involves removing the distributor from the engine, this test may be postponed until other system checks have been made. A dwell reading cannot be obtained on this distributor and it is not likely that the centrifugal or vacuum advance will be a cause of trouble.

COIL REPLACEMENT

1. Disconnect ignition switch and distributor leads from terminals on coil. On Corvettes equipped with radio, remove bolts securing ignition shield over distributor and coil.

2. Pull high tension wire from center terminal of coil.
3. Remove the two coil support mounting bolts or loosen friction clamp screw and remove coil.
4. Place new coil in position and install attaching bolts or tighten clamp screw.
5. Place high tension lead securely in center terminal of coil and connect ignition switch and distributor primary leads to terminals on coil. Replace ignition shield on Corvettes.
6. Start engine and test coil operation.

IGNITION PULSE AMPLIFIER

Disassembly

To check the amplifier for defective components, proceed as follows:

1. Remove the bottom plate from the amplifier.
2. To aid in reassembly, note the locations of the lead connections to the panel board.
3. Remove the three panel board attaching screws, and lift the assembly from the housing.
4. To aid in reassembly, note any identifying markings on the two transistors and their respective locations on the panel board and heat sink assembly.
5. Note the insulators between the transistors and the heat sink, and the insulators separating the heat sink from the panel board.
6. Remove the transistor attaching screws, and separate the two transistors and heat sink from the panel board.
7. Carefully examine the panel board for evidence of damage.

Component Checks (Figs. 17i and 18i)

With the two transistors separated from the assembly, an ohmmeter may be used to check the transistors and components on the panel board for defects. An ohmmeter having a 1-1/2 volt cell, which is the type usually found in service stations, is recommended. The low range scale on the ohmmeter should be used except where specified otherwise.

A 25 watt soldering gun is recommended, and a 60% tin 40% lead solder should be used when re-soldering. Avoid excessive heat which may damage the panel board. Clip away any epoxy involved, and apply new epoxy which is commercially available.

In order to check the panel board assembly, it is necessary to unsolder at the locations indicated in Figure 18i the two capacitors C2 and C3. In all of the following checks, connect the ohmmeter as shown and then reverse the ohmmeter leads to obtain two readings. The amplifier circuitry is shown in Figure 19i.

1. Transistors TR1 and TR2: Check each transistor by referring to Figure 20i. If both readings in Step 1 are zero, the transistor is shorted. If both readings in Step 2 are zero, the transistor is shorted; and if both readings are infinite, the transistor is open. Interpret Step 3 the same as Step 2.
2. Trigger Transistor TR3: If both readings in Step 1 are zero, the transistor is shorted. If both readings in Step 2 are zero, the transistor is shorted; and if both readings are infinite, the transistor is open. Interpret Step 3 the same as Step 2.
3. Diode D1: If both readings are zero, the diode is shorted; and if both readings are infinite, the diode is open.
4. Capacitor C1: If both readings are zero, the capacitor is shorted.
5. Capacitors C2 and C3: Connect the ohmmeter across each capacitor (not illustrated). The capacitor is shorted if both readings are zero.
6. Resistor R1: The resistor is open if both readings are infinite.

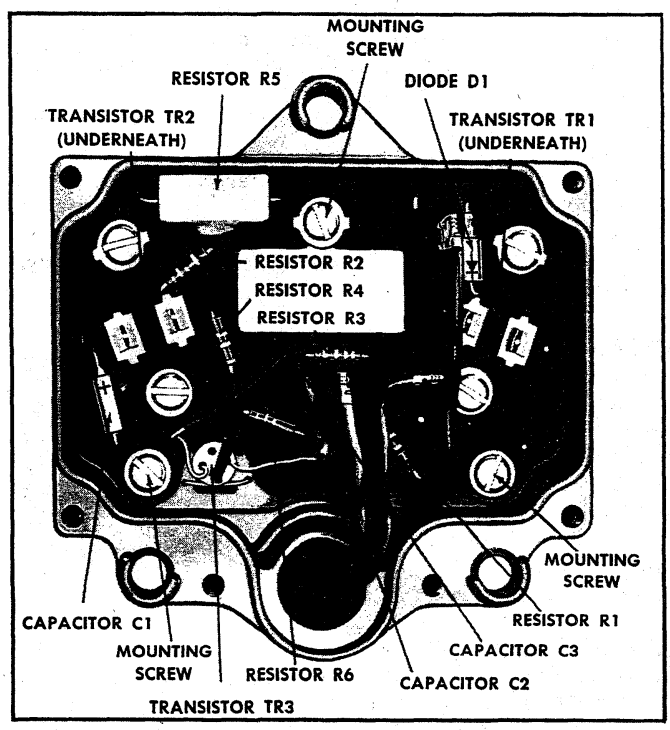


Fig. 17i—Ignition Pulse Amplifier Panel Board

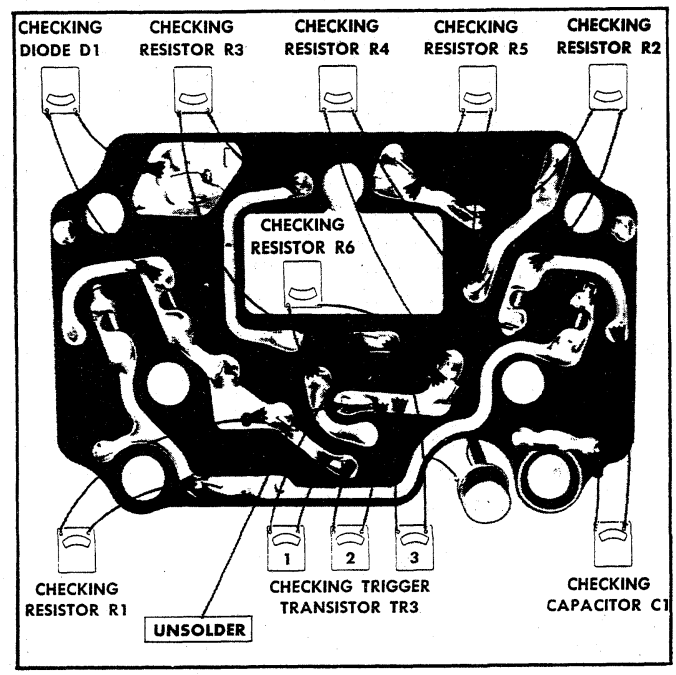


Fig. 18i—Ignition Pulse Amplifier Component Checks

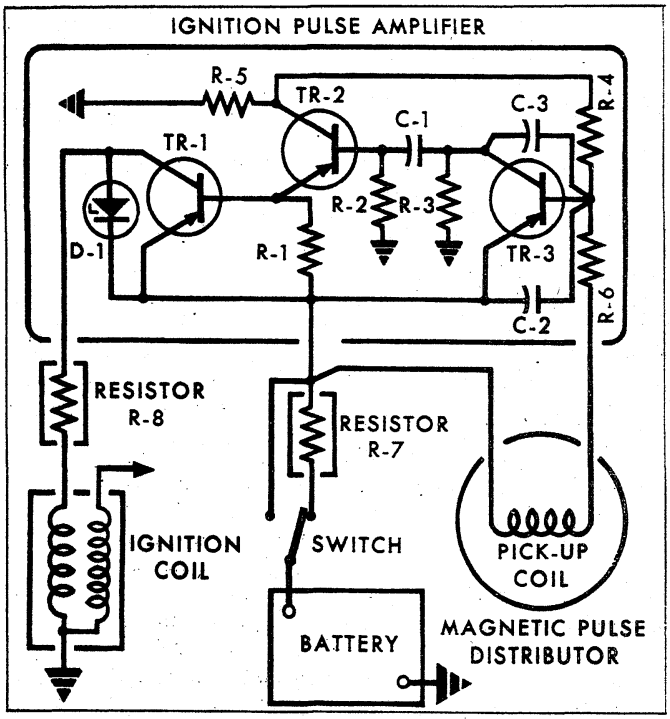


Fig. 19i—Ignition Pulse Amplifier Internal Circuitry

7. Resistor R2: Use an ohmmeter scale on which the 1800 ohm value is within, or nearly within, the middle third of the scale. If both readings are infinite, the resistor is open.
8. Resistor R3: Use an ohmmeter scale on which the 680 ohm value is within, or nearly within, the middle third of the scale. If both readings are infinite, the resistor is open.
9. Resistor R4: Select an ohmmeter scale on which the 15000 ohm value is within, or nearly within, the middle third of the scale. If either reading is infinite, the resistor is open.
10. Resistor R5: Use the lowest range ohmmeter scale. The resistor is open if either reading is infinite.

    NOTE: This resistor on some applications may be located in the vehicle wiring harness, and not on the panel board.

11. Resistor R6: An ohmmeter scale on which the 150 ohm value is within or nearly within, the middle third of the scale should be used. If both readings are infinite, the resistor is open.

Reassembly

During assembly, coat with silicone grease both sides of the flat insulators used between the transistors and heat sink, and also the heat sink on the side on which the transistors are mounted. The silicone grease, which is available commercially, conducts heat and thereby provides better cooling.

SPARK PLUGS

Cleaning and Regapping

Clean the spark plugs thoroughly, using an abrasive type cleaner. If the porcelains are badly glazed or

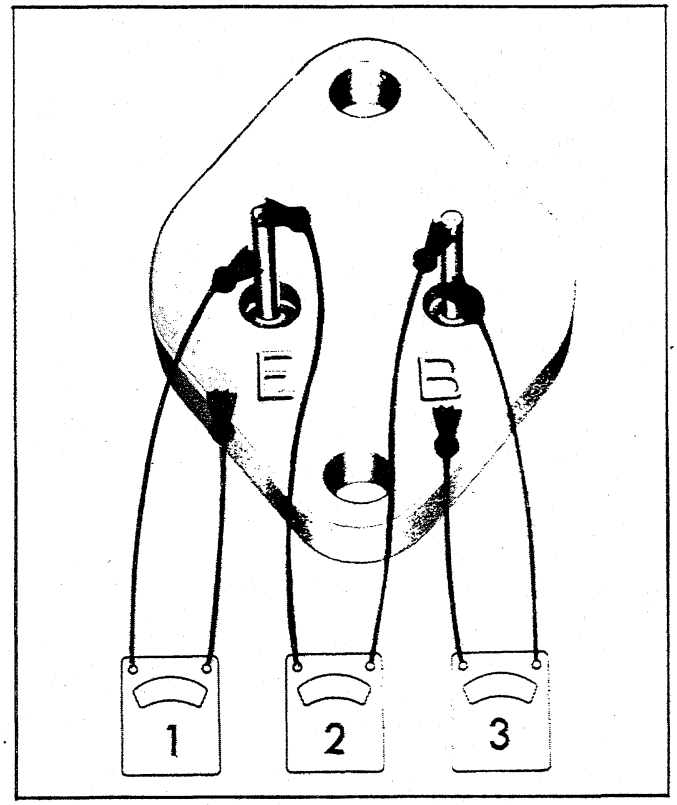


Fig. 20i—Transistor Checks

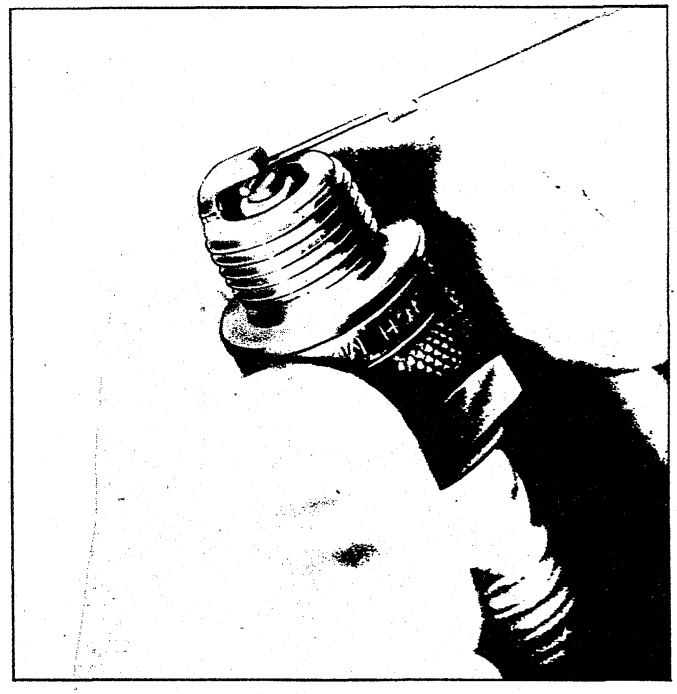


Fig. 21i—Checking Spark Plug Gap

blistered, the spark plugs should be replaced. All spark plugs must be of the same make and number or heat range. Use a round feeler gauge to adjust the spark plug gap to specifications (fig. 21i).

CAUTION: Before adjusting gap, file center electrode flat. In adjusting the spark plug gap, never bend the center electrode which extends through the porcelain center. Always make adjustment by bending the ground or side electrode.

Installation

Install the spark plugs in the engine with new gaskets and tighten to specifications. If torque wrench is not available, tighten plugs finger tight and 1/2 turn more. Plugs are of a 14 millimeter size and care must be exercised when installing or the gap setting may be changed.

STARTER CIRCUIT

INDEX

	Page		Page
General Description	6Y-31	Service Operations	6Y-33
Maintenance and Adjustments	6Y-32	Starter Motor	6Y-33
Resistance Checks	6Y-32	Removal and Installation	6Y-33
Starting Motor and Solenoid Check	6Y-32		

GENERAL DESCRIPTION

The function of the starting system, composed of the starting motor, solenoid and battery, is to crank the engine. The battery supplies the electrical energy, the solenoid completes the circuit to the starting motor, and the motor then does the actual work of cranking the engine.

The starting motor (fig. 1s) consists primarily of the drive mechanism, frame, armature, brushes, and field windings. The starting motor is a pad mounted 12-volt extruded frame type, having four pole shoes and four fields, connected with the armature. The aluminum drive end housing is extended to enclose the entire shift lever and plunger mechanism, protecting them from dirt, splash, and icing. The drive end frame also includes a grease reservoir to provide improved lubrication of the drive end bearing. The flange mounted solenoid switch operates the overrunning clutch drive by means of a linkage to the shaft lever.

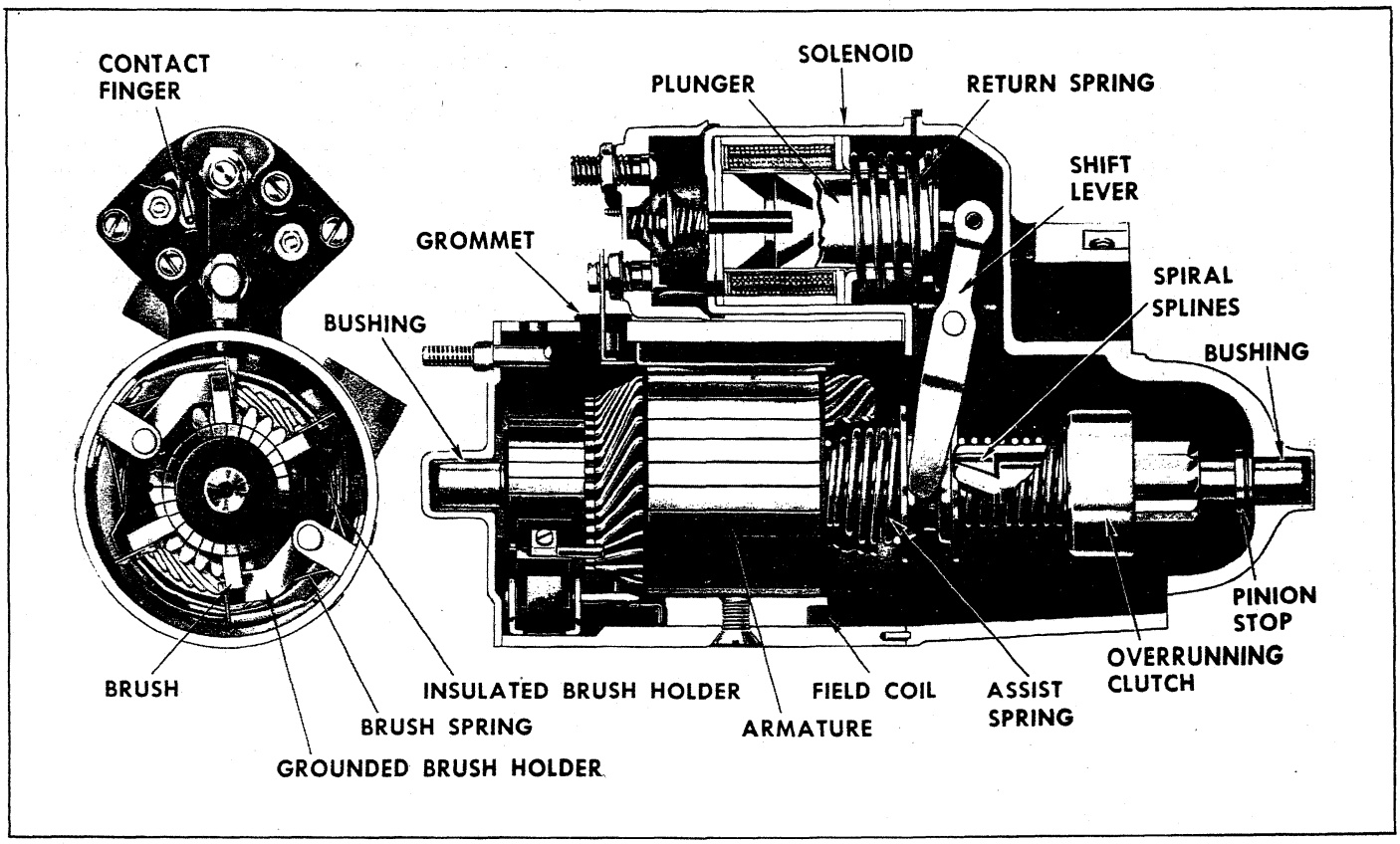


Fig. 1s—Starting Motor Cross Section (Typical)

MAINTENANCE AND ADJUSTMENTS

No periodic lubrication of the steering motor solenoid is required. Since the starting motor and brushes cannot be inspected without disassembling the unit, no service is required on these units between overhaul periods.

RESISTANCE CHECKS

Although the starting motor cannot be checked against specifications on the car, a check can be made for excessive resistance in the starting circuit (Fig. 2s). Place a voltmeter across points in the cranking circuit as outlined below and observe the reading with the starting switch closed and the motor cranking (distributor primary lead grounded to prevent engine firing).

1. From battery positive post To solenoid battery terminal.
2. From battery negative post To starting motor housing.
3. From solenoid battery terminal To solenoid motor terminal.

If voltage drop in any of above check exceeds 0.2 volts, excessive resistance is indicated in that portion of starting circuit and the cause of the excessive resistance should be located and corrected in order to obtain maximum efficiency in the circuit.

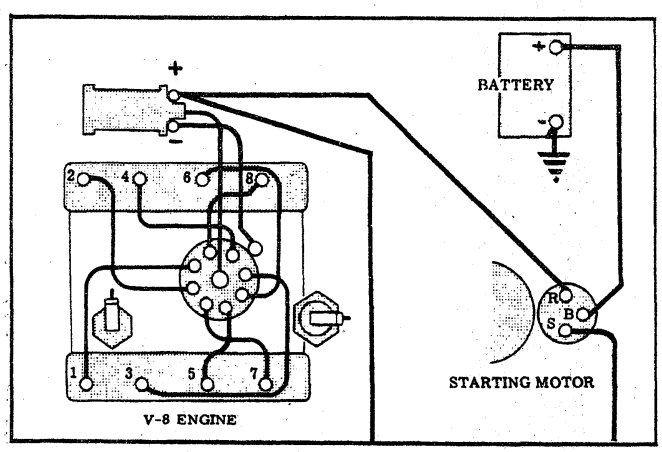


Fig. 2s—V-8 Starting Circuit Diagram

CAUTION: Do not operate the starting motor continuously for more than 30 seconds in order to avoid overheating.

When the solenoid fails to pull in, the trouble may be due to excessive voltage drop in the solenoid control circuit. To check for this condition, close the starting switch and measure the voltage drop between the BATTERY terminal of the solenoid and the SWITCH(S) terminal of the solenoid.

1. If this voltage drop exceeds 3.5 volts, excessive resistance in the solenoid control circuit is indicated and should be corrected.
2. If the voltage drop does not exceed 3.5 volts and the solenoid does not pull in, measure the voltage available at the SWITCH terminal of the solenoid.
3. If the solenoid does not feel warm, it should pull in whenever the voltage available at the SWITCH terminal is 7.7 volts or more. When the solenoid feels warm, it will require a somewhat higher voltage to pull in.

STARTING MOTOR AND SOLENOID CHECK

The following checks may be made if the specific gravity of the battery is 1.215 or higher.

1. If the solenoid does not pull in, measure the voltage between the switch(S) terminal of the solenoid and ground with the starting switch closed.

   CAUTION: If the solenoid feels warm, allow to cool before checking.

   If the voltage is less than 7.7 volts, check for excessive resistance in the solenoid control circuit. If the voltage exceeds 7.7 volts, remove the starting motor and check (1) solenoid current draw, (2) starting motor pinion clearance, and (3) freedom of shift lever linkage.
2. If the solenoid "chatters" but does not hold in, check the solenoid for an open "hold-in" winding. Whenever it is necessary to replace a starting motor solenoid, always check starting motor pinion clearance.
3. If motor engages but does not crank or cranks slowly, check for excessive resistance in the external starting circuit, trouble within the starting motor, or excessive engine resistance to cranking.

SERVICE OPERATIONS

STARTING MOTOR

Removal and Installation (Fig. 3s)

The following procedure is a general guide for all vehicles and will vary slightly depending on series and model.

1. Disconnect battery ground cable at battery.
2. Raise vehicle to a good working height.
3. Disconnect all wires at solenoid terminals.

   NOTE: Reinstall the nuts as each wire is disconnected as thread size is different but may be mixed and stripped.

4. Loosen starter front bracket (nut on V-8 and bolt on L-6) then remove two mount bolts.

   NOTE: On V-8 Engines incorporating solenoid heat shield, remove front bracket upper bolt and detach bracket from starter motor.

5. Remove the front bracket bolt or nut and rotate bracket clear of work area then lower starter from vehicle by lowering front end first -- (hold starter against bell housing and sort of roll end-over-end).

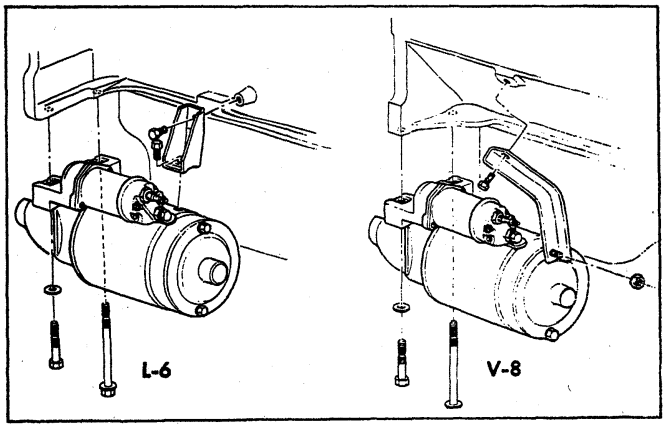


Fig. 3s—Starter Mounting and Solenoid Connections

6. Reverse the removal procedure to install. Torque the mount bolts to 25-35 ft. lbs. first, then torque brace bolt.
7. Check operation of starter on vehicle.

SPECIAL TOOLS

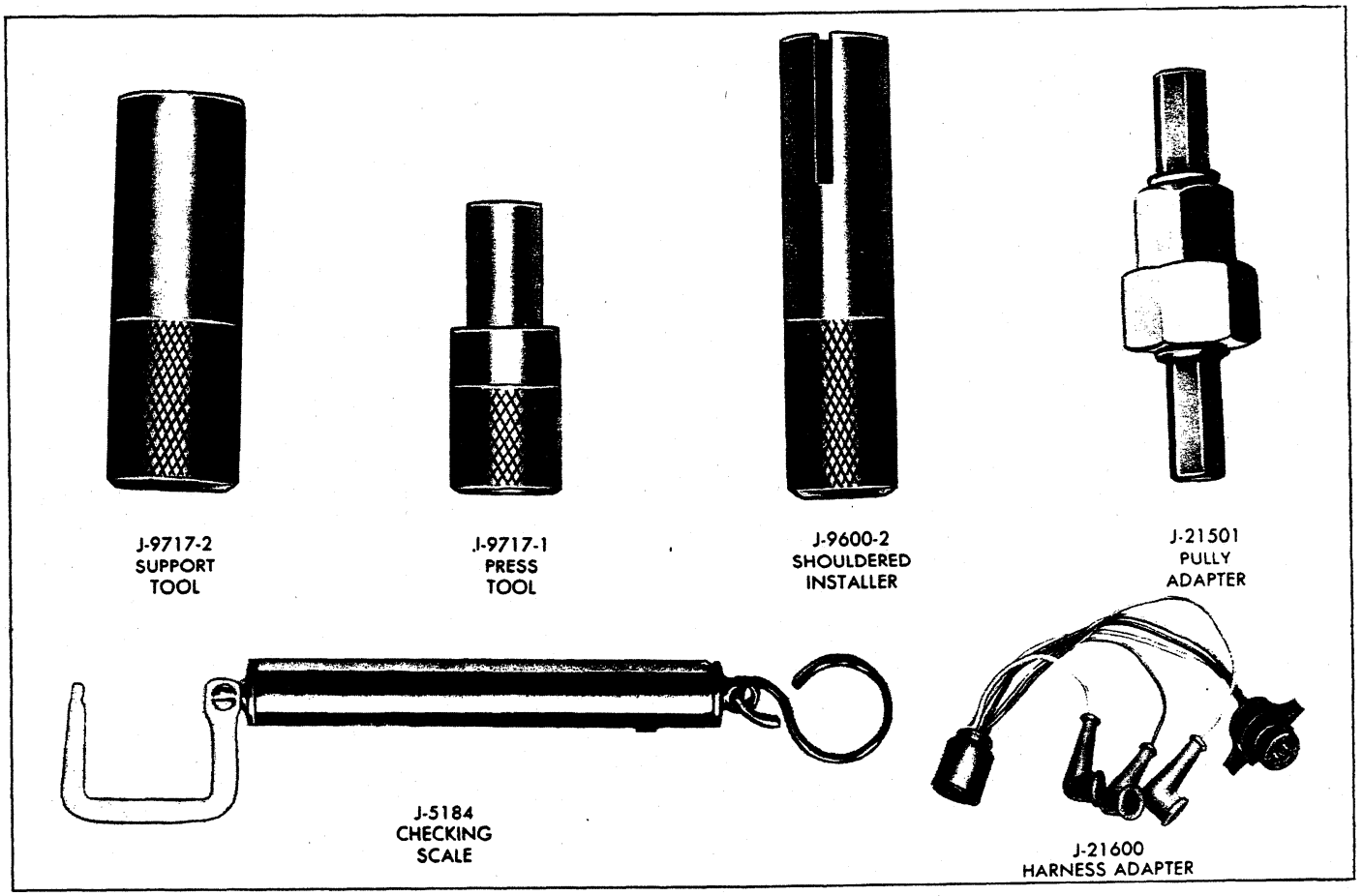


Fig. 4s—Special Tools

SECTION 7
CLUTCH AND TRANSMISSIONS

CONTENTS OF THIS SECTION

	Page		Page
Clutch	7-1	Turbo Hydra-Matic 350	7-28
Three-Speed Transmissions	7-6	Turbo Hydra-Matic 400	7-38
Four-Speed Transmissions	7-11	Special Tools	7-48
Powerglide and Torque Drive	7-16		

CLUTCH

INDEX

	Page		Page
General Description	7-1	Installation in Vehicle	7-2
Maintenance and Adjustments	7-1	Clutch Pedal	7-3
Linkage Inspection	7-1	Clutch Cross Shaft	7-3
Clutch Linkage Adjustment	7-1	Removal	7-3
Component Parts Replacement	7-2	Repairs	7-3
Clutch Assembly	7-2	Installation	7-3
Removal from Vehicle	7-2		

GENERAL DESCRIPTION

The diaphragm spring type clutch assemblies used with the different engine-transmission combinations consist of single plate units with two designs of diaphragm springs, flat and bent finger, and a dual plate bent finger spring type clutch. The latter unit is an optional heavy duty clutch assembly used with Mark IV engines having a 14-inch ring gear diameter.

The integral release fingers in the bent finger designs are bent back to gain a centrifugal boost and to insure quick reengagement at high engine speeds. This type of clutch has the advantages of increasing pressure plate load as the driven plate wears, and of low pedal effort with high plate load without requiring over center booster springs on the clutch linkage.

The clutch release bearing (fig. 3) used with the bent finger design has an overall length of 1-1/4" and is shorter than the release bearing used with the flat finger design clutch. Do not interchange the two bearings. The longer bearing, if used with the bent finger spring clutch, will cause inability to obtain free pedal travel, especially as the clutch wears, resulting in slippage and rapid wear.

The return spring preloads clutch linkage, removing looseness due to wear. The clutch free pedal travel, therefore, will increase with linkage wear and decrease with driven disc wear and the free travel felt at the clutch pedal is throwout bearing lash.

MAINTENANCE AND ADJUSTMENTS

LINKAGE INSPECTION

There are several things which affect good clutch operations. Therefore, it is necessary, before performing any major clutch operations, to make preliminary inspections to determine whether trouble is actually in the clutch.

Check the clutch linkage to be sure the clutch releases fully as follows:

1. With engine running, hold the clutch pedal approximately 1/2" from floor mat and move shift lever between first and reverse several times. If this can be done smoothly, the clutch is fully releasing. If shift is not smooth, clutch is not fully releasing and adjustment is necessary.
2. Check clutch pedal bushings for sticking or excessive wear.
3. Check fork for proper installation on ball stud. Lack of lubrication on fork can cause fork to be pulled off the ball.
4. Check for bent, cracked or damaged cross shaft levers or support bracket.
5. Loose or damaged engine mounts may allow the engine to shift its position causing a bind on clutch linkage at the cross shaft. Check to be sure there is some clearance between cross shaft and both mounting bracket.
6. Check throw out bearing end clearance between spring fingers and front bearing retainer on the transmission. If no clearance exists, fork may be improperly installed on ball stud or clutch disc may be worn out.

CLUTCH LINKAGE ADJUSTMENT

There is one linkage adjustment (clutch fork push rod or pedal push rod) to compensate for all normal clutch wear.

The clutch pedal should have free travel (measured at clutch pedal pad) before the throwout bearing engages the clutch diaphragm spring levers. Lash is required to prevent clutch slippage which would occur if the bearing was held against the fingers or to prevent the bearing from running continually until failure. A clutch

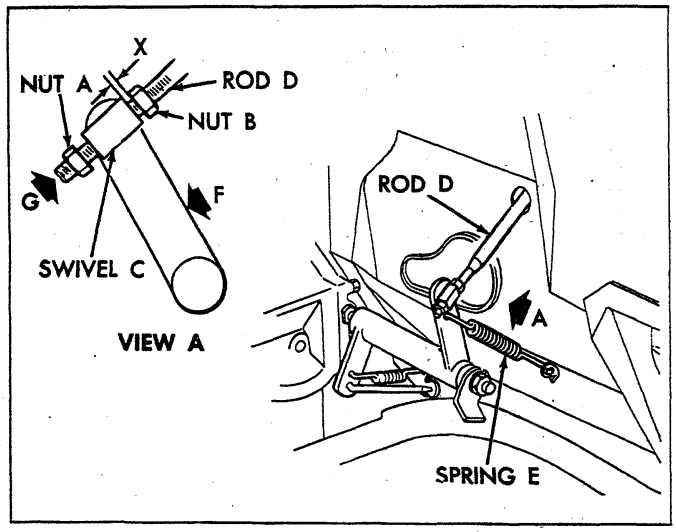


Fig. 1—Chevrolet Clutch Pedal Free Travel Adjustment

that has been slipping prior to free play adjustment may still slip right after the new adjustment due to previous heat damage. The vehicle should be returned to the Dealership the next day (at least 12 hours) to give clutch time to cool to normal temperatures. Any slippage should then be evaluated as follows:

1. Drive in high gear at 20-25 MPH.
2. Depress clutch pedal to the floor and rev engine to 2500-3500 rpm.
3. Engage clutch quickly (snap foot off pedal) and press accelerator to full throttle.

Engine speed should drop noticeably then accelerate with vehicle. If clutch is bad, the engine speed will increase.

NOTE: Do not repeat more than once or clutch will overheat.

Chevrolet and Corvette (Fig. 1)

1. Disconnect spring (E) between clutch push rod and cross shaft lever.
2. With clutch pedal against stop: loosen jam nuts sufficiently to allow the adjusting rod to move against the clutch fork until the release bearing contacts the pressure plate fingers lightly.
3. Rotate upper nut (B) against swivel and back off 4-1/2 turns. Tighten lower nut (A) to lock swivel against nut (B).
4. Install return spring (E) and check clutch pedal free travel. Pedal free travel should be:
   a. Chevrolet - 1" to 1-1/2"
   b. Corvette (STD) - 1-1/4" to 2"
   c. Corvette (HVY DTY) - 2" to 2-1/2"

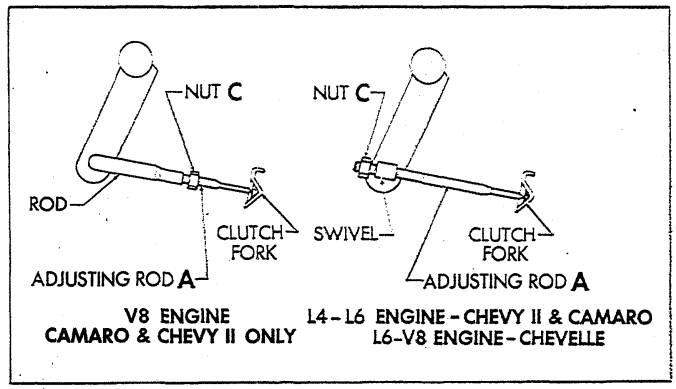


Fig. 2—Clutch Pedal Free Travel Adjustment—Except Chevrolet

Chevelle, Chevy II and Camaro (Fig. 2)

1. Disconnect return spring at clutch fork.
2. With clutch pedal against stop: loosen locknut (C) sufficiently to allow the adjusting rod to be turned out of swivel and against clutch fork until the release bearing contacts pressure plate fingers lightly.
3. Rotate push rod into swivel 3 turns and tighten locknut.

   NOTE: Chevy II and Camaro V-8 engine models use a two piece push rod. Turn adjusting rod portion of push rod 3 turns into rod end then tighten locknut.

4. Reinstall return spring and check pedal free travel. Pedal free travel should be:
   a. Chevelle - 1-1/8" to 1-3/4"
   b. Chevy II and Camaro - 1" to 1-1/8"

COMPONENT PARTS REPLACEMENT

CLUTCH ASSEMBLY

Removal From Vehicle

1. Support engine and remove transmission as outlined in transmission section.
2. Disconnect clutch fork push rod and spring.
3. Remove flywheel housing.
4. Slide clutch fork from ball stud and remove fork from dust boot.

   NOTE: Ball stud is threaded into clutch housing and is easily replaced, if necessary.

5. Install Tool J-5824 to support the clutch assembly during removal.

   NOTE: Look for "X" mark on flywheel and on clutch cover. If "X" mark is not evident, prick punch marks on flywheel and clutch cover for indexing purposes during installation.

6. Loosen the clutch-to-flywheel attaching bolts evenly 1 turn at a time until spring pressure is released, then remove the bolts, and remove clutch assembly.

Installation to Vehicle

Clean pressure plate and flywheel face. (They should be free of oil, grease, metal deposits or burned spots).

1. Position the clutch disc and pressure plate in relative installed position and support them with alignment Tool J-5824.

   NOTE: The driven disc is installed with the damper springs to the transmission side. THE GREASE SLINGER IS ALWAYS ON THE TRANSMISSION SIDE.

2. Turn clutch assembly until "X" mark on cover lines up with "X" mark on flywheel, then align cover bolt holes to nearest flywheel holes.

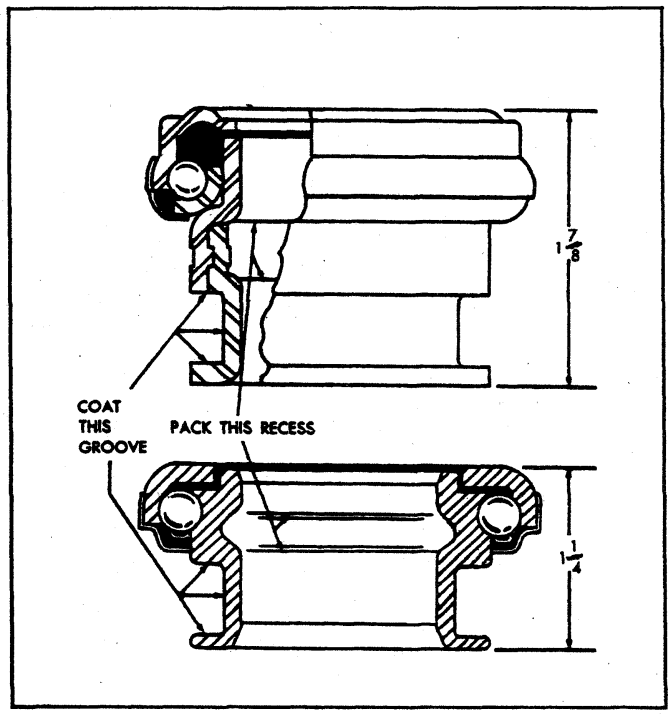


Fig. 3—Release Bearing Lubrication and Comparison

3. Install a bolt in every hole and tighten down evenly and gradually until tight (to avoid possible clutch distortion).

   NOTE: Cover loads are as high as 1-1/4 tons.

4. Remove pilot tool.
5. Unhook clutch fork and lubricate ball socket and fork fingers at release bearing end with a high melting point grease such as graphite and reinstall fork on ball stud. On Corvette models use Moly Grease.
6. Lubricate the recess on the inside of throwout bearing collar and the throwout fork groove with a light coat of graphite grease (fig. 3). On Corvette models use Moly Grease.
7. Install clutch fork and dust boot into clutch housing and install throwout bearing to the throwout fork, then install flywheel housing.
8. Install transmission as outlined in transmission section.
9. Connect fork push rod and spring.
10. Adjust shift linkage as outlined in transmission section.
11. Perform linkage adjustment for pedal free play and check clutch release position.

CLUTCH PEDAL (Fig. 4)

The clutch pedal is the pendant-type hung from a support brace common to the brake pedal and must be removed to remove brake pedal. Refer to Section 5 for brake and clutch pedal service procedure.

CLUTCH CROSS SHAFT (Fig. 5)

Removal

1. Remove linkage return and lower linkage springs and disconnect clutch pedal and fork push rods from respective cross shaft levers.
2. Loosen outboard ball stud nut and slide stud out of bracket slot.
3. Move cross shaft outboard, and as required to clear inboard ball stud, then merely lift out to remove from vehicle.

Repairs

The cross shaft has nylon ball stud seats which should be inspected for wear or damage. Also check condition of engine bracket ball stud assembly and special anti-rattle "O" ring. Figures show component parts of cross shaft. Replace parts as necessary based on wear or damage. Lubricate ball studs and seats with graphite grease before reassembly.

Installation

1. Reverse removal procedure to install.
2. Adjust clutch linkage as previously outlined.

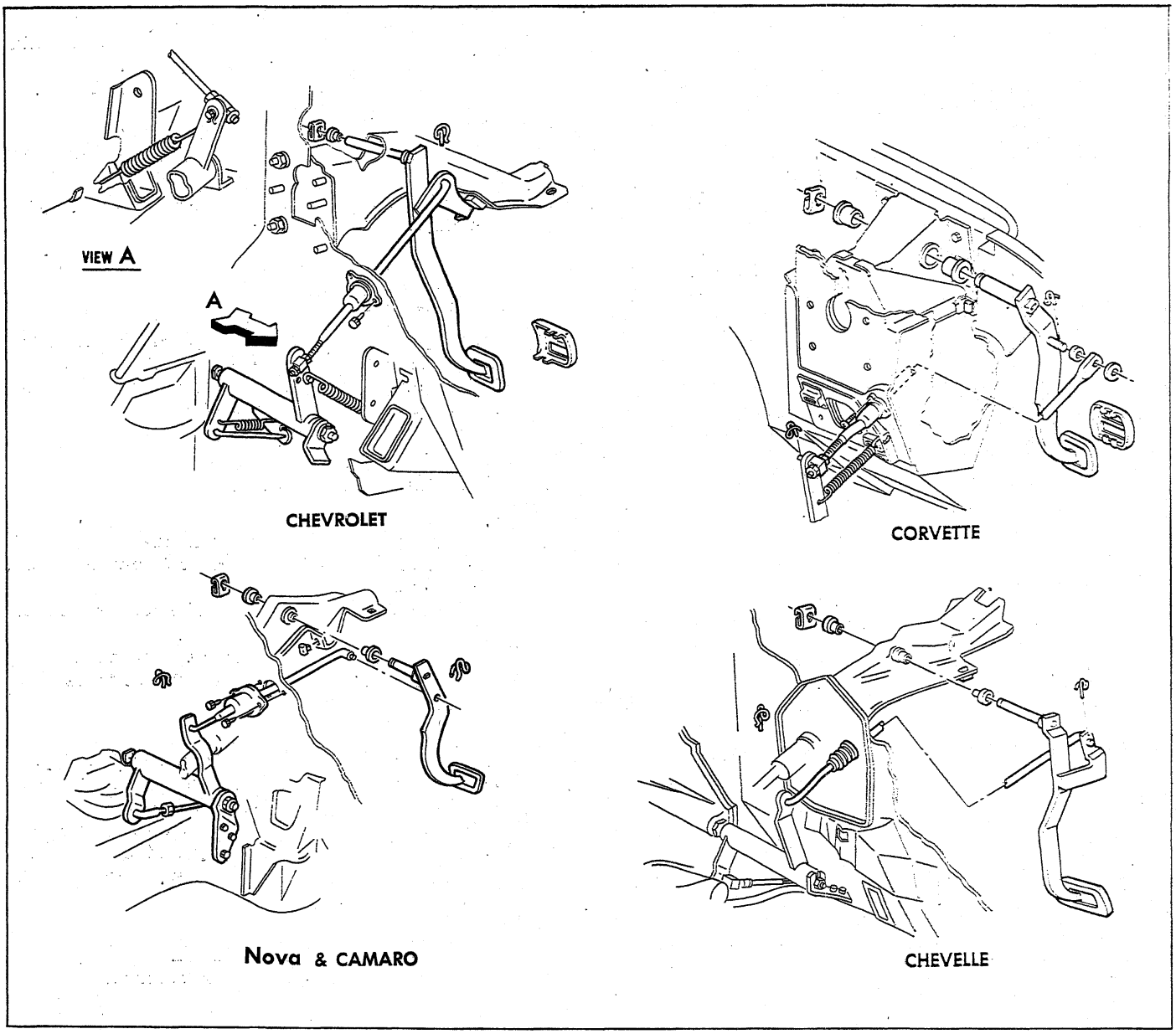


Fig. 4—Clutch Pedal Linkage

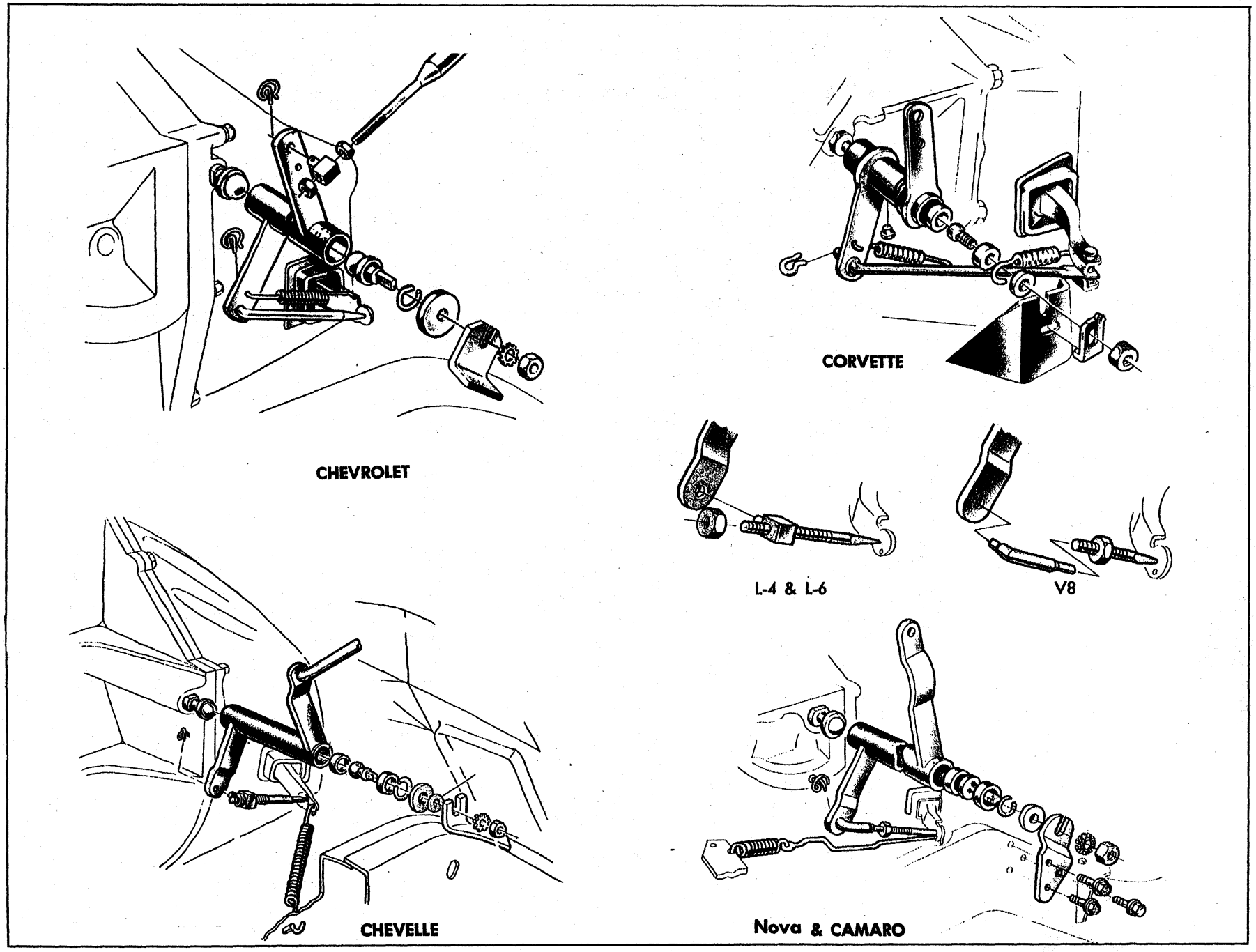


Fig. 5—Clutch Lower Linkage Details

THREE-SPEED TRANSMISSIONS (SAGINAW AND MUNCIE)

INDEX

	Page		Page
General Description	7-6	Transmission Side Cover	7-9
Maintenance and Adjustments	7-6	Removal	7-9
Shift Linkage Adjustment	7-6	Disassembly	7-10
Back Drive Linkage Adjustment	7-7	Assembly	7-10
Shift Control Lever and Bracket Assembly Replacement	7-8	Installation	7-10
Speedometer Driven Gear and Seal Replacement	7-9	Transmission Replacement	7-10
Extension Oil Seal Replacement	7-9	Removal	7-10
		Installation	7-10

GENERAL DESCRIPTION

There are two fully synchronized three-speed manual transmissions available with the 1969 passenger car; Saginaw and Muncie. The Muncie is utilized where ever heavy duty performance is required.

The Muncie three-speed is completely different from previous Muncie models and component parts are not interchangeable. This transmission, however, is very similar to the present Saginaw three-speed but has a 3.25 inch center distance instead of 3.00 inches. It has an iron case and larger bearings, output shaft, mainshaft, and gears.

The three-speed manual transmissions are fully synchronized in all forward gears and incorporate helical drive gears throughout. The main drive gear is supported by a ball bearing at the front end of the transmission and is piloted at the front end in an oil impregnated bushing mounted in the engine crankshaft. The front end of the mainshaft is piloted in a row of roller bearings set into the hollow end of the main drive gear and is carried at the rear end by a bearing mounted in the front of the extension housing.

The countergear is carried on rollers at both ends and thrust is taken on thrust washers located between the ends of the gear and the thrust bosses in the case. An anti-rattle plate assembly at the front of the countergear on Saginaw and Muncie models provides a constant spring tension between the counter and clutch gears to reduce torsional vibrations. The reverse idler gear is carried on a bushing finish bored in place and thrust is taken on the thrust bosses of the case.

Gear shifting is manual through shift control rods from the shifter tube in the mast jacket to the rearward shift lever of the side cover assembly for first and reverse gear; and through a cross shaft assembly attached to the forward side cover lever for second and third gear. All three forward gears are fully synchronized. The synchronizer assemblies consist of a clutch hub, clutch sleeve, two clutch key springs and three energizer clutch keys and are retained as an assembly on the main shaft by a snap ring. The transmission may be used as an aid in deceleration by downshifting in sequence without double-clutching or any gear clashing. Reverse is not synchronized, however, it is a helical gear to insure quiet operation.

MAINTENANCE AND ADJUSTMENTS

SHIFT LINKAGE ADJUSTMENT

Column Shift (Fig. 6)

1. Place ignition switch in the "OFF" position.
2. Loosen swivel lock nuts on both shift rods. The shift rods must pass freely through the swivels.
3. Set the column shift lever and transmission 1st/Reverse lever in the reverse position. Push up on the 1st/Reverse control rod until column lever is in the reverse detent position and tighten the swivel lock nut.
4. Shift the column and transmission levers to the neutral position. Insert the gauge pin into the alignment holes provided in the levers and into the alignment plate on the mast jacket.

   NOTE: Alignment holes are on the lower side of the levers on Chevelle and Chevy II, however, this procedure is still applicable.

5. Tighten 2nd/3rd shift control rod swivel lock nut supporting the rod and swivel while tightening to prevent movement of the swivel or rod.
6. Remove the alignment tool from the levers and shift the column shift lever (in car) to the reverse position. Turn key to "LOCK" position and check ignition interlock control. If binding, leave control in "LOCK" and readjust 1st/REV rod at the swivel.
7. Shift transmission through its shift pattern and return to neutral. Reinsert alignment tool through column levers. If tool does not pass freely through alignment holes and the bracket, loosen swivel lock nuts and readjust linkage.

Floor Shift (Except Corvette) (Fig. 7)

1. Turn ignition switch to the "OFF" position.
2. Loosen lock nuts at swivels on both shift rods and on back drive control rod. Rods should pass freely through the swivels.
3. Set transmission shift levers in neutral.
4. Set shift lever (in car) in neutral and install locating gauge into control lever bracket assembly.

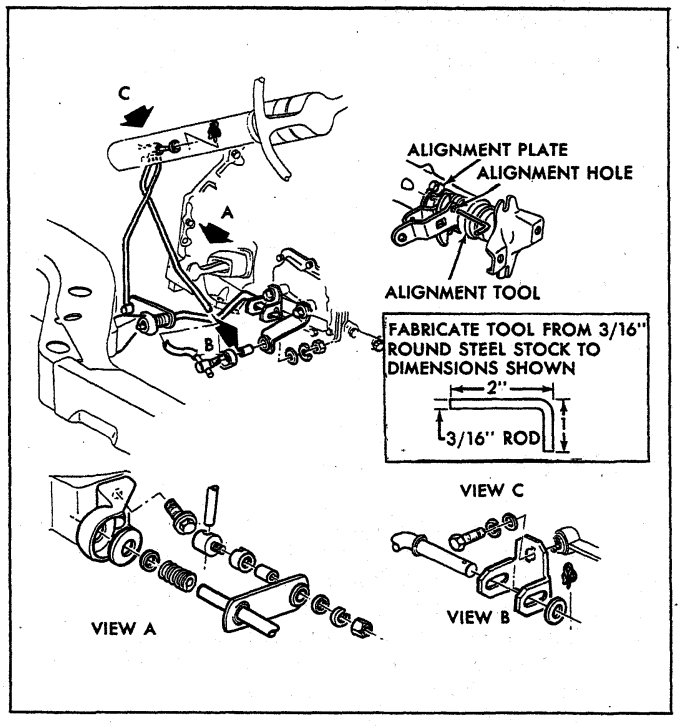


Fig. 6—3-Speed Column Shift Linkage Adjustment

5. Run 1st/REVERSE shift rod nut against swivel and tighten locknut against swivel.
6. Run 2nd/3rd shift rod nut against swivel, then tighten nut against swivel.
7. Remove locating gauge and shift lever into reverse. Push back drive control rod up to place column lever into the reverse position, then pull down slightly on rod to remove any slack in the column mechanism and tighten clevis jam nut. Place ignition switch control in "LOCK" position. Ignition switch should move freely in and out of lock. If binding, leave switch in "LOCK" and readjust back drive control rod.
8. Shift transmission through its shift pattern to insure proper operation.

Floor Shift—Corvette (Fig. 8)

1. Turn ignition switch to the "OFF" position.
2. Loosen swivel lock nuts on both shift rods. Rods should pass freely through swivels.
3. Place shift lever control (in car) into Neutral. Insert locating gauge (41/64 in.) in notch of lever and bracket assembly.
4. Place transmission levers in the neutral position.
5. Hold 1st/Reverse rod and lever against locating gauge, tighten locknut against swivel.
6. Hold 2nd/3rd rod and lever against locating gauge, tighten the forward nut against the swivel and then the aft.
7. Remove locating gauge. Shift transmission into reverse. Be sure column lever is in the reverse detent position.
8. Loosen bolts retaining the bracket assembly on the dash panel at the lower end of the mast jacket. This will allow any tension in the interlock cable to reposition the bracket. Check the bracket to make sure it is not stuck to the dash panel. Retighten bracket

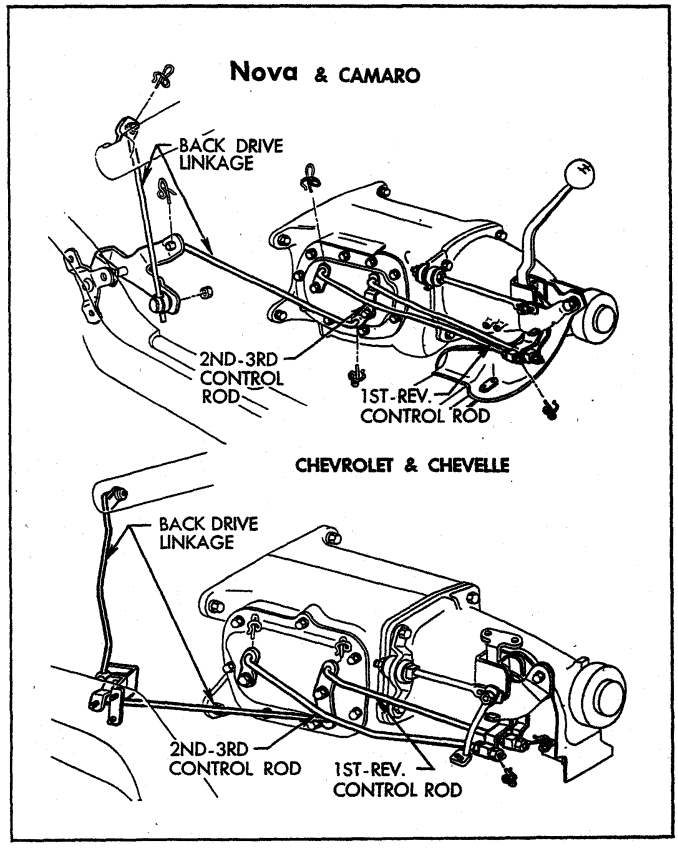


Fig. 7—3-Speed Floor Shift Linkage Adjustment (Except Corvette)

retaining bolts.
9. Check interlock control adjustment by moving the ignition key through the "OFF" and "LOCK" position. Key should move freely. If binding occurs, readjust interlock linkage assembly.
10. Check transmission shifting to ensure proper operation. Readjust linkage, if required.

BACK DRIVE LINKAGE
Column Mounted Shift Linkage (Fig. 6)

1. Put ignition switch in the "off" position and place

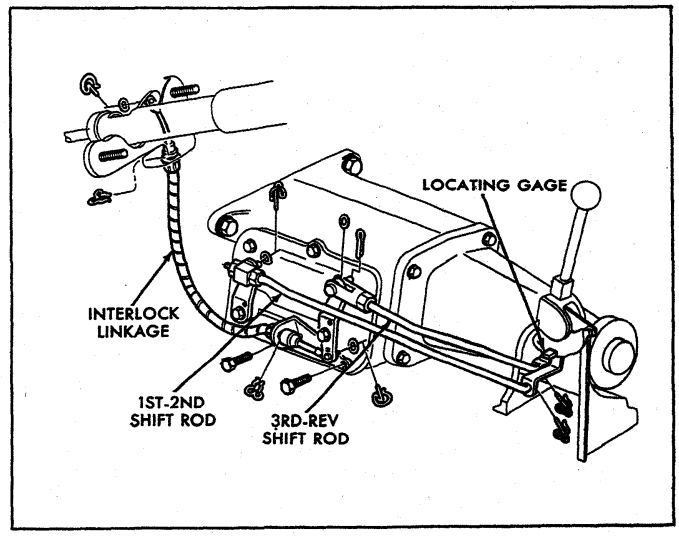


Fig. 8—3-Speed Floor Shift Linkage Adjustment (Corvette)

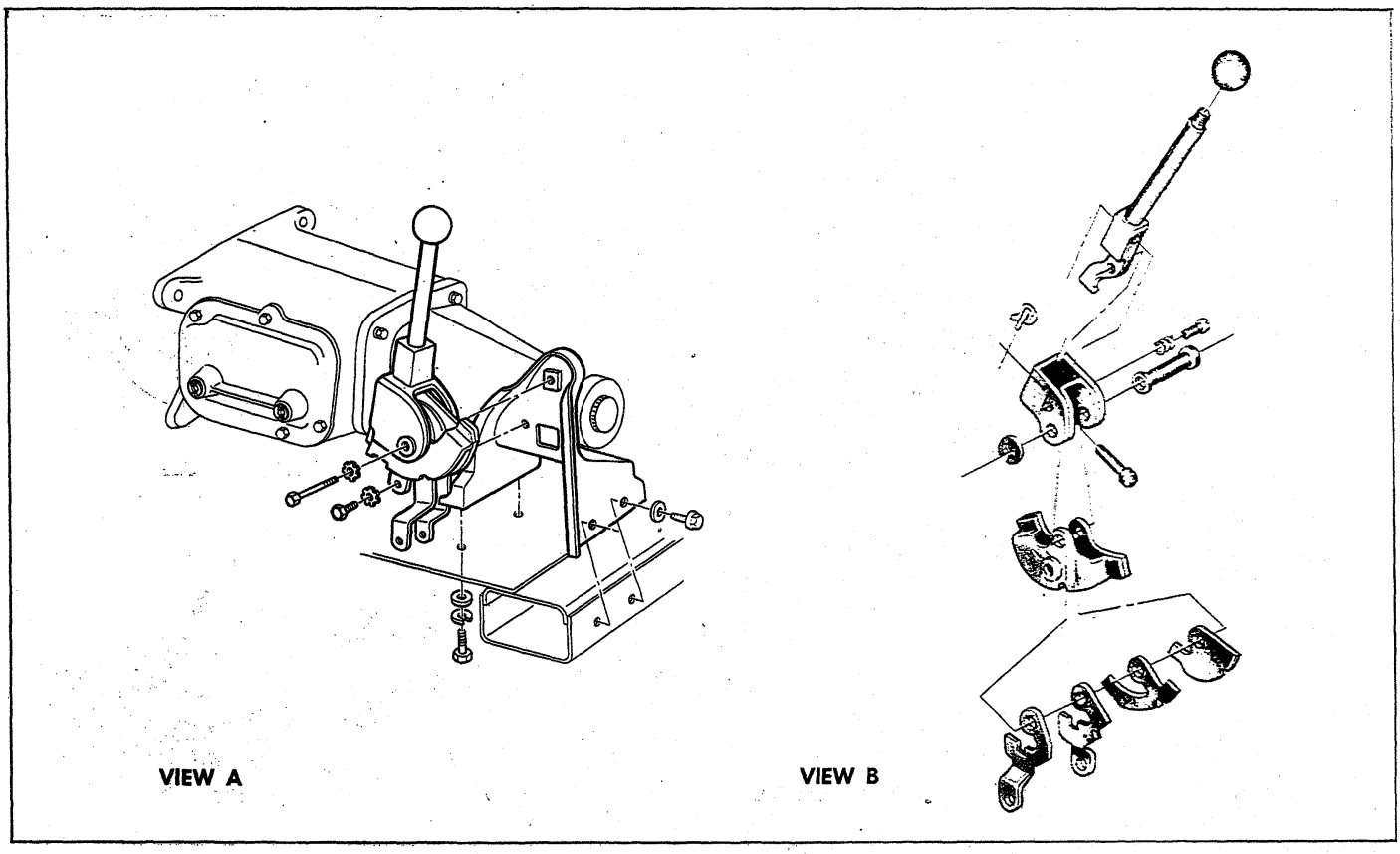


Fig. 9—3-Speed Floor Shift Control Assembly—Corvette

transmission shift lever on column in the "reverse" position.

2. Loosen 1st/reverse shift control rod swivel lock nut at the bell crank and push up on rod attached to column lever, then tighten the lock nut.

   NOTE: Column lever must be in the reverse position. Pull down on control rod to remove any slack in column mechanism.

3. Check interlock control. Ignition switch should move freely in and out of "lock" position. If binding, leave control in "lock" and readjust rod at bell crank.

Floor Shift Transmission

Chevelle, Camaro and Nova (Fig. 7)

1. Put ignition switch in "OFF" position and shift transmission into reverse position.
2. Loosen back drive control rod swivel lock nut and push up on control rod attached to the column shift lever until column is in reverse detent position, then tighten swivel lock nut.

   NOTE: Be sure column lever is in the reverse detent position.

3. Check interlock control. Ignition switch should turn freely through "OFF" and "LOCK" positions. If binding occurs, leave switch in "LOCK" position and readjust control rod at bell crank.

Corvette (Fig. 8)

1. Place ignition switch in the "OFF" position and shift transmission into the reverse position. Make sure column lever is in the reverse detent position.
2. Loosen the bolts retaining the bracket assembly on the dash panel in engine compartment at the lower end of the mast jacket. The bracket is slotted and tension on the cable should correctly position the bracket.

   NOTE: If bracket area is extremely dirty, it may be necessary to manually position bracket from the cowl.

3. With bracket in position, tighten retaining bolts and check interlock control. Key must move freely to the "LOCK" position with the shift control in reverse position.

SHIFT CONTROL LEVER AND BRACKET ASSEMBLY REPLACEMENT

Corvette (Fig. 9)

NOTE: This procedure is for 3 or 4 speed lever assembly.

1. Remove shift control lever knob inside vehicle.
2. Remove console trim plate and seat assembly.
3. Disconnect transmission control rods from shift control levers.
4. Remove shift control to support bracket retaining bolts.
5. Remove support bracket to crossmember retaining bolts.
6. Remove support assembly from vehicle, then pull down on control assembly to remove from console boot and vehicle.

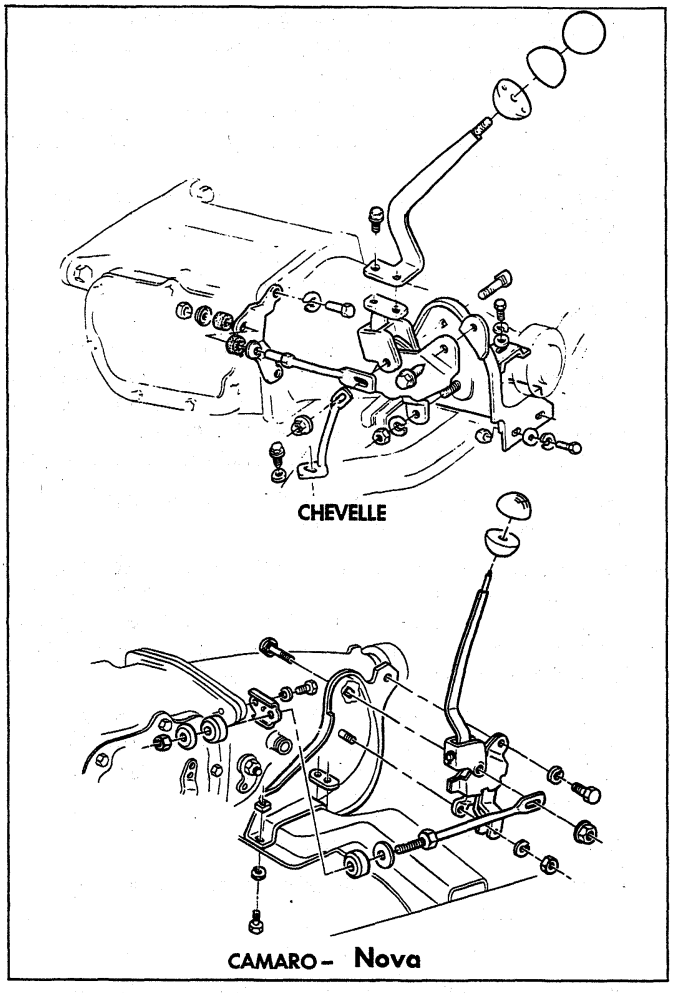


Fig. 10—3-Speed Floor Shift Control Assembly (Except Corvette)

NOTE: If disassembly of this control lever and bracket assembly is necessary refer to Figure 9 for parts breakdown and relative positioning for assembly.

7. To install, reverse removal procedure.

Chevelle, Camaro and Nova (Fig. 10)

NOTE: This procedure is for 3 or 4 speed lever assembly.

1. Remove shifter knob from control lever.

NOTE: Tool J-9138 or other suitable snap ring pliers may be used to remove lower half of two-piece knob assembly.

2. Remove console or floor trim plate assembly.
3. Raise vehicle on hoist.
4. Remove bracket stabilizer retaining nut and disconnect stabilizer rod(s) at control lever.
5. Disconnect transmission shift rods at side cover.
6. Remove crossmember to control support bracket attaching bolts.
7. Remove transmission rear mount attaching bolts.
8. Remove crossmember to frame attaching bolts. Support transmission and remove crossmember from vehicle or slide to rear.
9. Pull control lever and support down and to rear to disengage lever from floor seal and remove assembly from vehicle.
10. Disassemble control assembly from support bracket.
11. To install, reverse removal procedure.
12. Lower vehicle and remove from hoist.

SPEEDOMETER DRIVEN GEAR REPLACEMENT

Disconnect speedometer cable, remove lock plate to extension bolt and lock washer and remove lock plate. Insert screw driver in lock plate slot in fitting and pry fitting gear and shaft from extension. Pry "O" ring from groove in fitting.

Install new "O" ring in groove in fitting. Coat "O" ring and driven gear shaft with transmission lubricant and insert shaft.

Hold the assembly so slot in fitting is toward lock plate boss on extension and install in extension. Push fitting into extension until lock plate can be inserted in groove and attach to extension.

EXTENSION OIL SEAL REPLACEMENT

1. Remove propeller shaft as outlined in Section 4 and disconnect any necessary items to obtain clearance.
2. Pry seal out of extension.
3. Wash counterbore with cleaning solvent and inspect for damage.
4. Prelubricate between sealing lips and coat new seal O.D. with Permatex or equivalent and start straight in bore in case extension. Using Tool J-5154, tap seal into counterbore until flange bottoms against extension.
5. Reinstall propeller shaft and any items removed to obtain clearance.

TRANSMISSION SIDE COVER— SAGINAW AND MUNCIE

Removal

1. Disconnect control rods from levers; remove 2-3 cross shaft (Chevrolet).

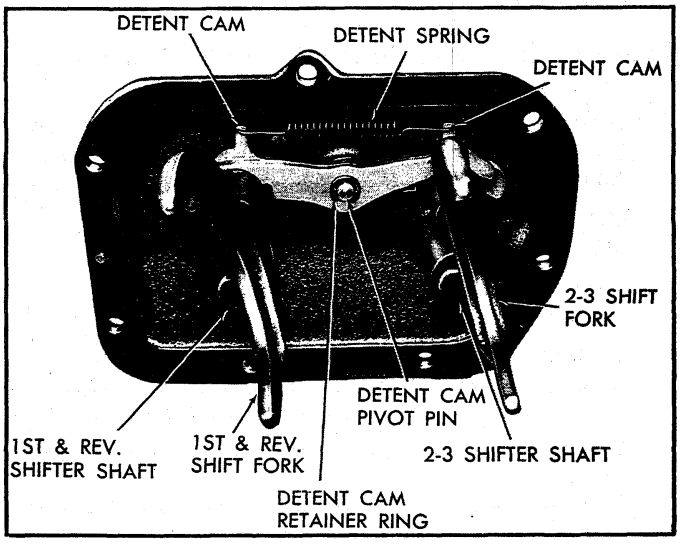


Fig. 11—Transmission Side Cover—Saginaw

2. Shift transmission into neutral detent positions before removing cover.
3. Remove cover assembly from transmission case carefully and allow oil to drain.

Disassembly (Fig. 11)

1. Remove the outer shifter levers.
2. Remove both shift forks from shifter shaft assemblies. Remove both shifter shaft assemblies from cover. "O" ring seals around shifter shaft may now be pryed out if replacement is required because of damage.
3. Remove detent cam spring and pivot retainer "C" ring. Remove both detent cams.
4. Replace damaged parts.

Assembly (Fig. 11)

1. With detent spring tang projecting up over the 2nd and 3rd shifter shaft cover opening install the first and reverse detent cam onto the detent cam pivot pin. With the detent spring tang projecting up over the first and reverse shifter shaft cover hole install the 2nd and 3rd detent cam.
2. Install detent cam retaining "C" ring to pivot shaft, and hook spring into detent cam notches.
3. Install both shifter shaft assemblies in cover being careful not to damage seals. Install both shift forks to shifter shaft assemblies, lifting up on detent cam to allow forks to fully seat into position.
4. Install outer shifter levers, flat washers, lock washers and bolts.

Installation

1. Shift shifter levers into neutral detent (center position. Position cover gasket on case.
2. Carefully position side cover into place making sure the shift forks are aligned with their respective mainshaft clutch sliding sleeves.
3. Install cover attaching bolts and tighten evenly to specified torque.
4. Remove filler plug and add lubricant specified in Section 0, to level of filler plug hole.

TRANSMISSION

Removal—Chevrolet, Chevelle, Nova and Camaro

1. Raise vehicle on hoist.
2. Disconnect speedometer cable at transmission and on floor shift models disconnect back-up lamp switch.
3. Remove propeller shaft assembly.

   NOTE: On Camaro models, disconnect exhaust pipe at manifold.

4. Remove crossmember to frame attaching bolts.

   NOTE: On floor shift models (fig. 10), remove crossmember to control lever support attaching bolts. On Chevelle models also remove control lever brace to crossmember attaching bolt.

5. Remove bolts retaining transmission mount to crossmember.
6. Support engine and raise slightly until crossmember may be slid rearward or removed.
7. Remove shift levers at transmission side cover.

   NOTE: On floor shift models, remove stabilizer to control lever assembly retaining nut. Push bolt toward transmission until stabilizer rod may be disconnected.

8. Remove transmission to clutch housing upper retaining bolts and install guide pins in holes then remove lower bolts.
9. Slide transmission rearward and remove from vehicle.

Installation—Chevrolet, Chevelle, Nova and Camaro

1. Raise transmission into position and slide forward, piloting clutch gear retainer into clutch housing.
2. Install transmission to clutch housing retaining bolts and lock washers. Torque to specifications.
3. Install shift levers at transmission side cover.

   NOTE: On floor shift models, install stabilizer rod to the control lever assembly.

4. Support engine and raise slightly until crossmember may be repositioned. Install retaining bolts and torque to specifications. Remove engine support.
5. Install transmission crossmember to mount retaining bolts.

   NOTE: On floor shift models, install crossmember to control lever support attaching bolts and control lever brace to crossmember attaching bolts (Chevelle only).

6. Install propeller shaft assembly.

   NOTE: On Camaro models, connect exhaust pipe to manifold.

7. Connect speedometer assembly.

   NOTE: On floor shift models, connect backing lamp switch wiring.

8. Fill transmission with lubricant and lower and remove vehicle from hoist. Check operation of transmission.

Removal—Corvette

1. Disconnect battery ground cable.
2. From inside vehicle, remove shifter ball.
3. Remove console trim plate. Refer to Corvette Body, Section 1A, Passenger Service Manual.
4. Raise vehicle on hoist.
5. Completely remove right and left exhaust pipes from vehicle. In order to remove the exhaust pipes on vehicles equipped with 427 cu. in. engines, it is necessary to remove the forward stud on each manifold.
6. Disconnect propshaft at transmission slip yoke. Lower front of propshaft. Remove slip yoke from transmission.
7. Remove bolts attaching rear mount to rear mount bracket. Raise engine lifting transmission off mount bracket.
8. Remove the bolts retaining transmission linkage mechanism mounting bracket to frame.
9. Remove bolts attaching gearshift assembly to mounting brackets and remove mounting bracket. Remove shifter mechanism with rods attached.
10. Disconnect shifter levers at transmission. Disconnect speedometer cable.

11. Remove transmission mount bracket to crossmember bolts and remove mount bracket. Remove bolts retaining rear mount cushion and exhaust pipe yoke.
12. Remove transmission-to-clutch housing retaining bolts and extension bottom bolt.
13. Pull transmission rearward and rotate clockwise until it is clear of clutch housing. To allow room for transmission removal slowly lower the rear of engine until the tachometer drive cable at the distributor just clears the horizontal ledge across the front of dash.

CAUTION: THE TACHOMETER CABLE CAN BE EASILY DAMAGED BY HEAVY CONTACT WITH THE DASH. SLIDE TRANSMISSION REARWARD OUT OF THE CLUTCH, THEN TIP FRONT END OF TRANSMISSION DOWNWARD AND LOWER THE ASSEMBLY FROM VEHICLE.

14. Reinstall transmission assembly by performing above steps in reverse order.

FOUR-SPEED TRANSMISSION (MUNCIE & AND SAGINAW)

INDEX

	Page
General Description	7-11
Maintenance and Adjustments	7-12
Shift Linkage Adjustment	7-12
Shift Control Lever and Bracket	7-12
Removal	
Installation	
Speedometer Driven Gear and Oil Seal	7-12
Replacement	7-12
Transmission Side Cover	7-13
Removal	7-13
Disassembly	7-13
Assembly	7-13
Installation	7-13
Extension Oil Seal	7-14
Replacement	7-14
Transmission Replacement	7-14
Removal from Vehicle	7-14
Installation in Vehicle	7-14

GENERAL DESCRIPTION

The Muncie four-speed synchromesh transmission incorporates helical gears throughout specially designed to provide high torque capacity without additional weight, and gear teeth proportioned to operate at high speeds with neither excessive heat generation nor excessive frictional losses. Shafts, bearings, high capacity clutches and other precision parts are held to close limits, providing proper clearances necessary for durability during extended heavy usage.

The main drive gear is supported by a heavy-duty ball bearing at the front end of the transmission case and is piloted at its front end in an oil impregnated bushing mounted in the engine crankshaft. The front end of the mainshaft is piloted in a row of roller bearings set into the hollow end of the main drive gear and the rear end is carried by a heavy-duty ball bearing mounted at the rear end of the transmission case in a retainer casing.

The counter gear is carried on a double row of rollers at both ends while thrust is taken on thrust washers located between the ends of the gear and the thrust bosses in the case.

The two-piece reverse idler gear is carried on bronze bushings while thrust is taken on thrust washers located between the front of the gear and the back of the reverse idler thrust boss and between the rear of the gear and the reverse idler shaft boss in the case extension.

Gearshifting is manual through shift control rods to the transmission cover shifter levers for first through fourth gears, and to the reverse lever located in the case extension. The shifter lever to the rear of the transmission cover controls first and second gears while the lever to the front controls third and fourth gears. All four forward gears are fully synchronized. The transmission may be used as an aid in deceleration by downshifting in sequence without double clutching. Reverse is not synchronized, however, it is a helical gear to insure quiet operation.

The Saginaw four-speed fully synchroinzed (all forward gears) transmission incorporates helical drive gears throughout.

The main drive gear is supported by a ball bearing at the front end of the transmission case and is piloted at its front end in an oil impregnated bushing mounted in the engine crankshaft. The front end of the mainshaft is piloted in a row of roller bearings set into the hollow end of the main drive gear and the rear end is carried by a ball bearing mounted in the front of the extension housing.

The countergear is carried on a single row of rollers at both ends while thrust is taken on thrust washers located between the ends of the gear and the thrust bosses in the case. An anti-rattle plate assembly at the front of the countergear provides a constant spring tension between the counter and clutch gears to reduce torsional vibrations.

The reverse idler gear is held in constant mesh with the 1st and 2nd synchronizer gear regardless of its position. The idler gear is carried on a bushing finish bored in place and rotates on a short idler shaft retainer by a Woodruff key.

The synchronizer assemblies consist of a clutch hub, clutch sleeve, two clutch key springs and three energizer clutch keys and are retained as an assembly on the main shaft by a snap ring.

A great deal of similarity and interchangeability now exists between the new 3 and 4-speed Saginaw transmissions.

However, the synchronizer assembly at the front of the mainshaft is used for the third and fourth rather than the second and third shift. The synchronizer assembly at the rear of the mainshaft is used for the first and second rather than the first and reverse shift. Gear teeth cut in the first and second synchronizer sleeve (reverse gear) distinguish it from the third and fourth synchronizer sleeve.

Starting from the front, gears on the mainshaft are third, second and first rather than second, first and reverse. A fourth blocker ring is used between the 1-2 synchronizer assembly and first gear on the four-speed transmissions.

The cover on the new four-speed transmission is located on the left-hand side of the case. It is similar to the three-speed cover with the addition of a reverse shifter shaft assembly, detent ball and detent spring.

Disassembly and assembly procedures are covered in this section.

MAINTENANCE AND ADJUSTMENTS

SHIFT CONTROL LEVER AND BRACKET ASSEMBLY

Refer to replacement procedures for three-speed transmission control lever and bracket assemblies described under 3-Speed Transmissions.

SPEEDOMETER DRIVEN GEAR AND OIL SEAL

Replacement

Disconnect speedometer cable, remove retainer to housing bolt and lock washer and remove retainer. Insert screw driver in slot in fitting and pry fitting, gear and shaft from housing. Pry "O" ring in groove in fitting.

Install new "O" ring in grove and insert shaft. Hold the assembly so slot in fitting is toward boss on housing and install in housing. Push fitting into housing until retainer can be inserted in groove and install retainer lock washer and bolt.

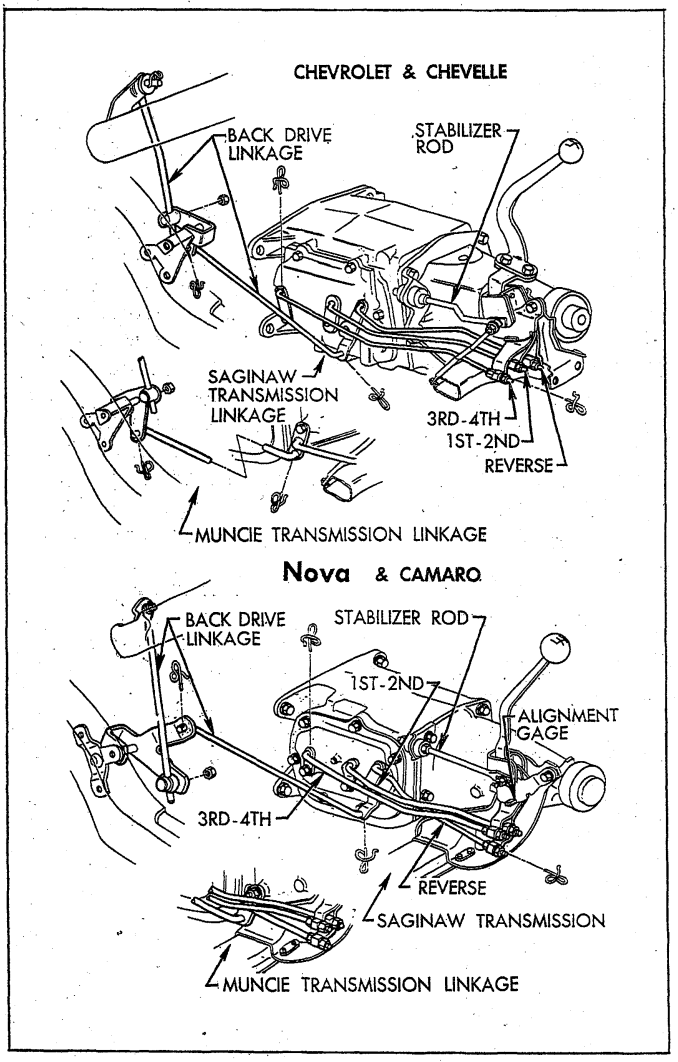


Fig. 12—4-Speed Transmission Shift Linkage—Chevrolet and Camaro

SHIFT LINKAGE ADJUSTMENTS (Fig. 12)

All Except Corvette

1. Place ignition switch in "OFF" position.
2. Loosen locknuts at swivels on the shift rods and back drive control rod. Rods should pass freely through swivels.
3. Set shift levers into neutral at the transmission.
4. Move shift control lever in the neutral detent position, align control assembly levers, and insert locating gauge into lever alignment slot.
5. Tighten locknuts at shift rod swivels and remove locating gauge. Discard gauge.

   NOTE: On Camaro models only with Muncie transmission, readjust reverse rod by the shortening the rod three turns of the jam nuts.

6. Shift transmission control lever into reverse. Set column lever in reverse detent position. Push up on the back drive control rod and tighten the swivel locknut.
7. Check interlock control. The ignition key should move freely to and from the "LOCK" position. Readjust back drive control rod, if necessary.
8. Check transmission shift operation. Readjust shift controls, if necessary.

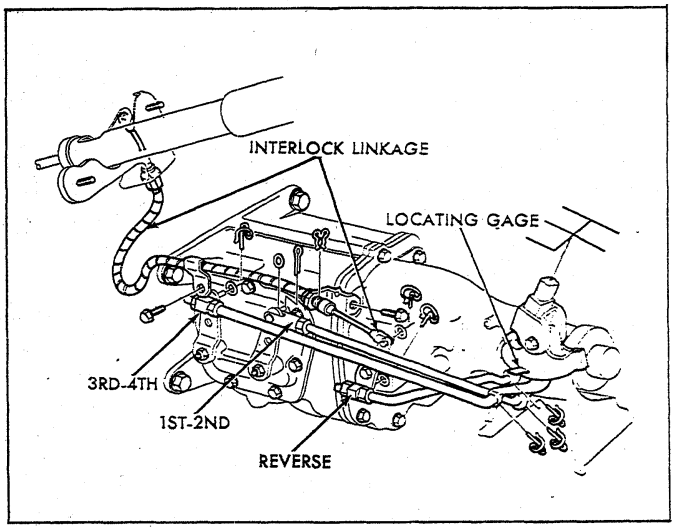


Fig. 13—4-Speed Transmission Shift Linkage—Corvette

Corvette (Fig. 13)

1. Place ignition switch in the "OFF" position.
2. Loosen swivel locknuts on shift rods. Rods should pass freely through the swivels.
3. Set transmission shift levers in the neutral detent position.
4. Move shift control lever to the neutral detent position and insert locating gauge into the lever bracket assembly.
5. Tighten the reverse lever swivel locknuts.
6. Tighten the swivel locknuts on the 1st/2nd and 3rd/4th control rods.
7. Remove locating gauge and discard. Check shift for operation. Readjust if necessary.

   NOTE: Check interlock control. If the ignition key does not move freely through the "OFF" and "LOCK" positions perform the following steps.

8. Set transmission and column levers in the reverse position.

   NOTE: Column lever must be in the reverse position.

9. Loosen bolts retaining interlock bracket assembly on the mast jacket to the dash panel (inside engine compartment). Tension in the interlock linkage should reposition bracket. Retighten the retaining bolts.
10. Check interlock control. Ignition key should move freely to the "LOCK" position. Readjust if necessary.

BACK DRIVE CONTROL LINKAGE (ALL MODELS)

Adjust procedures of the back drive control linkage on vehicles equipped with floor shift four-speed transmissions is the basically the same as on vehicles having a floor shift Three-speed transmission. Refer to the adjustment procedures described under three-speed transmissions included in this manual.

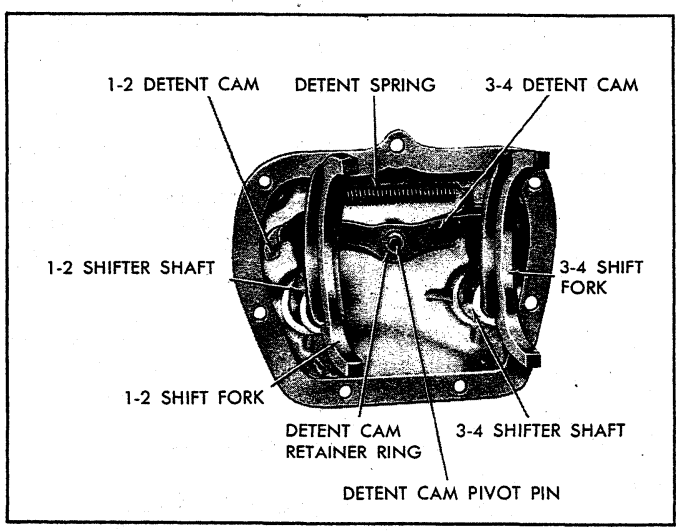


Fig. 14—Transmission Side Cover—Muncie

TRANSMISSION SIDE COVER (Muncie)

Removal

1. Disconnect control rods from levers.
2. Shift transmission into second speed before removing cover, by moving 1-2 (Rear Cover) shifter lever into forward detent position.
3. Remove cover assembly from transmission case carefully and allow oil to drain.

Disassembly (Fig. 14)

1. Remove the outer shifter lever nuts, lock washers and flat washers. Pull levers from shafts.
2. Remove both shift forks from shifter shaft and detent plate assemblies. Remove both shifter shaft assemblies from cover. Lip seals in side cover may now be pryed out if replacement is required because of damage.

   CAUTION: Components should be marked so they may be reinstalled with same relationship.

3. Remove detent cam spring and pivot retainer "C" ring. Remove both detent cams.
4. Replace necessary parts.

Assembly (Fig. 14)

1. Install 1-2 detent cam to cover pivot pin first, then install 3-4 detent cam so the detent spring notches are offset or opposite each other. Detent cam notches must be facing downward.
2. Install detent cam retaining "C" ring to pivot shaft, and hook spring into detent cam notches.
3. Install both shifter shaft assemblies in cover being careful not to damage lip seals. Install both shift forks to detent plates, lifting up on detent cam to allow forks to fully seat into position.
4. Install outer shifter levers, flat washers, lock washers and nuts.

Installation (Fig. 15)

1. Shift 1-2 shifter lever into second speed (forward) position. Position cover gasket on case.

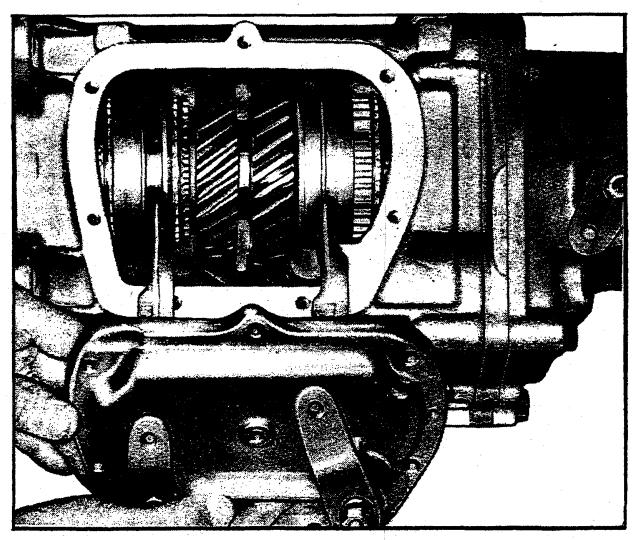


Fig. 15—Installing Side Cover Assembly

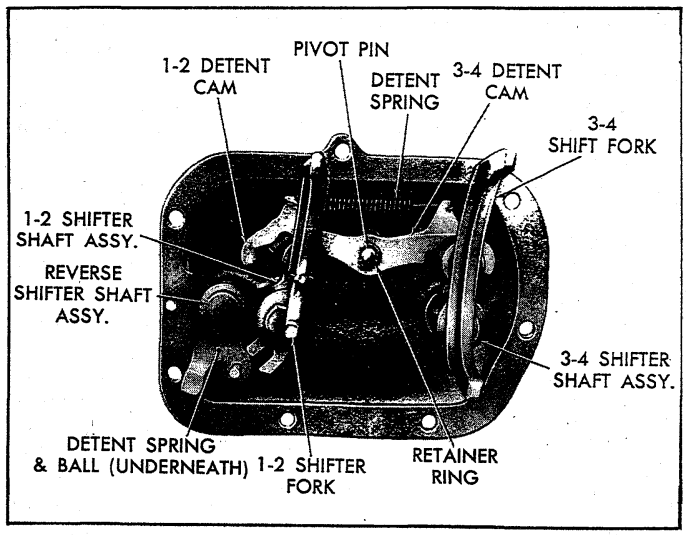


Fig. 16—Transmission Side Cover Assembly—Saginaw

2. Carefully position side cover into place making sure the shift forks are aligned with their respective mainshaft clutch sliding sleeves.
3. Install cover attaching bolts and tighten evenly to 15-20 ft. lbs. torque.
4. Remove filler plug and add lubricant specified in Section 0, to level of filler plug hole.

TRANSMISSION SIDE COVER (Saginaw)

Removal

1. Disconnect control rods from levers.
2. Shift transmission into neutral detent positions before removing cover.
3. Remove cover assembly from transmission case carefully and allow to drain.

Disassembly (Fig. 16)

1. Remove the outer shifter levers.
2. Remove both shift forks from shifter shaft assemblies. Remove all three shifter shaft assemblies from cover. "O" ring seals around shifter shaft may now be pryed out if required because of damage. Remove reverse shifter shaft detent ball and spring.
3. Remove detent cam spring and pivot retainer "C" ring. Mark to identify for reassembly, then remove both detent cams.
4. Replace damaged parts.

Assembly (Fig. 16)

1. With detent spring tang projecting up over the 3rd and 4th shifter shaft cover opening install the first and second detent cam onto the detent cam pivot pin. With the detent spring tang projecting up over the first and second shifter shaft cover hole install the 3rd and 4th detent cam.

   NOTE: The 1-2 detent cam has .090" greater contour on the inside detent notch.

2. Install detent cam retaining "C" ring to pivot shaft, and hook spring into detent cam notches.
3. Install 1-2 and 3-4 shifter shaft assemblies in cover being careful not to damage seals. Install both shift forks to shifter shaft assemblies, lifting up on detent cam to allow forks to fully seat into position.
4. Install reverse detent ball and spring to cover, then install reverse shifter shaft assembly to cover.
5. Install outer shifter levers, flat washers, lock washers and bolts.

Installation

1. Shift shifter levers into neutral detent (center) position. Position cover gasket on case.
2. Carefully position side cover into place making sure the shift forks are aligned with their respective mainshaft clutch sliding sleeves.
3. Install cover attaching bolts and tighten evenly to specified torque.
4. Remove filler plug and add lubricant specified in Section 0, to level of filler plug hole.

EXTENSION OIL SEAL

Replacement

1. Remove propeller shaft.
2. Pry out the extension oil seal.
3. Prelubricate between sealing lips and press new oil seal carefully into place in extension using J-5154 or similar tool.

   CAUTION: Do not excessively force the seal against the seat in the extension.

TRANSMISSION

Removal—Chevrolet, Chevelle, Nova and Camaro

1. Support vehicle on hoist.
2. Disconnect speedometer cable at transmission and back-up lamp switch wiring.
3. Remove propeller shaft assembly.

   NOTE: On Camaro models, disconnect exhaust pipe at manifold.

4. Remove crossmember to frame attaching bolts and crossmember to control lever support attaching bolts. On Chevelle models also remove control lever brace to crossmember attaching bolt.

   NOTE: Complete removal of the control lever support bracket will provide greater clearance for moving transmission rearward.

5. Remove bolts retaining transmission mount to crossmember.
6. Support engine and raise slightly until crossmember may be slid rearward or removed.
7. Remove shift levers at transmission side cover. Remove stabilizer to control lever assembly retaining nut. Push bolt toward transmission until stabilizer rod may be disconnected.
8. Remove transmission to clutch housing upper retaining bolts and install guide pins in holes then remove lower bolts.
9. Slide transmission rearward and remove from vehicle.

Installation—Chevrolet, Chevelle, Nova and Camaro

1. Raise transmission into position and slide forward, piloting clutch gear retainer into clutch housing.
2. Install transmission to clutch housing retaining bolts

and lock washers. Torque to specifications.
3. Install shift levers at transmission side cover and stabilizer rod to the control lever assembly.
4. Support engine and raise slightly until crossmember may be repositioned. Install retaining bolts and torque to specifications. Remove engine support.
5. Install transmission crossmember to mount retaining bolts, crossmember to control lever support attaching bolts and control lever brace to crossmember attaching bolts (Chevelle only).

   NOTE: Connect exhaust pipe to exhaust manifold on Camaro models.

6. Install propeller shaft assembly.

   CAUTION: Prelube bushing extension.

7. Connect speedometer assembly and connect backing lamp switch wiring.
8. Fill transmission with lubricant and lower vehicle and check operation of transmission.

Removal—Corvette

1. Disconnect battery ground cable.
2. From inside vehicle remove shifter ball and "T" handle.
3. Remove console trim plate. Refer to Corvette Body, Section 1A, Passenger Service Manual.
4. Raise vehicle on hoist.
5. Completely remove right and left exhaust pipes from vehicle. In order to remove the exhaust pipes on vehicles equipped with 396 or 427 cu. in. engine, it is necessary to remove the forward stud on each manifold.
6. Disconnect propshaft at transmission slip yoke. Lower propshaft. Remove slip yoke from transmission.
7. Remove bolts attaching rear mount to rear mount bracket. Raise engine lifting transmission off mount bracket.
8. Remove the bolts retaining transmission linkage mechanism mounting bracket to frame.
9. Remove bolts attaching gearshift assembly to mounting bracket and remove mounting bracket. Remove shifter mechanism with rods attached.
10. Disconnect shifter levers at transmission. Disconnect speedometer cable.
11. Remove transmission mount bracket to crossmember bolts and remove mount bracket. Remove bolts retaining rear mount cushion and exhaust pipe yoke.
12. Remove transmission-to-clutch housing retaining bolts and lower (left) extension bolt.
13. Pull transmission rearward until it is clear of clutch housing. Rotate clockwise while pulling to rear. To allow room for transmission removal slowly lower the rear of engine until the tachometer drive cable at the distributor just clears the horizontal ledge across the front of dash.

    CAUTION: THE TACHOMETER CABLE CAN BE EASILY DAMAGED BY HEAVY CONTACT WITH THE DASH. SLIDE TRANSMISSION REARWARD OUT OF THE CLUTCH, THEN TIP FRONT END OF TRANSMISSION DOWNWARD AND LOWER THE ASSEMBLY FROM VEHICLE.

14. Reinstall transmission assembly by performing above steps in reverse order.

ALUMINUM POWERGLIDE AND TORQUE DRIVE

INDEX

	Page
General Description	7-16
Powerglide	7-16
Torque Drive	7-16
Maintenance and Adjustments	7-16
Oil Level Check	7-16
Periodic Oil Change	7-17
Periodic Low Band Adjustment	7-17
Manual Shift Linkage Check and Adjust	7-19
Back Drive Adjustment	7-19
Floor Shift Linkage	7-20
Cable Type	7-20
Rod Type	7-20
Throttle Valve Linkage	7-21
Neutral Safety Switch	7-21
Throttle Return Check Valve (Dashpot)	7-22
Floor Mounted Shift Control Lever	7-22
Component Parts Replacement	7-22
Transmission Replacement	7-22
Other Service Operations	7-24
Diagnosis	7-24
Warming Up Transmission	7-25
Shop Warm Up	7-25
Road Warm Up	7-25
Checking Fluid Level and Condition	7-25
Manual Linkage	7-25
Oil Leaks	7-25
Basic Pressure Checks	7-25
Wide Open Throttle Upshift Pressure Check	7-25
Idle Pressure in Drive Range	7-26
Manual "Low" Range Pressure Check	7-26
Drive Range Overrun (Coast) Pressure	7-26
Torque Drive Pressure Check	7-26
Powerglide Shift Points	7-26

GENERAL DESCRIPTION

POWERGLIDE

The case and converter housing of the two speed aluminum Powerglide Transmission is a single case aluminum unit. When the manual control is placed in the drive position, the transmission automatically shifts to low gear for initial vehicle movement. As the car gains speed and depending on load and throttle position, an automatic shift is made to high gear. A forced downshift feature provides a passing gear by returning the transmission to low range.

The oil pump assembly is a conventional gear type and the oil pump housing is of the large diameter type acting as the front bulkhead of the transmission. The torque converter is a conventional three element welded design bolted to the engine flywheel which drives through a two-speed planetary gearset. The high clutch assembly is typical of the designs used in this type transmission. The aluminum Powerglide uses an output shaft mounted governor which requires a hole through the output shaft. The reverse clutch assembly is a multiple disc type clutch. The steel plates are splined directly to the case while the face plates are splined to the internal or ring gear. The clutch piston operates within the rear portion of the case. The internal diameter of the piston is sealed to an integral hub portion of the case rear bulkhead. The outside diameter is sealed to a machined portion of the case. The piston is hydraulically applied and is released by separate coil springs. The valve body assembly is bolted to the bottom of the transmission case and is accessible for service by removing the oil pan assembly. The valve body consists of an upper and lower body located on either side of a transfer plate. The vacuum modulator is located on the left rear face of the transmission case. The modulator valve bore is located in the upper valve body.

TORQUE DRIVE

The manual shifting Torque Drive transmission is basically a Powerglide automatic transmission with the automatic shifting provisions removed. The component differences are outlined below.

The case has been modified to remove the vacuum modulator can tapped hole, governor feed passage and machining in the governor support area. A pilot ring is used to adapt the transmission to the extension.

Since there is no throttle valve used on the Torque Drive transmission, the T.V. lever hole has been removed on the Park Lock and Range Selector lever.

The oil pump has a new downshift timing valve. The stator shaft and input shaft are common between the Torque Drive and small gearset Powerglide.

The carrier assembly is similar to the Powerglide except the output shaft has a lube orifice extending to the former rear pump drive pin hole. Oil is exited at this point to lubricate the bushing and speedometer gears.

All valves except the pressure regulator, hydraulic modulator, and manual shift have been eliminated from the valve body. The valve body can be identified by the raised letters T.D. located in the center of the casting of the upper and lower portions.

This transmission has been released for use with the L-4 and 6-cylinder Nova, and 6-cylinder Camaro models.

Where applicable, the following Powerglide Service procedures will also apply to the Torque Drive transmission.

MAINTENANCE AND ADJUSTMENT

OIL LEVEL CHECK

The transmission oil level should be checked periodically as recommended in Section 0. Oil should be added only when level is on or below the "ADD" mark on the dip stick with oil hot or at operating temperature. The oil level dip stick is located at the right rear of the engine compartment. Fill with oil specified in Section 0.



Fig. 1PG—Adjusting Low Band Using J—21848

In order to check oil level accurately, the engine should be idled with the transmission oil hot and the control lever in neutral (N) position.

It is important that the oil level be maintained no higher than the "FULL" mark on the transmission oil level gauge. DO NOT OVERFILL, for when the oil level is at the full mark on the dip stick, it is just slightly below the planetary gear unit. If additional oil is added, bringing the oil level above the full mark, the planetary unit will run in the oil, foaming and aerating the oil. This aerated oil carried through the various oil pressure passages (low servo, reverse servo, clutch apply, converter, etc.) may cause malfunction of the transmission assembly, resulting in cavitation noise in the converter and improper band or clutch application. Overheating may also occur.

If the transmission is found consistently low on oil, a thorough inspection should be made to find and correct all external oil leaks.

PERIODIC OIL CHANGE

The transmission oil should be changed periodically as recommended in Section 0, and whenever transmission is to be removed from the vehicle for repairs.

1. Run engine for one minute in neutral prior to changing.
2. Be sure vehicle is level or raise from the rear only.
3. Remove the oil pan drain plug and allow oil to drain thoroughly into a pan or can.
4. Replace drain plug and refill with approximately two quarts of oil specified in Section 0.

NOTE: To refill the transmission, remove dip stick from oil filler tube and refill transmission with oil specified in Section 0. Then, after shifting into all ranges at idle speed to fill all oil passages, the engine should be run at 800-1000 rpm with the transmission in Neutral until the oil warms up, then add oil as required to raise the fluid level to the full mark on the dip stick. Refill capacity is approximately 2 qts.

PERIODIC LOW BAND ADJUSTMENT (Fig. 1PG)

Low band adjustment should be performed at first transmission fluid change or sooner, as necessary if operating performance indicates low band slippage.

1. Raise vehicle and place selector lever in neutral.

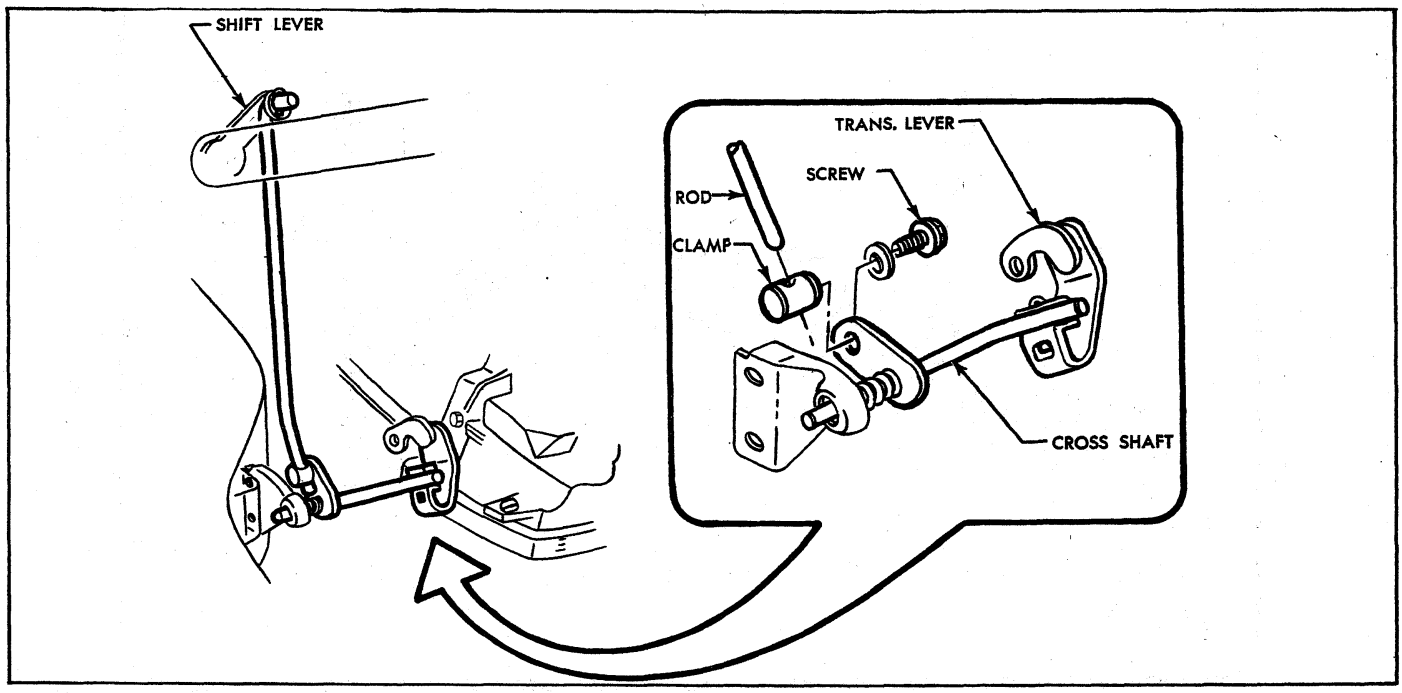


Fig. 2PG—Chevrolet Shift Linkage Adj.—Column

2. Remove protective cap from transmission adjusting screw.
3. On Chevelle Models: To gain clearance between underbody and transmission, it may be necessary to remove rear mount bolts from crossmember, and move transmission slightly toward passenger side of vehicle.
4. Loosen adjusting screw locknut 1/4 turn and hold in this position with wrench.
5. Using Special Tool J-21848 adjust band to 70 in. lbs. and back off four (4) complete turns for a band which has been in operation for 6,000 miles or more, or three (3) turns for one in use less than 6,000 miles.

   CAUTION: Be sure to hold the adjusting screw locknut at 1/4 turn loose with a wrench during the adjusting procedure.

6. Tighten the adjusting screw locknut to specified torque.

   CAUTION: The amount of back-off is not an approximate figure, it must be exact.

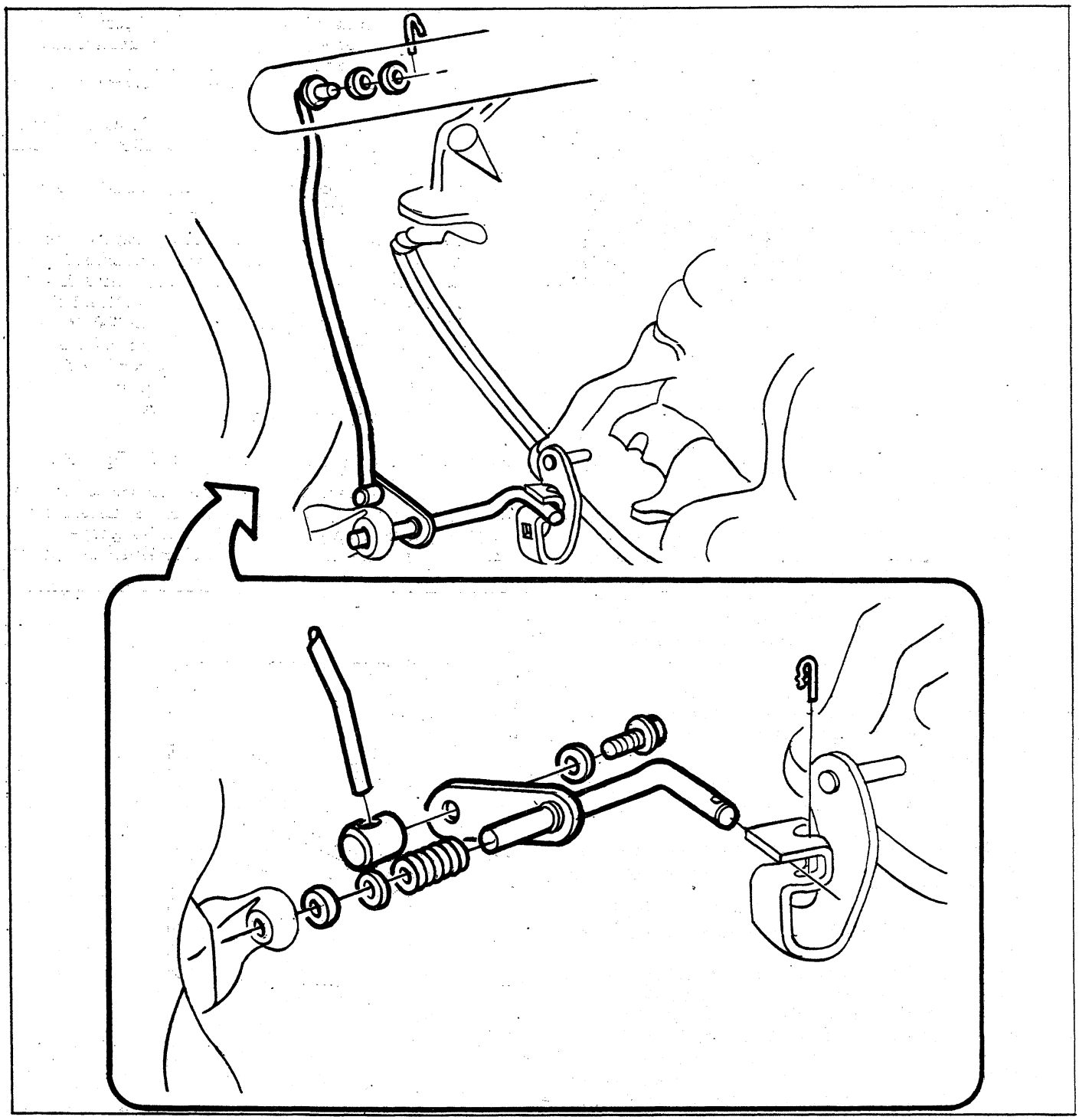


Fig. 3PG—Chevelle Shift Linkage Adj.—Column

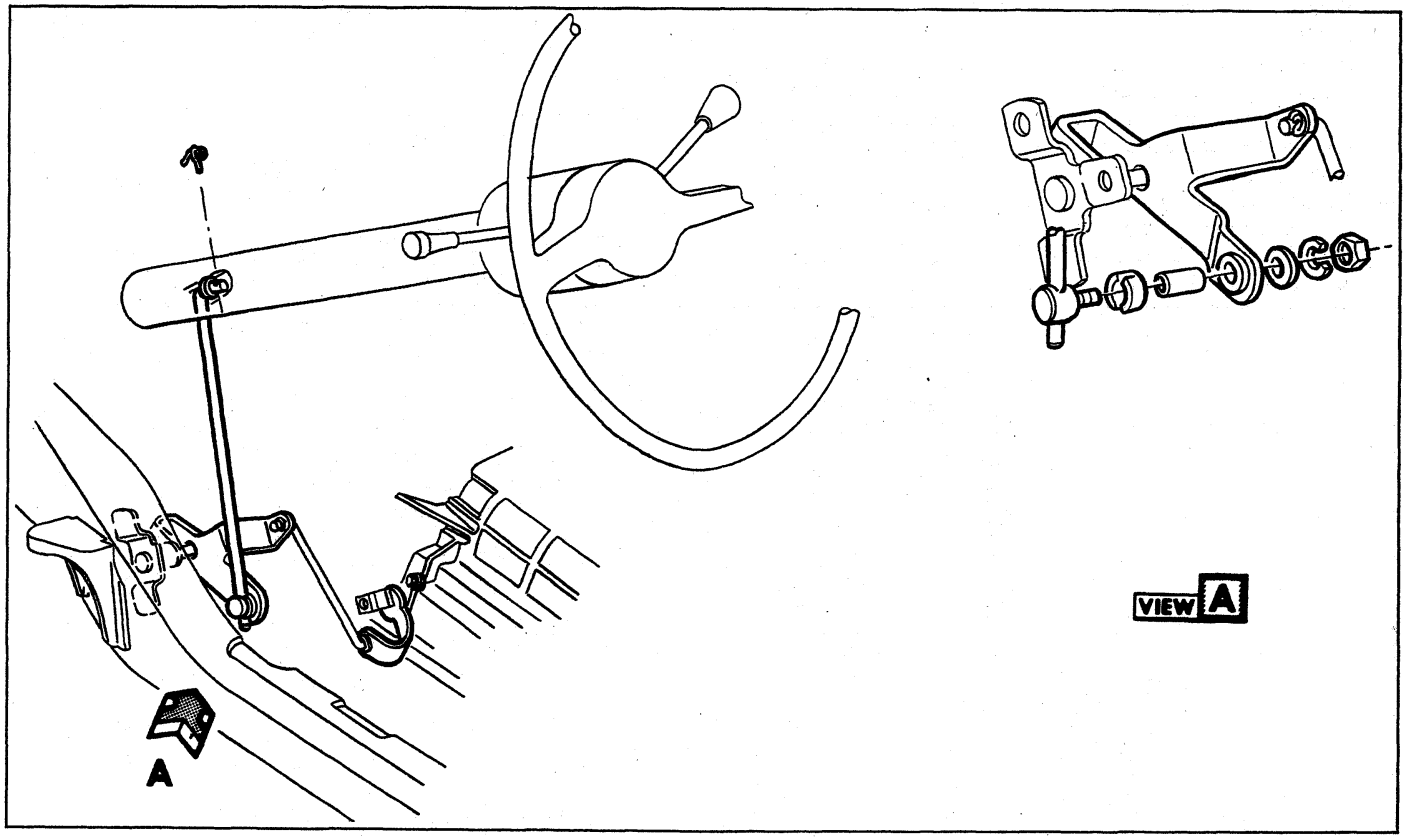


Fig. 4PG—Nova, Camaro Shift Linkage Adj. Column

MANUAL SHIFT LINKAGE CHECK & ADJUST (Column Type)

1. The shift tube and lever assembly must be free in the mast jacket. See Section 9 for alignment of steering column assembly if necessary.
2. To check for proper shift linkage adjustment, lift the transmission selector lever towards the steering wheel. Allow the selector lever to be positioned in drive (D) or (Hi) by the transmission detent.

   NOTE: Do not use the indicator pointer as a reference to position the selected lever. When performing linkage adjustment, pointer is adjusted last.

3. Release the selector lever. The lever should be inhibited from engaging low range unless the lever is lifted.
4. Lift the selector lever towards the steering wheel, and allow the lever to be positioned in neutral (N) by the transmission detent.
5. Release the selector lever. The lever should now be inhibited from engaging reverse range unless the lever is lifted.
6. A properly adjusted linkage will prevent the selector lever from moving beyond both the neutral detent, and the drive detent unless the lever is lifted to pass over the mechanical stop in the steering column.
7. In the event that an adjustment is required, place the selector lever in drive (D) or (Hi) position as determined by the transmission detent. See Steps 2 and 3.
8. Loosen the adjustment swivel or clamp at the cross-shaft, and rotate the transmission lever so that it contacts the drive stop in the steering column.
9. Tighten the swivel and recheck the adjustment. See Steps 2 and 6.
10. Readjust indicator needle if necessary to agree with the transmission detent positions. See Section 9.
11. Readjust neutral safety switch if necessary to provide the correct relationship to the transmission detent positions. See Section 12.

BACK DRIVE ADJUSTMENT

1. Disconnect lower rod at transmission lever.
2. Move transmission lever to (P) Park position (fully clockwise).
3. Place transmission selector lever to (P) Park position. (Steering Column)
4. Attach lower rod to transmission lever and check for proper operation.

   NOTE: With shift lever in Park position the ignition key must move freely to lock position.

   CAUTION: Any inaccuracies in the above adjustments may result in premature failure of the transmission due to operation without controls in full detent. Such operation results in reduced oil pressure and in turn partial engagement of the affected clutches. Partial engagement of the clutches with sufficient pressure to cause apparent normal operation of the vehicle will result in failure of the clutches or other internal parts after only a few miles of operation.

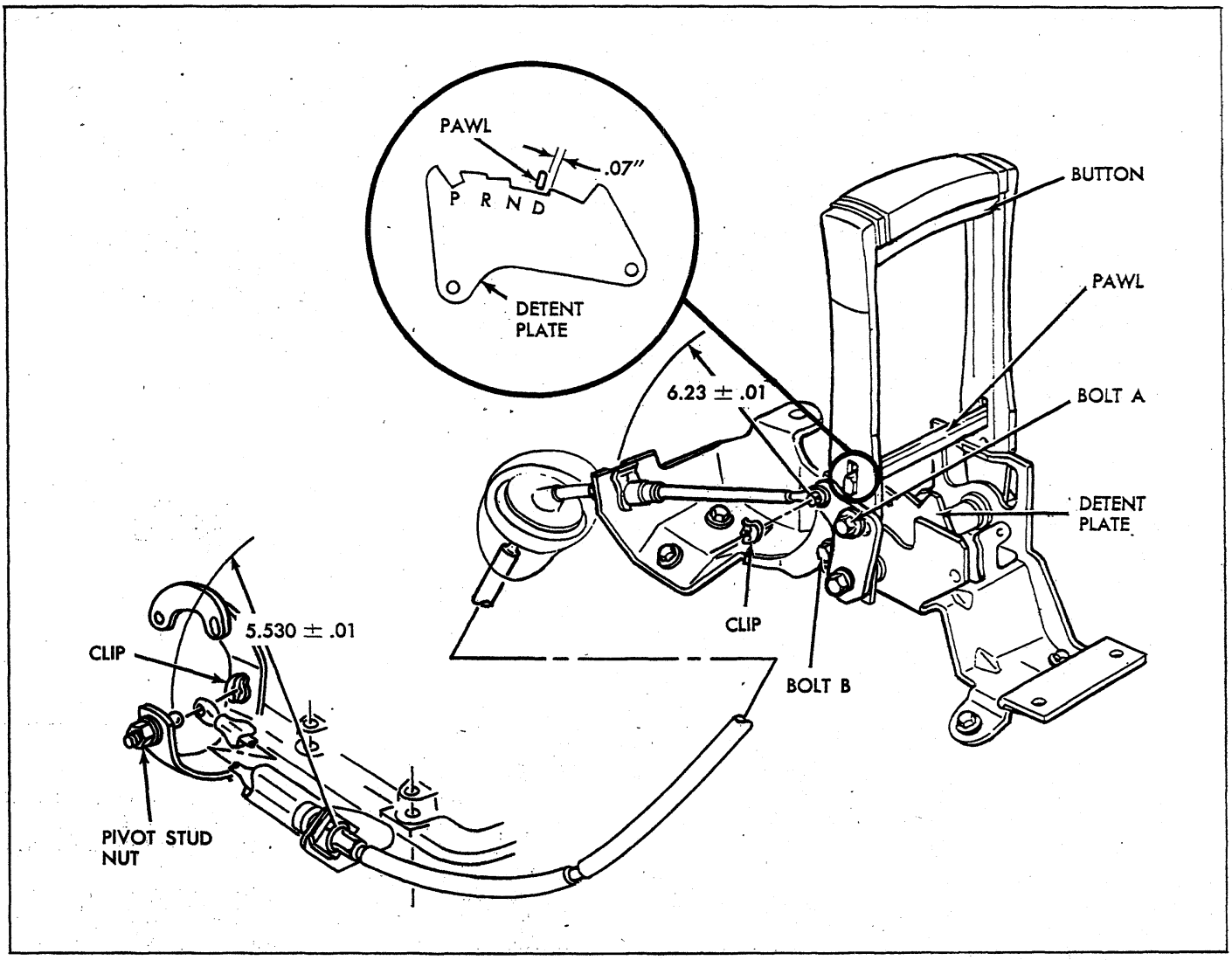


Fig. 5PG—Chevrolet Floor Shift Linkage Adjustments

CHEVROLET

Floor Shift Linkage—Cable Type (Refer to Fig. 5PG)

1. Place shift lever in (D) drive.
2. Raise vehicle. Disconnect cable from transmission lever by removing clip. Manually place transmission lever in Drive. Measure distance from rearward face of attachment bracket to center of cable attachment stud (dimension A). This dimension should be 5.5". If not, loosen stud nut and move stud accordingly. Retighten stud nut, if loosened. Adjust end of cable so that it freely fits on stud. Reinstall clip.
3. Lower vehicle. Remove shift quadrant cover. Raise quadrant plate, disconnect illumination bulbs and remove plate. Remove cable clip and disengage cable from shift lever.
4. Insert a .07" gauge between pawl and detent as shown in View A. Measure distance between forward face of shifter bracket and center of cable pivot pin (dimension B). This dimension should be 6.25". If not, loosen bolt 'A' and move lever until dimension is attained. Retighten bolt. Adjust cable end until it freely enters pin. Install clip.

   NOTE: If lift on handle button does not clear detents or detents can be cleared without lifting handle, pawl engagement can be adjusted by the raising or lowering of the detent plate after loosening bolt 'B'. If such an adjustment is made the adjustment outlined in Step 4 will have to be repeated.

5. Remove gauge. Check operation.
6. Reinstall shift plate and cover.

Nova Linkage Adjustment Rod Type (Fig. 7PG)

1. Loosely assemble nuts (A) and (B) on Lower Rod (C).
2. Set Transmission Lever (D) in "DRIVE" position.

   NOTE: Obtain "DRIVE" position by moving Trans. Lever Counter-clockwise to "LOW" detent, then clockwise one detent position to "DRIVE."

3. Set Control Pawl Rod (E) in the "NEUTRAL or DRIVE" notch of Detent (F). See View A.
4. Apply load in direction of Arrow (Y) on Actuating Lever (G) until pawl Rod comes in contact with Detent at Contact Point (Z). See View A and B.

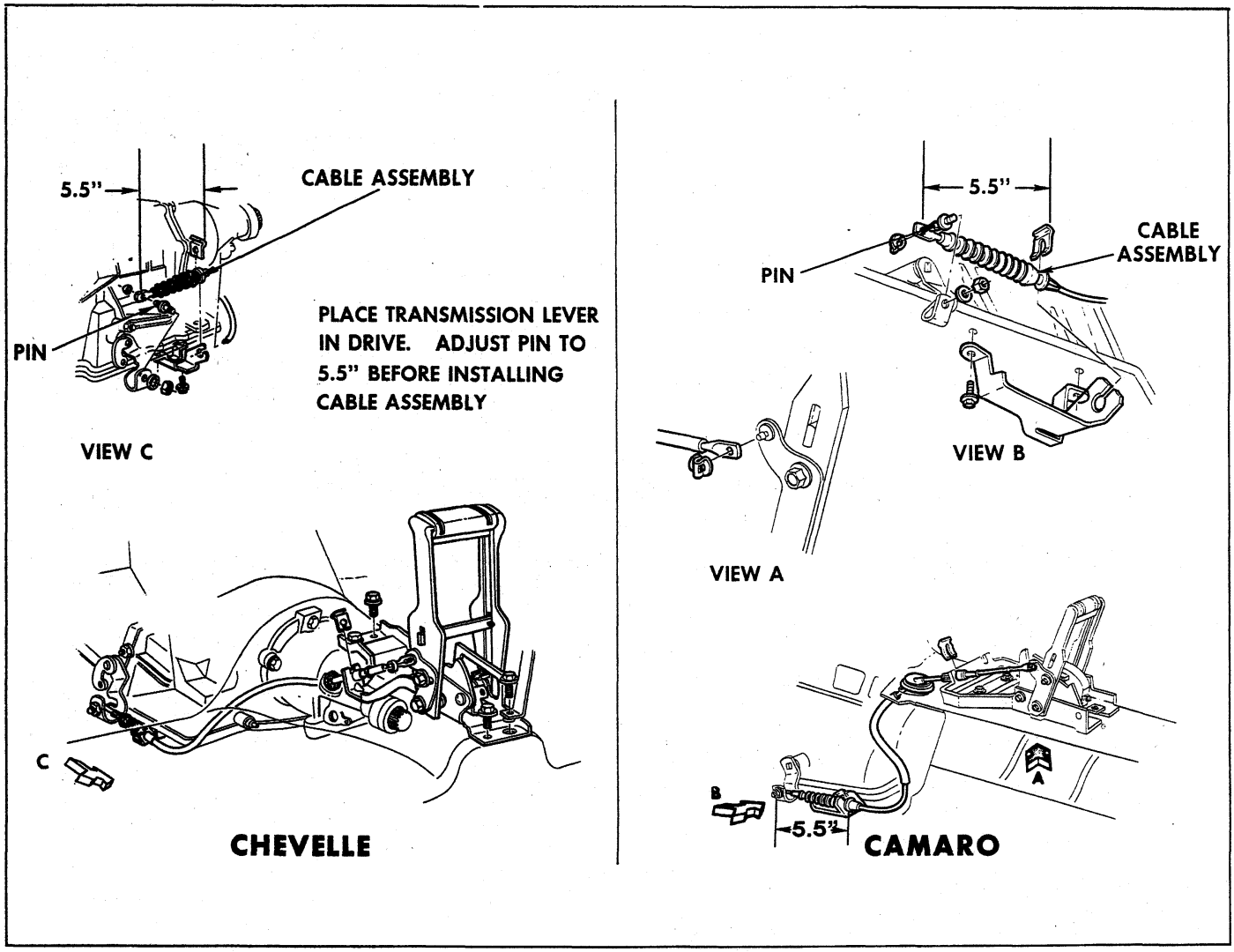


Fig. 6PG—Chevelle, Camaro Floor Shift Linkage Adjustments—Powerglide

5. Place a .094" Spacer (H) between Nut (A) and Swivel (J), run Nut (A) until it touches Spacer. Tighten Nut (B) against Swivel and lock Swivel between Nuts (A) and (B). See View B.
6. Place transmission and shift lever in "PARK" position.
7. Install column rod (K) to column lever and, cross-shaft (L).

NOTE: With shift lever in "PARK" the ignition key must move freely to "LOCK" position.

The foregoing procedure will provide a .050" over travel gap in the notches of Detent (F).

Throttle Valve Linkage Adjustment L-4 and L-6 Models

With accelerator pedal depressed, Bell Crank on L-4 and L-6 models must be at wide open throttle position. Dash Lever must be 1/64"-1/16" off Lever Stop and Transmission Lever must be against transmission internal stop.

V-8 Models—With Uni-Directional Linkage

1. Remove air cleaner.
2. Disconnect accelerator linkage at carburetor.
3. Disconnect accelerator return and TV rod return springs.
4. With right hand, pull TV upper rod forward until transmission is through detent. With left hand, open carburetor to wide open throttle position. Carburetor must reach wide open throttle position at the same time the ball stud contacts end of slot in upper TV rod.
5. Adjust swivel on end of upper TV rod to obtain setting described in Step 4. Allowable tolerance is approximately 1/32".
6. Connect and adjust accelerator linkage as described in Section 6.
7. Check for throttle linkage freedom.

Neutral Safety Switch Adjustment

The adjustment at the neutral safety switch is described in the Electrical Section 12.

Throttle Return Check Valve (Dashpot) Adjustment

The adjustment of the throttle return check valve is described in Section 6M for each carburetor installation.

Floor Mounted Shift Control Lever (Refer to Fig. 8PG)

Disassembly—Control Lever

1. Remove neutral safety back-up switch.
2. Remove (2) pivot bolts. Place punch in shaft hole to keep shaft from rotating.
3. Remove cable drive lever.
4. Spread lever handle to remove lever strap and button mechanism.
5. Spread control lever strap to remove pawl and disassemble button mechanism.
6. Remove screws to disassemble handle from lever.

Control Lever Cover

To replace handle cover, drill attaching points with suitable size drill. Place new cover on handle and secure to handle by applying heat (soldering iron) to retaining tabs. Be sure cover is securely assembled to handle.

Detent

To remove detent from mounting bracket, remove attaching bolt and rivet. Replace rivet with suitable bolt at assembly.

Assembly—Control Lever

Use reverse of disassembly procedure. Place handle in Drive position when installing neutral safety-back-up switch. See Section 12 for adjustment.

COMPONENT PARTS REPLACEMENT

TRANSMISSION REPLACEMENT

Removal

1. Place car on hoist and remove oil pan drain plug to drain oil.

   NOTE: If desired, the oil may be drained after transmission removal.

2. Disconnect the oil cooler lines (external cooled models), vacuum modulator line (Powerglide) and the speedometer drive cable fitting at the transmission. Tie lines out of the way.
3. Disconnect manual and TV (Powerglide) control lever rods from transmission.
4. Disconnect propeller shaft from transmission.
5. Install suitable transmission lift equipment to jack or other lifting device and attach on transmission.
6. Disconnect engine rear mount on transmission extension, then disconnect the transmission support crossmember and slide rearward. Remove crossmember on Camaro models.
7. Remove converter underpan, scribe flywheel-converter relationship for assembly, then remove the flywheel-to-converter attaching bolts.

   NOTE: The "light" side of the converter is denoted by a "blue" stripe painted across the ends of the converter cover and housing. This marking should be aligned as closely as possible with the "white" stripe painted on the engine side of the flywheel outer rim (heavy side of engine) to maintain balance.

8. Support engine at the oil pan rail with a jack or other suitable brace capable of supporting the engine weight when the transmission is removed.
9. Lower the rear of the transmission slightly so that the upper transmission housing-to-engine attaching bolts can be reached using a universal socket and a long extension. Remove upper bolts.

   CAUTION: On V-8 engines, care must be taken not to lower rear of transmission too far as the distributor housing may be forced against the dash causing damage to the distributor. It is best to have an assistant observe clearance of all upper engine components while the transmission rear end is being lowered.

10. Remove remainder of transmission housing-to-engine attaching bolts.
11. Remove the transmission by moving it slightly to the rear and downward, then remove from beneath the car and transfer to a work bench.

    NOTE: Observe converter when moving the transmission rearward. If it does not move with the transmission, pry it free of flywheel before proceeding.

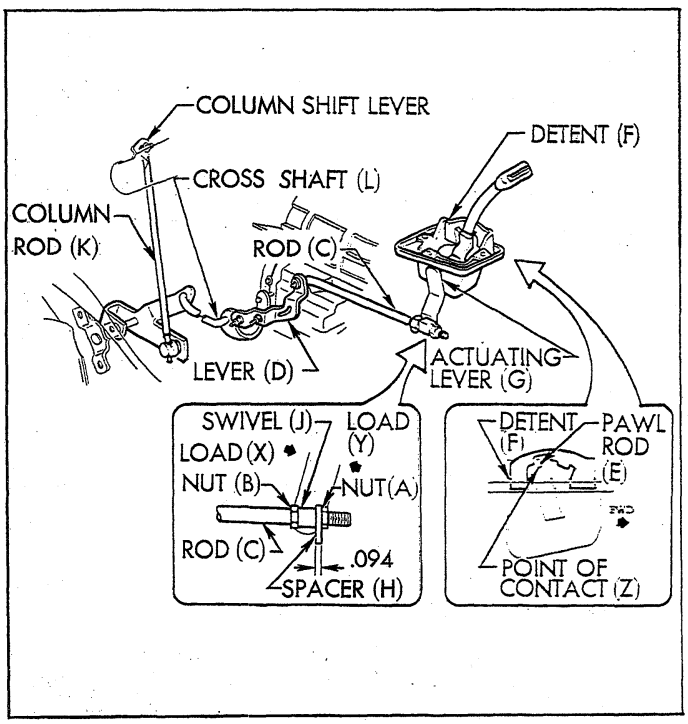


Fig. 7PG—Nova Floor Shift Linkage Adjustments—Powerglide

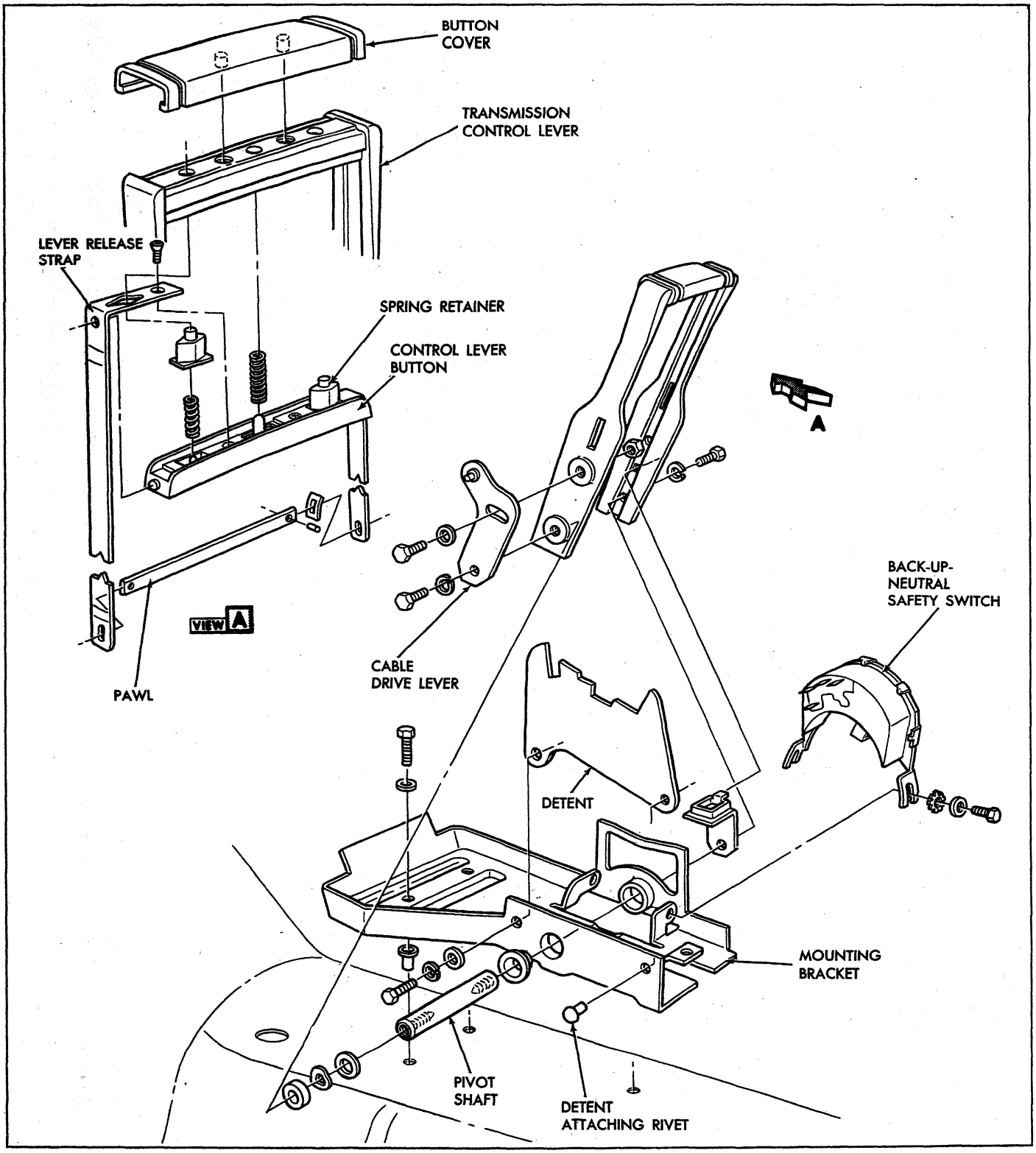


Fig. 8PG—Transmission Floor Mounted Shift Control Lever

CAUTION: Keep front of transmission upward to prevent the converter from falling out. Install converter Tool J-9549 (or a similar tool constructed as shown in Figure 9PG, or, in an emergency, a length of strong wire may be used) immediately after removal from the engine.

Installation

NOTE: The "light" side of the converter is denoted by a "blue" stripe painted across the ends of the converter cover and housing. This marking should be aligned as closely as possible with the "white" stripe painted on the engine

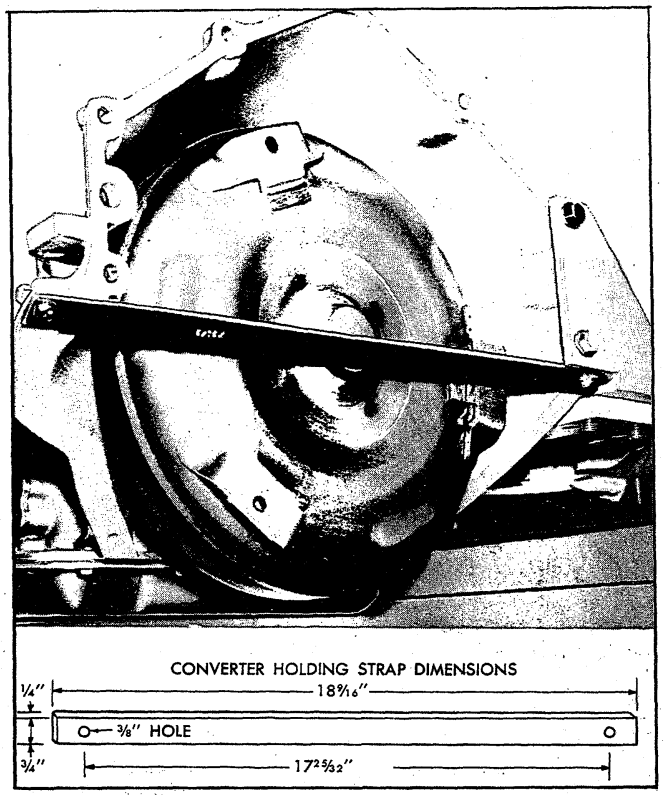


Fig. 9PG—Converter Holding Tool

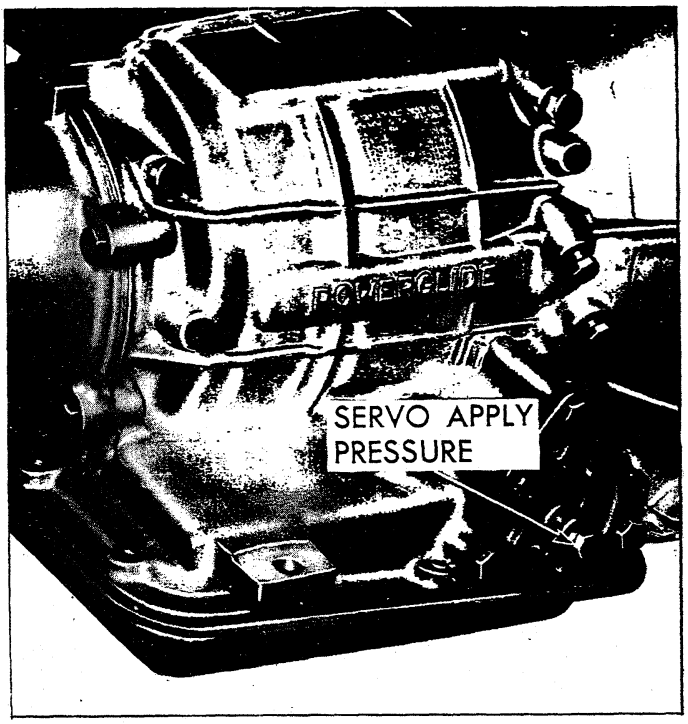


Fig. 10PG—Pressure Test Plug

side of the flywheel outer rim, denoting the "heavy" side of the engine.

1. Mount transmission on transmission lifting equipment installed on jack or other lifting device.
2. Remove converter holding tool.

CAUTION: Do not permit converter to move forward after removal of holding tool.

3. Raise transmission into place at rear of engine and install transmission case to engine upper mounting bolts, then install remainder of the mounting bolts. Torque bolts to 35 ft. lbs.
4. Remove support from beneath engine, then raise rear of transmission to final position.
5. Through flywheel cover opening align as closely as possible the "white" flywheel balance mark stripe and the "blue" painted stripe on the end of converter cover and housing. If scribed during removal, align scribe marks on flywheel and converter cover. Install converter to flywheel attaching bolts. Torque bolts to 30-35 ft. lbs.
6. Install converter under pan.
7. Reinstall transmission support crossmember to transmission and frame.
8. Remove transmission lift equipment.
9. Connect propeller shaft to transmission.
10. Connect manual and TV control lever rods to transmission.
11. Connect oil cooler lines (if so equipped), vacuum modulator line, and speedometer drive cable to transmission.
12. Refill transmission through filler tube following the recommended procedure provided earlier in this section.
13. Check transmission for proper operation and for leakage. Check and, if necessary, adjust linkage.
14. Remove car from hoist.

OTHER SERVICE OPERATIONS

Although certain operations, such as oil pan gasket or manual levers and oil seal replacement, valve body, governor (Powerglide), filler pipe "O" ring, speedometer drive gear, case extension "O" ring and rear oil seal, vacuum modulator (Powerglide), and servo cover or gasket service may be performed from underneath the vehicle without removing the transmission; their service procedure is covered in the Passenger Overhaul Manual and is not repeated here. Refer to the Powerglide Section of the Passenger Overhaul Manual for all other service operations not covered here.

DIAGNOSIS

Proper operation of the Powerglide or Torque Drive transmissions may be affected by a number of factors, all of which must be considered when trouble in the unit is diagnosed.

Proper trouble diagnosis can only be accomplished when performed in a thorough step by step procedure. The following procedure has been devised and tested and is recommended for all trouble diagnosis complaints and

if the service man will follow this checking procedure, accurate and dependable diagnosis may be accomplished. This will result in a savings of time, not only to the service man, but to the customer as well.

WARMING UP TRANSMISSION

Before attempting to check and/or correct any complaints on the transmission it is absolutely essential that the oil level be checked and corrected if necessary. An oil level which is either too high or too low can be the cause of a number of abnormal conditions from excessive noise to slippage in all ranges.

It must be remembered that cold oil will slow up the action of the hydraulic controls in the transmission. For this reason a trouble or oil leak diagnosis should not be attempted until the transmission has been warmed up by either of the following procedures:

Shop Warm Up

1. Connect tachometer to engine.
2. Set parking brake tight and start engine.
3. Place selector lever in "D" or "Hi" (drive) range.
4. Adjust carburetor idle speed adjusting screw to run engine at approximately 750 rpm and operate in this manner for two minutes. At the end of two minutes of operation, the transmission will be sufficiently warmed up for diagnosis purposes.

NOTE: At this point, readjust the engine idle speed to 450-475 rpm in "D" or "Hi" range.

Road Warm Up

Drive the car approximately 5 miles with frequent starts and stops.

NOTE: At this point, make sure the engine idle speed is set to 450-475 rpm in "D" or "Hi" range.

CHECKING FLUID LEVEL AND CONDITION

After transmission has been warmed up, check the fluid level with the engine idling, parking brake set and control lever in "N" (neutral). If the fluid level is low, add fluid to bring level up to the full mark on gauge rod.

CAUTION: If fluid level is too high, fluid may be aerated by the planet carrier. Aerated fluid will cause turbulence in the converter which will result in lost power, lower stall speed and lower pressures in control circuits. Lower fluid level to full mark, then shut off engine to allow air bubbles to work out of fluid.

When checking oil level, a burned smell and discoloration indicate burned clutches or bands and the transmission will have to be removed.

MANUAL LINKAGE

Manual linkage adjustment and the associated neutral safety switch are important from a safety standpoint. The neutral safety switch should be adjusted so that the engine will start in the Park and Neutral positions only.

With the selector lever in the Park position, the parking pawl should freely engage and prevent the vehicle from rolling. The pointer on the indicator quadrant should line up properly with the range indicators in all ranges.

OIL LEAKS

Before attempting to correct an oil leak, the actual source of the leak must be determined. In many cases the source of the leak can be deceiving due to "wind flow" around the engine and transmission.

The suspected area should be wiped clean of all oil before inspecting for the source of the leak. Red dye is used in the transmission oil at the assembly plant and will indicate if the oil leak is from the transmission.

The use of a "black light" to identify the oil at the source of leak is also helpful. Comparing the oil from the leak to that on the engine or transmission dip stick (when viewed by black light) will determine the source of the leak.

Oil leaks around the engine and transmission are generally carried toward the rear of the car by the air stream. For example, a transmission "oil filter tube to case leak" will sometimes appear as a leak at the rear of the transmission. In determining the source of an oil leak it is most helpful to keep the engine running.

The mating surfaces of servo cover, converter housing, transmission case and transmission case extension should be carefully examined for signs of leakage. The vacuum modulator must also be checked to insure that the diaphragm has not ruptured as this would allow transmission oil to be drawn into the intake manifold. Usually, the exhaust will be excessively smoky if the diaphragm ruptures due to the transmission oil added to the combustion. The transmission case extension rear oil seal should also be checked. All test plugs should be checked to make sure that they are tight and that there is no sign of leakage at these points. The converter underpan should also be removed. Any appreciable quantity of oil in this area would indicate leakage at the pump square seal ring, pump seal assembly, or pump bolt sealing washers.

BASIC PRESSURE CHECKS

Four basic pressure checks are used for diagnosis and operational checks for the Aluminum Powerglide transmission. All checks should be made only after thoroughly warming up the transmission.

- Wide Open Throttle Upshift Pressure.
- Idle Pressure in "Drive" Range.
- Manual "Low" Range Pressure.
- "Drive" Range Overrun (Coast) Pressure.

It is not recommended that stall tests be conducted which would result in engine vacuum falling below 10" Hg.

Pressure gauge hose connections should be made at the low servo apply (main line) test point (fig. 9PG). Run the gauge line into the driving compartment by pushing aside the mast jacket seal. The line out of the way of the drivers feet and connect to pressure gauge J-21867.

- Wide Open Throttle Upshift Pressure Check

* A "Black Light" testing unit may be obtained from several different service tool suppliers.

Refer to the pressure check chart for upshift pressure points as indicated on the lower servo apply (main line) gauge.

- Idle Pressure in "Drive" Range

In addition to the oil pressure gauges, a vacuum gauge is needed for this check.

With the parking brake applied and the shift selector lever in "Drive", low servo apply (main line) pressure should be as shown on the pressure check chart.

If pressures are not within these ranges, the following items should be checked for oil circuit leakage:

1. Pressure regulator valve stuck.
2. Vacuum modulator valve stuck.
3. Hydraulic modulator valve stuck.
4. Leak at low servo piston ring (between ring and bore).
5. Leak at low servo piston rod (between rod and bore).
6. Leak at valve body to case gasket.
7. Leak at valve body gaskets.
8. Oil pump clearances.
9. Check passages in transmission case or porosity.

- Manual "Low" Range Pressure Check

Connect a tachometer, apply the parking brake, place the selector lever in "Low" range, and adjust the engine speed to 1000 rpm with the car stationary.

Low servo apply (main line) pressure should be as shown on the pressure check chart.

Pressures not within this range can indicate the following possibilities:

1. Partially plugged oil suction screen.
2. Broken or damaged ring low servo.
3. Pressure regulator valve stuck.
4. Leak at valve body to case gasket.
5. Leak between valve body gaskets.
6. Leak at servo center.
7. Oil pump clearances.

- Drive Range Overrun (Coast Pressure

With the vehicle coasting in "Drive" range at 20-25 MPH with engine vacuum at approximately 20" Hg., low servo apply (main line) pressure should be as shown on the pressure check chart.

TORQUE DRIVE

Mainline pressure taken at the low servo provision should be approximately 130 p.s.i. with the selector in 1st and the engine at 1000 R.P.M. Mainline pressure with the selector in Hi and the engine at idle should be approximately 110 p.s.i.

POWERGLIDE BASIC PRESSURE (MAINLINE) CHECK CHART

Engine	Wide Open Throttle Upshift (psi)	Idle Pressure In "Drive" Range		Manual "Low" Range @ 1000 RPM (psi)	Drive Range Overrun (Coast) @ 20 - 25 MPH (20" Hg. Approx.) - psi
		16" Hg.	10" Hg.*		
L-4 - 153	86 - 101	48 - 53	55 - 73	105 - 117	48 - 53
L-6 - 230	94 - 113	53 - 75	82 - 102	125 - 138	48 - 53
L-6 - 250	88 - 106	52 - 72	78 - 97	105 - 117	48 - 53
V-8 - 307	88 - 106	52 - 74	81 - 100	115 - 128	48 - 53
V-8 - 327	89 - 108	53 - 75	82 - 102	125 - 138	48 - 53
V-8 - 350 (LM65, LM1)	102 - 120	53 - 75	82 - 102	125 - 138	48 - 53
V-8 - 350 (L48)	89 - 108	53 - 75	82 - 102	125 - 138	48 - 53

*Partially open throttle until vacuum reads 10" Hg.

SHIFT POINTS—POWERGLIDE

CHEVROLET MODELS (MPH)

Engine	L-250 (Base) 3.08 Axle 8.25-14 Tire		V-327 (Base) 3.08 Axle 3.25-14 Tire		V-350 (L-65) 3.08 Axle 8.25-14 Tire		V-350 (LM1) 3.07/3.08 Axle 8.25-14 Tire		V-350 (L-48) 3.07/3.08 Axle 8.25-14 Tire	
Throttle Position	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
Closed	15-18	14-17	15-19	14-18	15-19	14-18	15-19	14-18	15-19	14-18
Detent Touch	45-56	30-44	55-67	32-46	54-66	31-46	54-66	31-46	57-71	30-47
Full Detent	54-62	50-59	66-74	62-71	66-74	62-71	66-74	62-71	71-80	66-77

CHEVELLE MODELS (MPH)

Engine	L-230 (Base) 3.08 Axle 7.35-14 Tire		L-250 (L-22) 3.08 Axle 7335-14 Tire		V-307 (Base) Sm. Gear Set 3.08 Axle 7.35-14 Tire		V-307 (Base) Lg. Gear Set 3.08 Axle 9.35-14 Tire		V-350 (L-65) 2.73 Axle 7.35-14 Tire		V-350 (LM-1) 2.73 Axle 7.35-14 Tire		V-350 (L-48) 2.73 Axle 7.35-14 Tire	
Throttle Position	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
Closed	14-18	13-17	14-18	13-17	14-18	13-17	14-18	13-17	16-20	15-19	16-20	15-19	16-20	15-19
Detent Touch	43-54	29-42	43-54	29-42	45-56	26-39	47-58	27-40	58-71	33-43	57-71	33-49	61-77	32-51
Full Detent	52-60	48-56	52-60	48-56	55-62	51-59	57-64	53-61	71-79	66-76	71-79	66-76	76-86	71-82

NOVA MODELS (MPH)

Engine	L-153 (Base) 3.08 Axle 7.35-14 Tire		L-230 (Base) 2.73 Axle 7.35-14 Tire		L-250 (L-22) 2.72 Axle 7.35-14 Tire		V-307 (Base) 2.73 Axle 2.35-14 Tire		V-350 (L-65) 2.56 Axle E70-14 Tire		V-350 (LM-1) 3.07/3.08 Axle 5.70-14 Tire		V-350 (L-48) 3.07/3.08 Axle E70-14 Tire	
Throttle Position	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
Closed	14-18	13-17	16-20	15-19	16-20	15-19	16-20	13-19	17-21	15-20	14-18	13-17	14-18	13-17
Detent Touch	40-52	22-36	48-61	32-47	48-60	33-47	55-65	31-45	60-75	35-51	50-62	29-43	54-67	28-44
Full Detent	50-58	46-55	59-67	54-63	59-67	54-63	64-72	60-69	74-83	69-80	62-69	58-66	66-75	62-72

CAMARO MODELS (MPH)

Engine	L-230 (Base) 2.73 Axle 7.35-14 Tire		L-250 (L-22) 2.73 Axle 7.35-14 Tire		V-307 (Base) 2.73 Axle 7.35-14 Tire		V-327 (LF-7) 2.73 Axle 7.35-14 Tire		V-350 (L-65) 2.56 Axle F70-14 Tire		V-350 (LM-1) 3.07/3.08 Axle F70-14 Tire		V-350 (L-48) 3.07/3.08 Axle F70-14 Tire	
Throttle Position	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
Closed	16-20	15-19	16-20	15-19	16-20	15-19	16-20	15-19	17-22	16-20	14-18	13-17	15-18	13-17
Detent Touch	48-60	32-47	48-60	33-47	53-65	31-45	54-67	32-46	62-77	36-53	52-64	30-44	55-69	28-45
Full Detent	59-67	54-63	59-67	54-63	64-72	60-69	67-75	63-72	76-86	71-82	64-71	59-68	68-77	64-74

TURBO HYDRA-MATIC 350

INDEX

	Page
General Description	7-28
Maintenance and Adjustments	7-28
Oil Level Check	7-28
Periodic Oil Change	7-29
Manual Shift Linkage Check and Adjustment	7-29
Back Drive Adjustment	7-30
Floor Shift Linkage - Cable Type	7-31
- Rod Type	7-31
Nova Linkage Adjustment Rod Type	7-31
Detent Cable Adjustment	7-31
Transmission Replacement	7-31
Other Service Operations	7-32
Turbo Hydra-Matic 350 Diagnosis Procedure	7-33
Sequence	7-33
Oil Level and Condition Check	7-33
Manual Linkage	7-34
Oil Leaks	7-34
Case Porosity Repair	7-35
Vacuum Modulator Checks	7-36
Transmission Shift Points	7-37

GENERAL DESCRIPTION

The purpose of a transmission is to provide suitable gear ratios between the engine and rear wheels for all driving conditions. The Turbo Hydra-Matic 350 is a fully automatic 3-speed transmission encased in a two-piece aluminum casting (main housing and extension). The transmission consists primarily of a hydraulic torque converter and compound planetary gear set. Four multiple-disc clutches, two roller clutch assemblies, and one band provide the friction elements required to obtain the desired function of the planetary gear set.

The torque converter is a simple transmission that couples the engine to the planetary gears through oil and provides hydraulic torque multiplication when required. The compound planetary gear set produces three forward speeds and reverse.

The hydraulic system, pressurized by a gear type pump, provides the working pressure required to operate the friction elements and automatic controls.

The vacuum modulator is of the aneriod type and is used to automatically sense any change in torque input to the transmission. It transmits this signal to the pressure regulator, to the intermediate clutch accumulator valve, and to the shift valves so that all torque and shift speed requirements of the transmission are met and smooth shifts are obtained at all throttle openings and altitude conditions.

The cable operated detent system is designed to ensure positive part throttle or full throttle downshifting depending on throttle position.

External control connections to transmission are:

Manual Linkage--To select the desired operating range.

Engine Vacuum--To operate the vacuum modulator.

Detent Cable--To operate Detent System.

The Turbo Hydra-Matic 350 transmission features three forward driving ranges, which can be selected with the shift lever.

Approximate gear ratios of the transmission are as follows:

FIRST--2.5:1
INTERMEDIATE--1.5:1
DIRECT--1.00:1
REVERSE--2.00:1

The selector quadrant has six selector positions--P, R, N, D, L_2, L_1.

P--PARK position positively locks the output shaft to the transmission case, by means of a locking pawl, to prevent the vehicle from rolling in either direction. This position should be selected whenever the driver leaves the vehicle. The engine may be started in Park position.

R--REVERSE enables the vehicle to be operated in a reverse direction.

N--NEUTRAL position enables the engine to be started and run without moving the vehicle.

D--DRIVE RANGE, used for all normal driving conditions and maximum economy, has three gear ratios. Detent downshifts are available for safe passing, by depressing the accelerator to the floor.

L_2--L_2 RANGE for congested traffic or hilly terrain. L_2 Range has the same starting ratio as Drive Range, but prevents the transmission from shifting above second gear. This retains second speed acceleration when extra performance is desired, and can also be used for engine braking.

L_2 Range can be selected at any vehicle speed, and the transmission will shift to second gear, and remain in second until the vehicle speed or the throttle opening is changed to obtain first gear operation, in the same manner as in Drive Range.

L_1--L_1 RANGE can be selected at any vehicle speed. When selected at speeds over 50 mph, the transmission will shift to second gear and remain in second until vehicle speed is reduced to approximately 50 mph (depending on axle ratio) before shifting to first gear.

L_1 Range position prevents the transmission from shifting out of first gear. This is particularly beneficial for maintaining maximum engine braking when continuous first gear operation is desirable.

MAINTENANCE AND ADJUSTMENTS

OIL LEVEL CHECK

The transmission oil level should be checked periodically as recommended in Section 0. Oil should be added only when level is on or below the "ADD" mark on the dip stick with oil hot or at operating temperature. The oil level dip stick is located at the right rear of the engine compartment. Fill with oil specified in Section 0.

In order to check oil level accurately, the engine should be idled with the transmission oil hot and the control lever in neutral (N) position.

It is important that the oil level be maintained no higher than the "FULL" mark on the transmission oil level gauge. DO NOT OVERFILL, for when the oil level is at the full mark on the dip stick, it is just slightly below the planetary gear unit. If additional oil is added, bringing the oil level above the full mark, the planetary unit will run in the oil, foaming and aerating the oil. This aerated oil carried through the various oil pressure passages (clutch apply, converter, etc.) may cause malfunction of the transmission assembly, resulting in cavitation noise in the converter and improper band or clutch application. Overheating may also occur.

If the transmission is found consistently low on oil, a thorough inspection should be made to find and correct all external oil leaks.

PERIODIC OIL CHANGE

The transmission oil should be changed periodically as recommended in Section 0, and whenever transmission is to be removed from the vehicle for repairs.

1. Run engine for one minute in neutral prior to changing.
2. Be sure vehicle is level or raise from the rear only.
3. Remove the oil pan drain plug and allow oil to drain thoroughly into a pan or can.
4. Replace drain plug and refill with approximately 2.5 quarts (U.S. measure, 2 qts. Imperial measure) of oil specified in Section 0.

NOTE: To refill the transmission, remove dip stick from oil filler tube and refill transmission with oil specified in Section 0. Then, after shifting into all ranges at idle speed to fill all oil passages, the engine should be run at 800-1000 rpm with the transmission in Neutral until the oil warms up, then add oil as required to raise the fluid level to the full mark on the dip stick. Refill capacity is approximately 2.5 qts. (U.S. measure - 2 qts. Imperial measure).

MANUAL SHIFT LINKAGE CHECK & ADJUST (Column Type)

1. The shift tube and lever assembly must be free in the mast jacket. See Section 9 for alignment of steering column assembly if necessary.

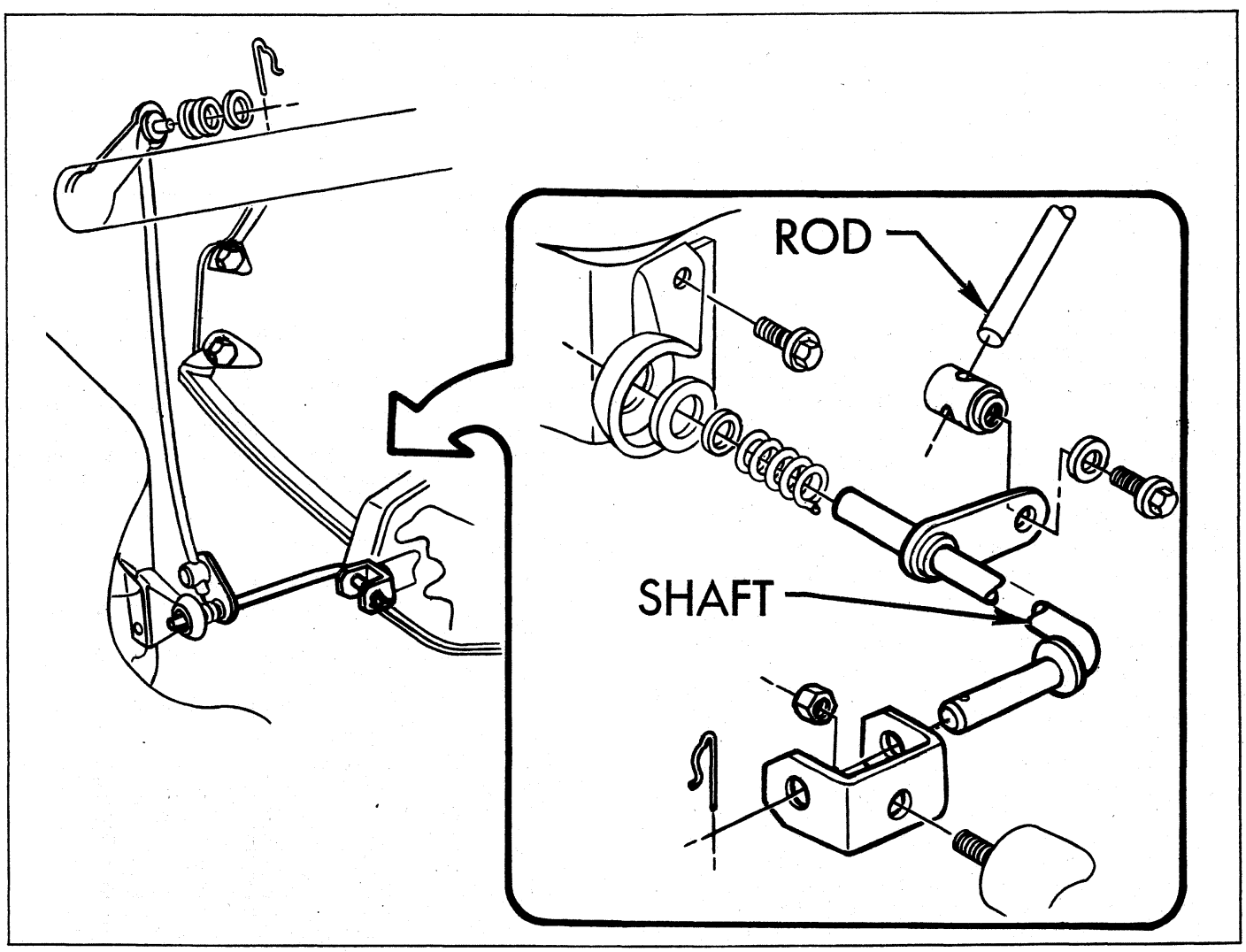


Fig. 1—Chevrolet Shift Linkage Adjustments—Column

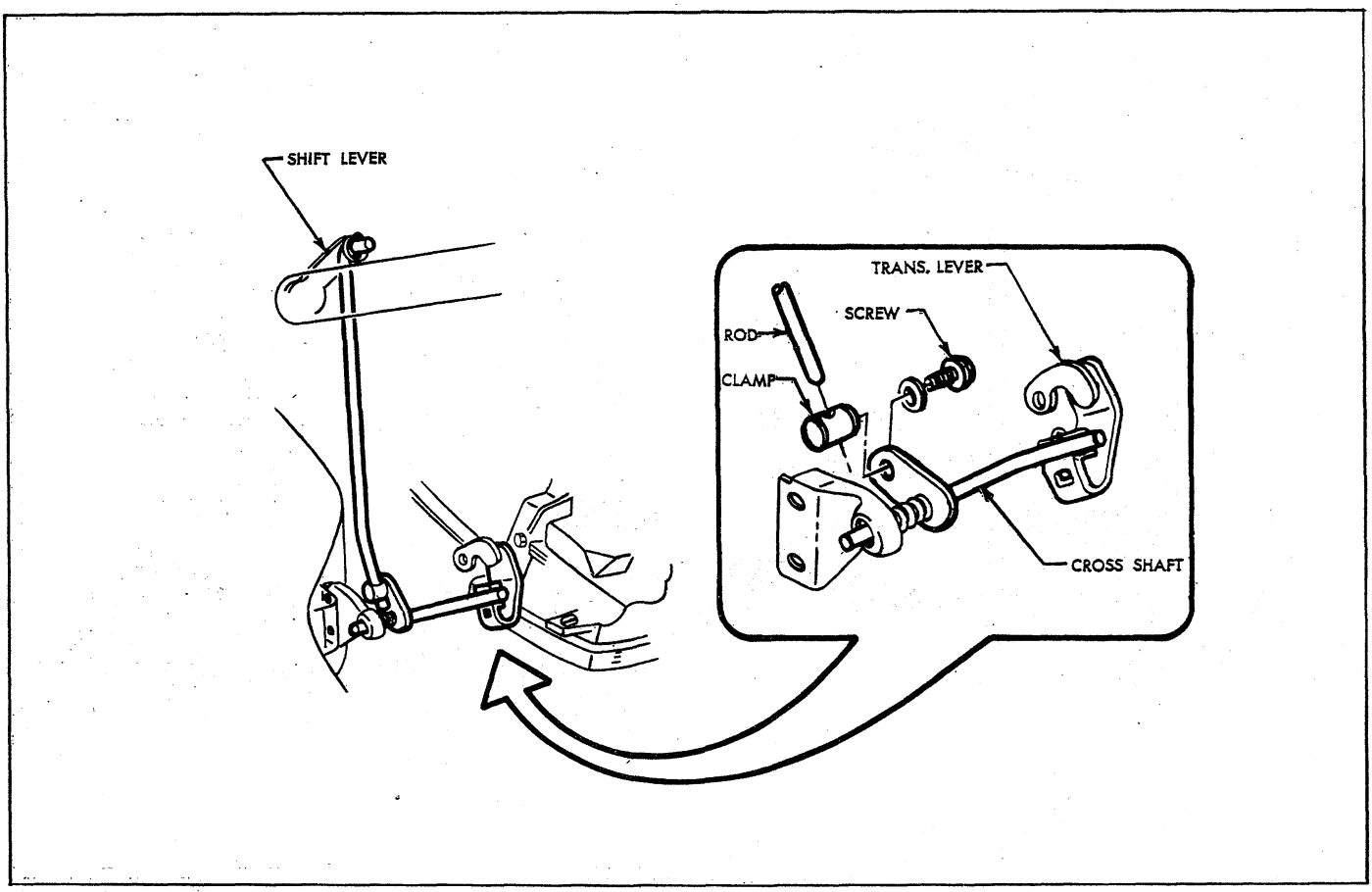


Fig. 2—Chevelle Shift Linkage Adjustments—Column

2. To check for proper shift linkage adjustment, lift the transmission selector lever towards the steering wheel. Allow the selector lever to be positioned in drive (D) by the transmission detent.

   NOTE: Do not use the indicator pointer as a reference to position the selected lever. When performing linkage adjustment, pointer is adjusted last.

3. Release the selector lever. The lever should be inhibited from engaging low range unless the lever is lifted.
4. Lift the selector lever towards the steering wheel, and allow the lever to be positioned in neutral (N) by the transmission detent.
5. Release the selector lever. The lever should now be inhibited from engaging reverse range unless the lever is lifted.
6. A properly adjusted linkage will prevent the selector lever from moving beyond both the neutral detent, and the drive detent unless the lever is lifted to pass over the mechanical stop in the steering column.
7. In the event that an adjustment is required, place the selector lever in drive (D) position as determined by the transmission detent. See Steps 2 and 3.
8. Loosen the adjustment swivel at the cross-shaft, and rotate the transmission lever so that it contacts the drive stop in the steering column.
9. Tighten the swivel and recheck the adjustment. See Steps 2 and 6.
10. Readjust indicator needle if necessary to agree with the transmission detent positions. See Section 9.
11. Readjust neutral safety switch if necessary to provide the correct relationship to the transmission detent positions. See Section 12.

BACK DRIVE ADJUSTMENT

1. Disconnect lower rod at transmission lever.
2. Move transmission lever to (P) Park position (fully clockwise).
3. Place transmission selector lever to (P) Park position. (Steering column)
4. Attach lower rod to transmission lever and check for proper operation.

CAUTION: Any inaccuracies in the above adjustments may result in premature failure of the transmission due to operation without controls in full detent. Such operation results in reduced oil pressure and in turn partial engagement of the affected clutches. Partial engagement of the clutches with sufficient pressure to cause apparent normal operation of the vehicle will result in failure of the clutches or other internal parts after only a few miles of operation.

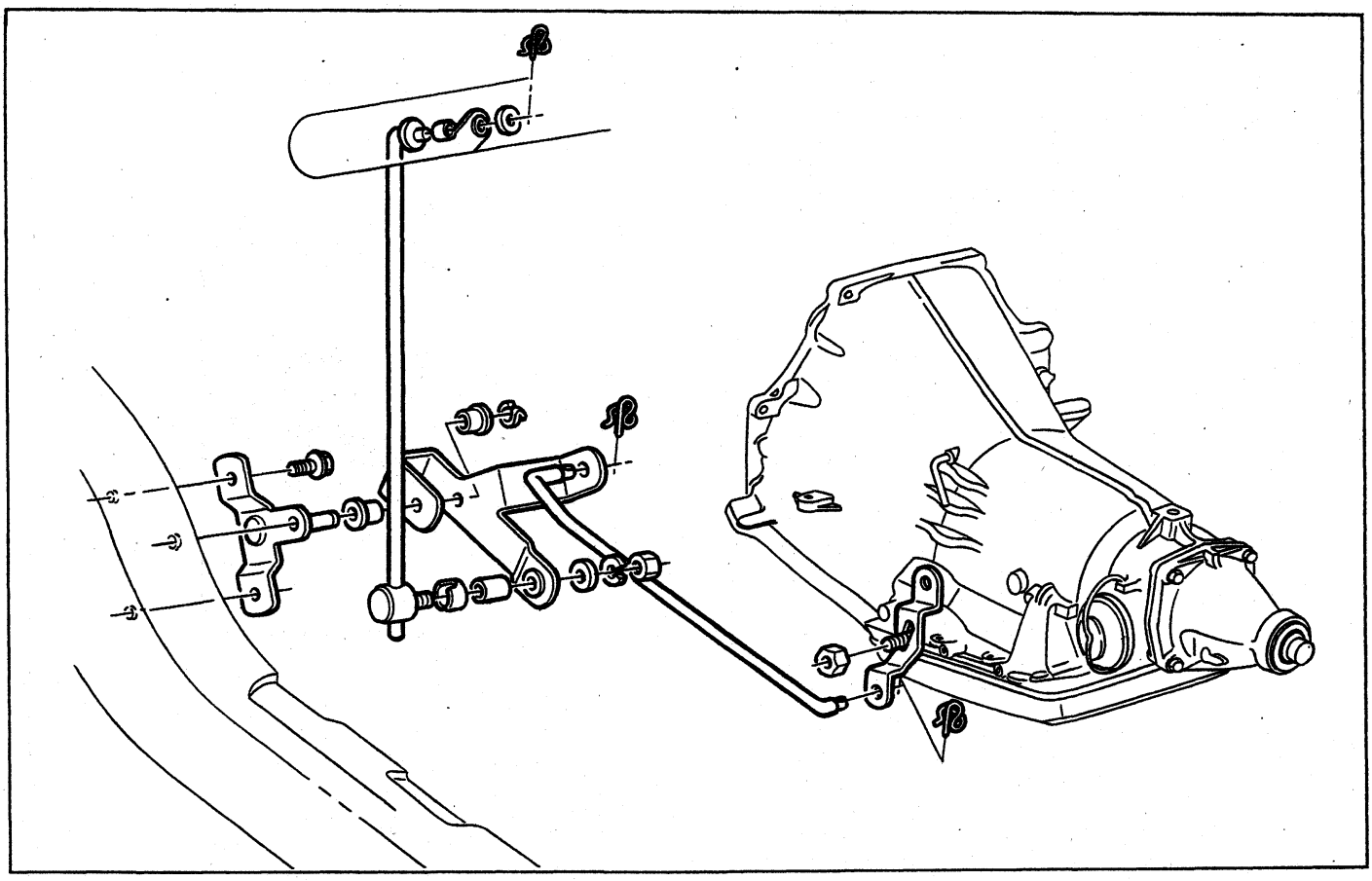


Fig. 3—Nova, Camaro Shift Linkage Adjustment Column

CHEVROLET

Floor Shift Linkage—Cable Type (Refer to Fig. 4)

(See Page 7-19 of Powerglide Service Procedures of this section.)

Nova Linkage Adjustment Rod Type (Fig. 7) AM)

(See Page 7-19 of Powerglide Service Procedures of this section.)

DETENT CABLE ADJUSTMENT TURBO HYDRA-MATIC 350 TRANSMISSION

Refer to Figure 6

1. Remove air cleaner.
2. Loosen detent cable screw.
3. With choke off and accelerator linkage properly adjusted (See Section 6) position carburetor lever in wide open throttle position.
4. Pull detent cable rearward until wide open throttle stop in transmission is felt.

   NOTE: Cable must be pulled through detent position to reach wide open throttle stop in transmission.

5. Tighten detent cable screw and check linkage for proper operation.

Floor Mounted Shift Control Lever (Refer to Fig. 8PG)

TRANSMISSION REPLACEMENT

Before raising the car, disconnect the negative battery cable and release the parking brake.

1. Place car on hoist.
   Camaro models only:
   a. Disconnect parking brake cables.
   b. Remove underbody reinforcement plate. (convertible)
   c. Disconnect left exhaust pipe from manifold for clearance.
2. Remove propeller shaft.
3. Disconnect speedometer cable, detent cable, modulator, vacuum line and oil cooler pipes.
4. Disconnect shift control linkage.
5. Support transmission with suitable transmission jack.
6. Disconnect rear mount from frame crossmember.
7. Remove two bolts at each end of frame crossmember. Remove crossmember.
8. Remove oil cooler lines, vacuum modulator line, speedo cable, and detent cable at transmission.
9. Remove converter under pan.
10. Remove converter to flywheel bolts.
11. Loosen exhaust pipe to manifold bolts approximately 1/4 inch (Chevrolet and Chevelle). Lower transmission until jack is barely supporting it.

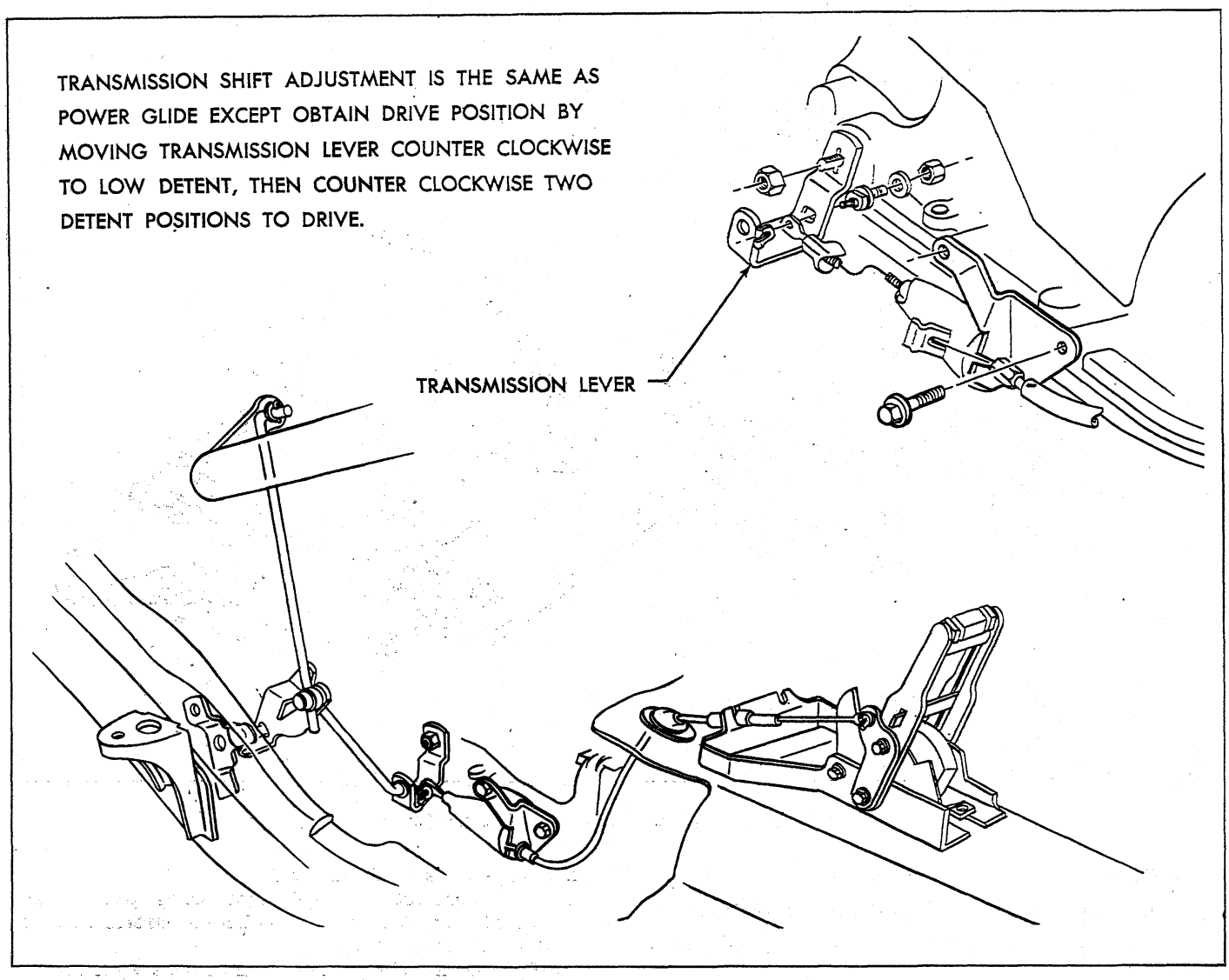


Fig. 4—Chevrolet Floor Shift Linkage Adjustment

CAUTION: On V-8 engines, care must be taken not to lower rear of transmission too far as the distributor housing may be forced against the dash causing damage to the distributor. It is best to have an assistant observe clearance of all upper engine components while the transmission rear end is being lowered.

12. Remove transmission to engine mounting bolts and remove oil filler tube at transmission.
13. Raise transmission to its normal position, support engine with jack and slide transmission rearward from engine and lower it away from vehicle.

CAUTION: Use suitable converter holding tool when lowering transmission or keep rear of transmission lower than front so as not to lose converter.

The installation of the transmission is the reverse of the removal with the following added step. Before installing the flex plate to converter bolts, make certain that the attaching lugs on the converter are flush with the flex plate and the converter rotates freely by hand in this position. Then, hand start all three bolts and tighten finger tight before torqueing to specification. This will insure proper converter alignment.

NOTE: After installation of transmission, remove car from hoist. Check linkage for proper adjustment.

OTHER SERVICE OPERATIONS

Although certain operations, such as oil pan gasket or manual levers and oil seal replacement, valve body, governor, filler pipe "O" ring, speedometer drive gear, case extension "O" ring and rear oil and yoke seal, vacuum modulator, and intermediate clutch accumulator cover service may be performed from underneath the

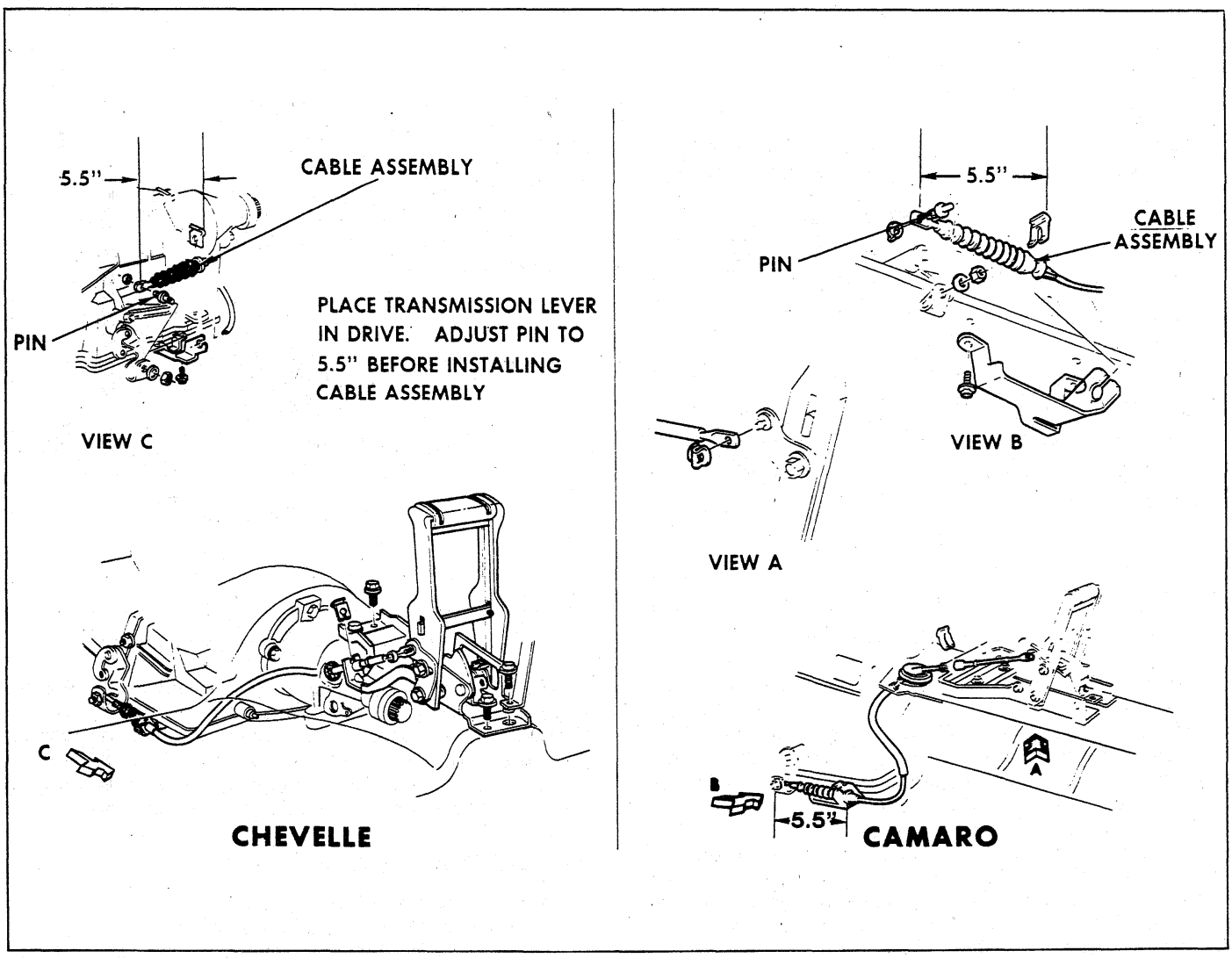


Fig. 5—Chevelle, Camaro Floor Shift Linkage Adjustment

vehicle without removing the Turbo Hydra-Matic 350; their service procedure is covered in the Passenger Overhaul Manual and is not repeated here. Refer to the Turbo Hydra-Matic 350 Section of the Passenger Overhaul Manual for all other service operations not covered here.

TURBO HYDRA-MATIC 350 DIAGNOSIS PROCEDURE

Accurate diagnosis of transmission problems begins with a thorough understanding of normal transmission operation. In particular, knowing which units are involved in the various speeds or shifts so that the specific units or circuits involved in the problem can be isolated and investigated further. Analytical diagnosis will protect the technician from come backs and certainly will improve owner satisfaction.

An important and often overlooked aspect of diagnosis is finding out specific customer complaints. For this purpose a short ride with the customer will often prove beneficial. It may be found that the condition the customer wants corrected is standard and should not be altered.

The following sequence, based on field experience, provides the desired information quickly and in most cases actually corrects the malfunction without requiring the removal of the transmission. Details of the items listed in this sequence are covered further in the text.

SEQUENCE FOR TURBO HYDRA-MATIC 350 DIAGNOSIS PROCEDURE

1. Check oil level and condition.
2. Check and correct detent cable adjustment.
3. Check and correct vacuum line and fittings.
4. Check and correct manual linkage.

OIL LEVEL AND CONDITION CHECK

Always check the oil level before road testing. Oil must be visible on dip stick prior to operating the vehicle. Erratic shifting, pump noise, or other malfunctions can in some cases be traced to improper oil level.

Oil level should be checked with the selector lever in

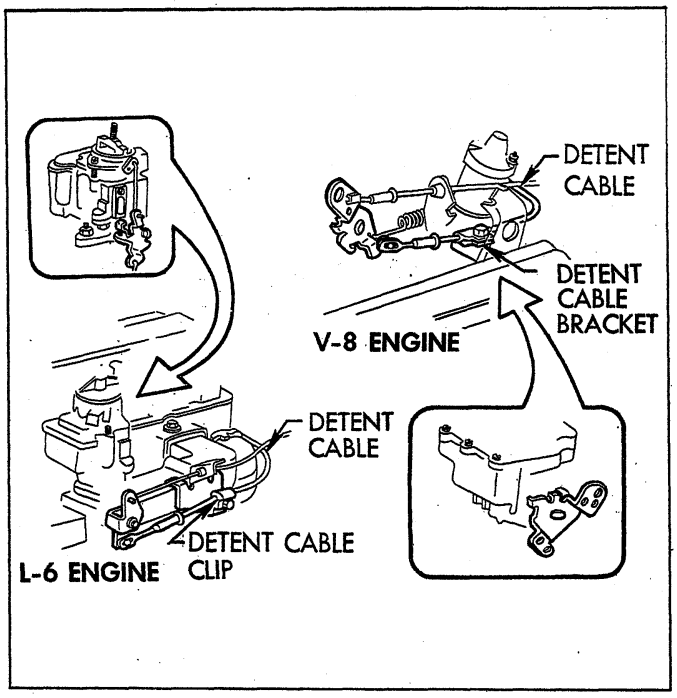


Fig. 6—Detent Cable Adjustment

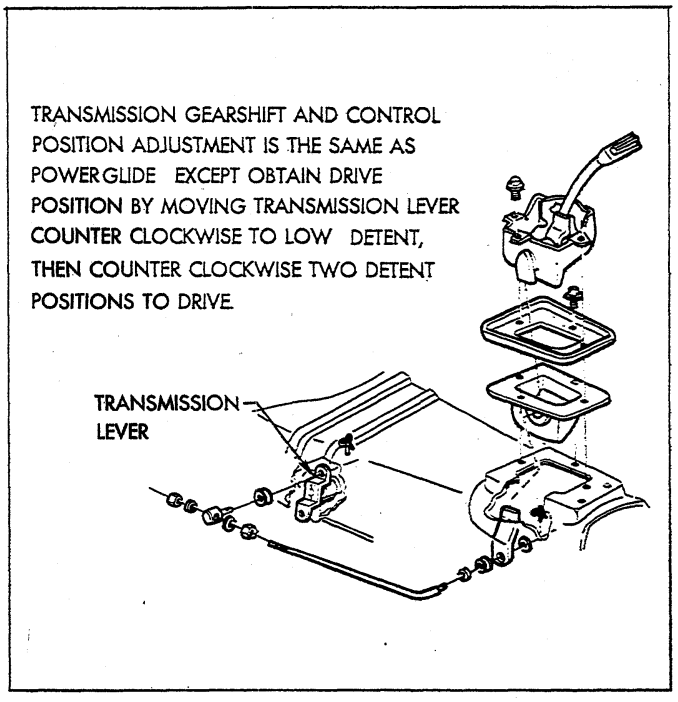


Fig. 7—Nova Floor Shift Linkage Adjustment

the Neutral (N) position, engine running, and the vehicle on level pavement.

Fluid level should be to the FULL mark with the transmission at normal operating temperature (170°-190°F.). With warm fluid (room temperature), the level should be at or slightly below the ADD mark.

If oil level was low, refer to Oil Leaks.

The condition of the oil is often an indication of whether the transmission should be removed from the vehicle, or to make further tests. When checking oil level, a burned smell and discoloration indicate burned clutches or band and the transmission will have to be removed.

MANUAL LINKAGE

Manual linkage adjustment and the associated neutral safety switch are important from a safety standpoint. The neutral safety switch should be adjusted so that the engine will start in the Park and Neutral positions only.

With the selector lever in the Park position, the parking pawl should freely engage and prevent the vehicle from rolling. The pointer on the indicator quadrant should line up properly with the range indicators in all ranges.

OIL LEAKS

Before attempting to correct an oil leak, the actual source of the leak must be determined. In many cases, the source of the leak can be deceiving due to "wind flow" around the engine and transmission.

The suspected area should be wiped clean of all oil before inspecting for the source of the leak. Red dye is used in the transmission oil at the assembly plant and will indicate if the oil leak is from the transmission.

The use of a "black light" to identify the oil at the source of leak is also helpful. Comparing the oil from the leak to that on the engine or transmission dip stick (when viewed by black light) will determine the source of the leak.

Oil leaks around the engine and transmission are generally carried toward the rear of the car by the air stream. For example, a transmission "oil filler tube to case leak" will sometimes appear as a leak at the rear of the transmission. In determining the source of an oil leak it is most helpful to keep the engine running.

POSSIBLE POINTS OF OIL LEAKS

1. TRANSMISSION OIL PAN LEAK
   a. Attaching bolts not correctly torque.
   b. Improperly installed or damaged pan gasket.
   c. Oil pan gasket mounting face not flat.
2. REAR EXTENSION LEAK
   a. Attaching bolts not correctly torqued.
   b. Rear seal assembly - damaged or improperly installed.
   c. "O" ring seal - (extension to case) damaged or improperly installed.
   d. Porous casting.
3. CASE LEAK
   a. Filler pipe "O" ring seal damaged or missing; misposition of filler pipe bracket to engine - "loading" one side of "O" ring.
   b. Modulator assembly "O" ring seal - damaged or improperly installed.
   c. Governor cover "O" ring seal - damaged, loose; case face leak.
   d. Speedo gear - "O" ring damaged.
   e. Manual shaft seal - damaged, improperly installed.
   f. Line pressure tap plug - stripped, shy sealer compound.
   g. Parking pawl shaft cup plug - damaged, improperly installed.
   h. Vent pipe (refer to Item 5).
   i. Detent cable "O" ring seal damaged.
   j. Porous case.

4. FRONT END LEAK
   a. Front seal - damaged (check converter neck for nicks, etc., also for pump bushing moved forward).
   b. Pump attaching bolts and seals - damaged, missing, bolts loose.
   c. Converter - leak in weld.
   d. Pump "O" ring seal - damaged. (Also check pump groove and case bore.)
   e. Porous casting (pump or case).
5. OIL COMES OUT VENT PIPE
   a. Transmission over-filled.
   b. Water in oil.
   c. Pump to case gasket mispositioned.
   d. Foreign material between pump and case, or betwenn pump cover and body.
   e. Case - porous, pump face improperly machined.
   f. Pump - shy of stock on mounting faces, porous casting.

CASE POROSITY—REPAIR

Transmission leaks caused by aluminum case porosity have been successfully repaired with the transmission in the vehicle by using the following procedure.

1. Road test and bring the transmission to operating temperature.
2. Raise the car and, with the engine running, locate the source of the oil leak. Check for leaks in all operating positions.

   NOTE: The use of a mirror will be helpful in finding leaks.

3. Shut off engine and thoroughly clean area with a solvent and air dry.
4. Using the instruction of the manufacturer, mix a sufficient amount of epoxy cement, part #1360016, to make the repair.
5. While the transmission is still hot, apply the epoxy to the area, making certain that the area is fully covered.
6. Allow epoxy cement to dry for three hours and retest for leaks, as outlined in Steps 1 and 2.

OIL PRESSURE CHECK

With Car Stationary

Transmission oil pressure gauge and engine tachometer should be connected and the oil pressures should check as follows:

1. Pressures (psi) indicated below are at O Output Speed with the Vacuum Modulator Tube Disconnected and with Engine at 1200 rpm

Approximate Altitude of Check (Ft. Above Sea Level)	All L-6			All V-8 Except 350 V-8 with 2 Bbl. Carb.			350 V-8 with 2 Bbl. Carb.			L-6 and V-8 Taxi		
	Drive Neutral Park	L1 or L2	Reverse	Drive Neutral Park	L1 or L2	Reverse	Drive Neutral Park	L1 or L2	Reverse	Drive Neutral Park	L1 or L2	Reverse
0	139	139	259	149	149	255	149	149	247	139	139	250
2000	139	139	244	149	149	241	149	149	233	139	139	235
4000	139	139	230	149	149	228	145	146	219	139	139	221
6000	138	138	217	142	144	215	136	139	206	132	134	203
8000	130	133	204	134	138	203	128	134	195	125	129	195
10000	123	127	193	127	133	192	121	128	184	117	123	184
12000	116	122	182	120	127	182	114	123	173	110	118	173
14000	109	118	171	113	123	172	108	119	164	104	113	163

2. Pressures (psi) indicated below are at O Output Speed with the Vacuum Modulator Tube Connected and with sufficient Engine Speed to maintain 16 inches Hg Absolute Manifold Pressure

Approximate Altitude of Check (Ft. Above Sea Level)	Absolute Manifold Pressure ("Hg.)	Relative Engine Vacuum ("Hg.)	All L-6			All V-8 Except 350 V-8 with 2 Bbl. Carb.			350 V-8 with 2 Bbl. Carb.			L-6 and V-8 Taxi		
			Drive Neutral Park	L1 or L2	Reverse	Drive Neutral Park	L1 or L2	Reverse	Drive Neutral Park	L1 or L2	Reverse	Drive Neutral Park	L1 or L2	Reverse
0	16	13.92	82	98	128	86	103	131	81	99	123	76	94	120
2000	16	11.83	85	100	133	89	105	136	84	101	127	79	96	124
4000	16	9.86	88	102	138	92	107	140	87	103	131	82	98	129
6000	16	7.96	91	104	142	95	109	144	89	105	135	85	100	133
8000	16	6.23	93	106	146	97	117	148	92	107	139	87	102	137
10000	16	4.58	95	107	150	100	113	151	94	109	143	90	103	141
12000	16	3.04	98	109	153	102	114	155	96	110	146	92	105	144
14000	16	1.59	100	111	157	104	116	158	98	112	149	94	107	143

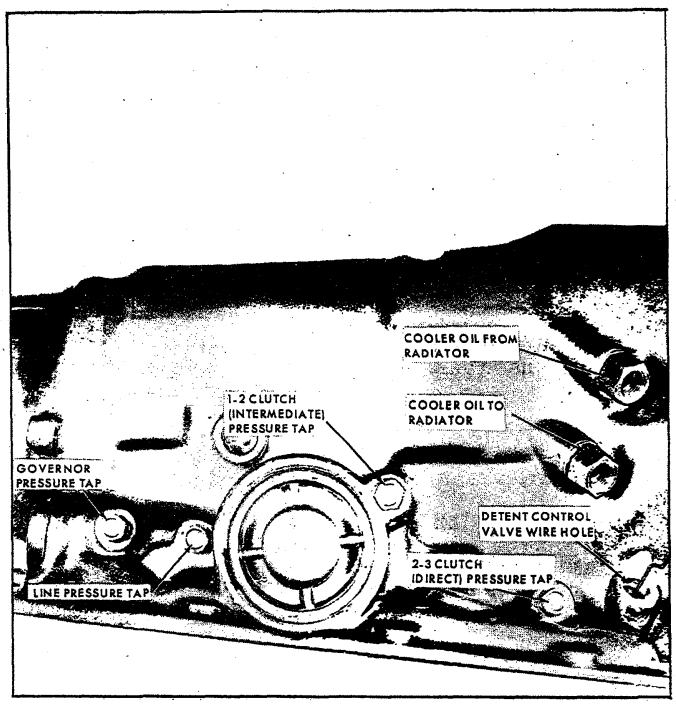


Fig. 8—Pressure Tap Plugs

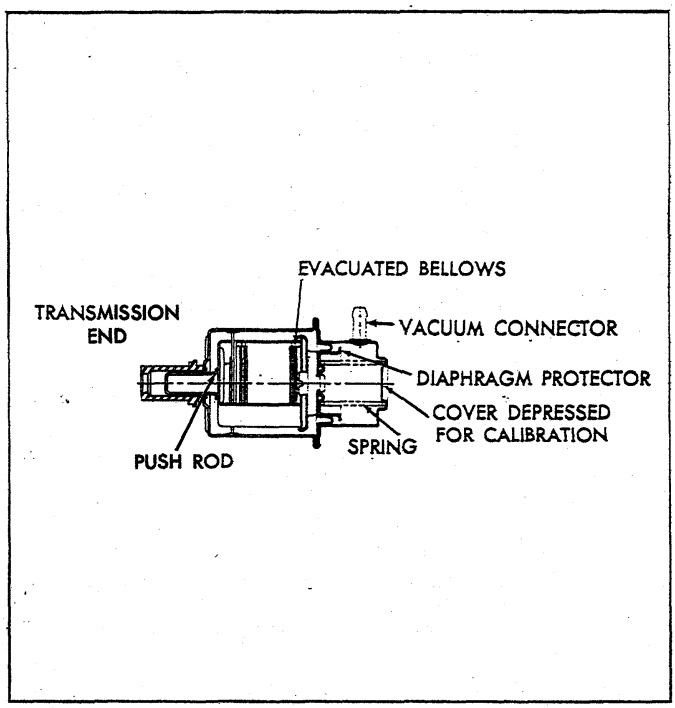


Fig. 9—Vacuum Modulator Assy.

VACUUM MODULATOR ASSEMBLY

1. Vacuum Diaphragm Leak Check (Fig. 9)

Insert a pipe cleaner into the vacuum connector pipe as far as possible and check for the presence of transmission oil. If oil is found, replace the modulator.

NOTE: Gasoline or water vapor may settle in the vacuum side of the modulator. If this is found without the presence of oil, the modulator should not be changed.

2. Atmospheric Leak Check

Apply a liberal coating of soap bubble solution to the vacuum connector pipe seam, the crimped upper to lower housing seam. Using a short piece of rubber tubing, apply air pressure to the vacuum pipe by blowing into the tube and observe for leak bubbles. If bubbles appear, replace the modulator.

NOTE: Do not use any method other the human lung power for applying air pressure, as pressures over 6 psi may damage the modulator.

3. Bellows Comparison Check

Using a comparison gauge, as shown in Fig. 10, compare the load of a known good Turbo Hydra-Matic 350 modulator with the assembly in question.

A. Install the modulator that is known to be acceptable on either end of the gauge.
B. Install the modulator in question on the opposite end of the gauge.
C. Holding the modulators in a horizontal position, bring them together under pressure until either modulator sleeve end just touches the line in the center of the gauge. The gap between the opposite modulator sleeve end and the gauge line should then be 1/16" or less. If the distance is greater than this amount, the modulator in question should be replaced.

4. Sleeve Alignment Check

Roll the main body of the modulator on a flat surface and observe the sleeve for concentricity to the can. If the sleeve is concentric and the plunger is free, the modulator is acceptable.

Once the modulator assembly passes all of the above tests, it is an acceptable part and should be re-used.

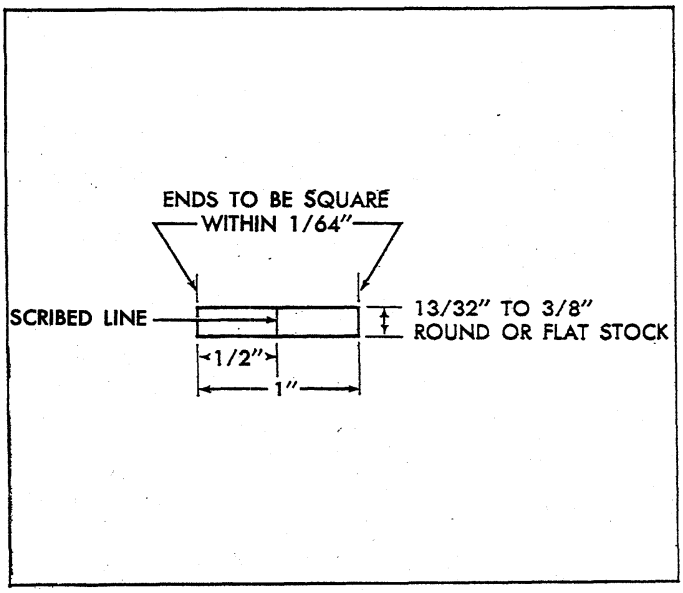


Fig. 10—Bellows Comparison Gauge

TURBO HYDRA-MATIC 350 SHIFT POINTS (MPH* In Drive)

Model	CHEVROLET																			
Engine	L-6 Base (250) 2.73 Axle 8.25-14 Tire				V-8 Base (327) 2.73 Axle 8.25-14 Tire				V-8 L-65 (350) 2.73 Axle 8.25-14 Tire				V-8 LMI or L-48 (350) 2.73 Axle 8.25-14 Tire				Taxi 2.73 Axle 8.25-15 Tire			
Shift	1-2	2-3	3-2	2-1	1-2	2-3	3-2	2-1	1-2	2-3	3-2	2-1	1-2	2-3	3-2	2-1	1-2	2-3	3-2	2-1
Closed Throttle	9-15	19-22	21-17	13-6	9-15	19-22	21-17	13-6	9-15	19-22	21-17	13-6	9-15	19-22	21-17	13-6	9-15	19-23	22-18	13-7
Detent TWO Touch	34-49	63-75	69-54	12-6	34-49	63-75	69-54	11-6	35-49	64-76	70-55	12-6	38-53	67-78	71-57	11-6	31-46	61-73	68-53	12-7
Wide Open Throttle	35-54	71-87	83-67	46-24	40-59	75-90	87-70	50-27	43-62	79-95	92-75	51-27	43-62	79-95	92-75	50-27	35-55	72-87	84-67	47-24

Model	CHEVELLE															
Engine	L-6 Base or L-22 (230 & 250) 2.73 Axle 7.35-14 Tire				V-8 Base (307) 2.73 Axle 7.35-14 Tire				V-8 L-65 (350) 2.56 Axle 7.35-14 Tire				V-8 LMI or L-48 (350) 2.56 Axle 7.35-14 Tire			
Shift	1-2	2-3	3-2	2-1	1-2	2-3	3-2	2-1	1-2	2-3	3-2	2-1	1-2	2-3	3-2	2-1
Closed Throttle	9-15	18-21	20-17	12-6	9-15	18-21	20-17	12-6	9-15	19-23	22-18	13-6	9-16	19-23	22-18	13-6
Detent TWO Touch	33-46	60-71	66-52	11-6	33-46	60-71	66-52	11-6	36-50	65-77	71-56	12-6	39-53	68-80	73-58	11-6
Wide Open Throttle	33-52	68-82	79-64	44-23	38-56	71-86	83-67	48-25	44-63	80-96	93-76	52-28	44-63	80-96	93-76	51-27

Model	NOVA															
Engine	L-6 Base or L-22 (230 & 250) 2.73 Axle 7.35-14 Tire				V-8 Base (307) 2.73 Axle 7.35-14 Tire				V-8 L-65 (350) 2.56 Axle E70-14 Tire				V-8 LMI or L-48 (350) 3.08 Axle E70-14 Tire			
Shift	1-2	2-3	3-2	2-1	1-2	2-3	3-2	2-1	1-2	2-3	3-2	2-1	1-2	2-3	3-2	2-1
Closed Throttle	9-15	18-21	20-17	12-6	9-15	18-21	20-17	12-6	9-15	19-22	21-17	13-6	8-13	15-19	18-14	11-5
Detent TWO Touch	33-46	60-71	66-52	11-6	33-46	60-71	66-52	11-6	35-49	64-75	69-55	12-6	32-44	55-65	59-47	9-5
Wide Open Throttle	33-52	68-82	79-64	44-23	38-56	71-86	83-67	48-25	43-61	79-94	91-75	51-27	36-51	65-79	76-62	42-22

Model	CAMARO																			
Engine	L-6 Base or L-22 (230 & 250) 2.73 Axle 7.35-14 Tire				V-8 Base (307) 2.73 Axle 7.35-14 Tire				V-8 LF7 (327) 2.73 Axle 7.35-14 Tire				V-8 L-65 (350) 2.56 Axle F70-14 Tire				V-8 LMI or L-48 (350) 3.08 Axle F70-14 Tire			
Shift	1-2	2-3	3-2	2-1	1-2	2-3	3-2	2-1	1-2	2-3	3-2	2-1	1-2	2-3	3-2	2-1	1-2	2-3	3-2	2-1
Closed Throttle	9-15	18-21	20-17	12-6	9-15	18-21	20-17	12-6	9-15	18-21	20-17	12-6	9-15	19-23	22-18	13-7	8-13	16-19	18-15	11-5
Detent TWO Touch	33-46	60-71	66-52	11-6	33-46	60-71	66-52	11-6	33-46	60-71	66-52	11-6	36-51	65-78	71-56	12-7	33-45	57-67	61-49	10-5
Wide Open Throttle	33-52	68-82	79-64	44-23	38-56	71-86	83-67	48-25	38-56	71-86	83-67	48-25	44-63	81-97	94-77	52-28	37-53	67-81	78-64	43-23

*MPH Range Specified is at signal of shift and represents middle 75% of the absolute shift band.

TURBO HYDRA-MATIC 400 TRANSMISSION

INDEX

	Page
General Description	7-38
Maintenance and Adjustments	7-39
Transmission Fluid	7-40
Fluid Checking Procedure	7-40
Fluid Level Indicator	7-41
Shift Control Linkage Adjustment	7-41
Detent Switch Adjustment	7-42
Neutral Safety Switch Adjustment	7-42
Draining and Refilling Transmission	7-42
Pressure Regulator Valve	7-43
Control Valve Body	7-43
Governor	7-43
Modulator and Modulator Valve	7-43
Parking Linkage	7-43
Rear Seal	7-43
Other Service Operations	7-43
Transmission Replacement	7-44
Turbo Hydra-Matic 400 Diagnosis Procedure	7-44
Sequence	7-44
Oil Level and Condition Check	7-44
Manual Linkage	7-44
Oil Leaks	7-45
Case Porosity - Repair	7-45
Oil Pressure Check	7-45
Vacuum Modulator Assembly	7-46
Transmission Shift Points	7-47
Special Tools	7-48

GENERAL DESCRIPTION

The Turbo Hydra-Matic 400 transmission is a fully automatic unit consisting primarily of a 3-element hydraulic torque converter and a compound planetary gear set. Three multiple-disc clutches, one sprag unit, one roller clutch and two bands provide the friction elements required to obtain the desired function of the compound planetary gear set.

The torque converter couples the engine to the planetary gears through oil and provides hydraulic torque multiplication when required. The compound planetary gear set produces three forward speeds and reverse.

The 3-element torque converter consists of a pump or driving member, a turbine or driven member, and a stator assembly. The stator is mounted on a one-way roller clutch which will allow the stator to turn clockwise but not counter-clockwise.

The torque converter housing is filled with oil and is attached to the engine crankshaft by a flex plate and always rotates at engine speed. The converter pump is an integral part of the converter housing, therefore the pump blades, rotating at engine speed, set the oil within the converter into motion and direct it to the turbine, causing the turbine to rotate.

As the oil passes through the turbine it is traveling in such a direction that if it were not re-directed by the stator it would hit the rear of the converter pump blades and impede its pumping action. So at low turbine speeds, the oil is re-directed by the stator to the converter pump in such a manner that it actually assists the converter pump to deliver power or multiply engine torque.

As turbine speed increases, the direction of the oil leaving the turbine changes and flows against the rear side of the stator vanes in a clockwise direction. Since the stator is now impeding the smooth flow of oil, its roller clutch releases and it revolves freely on its shaft. Once the stator becomes inactive, there is no further multiplication of engine torque within the converter. At this point, the converter is merely acting as a fluid coupling as both the converter pump and turbine are being driven at approximately the same speed - or at a one-to-one ratio.

A hydraulic system pressurized by a gear type pump provides the working pressure required to operate the friction elements and automatic controls.

External control connections to transmission are:

Manual Linkage	- To select the desired operating range.
Engine Vacuum	- To operate a vacuum modulator unit.
12 Volt Electrical Signal	- To operate an electrical detent solenoid.

A vacuum modulator is used to automatically sense any change in the torque input to the transmission. The vacuum modulator transmits this signal to the pressure regulator for line pressure control, to the 1-2 accumulator valve, and to the shift valves so that all torque requirements of the transmission are met and smooth shifts are obtained at all throttle openings.

The detent solenoid is activated by an electric switch on the carburetor. When the throttle is fully opened, the switch on the carburetor is closed, activating the detent solenoid and causing the transmission to downshift at speeds below approximately 70 MPH.

The selector quadrant has six selector positions: P,R, N,D,L2,L1. (P,R,N,3,2,1)

P. - Park position positively locks the output shaft to the transmission case by means of a locking pawl to prevent the vehicle from rolling in either direction. The engine may be started in Park position.

R. - Reverse enables the vehicle to be operated in a reverse direction.

N. - Neutral position enables the engine to be started and run without driving the vehicle.

3-D. - Drive Range is used for all normal driving conditions and maximum economy. Drive Range has three gear ratios, from the starting ratio to direct drive. Detent downshifts are available by depressing the accelerator to the floor.

2-L2. - L2 Range has the same starting ratio as Drive Range, but prevents the transmission from shifting above second speed to retain second speed acceleration when extra performance is desired. L2 Range can also be used for engine braking. L2 Range can be selected at any vehicle speed, and the transmission will shift to second gear

and remain in second until the vehicle speed or the throttle are changed to obtain first gear operation in the same manner as in D Range.

1-L1. - L1 Range can be selected at any vehicle speed, and the transmission will shift to second gear and remain in second until vehicle speed is reduced to approximately 40 MPH, depending on axle ratio. L1 Range position prevents the transmission from shifting out of first gear.

It is very important that any communication concerning the Turbo Hydra-Matic 400 always contain the transmission serial and Vehicle Identification number and that all transmission parts returned to Chevrolet Motor Division always be tagged with the transmission serial number.

MAINTENANCE AND ADJUSTMENTS

TURBO HYDRA-MATIC 400 DETENT SWITCH ADJUSTMENTS

Corvette & Chevelle Adjustment Procedure

1. Pull detent switch driver rearward until the hole in the switch body aligns with hole in driver. Insert a .092 inch diameter pin through the aligned holes to a depth of .10 inches. This will hold driver in position.
2. Loosen mounting bolt.
3. Depress accelerator to W.O.T. position. With accelerator pedal in this position move switch forward until driver contacts accelerator lever.
4. Tighten mounting bolt. Remove pin.

Chevrolet, Nova and Camaro Adjustment Procedure

1. Loosen mounting bolts.
2. With automatic choke in 'open' position, move accelerator linkage to W.O.T. position. Depress detent switch plunger till it bottoms in switch. Move switch toward throttle lever paddle until there is only .23±

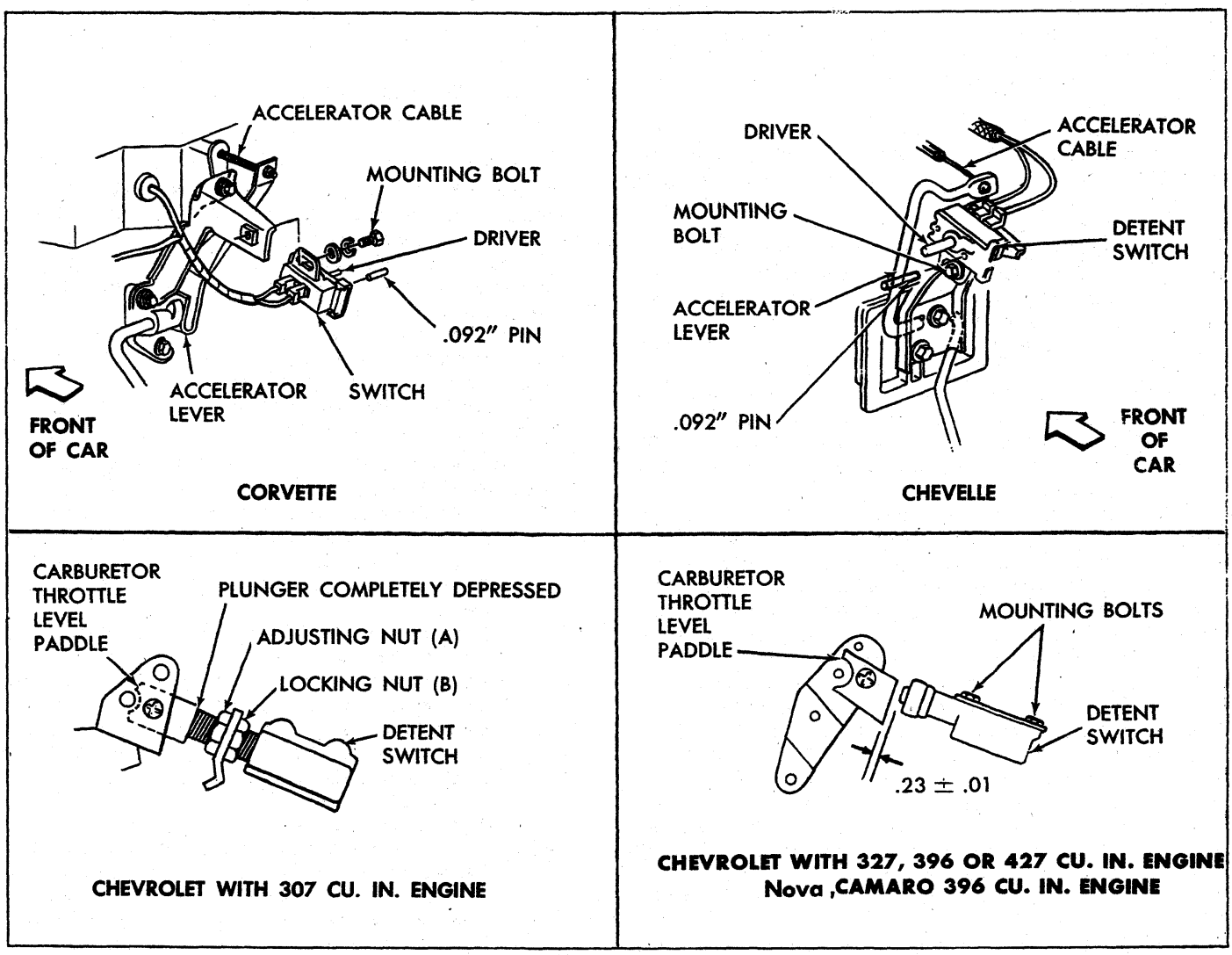


Fig. 1T—Turbo Hydra-Matic 400 Detent Switch Adjustment

.01 inches between the face of the lever paddle and the depressed detent switch plunger.

3. Tighten mounting bolts.

TRANSMISSION FLUID

Transmission fluid level should be checked with transmission warm and selector lever in "P" Park position, every time engine oil level is checked or as specified in Section 0 when engine oil is changed.

FLUID CHECKING PROCEDURE

To determine proper fluid level, proceed as follows:

CAUTION: The full mark on the dipstick is an indication of transmission fluid at normal operating temperature of 180° F. This temperature is only obtained after at least 15 miles of expressway driving or equivalent of city driving.

1. With manual control lever Park position start engine. DO NOT RACE ENGINE. Move manual control lever through each range.
2. Immediately check fluid level with selector lever in Park, engine running, and vehicle on LEVEL surface.

At this point, when a reading is made, fluid level on the dipstick should be at the "FULL" mark.

3. If additional fluid is required, add fluid to the "FULL" mark on the dipstick.

IMPORTANT: When adding fluid, use only DEXRON automatic transmission fluid. The difference in oil level between ADD and FULL is one pint.

In all 1967 and earlier model automatic transmissions, use either DEXRON automatic transmission fluid or Type A automatic transmission fluid identified by the mark "AQ-ATF", followed by a number and the suffix letter "A" (AQ-ATF-XXXXA).

If vehicle is not driven 15 expressway miles or equivalent, and it becomes necessary to check fluid level, the transmission fluid must be at room temperature (70°F).

With fluid at room temperature (70°F) follow Steps 1, 2 and 3 below.

1. With manual control lever Park position start en-

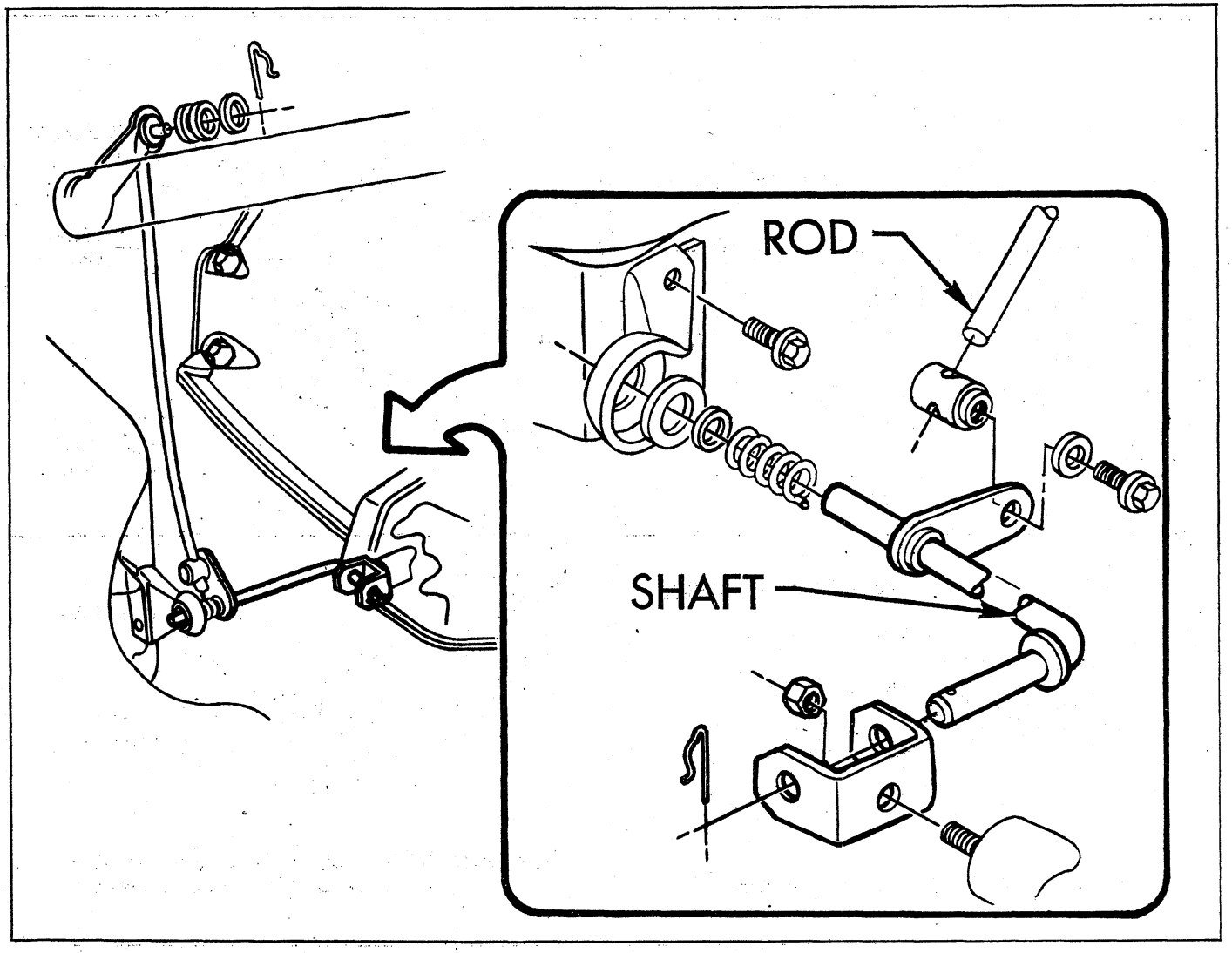


Fig. 2T—Shift Linkage Adjustment (Column)-Typical

gine. DO NOT RACE ENGINE. Move manual control lever through each range.

2. Immediately check fluid level with selector lever in Park, engine running, and vehicle on LEVEL surface.

At this point, when a reading is made, fluid level on the dipstick should be 1/4" below the "ADD" mark.

CAUTION: Do Not Overfill, as foaming and loss of fluid through the vent pipe might occur as fluid heats up. If fluid is too low, especially when Cold, complete loss of drive may result which can cause transmission failure.

NOTE: If transmission fluid level is correctly established at 70°F it will appear at the "FULL" mark on the dipstick when the transmission reaches normal operating temperature (180°F). The fluid level is set 1/4" below the "ADD" mark on the dipstick to allow for expansion of the fluid which occurs as transmission temperatures rise to normal operating temperature of 180°F.

3. If additional fluid is required, add fluid to bring level to 1/4" below the "ADD" mark on the dipstick.

FLUID LEVEL INDICATOR

The fluid level indicator is located in the filler pipe at the right rear corner of the engine. To bring the fluid level from the add mark to the full mark add 1 pint.

Fluid level should be to the full mark with transmission at normal operating temperature. With cold fluid the level should be approximately 1/4" below the add mark.

SHIFT CONTROL LINKAGE ADJUSTMENT

Column Type

Adjust linkage as shown below (Column) and in Figure 3T (Console).

1. The shift tube and lever assembly must be free in the mast jacket. See Section 9 for alignment of steering column assembly if necessary.
2. To check for proper shift linkage adjustment, lift the transmission selector lever towards the steering wheel. Allow the selector lever to be positioned in drive (D) by the transmission detent. (Rotate selector lever counter-clockwise to low detent then clockwise two positions for drive.)

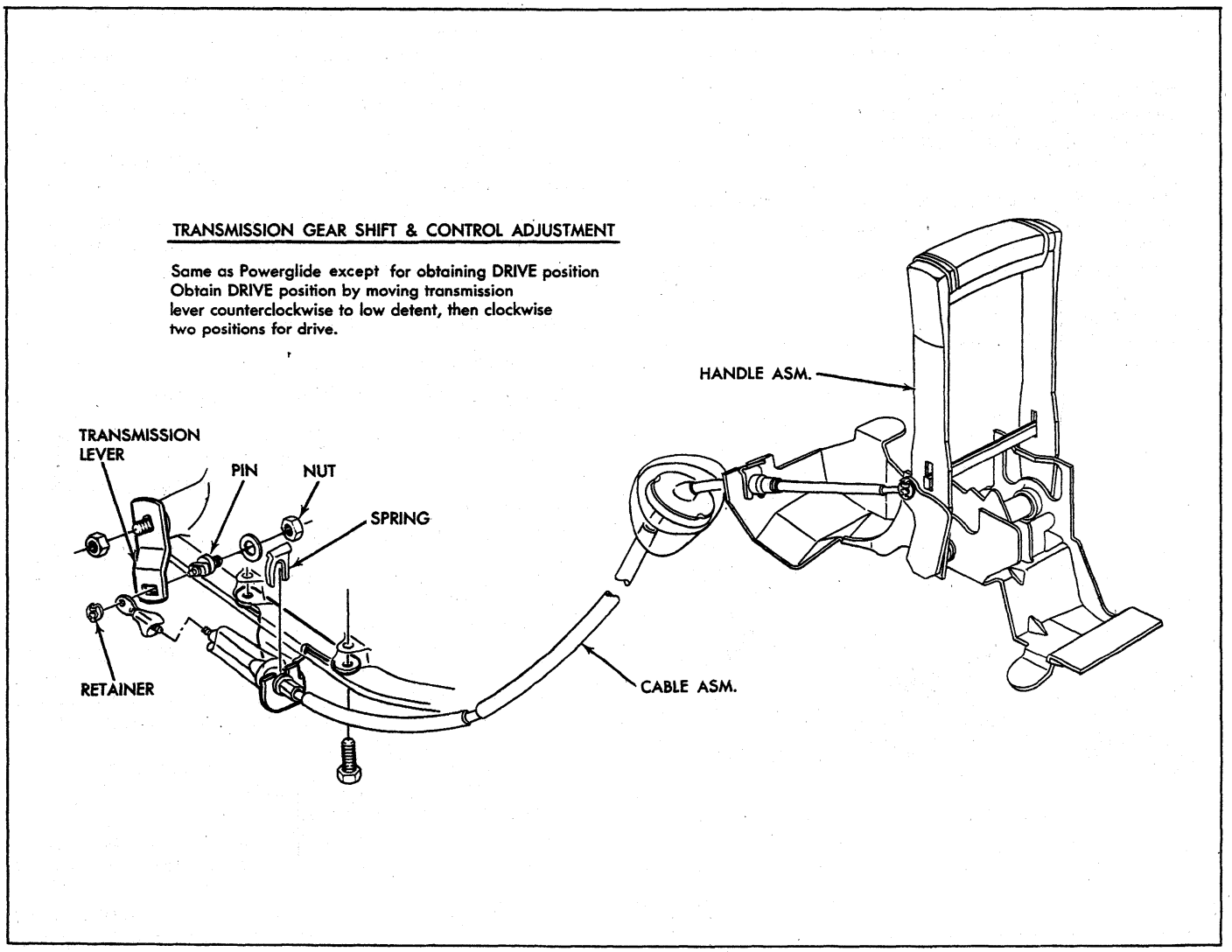


Fig. 3T—Shift Linkage Adjustment (Console) Typical

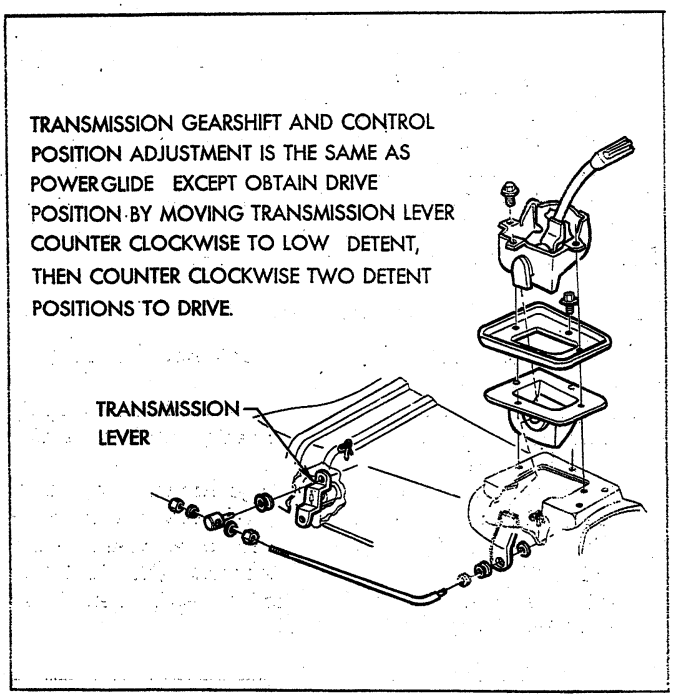


Fig. 4T—Shift Linkage Adjustment Console—Nova

NOTE: Do not use the indicator pointer as a reference to position the selector lever. When performing linkage adjustment, pointer is adjusted last.

3. Release the selector lever. The lever should be inhibited from engaging low range unless the lever is lifted.
4. Lift the selector lever towards the steering wheel, and allow the lever to be positioned in neutral (N) by the transmission detent.

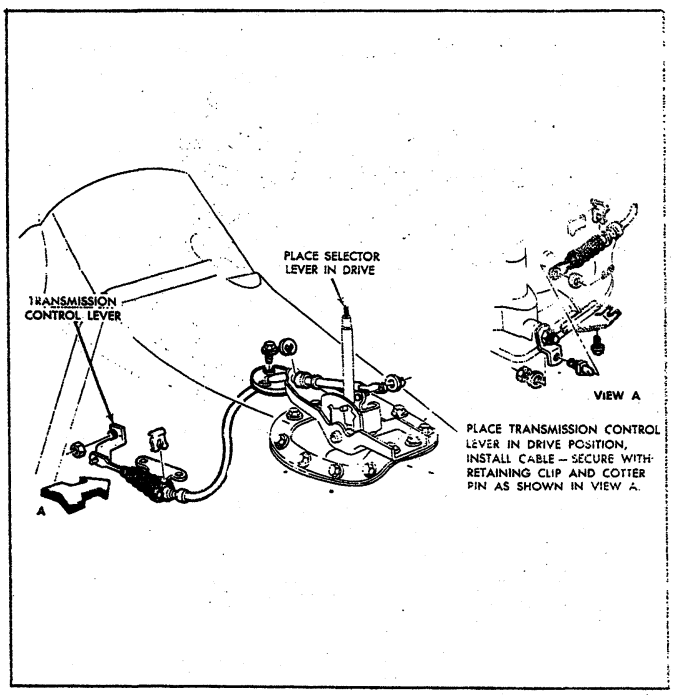


Fig. 5T—Shift Linkage Adjustment (Console)—Corvette

5. Release the selector lever. The lever should now be inhibited from engaging reverse range unless the lever is lifted.
6. A properly adjusted linkage will prevent the selector lever from moving beyond both the neutral detent, and the drive detent unless the lever is lifted to pass over the mechanical stop in the steering column.
7. In the event that an adjustment is required, place the selector lever in drive (D) position as determined by the transmission detent. See Steps 2 and 3.
8. Loosen the adjustment swivel at the cross-shaft, and rotate the transmission lever so that it contacts the drive stop in the steering column.
9. Tighten the swivel and recheck the adjustment. See Steps 2 and 6.
10. Readjust indicator needle if necessary to agree with the transmission detent positions. See Section 9.
11. Readjust neutral safety switch if necessary to provide the correct relationship to the transmission detent positions. See Section 12.
12. When properly adjusted the following conditions must be met by manual operation of the steering column shift lever:
    a. From reverse to drive position travel, the transmission detent feel must be noted and related to indicated position on dial.
    b. When in drive and reverse positions, pull lever rearward (towards steering wheel) and then release. It must drop back into position with no restrictions.

Floor Shift Adjustment—Nova and Corvette
Refer to Figs. 4T and 5T

NOTE: For procedures to cover NOVA Linkage Adjustment see page 7-19 of Powerglide Service Procedure this section.

DETENT SWITCH ADJUSTMENT

Adjust switch as shown in Figure 1T

NEUTRAL SAFETY SWITCH ADJUSTMENT

The neutral safety switch must be adjusted so that the car will start in the park or neutral position, but will not start in the other positions. For replacement refer to Section 12 of this Manual.

DRAINING AND REFILLING TRANSMISSION

Drain oil immediately after operation before it has had an opportunity to cool.

To drain oil proceed as follows:

1. Remove bottom pan attaching screws, pan, and gasket. Discard gasket.
2. Remove oil strainer retainer bolt, oil strainer and "O" ring seal from intake pipe and discard the strainer and "O" ring.
3. Install new "O" ring seal on intake pipe and install new strainer on pipe assembly.
4. Thoroughly clean bottom pan.
5. Affix new gasket to bottom pan with petroleum jelly.
6. Install bottom pan with attaching screws and torque to 12 lb. ft.
7. If only the pan has been removed, pour approximately 7-1/2 pints (U.S. measure, 6-1/4 pints Imperial measure) of fluid into the transmission. If the valve body has also been removed use 9-1/2 pints (U.S.

measure, 8 pints Imperial measure). After a complete overhaul approximately 19 pints (U.S. measure 15-3/4 pints Imperial measure) are required. Be sure container, spout, or funnel is clean.

8. Start engine and let idle (carburetor off fast idle step). Place selector lever in P position and apply hand brake.
9. With transmission warm (approximately 180°F), add fluid to bring level to full mark on indicator. With transmission at room temperature (approximately 70°F, add fluid to 1/4" below the add mark.

CAUTION: Do not overfill. Foaming will result.

PRESSURE REGULATOR VALVE

Removal

1. Remove bottom pan and strainer.
2. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring, using J-5403 pliers.
3. Remove regulator boost valve bushing and valve.
4. Remove pressure regulator spring.
5. Remove regulator valve, spring retainer, and spacer(s) if present.

Installation

Installation of the pressure regulator valve is the reverse of the removal. Adjust oil level.

CONTROL VALVE BODY

Removal

1. Remove bottom pan and strainer.
2. Disconnect solenoid lead from connector terminal.
3. Remove control valve body attaching screws and detent roller spring assembly.

NOTE: Do not remove solenoid attaching screws.

4. Remove control valve body assembly and governor pipes. If care is taken in removing control valve body the six (6) check balls will stay in place above the spacer plate.

CAUTION: Do not drop manual valve.

5. Remove the governor pipes and manual valve from control valve body.

Installation

Installation of the control valve body is the reverse of the removal. Adjust oil level.

GOVERNOR

NOTE: If difficulty is encountered when removing the governor assembly, it may be necessary to remove the oil pan and withdraw the governor pipes (approximately 1/8") to free governor assembly.

Removal

1. Remove governor cover attaching screws, cover, and gasket.
2. Discard gasket.
3. Withdraw governor assembly from case.

Installation

Installation of the governor assembly is the reverse of the removal. Use a new gasket under the governor cover. Adjust oil level.

MODULATOR AND MODULATOR VALVE

Removal

1. Remove modulator assembly attaching screw and retainer.
2. Remove modulator assembly from case. Discard "O" ring seal.
3. Remove modulator valve from case.

Installation

Installation of the modulator assembly and modulator valve is the reverse of the removal. Use a new "O" ring seal on the modulator assembly. Adjust oil level.

PARKING LINKAGE

Removal

1. Remove bottom pan and oil strainer.
2. Unthread jam nut holding detent lever to manual shaft.
3. Remove manual shaft retaining pin from case.
4. Remove manual shaft and jam nut from case.

NOTE: DO NOT remove manual shaft seal unless replacement is required.

5. Remove parking actuator rod and detent lever assembly.
6. Remove parking pawl bracket attaching screws and bracket.
7. Remove parking pawl return spring.

NOTE: The following steps should not be completed unless part replacement is required.

8. Remove parking pawl shaft retainer.
9. Remove parking pawl shaft, cup plug, parking pawl shaft, and parking pawl.

Installation

Installation of the parking linkage is the reverse of the removal. Use new seal and cup plug, if removed, and new bottom pan gasket. Adjust oil level.

REAR SEAL

Removal

1. Remove propeller shaft.
2. Pry seal out with screw driver or small chisel.

Installation

1. Using Tool J-21359 install new seal.
2. Re-install propeller shaft.

OTHER SERVICE WITH TRANSMISSION IN VEHICLE

The following operations when done as single operations and not as part of a general overhaul should, as a practical matter, be performed with the transmission in the vehicle. Refer to the "Transmission Disassembly and Reassembly" section of the Overhaul Manual for service procedures.

a. Oil filler pipe and "O" ring seal.

b. Oil pan and gasket.
c. Down shift solenoid or connector.
d. Valve body spacer plate, gasket and check balls.
e. Front accumulator piston.
f. Rear servo and rear accumulator assembly.
g. Rear band apply checking with Tool J-21370.
h. Front servo assembly.
i. Speedo driven gear.
j. Case extension or gasket.
k. Strainer and "O" ring.

TRANSMISSION REPLACEMENT

Before raising the car, disconnect the negative battery cable and release the parking brake.

1. Place car on hoist.
   Camaro models only:
   a. Disconnect parking brake cables.
   b. Remove underbody reinforcement plate. (convertible)
   c. Disconnect left exhaust pipe from manifold for clearance.
   On Corvette models, remove both exhaust pipes.
2. Remove propeller shaft.
3. Disconnect speedometer cable, electrical lead to case connector, vacuum line modulator, and oil cooler pipes.
4. Disconnect shift control linkage.
5. Support transmission with suitable transmission jack.
6. Disconnect rear mount from frame crossmember.
7. Remove two bolts at each end of frame crossmember (plus through bolt at inside of frame and parking brake pulley on Corvette models). Remove crossmember.
8. Remove oil cooler lines, vacuum modulator line, speedo cable, and detent solenoid connector wire at transmission.
9. Remove converter under pan.
10. Remove converter to flywheel bolts.
11. Loosen exhaust pipe to manifold bolts approximately 1/4 inch (Chevrolet and Chevelle). Lower transmission until jack is barely supporting it.
12. Remove transmission to engine mounting bolts and remove oil filler tube at transmission.
13. Raise transmission to its normal position, support engine with jack and slide transmission rearward from engine and lower it away from vehicle.

CAUTION: Use converter holding Tool J-5384 when lowering transmission or keep rear of transmission lower than front so as not to lose converter.

The installation of the transmission is the reverse of the removal with the following added step. Before installing the flex plate to converter bolts, make certain that the weld nuts on the converter are flush with the flex plate and the converter rotates freely by hand in this position. Then, hand start all three bolts and tighten finger tight before torqueing to specification. This will insure proper converter alignment.

NOTE: After installation of transmission, remove car from hoist. Check linkage for proper adjustment.

TURBO HYDRA-MATIC 400 DIAGNOSIS PROCEDURE

CAUTION: In the event of a major transmission failure, replace strainer assembly, and flush oil cooler and cooler lines.

Accurate diagnosis of transmission problems begins with a thorough understanding of normal transmission operation. In particular, knowing which units are involved in the various speeds or shifts so that the specific units or circuits involved in the problem can be isolated and investigated further. Analytical diagnosis will protect the technician from come backs and certainly will improve owner satisfaction.

An important and often overlooked aspect of diagnosis is finding out specific customer complaints. For this purpose a short ride with the customer will often prove beneficial. It may be found that the condition the customer wants corrected is standard and should not be altered.

The following sequence, based on field experience, provides the desired information quickly and in most cases actually corrects the malfunction without requiring the removal of the transmission. Details of the items listed in this sequence are covered further in the text.

SEQUENCE FOR TURBO HYDRA-MATIC 400 DIAGNOSIS PROCEDURE

1. Check oil level and condition.
2. Check and correct detent switch.
3. Check and correct vacuum line and fittings.
4. Check and correct manual linkage.

OIL LEVEL AND CONDITION CHECK

Always check the oil level before road testing. Oil must be visible on dip stick prior to operating the vehicle. Erratic shifting, pump noise, or other malfunctions can in some cases be traced to improper oil level.

Oil level should be checked with the selector lever in the Park (P) position, engine running, and the vehicle on level pavement.

Fluid level should be to the FULL mark with the transmission at normal operating temperature (170°-190°F.). With warm fluid (room temperature), the level should be at or slightly below the ADD mark.

If oil level is low, refer to Oil Leaks.

The condition of the oil is often an indication of whether the transmission should be removed from the vehicle, or to make further tests. When checking oil level, a burned smell and discoloration indicate burned clutches or bands and the transmission will have to be removed.

MANUAL LINKAGE

Manual linkage adjustment and the associated neutral safety switch are important from a safety standpoint. The neutral safety switch should be adjusted so that the

engine will start in the Park and Neutral positions only.

With the selector lever in the Park position, the parking pawl should freely engage and prevent the vehicle from rolling. The pointer on the indicator quadrant should line up properly with the range indicators in all ranges.

OIL LEAKS

Before attempting to correct an oil leak, the actual source of the leak must be determined. In many cases, the source of the leak can be deceiving due to "wind flow" around the engine and transmission.

The suspected area should be wiped clean of all oil before inspecting for the source of the leak. Red dye is used in the transmission oil at the assembly plant and will indicate if the oil leak is from the transmission.

The use of a "black light" to identify the oil at the source of the leak is also helpful. Comparing the oil from the leak to that on the engine or transmission dip stick (when viewed by black light) will determine the source of the leak.

Oil leaks around the engine and transmission are generally carried toward the rear of the car by the air stream. For example, a transmission "oil filler tube to case leak" will sometimes appear as a leak at the rear of the transmission. In determining the source of an oil leak it is most helpful to keep the engine running.

POSSIBLE POINTS OF OIL LEAKS

1. TRANSMISSION OIL PAN LEAK
   a. Attaching bolts not correctly torqued.
   b. Improperly installed or damaged pan gasket.
   c. Oil pan gasket mounting face not flat.
2. REAR EXTENSION LEAK
   a. Attaching bolts not correctly torqued.
   b. Rear seal assembly - damaged or improperly installed.
   c. Gasket seal - (extension to case) damaged or improperly installed.
   d. Porous casting.
3. CASE LEAK
   a. Filler pipe "O" ring seal damaged or missing; misposition of filler pipe bracket to engine - "loading" one side of "O" ring.
   b. Modulator assembly "O" ring seal - damaged or improperly installed.
   c. Governor cover, gasket and bolts - damaged, loose; case face leak.
   d. Speedo gear - "O" ring damaged.
   e. Manual shaft seal - damaged, improperly installed.
   f. Line pressure tap plug - stripped, shy sealer compound.
   g. Parking pawl shaft cup plug - damaged, improperly installed.
   h. Vent pipe (refer to Item 5).
   i. Porous case.
4. FRONT END LEAK
   a. Front seal - damaged (check converter neck for nicks, etc., also for pump bushing moved forward); garter spring missing from pump to converter seal.
   b. Pump attaching bolts and seals - damaged, missing, bolts loose.
   c. Converter - leak in weld.
   d. Pump "O" ring seal - damaged. (Also check pump groove and case bore.)
   e. Porous casting (pump or case).
5. OIL COMES OUT VENT PIPE
   a. Transmission over-filled.
   b. Water in oil.
   c. Pump to case gasket mispositioned.
   d. Foreign material between pump and case, or between pump cover and body.
   e. Case - porous, pump face improperly machined.
   f. Pump - shy of stock on mounting faces, porous casting.

CASE POROSITY—REPAIR

Transmission leaks caused by aluminum case porosity have been successfully repaired with the transmission in the vehicle by using the following procedure.

1. Road test and bring the transmission to operating temperature.
2. Raise the car and, with the engine running, locate the source of the oil leak. Check for leaks in all operating positions.

   NOTE: The use of a mirror will be helpful in finding leaks.

3. Shut off engine and thoroughly clean area with a solvent and air dry.
4. Using the instruction of the manufacturer, mix a sufficient amount of epoxy cement, part #1360016, to make the repair.
5. While the transmission is still hot, apply the epoxy to the area, making certain that the area is fully covered.
6. Allow epoxy cement to dry for three hours and retest for leaks, as outlined in Steps 1 and 2.

OIL PRESSURE CHECK

With Car Stationary

Oil Pressure Check - Road or Normal Operating Conditions

1. While road testing with the transmission oil pressure gauge attached and the vacuum modulator tube connected, the transmission pressures should check approximately as shown on chart.

		Minimum	Maximum
L_2-2nd Gear - Steady road load at approximately 25 mph		145 psi	155 psi
Gear	**Selector Lever Position**	**Minimum**	**Maximum**
1st 2nd 3rd	Drive ("Zero" throttle to full throttle)	60	150
3rd	Drive Range, Zero Throttle at 30 mph	60	
Reverse	Rev. (Zero to full throttle)	95	260

Transmission oil pressure gauge and engine tachometer should be connected and the oil pressures should check as follows:

2. Pressures indicated below are at 0 output speed with the vacuum modulator tube disconnected and with engine at 1200 rpm.

Approximate Altitude of Check (Ft. above sea level)	Drive Neutral Park	L1 or L2	Reverse
0	150	150	244
2,000	150	150	233
4,000	145	150	222
6,000	138	150	212
8,000	132	150	203
10,000	126	150	194
12,000	121	150	186
14,000	116	150	178

3. Pressures indicated below are with the vacuum tube connected for normal modulator operation, and with the engine at approx. 1000 rpm.

NOTE: Pressures are not significantly affected by altitude or barometric pressure when the vacuum tube is connected.

Drive, Neutral, Park	(1 or 2) L1 or L2	Reverse
60	150	107

VACUUM MODULATOR ASSEMBLY

After thorough investigation of field return modulator assemblies, it has been found that over 50% of the parts returned as defective were good. For this reason, the following procedure is recommended for checking Turbo Hydra-Matic 400 modulator assemblies in the field before replacement is accomplished.

1. Vacuum Diaphragm Leak Check

Insert a pipe cleaner into the vacuum connector pipe as far as possible and check for the presence of transmission oil. If oil is found, replace the modulator.

NOTE: Gasoline or water vapor may settle in the vacuum side of the modulator. If this is found without the presence of oil, the modulator should not be changed.

2. Atmospheric Leak Check

Apply a liberal coating of soap bubble solution to the vacuum connector pipe seam, the crimped upper to lower housing seam, and the threaded screw seal (Fig. 6T). Using a short piece of rubber tubing, apply air pressure to the vacuum pipe by blowing into the tube and observe for leak bubbles. If bubbles appear, replace the modulator.

NOTE: Do not use any method other than human lung power for applying air pressure, as pressures over 6 psi may damage the modulator.

3. Bellows Comparison Check

Using a comparison gauge, as shown in Fig. 7T, compare the load of a known good Hydra-Matic modulator with the assembly in question.

A. Install the modulator that is known to be acceptable on either end of the gauge.
B. Install the modulator in question on the opposite end of the gauge.
C. Holding the modulators in a horizontal position, bring them together under pressure until either modulator sleeve end just touches the line in the center of the gauge. The gap between the opposite modulator sleeve end and the gauge line should then be 1/16" or less. If the distance is greater than this amount, the modulator in question should be replaced.

4. Sleeve Alignment Check

Roll the main body of the modulator on a flat surface and observe the sleeve for concentricity to the can. If the sleeve is concentric and the plunger is free, the modulator is acceptable.

Once the modulator assembly passes all of the above tests, it is an acceptable part and should be re-used.

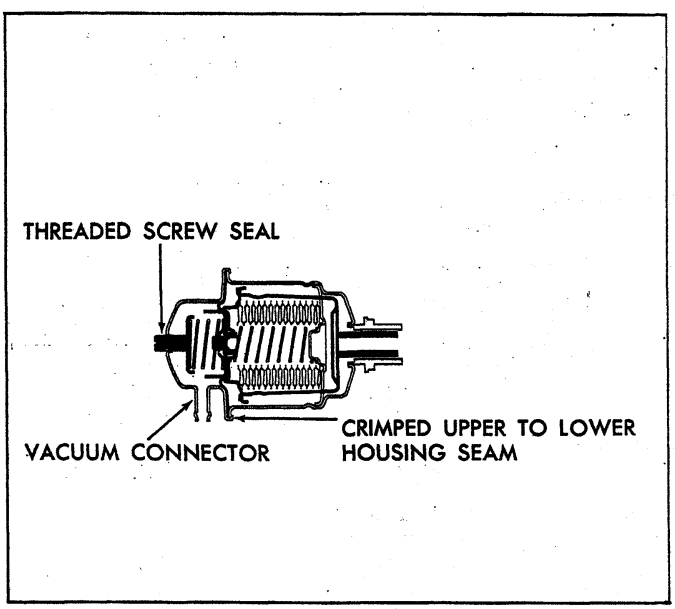


Fig. 6T—Vacuum Modulator Assembly

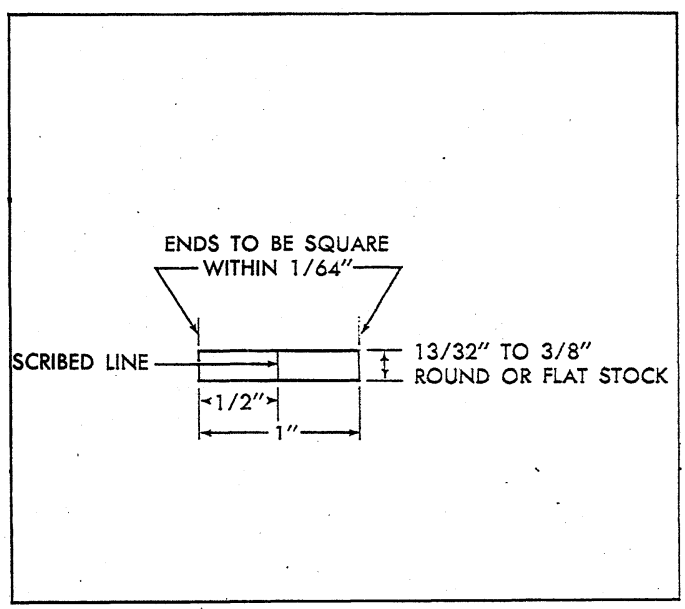


Fig. 7T—Bellows Comparison Gauge

TURBO HYDRA-MATIC 400 SHIFT POINTS

CHEVROLET MODELS (MPH)

Engine	CD V-327 (Base) 2.73 Axle 8.25-14 Tire				CD V-350 (L-65) 2.73 Axle 8.25-14 Tire				CA V-350 (LM-1 & L-48) 2.73 Axle 8.25-14 Tire				CA V-396 (L66) 2.56 Axle 8.25-14 Tire			
Throttle Position	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn
Closed	8-12	11-7	16-21	18-12	8-12	11-7	16-21	18-12	8-12	11-7	16-21	18-12	8-13	12-7	17-22	19-13
Thru Detent	37-51	44-27	72-89	83-64	37-51	44-27	72-89	83-64	40-53	46-31	73-90	84-66	42-57	49-33	78-96	90-70

CHEVROLET MODELS (MPH)

Engine	CQ V-427 (L-51) 2.56 Axle 8.25-14 Tire				CB V-427 (L-36) 2.73 Axle G70-15 Tire				CY V-427 (L-72) 3.07 Axle G70-15 Tire			
Throttle Position	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn
Closed	9-14	13-7	17-22	19-13	9-13	12-7	18-26	20-15				
Thru Detent	46-61	43-22	77-95	88-68	48-63	46-23	84-104	97-76				

CHEVROLET MODELS (MPH)

Engine	CG V-396 (GT2) (U/W L-66) 2.29 Axle 8.25-14 Tire				CF V-427 (GT2) (U/W LS-1) 2.29 Axle 8.25-14 Tire				CH V-327 (GT2) (U/W L-36) 2.29 Axle G70-15 Tire			
Throttle Position	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn
Closed	9-14	13-8	19-24	21-15	10-16	14-8	19-24	21-15	10-16	14-8	22-31	24-18
Thru Detent	48-63	55-37	88-108	100-79	51-68	49-25	86-106	99-77	57-76	54-27	100-124	116-90

CHEVELLE MODELS (MPH)

Engine	CC V-396 (L-35) 3.07 Axle G70-14 Tire				CE V-396 (L-34) 3.31 Axle G70-14 Tire				CY V-396 (L-78, L-89) 3.31 Axle G70-14 Tire			
Throttle Position	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn
Closed	8-11	10-6	16-23	18-13	7-10	10-6	14-21	16-12				
Thru Detent	37-51	39-19	72-89	83-65	38-50	36-18	67-83	77-60				

NOVA MODELS (MPH)

Engine	CE V-396 (L-34) 3.07 Axle E70-14 Tire				CY V-396 (L-78) 3.31 Axle E70-14 Tire			
Throttle Position	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn
Closed	7-11	10-6	15-22	17-13				
Thru Detent	40-52	38-19	69-86	80-33				

CAMARO MODELS (MPH)

Engine	CC V-396 (L-35) 2.73 Axle F70-14 Tire				CE V-396 (L-34) 3.07 Axle F70-14 Tire				CY V-396 (L-78, L-89) 3.31 Axle F70-14 Tire			
Throttle Position	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn
Closed	8-13	11-7	17-25	19-14	7-11	10-6	15-22	17-13				
Thru Detent	41-56	43-21	80-99	92-72	40-54	39-19	71-88	82-64				

CORVETTE MODELS (MPH)

Engine	CK V-350 (Base) 3.08 Axle F70-15 Tire				CL V-427 (L-36, L-68) 3.08 Axle F70-15 Tire			
Throttle Position	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn	1-2 Up	2-1 Dn	2-3 Up	3-2 Dn
Closed	7-10	10-6	14-18	16-11	8-11	10-6	16-23	18-13
Thru Detent	35-47	41-27	64-79	74-58	42-55	40-20	73-90	84-60

SPECIAL TOOLS

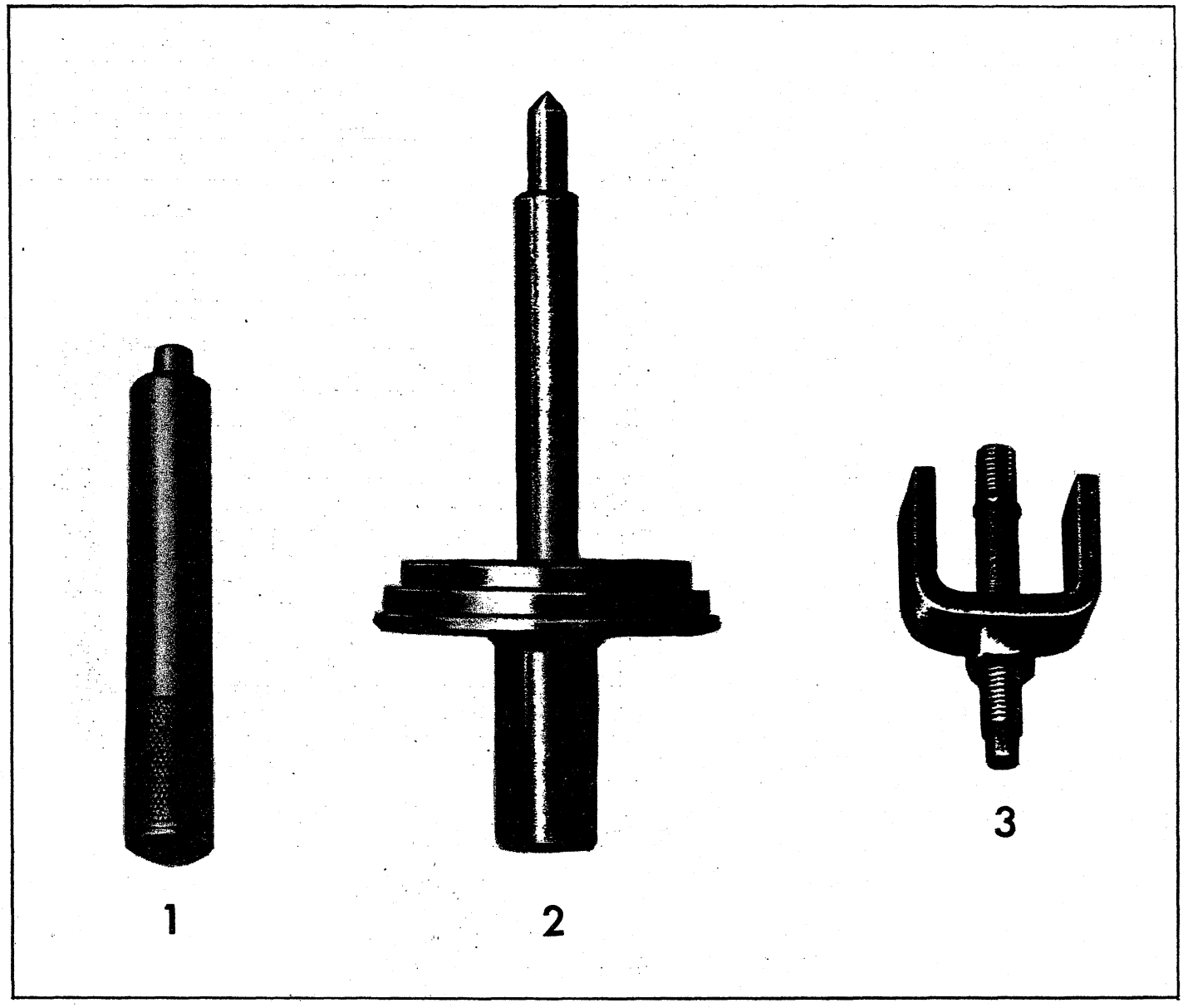


Fig. 1ST—Clutch—Special Tools

1. J-1522 Pilot Bearing Driver
2. J-5824 Clutch Pilot Tool
3. J-1448 Pilot Bearing Puller

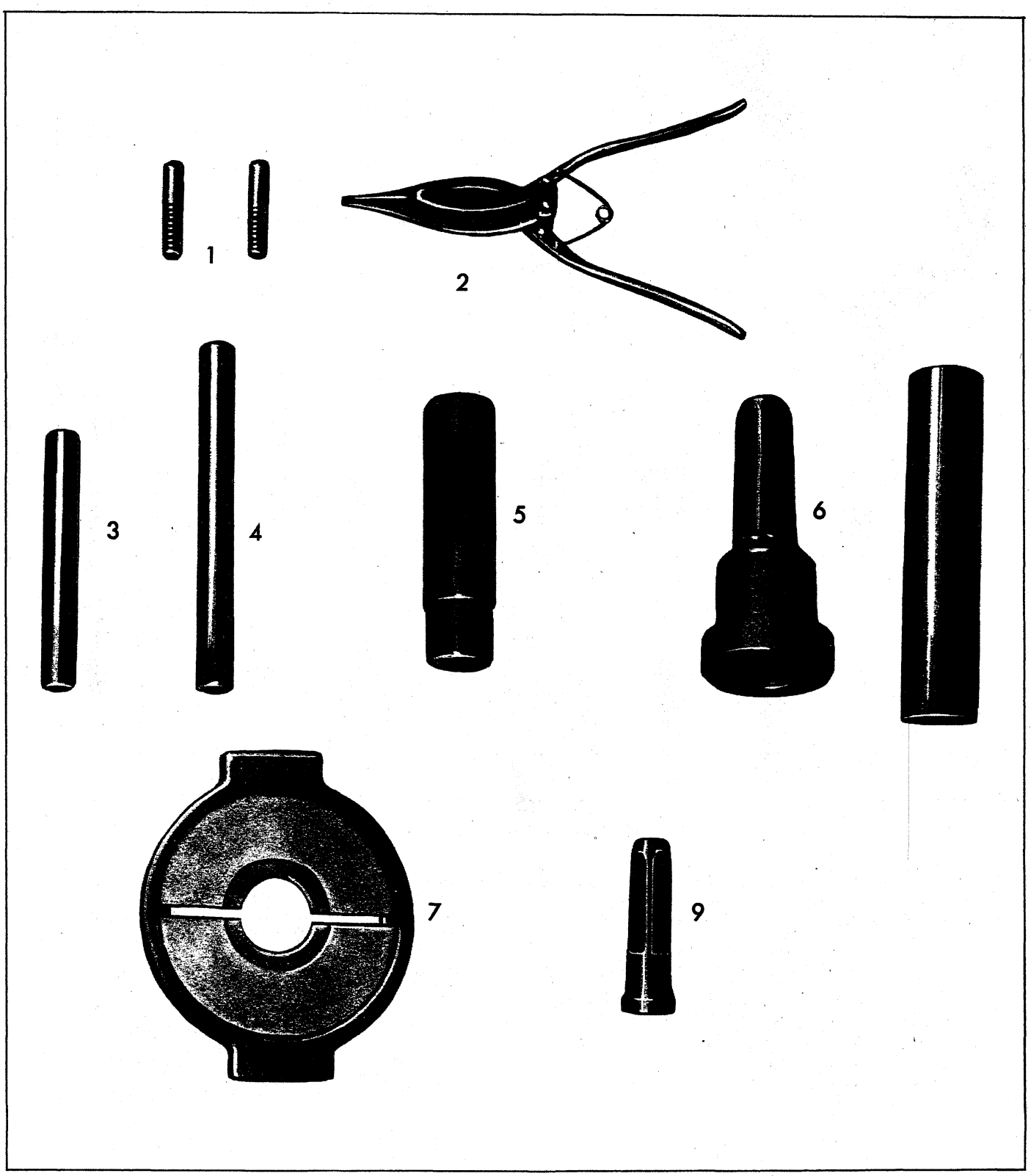


Fig. 2ST—Manual Transmission Special Tools

1. J-1126 Transmission Guide Pins
2. J-8059 Retainer Snap Ring Pliers
3. J-21629 Countergear Loading Tool
4. J-22246 Countergear Loading Tool
5. J-5778 Extension Housing Bushing Remover and Installer
6. J-5154 Extension Housing Seal Installer
7. J-1453-01 Press Plates
   J-358-1 Press Plate Holder
8. J-5590 Clutch Gear Bearing Installer
9. J-23096 Clutch Gear Retainer Lip Seal Installer

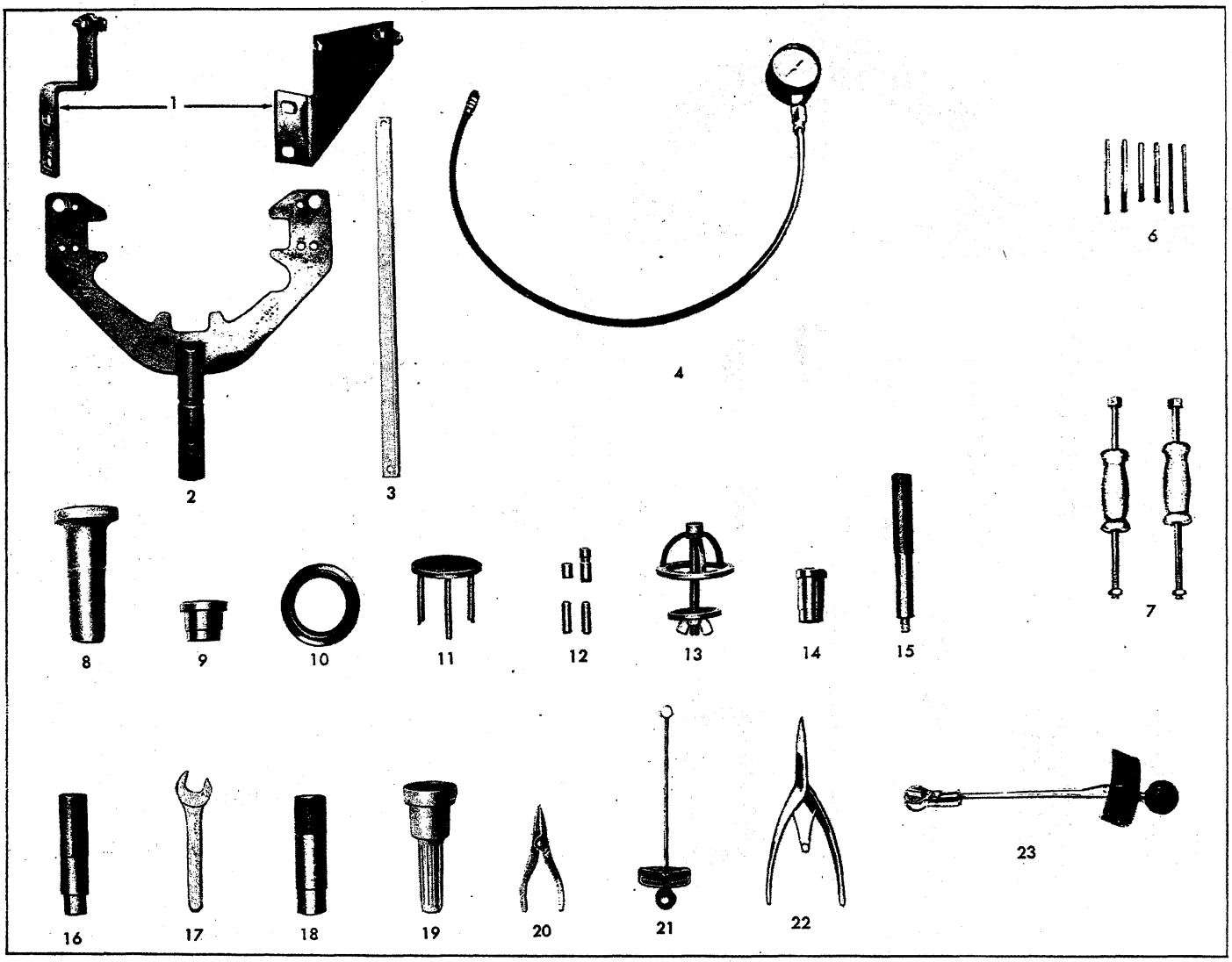


Fig. 3ST—Aluminum Powerglide Special Tools

1. J-9506 Holding Fixture Adapters
2. J-3289-01 Holding Fixture (Use with J-3289-20 Base)
3. J-9549 Converter Safety Strap
4. J-21867 Transmission Pressure Gauge and Hose
6. J-3387 Pilot Stud Set
7. J-9539 Oil Pump Puller Bolts (Use with weights from Slide Hammers J-6585)
8. J-6839 Oil Pump Seal Driver
9. J-9546 Clutch Drum Bushing Remover and Installer
10. J-7782 Clutch Spring Compressor Adapter Plate
11. J-5133 Clutch Spring Compressor
12. J-4599 Planet Pinion Assembly Tool Set
13. J-9542 Reverse Piston Spring Compressor
14. J-9557 Transmission Case Rear Bushing Remover and Installer
15. J-7079 Handle
16. J-6582 Governor Support Bushing Installer
17. J-9543 Vacuum Modulator Wrench
18. J-5778 Extension Bushing Remover and Installer
19. J-5154 Extension Oil Seal Installer
20. J-5403 Snap Ring Pliers
21. J-5853 Torque Wrench
22. J-8039 Snap Ring Pliers
23. J-21848 Low Band Adjusting Tool
J-8001 Dial Indicator (Not Illustrated)
J-5492 Dial Indicator Support Strap (Not Illustrated)
J-6585 Slide Hammers (Not Illustrated)
J-6585-3 Slide Hammer Adapters (Not Illustrated)
J-9534 Bushing Remover (Not Illustrated)

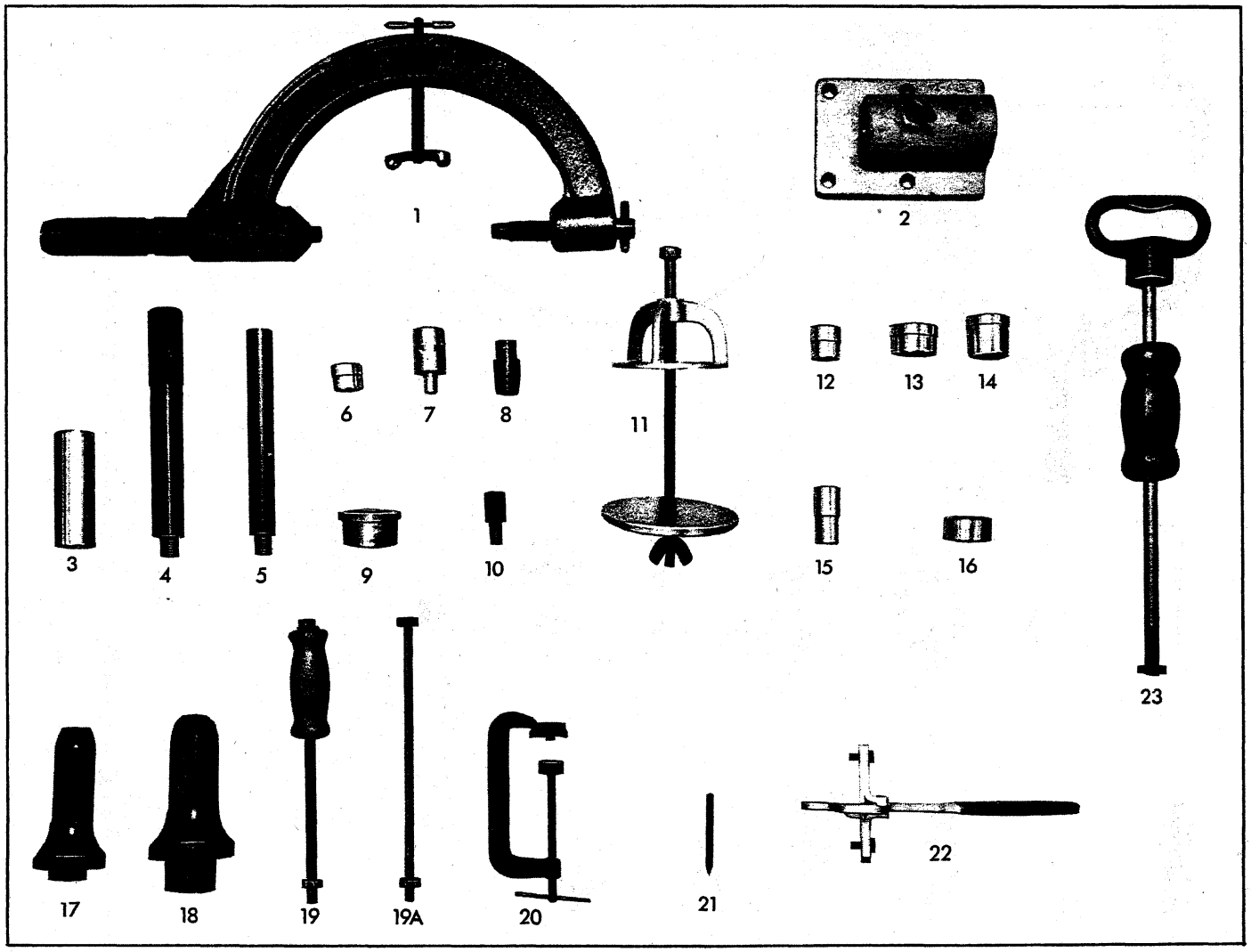


Fig. 4ST—Turbo Hydra-Matic 350 Special Tools

1. J-8763 Transmission Holding Fixture (Modified to suit THM-350)
2. J-3289-14 Transmission Holding Fixture Base
3. J-23103 Propeller Shaft Yoke Seal Remove and Installer
4. J-8092 Driver Handle
5. J-21465-13 Driver Handle Extension
6. J-23062-3 Sun Gear and Reaction Carrier Bushing
7. J-23062-7 Output Shaft Bushing Installer
8. J-21465-15 Stator Shaft Front Bushing Remover
9. J-23329 Direct Clutch Bushing Installer
10. J-9534-01 Output Shaft Bushing Remover
11. J-23327 Clutch Spring Compressor
12. J-23062-2 Stator Shaft Rear Bushing Installer
13. J-23062-1 Case Bushing Installer
14. J-21424-9 Extension Housing Bushing Installer
15. J-21424-7 Stator Shaft Front Bushing Installer
16. J-23062-5 Input Ring Gear Bushing Installer
17. J-5154 or J-21426 Extension Housing Seal Installer
18. J-21359 Pump Seal Installer
19. J-6585 Slide Hammer Weights
19a. J-9539 Slide Hammer Screw
20. J-21885 2-3 Accumulator Piston Compressing Tool
21. J-23071 Intermediate Band Apply Pin Gauge
22. J-23069 1-2 Accumulator Cover Remover and Installer
23. J-2619 Slide Hammer (Used with J-2619-4 Adapter and J-9539-01 Stator Shaft Front Bushing Remover

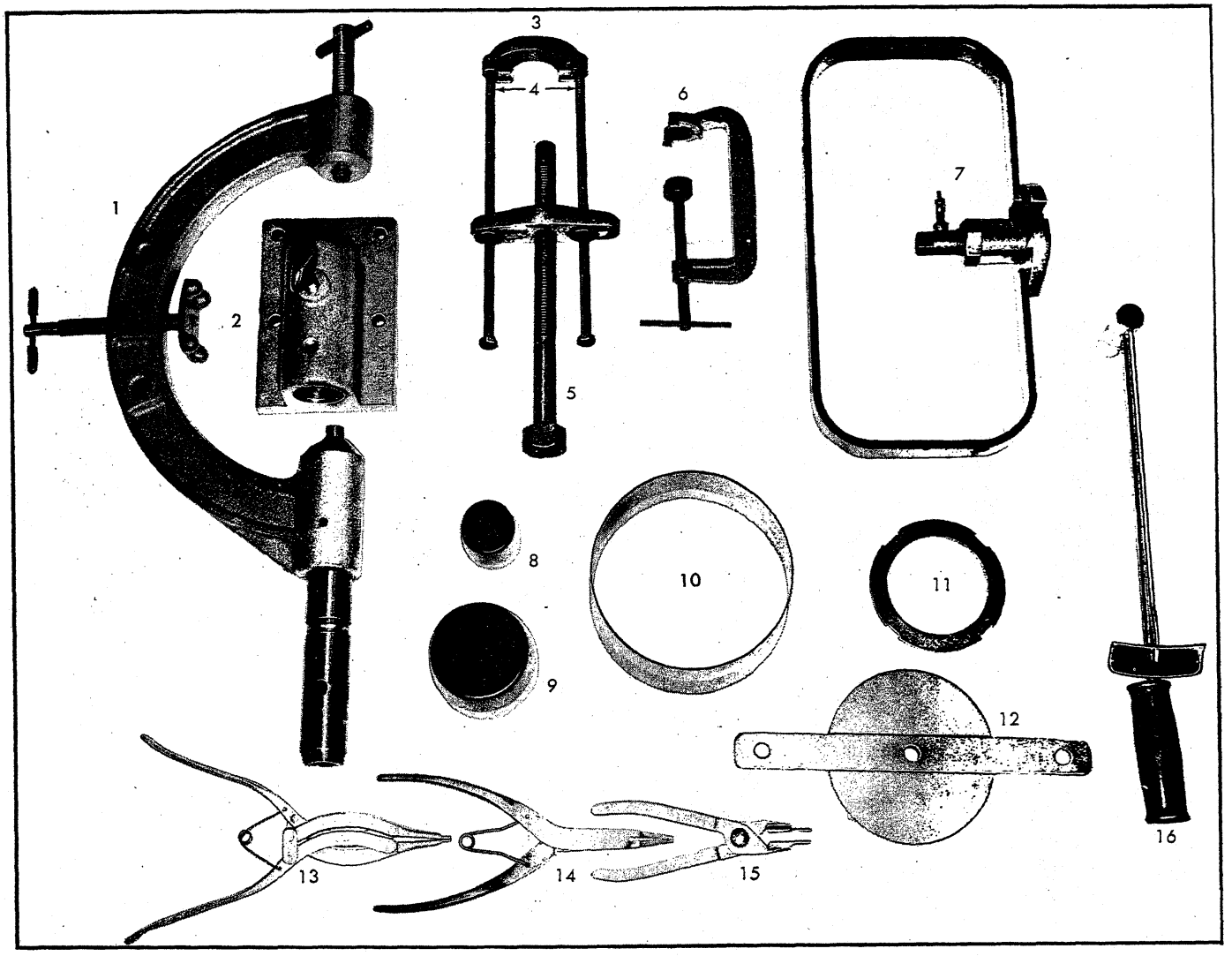


Fig. 5ST—Turbo Hydra-Matic 400 Special Tools

1. J-8763 Transmission Holding Fixture
2. J-3289-14 Holding Fixture Base
3. J-21427-1 Speedo Gear Remover
4. J-9539 Slide Hammer Bolts (3/8" - 16 Threads)
5. J-8105 Speedo Gear Remover Puller
6. J-21885 Accumulator Piston Installer
7. J-21369 Converter Pressure Check Fixture
8. J-21362 Seal Protector - Forward & Direct Clutch - Inner
9. J-21363 Seal Protector - Intermediate Clutch - Inner
10. J-21409 Seal Protector - Forward Clutch - Outer
11. J-21664 Clutch Spring Compressor Adapter Ring
12. J-4670 Clutch Spring Compressor
13. J-8059 Snap Ring Pliers
14. J-5586 Snap Ring Pliers
15. J-5403 Snap Ring Pliers
16. J-1313 Torque Wrench 0-140 Ft. Lbs.

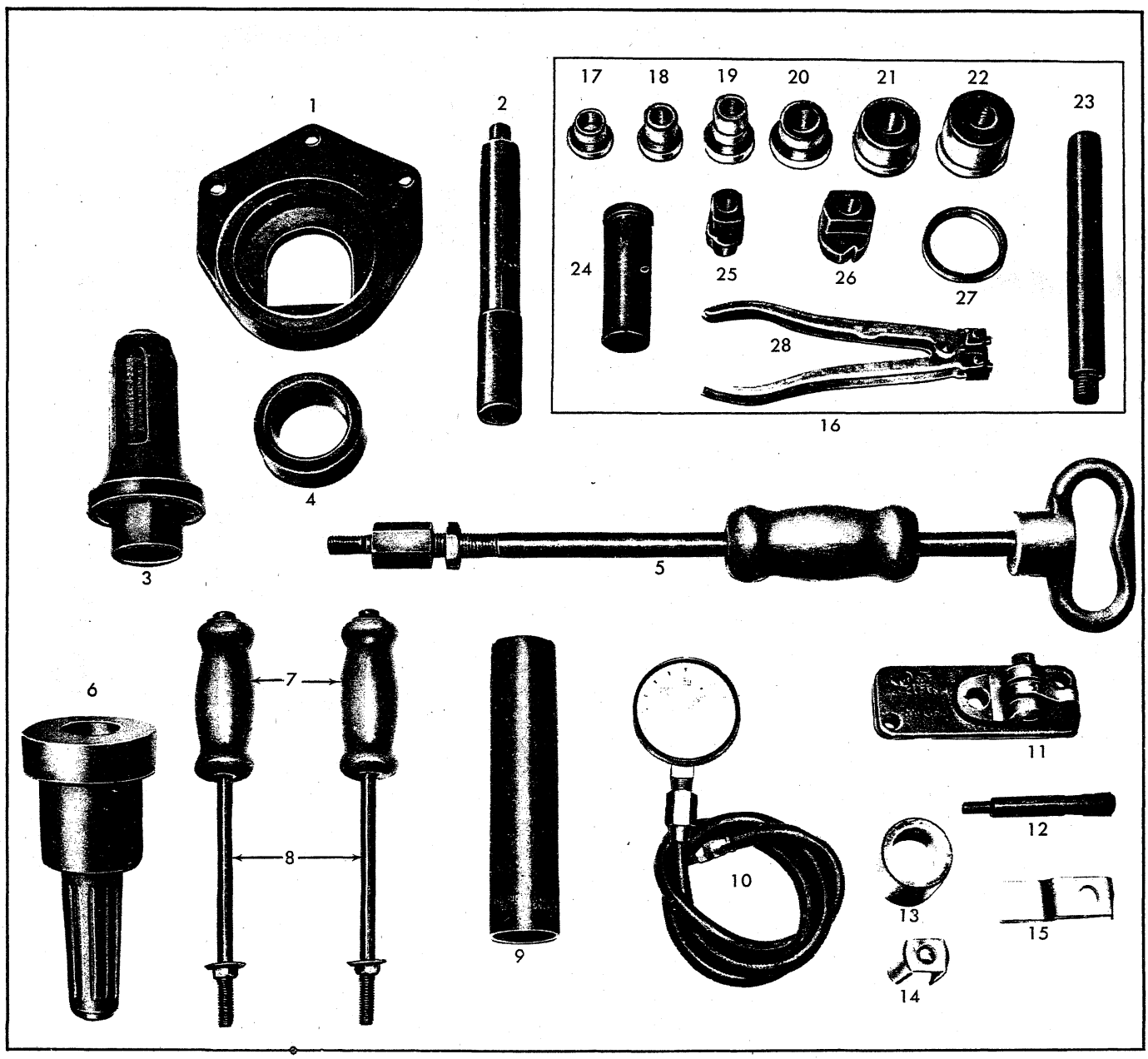


Fig. 6ST—Turbo Hydra-Matic 400 Special Tools

1. J-6116-01 Rear Unit Holding Fixture
2. J-8092 Driver Handle
3. J-21359 Pump Oil Seal Installer
4. J-21364 Holding Fixture Adapter (Used with J-6116-01 Fixture)
5. J-2619 Slide Hammer (Used with 2619-4 Adapter and Remover Tools J-21465-01)
6. J-5154 Extension Oil Seal Installer
7. J-6585 Slide Hammer Weights
8. J-9539 Slide Hammer Bolts (3/8" - 16 Threads)
9. J-5590 Speedo Gear Installer
10. J-21867 Pressure Gauge and Hose
11. J-21370-6 Rear Band Apply Fixture
12. J-21370-5 Rear Band Apply Pin
13. J-21795-1 Gear Unit Assembly Holding Tool
14. J-21795-2 Part of Above Holding Tool
15. J-5384 Converter Holding Strap
16. J-21465-01 Bushing Tool Set
17. J-21465-5 Part of Bushing Tool Set
18. J-21465-3 Part of Bushing Tool Set
19. J-21465-2 Part of Bushing Tool Set
20. J-21465-1 Part of Bushing Tool Set
21. J-21465-17 Part of Bushing Tool Set
22. J-21465-8 Part of Bushing Tool Set
23. J-21465-13 Part of Bushing Tool Set
24. J-21465-6 Part of Bushing Tool Set
25. J-21465-15 Part of Bushing Tool Set
26. J-21465-16 Part of Bushing Tool Set
27. J-21465-9 Part of Bushing Tool Set
28. J-21465-10 Part of Bushing Tool Set
29. J-22182 Extension Bushing Remover & Installer (Not Illustrated)

SECTION 8
FUEL TANK AND EXHAUST SYSTEMS

CONTENTS OF THIS SECTION

Subject	Page
Fuel Tanks	8-1
Exhaust Systems	8-10

FUEL TANKS

INDEX

	Page
General Description	8-1
Component Part Replacement	8-1
Draining Fuel Tank	8-1
Fuel Tank	8-2
Metering Units (Gauge Sending Unit)	8-3
Fuel Tank Vent Lines	8-5
Fuel Lines	8-5
Fuel Line Retainer Clip	

GENERAL DESCRIPTION

All fuel tanks are of steel construction. All tanks, except Station Wagons, are mounted between the frame rails and behind the rear axle. Station Wagon tanks are side-mounted and located rear of the left rear quarter wheelhouse.

All fuel tanks are vented to the atmosphere. Chevrolet and Chevelle sedan tanks incorporate external vent hoses. All other models use a vented, anti-surge type filler cap.

Filler neck assemblies are similar in design to previous models except for Chevrolet and Camaro. The Chevrolet filler neck inserts into a rubber hose which is permanently attached to the fuel tank. This hose is not replaceable since it is part of the tank assembly. The Camaro filler neck is one piece and is welded to the tank.

The fuel pickup pipe is built integrally with the tank gauge and is located on the upper side of all tanks except Corvette. The Corvette gauge is located on the lower side of the tank. The metering unit cannot be serviced on any model (except Corvette) without first removing the fuel tank assembly.

Sedan and pickup tanks, (except Corvette) are held in place by two metal straps, hinged at either the front or rear end (with a bolt through the hinge) and secured at the opposite end with a bolt and nut assembly. Corvette tank straps are hinged at the tank support and attached at the rear end with bolts. Station Wagon tanks are secured with two metal straps located at the front and lower sides of tank.

COMPONENT PART REPLACEMENT

DRAINING FUEL TANK

The absence of a gas tank drain plug makes it necessary to siphon fuel from the tank when draining is needed. The following procedure is recommended:

1. Obtain approximately 10 feet of 3/8" I.D. hose and cut a flap-type slit 18" from one end. Make this cut in the direction of the shorter end of hose (See Figure 1).
2. Insert a small pipe nipple (slightly larger O.D. than the hose I.D.) into the opposite end of hose.
3. Insert the nipple end of siphon hose into the fuel tank filler neck with the natural curl of the hose pointed down. Insert until the hose is heard to strike the bottom of the tank.
4. With the opposite end of the hose in a suitable container, insert an air hose in the downward direction in the flap-type slit and trigger the flow of fuel.

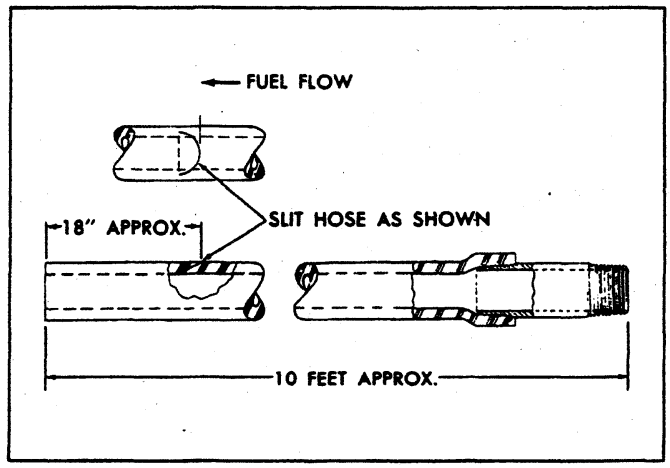


Fig. 1—Siphon Construction

CAUTION: Before draining, be sure that the fuel tank gauge unit wire or battery negative cable is disconnected.
Always drain gasoline from complete fuel system including carburetor, fuel pump, all fuel lines and fuel tank if the vehicle is to be stored for any appreciable length of time. This precaution will prevent accumulation of gum formation and resultant poor engine performance.

FUEL TANK

Chevelle Pickup and all Sedans except Corvette Figs. 2, 3, 4 and 5

Removal and Installation

CAUTION: On Chevrolet models, do not attempt to remove or service the rubber hose attached to the tank. It is part of the tank assembly and is not removable.

1. Disconnect meter wire at rear wiring harness connector. On sedan models, push out grommet and thread meter wire through hole in trunk compartment floorpan.
2. Raise car on hoist.
3. Drain fuel tank.
4. Disconnect fuel line hose at gauge unit pickup line.
5. Remove gauge ground wire screw at underbody floorpan.
6. Chevrolet--Remove vent hose at tank and filler neck retaining screws.
   Chevelle Sedan--Remove vent hoses from floorpan retainer clip.
7. Chevelle Pickup--Remove tank filler neck bolt.
8. Remove tank strap bolts and lower tank carefully.
9. To install, reverse Steps 1 through 8.

Station Wagons—Fig. 6 and 7

Removal and Installation

1. Raise car on hoist.
2. Chevelle--Place rear of vehicle on jack stands and then lower rear axle into full rebound. Remove left rear wheel and tire assembly.
3. Disconnect meter wire at rear wiring harness.
4. Drain fuel tank.
5. Remove gas tank front shield.
6. Remove gauge ground wire at rear quarter inner panel.
7. Disconnect fuel line hose and gauge wires at gauge unit.
8. Remove tank strap bolts and lower tank carefully.
9. To install, reverse Steps 1 through 8.

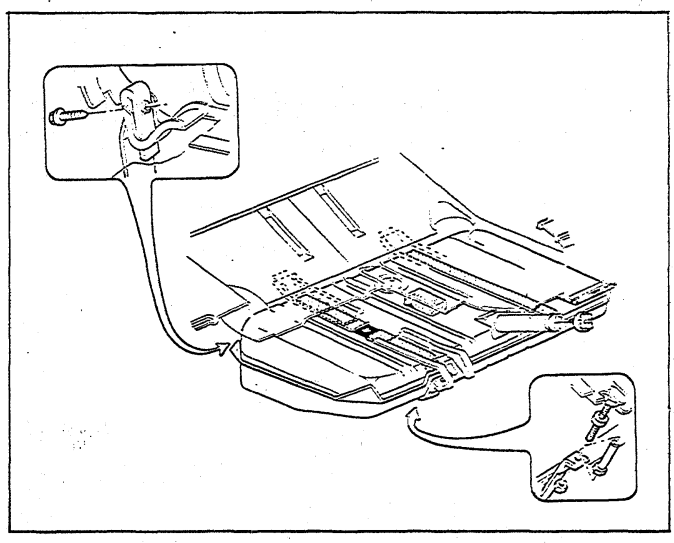


Fig. 3—Nova Fuel Tank

Corvette—Fig. 8

Removal and Installation

1. Remove battery ground cable.
2. Remove gas cap, filler neck boot from top of tank and disconnect drain line (fig. 9).
3. Raise vehicle on hoist.

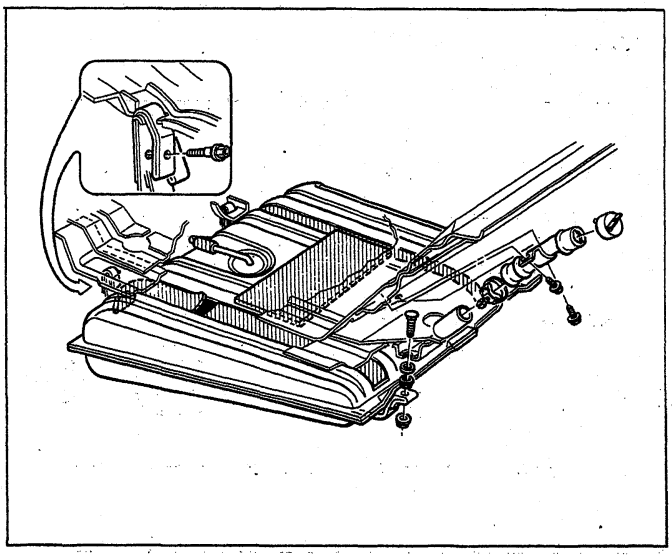


Fig. 2—Chevrolet Fuel Tank

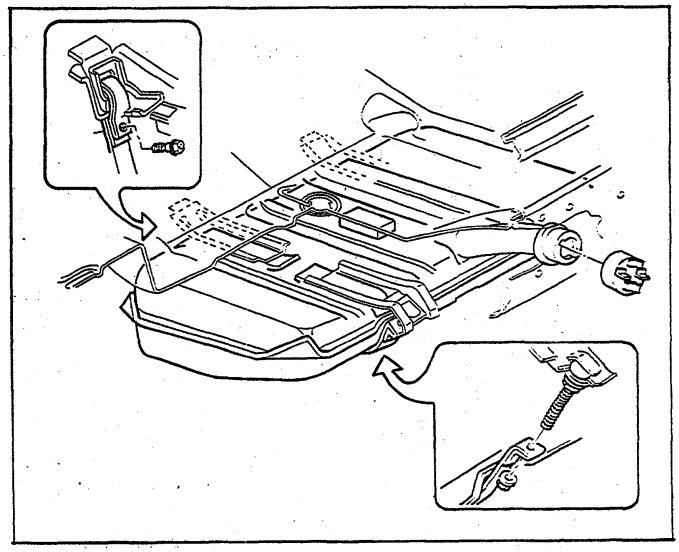


Fig. 4—Camaro Fuel Tank

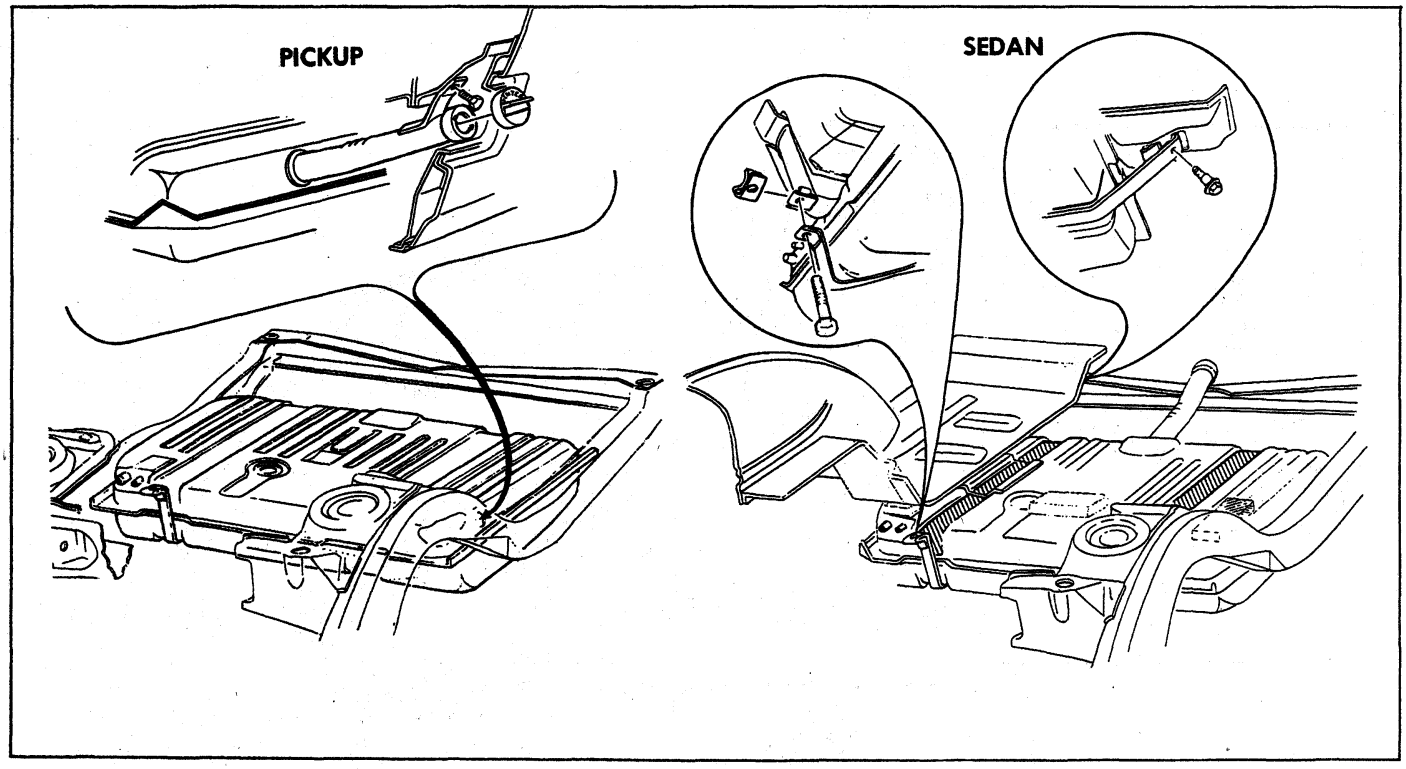


Fig. 5—Chevelle Fuel Tanks

4. Remove the spare tire from tire carrier (fig. 10).
5. Remove spare tire carrier bolted attachments and remove carrier.

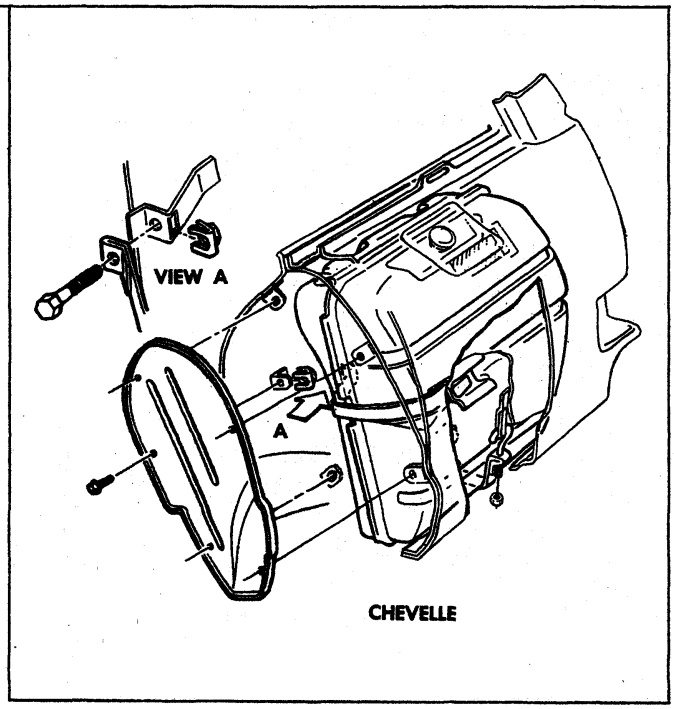


Fig. 6—Chevelle Station Wagon Fuel Tank

6. Loosen "U" clamps and separate exhaust systems at transmission support.
7. Remove rear muffler brackets at frame and slide exhaust systems rearward.
8. Remove fuel tank retaining strap bolts.
9. Remove tank gauge unit wires and fuel lines and drain fuel tank.
10. Remove tank support to frame bolts and remove support.
11. Lower tank, rotating toward front of vehicle.
12. To install, reverse Steps 1 through 11.

METERING UNITS (GAUGE SENDING UNIT) (Fig. 13)

All Models Except Corvette

Removal and Installation

1. Follow tank removal procedure.
2. Use Tool J-22554 (fig. 11) to remove cam lock on Chevrolet Sedan tanks: Use Tool J-23346 on all other models (fig. 12).
3. Remove unit and gasket.

CAUTION: REMOVE UNIT CAREFULLY TO AVOID DAMAGE TO SCREEN AT END OF PICKUP PIPE.

4. Clean strainer screen by blowing out with compressed air.
5. Reverse removal procedure to install.

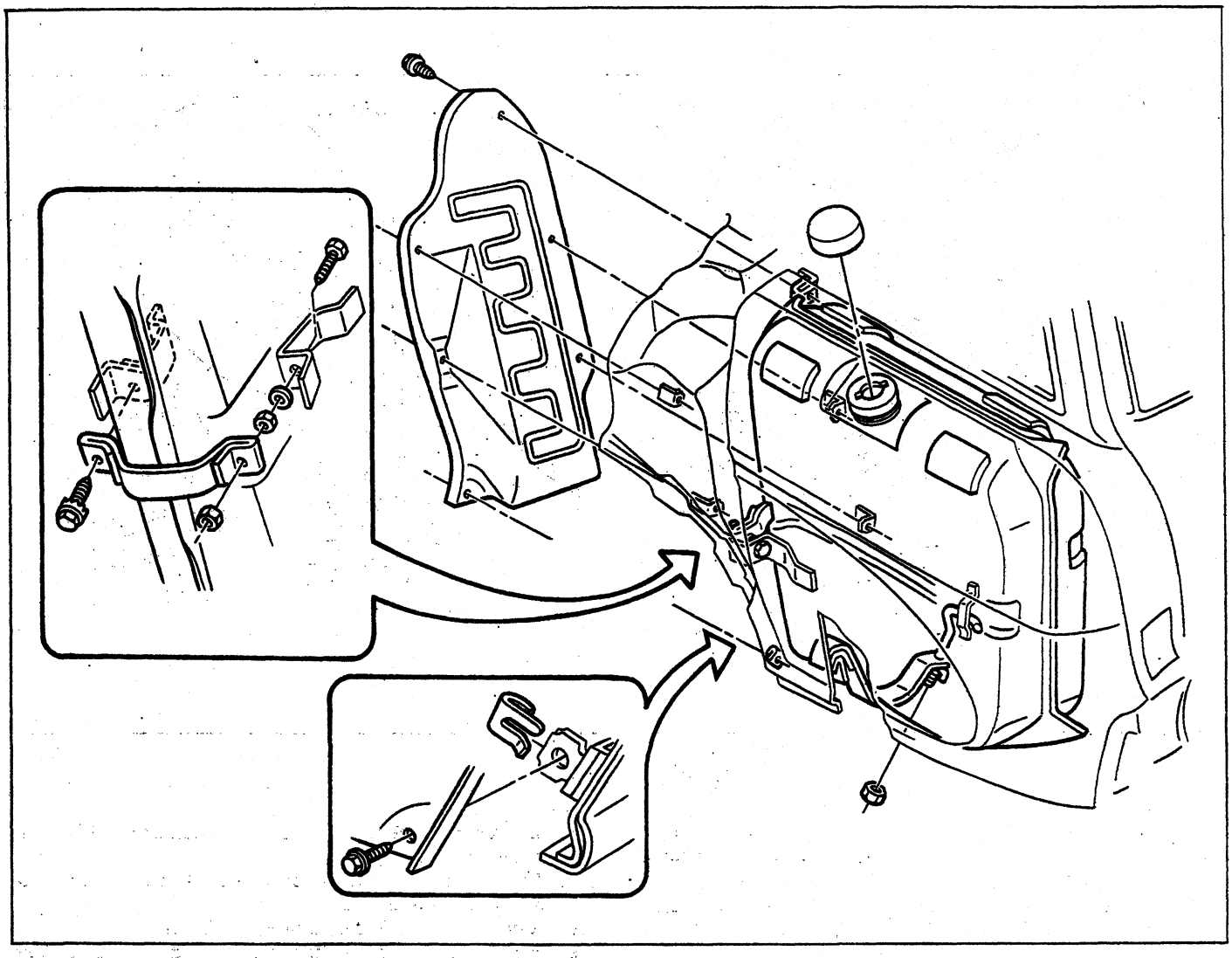


Fig. 7—Chevrolet Station Wagon Fuel Tank

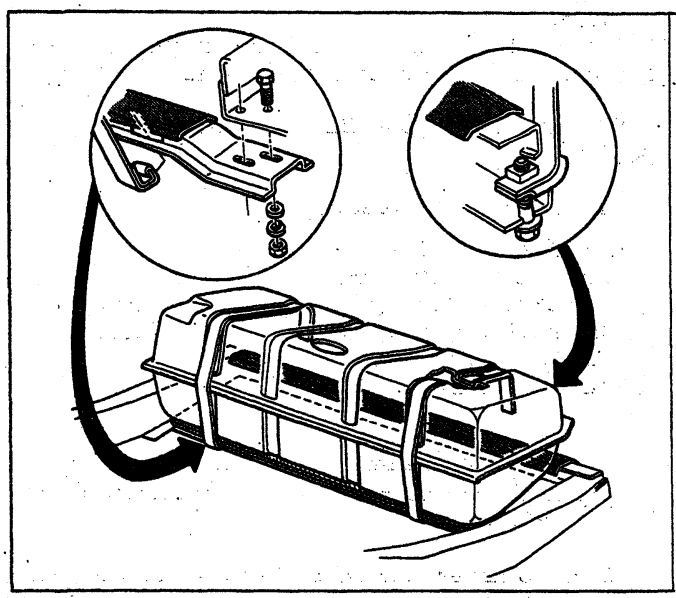


Fig. 8—Corvette Fuel Tank

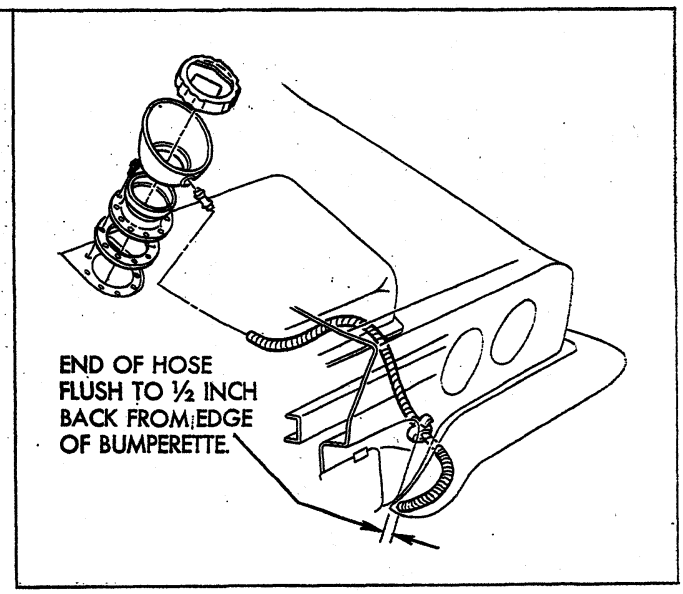


Fig. 9—Corvette Fuel Tank Filler Neck

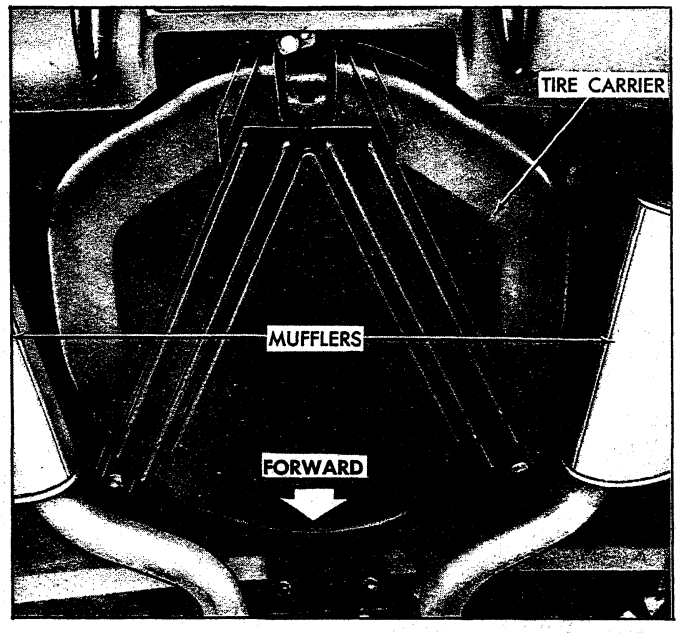


Fig. 10—Spare Tire Carrier Installed

CAUTION: When installing cam lock, it may be necessary to compress gasket slightly by pressing down on Gauge Tool. Once cam lock is started under retaining tangs, pressure may be released.
Always use a new gasket when replacing or installing a new gauge unit.

Corvette

It has been reported that some technicians have been checking the operation of the Corvette fuel gauge unit by reaching through the large filler neck opening with a metal rod to operate the float arm. Although this method provides a usable test for full range operation it is not in line with good safety practices. There is the possibility of sparking between the metal rod and the lip of the gas tank as a result of friction and/or an open circuit with the gauge unit (grounding through the rod).

A far safer method is to remove the leads from the installed tank unit and connect them to a known good tank unit, outside the tank.

Removal and Installation

1. Remove spare tire from carrier.
2. Remove spare tire carrier bolted attachments and let carrier hang; then remove plastic cover.
3. Disconnect tank gauge wires.
4. Drain fuel tank.
5. Disconnect fuel lines at gauge unit.
6. Use Tool J-23346 to remove cam lock.
7. Remove unit and rubber gasket.

CAUTION: REMOVE UNIT CAREFULLY TO AVOID DAMAGE TO SCREEN AT END OF PICKUP PIPE.

8. Clean strainer by blowing out with compressed air.
9. Reverse removal procedure to install.

NOTE: Always use a new gasket when replacing or installing a new gauge unit.

FUEL TANK VENT LINES

The Chevrolet Sedan vent line is connected by a rubber hose, with two clamps, to the gauge pickup line. A rubber grommet around the vent pipe acts as a seal to prevent gasoline fumes from entering the passenger compartment.

Chevelle sedan models are vented with two rubber vent hoses at the right forward edge of tank. Hoses are attached to the tank with clamps and to the underbody.

IMPORTANT It is important to note that the above gas tanks use non-vented filler neck caps; therefore, it is necessary to be assured that the vent hoses and lines are free from dirt and foreign material and that they are open at all times.

The larger 1/2" vent hose on Chevelle sedan models incorporates a restrictor which should be checked occasionally, and if plugged, cleaned in gasoline and then reinserted flush with end of vent hose.

All other vehicles use a vented, anti-surge type filler neck cap.

FUEL LINES

The fuel lines, extending from the fuel tank to fuel pump, are routed along the right frame rail on all models. Fuel lines are secured to the frame or underbody with clamp and screw assemblies. When replacing a fuel line, only seamless steel tubing is to be used. Also, the ends of the tubing must be double-flared using commercially available double flaring tools. All fuel lines must be properly routed and retained as shown in Figures 14 thru 18. Flexible hoses are located at the fuel tank pickup and at the fuel pump.

The fuel lines should be inspected occasionally for leaks, kinks or dents. If evidence of dirt is found in the carburetor, fuel pump or on a disassembly, the lines should be disconnected and blown out. Check the fuel strainer in the tank for damage or omission.

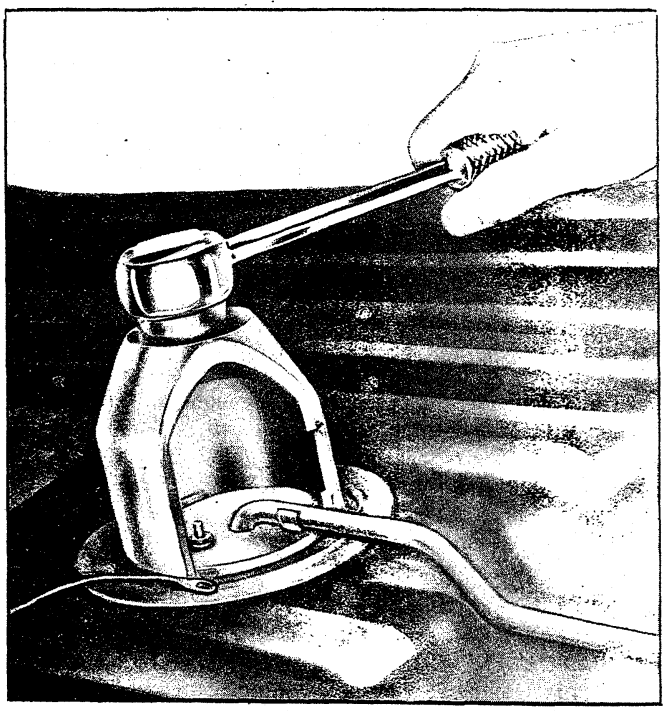


Fig. 11—Meter Assembly Removal Using Tool J-22554

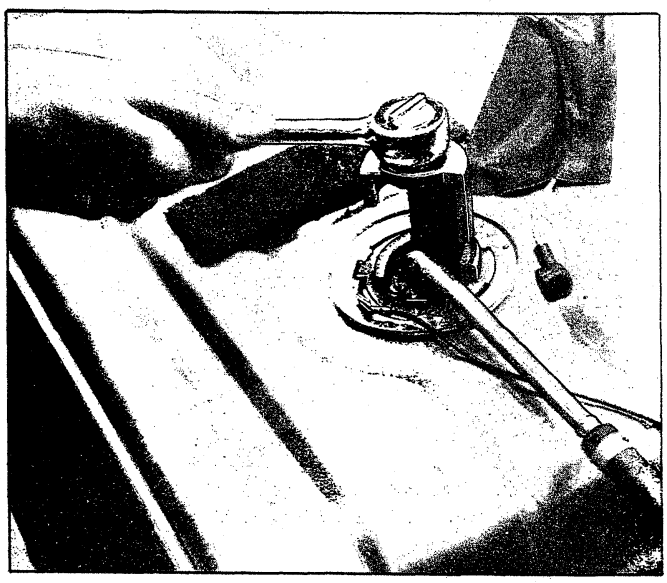


Fig. 12—Metering Unit Removal Using Tool J-23346

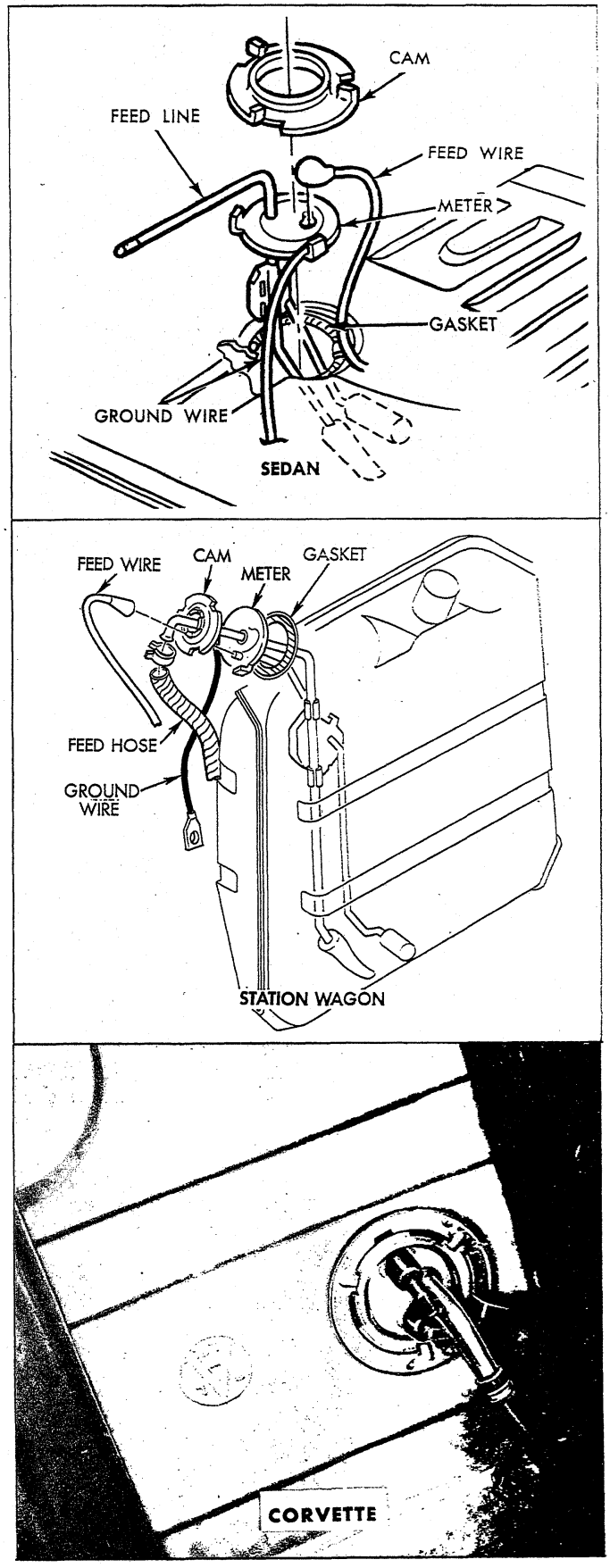


Fig. 13—Metering Units - Typical

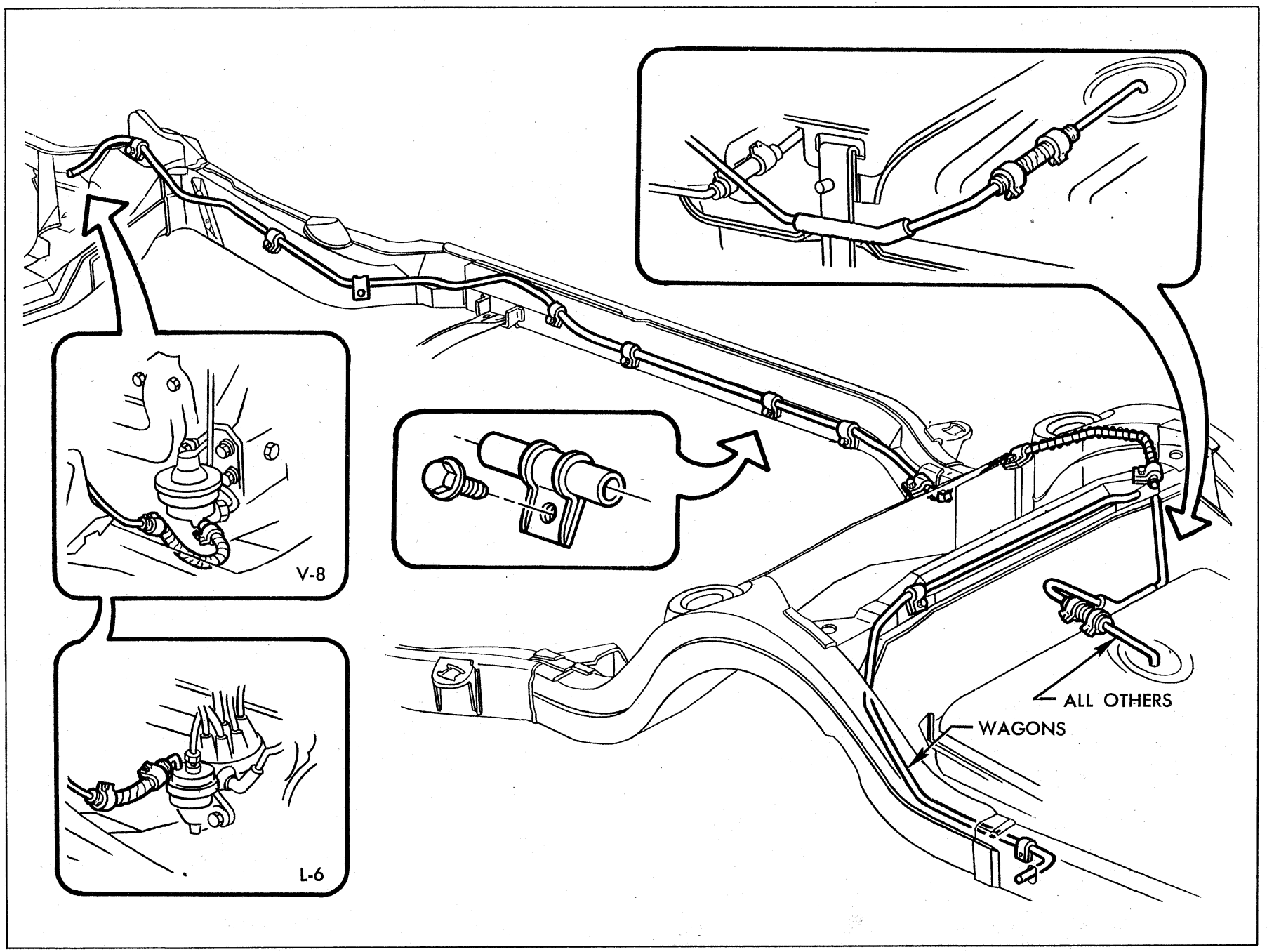


Fig. 14—Chevrolet Fuel Lines

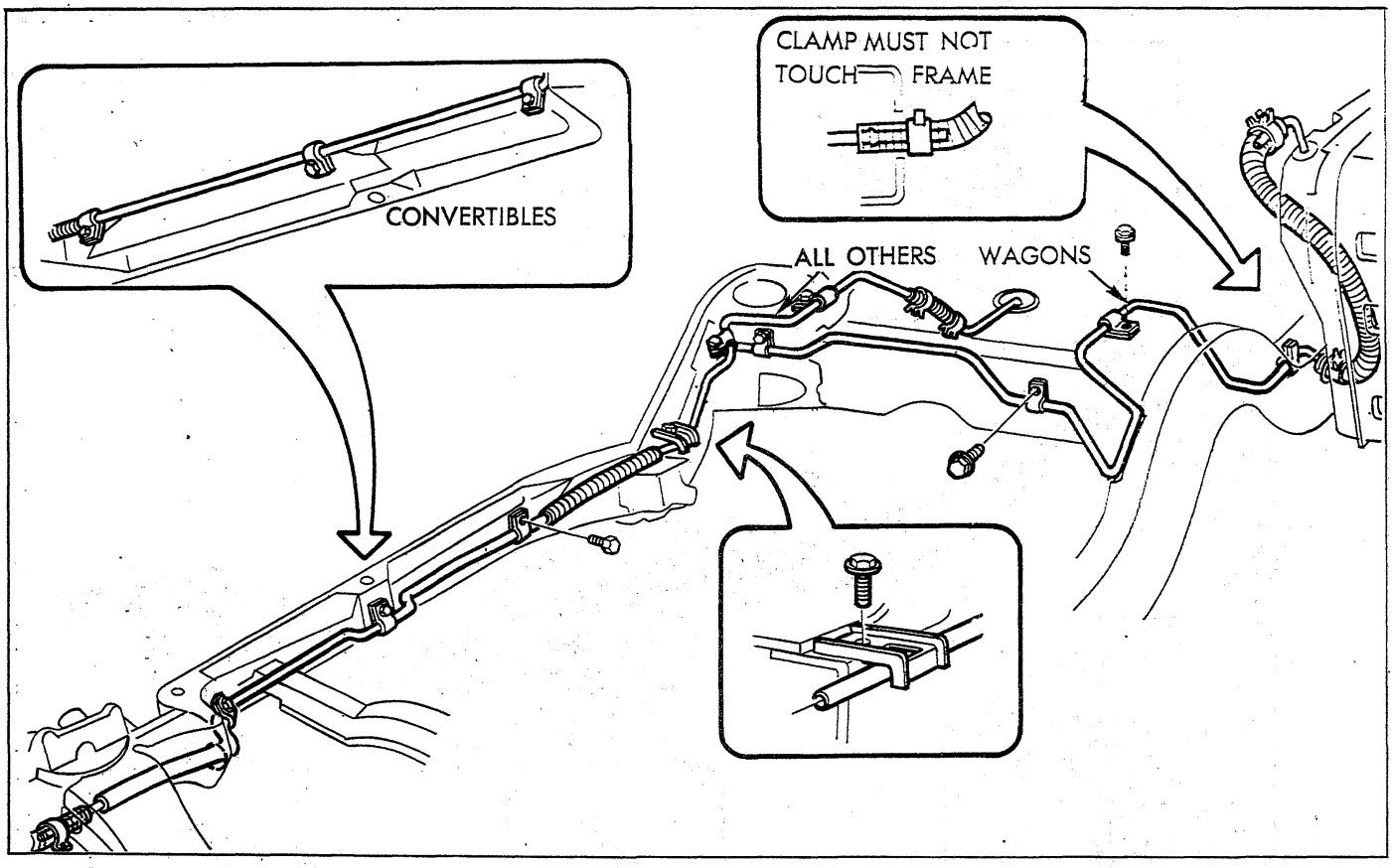


Fig. 15—Chevelle Fuel Lines

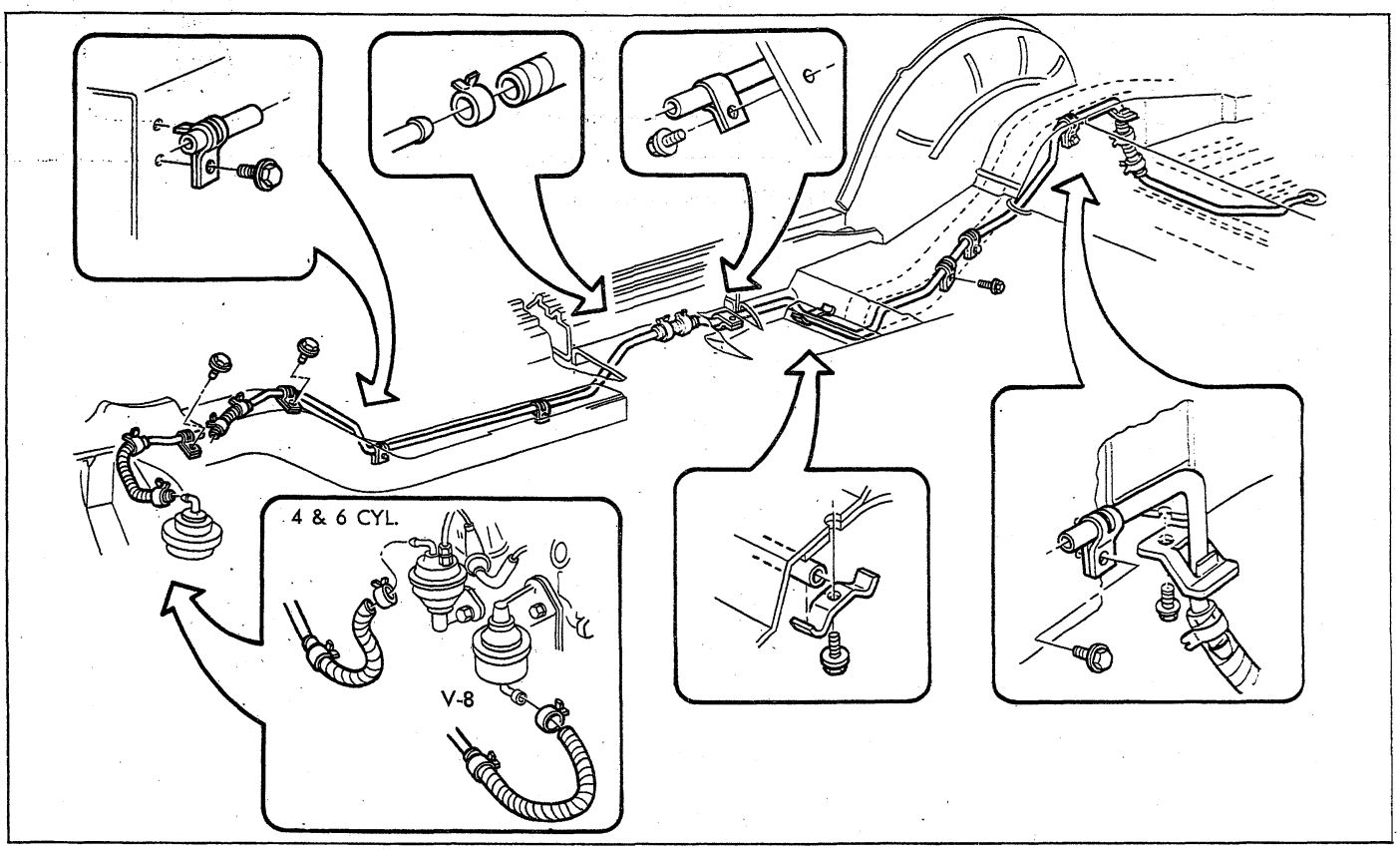


Fig. 16—Nova Fuel Lines

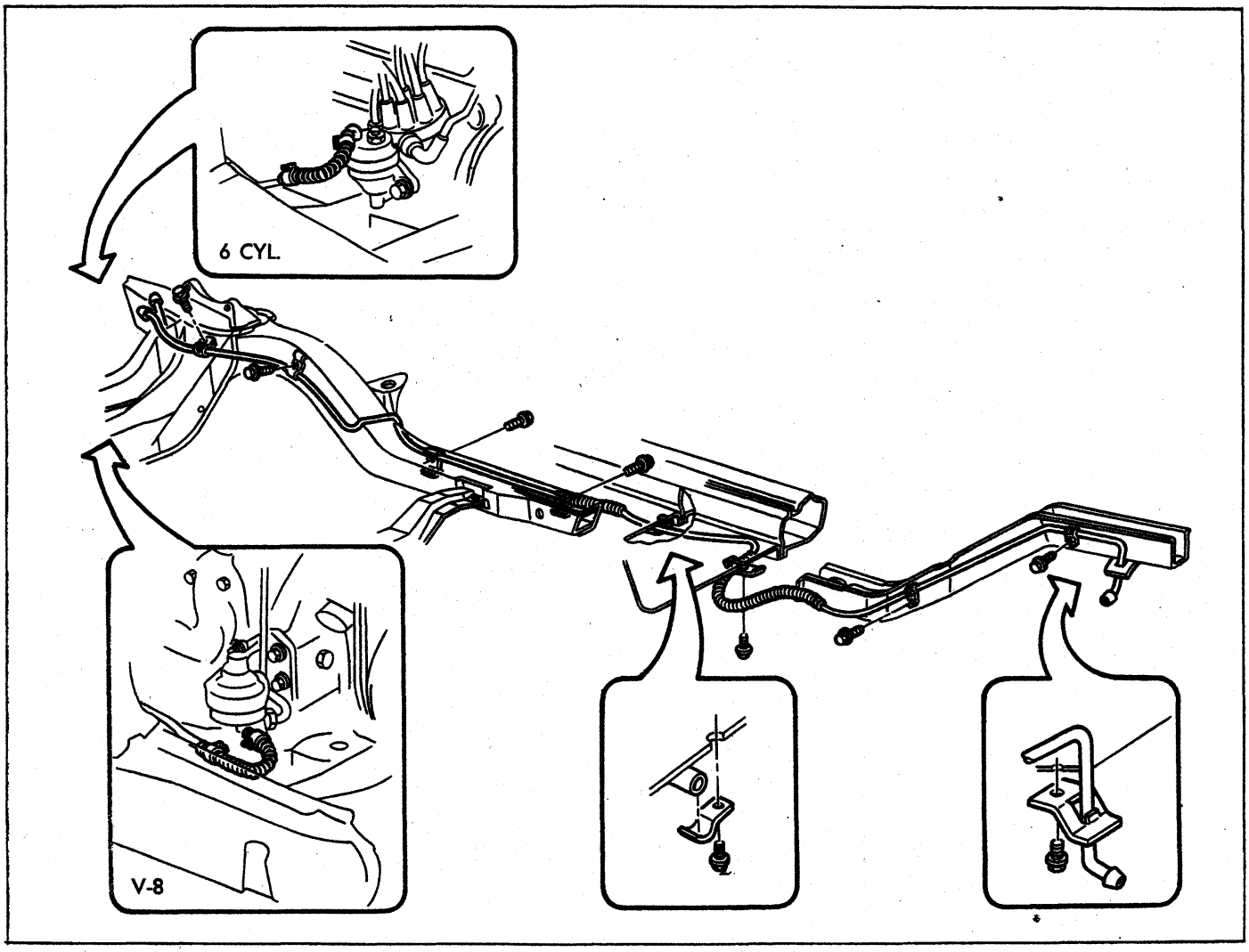


Fig. 17—Camaro Fuel Lines

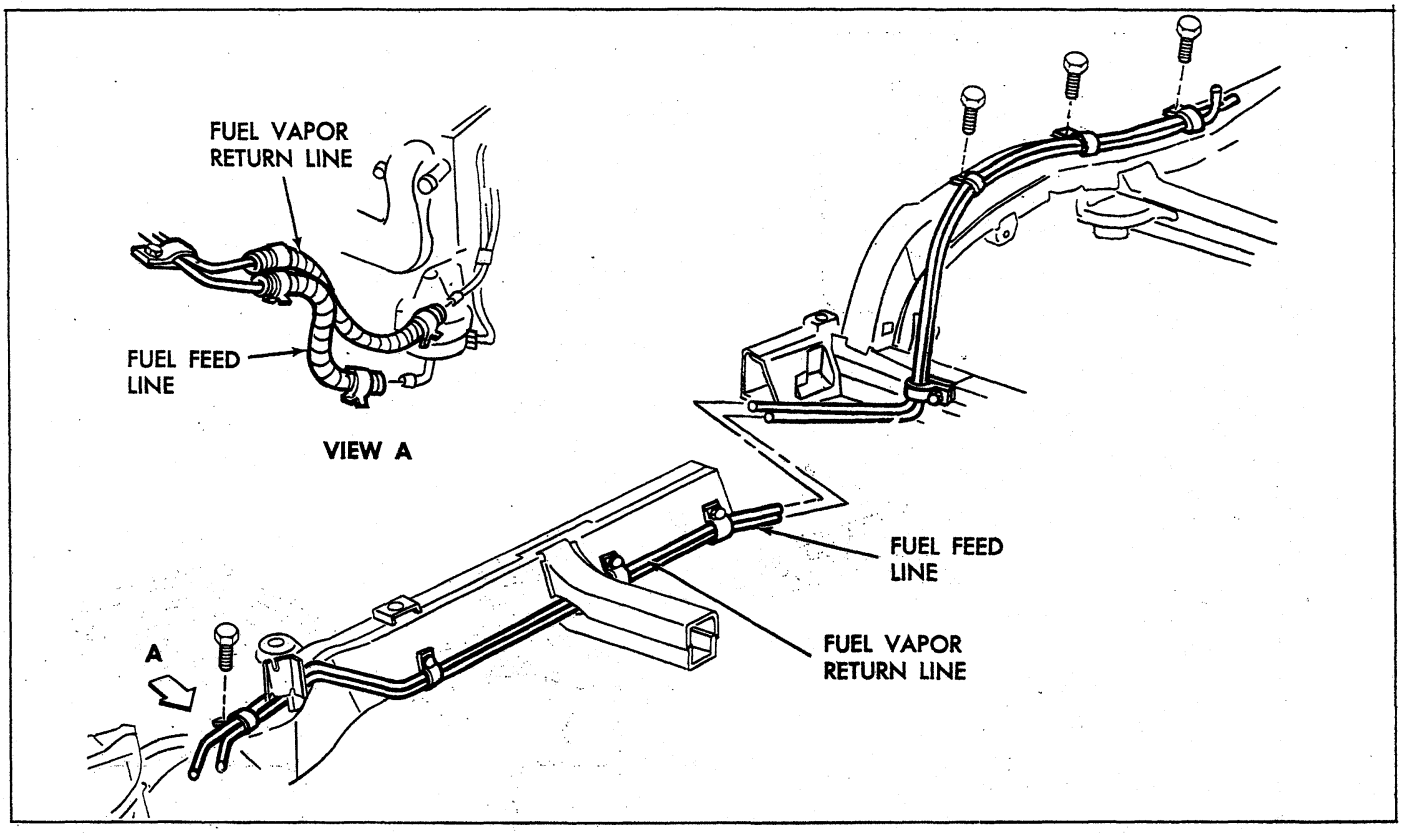


Fig. 18—Corvette Fuel Lines

EXHAUST SYSTEMS

INDEX

	Page
General Description	8-10
Component Part Replacement	8-11
Chevrolet	8-11
Muffler Assembly	8-11
Exhaust Pipe (Crossunder With V-8 Engine Single Exhaust)	8-11
Tail Pipe and/or Resonator	8-11
Chevelle	8-11
Muffler	8-11
Exhaust Pipe (Crossunder With V-8 Engine Single Exhaust)	8-11
Tail Pipe and/or Resonator	8-11
Nova and Camaro	8-11
Muffler and Tail Pipe Assembly	8-11
Resonator Assemblies (Dual Exhaust)	8-14
Exhaust Pipe (Single Exhaust)	8-14
Front Exhaust Pipe (Dual Exhaust)	8-14
Rear Exhaust Pipe (Dual Exhaust)	8-14
Left Tail Pipe (Dual Exhaust)	8-14
Corvette	8-18
Muffler Assembly	8-18
Front Exhaust Pipes	8-18
Special Tools	8-19

GENERAL DESCRIPTION

All Chevrolet exhaust systems are of the split system in which all components (exhaust pipes, mufflers, resonators and tail pipes) can be separated by removing clamps. All other models have at least two components that cannot be separated by merely removing a clamp.

All V-8 single exhaust systems incorporate a "crossunder" exhaust pipe in which either the left or right exhaust pipe crosses under the engine oil pan to join the rest of the system.

Dual exhaust systems are available as regular production or optional equipment on all models. Chevrolet and Camaro offer an optional "Deep Tone" system which eliminates the resonators.

All exhaust systems are suspended on insulated brackets for rattle free operation. System components are attached to the brackets or to one another with "U" bolt clamps.

COMPONENT PART REPLACEMENT

CHEVROLET (Fig. 19-20)

MUFFLER ASSEMBLY

Remove and Replace

1. Remove front and rear muffler clamps.
2. Remove tailpipe from muffler.
3. Remove muffler from exhaust pipe.
4. Install new muffler using new "U" bolt clamps.
5. Check clearances before tightening clamps.

EXHAUST PIPE (CROSSUNDER WITH V-8 ENGINE SINGLE EXHAUST)

Remove and Replace

1. Remove exhaust pipe to manifold nuts, extension and packing--separate pipe from manifold.
2. Remove muffler and/or exhaust pipe clamps and remove pipe.
3. Attach pipe to muffler, then secure to manifold using new nuts and packings. Do not secure attachments until clearances for the standard and automatic control linkages, underbody and crossmember have been checked.

   NOTE: Clean manifold stud threads with wire brush and use new nuts to secure exhaust pipe to manifold.

4. Tighten nuts uniformly.

TAIL PIPE AND/OR RESONATOR

Remove and Replace

1. Remove "U" clamp attachment at muffler.
2. Remove attachments at tail pipe hangers.
3. Remove tail pipe and/or resonator assembly.
4. Replace tail pipe at muffler, then install at hangers. Do not secure attachments until clearances have been checked.

CHEVELLE (Fig. 21-22)

MUFFLER ASSEMBLY

Replacement

1. Cut the exhaust pipe near the muffler to allow sufficient pipe for muffler replacement:

   CAUTION: Before cutting the exhaust pipe, measure service muffler exhaust pipe extension and make certain to allow 1-1/2" for engagement of exhaust pipe into muffler extension.

2. Remove "U" bolt clamp at center mounting and disengage muffler from tail pipe.
3. Install new muffler and secure with new "U" bolt clamps.
4. Realign and check clearances before finally tightening all hardware.

   NOTE: If bracket mounting insulators are fatigued, replace to insure a secure exhaust system.

EXHAUST PIPE (CROSSUNDER WITH V-8 ENGINE SINGLE EXHAUST)

Replacement

On L-6 single and V-8 dual exhaust systems, it will be necessary to replace both the exhaust pipe and muffler with service replacement parts.

1. Remove nuts attaching exhaust pipe to manifold.
2. Remove muffler and exhaust pipe clamps and remove muffler and exhaust pipe assembly.
3. Attach muffler to tail pipe, then secure to manifold using new packings and stud nuts.

   NOTE: Clean manifold stud threads with a wire brush before installing new nuts. Check exhaust system clearances before tightening nuts and clamps.

On V-8 single exhaust systems, replacement can be made as follows:

1. Remove nuts attaching left and right exhaust pipes to exhaust manifolds.
2. Remove "U" bolt clamp securing front exhaust pipe to rear exhaust pipe and muffler assembly and remove front pipe.
3. Using new manifold flange gaskets and nuts, install new exhaust pipe.

   NOTE: Check all clearances before tightening hardware. Clean manifold stud threads before installing new nuts.

TAIL PIPE AND/OR RESONATOR

Replacement

1. Remove clamp attachment at muffler and at tail pipe rear hanger.
2. Disengage tail pipe from muffler and remove from vehicle.
3. Install tail pipe to rear of muffler.
4. Position tail pipe to obtain proper clearance to rear spring bracket and underside of frame rail.
5. Install tail pipe clamp over rear hanger and position on pipe to maintain vertical position of insulator without twist.
6. Tighten nuts on "U" bolt clamp at rear of muffler, then secure rear tail pipe clamp.

NOVA AND CAMARO (Fig. 23-26)

MUFFLER AND TAILPIPE ASSEMBLY

Remove and Replace

1. Single Exhaust - Remove "U" bolt clamp at muffler inlet.
   Dual Exhaust - Remove "U" bolt clamps at muffler inlets and also left hand muffler outlet.
2. Remove screw attachment at right hand tail pipe rear hanger and remove muffler and tail pipe assembly.
3. Install new muffler at exhaust pipe(s). On dual exhaust, install left rear tail pipe. Install right rear tail pipe hanger. Do not secure exhaust and tail pipe attachments until clearances have been checked.

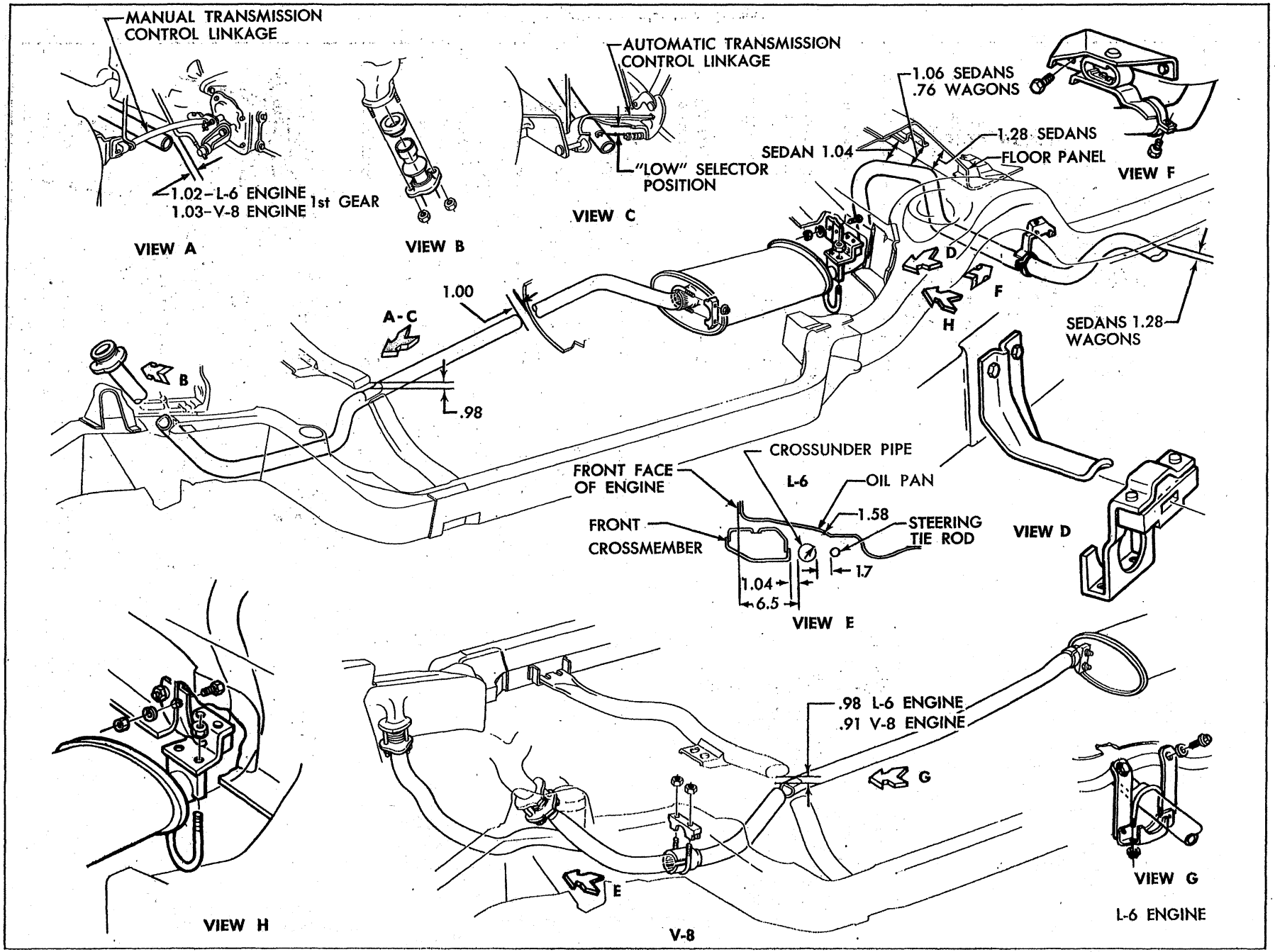


Fig. 19—Chevrolet Single Exhaust System

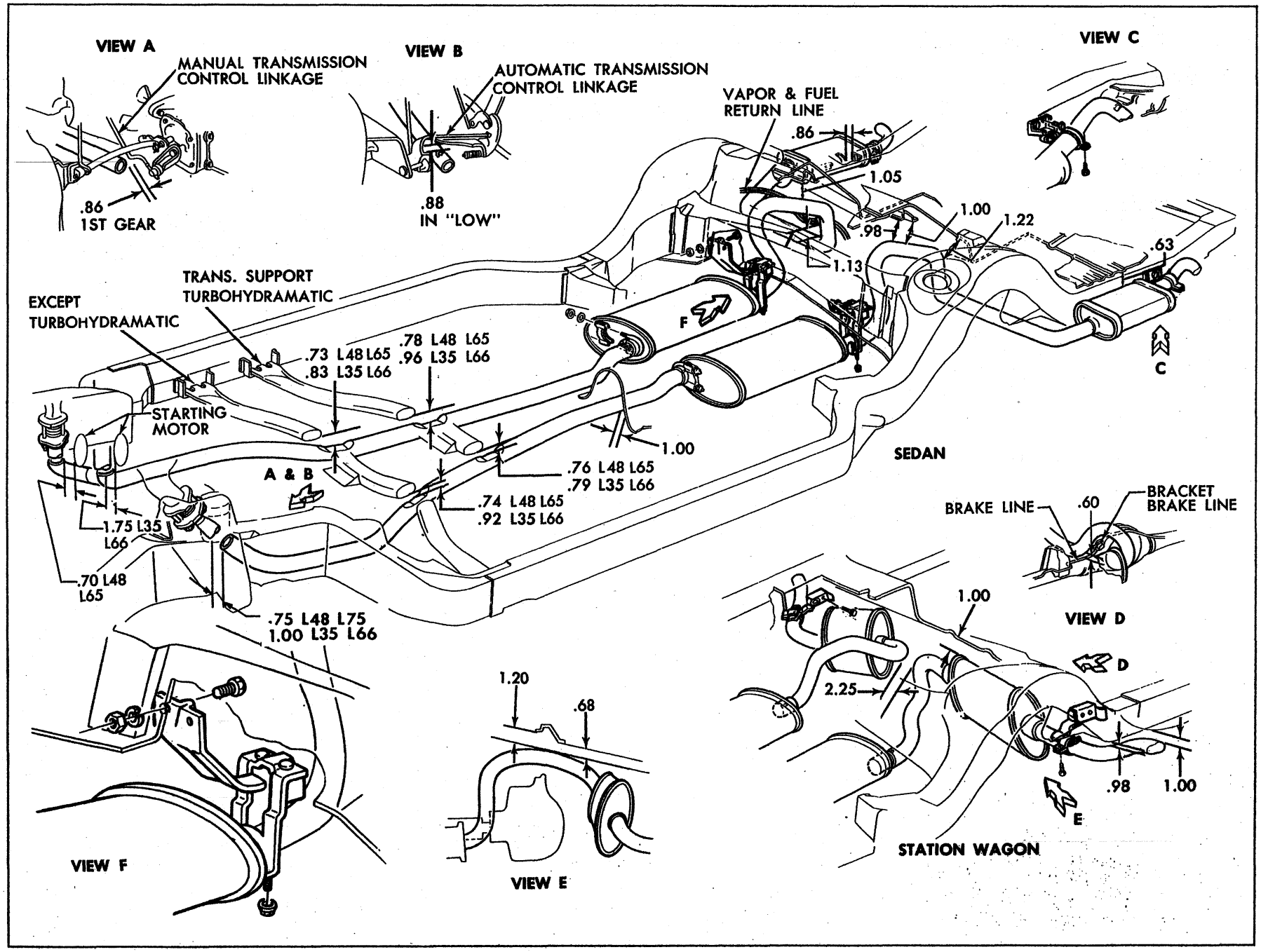


Fig. 20—Chevrolet Dual Exhaust

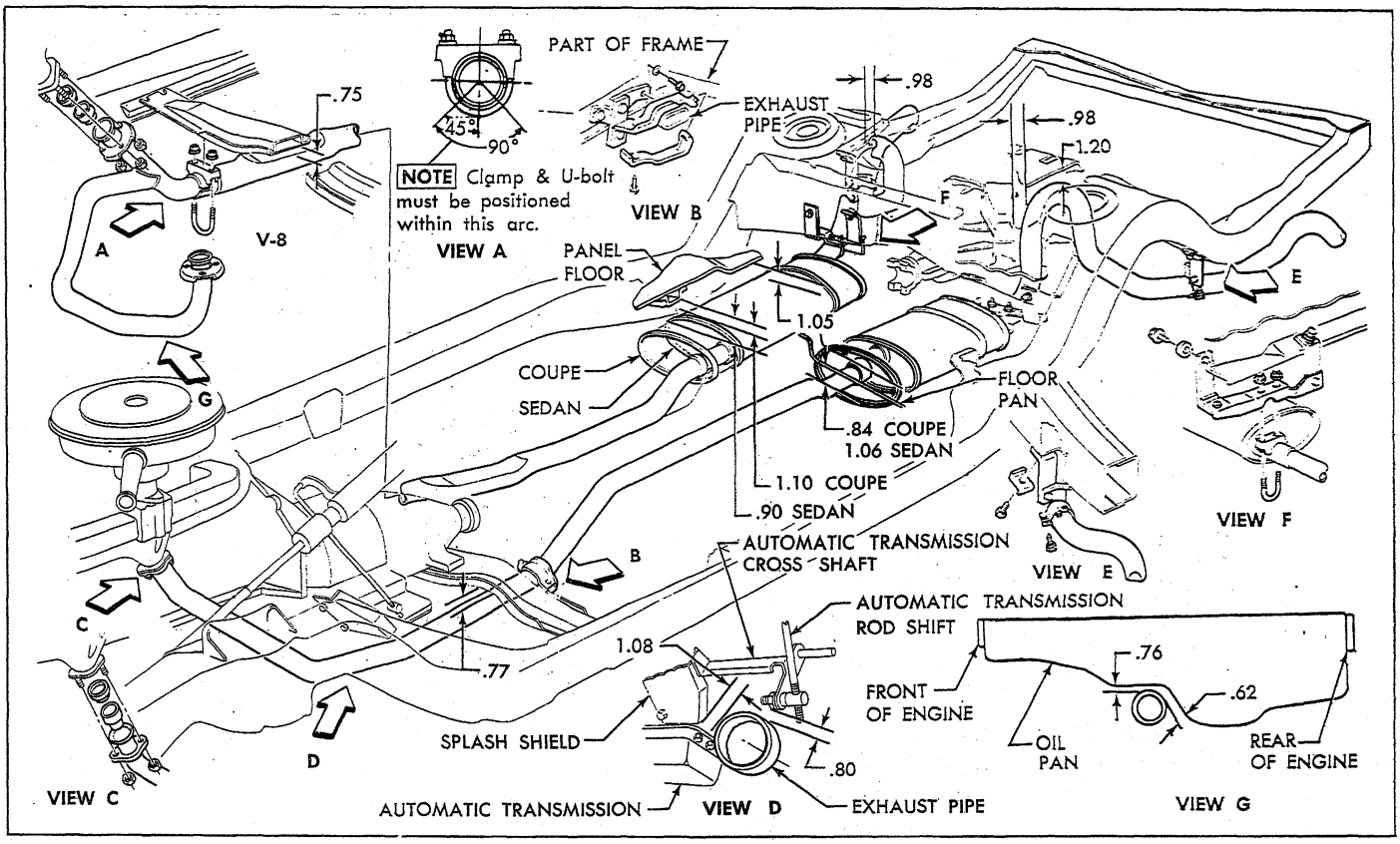


Fig. 21—Chevelle Single Exhaust

RESONATOR ASSEMBLIES (DUAL EXHAUST)

Remove and Replace

1. Before cutting exhaust pipe, measure service resonator exhaust pipe extension and make certain to allow 1-1/2" for engagement of exhaust pipe into resonator extension.
2. Remove "U" bolt clamp at resonator outlet, and remove resonator.
3. Install new resonator and secure with "U" bolt clamps.

NOTE: Realign and check all clearances before finally tightening all clamps. If bracket mounting insulators are fatigued, replace to insure a secure exhaust system.

EXHAUST PIPE (SINGLE EXHAUST)

Remove and Replace

1. Remove exhaust pipe to manifold nuts, extensions and packings and separate pipe(s) from manifold.
2. Remove "U" bolt clamp at muffler and remove exhaust pipe.
3. To install new pipe, attach pipe to muffler and then secure to manifold using new packings and nuts.

NOTE: Clean manifold stud threads before installing new nuts. After checking clearances, tighten nuts uniformly.

FRONT EXHAUST PIPE (DUAL EXHAUST)

Remove and Replace

1. Remove exhaust pipe to manifold nuts, extensions and packings and separate pipes from manifolds.
2. Remove "U" bolt clamps at resonator outlet and remove exhaust pipe and resonator assemblies.
3. To install new pipes, connect resonator to rear exhaust pipe and then attach pipe to manifold using new packings and nuts. Be sure to clean manifold stud threads and check system clearances before tightening nuts and clamps.

REAR EXHAUST PIPE (DUAL EXHAUST)

Remove and Replace

1. Remove "U" bolt clamps at muffler inlet and at resonator outlet connections.
2. Disconnect pipe at muffler and then at resonator outlet.
3. To install new rear exhaust pipe, connect to resonator outlet and then to muffler.
4. Install "U" bolt clamps and tighten after checking system clearances.

LEFT TAILPIPE (DUAL EXHAUST)

Remove and Replace

1. Remove "U" bolt clamp at muffler.

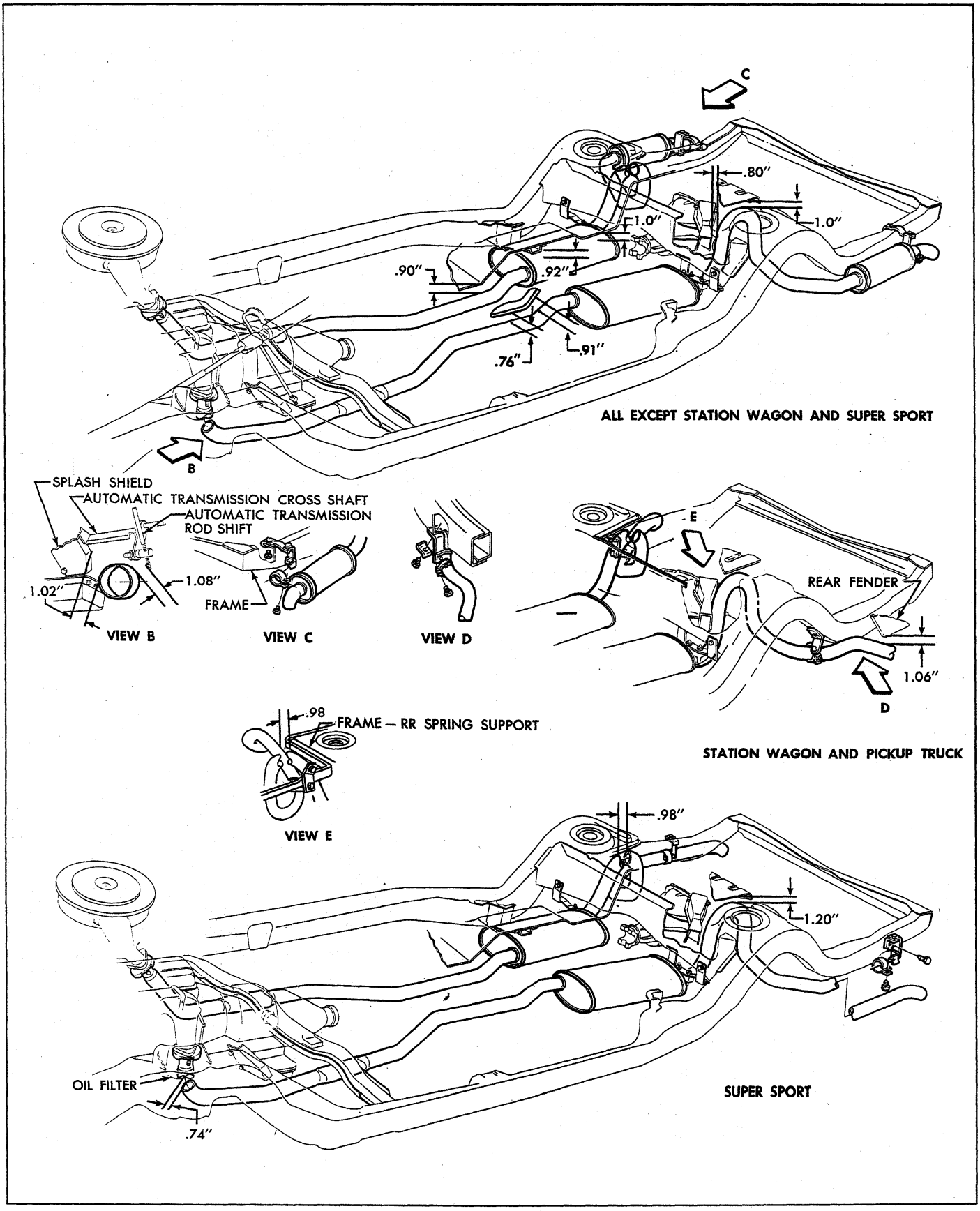


Fig. 22—Chevelle Dual Exhaust

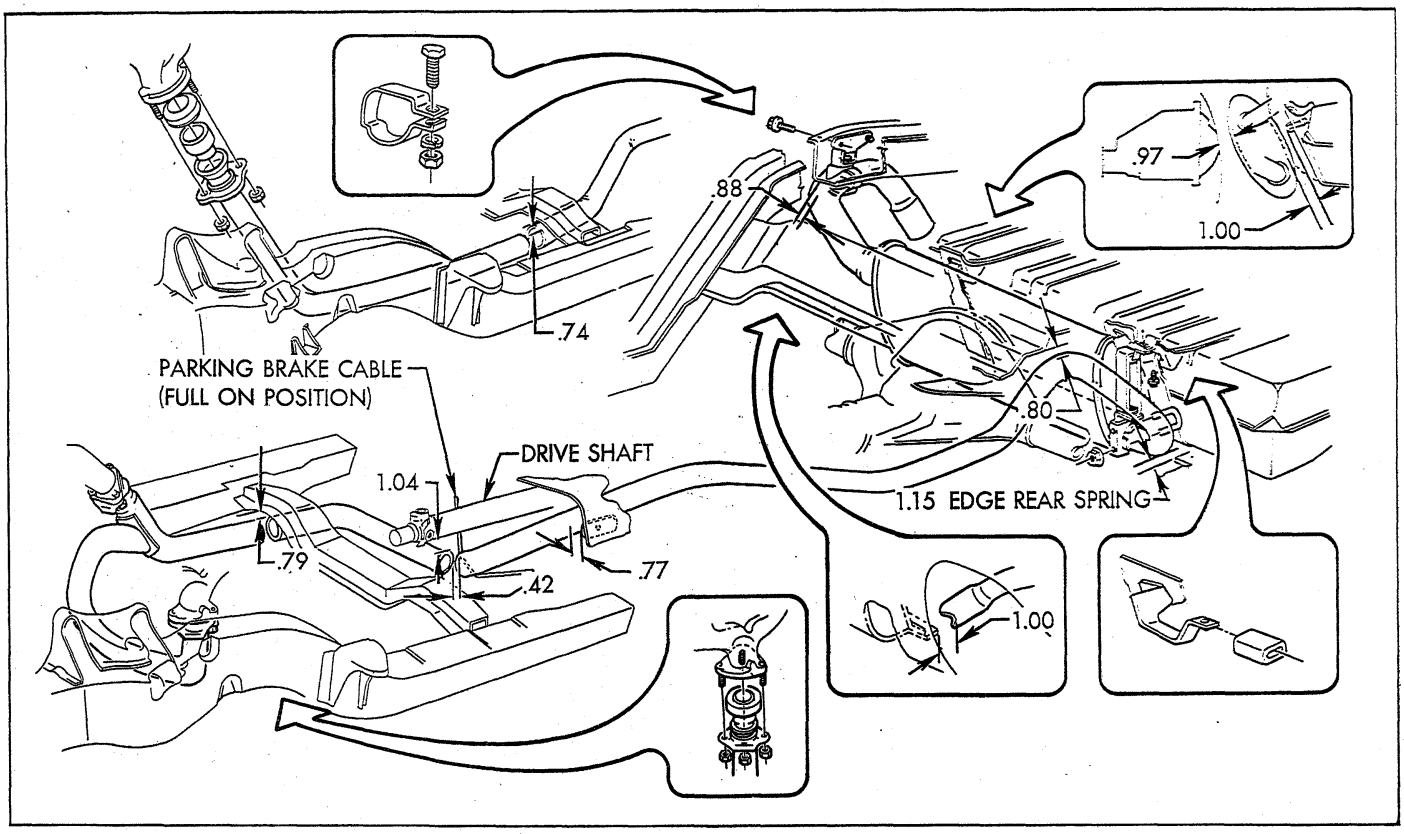


Fig. 23—Nova Single Exhaust

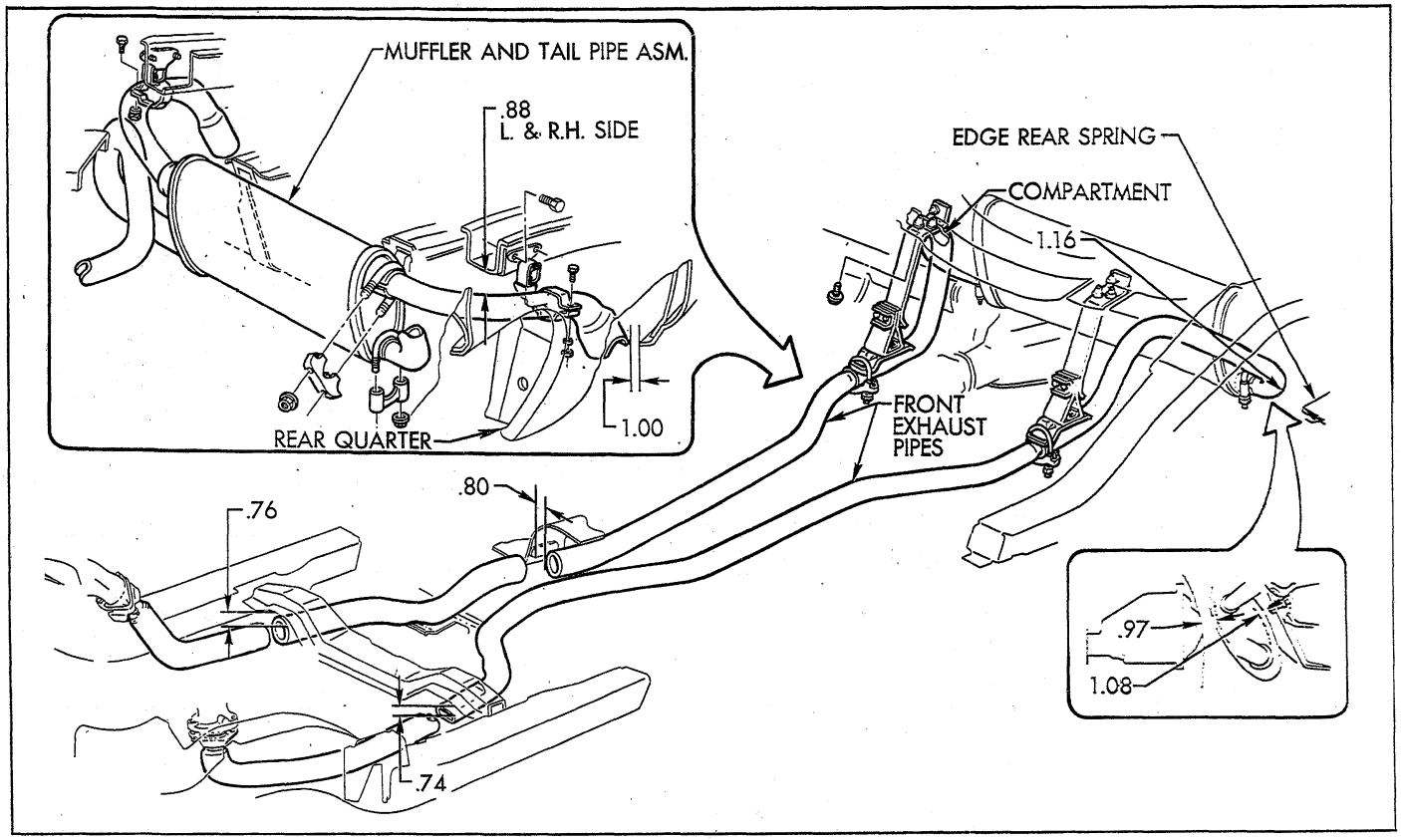


Fig. 24—Nova Dual Exhaust

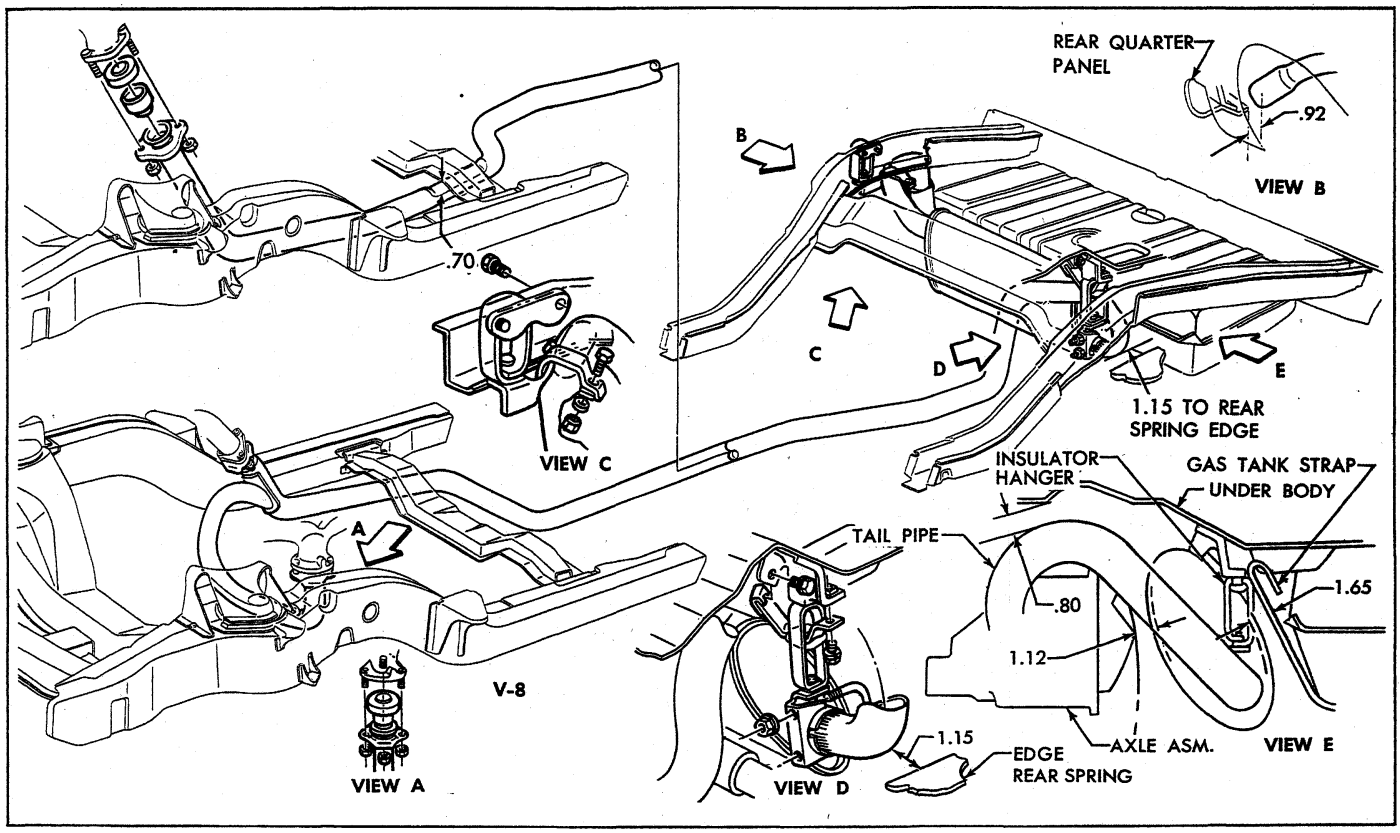


Fig. 25—Camaro Single Exhaust

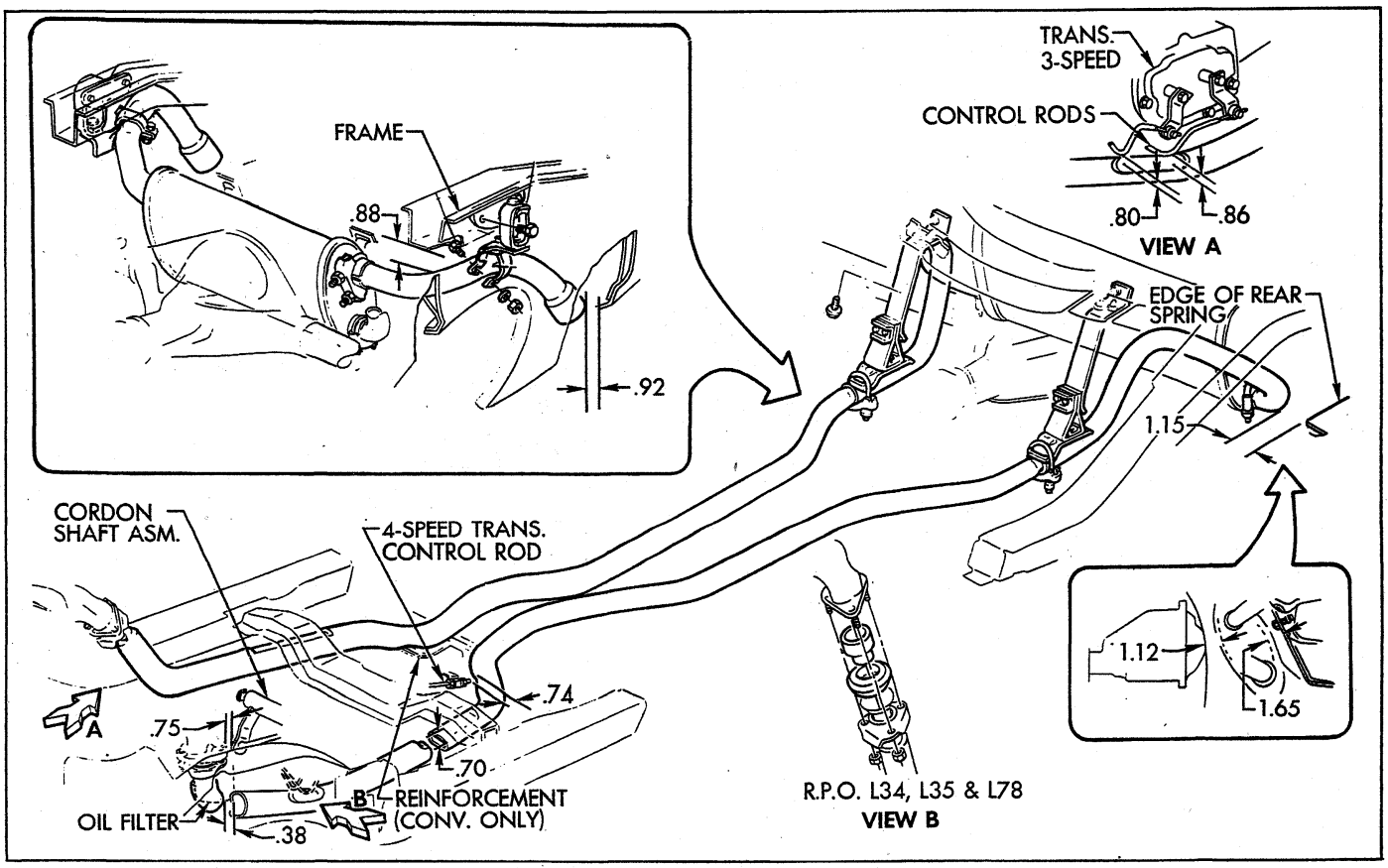


Fig. 26—Camaro Dual Exhaust

2. Remove screw attachment at tail pipe rear hanger and remove tail pipe.
3. Install new tail pipe to muffler, then install at rear hanger.

   NOTE: Be sure to check clearances before tightening attachments.

CORVETTE (Fig. 27)

MUFFLER ASSEMBLY

Replacement (Also Rear Exhaust and Tail Pipes)

1. Remove "U" bolt attachments at both rear tail pipes and remove tail pipes.
2. Separate the exhaust system at the crossmember tube by loosening the "U" bolt nuts.
3. Remove rear muffler bracket screws and slide the muffler system rearward.

   CAUTION: Before cutting the rear exhaust pipe, measure service muffler exhaust pipe end and make certain to allow 1-1/2" for engagement of the rear exhaust pipe into service muffler pipe.

4. Cut the exhaust pipe near the muffler (see caution above) to allow sufficient pipe for muffler replacement.
5. Replace muffler and secure with new clamps.

   NOTE: Clamps must be assembled with nuts attached toward the rear of the vehicle - reference 90° to sawcuts in service muffler pipe.

6. Reverse procedure for installation.

   NOTE: If bracket mounting insulators are fatigued, replace to insure a secure exhaust system.

7. In the event the tail pipe bezel has been damaged and replacement is required, remove three screws and replace the bezel.

FRONT EXHAUST PIPES

Replacement

1. Remove exhaust pipe to manifold nuts, extensions and packings.
2. Remove clamps just forward of transmission crossmember and remove front exhaust pipe.
3. To install, connect front pipe to rear pipe and then install at manifold using new packings and nuts.

   NOTE: Clean manifold stud threads before installing new nuts. Check exhaust system clearances before tightening nuts and clamps.

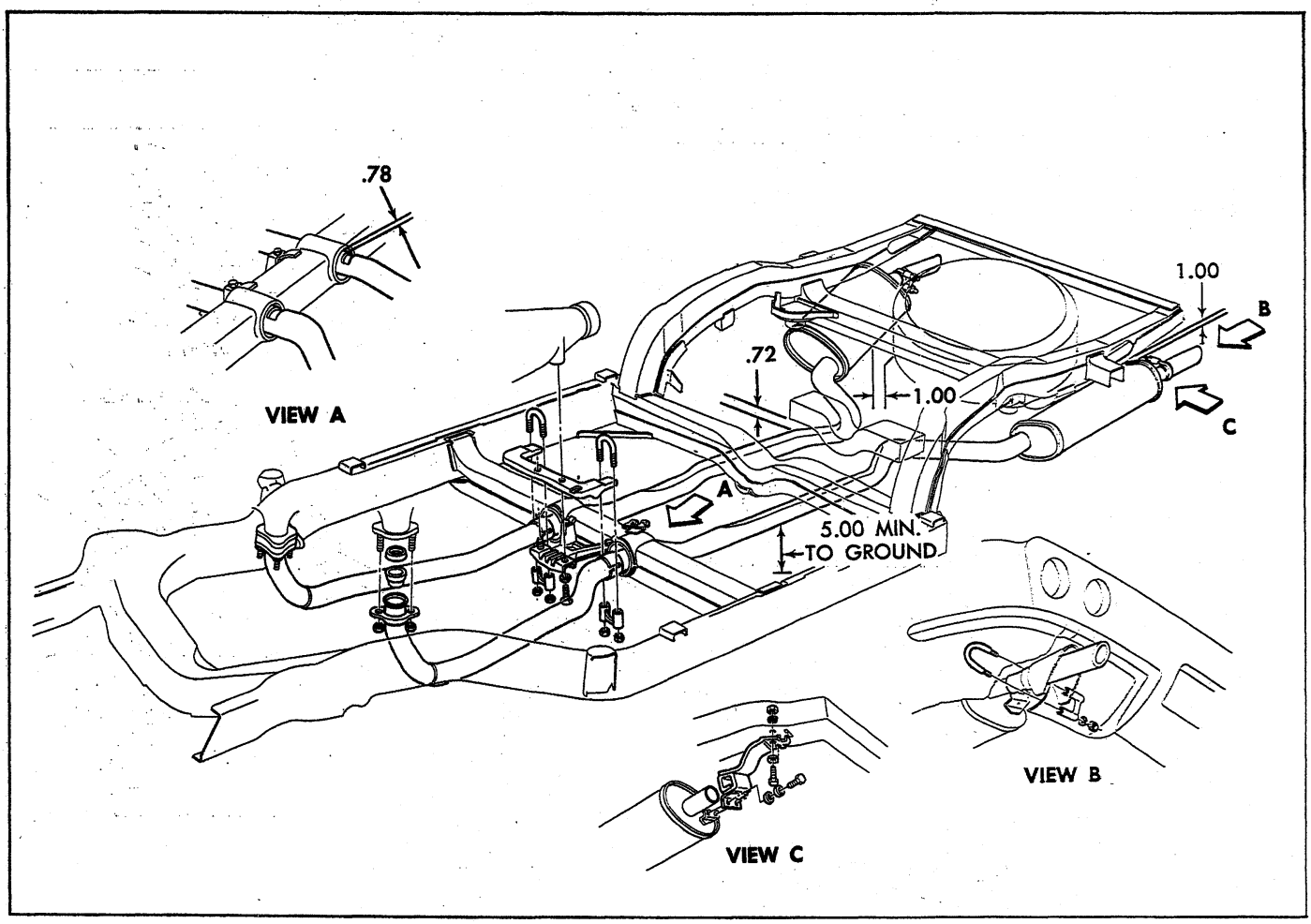


Fig. 27—Corvette Dual Exhaust

SPECIAL TOOLS

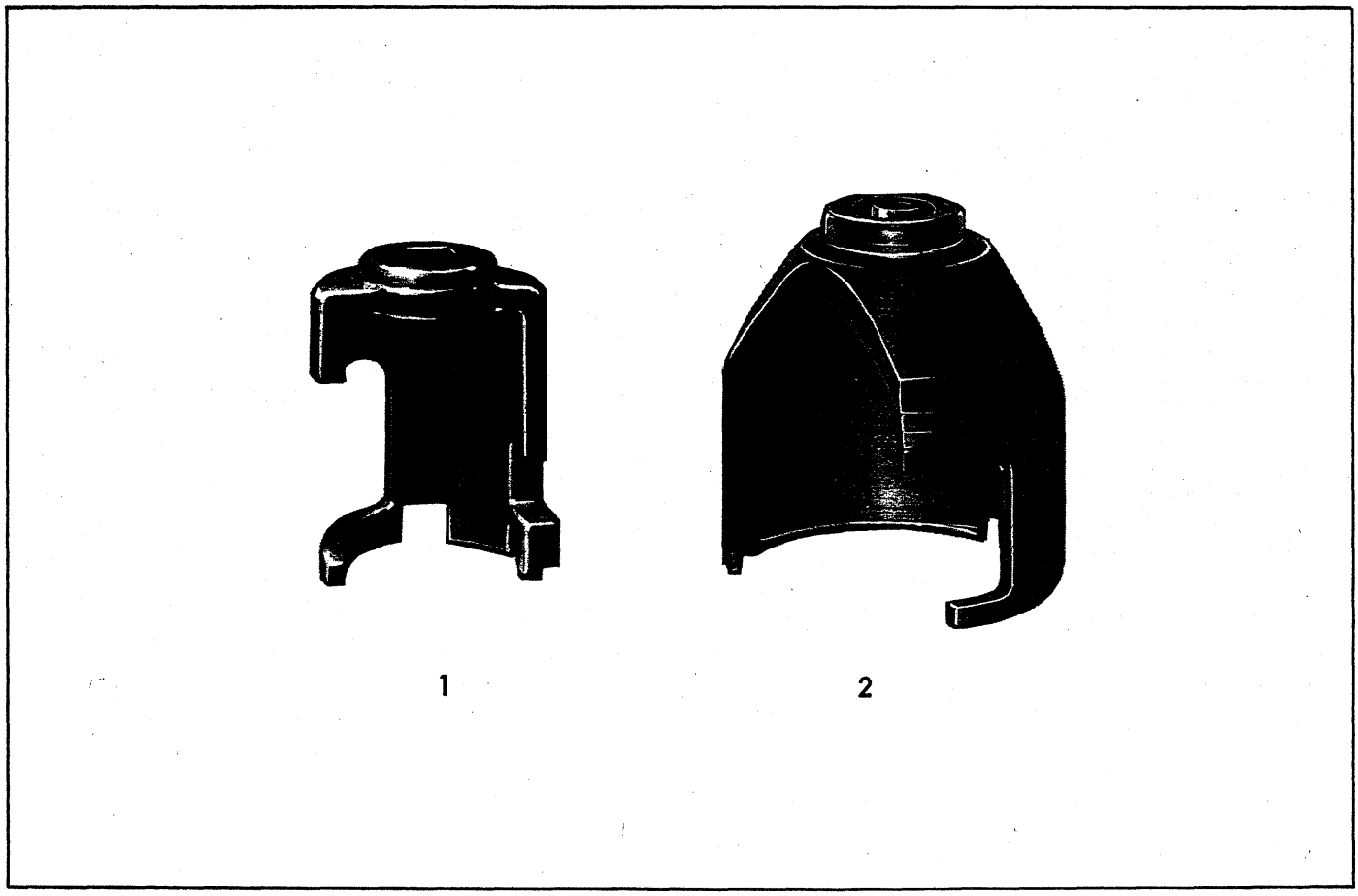


Fig. 28—Special Tools

1. J-23346 Fuel Tank Gauge Unit Spanner (All except Chevrolet)
2. J-22554 Fuel Tank Gauge Unit Spanner (Chevrolet)

SECTION 9
STEERING

CONTENTS OF THIS SECTION

	Page
Standard Steering	9-1
Power Steering	9-28
Special Tools	9-35

STANDARD STEERING

INDEX

	Page
General Description	9-1
Maintenance and Adjustments	9-2
Adjustments	9-2
Steering Gear	9-2
Steering Wheel Alignment and High Point Centering	9-4
Toe-in Adjustment	9-5
Corvette Steering Ratio	9-5
Component Replacement and Repairs	9-5
Steering Wheel	9-5
Regular Production	9-5
Deluxe Steering Wheel	9-5
Simulated Wood	9-6
Corvette Tilt-Telescoping	9-6
Steering Coupling	9-7
Flexible Coupling	9-7
Pot Joint Coupling (Chevelle Only)	9-7
Steering Gear	9-8
Sector Shaft Seal Replacement	9-8
Directional Signal Switch	9-8
All Except Tilt-Telescoping Columns	9-8
Tilt-Telescoping Columns	9-10
Lock Cylinder	9-10
Ignition Key Warning Switch	9-11
Ignition Switch	9-12
Steering Column	9-12
Column Removal - All Columns	9-13
Disassembly - All Except Tilt and Tilt-Telescoping	9-14
Assembly - All Except Tilt and Tilt-Telescoping	9-17
Disassembly - Tilt and Tilt-Telescoping	9-18
Assembly - Tilt and Tilt-Telescoping	9-22
Column Installation - Mandatory Sequence	9-23
Chevrolet	9-23
Chevelle	9-24
Chevy Nova and Camaro	9-24
Corvette	9-25
Steering Linkage	9-25
Tie Rods	9-25
Relay Rod	9-27
Idler Arm	9-27
Pitman Arm	9-27
Steering Arms	9-27

GENERAL DESCRIPTION

The regular production steering gear is the recirculating ball type. This gear provides for ease of handling by transmitting forces from worm to sector gear through ball bearings. The steering linkage is of the relay type, and extended interval lubrication design, with the pitman arm connected to one end of the relay rod. The outer end of the relay rod is connected to an idler arm which is connected to the frame side rail opposite the steering gear. Two adjustable tie rods connect the relay rod to the steering arms.

All passenger cars for 1969 are equipped with Function Locking Energy Absorbing Steering Columns. The mast jacket, shift tube, and steering shaft are designed to collapse under various front impact conditions. When an automobile is involved in a frontal collision, the primary force (forward movement of the car) is suddenly halted, while the secondary force (the driver) continues its forward direction. A severe collision generally involves these two forces--the primary and secondary forces. The secondary impact occurs when the driver is thrust forward into the steering wheel and column.

The Function Locking Energy Absorbing Column is designed to absorb these primary and secondary forces to the extent that the severity of the secondary impact is reduced. During a collision the steering column compresses, thereby reducing its tendency to move rearward into the driver's compartment. A split second later when the driver is thrown forward (the secondary impact) his energy is also partially absorbed by the compression characteristics of the column. See Figure 1.

The column jacket no longer incorporates the collapsible steel mesh design. Instead, the jacket features a ball bearing energy absorbing device. Ball bearings imbedded in plastic are pressed between the upper and lower jackets (fig. 2). The assembly collapses under a predetermined load.

The steering shaft and shift tube collapse under predetermined loads by shearing injected plastic pins.

The 1969 columns are not only designed for safety, but incorporate the ignition lock, ignition switch and an anti-theft system. The design is such that the key cannot be removed unless the transmission is in "Park" on automatics or "Reverse" on manuals, and the lock bezel is turned to the "Lock" position. With the lock in the "Lock" position, the steering wheel and shift lever are automatically locked by a rod and lockplate mechanism inside the

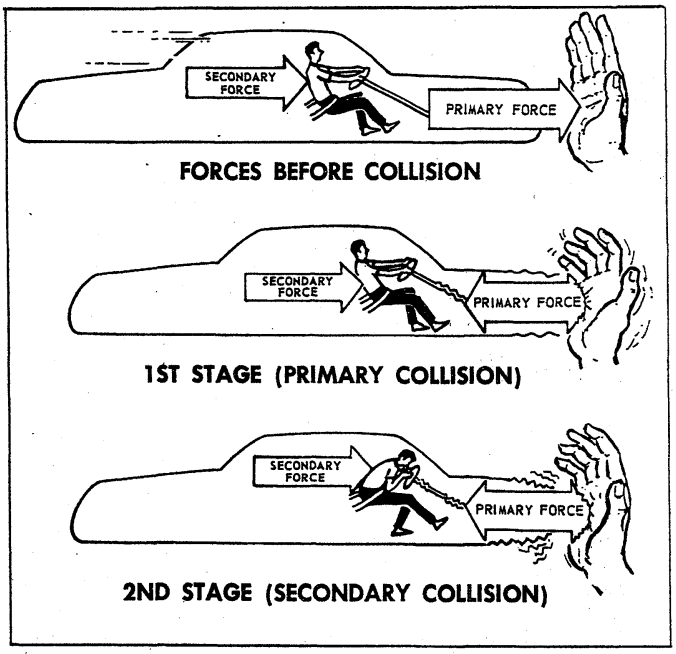


Fig. 1—Reaction of Forces in Two Stages of Collision

column assembly. A mechanical linkage (back-drive linkage) between the floor shift transmission controls and the steering column provide anti-theft features for all floor-mounted controls.

All new columns are of the above design, including the tilt and tilt-telescoping options.

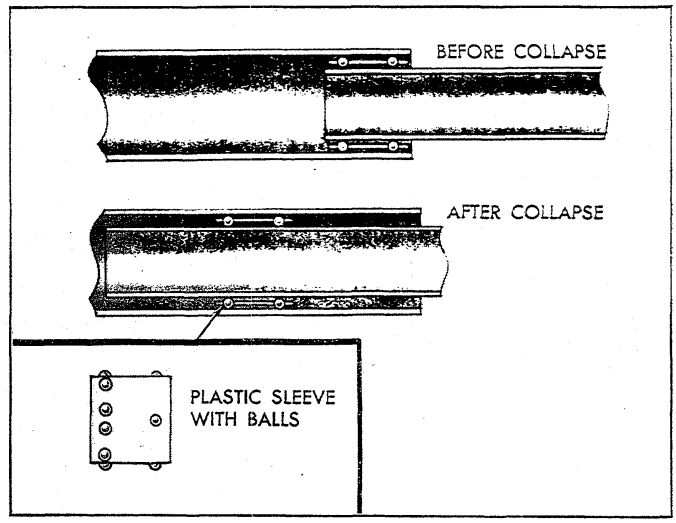


Fig. 2—Steering Column Jacket Design

MAINTENANCE AND ADJUSTMENTS

The manual steering gear is filled at the factory with a water resistant grease. Seasonal change of this lubrication is unnecessary and the housing should not be drained. The steering gear lubricant level should be checked every 36,000 miles. Whenever required, additions should be made using a water resistant EP chassis lubricant.

Check and fill steering gear as follows:

1. Remove lower and outboard cover retaining screws (fig. 3).
2. Insert filling device in lower screw hole.
3. Inject lubricant until it appears in outboard screw hole; gear is now filled to correct level.

The steering linkage should be lubricated with water resistant EP chassis lubricant every 6,000 miles or four months, whichever occurs first. Lubrication points and additional information on the chassis lubricant to be used can be found in Section 0 -- General Information and Lubrication.

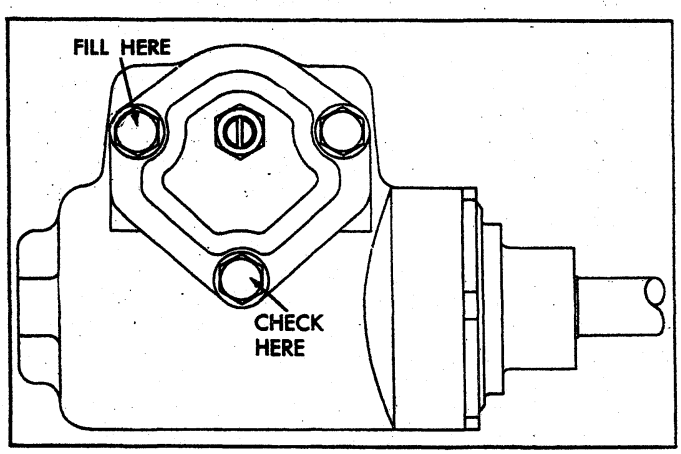


Fig. 3—Cover Attaching Bolts (Typical)

ADJUSTMENTS

Steering Gear

Before any adjustments are made to the steering gear in an attempt to correct such conditions as shimmy, loose or hard steering etc., a careful check should be made of front end alignment, shock absorbers, wheel balance and tire pressure for possible cause.

Correct adjustment of the steering gear is very important. Perform adjustments following the sequence listed below.

1. Remove pitman arm nut and mark relation of pitman arm position to sector shaft. Remove pitman arm with Tool J-6632 as shown in Figure 4.
2. Loosen the pitman shaft lash adjuster screw locknut and turn the adjuster screw a few turns in a counter-clockwise direction (fig. 5). This removes the load imposed on the worm bearings by the close meshing of rack and sector teeth. Turn steering wheel gently in one direction until stopped by gear, then back away about one turn.

   CAUTION: Do not turn steering wheel hard against stops when steering relay rod is disconnected as damage to ball guides may result.

3. a. Disconnect wiring harness at column connector. On vehicles with regular steering, check preload by removing horn button or shroud and applying

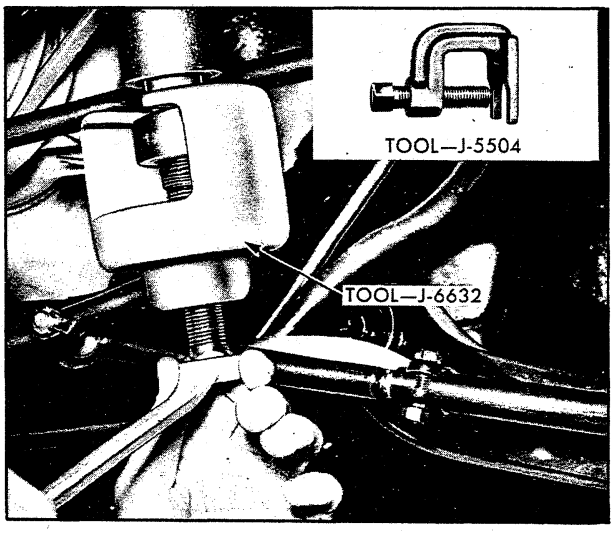


Fig. 4—Removing Pitman Arm

a torque wrench with a 3/4 inch socket on the steering wheel nut (fig. 6).

NOTE: Do not use torque wrench having maximum torque reading of more than 100 inch pounds.

b. On vehicles with Tilt Steering Columns, it will be necessary to disconnect the steering coupling to obtain a torque reading of the steering column. This reading should then be subtracted from any reading taken on the gear.
c. On vehicles with Simulated Wood Steering Wheels, it will be necessary to remove contact ring to gain access to the steering wheel nut.
d. On vehicles with Telescopic Steering Columns, check preload by removing the horn button and applying torque wrench, with a phillips-head adapter socket, on the star-headed screw in center of steering wheel.

NOTE: Apply a light vertical pressure to torque wrench end to keep phillips-head engaged in screw.

e. If torque does not lie within limits given in specifications at rear of manual, adjustment is necessary.

4. To adjust worm bearings, loosen worm bearing adjuster locknut and turn worm bearing adjuster shown in Figure 5 until there is no perceptible end play in worm. Check pull at steering wheel, readjusting if necessary to obtain proper pull. Tighten locknut and recheck pull. If the gear feels "lumpy" after adjustment of worm bearings, there is probably damage in the bearings due to severe impact or to improper adjustment and the gear must be disassembled for replacement of damaged parts.
5. After proper adjustment of worm is obtained and all mounting bolts securely tightened, adjust lash adjuster screw. First turn the steering wheel gently from one stop all the way to the other, carefully counting the total number of turns. Then turn wheel back exactly half way, to center position. Turn lash adjuster screw clockwise to take out all lash in gear teeth, and tighten locknut. Check pull at steering wheel taking highest reading as wheel is turned through center position. See specifications in rear of manual for proper sector lash adjustment. Readjust if necessary to obtain proper pull.

NOTE: If maximum specification is exceeded, turn lash adjuster screw counter-clockwise, then come up on adjustment by turning the adjuster in a clockwise motion.

6. Tighten locknut then recheck pull, as it must lie between specified readings.
7. Reassemble pitman arm to sector shaft, lining up marks made during disassembly. Refer to torque

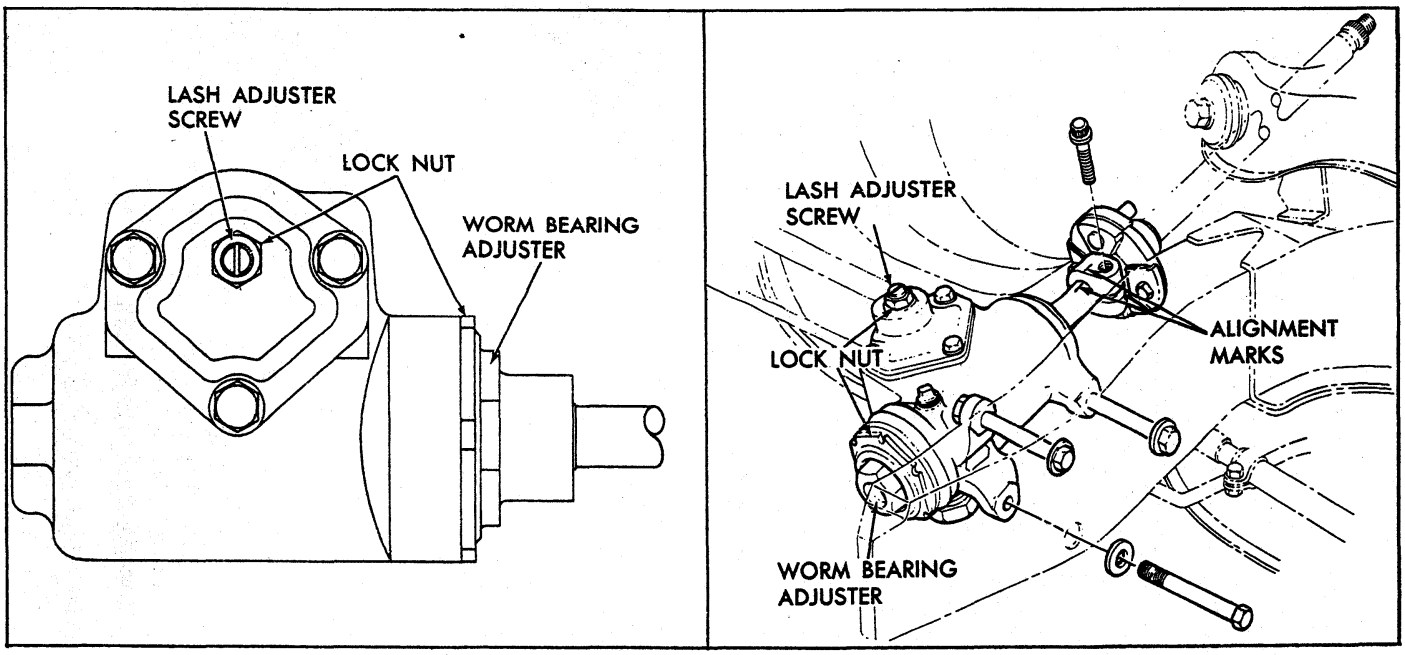


Fig. 5—Steering Gear Adjustment Points

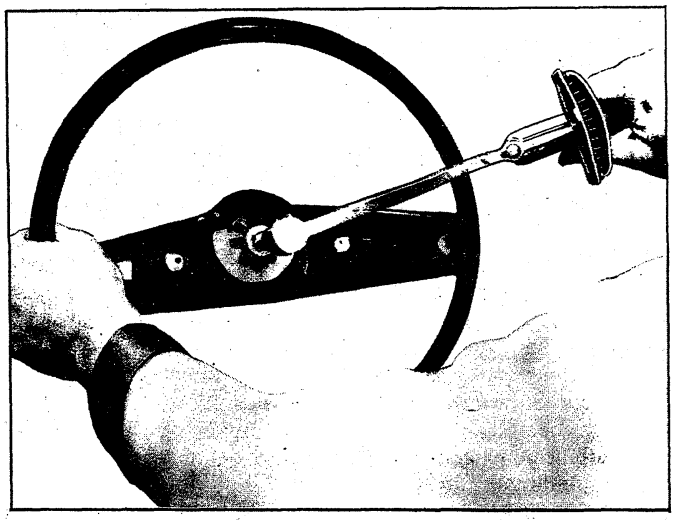


Fig. 6—Checking Wheel Pull (Typical)

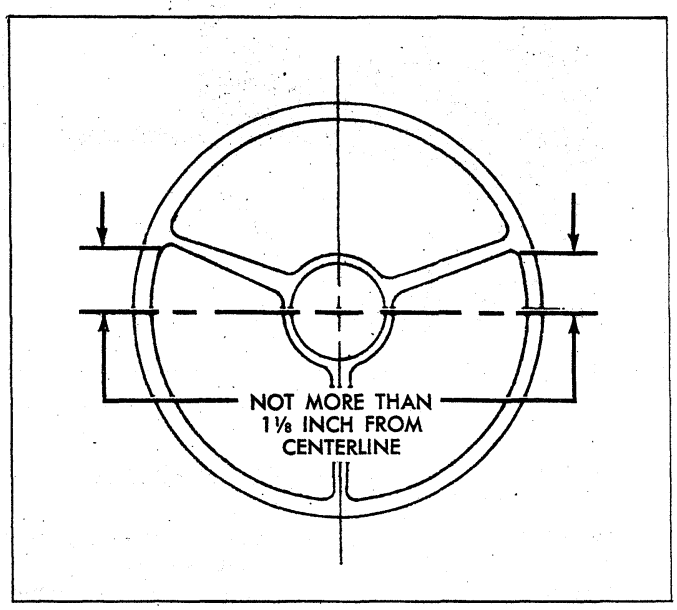


Fig. 7—Steering Wheel Alignment

specifications at rear of manual for correct torque value.

8. Install horn cap or shroud and connect steering column harness at chassis connector.

Steering Wheel Alignment and High Point Centering

1. Set front wheels in straight ahead position. This can be checked by driving vehicle a short distance on a flat surface to determine steering wheel position at which vehicle follows a straight path.
2. With front wheels set straight ahead, check position of mark on wormshaft designating steering gear high point. This mark should be at the top side of the shaft at 12 o'clock position and lined up with the mark in the coupling lower clamp.
3. If gear has been moved off high point when setting wheels in straight ahead position, loosen adjusting sleeve clamps on both left and right hand tie rods, then turn both sleeves an equal number of turns in the same direction to bring gear back on high point.

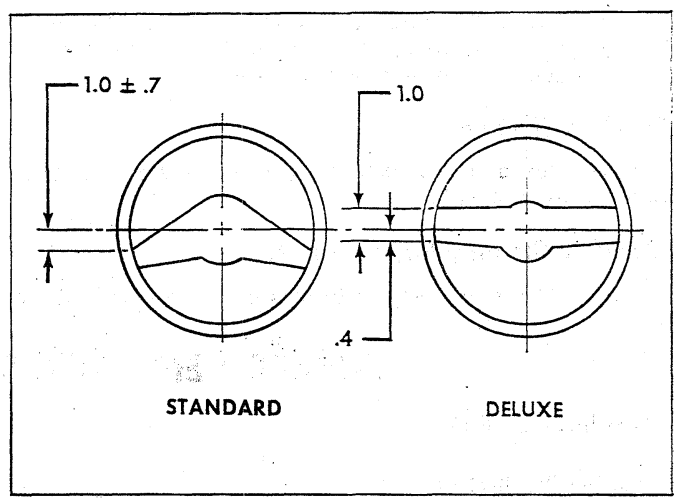


Fig. 8—Steering Wheel Alignment

CAUTION: Turning the sleeves an unequal number of turns or in differential directions will disturb the toe-in setting of the wheels.

4. Readjust toe-in as outlined in Section 3 (if necessary).
5. With wheels in a straight ahead position and the steering gear on highpoint, check the steering wheel alignment by measuring the distance from each spoke to the horizontal centerline of the steering wheel

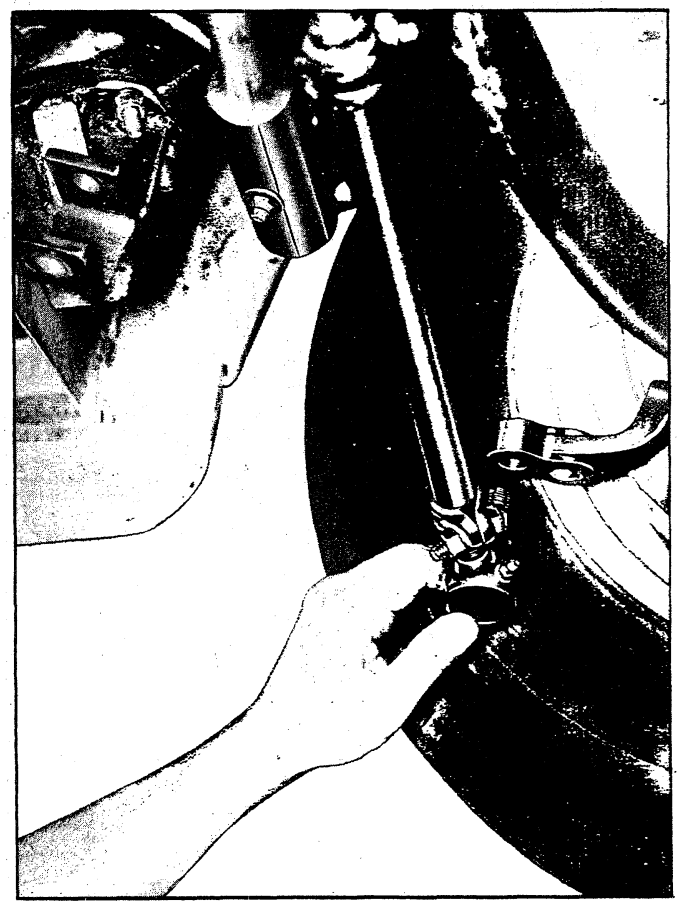


Fig. 9—Adjusting Steering Ratio-Corvette

(fig. 7 and 8). If the spokes are not within the limits specified, the wheel should be removed and centered. (See steering wheel removal in this section).

Toe-In Adjustment

Adjust the steering linkage for proper toe-in setting as outlined in Section 3.

Corvette Steering Ratio (Fig. 9)

The Corvette steering ratio may be changed as follows:

CAUTION: Do not use the rearward hole in the steering arm with power steering equipment or interference may result.

1. Remove tie rod ball stud nut at steering arm and disconnect tie rod from steering arm.
2. Move tie rod end to forward hole for 17.6:1 ratio (fast ratio) or rear hole for 20.2:1 ratio (standard ratio).
3. Install tie rod stud nut and tighten securely. Repeat operation on opposite steering arm.

COMPONENT REPLACEMENT AND REPAIRS

STEERING WHEEL

Regular Production

Removal

1. Disconnect battery ground cable.
2. Pull out horn button cap or center ornament and retainer.
3. Remove three screws from the receiving cup.
4. Remove the receiving cup, belleville spring, bushing, and pivot ring.
5. Remove the steering wheel nut and washer.
6. Using Tool J-2927, install centering adapter on steering shaft, thread puller anchor screws into threaded holes provided in steering wheel. Turn center bolt of tool clockwise to remove steering wheel (fig. 11).

Installation

1. With directional cancelling cam and horn contact assembly in place, set wheel onto steering shaft. Secure with washer and nut. Refer to torque specifications at rear of manual for correct torque values.

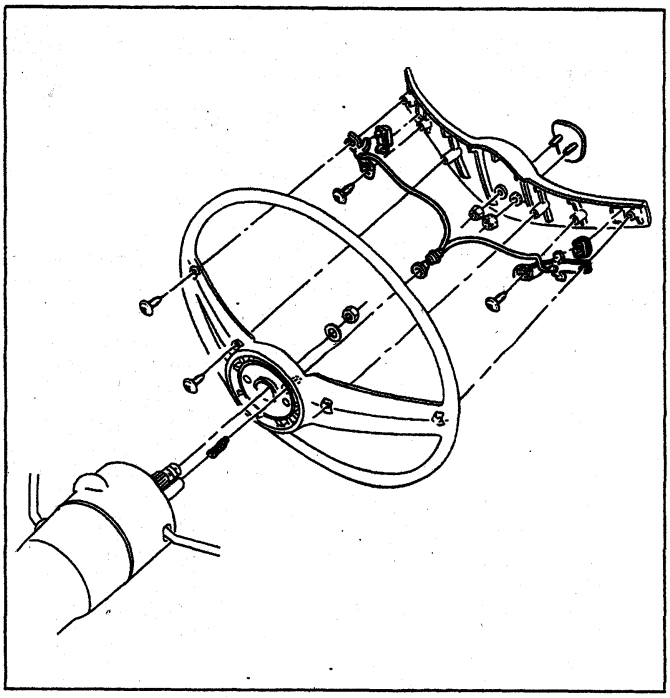


Fig. 10—Steering Wheel and Horn Attachments

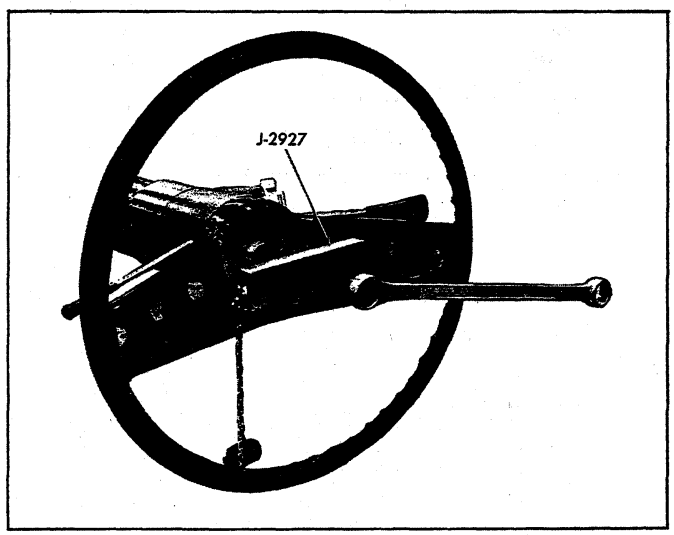


Fig. 11—Removing Steering Wheel with Tool J-2927

CAUTION: Do not over-torque shaft nut or steering wheel rub may result.

2. Install belleville spring (with dish of spring up), pivot ring, bushing and receiving cup with screws.
3. Install retainer and horn button cap or center ornament.
4. Connect battery ground cable.

Deluxe Steering Wheel (Fig. 10)

Removal

1. Disconnect battery ground cable.
2. Remove four attaching screws on underside of steering wheel.
3. Lift steering wheel shroud from wheel and then pull horn wires from cancelling cam tower.
4. Remove steering wheel nut and washer.
5. Using Tool J-2927, install centering adapter on steering shaft, thread puller anchor screws into threaded bolts provided in steering wheel. Turn center bolt of tool clockwise to remove steering wheel (fig. 11).

Assembly

1. With horn contact in place, set wheel onto steering shaft. Secure with washer and nut. Refer to torque specifications at rear of manual for correct torque values.

CAUTION: Do not over-torque shaft nut or

steering wheel rub may result.

2. Insert horn wires into cancelling cam tower.
3. Position shroud on steering wheel.
4. Install four attaching screws on underside of steering wheel.
5. Connect battery ground cable.

Simulated Wood (Fig. 12)

Removal

1. Disconnect battery ground cable.
2. Remove horn cap assembly by pulling up.
3. Remove contact assembly attaching screws and remove contact assembly.

   NOTE: If the steering wheel is being removed to perform work on the internal parts of the column only, omit Step 4 and proceed with Steps 5 and 6.

4. Remove remaining screws from steering wheel and remove wheel from hub assembly.
5. Remove steering wheel nut and washer.
6. Using Tool J-2927, install centering adapter on steering shaft, thread puller anchor screws into threaded holes provided in hub assembly. Turn center bolt of tool clockwise to remove hub assembly.

Installation

1. With horn contact in place, install hub assembly on steering shaft. Secure with washer and nut. Refer to torque specifications at rear of manual for correct torque value.
2. Attach steering wheel to hub assembly using the six attaching screws and tighten securely.
3. Place horn contact on steering wheel and attach with three screws. Tighten securely.
4. Snap horn button in place.
5. Connect battery ground cable.

Corvette Tilt-Telescoping (Fig. 13)

Removal

1. Disconnect battery ground cable.
2. Pry off horn button cap.
3. Remove three screws securing upper horn contact to spacer and hub.

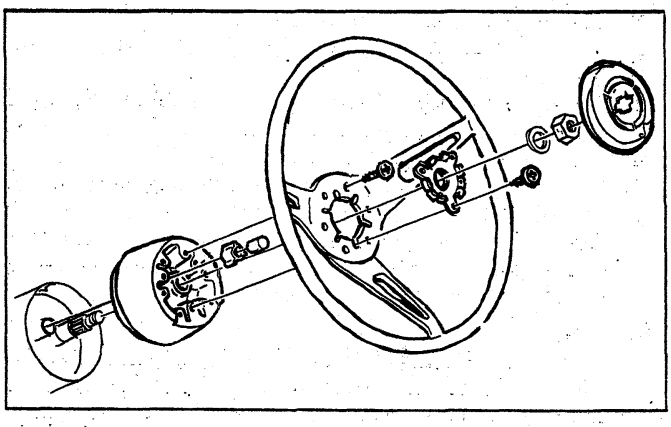


Fig. 12—Simulated Wood Steering Wheel and Attaching Parts

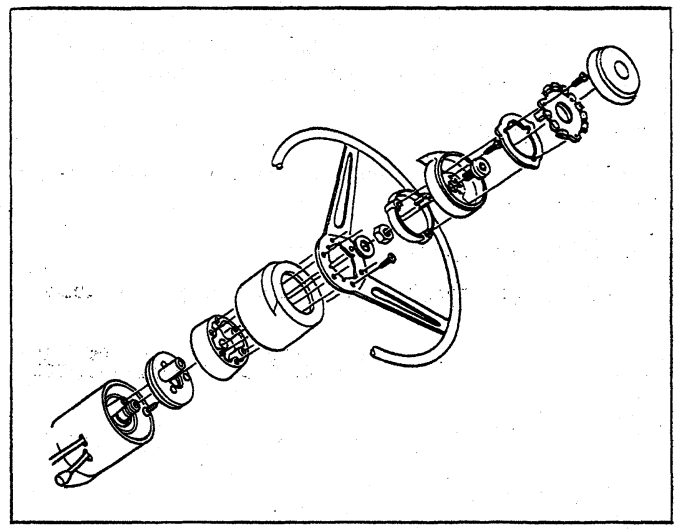


Fig. 13—Corvette Telescoping Wheel Option

4. Remove two screws securing lock screw to lock knob, and remove lock screw, lock knob, and spacer.

   NOTE: If the steering wheel is being removed to perform work on the internal parts of the column only, omit Step 5 and proceed with Steps 6 and 7.

5. Remove six screws securing steering wheel to hub and remove wheel.
6. Remove nut and washer from shaft and using steering wheel puller Tool J-2927, remove steering wheel, extension and hub from vehicle.
7. Remove lower horn contact.

Installation

NOTE: Refer to torque specifications at rear of manual for correct torque values.

1. Place lower horn contact on end of shaft.
2. If hub was removed from steering wheel, attach hub and extension to steering wheel with screws removed during disassembly.

   CAUTION: Position the horn contact tower so that it will engage the hole in the steering wheel before installing the wheel.

3. Place steering wheel and hub assembly in position and secure to column with washer and nut.
4. Position spacer on steering wheel.
5. Position lock knob on steering wheel.
6. Install lock screw through lock knob, turn into shaft, and adjust to lock position.
7. Attach spacer to wheel with three screws.
8. Place lock knob in lock position and attach to lock screw with two screws.
9. Remove three screws holding spacer. Attach upper horn contact to spacer and steering wheel with three screws.
10. Install horn button cap.
11. Connect battery ground cable.

STEERING COUPLING

Before removing the flexible or pot joint coupling, the mast jacket must be lowered and pulled rearward far enough to permit coupling removal; refer to "Steering Column - Removal" and "Steering Column Mandatory Installation Sequence".

CAUTION: Do not allow the steering column to hang down from the dash panel or distortion to the column will result. When the instrument panel mounting bracket is removed, be sure the column is supported.

Flexible Coupling (Fig. 14)

Removal

1. After marking the wormshaft to steering shaft relationship, remove the bolt from the coupling clamp.

   NOTE: This is a special bolt and will require a 12-point socket or box end wrench.

2. Tap the coupling with a soft hammer to remove it from the wormshaft. The coupling is splined to the wormshaft.

Installation

1. Install the coupling assembly onto the wormshaft, aligning the marks made at removal.
2. Install the coupling clamp bolt and torque to specifications.

   CAUTION: Be sure the coupling is installed far enough for the clamp bolt to pass through the undercut on the wormshaft.

Pot Joint Coupling (Chevelle Only)—Fig. 15

Removal

1. Remove the pot joint coupling clamp bolt and remove the lower steering shaft.

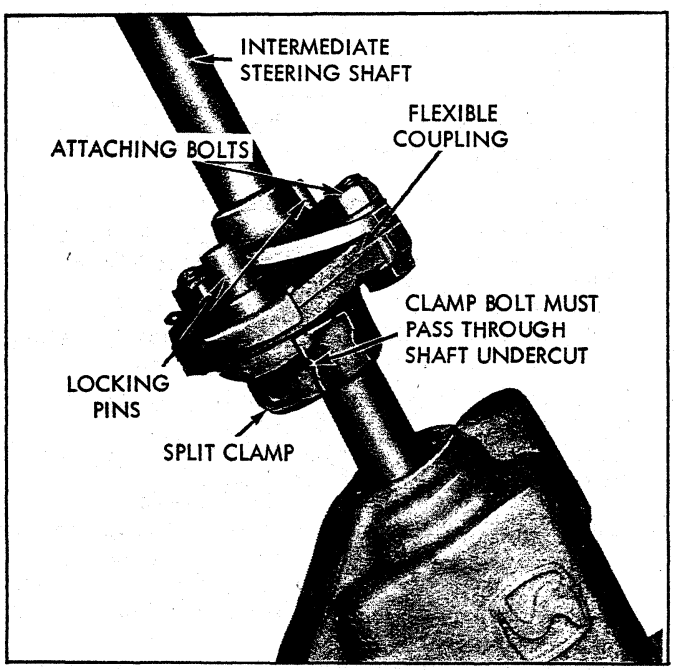
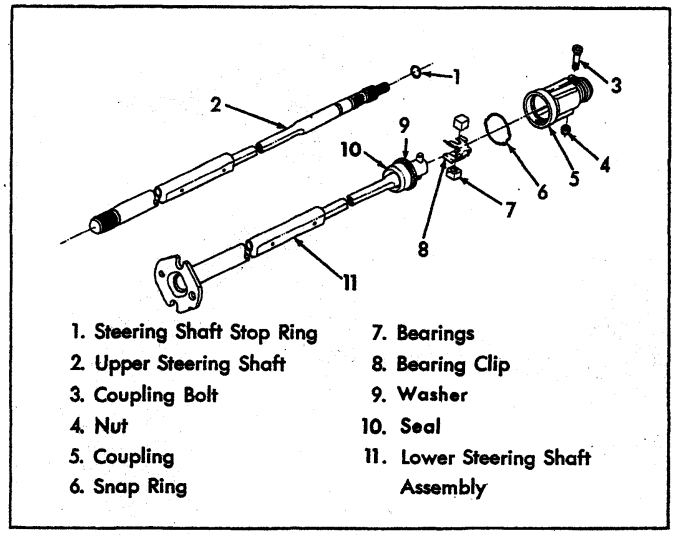


Fig. 14—Flexible Type Steering Coupling



1. Steering Shaft Stop Ring
2. Upper Steering Shaft
3. Coupling Bolt
4. Nut
5. Coupling
6. Snap Ring
7. Bearings
8. Bearing Clip
9. Washer
10. Seal
11. Lower Steering Shaft Assembly

Fig. 15—Pot Joint Steering Coupling

2. Pry off the snap ring and slide the coupling cover from the shaft.
3. Remove the bearings, spring and tension spring from the pivot pin.
4. Clean the grease off the pin and end of shaft. Scribe a location mark on the pin on the same side as the chamfer in the shaft.
5. Supporting the shaft assembly securely, with chamfer up, press the pin out of the shaft using an arbor press.

   NOTE: Do not drive the pin out with a hammer. This will cause sticky or binding bearings when reassembled.

6. Slide the washer, seal and seal garter spring off the end of the shaft.

Installation

1. Be sure all parts are free of dirt. Slide the seal, seal garter spring and washer onto the steering shaft with the lip of the washer towards the lower end of the shaft.
2. Press the pin into the shaft from the chamfered side. Locate the pin in the shaft using the scribe mark as a reference.

   NOTE: The pin must be centered within .012" or binding in the coupling will result.

3. Check centering of the pin (fig. 16).
   a. Place just enough 3/8" flat washers on the pin to prevent the bearings from bottoming when installed.
   b. Measure the distance from the end of the pin to the top of the bearing with a micrometer.
   c. Remove the bearing and washers and place the same bearing and washers on the other end of the pin. Measure the distance from the end of the pin to the top of the bearing. If the micrometer readings in Steps b and c differ more than .012", repeat the last part of Step 2 and recheck.
4. Apply a liberal amount of wheel bearing grease to the inside and outside of the bearings and the inside of the cover.
5. Position the tension spring and bearings on the pin.

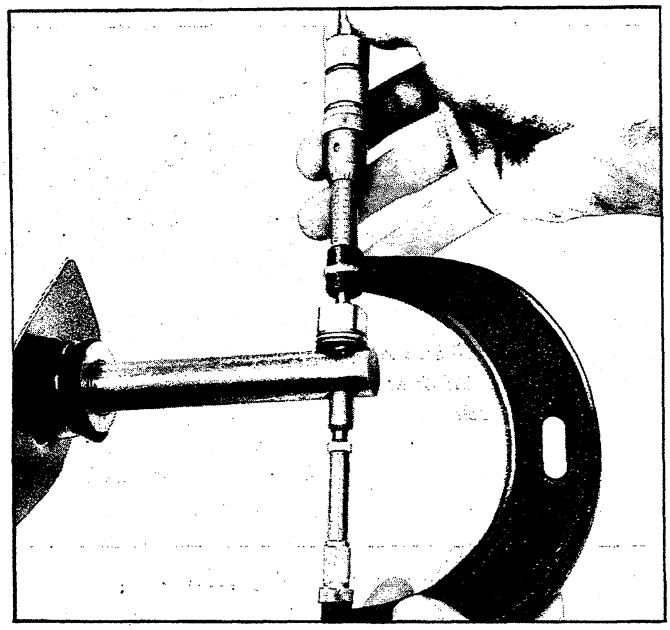


Fig. 16—Checking Coupling Pin Centering

6. Slide the cover over the bearings, aligning the reference mark on the cover with the mark on the shaft. Install the washer and seal into the end of the cover and secure with the snap ring retainer.
7. Install the lower shaft and coupling assembly onto the upper shaft and secure with the clamp and bolt assembly.

STEERING GEAR

Removal

1. Remove retaining nuts, lock washers, and bolts at steering coupling.
2. Remove pitman arm nut and washer from sector shaft and mark relation of arm position to shaft.
3. Remove pitman arm with Tool J-6632 as shown in Figure 4.

   NOTE: On Camaro models, use care not to bend or fracture brake pipe when removing steering gear.

4. Remove screws securing steering gear to frame and remove gear from vehicle.

Installation

1. Place gear into position so that steering coupling mounts properly to flanged end of steering shaft. Secure gear to frame with washers and bolts. On Corvette models, install gear with bolts, washers, and nuts.

   NOTE: Be sure the coupling is installed far enough onto the wormshaft for the coupling bolt to pass through the undercut on the wormshaft.

2. Secure steering coupling to flanged end of steering column with lock washers, and nuts. Maintain coupling adjustment shown in Figures 55, 56, 57 and 58.
3. Install pitman arm, aligning marks made during removal, and secure with washer and retaining nut.

Sector Shaft Seal Replacement

A faulty seal may be replaced without removal of steering gear from car by removing pitman arm as outlined under Maintenance and Adjustments—Steering Gear Adjustments and proceed as follows:

1. Loosen lash adjuster lock nut and turn lash adjuster screw several turns counter-clockwise.
2. Remove three cap screws holding side cover to gear housing.
3. Pull side cover and sector shaft from gear housing as a unit. Do not separate side cover from sector shaft.
4. Pry the sector shaft seal from gear housing using a screw driver being careful not to damage housing bore.
5. Coat new seal with chassis grease and position in sector shaft bore.
6. Place a socket or piece of pipe of suitable diameter on top of seal and drive seal into bore by tapping pipe or socket with soft hammer.
7. Install sector shaft side cover assembly, being careful not to damage new seal with splines on end of shaft; splines may be wrapped with a few turns of tape to prevent this.
8. Install new side cover gasket and align side cover on gear housing and install cap screw.
9. Perform steering gear adjustment and install pitman arm as outlined under Maintenance and Adjustments.

DIRECTIONAL SIGNAL SWITCH

The directional signal switch can be removed with the steering column in the vehicle and without disturbing any of the column mountings.

All Except Tilt-Telescoping Columns

Removal

1. Remove the steering wheel as outlined under "Steering Wheel—Removal".
2. Remove the three cover screws and lift the cover off the shaft.

   NOTE: The cover screws have plastic retainers on the back of the cover so it is not necessary to completely remove these screws.

3. Place Lock Plate Compressing Tool J-23131 on the end of the steering shaft and compress the lock plate as far as possible using the shaft nut as shown in Figure 17. Pry the round wire snap ring out of the shaft groove and discard the ring. Remove Tool J-23131 and lift the lock plate off the end of the shaft.

   CAUTION: If the column is being disassembled on the bench, with the snap ring removed the shaft could slide out of the lower end of the mast jacket, damaging the shaft assembly.

4. Slide the directional signal cancelling cam, upper bearing preload spring and thrust washer off the end of the shaft.
5. Remove the directional signal lever screw and remove the lever.
6. Push the hazard warning knob in and unscrew the knob.

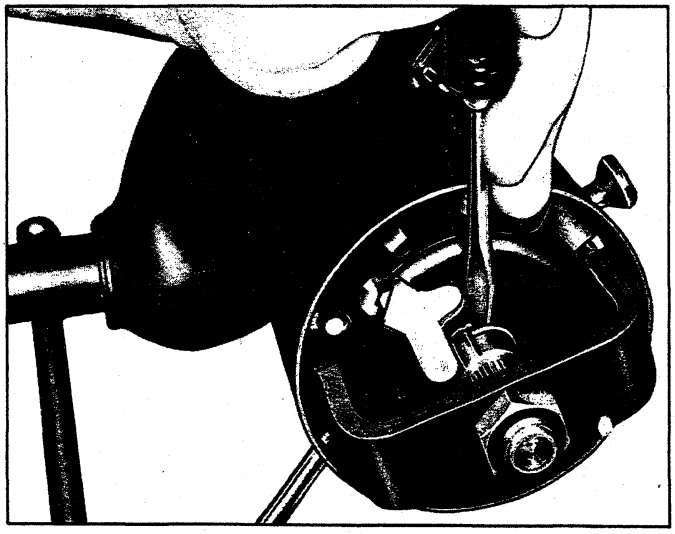


Fig. 17—Removing Lock Plate Retaining Ring Using Tool J-23131

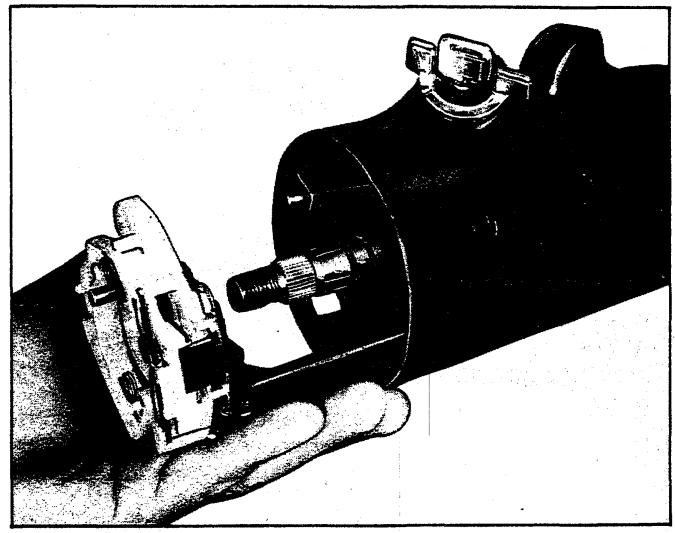


Fig. 19—Removing Directional Signal Switch Assembly

7. Pull the switch connector out of the bracket on the jacket and wrap the upper part of the connector with tape (fig. 18) to prevent snagging the wires during switch removal. On Tilt Models, position the directional signal and shifter housing in the "low" position. Remove the harness cover being careful not to damage the wires.
8. Remove the three switch mounting screws and pull the switch straight up, guiding the wiring harness and cover through the column housing (fig. 19).

Installation

CAUTION: It is extremely important that only the specified screws, bolts and nuts be used at assembly. Use of overlength screws could prevent a portion of the assembly from compressing under impact.

1. All except Tilt--Be sure that the wiring harness is in the protector. Feed the connector and cover down through the housing and under the mounting bracket (column in vehicle).
   Tilt--Feed the connector down through the housing and under the mounting bracket. Then install the cover on the harness.
2. Install the three mounting screws and clip the connector to the bracket on the jacket (fig. 20).
3. Install the hazard warning knob and directional signal lever.
4. Make certain that the switch is in "Neutral" and the hazard warning knob is out. Slide the thrust washer, upper bearing preload spring and cancelling cam onto the upper end of the shaft.
5. Place the lock plate and a NEW snap ring onto the end of the shaft. Using Tool J-23131, compress the lock plate as far as possible. Slide the new snap ring into the shaft groove and remove Tool J-23131.

CAUTION: Always use a new snap ring when re-assembling.

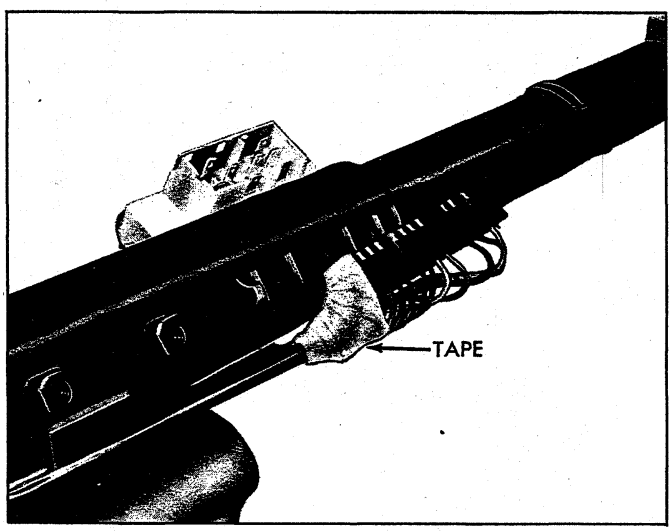


Fig. 18—Taping Directional Signal Connector and Wires

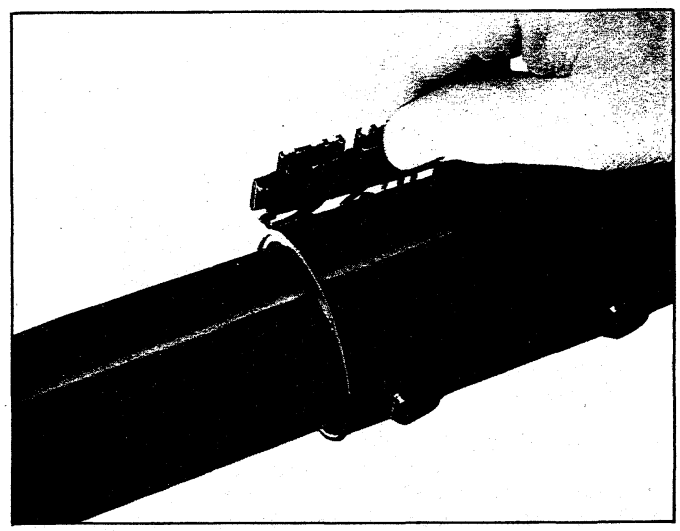


Fig. 20—Installing Switch Connector into Jacket Clips

6. Place the cover on the end of the shaft and reinstall the three screws.
7. Install the steering wheel as outlined under "Steering Wheel--Installation".

Tilt-Telescoping Columns

Removal

1. Remove the steering wheel as outlined under "Steering Wheel--Removal".
2. Using Horn Contact Carrier and Spring Removal Tool J-22191, compress the horn contact carrier assembly and pry out the shaft "C" ring (fig. 21).
3. Lift the lock plate, horn contact carrier and upper bearing preload spring off the end of the shaft.
4. Pull the switch connector out of the bracket on the jacket, remove the harness cover and wrap the upper part of the connector with tape to prevent snagging the wires during switch removal.
5. Push the hazard warning knob in and remove the knob.
6. Remove the directional signal lever.
7. Place the directional signal and shifter housing in "Low" position. Remove the three directional switch screws and pull the switch straight up, guiding the wiring harness out of the housing.

Installation

CAUTION: It is extremely important that only the specified screws, bolts and nuts be used at assembly. Use of over-length screws could prevent a portion of the column from compressing under impact.

1. Feed the harness connector down through the housing and under the mounting bracket, reinstall the cover on the harness and clip the connector to the jacket.
2. Install the three switch mounting screws, the switch lever and the hazard warning knob.
3. Make certain that the switch is in "Neutral" and that the hazard knob is out. Place the upper bearing preload spring, horn contact carrier and lock plate onto the upper end of the shaft.
4. Using Tool J-22191, compress the horn contact carrier and reinstall the shaft "C" ring.
5. Install the steering wheel as outlined under "Steering Wheel--Installation".

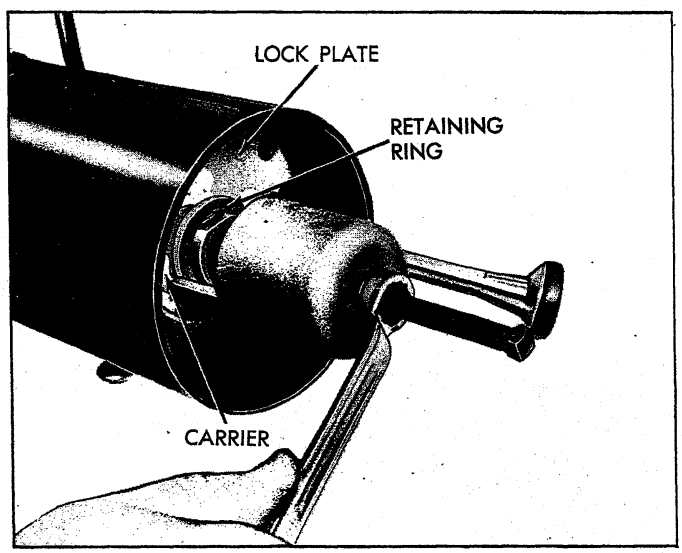


Fig. 21—Removing Carrier and Lock Plate Retaining Ring Using Tool J-22191

LOCK CYLINDER

The lock cylinder is located on the upper right hand side of the column. The lock cylinder may be removed in any position from "Accessory" to "On"; however, the "Lock" position is recommended because of its positive location.

Removal

1. Remove the steering wheel as outlined under "Steering Wheel--Removal".
2. Remove the directional signal switch as outlined under "Directional Signal Switch--Removal".
3. Insert a small screw driver or similar tool into the turn signal housing slot as shown in Figure 22. Keeping the tool to the right side of the slot, break the housing flash loose and at the same time depress the spring latch at the lower end of the lock cylinder. With the latch depressed, the lock cylinder can be removed from the housing.

Disassembly (Fig. 23)

1. Using a paper clip or similar quality wire, place a 90° bend about 1/8" from one end of the wire.
2. Place the cylinder in "lock" position. Using the wire hook fashioned in Step 1 above, depress the plunger pin (above the stake mark) approximately 1/8" vertically in the sleeve housing (fig. 24). While depressing the pin and maintaining light upward pressure on the lock assembly, rotate the cylinder counterclockwise until the cylinder pops up from the sleeve assembly.
3. Remove the ignition key.
4. Tap the lower end of the sleeve on the work bench several times (on side containing the wire spring and retainer). Remove the sleeve assembly, anti-theft ring and wave washer from the lock cylinder assembly.

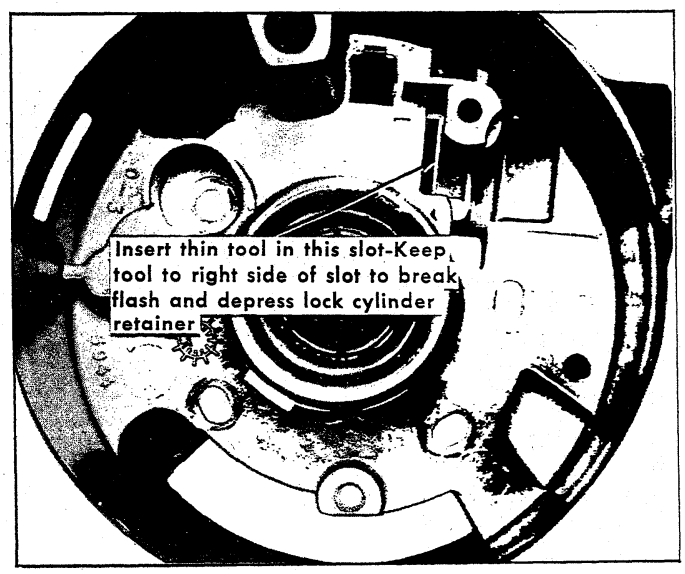


Fig. 22—Removing Flash and Depressing Lock Cylinder Retainer

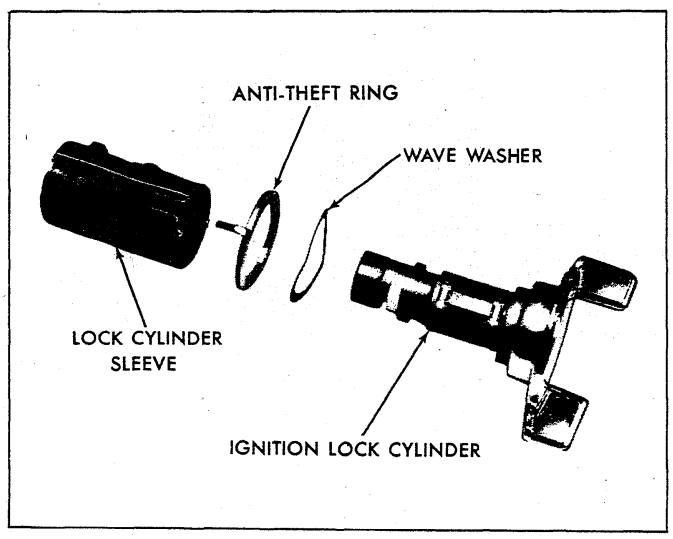


Fig. 23—Ignition Lock Assembly - Exploded View

Assembly

1. Place the key part way into the lock cylinder assembly. Place the wave washer and anti-theft ring onto the lower end of the lock cylinder.

   NOTE: If the key is installed all the way into the lock cylinder, the plastic keeper in the lock cylinder protrudes and prevents installation of the sleeve assembly.

2. Make sure that the plastic keeper in the sleeve assembly protrudes from the sleeve.
3. Align the lock bolt on the lock cylinder and the tab on the anti-theft washer with the slot in the sleeve assembly (fig. 25). Push the sleeve all the way onto the lock cylinder assembly, push the ignition key the rest of the way in and rotate the lock cylinder clockwise.

Installation

1. Hold the lock cylinder sleeve and rotate the knob clockwise against the stop. Insert the cylinder into the housing bore with the key on the cylinder sleeve aligned with the keyway in the housing. Push the cylinder into abutment of cylinder and sector. Rotate counter-clockwise, maintaining a light pressure on the cylinder, until the drive section of the cylinder mates with the sector. Push in until the snap ring pops into the grooves and the lock cylinder is secured in the housing. Check the lock cylinder for freedom of rotation.
2. Install the Direction Signal Switch and Steering Wheel as outlined previously in this section.

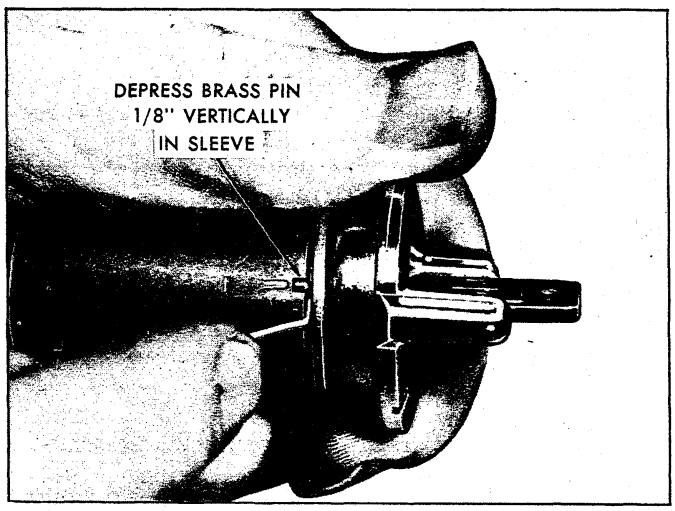


Fig. 24—Ignition Lock-Disassembly

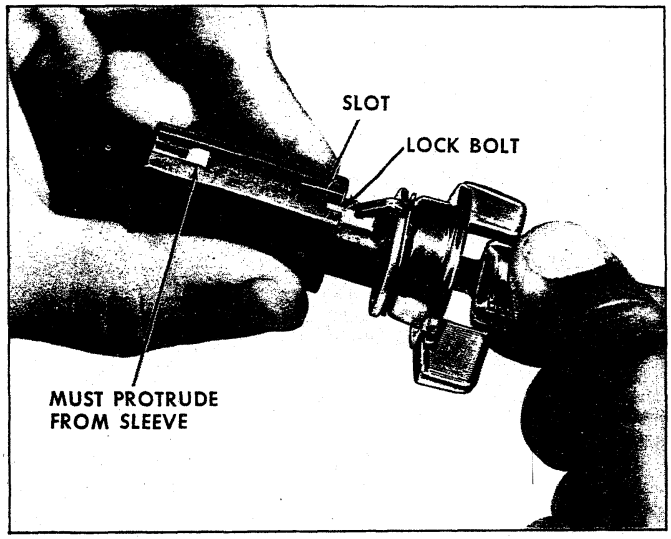


Fig. 25—Ignition Lock-Assembly

IGNITION KEY WARNING SWITCH

The ignition key warning switch (buzzer switch) is located within the column housing and cannot be removed until the steering wheel and directional signal switch are removed.

Removal

1. Remove the steering wheel and directional signal switch as outlined previously in this section.
2. With a pair of needle nose pliers, remove the buzzer

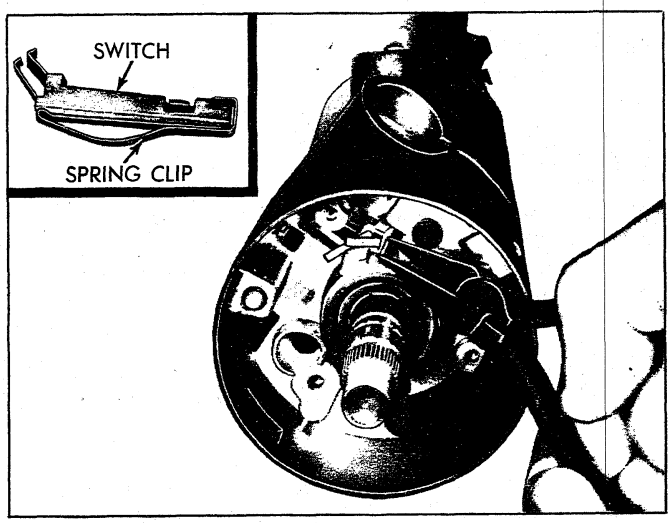


Fig. 26—Removing Ignition Key Warning Switch

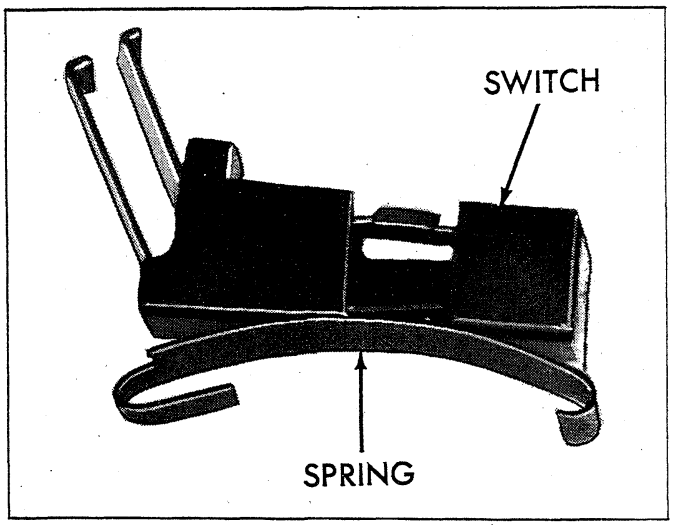


Fig. 27—Ignition Key Warning Switch - Tilt and Tilt-Telescoping Columns

switch assembly as shown in Figure 26.

NOTE: If the lock cylinder is in the housing, it must be in the "On" position.

CAUTION: Do not drop the spring clip into the housing.

Installation

CAUTION: If the lock cylinder is in the column, the buzzer switch actuating button on the lock cylinder must be depressed before the buzzer switch can be installed.

1. Install the buzzer switch with the contacts toward the upper end of the steering column and with the formed end of the spring clip around the lower end of the switch.

   NOTE: On Tilt and Tilt-Telescoping column switches, the spring clip must be reinstalled in the housing with the bowed side towards the switch (fig. 27).

2. Reinstall the directional signal switch and steering wheel as previously outlined in this section.

IGNITION SWITCH

The ignition switch is mounted on top of the mast jacket near the front of the dash. For anti-theft reasons, the switch is located inside the channel section of the brake pedal support and is completely inaccessible. The switch is actuated by a rod and rack assembly. A portion of the rack is toothed and engages a gear on the end of the lock cylinder, thus enabling the rod and rack to be moved axially (with respect to the column) to actuate the switch when the lock cylinder is rotated.

Removal

1. Remove or lower the steering column as outlined under "Steering Column--Removal" later in this section.

   CAUTION: If the steering column is not removed from the vehicle, be sure that it is properly supported, before proceeding.

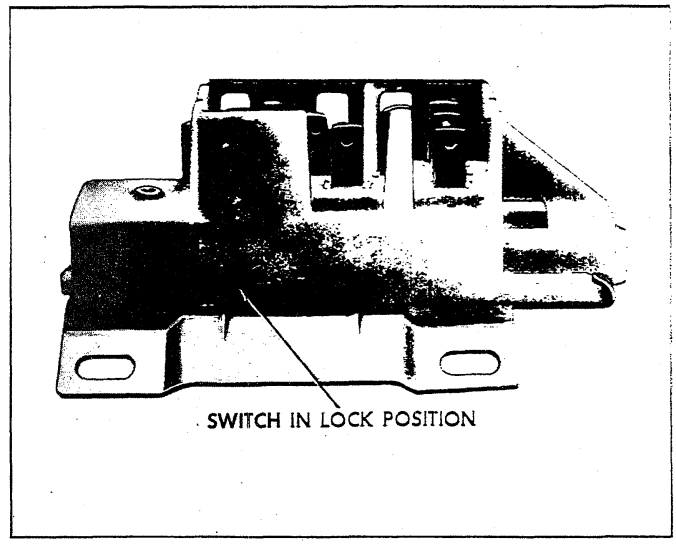


Fig. 28—Ignition Switch Assembly

2. The switch should be positioned in "Lock" position before removing. If the lock cylinder has already been removed, the actuating rod to the switch should be pulled up until there is a definite stop, then moved down one detent, which is the "Lock" position.
3. Remove the two switch screws and remove the switch assembly.

Installation

1. Before replacing the switch, be sure that the lock is in the "Lock" position. Make certain that the switch is in "Lock" position (fig. 28); if it is not, a screw driver (placed in the locking rod slot) can be used to move the switch to "Lock".
2. Install the activating rod into the switch and assemble the switch on the column; tighten the mounting screws.

   CAUTION: Use only the specified screws since over-length screws could prevent a portion of the assembly from compressing under impact.

3. Reinstall the steering column assembly following the mandatory installation sequence outlined later in this section.

STEERING COLUMN

All models are equipped with the new Function Locking Energy Absorbing Steering Columns. The columns are of four basic designs as follows:

1. Synchromesh -- The synchromesh column is used on models with the standard transmission and column mounted shift levers. The shift tube, within the outer mast jacket, includes two lower shift levers for connection to the transmission control linkage.
2. Automatic and Floor Shift -- This column is used on models equipped with the column mounted automatic transmission shift lever and models with floor shift. This column has a single lower shift lever for shifting the automatic transmission or for attachment of the back-drive linkage (for locking the transmission) on floor shift models.
3. Tilt Wheel Option -- The upper end and steering shaft of this column is specifically designed to accommodate the optional tilt steering wheel.

4. Tilt-Telescoping Column (Corvette Only) -- This column is similar in design to the tilt column with the added feature of telescoping up to a maximum of 3".

To perform service procedures on the steering column upper end components, it is not necessary to remove the column from the vehicle.

The steering wheel, horn components, directional signal switch, ignition lock cylinder and ignition key warning switch may be removed with the column remaining in the vehicle as described earlier in this section.

CAUTION: The outer mast jacket shift tube, steering shaft and instrument panel mounting bracket are designed as energy absorbing units. Because of the design of these components, it is absolutely necessary to handle the column with care when performing any service operation. Avoid hammering, jarring, dropping or leaning on any portion of the column.

When reassembling the column components, use only the specified screws, nuts and bolts and tighten to specified torque. Care should be exercised in using over-length screws or bolts as they may prevent a portion of the column from compressing under impact.

Inspection

To determine if the energy absorbing steering column components are functioning as designed, or if repairs are required, a close inspection should be made. An inspection is called for in all cases where damage is evident or whenever the vehicle is being repaired due to a front end collision. Whenever a force has been exerted on the steering wheel or steering column, or its components, inspection should also be made. If damage is evident, the affected parts must be replaced.

The inspection procedure for the various steering column components on all 1969 Passenger Cars is as follows:

Column Support Bracket

Damage in this area will be indicated by separation of the mounting capsules from the bracket. The bracket will have moved forward toward engine compartment and will usually result in collapsing of the jacket section of the steering column.

Column Jacket

Inspect jacket section of column for looseness, and/or bends.

Shifter Shaft

Separation of the shifter shaft sections will be internal and cannot be visually identified. Hold lower end of the "shifter shaft" and move "shift lever" on column through its ranges and up and down. If there is little or no movement of the "shifter shaft", the plastic joints are sheared.

Steering Shaft

Hold steering shaft at coupling and rotate steering wheel back and forth, no lash should be evident. Lash will indicate that the plastic pins have sheared. It should be noted that if the steering shaft pins are sheared due to minor collision with no appreciable damage to other components, that the vehicle can be safely steered, however, steering shaft replacement is recommended.

Because of the differences in the steering column types, be sure to refer to the set of instructions below which apply to the column being serviced.

Column Removal—All Columns

1. Disconnect the battery ground cable.
2. Remove the steering wheel as outlined under "Steering Wheel-Removal".
3. Remove the nuts and washers securing the flanged end of the steering shaft to the flexible coupling.
4. Disconnect the transmission control linkage (back-drive linkage on floor shift models) from the column shift tube levers.
5. Disconnect the steering column harness at the connector. Disconnect the neutral-safety switch and back-up lamp switch connectors if so equipped.
6. Remove the floor pan trim cover screws and remove the cover.
7. All except Corvette--Remove the screws securing the two halves of the floor pan cover; then remove the screws securing the halves and seal to the floor pan and remove the covers (figs. 30, 31 and 32). Corvette--Remove the two nuts securing the floor pan bracket to the mounting studs (fig. 33).
8. Remove the instrument panel trim cover screws and remove the trim cover.
9. Remove the transmission indicator cable, if so equipped (Fig. 29).
10. Move the front seat as far back as possible to provide maximum clearance.
11. Remove the two column bracket-to-instrument panel nuts and carefully remove from vehicle. Additional help should be obtained to guide the lower shift levers through the firewall opening.

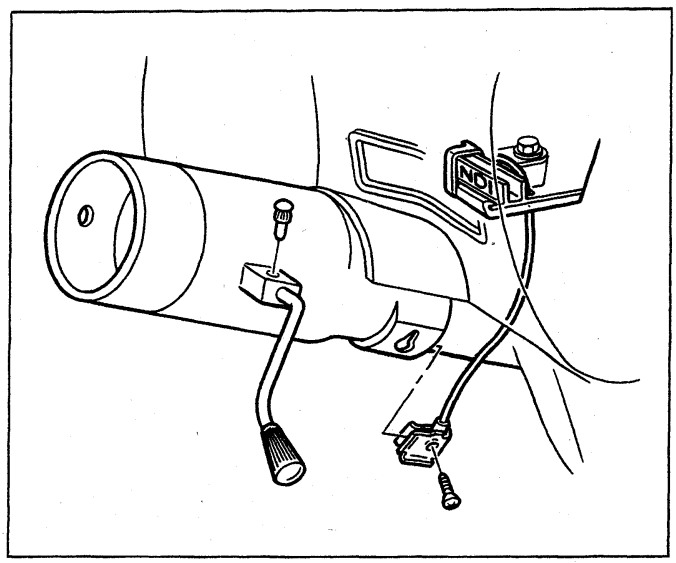


Fig. 29—Automatic Transmission Indicator Connection (Typical)

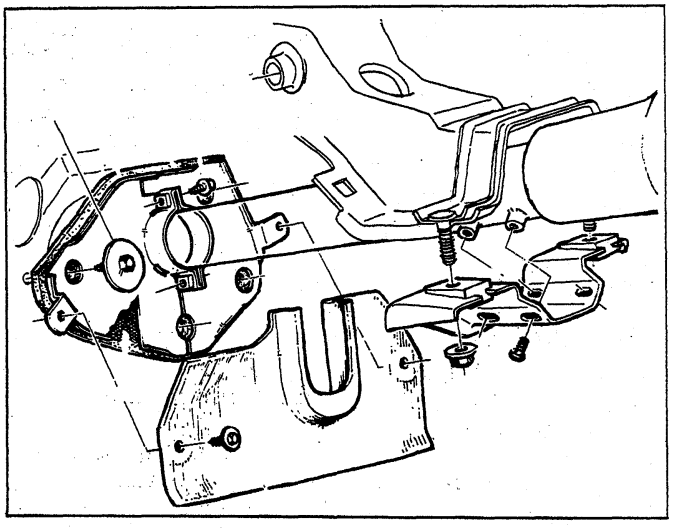


Fig. 30—Steering Column to Dash Panel-Chevrolet

Disassembly—All Except Tilt and Tilt-Telescoping Columns (Fig. 34)

NOTE: The Chevelle steering columns differ from those in Figures 34 and 44 in that the steering shaft incorporates a pot joint coupling as shown in Figure 35.

1. Remove the four dash panel bracket-to-column screws and lay the bracket in a safe place to prevent damage to the mounting capsules.
2. Place the column in a vise using both weld nuts of either Set A or B as shown in Figure 36. The vise jaws must clamp onto the sides of the weld nuts indicated by arrows shown on Set B.

CAUTION: Do not place the column in a vise by clamping onto only one weld nut, by clamping onto one weld nut of both sets A and B or by clamping onto the sides not indicated by arrows, since damage to the column could result.

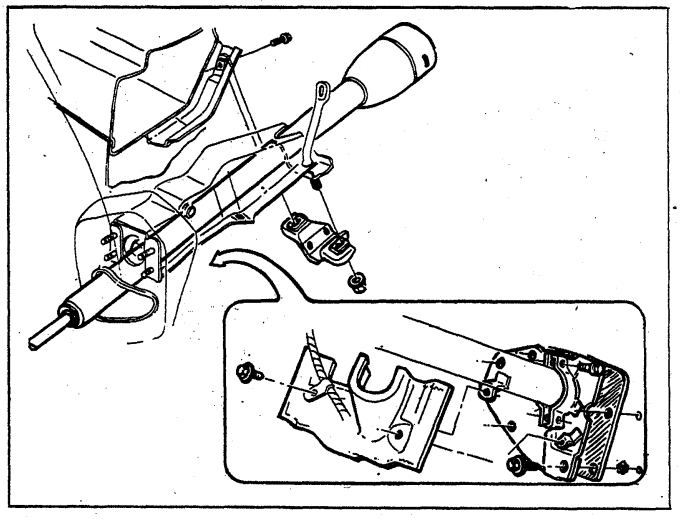


Fig. 31—Steering Column to Dash Panel-Chevelle

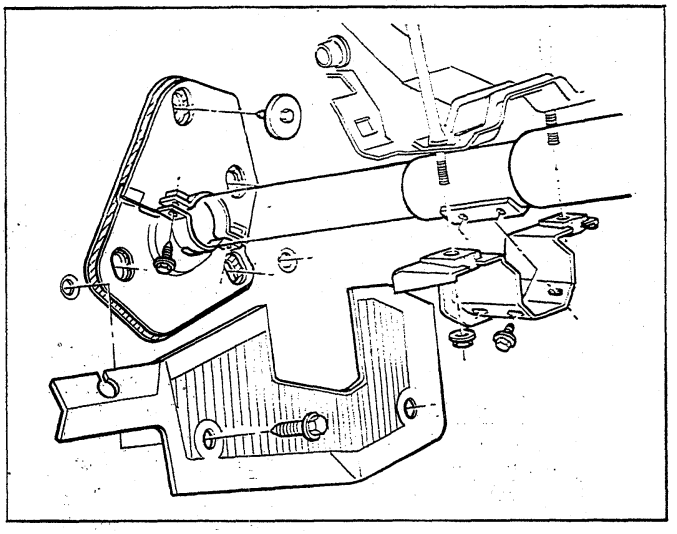


Fig. 32—Steering Column to Dash Panel-Nova and Camaro

3. Remove the Directional Signal Switch, Lock Cylinder, Ignition Key Warning Switch and Ignition Switch as outlined previously in this section.
4. Column Shift Models--Drive out the upper shift lever pivot pin and remove the shift lever.
5. Remove the upper bearing thrust washer. Remove the four screws attaching the turn signal and ignition lock housing to the jacket and remove the housing assembly (fig. 37).
6. Remove the thrust cup from the lower side of the housing.
7. Lift the ignition switch actuating rod and rack assembly, the rack preload spring and the shaft lock bolt and spring assembly out of the housing (fig. 38).
8. Remove the shift lever detent plate (shift gate).
9. Remove the ignition switch actuator sector through the lock cylinder hole by pushing firmly on the block tooth of the sector with a blunt punch or screw driver (fig. 39). Remove the sector shaft.
10. Remove the gearshift lever housing and shroud from the jacket assembly (transmission control lock tube housing and shroud on floor shift models).

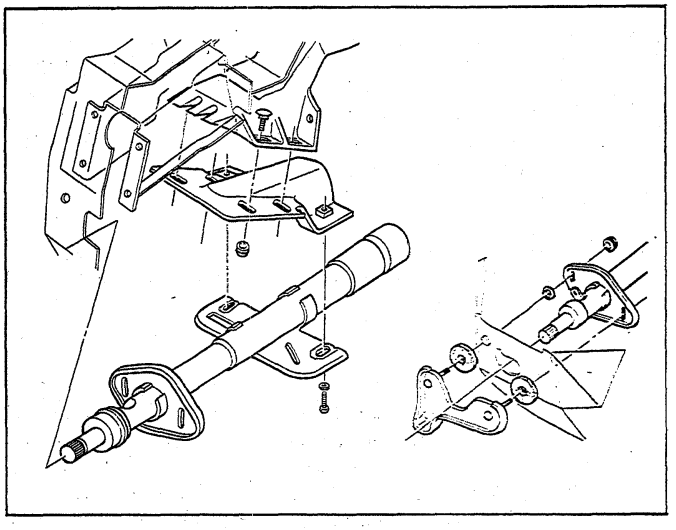


Fig. 33—Steering Column to Dash Panel-Corvette

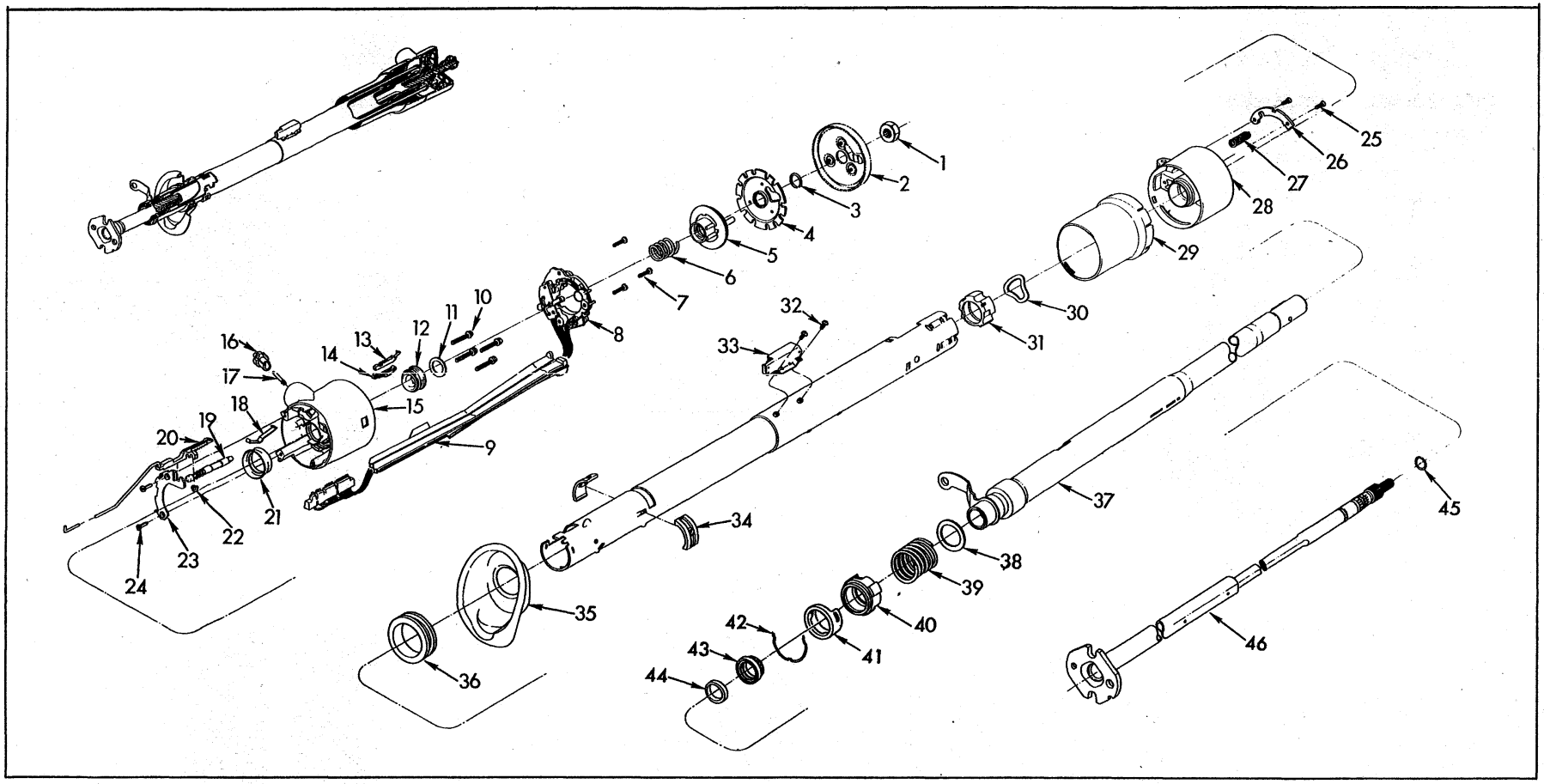
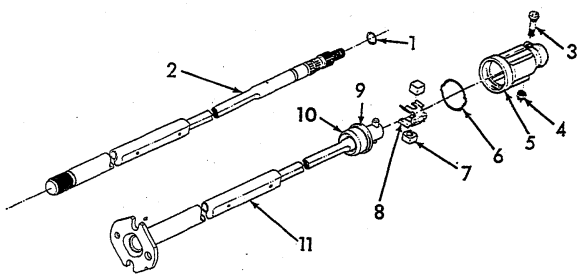


Fig. 34—Steering Column (Except Tilt and Tilt-Telescope)

1. Shaft Nut
2. Cover
3. Lock Plate Retaining Ring
4. Lock Plate
5. Cancelling Cam
6. Bearing Preload Spring
7. Turn Signal Screws
8. Turn Signal Switch
9. Protector Cover
10. Turn Signal Housing Screws
11. Bearing Thrust Washer
12. Upper Bearing
13. Key Warning Switch
14. Switch Clip
15. Turn Signal Housing
16. Ignition Switch Sector
17. Sector Shaft
18. Switch Rack Preload Spring
19. Shaft Lock Bolt
20. Switch Rod and Rack Assembly
21. Thrust Cup
22. Shaft Lock Bolt Washer
23. Shift Lever Detent Plate
24. Detent Plate Screws
25. Shift Tube Lock Plate Screws
26. Shift Tube Lock Plate
27. Shift Tube Spring
28. Gearshift Lever Housing
29. Shift Shroud
30. Wave Washer
31. Gearshift Housing Bearing
32. Ignition Switch Screws
33. Ignition Switch
34. Neutral Safety or Back-Up Switch Retainers
35. Dash Seal
36. Jacket Collar
37. Shift Tube
38. Thrust Spring Washer
39. Shift Tube Thrust Spring
40. Lower Bearing Adapter
41. Lower Bearing Reinforcement
42. Retainer
43. Lower Bearing
44. Spacer
45. Shaft Stop Ring
46. Steering Shaft



1. Steering Shaft Stop Ring
2. Upper Steering Shaft
3. Coupling Bolt
4. Nut
5. Coupling
6. Snap Ring
7. Bearings
8. Bearing Clip
9. Washer
10. Seal
11. Lower Steering Shaft Assembly

Fig. 35—Chevelle Steering Shaft Assembly

11. Remove the shift tube lock plate and spring from the gearshift lever housing (lock tube lock plate and spring on floor shift models).
12. Pull the steering shaft from lower end of the jacket assembly.
13. Remove the two screws holding the back-up switch or neutral-safety switch to the column and remove the switch.
14. Remove the lower bearing retainer clip (fig. 40).
15. Automatic and Floorshift Columns--Remove the lower bearing retainer, bearing adapter assembly, shift tube thrust spring and washer. The lower bearing may be removed from the adapter by light pressure on the bearing outer race. Slide out the shift tube assembly.

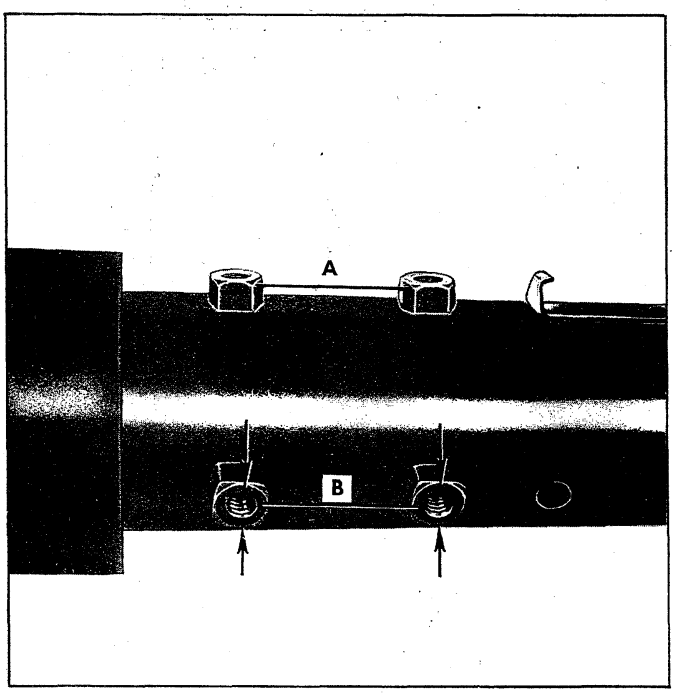


Fig. 36—Installing Steering Column in Vise

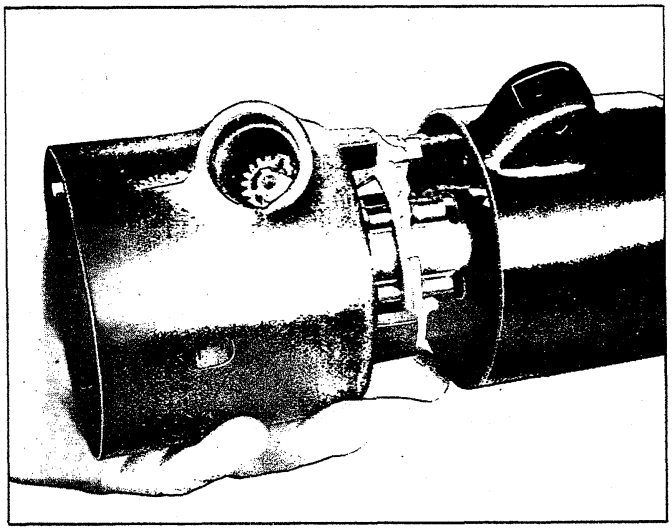


Fig. 37—Removing Turn Signal Housing

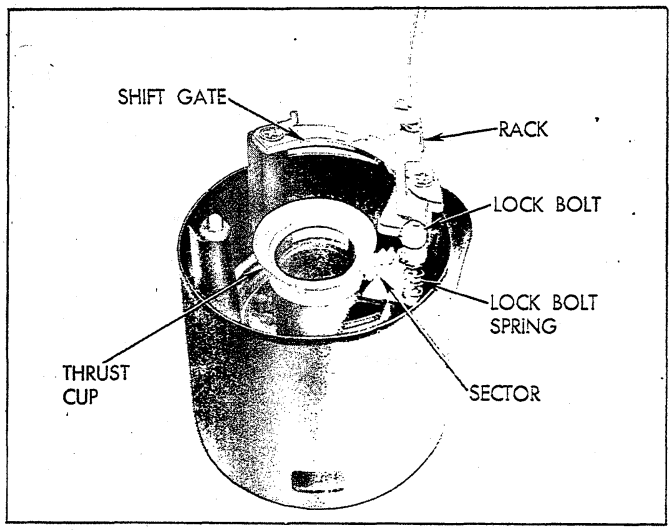


Fig. 38—Turn Signal Housing Assembly

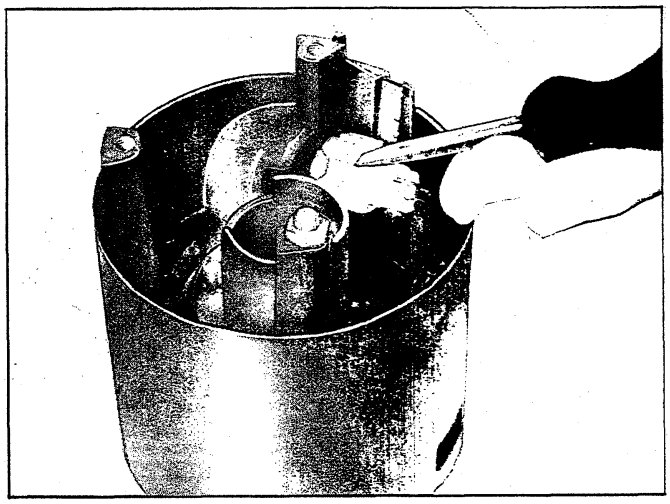


Fig. 39—Removing Ignition Switch Actuator Sector

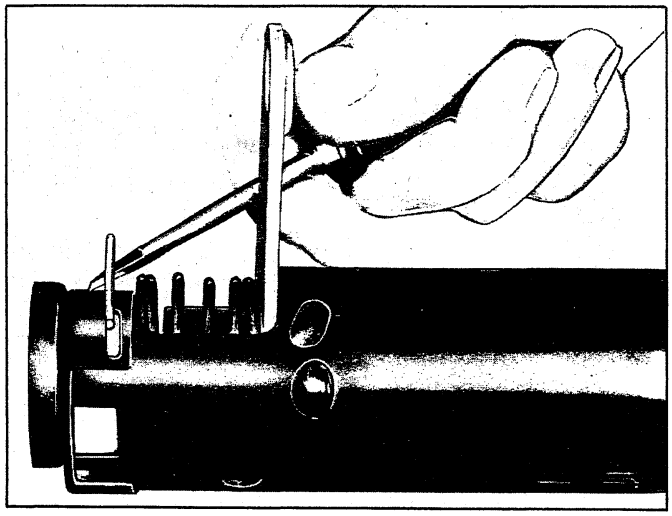


Fig. 40—Removing Lower Bearing Retainer

Manual Transmission-Column Shift--Remove the lower bearing adapter, bearing and the first-reverse shift lever. The lower bearing may be removed from the adapter by light pressure on the bearing outer race. Remove the three screws from bearing at the lower end and slide out the shift tube assembly.

16. Remove the wave washer and the gearshift housing lower bearing from the upper end of the mast jacket.

Assembly—All Except Tilt and Tilt-Telescoping

NOTE: Apply a thin coat of lithuim soap grease to all friction surfaces.

1. Install the sector shaft and sector into the turn signal and lock cylinder housing. Install the sector in the lock cylinder hole over the sector shaft with the tang end to the outside of the hole. Press the sector over the shaft with a blunt tool.
2. Install the shift lever detent plate onto the housing.
3. Insert the rack preload spring into the housing from the bottom side. The long section should be toward the handwheel and hook onto the edge of the housing (fig. 41).

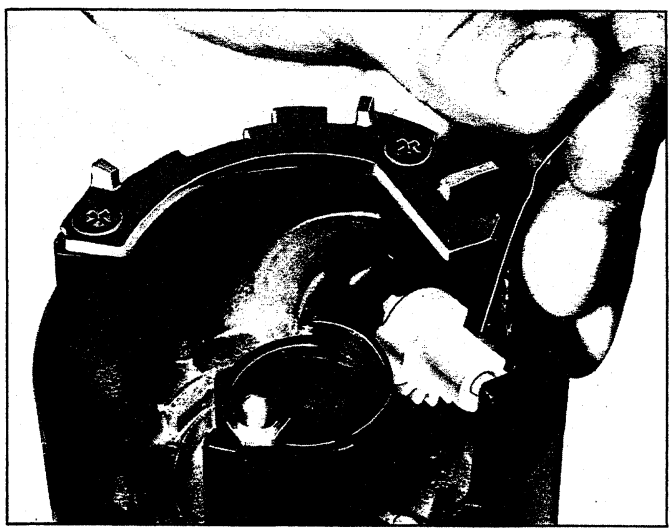


Fig. 41—Installing Rack Preload Spring

4. Assemble the locking bolt onto the crossover arm on the rack and insert the rack and lock bolt assembly into the housing from the bottom with the teeth up (toward handwheel) and toward the centerline of the column (fig. 38). Align the 1st tooth on the sector with the 1st tooth on the rack; if aligned properly, the block teeth will line up when the rack assembly is pushed all the way in.
5. Install the thrust cup on the bottom hub of the housing.
6. Install the gearshift housing lower bearing and wave washer. Insert the bearing from the very end of the jacket, aligning the indentations in the bearing with the projections on the jacket (fig. 42).

CAUTION: If the bearing is not installed correctly, it will not rest on all of the stops provided.

7. Install the shift tube lock plate and spring into the gearshift lever housing, then install the gearshift lever housing and shroud onto the upper end of the mast jacket. Rotate the housing to be sure it is seated in the bearing.
8. With the shift lever housing in place, install the turn signal and lock cylinder housing onto the jacket. The gearshift housing should be in "Park" position and the rack pulled downward. Be sure the turn signal housing is seated on the jacket and drive the four screws.
9. Press the lower bearing into the adapter assembly.
10. Insert the shift tube assembly into the lower end of the jacket and rotate until the upper shift tube key slides into the housing keyway.
11. Automatic and Floorshift Columns--Assemble the spring and lower bearing and adapter assembly into the bottom of the jacket. Holding the adapter in place, install the lower bearing reinforcement and retainer clip. Be sure the clip snaps into the jacket and reinforcement slots.
12. Manual Transmission-Column Shift--Loosely attach the three screws in the jacket and shift tube bearing. Assemble the 1st-Reverse lever and lower bearing and adapter assembly into the bottom of the jacket.

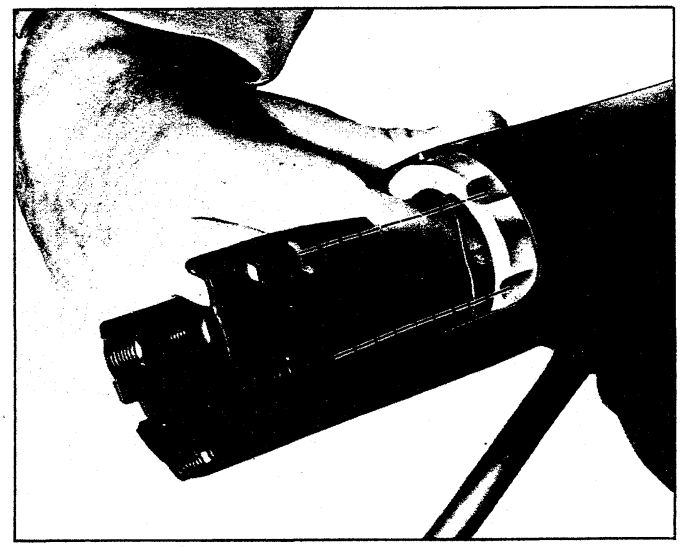


Fig. 42—Installing Gearshift Housing Lower Bearing and Wave Washer

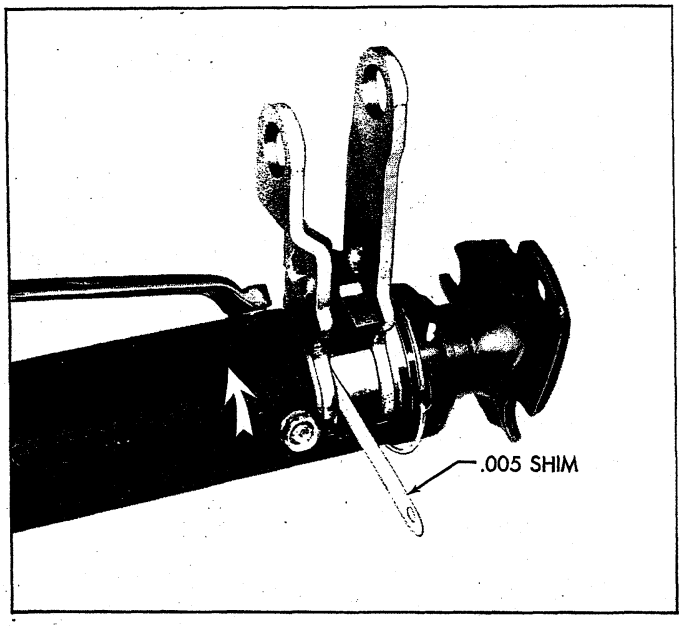


Fig. 43—Adjusting Lower Bearing (Manual Transmission - Column Shift)

Holding the adapter in place, install the bearing reinforcement and retaining clip. Be sure the retaining clip snaps into the jacket and reinforcement slots.

Place a .005" shim between the 1st-Reverse lever and lever spacer and turn the upper shift tube bearing down and tighten the three screws. Remove the shim (fig. 43).

13. Install the neutral-safety or back-up switch as outlined in Section 12 of this manual.
14. Slide the steering shaft into the column and install the upper bearing thrust washer.
15. Install the ignition key warning switch, turn signal switch, lock cylinder assembly and ignition switch as previously outlined in this section.
16. Install the shift lever and shift lever pivot pin.
17. Remove the column from the vise and install the dash bracket to the column; torque the four screws to specifications.

Disassembly—Tilt and Tilt-Telescoping Columns (Fig. 44 and 45)

NOTE: Steps 3-14 may be performed with the steering column in the vehicle.

1. Remove the four screws retaining the dash mounting bracket to the column and set the bracket aside to protect the breakaway capsules.
2. Mount the column in a vise using both weld nuts of either Set A or B as shown in Figure 36. The vise jaws must clamp onto the sides of the weld nuts indicated by arrows shown on Set B.

CAUTION: Do not place the column in a vise by clamping onto only one weld nut, by clamping onto one weld nut of both Sets A and B or by clamping onto the sides not indicated by arrows, since damage to the column could result.

3. Remove the directional signal switch, ignition key warning switch, lock cylinder and ignition switch as outlined previously in this section.
4. Remove the tilt release lever. Drive out the shift lever pivot pin and remove the shift lever from the housing (Tilt columns only).
5. Remove the three turn signal housing screws and remove the housing.
6. Install the tilt release lever and place the column in the full "up" position. Remove the tilt lever spring retainer using a screw driver blade that just fits into the slot opening. Insert the screw driver in the slot, press in approximately 3/16", turn approximately 1/8 turn counter-clockwise until the ears align with the grooves in the housing and remove the retainer, spring and guide (fig. 46).
7. Tilt Columns Only - Remove the upper steering shaft locknut using Thin Wall Socket J-23193 (fig. 47). Push the steering shaft in sufficiently to remove the steering shaft upper bearing inner race and seat. Remove the lower steering shaft flange and spacer. Pry off the lower bearing retainer clip and remove the bearing reinforcement, bearing and bearing adapter assembly from the lower end of the mast jacket.

   Tilt-Telescoping Columns - Push the upper steering shaft in sufficiently and remove the lower steering shaft flange. Pry off the lower bearing retainer clip and remove the lower bearing preload spring clamp, preload spring, bearing and adapter from the lower end of the mast jacket. Remove the upper steering shaft wedge and upper bearing race and seat.
8. Remove the upper bearing housing pivot pins using Tool J-21854-1 (fig. 48).
9. Install the tilt release lever and disengage the lock shoes. Remove the bearing housing by pulling upward to extend the rack full down, and then moving the housing to the left to disengage the ignition switch rack from the actuator rod. Remove the actuator rod assembly.
10. Remove the steering shaft assembly from the upper end of the column.
11. Disassemble the steering shaft by removing the centering spheres and the anti-lash spring.

    Tilt-Telescoping Columns - Disassemble the upper steering shaft, locking wedge, locking rod and bumper stop from the upper yoke.
12. Remove the transmission indicator wire, if equipped.
13. Remove the four steering shaft bearing housing support to gearshift housing screws and remove the bearing housing support.
14. Remove the shift tube retaining ring with a screw driver and then remove the thrust washer.
15. Install Tool J-23072 into the lock plate, making sure that the tool screws have good thread engagement in the lock plate. Then, turning the center screw clockwise, force the shift tube from the housing (fig. 49). Remove the shift tube (transmission control lock tube on floor shift models) from the lower end of the mast jacket. Remove Tool J-23072.

CAUTION: When removing the shift tube, be sure to guide the lower end through the slotted opening in the mast jacket. If the tube is allowed to interfere with the jacket in any way, damage to the tube and jacket could result.

16. Remove the bearing housing support lock plate by sliding it out of the jacket notches, tipping it down

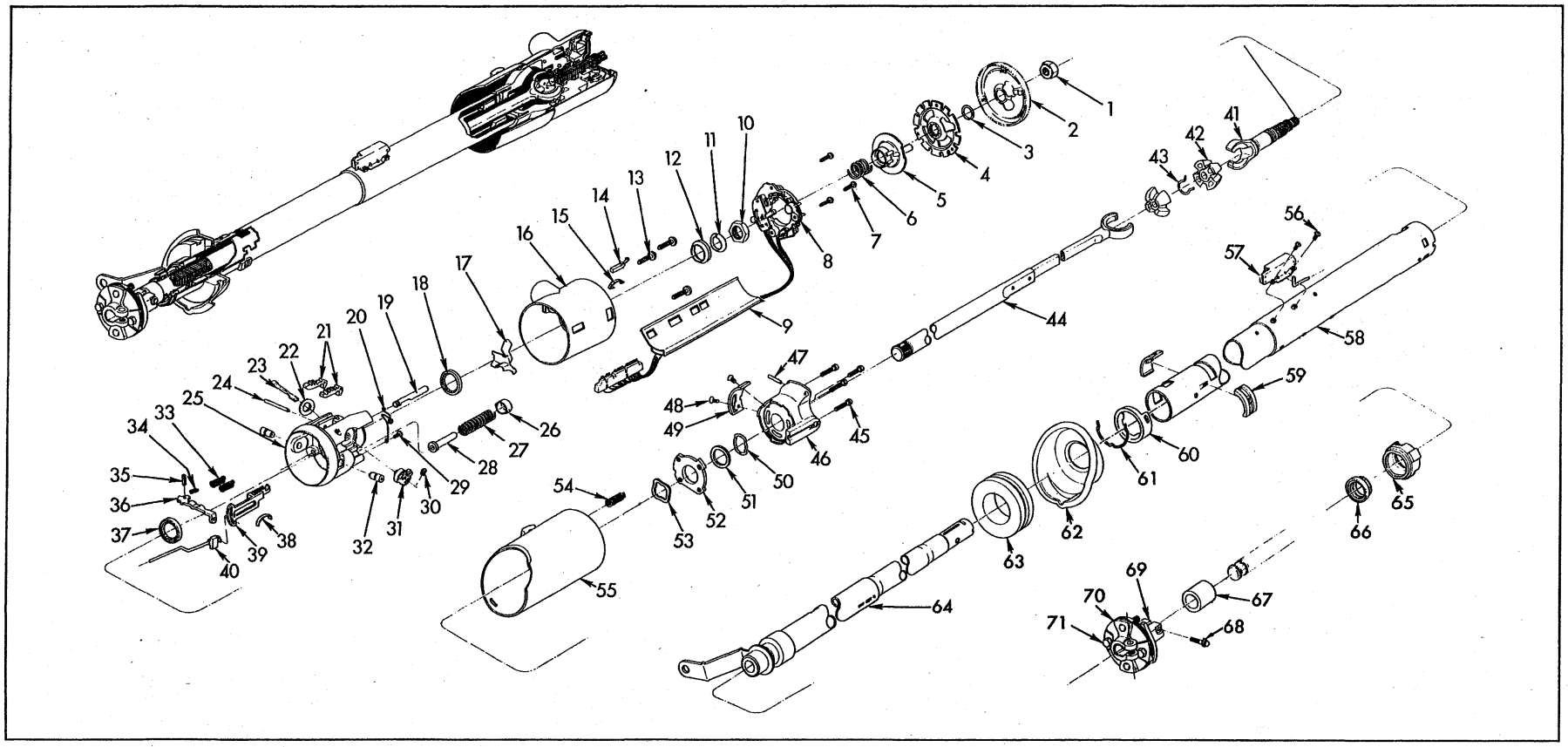


Fig. 44—Tilt Steering Column Assembly (Typical)

1. Shaft Nut
2. Cover
3. Lock Plate Retaining Ring
4. Lock Plate
5. Cancelling Cam
6. Bearing Preload Spring
7. Turn Signal Screws
8. Turn Signal Switch
9. Protector Cover
10. Upper Bearing Nut
11. Upper Bearing Seat
12. Upper Bearing Race
13. Turn Signal Housing Screws
14. Key Warning Switch
15. Switch Clip
16. Turn Signal Housing
17. Tilt Lever Opening Shield
18. Upper Bearing
19. Shaft Lock Bolt
20. Lock Bolt Spring
21. Lock Shoes
22. Sector Shaft Washer
23. Sector Shaft
24. Lock Shoe Pin
25. Bearing Housing
26. Tilt Lever Spring Retainer
27. Tilt Lever Spring
28. Tilt Lever Spring Guide
29. Lock Bolt Spring Screw
30. Sector Snap Ring
31. Sector
32. Bearing Housing Pivot Pins
33. Shoe Release Springs
34. Spring
35. Shoe Release Lever Pin
36. Shoe Release Lever
37. Lower Bearing
38. Ignition Switch Rack Spring
39. Ignition Switch Rack
40. Ignition Switch Rod
41. Upper Steering Shaft
42. Centering Spheres
43. Centering Sphere Spring
44. Lower Steering Shaft
45. Bearing Housing Support Screws
46. Bearing Housing Support
47. Pin
48. Shift Tube Index Plate Screws
49. Shift Tube Index Plate
50. Support Retaining Ring
51. Support Thrust Washer
52. Support Plate Lock
53. Support Wave Washer
54. Gearshift Lever Spring
55. Gearshift Lever Housing
56. Ignition Switch Screws
57. Ignition Switch
58. Mast Jacket
59. Neutral-Safety or Back-Up Switch Retainers
60. Lower Bearing Reinforcement
61. Retainer
62. Dash Seal
63. Jacket Collar
64. Shift Tube
65. Lower Bearing Adapter
66. Lower Bearing
67. Spacer
68. Shaft Flange Bolt
69. Shaft Flange
70. Flexible Coupling
71. Flexible Coupling Bolts

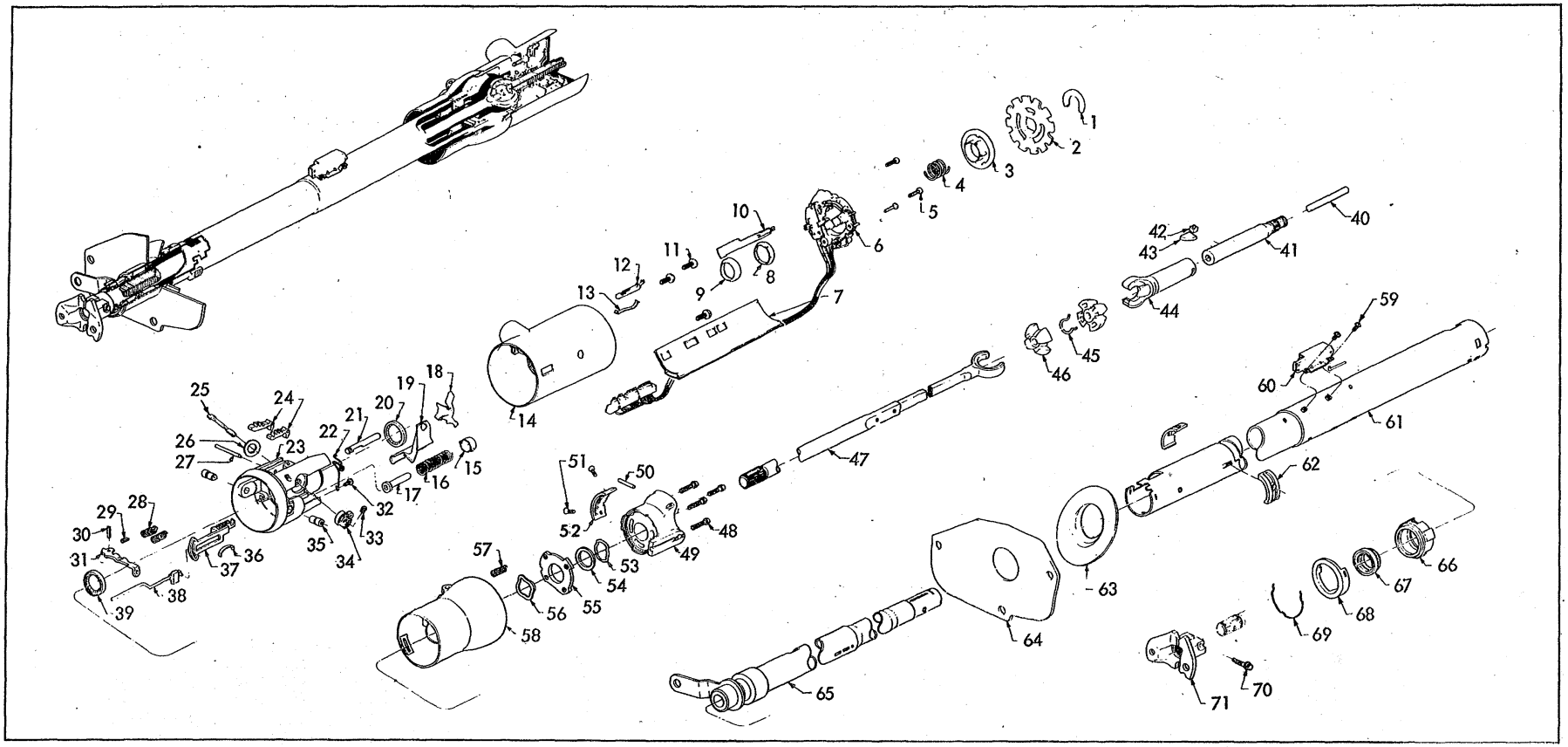


Fig. 45–Tilt-Telescoping Steering Column Assembly - Corvette

1. Lock Plate Retaining Ring
2. Lock Plate
3. Horn Contact Carrier
4. Preload Spring
5. Turn Signal Screws
6. Turn Signal Switch
7. Protector Cover
8. Upper Bearing Seat
9. Upper Bearing Race
10. Hazard Switch Lever
11. Turn Signal Housing Screws
12. Key Warning Switch
13. Switch Clip
14. Turn Signal Housing
15. Tilt Lever Spring Retainer
16. Tilt Lever Spring
17. Tilt Lever Spring Guide
18. Turn Signal Lever Shield
19. Tilt Lever Shield
20. Upper Bearing
21. Shaft Lock Bolt
22. Lock Bolt Spring
23. Bearing Housing
24. Lock Shoes
25. Sector Shaft
26. Sector Shaft Washer
27. Lock Shoe Pin
28. Shoe Release Springs
29. Spring
30. Shoe Release Lever Pin
31. Shoe Release Lever
32. Lock Bolt Spring Screw
33. Sector Snap Ring
34. Sector
35. Bearing Housing Pivot Pins
36. Ignition Switch Rack Spring
37. Ignition Switch Rack
38. Ignition Switch Rod
39. Lower Bearing
40. Lock Rod
41. Upper Shaft
42. Bumper
43. Wedge
44. Yoke
45. Centering Sphere Spring
46. Centering Spheres
47. Lower Shaft
48. Bearing Housing Support Screws
49. Bearing Housing Support
50. Pin
51. Shift Tube Index Plate Screws
52. Shift Tube Index Plate
53. Support Retaining Ring
54. Support Thrust Washer
55. Support Plate Lock
56. Support Wave Washer
57. Gearshift Lever Spring
58. Gearshift Lever Housing
59. Ignition Switch Screws
60. Ignition Switch
61. Mast Jacket
62. Neutral-Safety or Back-Up Switch Retainers
63. Jacket Grommet
64. Dash Seal
65. Shift Tube
66. Lower Bearing Adapter
67. Lower Bearing
68. Lower Bearing Reinforcement
69. Lower Bearing Clip
70. Shaft Flange Bolt
71. Shaft Flange

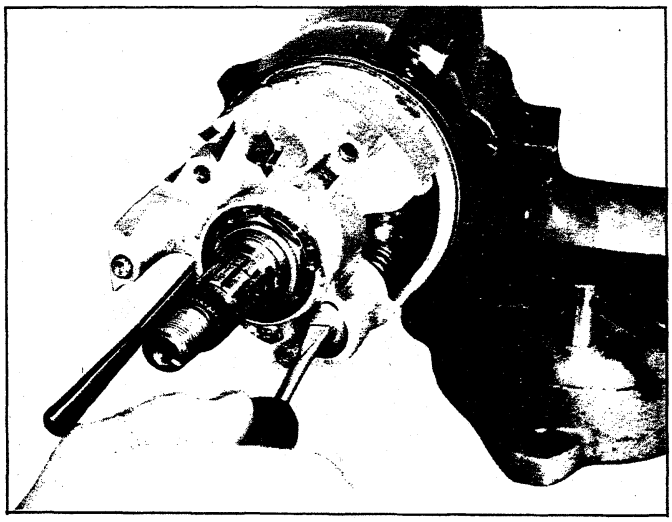


Fig. 46—Removing Tilt Lever Spring Retainer

toward the housing hub at the 12 o'clock position and sliding it under the jacket opening. Remove the wave washer.

17. Remove the shift lever housing from the mast jacket. Remove the shift lever spring by winding the spring up with pliers and pulling it out. On floor shift models, remove the spring plunger.
18. Disassemble the bearing housing as follows:
    a. Remove the tilt lever opening shield. On Tilt-Telescoping columns, remove the turn signal lever opening shield.
    b. Remove the lock bolt spring by removing the retaining screw and moving the spring clockwise to remove it from the bolt (fig. 50).
    c. Remove the snap ring from the sector drive shaft. With a small punch, lightly tap the drive shaft from the sector (fig. 51). Remove the drive shaft, washer, sector and lock bolt. Remove the rack and rack spring.
    d. Remove the tilt release lever pin with a punch and hammer. Remove the lever and release lever

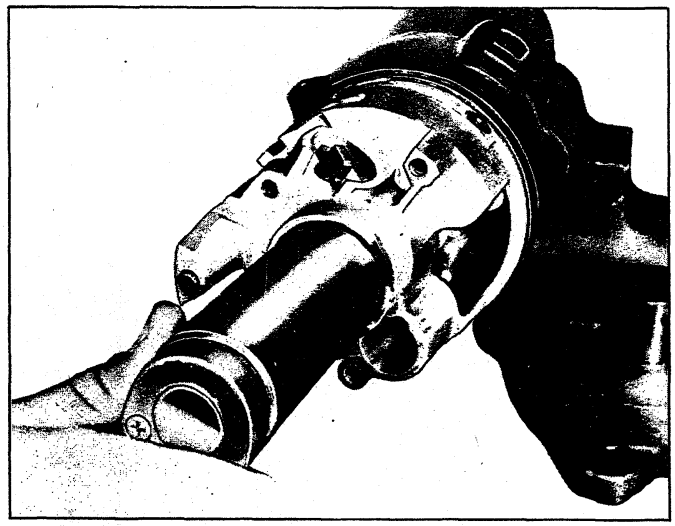


Fig. 47—Removing Upper Steering Shaft Locknut Using Socket J-23193

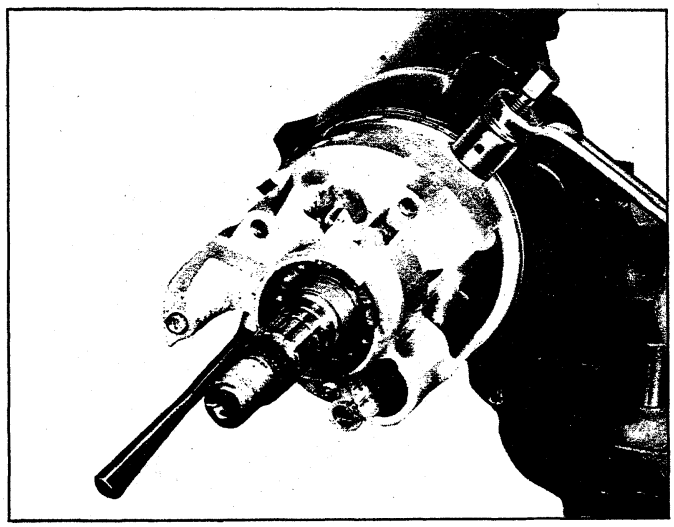


Fig. 48—Removing Bearing Housing Pivot Pins Using Tool J-21854

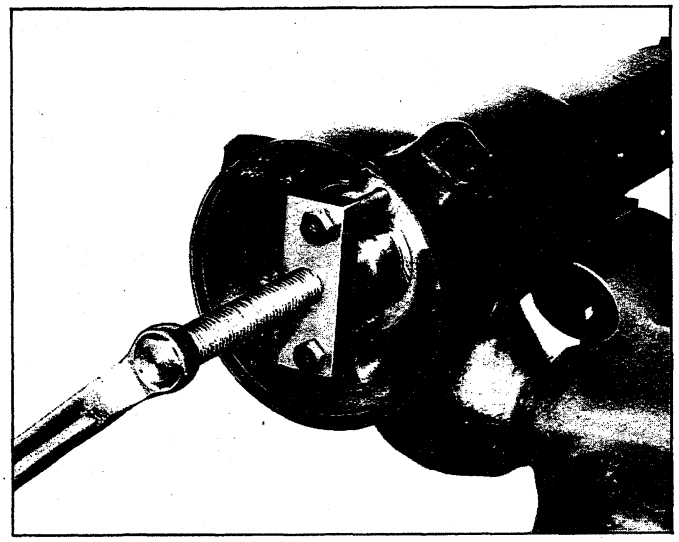


Fig. 49—Removing Shift Tube Using Tool J-23072

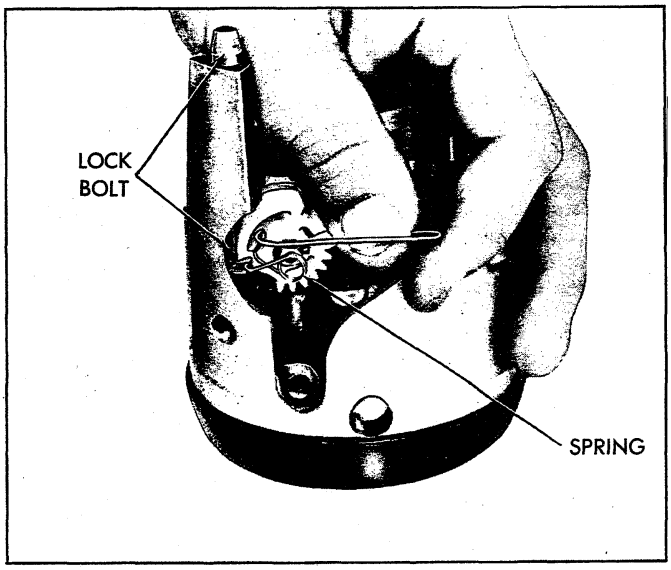


Fig. 50—Replacing Lock Bolt Spring

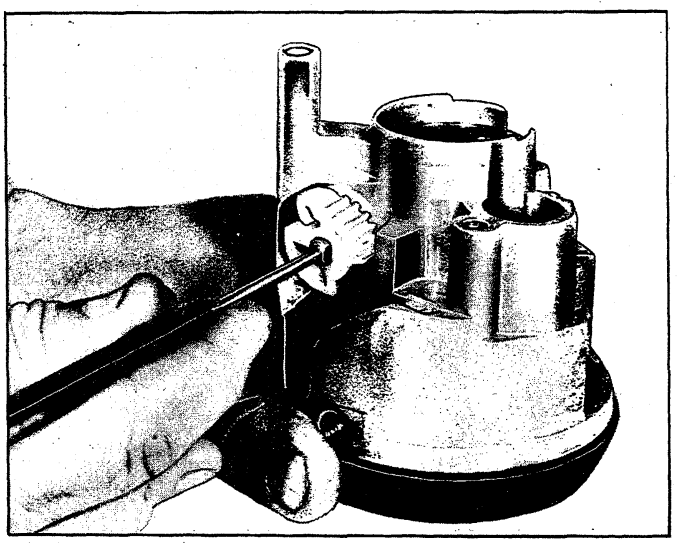


Fig. 51—Removing Sector Drive Shaft

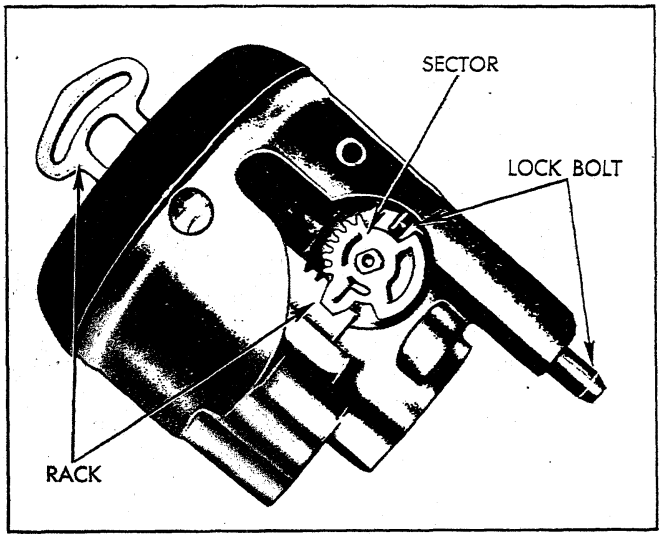


Fig. 52—Installing Lock Bolt and Rack Assemblies

spring. To relieve the load on the release lever, hold the shoes inward and wedge a block between the top of the shoes (over slots) and bearing housing.

e. Remove the lock shoe retaining pin with a punch and hammer. Remove the lock shoes and lock shoe springs.

NOTE: With the tilt lever opening on the left side and shoes facing up, the four slot shoe is on the left.

f. Remove the bearings from the bearing housing only if they are to be replaced. Remove the separator and balls from the bearings. Place the housing on work bench and with a pointed punch against the back surface of the race, carefully hammer the race out of the housing until a bearing puller can be used. Repeat for the other race.

Assembly—Tilt and Tilt-Telescoping Columns

Apply a thin coat of lithium grease to all friction surfaces.

1. If the bearing housing was disassembled, repeat the following steps:
   a. Press the bearings into the housing, if removed, using a suitable size socket. Be careful not to damage the housing or bearing during installation.
   b. Install the lock shoe springs, lock shoes and shoe pin in the housing. Use an approximate .180" rod to line up the shoes for pin installation.
   c. Install the shoe release lever, spring and pin.

   NOTE: To relieve the load on the release lever, hold the shoes inward and wedge a block between the top of the shoes (over slots) and bearing housing.

   d. Install the washer onto the sector drive shaft and install the shaft into the housing. Lightly tap the sector onto the shaft far enough to install the snap ring. Install the snap ring.
   e. Install the lock bolt and engage it with the sector cam surface. Then install the rack and spring. The block tooth on the rack should engage the block tooth on the sector (fig. 52). Install the external tilt release lever.
   f. Install the lock bolt spring and retaining screw (fig. 50). Tighten the screw to 35 in. lbs.
2. Install the shift lever spring in the housing by winding it up with pliers and pushing it into the housing. On floor shift models, install the plunger. Slide the gearshift lever housing onto the mast jacket.
3. Install the bearing support lock plate. Work it into the notches in the jacket by tipping it toward the housing hub at the 12 o'clock position and sliding it under the jacket opening. Slide the lock plate into the notches in the jacket. Install the wave washer.
4. Carefully install the shift tube into the lower end of the mast jacket. Align the keyway in the tube with the key in the shift lever housing. Install the wobble plate end of Tool J-23073 into the upper end of the shift tube far enough to reach the enlarged portion of the tube. Then install the adapter over the end of the tool, seating it against the lock plate. Place the nut on the threaded end of the tool and pull the shift

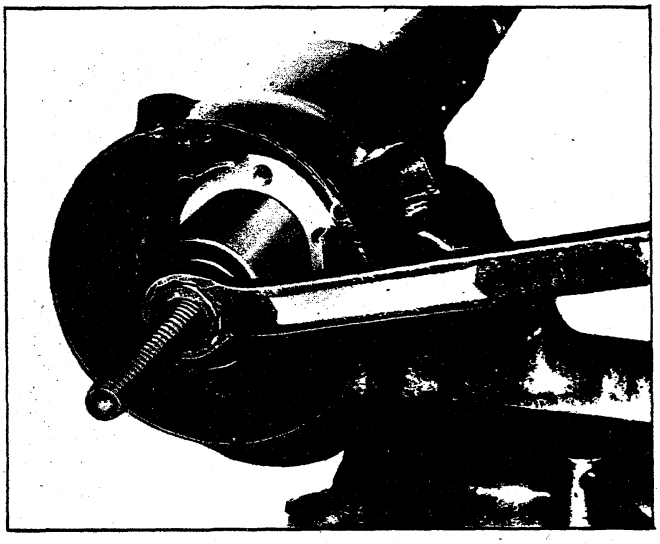


Fig. 53—Installing Shift Tube Using Tool J-23073

tube into the housing (fig. 53). Remove Tool J-23073.

CAUTION: Do not push or tap on the end of the shift tube. Be sure that the shift tube lever is aligned with the slotted opening at the lower end of the mast jacket or damage to the shift tube and mast jacket could result.

5. Install the bearing support thrust washer and retaining ring by pulling the shift lever housing up far enough to compress the wave washer.
6. Install the bearing support by aligning the "V" in the support with the "V" in the jacket. Insert the screws through the support and into the lock plate and torque to 60 in. lbs.
7. Align the lower bearing adapter with the notches in the jacket and push the adapter into the lower end of the mast jacket. Install the lower bearing, bearing reinforcement and retaining clip, being sure that the clip is aligned with the slots in the reinforcement, jacket and adapter.
8. Install the centering spheres and anti-lash spring in the upper shaft. Install the lower shaft from the same side of the spheres that the spring ends protrude.
   Tilt-Telescoping Columns - Install the upper steering shaft, locking wedge, locking rod and bumper in the upper yoke.
9. Install the steering shaft assembly into the shift tube from the upper end. Carefully guide the shaft through the shift tube and bearing.
10. Install the ignition switch actuator rod through the shift lever housing and insert in the slot in the bearing support. Extend the rack downward from the bearing housing. Assemble the bearing housing over the steering shaft and engage the rack over the end of the actuator rod (fig. 54).
11. With the external release lever installed, hold the lock shoes in the disengaged position and assemble the bearing housing over the steering shaft until the pivot pin holes line up.
12. Install the pivot pins.
13. Place the bearing housing in the full "up" position and install the tilt lever spring guide, spring and spring retainer. With a suitable screw driver, push the retainer in and turn clockwise to engage in the housing.
14. Tilt Columns Only - Install the upper bearing inner race, race seat and bearing locknut. Determine torque to rotate the steering shaft and then with the column in the straight ahead position, torque the nut to 5-10 in. ounces over the steering shaft torque using Socket J-23193.
15. Install the tilt lever opening shield and on tilt-telescoping columns, install the turn signal lever opening shield.
16. Remove the tilt release lever, install the turn signal housing and torque the three retaining screws to 45 in. lbs.
17. Install the tilt release lever and shift lever. Drive the shift lever pin in.
18. Install the ignition key warning switch, lock cylinder, turn signal switch, lock cylinder and ignition switch as outlined previously in this section.
19. Tilt Columns Only - Install the lower steering shaft flange and torque bolt to 30 ft. lbs.
    Tilt-Telescoping Columns - Slide the lower bearing preload spring and clamp over the lower end of the shaft and tighten the clamp bolt. Install the lower steering shaft flange and torque bolt to 30 ft. lbs.
20. Install the neutral-safety switch or back-up switch.
21. Install the four dash panel bracket to column screws and torque to specifications.

CAUTION: Be sure that the slotted openings in the bracket (for the mounting capsules) face the upper end of the steering column.

Column Installation—Mandatory Sequence

Chevrolet (Fig. 55)

1. Loose assemble inner (A) and outer (B) dash covers on column with two screws (C) and (D). Dash covers must be able to slide on column.
2. Glue cover seal (E) to outer cover (B).
3. Position rolled portion of dash seal (part of column assembly) at column lower reaction tab approximately 2" from bottom of jacket.

CAUTION: Rolled portion of seal must be di-

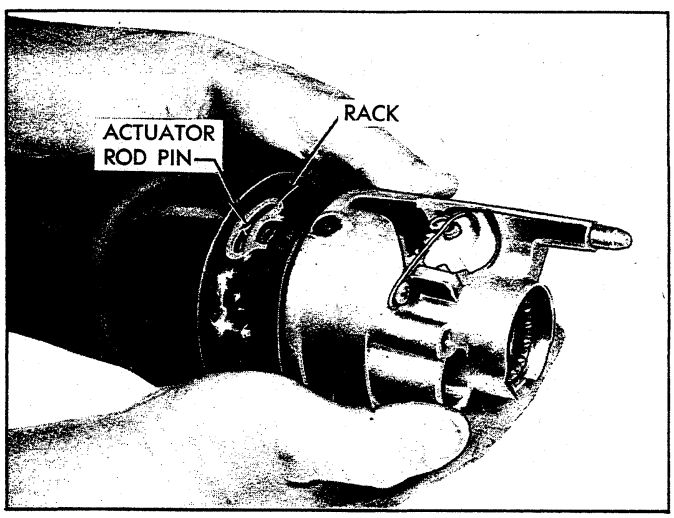


Fig. 54—Installing Bearing Housing

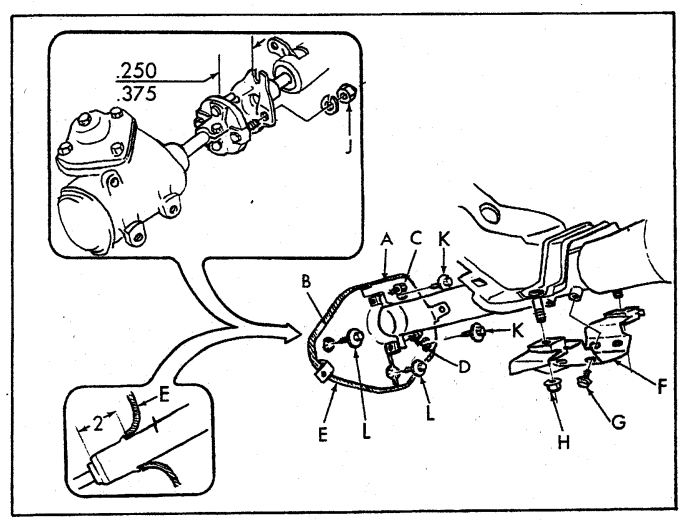


Fig. 55—Chevrolet Steering Column Mounting

rected down column toward front of car and must remain in this position during and after column installation (see Figure 55).

4. Position column in car, install all electrical connections and loosely install nuts (H).
5. Attach steering shaft flange to rag joint and tighten nuts to specified torque.

CAUTION: Do not tighten column to instrument panel unless vehicle is setting on its wheels or suspension.

6. Tighten two mast jacket bracket retaining nuts (H) to specified torque while holding rag joint to flange clearance dimension shown.

NOTE: For remaining steps, inner cover (A) and outer cover (B) must move to established position of column which has been determined by rag joint and I.P. attachment.

7. Push inner cover (A) and outer cover (B) to dash and line up all cover to dash attaching holes.
8. Holding both inner and outer cover assemblies against dash and column install and tighten two inner cover screws (K).
9. Tighten screw (C) to specified torque.
10. Tighten screw (D) to specified torque.
11. Loosen two screws (K).
12. Tighten two screws (L) to specified torque.
13. Retighten screws (K) to specified torque.

CAUTION: The alignment between the steering shaft and the steering gear must be such that a .04" gap is maintained between the coupling rivets and the steering shaft flange with the steering shaft in straight ahead position and without torque on wheel. Less than .04" gap indicates that column must be realigned.

14. Install transmission indicator cable on column automatics.
15. Install the instrument panel trim cover.
16. Connect the transmission control linkage at the shift tube levers.
17. Install the steering wheel as outlined previously in this section.
18. Connect the battery ground cable.

Chevelle (Fig. 56)

1. Loose assemble inner (A) and outer (B) dash cover on column with two screws (C). Dash covers must be able to slide on column.
2. Glue cover seal (D) to outer cover (B).
3. Position rolled portion of dash seal (part of column assembly) at column lower reaction tab, two inches from bottom of jacket.

CAUTION: Rolled portion of seal must be directed down column toward front of car and must remain in this position during and after column installation (see Figure 56).

4. Position column in vehicle, install all electrical connections and position flange to rag joint and install lock washers and nuts (E). (May be tightened to specified torque at any time.)
5. Loose assemble nuts (F) on brace rods.
6. Position outer cover to dash and start screw (Q).

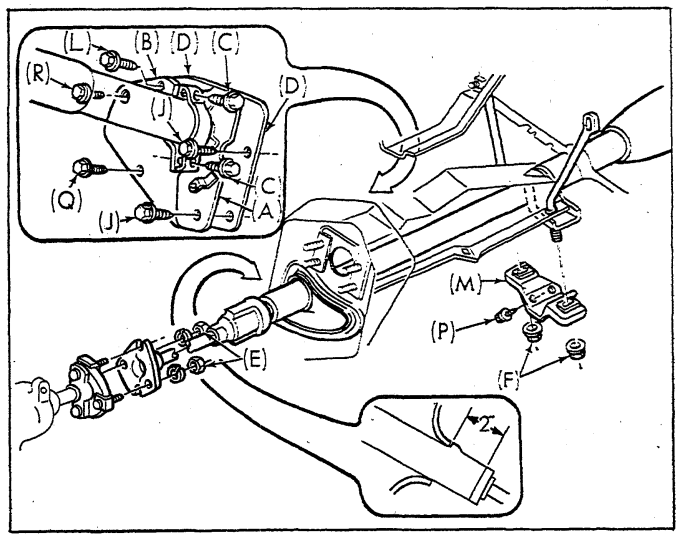


Fig. 56—Chevelle Steering Column Mounting

7. Install screw (L) and tighten to specified torque. Tighten screw (Q) to specified torque and install and tighten screw (R) to specified torque.
8. Tighten two clamp screws (C) to specified torque.
9. Install two inner cover screws (J) and tighten to specified torque.
10. Tighten two nuts (F) to specified torque.
11. Install the transmission indicator cable on column automatics.
12. Install the instrument panel trim cover.
13. Connect the transmission control linkage at the shift tube levers.
14. Install the steering wheel as outlined previously in this Section.
15. Connect the battery ground cable.

Nova and Camaro (Fig. 57)

1. Position rolled portion of dash panel seal (part of column assembly) at the column lower reaction tab two inches from bottom of jacket.

CAUTION: Rolled portion of seal must be directed down column toward front of car and must

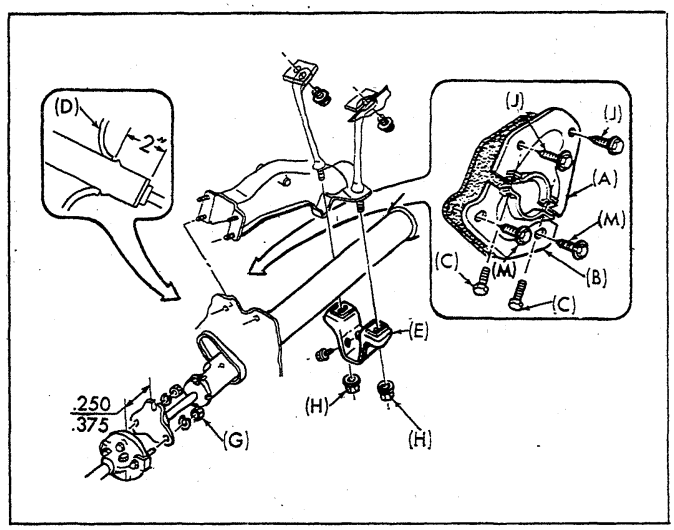


Fig. 57—Nova and Camaro Steering Column Mounting

remain in this position during and after column installation (See Figure 57).

2. Install upper (A) and lower (B) steering column to dash covers on column and tighten two screws (C) so that cover assembly is snug on column but still will move with respect to column.
3. Glue seal (D) (part of the column assembly) to upper (A) and lower cover (B).
4. Position column in car and install all electrical connections.
5. Attach steering shaft flange to rag joint and tighten nuts (G) to specified torque.
6. Install two rearward mast jacket bracket retaining nuts (H) and tighten nuts to specified torque while holding rag joint to flange clearance dimension shown.
7. Push upper (A) and lower (B) cover assembly to dash and line up all cover to dash attaching holes.

CAUTION: Do not permit rolled section of seal (D) to reverse itself.

8. Holding both upper and lower cover assemblies against dash and column, install and tighten two screws (J) to the specified torque.
9. Tighten two screws (C) to specified torque.
10. Loosen two screws (J) and shake column in area immediately above cover, so as to make certain column position is not affected by column to dash cover attachment.
11. Install screws (M) and tighten along with two screws (J) to specified torque.

CAUTION: The alignment between the steering shaft and the steering gear must be such that a .04" gap is maintained between the coupling rivets and the steering shaft flange with the steering shaft in straight ahead position and without torque on wheel. Less than .04" gap indicates that column must be realigned.

12. Install the transmission indicator cable on column automatics.
13. Install the instrument panel trim cover.
14. Connect the transmission control linkage.
15. Install the steering wheel as outlined previously in this Section.
16. Connect the battery ground cable.

Corvette (Fig. 58)

1. Loosely assembly support (U) to bracket (T) with shouldered bolts (W) and nuts (Y).
2. Assemble upper end of rag joint (Z) to steering gear and attach gear to frame, torquing screws.
3. Position column assembly into vehicle, sliding splined end of steering shaft into upper end of rag joint (Z). Connect all electrical wiring.
4. Start two steering column to support (U) attaching screws (H).
5. Install transmission control cable bracket (N) with bolt (M) and hold in place.
6. Maintaining a gap of .03 ± .03 between mast jacket and inside semi-circular surface of instrument panel, install nuts (K) and tighten to specified torque. Then pull support (U) rearward to accommodate height differential of instrument panel to bracket (T). With column position now defined, tighten

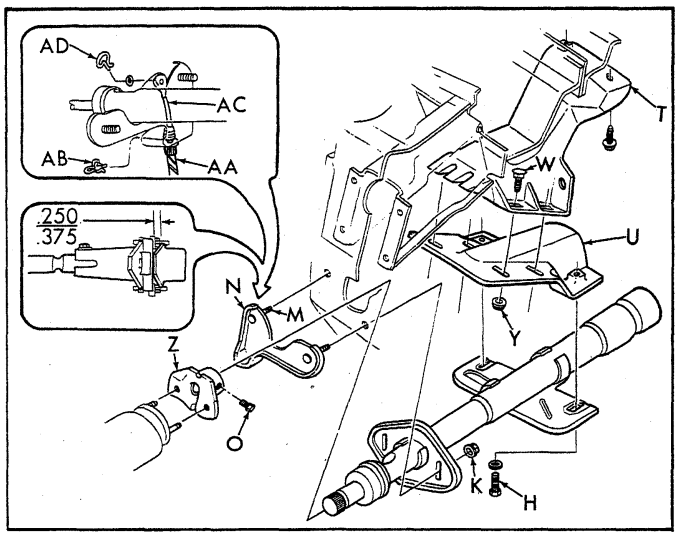


Fig. 58—Corvette Steering Column Mounting

screws (H) and then nuts (Y) to specified torque. Loosen nuts (K).

CAUTION: Do not tighten column to instrument panel until vehicle is on its wheels or suspension.

7. Maintaining rag joint dimension shown, torque upper rag joint flange pinch bolt (O).
8. Attach back drive cable sheath (AA) to transmission control cable bracket (N) with spring clip (AB), then attach inner cable (AC) to lever on steering column with retainer (AD).
9. Secure steering column lower plate to front of dash by tightening nuts (K) to specified torque.

CAUTION: The alignment between the steering shaft and the steering gear must be such that a .04" gap is maintained between the coupling rivets and the steering shaft flange with the steering shaft in straight ahead position and without torque on wheel. Less than .04" gap indicates that column must be realigned.

10. Install the steering wheel as outlined previously in this Section.
11. Connect the battery ground cable.

STEERING LINKAGE (Fig. 59)

Tie Rods

There are two tie rod assemblies used on all models. Each assembly is of three piece construction, consisting of a sleeve and two tie rod ends. The ends are threaded into the sleeve and locked with clamps. Right and left hand threads are provided to facilitate toe-in adjustment and steering gear centering.

The tie rod ends are self-adjusting for wear and require no attention in service other than periodic lubrication and occasional inspection to see that ball studs are tight. Replacement of tie rod ends should be made when excessive up and down motion is evident or if any lost motion or end play at ball end of stud exists.

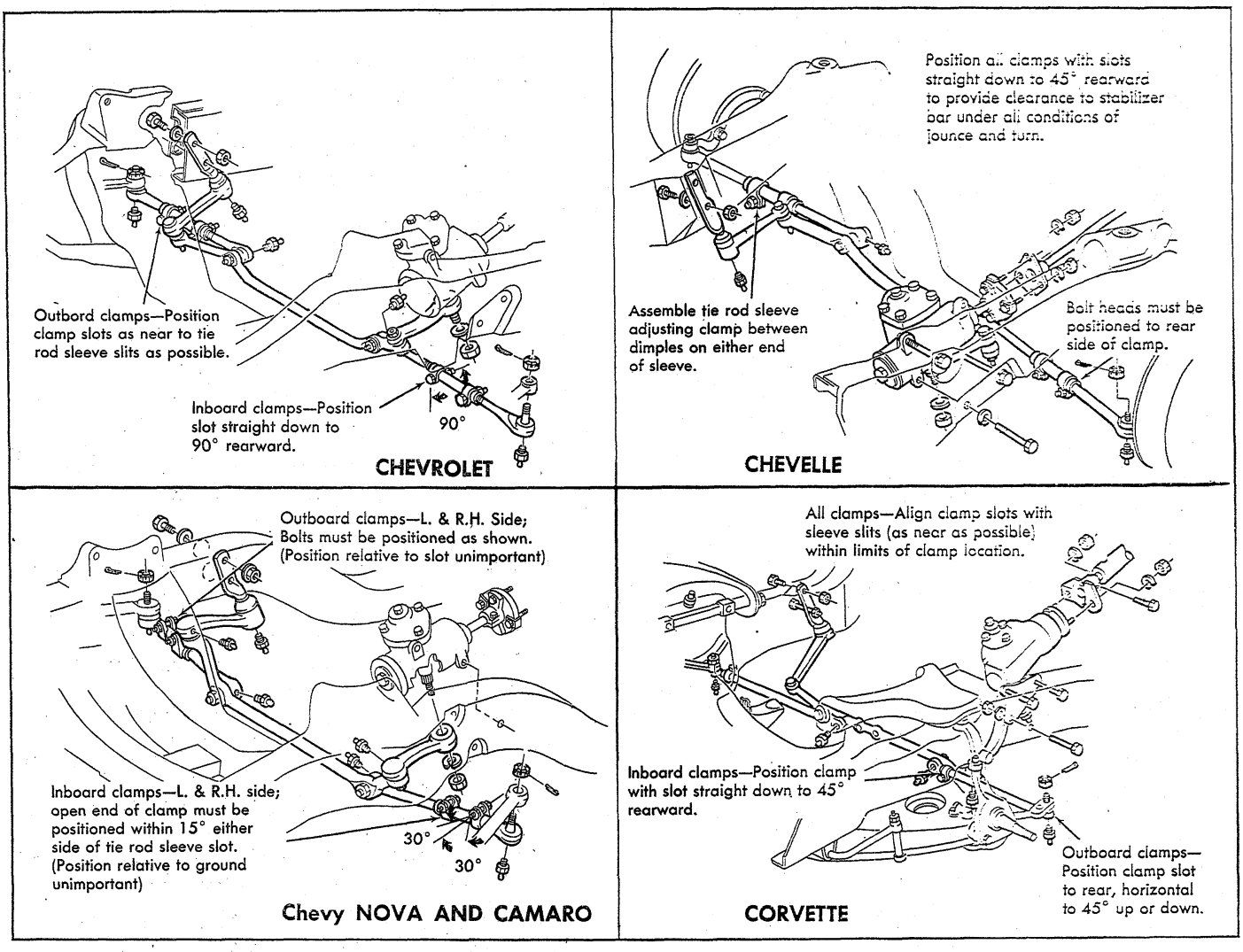


Fig. 59—Steering Linkage

Removal

1. Remove cotter pins from ball studs and remove castellated nuts.
2. To remove outer ball stud, tap on steering arm at tie rod end with a hammer while using a heavy hammer or similar tool as a backing (fig. 60). If necessary pull downward on tie rod to remove from steering arm.
3. Remove inner ball stud from relay rod using same procedure as described in Step 2.
4. To remove tie rod ends from tie rods loosen clamp bolts and unscrew end assemblies.

Installation

1. If the tie rod ends were removed, lubricate the tie rod threads with EP Chassis lube and install ends on tie rod making sure both ends are threaded an equal distance from the tie rod.
2. Make sure that threads on ball stud and in ball stud nuts are perfectly clean and smooth. Install neoprene seals on ball studs.

NOTE: If threads are not clean and smooth, ball studs may turn in tie rod ends when attempting to tighten nut.

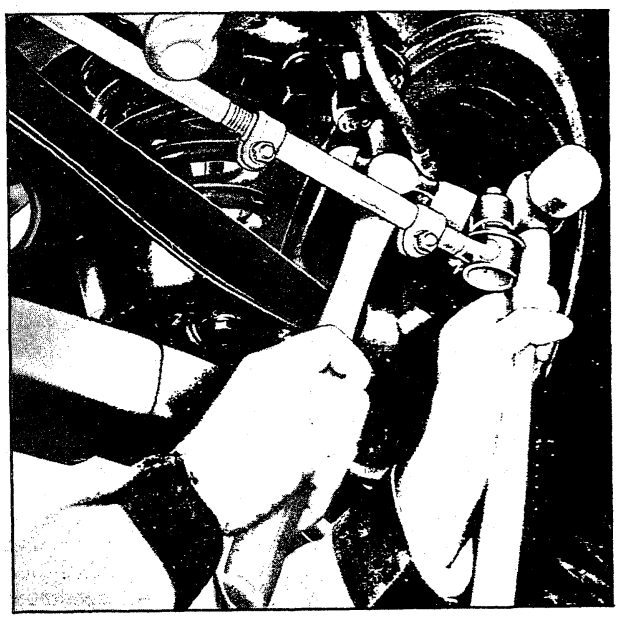


Fig. 60—Freeing Ball Stud

3. Install ball studs in steering arms and relay rod.
4. Install ball stud nut, and install cotter pins. Lubricate tie rod ends.
5. Adjust toe-in as described in Section 3.

NOTE: Before locking clamp bolts on the rods, make sure that the tie rod ends are in alignment with their ball studs (each ball joint is in the center of its travel). If the tie rod is not in alignment with the studs, binding will result.

Relay Rod—All Models Except Corvette

Removal

1. Remove inner ends of tie rods from relay rod as described under Tie Rod - Removal.
2. Remove cotter pin and nut from relay rod ball stud attachment at pitman arm.
3. Detach relay rod from pitman arm. Shift steering linkage as required to free pitman arm from relay rod.
4. Remove cotter pin and nut from idler arm and remove relay rod from idler arm.

Installation

1. Install relay rod to idler arm, making certain idler stud seal is in place, then install and tighten nut. Advance nut just enough to align castellation with cotter pin hole and install pin.
2. Raise end of rod and install on pitman arm. Secure with nut and cotter pin.
3. Install tie rod ends to relay rod as previously described under Tie Rods. Lubricate tie rod ends.
4. Adjust toe-in (see Section 3) and align steering wheel as described previously in this section under Steering Wheel Alignment and High Point Centering.

Relay Rod—Corvette

Removal

1. Remove inner ends of tie rods from relay rod as described under Tie Rod—Removal.
2. Remove cotter pin from end of relay rod at pitman arm ball stud attachment, and remove stud nut.
3. Tap ball stud out of pitman arm and lower relay rod.
4. Remove cotter key and nut from idler arm and remove relay rod from idler arm. Remove washer and seal from idler arm.

Installation

1. Place relay rod on idler arm stud, making certain idler stud seal and washer are in place, then install and tighten nut. Advance nut just enough to align castellation with cotter pin hole and install pin.
2. Install new seal and clamp over ball at end of pitman arm.
3. Install inner spring seat and spring to relay rod.
4. Raise end of rod and install on pitman arm.
5. Install spring seat, spring, and end plug.
6. Tighten end plug until springs are compressed and plug bottoms, then back off 3/4 turn plus amount necessary to insert cotter pin. Insert cotter pin to lock adjustment.
7. Install tie rod ends to relay rod as previously described under Tie Rods.
8. Lubricate tie rod ends and pitman arm to relay rod ball joint.
9. Adjust toe-in and align steering wheel as described previously in this section.

Idler Arm (Fig. 59)

Removal

1. Remove idler arm to frame nut, washer, and bolt. No washer is used on Corvette.
2. Remove cotter pin and nut from idler arm to relay rod ball stud.
3. Remove relay rod from idler arm by tapping relay rod with a hammer using a heavy hammer as a backing.
4. Remove idler arm.

Installation

1. On Chevrolet, place seal in position on idler arm stud; position stud up through frame, and secure with lock washer and nut.
2. On Chevelle, Camaro, Nova and Corvette, position idler arm on frame and install mounting bolts, washers and nuts. No washer is used on Corvette.
3. Install relay rod to idler arm, making certain seal is on stud. Install and tighten nut.
4. Install cotter pin.
5. Refer to torque specifications at rear of manual for correct torque values.

Pitman Arm

Removal

1. Remove cotter pin from pitman arm ball stud and remove nut.
2. Remove relay rod from pitman arm by tapping on side of rod or arm in which the stud mounts with a hammer while using a heavy hammer or similar tool as a backing. Pull down on relay rod to remove from stud.
3. Remove pitman arm nut from sector shaft and mark relation of arm position to shaft.
4. Remove pitman arm with Tool J-6632 as shown in Figure 4.

Installation

1. Install pitman arm on sector shaft, lining up the marks made upon removal.
2. Install sector shaft nut.
3. Position relay rod on to pitman arm. Install nut. Continue to tighten arm enough to align castellation with hole in stud and install cotter pin.

Steering Arm

If, through collision or other damage, it becomes necessary to remove and replace either steering arm, proceed as follows:

Removal

1. Remove tie rod from steering arm as outlined in this section.
2. Remove front wheel, hub and brake drum as a unit by removing hub cap and dust cap, cotter pin from spindle nut and the spindle nut. Pull assembly toward outside of vehicle. If removal is difficult, it may be necessary to back off brake adjustment to increase brake shoe-to-drum clearance; see Hydraulic Brake Adjustment, Section 5. On models with disc brakes, remove caliper and disc.

3. With wheel and drum assembly or caliper and disc removed, steering arm retaining bolt heads are accessible and removal of steering arm from vehicle may be accomplished by removing retaining nuts.

Installation

1. Place steering arm in position on vehicle and install retaining bolts.
2. Install nuts. Use only the special locknut listed for this use in the Parts Catalog.
3. Pack wheel bearings using a high quality wheel bearing lubricant. Install bearings and wheel-hub-brake drum assembly removed previously. On disc brake models, install disc and caliper.
4. Install keyed washer and spindle nut. Proceed as outlined under "Front Wheel Bearing Adjustment" in Section 3.
5. Install tie rod ball stud in steering arm. Be sure that the dust cover is in place on ball stud.
6. Install castellated nut on ball stud, tighten securely and install cotter pin.
7. Following directions given in Section 3 to check cornering wheel relationship and toe-in; correct as required.

POWER STEERING

	Page
General Description	9-28
Maintenance and Adjustments	9-28
Bleeding Hydraulic System	9-28
Fluid Level	9-29
Adjustments	9-29
Power Steering Gear	9-29
Pump Belt Tension	9-29
Hydraulic System Checks	9-29
Component Replacement and Repairs	9-30
Power Steering Pump	9-30
Power Steering Gear	9-31
Control Valve and Adapter Assembly	9-31
Valve Balancing	9-32
Power Cylinder	9-33
Power Steering Hoses	9-33
Special Tools	9-35

GENERAL DESCRIPTION

Two types of power steering are used for 1969. One is the conventional linkage type for Corvette and the other is the integral gear type for Chevrolet, Chevelle, Camaro, and Chevy Nova. For both types the hydraulic pressure is provided by an engine-driven vane-type pump.

On the Corvette linkage type power steering, hydraulic pressure is delivered through a hose from the pump to a valve which senses the requirement for power assistance and supplies the power cylinder accordingly. The steering gear used with this power steering is the same basic unit used on manually steered vehicles; it is serviced as outlined in the manual steering part of this section except for adjustment, which is covered in the following pages. The steering linkage also is serviced the same as manual counterparts.

The Chevrolet, Chevelle, Camaro, and Nova integral gear type power steering has the hydraulic pressure delivered from the pump through two hoses to the steering gear. In the power steering gear the steering shaft, hydraulic valve, worm, and rack-piston nut are all in line making a compact and space saving assembly. All oil passages are internal within the gear except the pressure and return hoses.

The steering gear for 1969 is basically the same as 1967 except the Camaro and Nova have a snap ring or rings located at the upper end of the housing which serves as a stop for the rack piston assembly. This prevents additional pressure from being applied to the linkage after the wheel stops have been reached.

The steering gear is a recirculating ball system in which steel balls act as a rolling thread between the steering worm and rack-piston nut. The rack-piston nut is all one piece and is geared to the sector of the piston shaft. The valve is contained in the gear housing eliminating the need of bolts or seals to attach a separate valve housing.

The valve is an open-center, rotary-type three way valve. The spool is held in neutral position by means of a torsion bar. The spool is attached by means of the stub shaft to one end of the torsion bar and to the valve body on the other end. Twisting of the torsion bar allows the spool to move in relation to the valve body thereby operating the valve.

MAINTENANCE AND ADJUSTMENTS

BLEEDING HYDRAULIC SYSTEM

1. Fill oil reservoir to proper level and let oil remain undisturbed for at least two minutes.
2. Start engine and run only for about two seconds.
3. Add oil if necessary.
4. Repeat above procedure until oil level remains constant after running engine.
5. Raise front end of vehicle so that wheels are off the ground.

6. Increase engine speed to approximately 1500 rpm.
7. Turn the wheels (off ground) right and left, lightly contacting the wheel stops.
8. Add oil if necessary.
9. Lower the car and turn wheels right and left on the ground.
10. Check oil level and refill as required.
11. If oil is extremely foamy, allow vehicle to stand a few minutes with engine off and repeat above procedure.
    a. Check belt tightness and check for a bent or loose pulley. (Pulley should not wobble with engine running.)
    b. Check to make sure hoses are not touching any other parts of the car, particularly sheet metal and exhaust manifold.
    c. Check oil level, filling to proper level if necessary, following operations 1 through 10. This step and Step "D" are extremely important as low oil level and/or air in the oil are the most frequent causes of objectionable pump noise.
    d. Check the presence of air in the oil. If air is present, attempt to bleed system as described in operations 1 through 10. If it becomes obvious that the pump will not bleed after a few trials, proceed as outlined under Hydraulic System Checks.

FLUID LEVEL

1. Check oil level in the reservoir by checking the dip stick when oil is at operating temperature. On Chevelle models equipped with remote reservoir, the reservoir should be maintained approximately 3/4 full when oil is at operating temperature.
2. Fill, if necessary, to proper level with GM Power Steering Fluid or, if this is not available, Automatic Transmission Fluid "Type A" bearing the mark "AQ-ATF" followed by a number and the suffix letter "A".

ADJUSTMENTS

Power Steering Gear

Chevrolet, Chevelle, Camaro and Nova

The over-center adjustment (fig. 61) is the only power steering gear adjustment which can be made on the car. However, in order to make this adjustment, it is also necessary to check the combined ball and thrust bearing preload.

If the vehicle is equipped with a tilt column it will be necessary to disconnect the steering coupling to obtain a torque reading of the column. This torque should then be subtracted from any reading taken on the gear.

1. Disconnect the pitman arm from the relay rod.
2. Loosen the pitman shaft adjusting screw locknut and thread the adjusting screw out to the limit of its travel through the side cover.
3. Disconnect the battery ground cable.
4. Remove horn button.
5. Turn the steering wheel through its full travel, then locate the wheel at its center of travel.
6. Check the combined ball and thrust bearing preload with an inch-pound torque wrench on the steering shaft nut by rotating through the center of travel (approximately 1/4 turn in each direction). Note the highest reading.
7. Tighten the pitman shaft adjusting screw and check torque at steering shaft nut until over center preload and total steering gear preload falls within specifications. Refer to torque specifications at rear of manual for correct torque values.
8. Install horn button. Connect the battery ground cable.

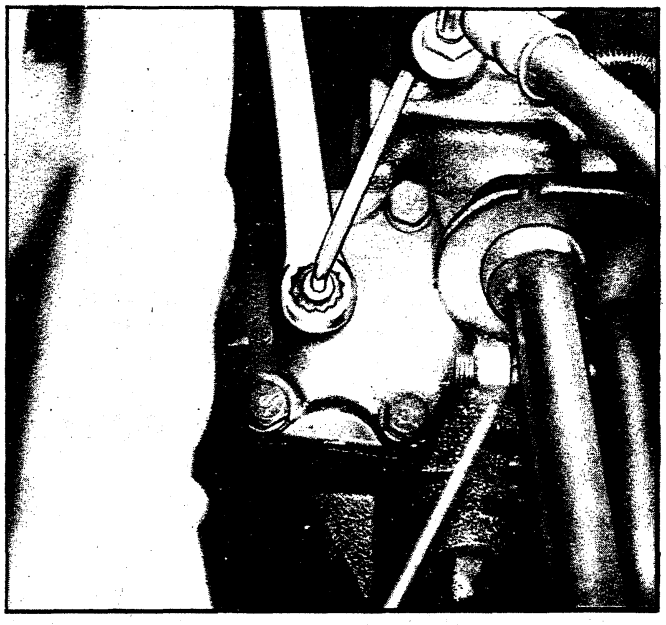


Fig. 61—Over-Center Adjustment

Corvette

The steering gear used with power steering is adjusted in the same manner as the manual steering gear.

Pump Belt Tension

1. Loosen nut on pivot bolt and pump brace adjusting nut.

   CAUTION: Do not move pump by prying against reservoir or by pulling on filler neck.

2. Move pump, with belt in place until belt is tensioned to specifications as indicated by Tool J-7316 (Fig. 62).
3. Tighten pump brace adjusting nut. Then tighten pivot bolt nut.

HYDRAULIC SYSTEM CHECKS

The following procedure outlines methods to identify and isolate power steering hydraulic circuit difficulties. This test is divided into two parts. Test number one provides means of determining whether power steering system hydraulic parts are actually faulty. If test number one results in readings indicating faulty hydraulic operation, test number two will identify the faulty part. Before performing hydraulic circuit test, carefully check belt tension and condition of driving pulley. Strand tension of belt should be 125 lbs. on new belts and 75 lbs. on old belts, as indicated by Tool J-7316 (Fig. 62).

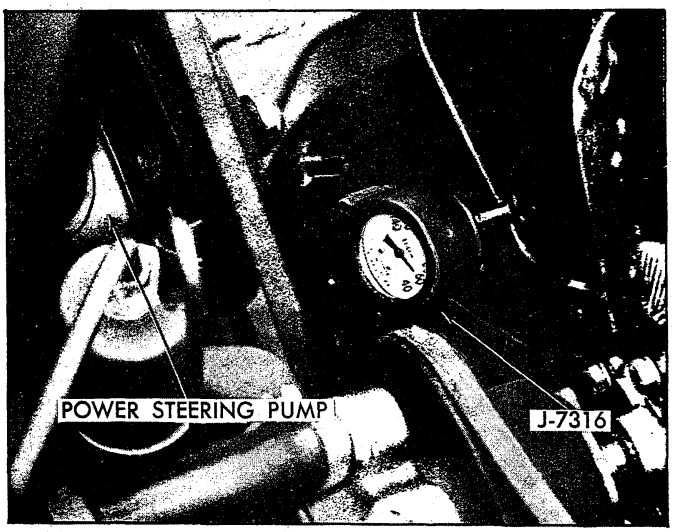


Fig. 62—Checking Belt Tension with Tool J-7316

Test Number One—Oil Circuit Open

Engine must be at normal operating temperature. Inflate front tires to correct pressure. All tests are made with engine idling, so adjust engine idle speed to correct specifications listed in Section 6 and proceed as follows:

a. With engine not running, disconnect flexible pressure line from pump and install Tool J-5176 as shown in Figure 63. Gauge must be between shut-off valve and pump. Open shut-off valve.

b. Remove filler cap from pump reservoir and check fluid level. Fill pump reservoir to full mark on dip stick. Start engine and, holding steering wheel against stop, check connections at Tool J-5176 for leakage. Bleed system as outlined under Maintenance and Adjustments. Insert thermometer (Tool J-5421) in reservoir filler opening. Move steering wheel from stop to stop several times until thermometer indicates that hydraulic fluid in reservoir has reached temperature of 150° to 170° F.

CAUTION: To prevent scrubbing flat spots on tires, do not turn steering wheel more than five times without rolling car to change tire-to-floor contact area.

c. Hold steering wheel against a stop momentarily and read pressure gauge. If the maximum pressure is below specifications see specifications at end of manual, a faulty hydraulic circuit is indicated. To determine which part is faulty, proceed with test number two.

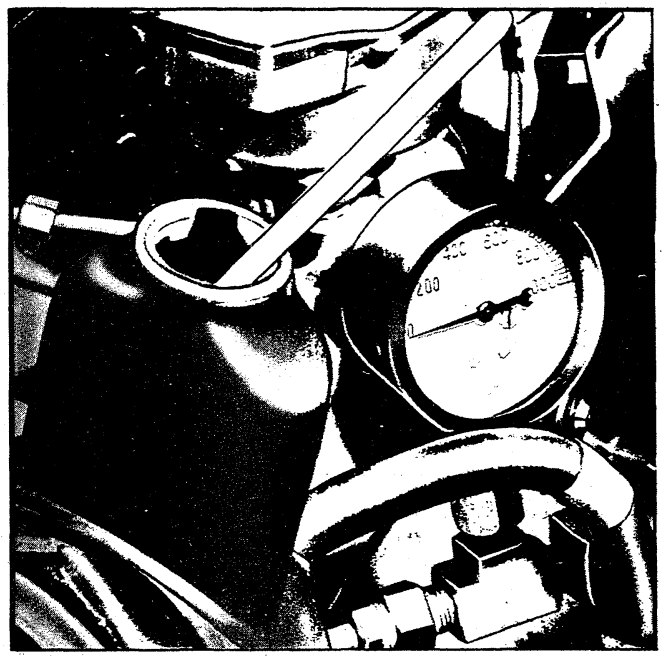


Fig. 63—Power Steering Diagnosis (L-6 Engine)

Test Number Two—Oil Circuit Closed

a. Slowly turn shut-off valve on J-5176 to closed position and read pressure indicated on gauge. Quickly reopen valve to avoid pump damage. If indicated pressure is less than specification, pump output is below requirement and pump may be considered faulty. If pressure indicated is within specifications, it may be safely assumed that the external hoses, connections, valve and adapter or steering gear is at fault.

NOTE: If pump proves faulty in test number two, test should be repeated after pump is repaired and installed in vehicle. This will provide a means of checking the repairs made to the pump and the condition of the steering gear or valve and adapter which may also be faulty.

COMPONENT REPLACEMENT AND REPAIRS

POWER STEERING PUMP

Removal (Fig. 64)

1. Disconnect hoses at pump or steering gear. When hoses are disconnected, secure ends in raised position to prevent drainage of oil. Cap or tape the ends of the hoses to prevent entrance of dirt.
2. Install two caps at hose fittings to prevent drainage of oil from pump.
3. Remove pump belt.
4. On Corvette with 427 engine, loosen alternator adjustment and remove pump to alternator belt.
5. Remove pump from attaching parts and remove pump from vehicle.
6. Remove drive pulley attaching nut.
7. Remove pulley from shaft with Tool J-21239 (for stamped pulleys) or Tool J-8433-1 with J-8433-2 adapter (for cast iron pulleys). Do not hammer pulley off shaft as this will damage the pump.

Installation

1. Install pump pulley.

CAUTION: Do not hammer on pump shaft. Use pulley nut to pull pulley on to shaft.

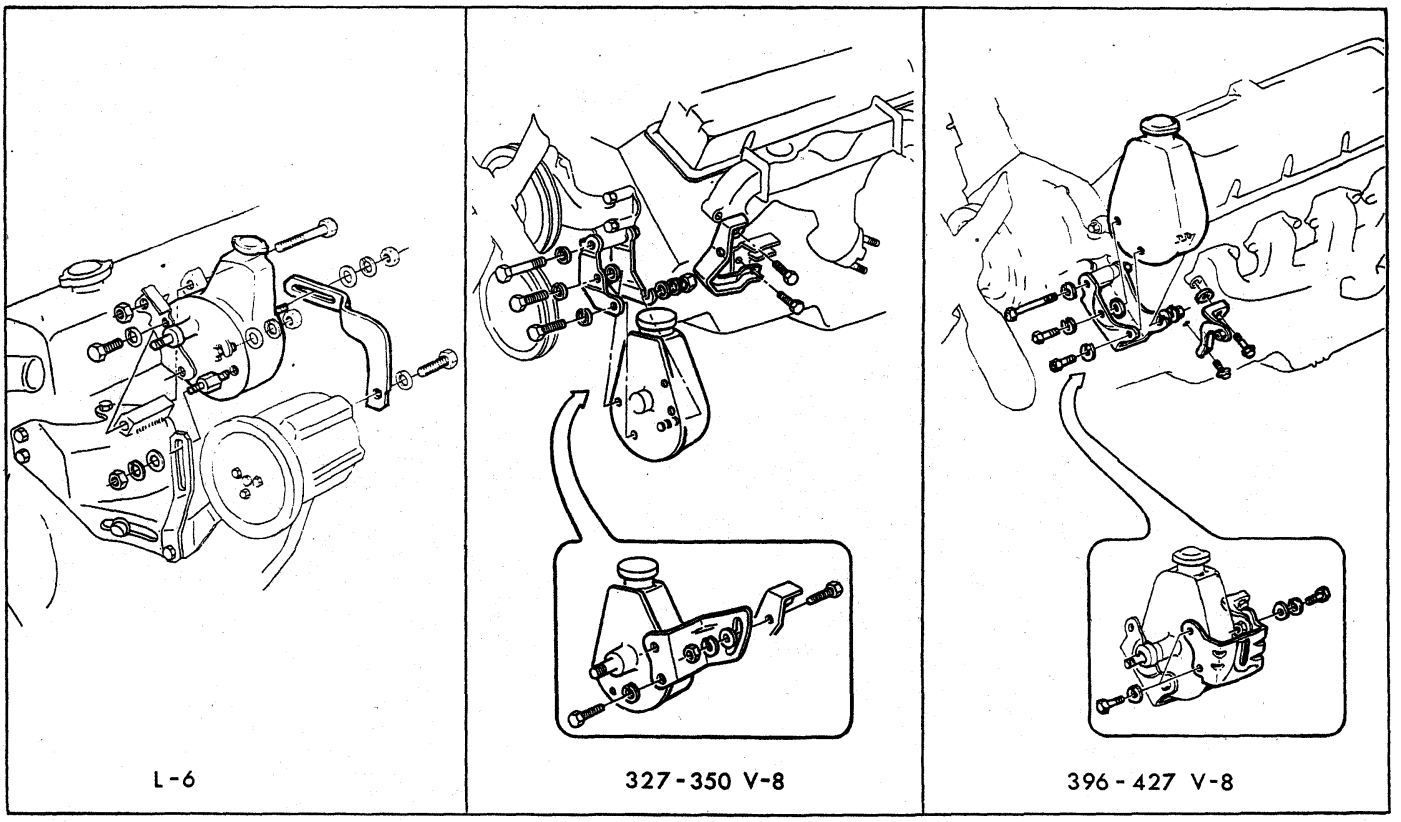


Fig. 64—Power Steering Pump Mounting-Chevrolet Shown

2. Position pump assembly on vehicle (fig. 64) and install attaching parts loosely.
3. Connect and tighten hose fittings.
4. Fill reservoir. Bleed pump by turning pulley backward (counter-clockwise as viewed from front) until air bubbles cease to appear.
5. Install pump belt over pulley.
6. Tension belt as outlined under "Pump Belt Tension Adjustment" in this section.
7. Bleed as outlined under "Maintenance and Adjustments."

POWER STEERING GEAR (Fig. 65)

Chevrolet, Chevelle, Nova and Camaro

Replacement procedures for the power steering gear are the same as for the manual type steering gear. Refer to steering gear procedures near the beginning of this section under "Component Replacement and Repairs". In addition, disconnect pressure and return hoses from the steering gear housing. Cap both hoses and steering gear outlets to prevent foreign material from entering the system. After service is performed and steering gear is installed, connect the pressure and return hoses to the steering gear housing. Bleed system as outlined under Maintenance and Adjustment in this section. Refer to torque specifications at rear of manual for correct torque values.

CONTROL VALVE AND ADAPTER ASSEMBLY—CORVETTE

Ball Stud Replacement (Fig. 66)

A ball stud seal is used on the power steering control valve. To replace the seal:

1. Remove the pitman arm as outlined under "Steering Linkage" in this section.
2. Remove clamp by removing nut, bolt and spacer or, if crimped type clamp is used, straighten clamp end and pull clamp and seal off end of stud.
3. Install new seal and clamp over stud so lips on seal mate with clamp. (A nut and bolt attachment type clamp replaces the crimped type for service.)
4. Center the ball stud, seal and clamp at opening in adapter housing, then install spacer, bolt and nut.

Removal

1. Raise the front of the vehicle off the floor and place it on stands.
2. Remove the relay rod to control valve clamp bolt.
3. Disconnect the two pump to control valve hose connections and allow fluid to drain into a container, then disconnect the two remaining valve to power cylinder hoses.
4. Remove the retaining nut from the ball stud to pitman arm connection and disconnect the control valve from the pitman arm.

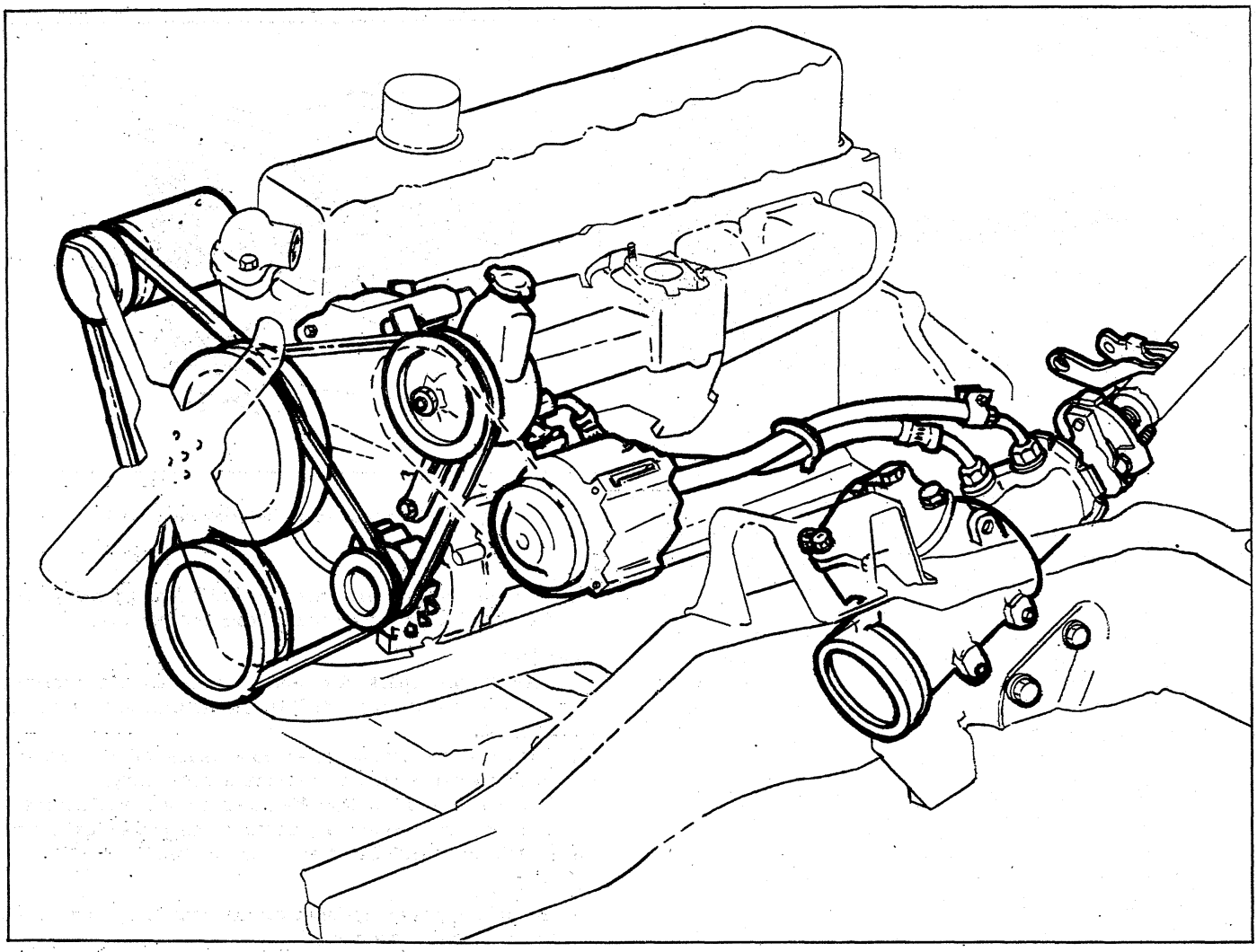


Fig. 65—Power Steering Gear-Chevrolet L-6 Shown

5. Turn the pitman arm to the right to clear the control valve and unscrew the control valve from the relay rod.
6. Remove the control valve from the vehicle.

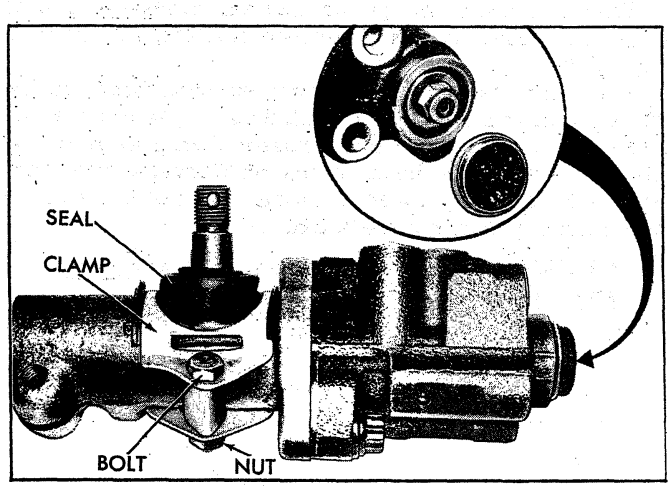


Fig. 66—Control Valve Ball Stud Seal Replacement (Service Type)

Installation

1. Install the control valve on the vehicle by reversing the removal procedure.
2. Reconnect the hydraulic lines, fill the system with fluid and bleed out air using the procedure outlined under "Maintenance and Adjustments." Grease ball joint.

Valve Balancing

The control valve must be adjusted, after being disassembled, as outlined in the following procedure. The same procedure may be followed to correct a complaint of harder steering effort required in one direction than the other. See Figure 67.

1. Install valve in vehicle. Connect all hoses and fill the pump reservoir with oil. Do not connect the piston rod to the frame bracket. If the vehicle is already in operation, it will be necessary to detach the piston rod from the frame bracket.
2. With the car on a hoist, start the engine. One of the following two conditions will exist:
   a. If the piston rod remains retracted, turn the adjusting nut clockwise until the rod begins to move out.

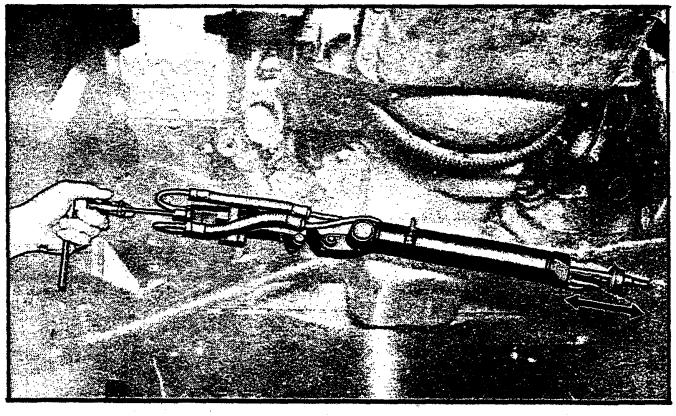


Fig. 67—Balancing Valve

Then turn the nut counter-clockwise until the rod just begins to move in. Now turn the nut clockwise to exactly one-half the rotation needed to change the direction of the piston rod movement. If the rod extends upon starting the pump, move the nut counter-clockwise until the rod begins to retract, then clockwise until the rod begins to move out again. Now position the rod to exactly one-half the rotation needed to change the direction of the piston rod movement.

CAUTION: Do not turn the nut back and forth more than is absolutely necessary to balance the valve, as this is a special friction nut.

3. With the valve balanced, it should be possible to move the rod in and out manually.
4. Turn off the engine and connect the cylinder rod to the frame bracket.
5. Restart the engine. If the front wheels (still on the hoist) do not turn in either direction from center the valve has been properly balanced. Correct the valve adjustment if necessary.
6. When the valve is properly adjusted, grease end of valve and install the dust cap.

POWER CYLINDER (Fig. 68)

Corvette

Removal

1. Disconnect the two hydraulic lines connected to the power cylinder and drain fluid into a container. Do not reuse.
2. Remove cotter pin, nut, retainer and grommet from power cylinder rod attached to the frame bracket.
3. Also remove grommet and retainer from bracket if replacement parts are required.

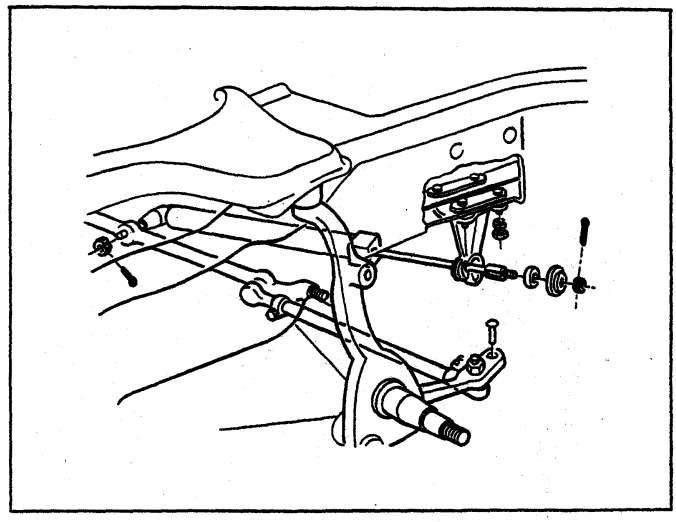


Fig. 68—Power Cylinder Installation-Corvette

4. Remove cottter pin, nut and ball stud at relay rod.
5. Remove the power cylinder from the vehicle.

Inspection

1. Inspect the seals for leaks; if leaks are present, replace the seals as outlined in the Chassis Overhaul Manual.
2. Examine the brass fitted hose connection seats for cracks or damage and replace if necessary.
3. For service other than ball seat or seal replacement and ball stud removal, replace the power cylinder.
4. Check the frame bracket parts for wear.

Installation

1. Install the power cylinder on the vehicle by reversing the removal procedure.
2. Reconnect the two hydraulic lines, fill the system with fluid and bleed out air using the procedure outlined under "Maintenance and Adjustments." Grease ball joint

POWER STEERING HOSES

When servicing the power steering hoses be sure to align the hoses in their correct position as shown in Figure 69.

It is important that the power steering hoses be installed correctly. Hoses installed out of position may be subjected to chafing or other abuses during sharp turns. Always make hose installations on Corvette with front wheels in straight ahead position. Do not twist hoses unnecessarily during installation.

CAUTION: Do not start engine with any power steering hose disconnected.

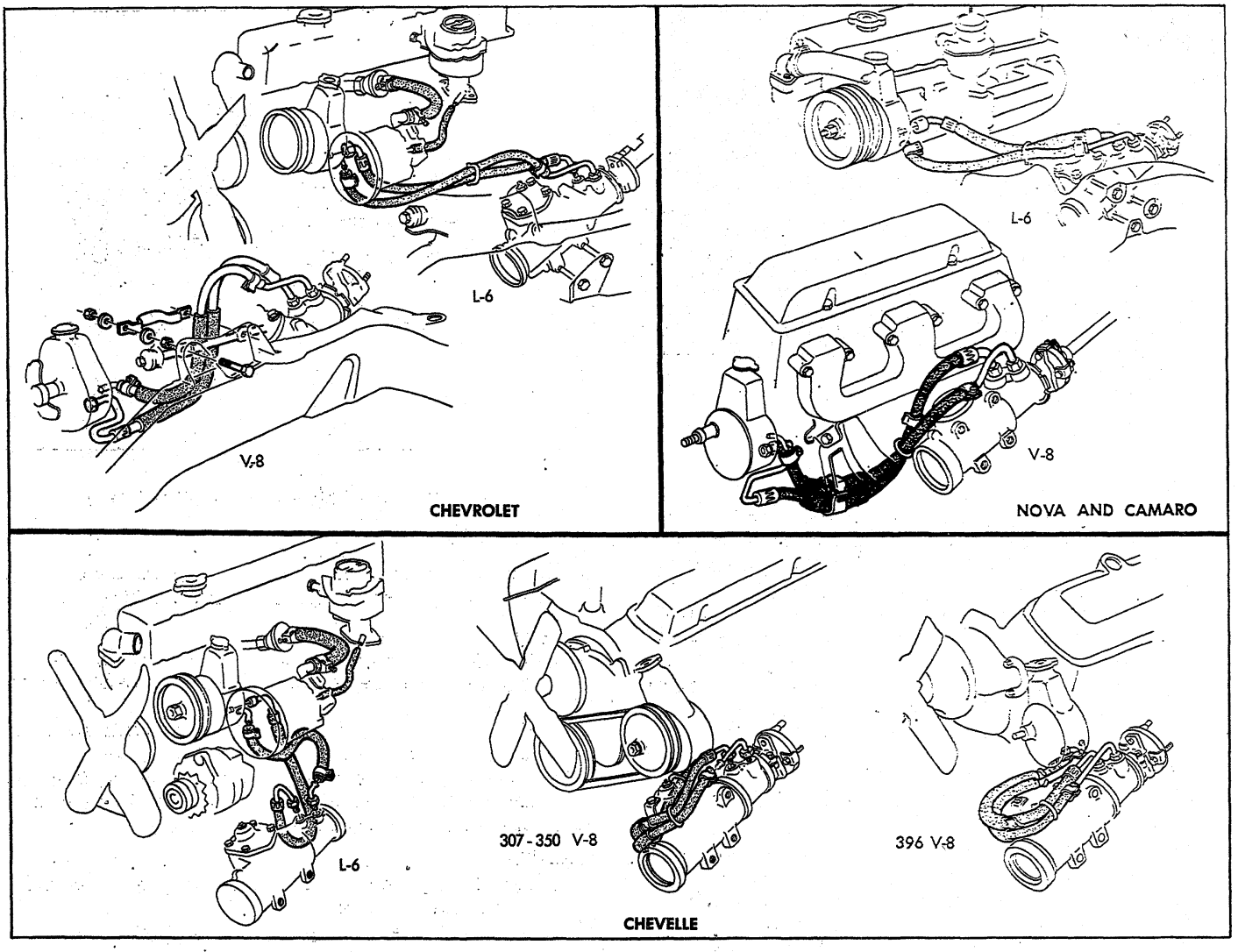


Fig. 69—Power Steering Hose Installation

SPECIAL TOOLS

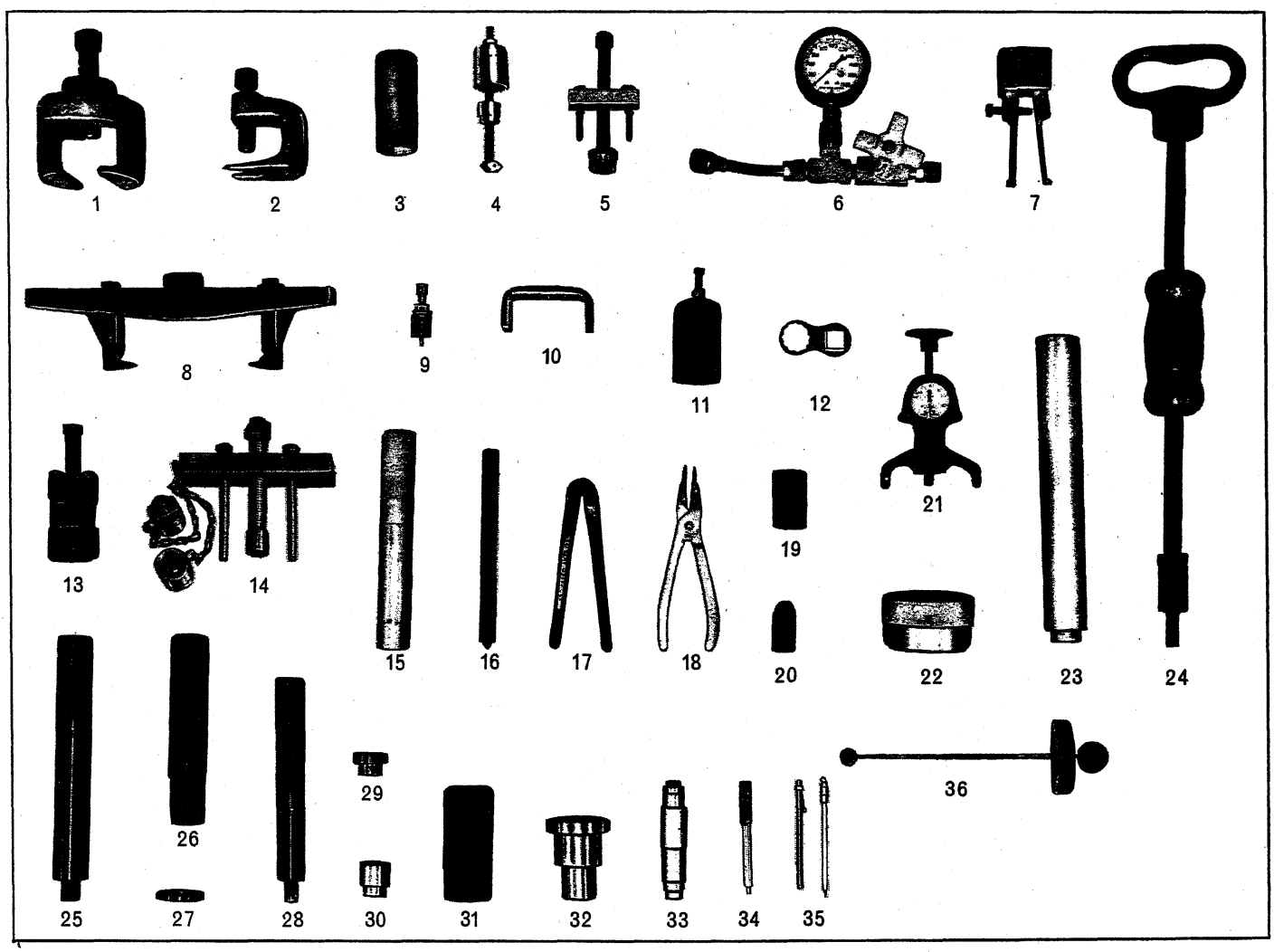


Fig. 70—Special Tools

1. J-6632 Pitman Arm Puller
2. J-5504 Pitman Arm Puller
3. J-23193 Tilt Column Locknut Socket
4. J-23073 Shift Tube Installer
5. J-23072 Shift Tube Remover
6. J-5176 Oil Pressure Gauge
7. J-5822 Wormshaft Bearing Cup Remover
8. J-8433 Pump Pulley Remover (Cast Pulley)
9. J-21854 Column Pivot Pin Remover
10. J-23131 Lock Plate Compressor
11. J-22191 Horn Contact Carrier Compressor
12. J-5860 Torque Wrench Adapter
13. J-21239 Pump Pulley Remover (Stamped Pulley)
14. J-2927 Steering Wheel Puller
15. J-1614 Sector Shaft Bushing Remover
16. J-7539 Ball Retainer
17. J-7624 Spanner Wrench
18. J-4245 #23 Internal Pliers
19. J-22670 Pump Shaft Seal Installer
20. J-6222 Shaft Seal Protector
21. J-7316 Belt Tension Gauge
22. J-8947 Rack-Piston Seal Compressor
23. J-5755 Wormshaft Bearing Cup Installer
24. J-2619 Slide Hammer
25. J-8092 Handle
26. J-6278 Pitman Shaft Bearing Remover
27. J-6278-2 Pitman Shaft Bearing Installer
28. J-7079-2 Handle
29. J-8524-1 Adjuster Plug Bearing Installer
30. J-8524-2 Adjuster Plug Bearing Remover
31. J-6219 Pitman Shaft Seal Installer
32. J-22407 Pitman Shaft Bearing Installer
33. J-8937 Ball Seal Remover
34. J-6217 Connector Seat Installer
35. J-5421 Thermometer
36. In. Lb. Torque Wrench
    Ft. Lb. Torque Wrench

SECTION 10

WHEELS AND TIRES

INDEX

	Page
General Description	10-1
Maintenance and Adjustments	10-1
Tires	10-1
Pressures	10-1
Inspection	10-1
Wear	10-1
Rotation	10-4
Noise	10-4
Cleaning	10-4
Change (w/Wheels)	10-4
Repair	10-4
Wheels	10-6
Valve Assembly	10-6
Balancing Wheels	10-6
Static Balancing (w/Tire)	10-6
Dynamic Balancing (w/Tire)	10-6
Run Out (w/o Tire)	10-7
Tire Wear Indicators	10-7
Service Operations	10-7
Tires	10-7
Removal	10-7
Installation	10-7
Rim	10-7

GENERAL DESCRIPTION

WHEELS

Chevrolet, Chevelle, Camaro, Chevy Nova and Corvette are base equipped with welded steel wheels. Five studs with nuts fasten each wheel to the front hub or rear axle flange. Disc brake equipped vehicles (except Chevrolet and Corvette) require special 14 inch diameter wheels with a revised design for clearance. Chevrolet disc brake equipped vehicles have 15 in. diameter wheels as do all Corvettes.

Chevrolet station wagons, Chevelle Super Sport 396 and Camaro Super Sport 350 are base equipped with 6 in. width wheels. All other vehicles have 5 in. width wheels, except Corvette models, which have 7 in. width wheels.

Do not install 6 inch width wheels or snow chains on Chevrolets equipped with rear fender skirts. Also, do not use tire chains on the rear wheels on Corvette or Camaro "SS" models. Clearance between tire and wheelhouse is insufficient to permit operation with chains installed.

TIRES

The factory installed tires on Chevrolet passenger cars are selected to provide the best all around tire performance for all normal operation. When inflated as recommended in the tire inflation pressure table they have the load carrying capacity to operate satisfactorily at all loads up to and including the specified full rated load at all normal highway speeds.

In addition, for those owners who may prefer the utmost in comfort, optional tire inflation pressures may be used with reduced loads.

Optional 8-Ply Rating Tires

Optional tires if listed in the tables in Specifications, Section 10 are not necessary on passenger cars for normal requirements. However, an extra margin of tire service is available when these options are used at loads up to and including full rated load.

On some models (example--Station Wagon), space limitations do not permit the use of a larger size tire; hence, the 8-ply rating tire is an available option. In either case, these tires are applicable to trailer towing or when an extra margin of tire service is desired. Use of a larger tire or an 8-ply rating tire should not be construed as permitting an increase in the full rated vehicle load.

MAINTENANCE AND ADJUSTMENTS

TIRES

Inflation Pressures

To insure the proper tire inflation pressure for the owners particular requirements follow the recommendations in the Vehicle Capacity Rating and Recommended Tire Inflation Pressures Table (see Specifications). Keep tires properly inflated, and check inflation pressures periodically. This will ensure the best tire life and riding comfort, over the full range of driving conditions.

Inspection

Every few thousand miles and at each lubrication, tires should be checked for sharp objects or stones in the tread. If tire is punctured, it should be repaired using one of several repair kits available through tire manufacturers' outlets.

Wear

Misalignment

This is wear due to excessive toe-in or toe-out. In either case, tires will revolve with a side motion and scrape the tread rubber off. If misalignment is severe, the rubber will be scraped off of both tires (or all four tires if front toe is not correct); if slight, only one will be affected.

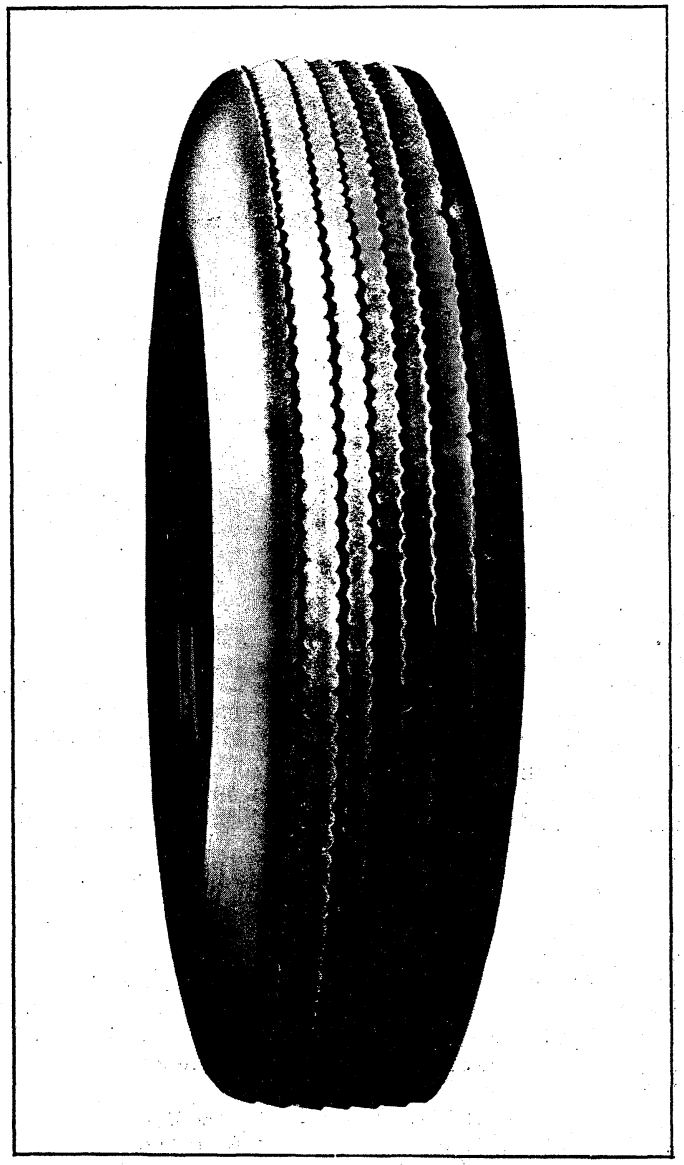


Fig. 1—Toe In or Toe Out Misalignment Wear

The scraping action against the face of the tire causes a small feather edge of rubber to appear on one side of the tread and this feather edge is certain indication of misalignment (fig. 1). The remedy is readjusting toe-in within specifications, or rechecking the entire front end alignment if necessary.

Heel and Toe

This is a saw-toothed effect where one end of each tread block is worn more than the other.

The end that wears is the one that first grips the road when the brakes are applied.

Heel and toe wear is less noticeable on rear tires than on front tires, because the propelling action of the rear wheels creates a force which tends to wear the opposite end of the tread blocks. The two forces, propelling and braking, make for more even wear of the rear tires, whereas only the braking forces act on the front wheels, and the saw-tooth effect is more noticeable.

A certain amount of heel and toe wear is normal. Excessive wear is usually due to high speed driving and excessive use of brakes. The best remedy, in addition to cautioning the owner of his driving habits is to interchange tires regularly.

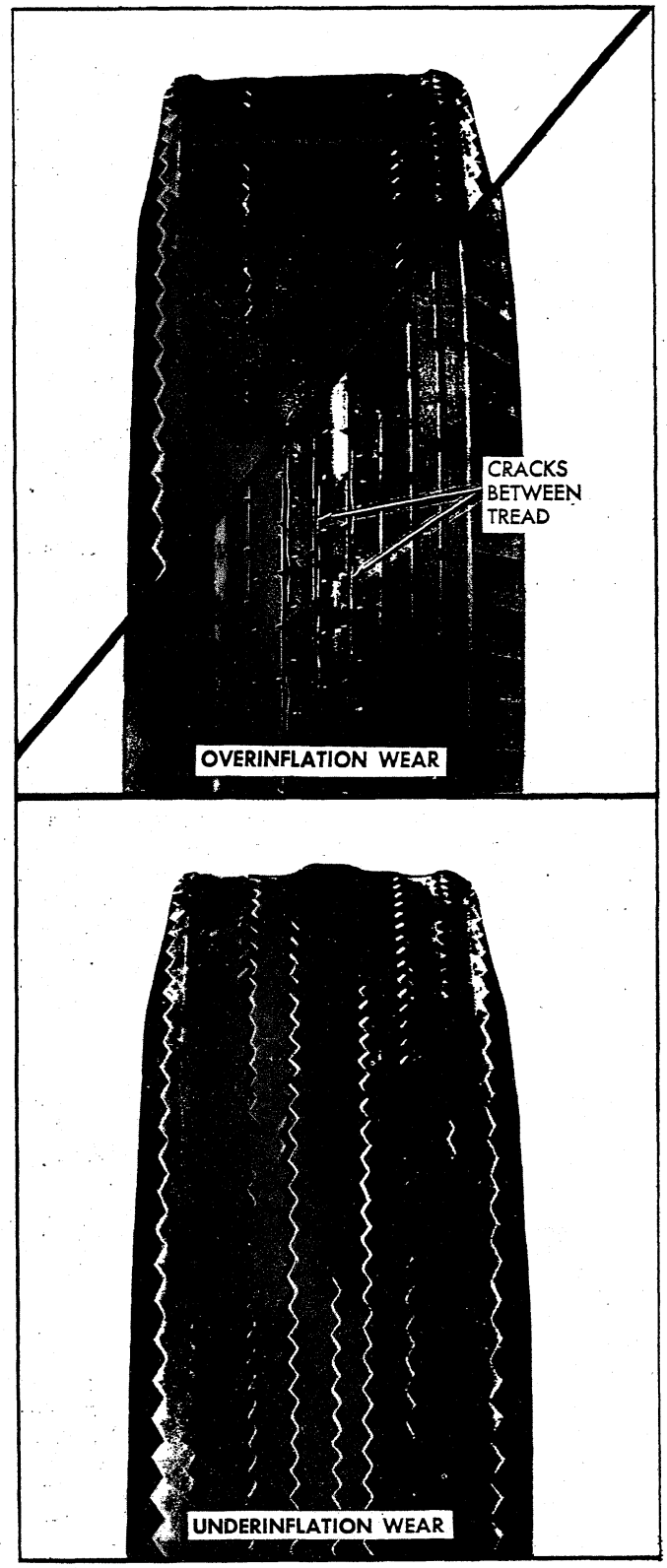


Fig. 2—Over and Under Inflation Wear

Side

This may be caused by incorrect wheel camber, underinflation, high cambered roads or taking corners at too high a rate of speed.

The first two causes are the most common. Camber wear can be readily identified because it occurs only on one side of the treads, whereas underinflation causes wear on both sides (fig. 2).

There is, of course, no correction for high cambered roads. Cornering wear is discussed further on.

Center

This is caused primarily by overinflation of the tire (fig. 2). Invisible fabric damage can also be caused by overinflation.

Uneven

Uneven or spotty wear (fig. 3) is due to such irregularities as unequal caster or camber, bent front or rear suspension parts, out-of-balance wheels, brake drums out-of-round, brakes out-of-adjustment, or other mechanical conditions. The remedy in each case consists of locating the mechanical defect and correcting it.

Cornering

Since the introduction of independent spring front and rear wheels, improvements in spring suspension have enabled drivers to negotiate curves at higher rates of speed with the same feeling of security that they had with the older cars at lower speeds. Consequently, curves are being taken at higher speeds with the result that a type of tire wear called "Cornering Wear" (fig. 4), frequently appears.

When a car makes an extremely fast turn, the weight is shifted from a normal loading on all four wheels to an abnormal load on the tires on the outside of the curve and a very light load on the inside tires due to centrifugal force. This unequal loading may have two unfavorable results.

First, the rear tire on the inside of the curve may be relieved of so much load that it is no longer geared to the road and it slips, grinding off the tread on the inside half of the tire at an excessive rate. This type of tire shows much the same appearance of tread wear as tire wear caused by negative camber.

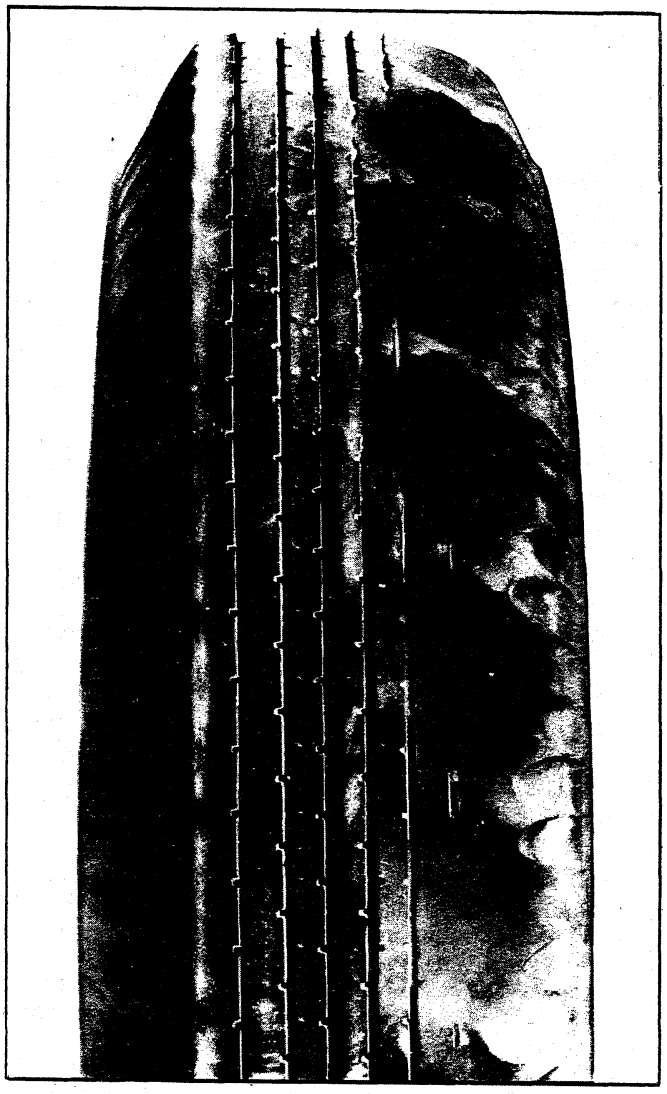


Fig. 3—Spot Wear

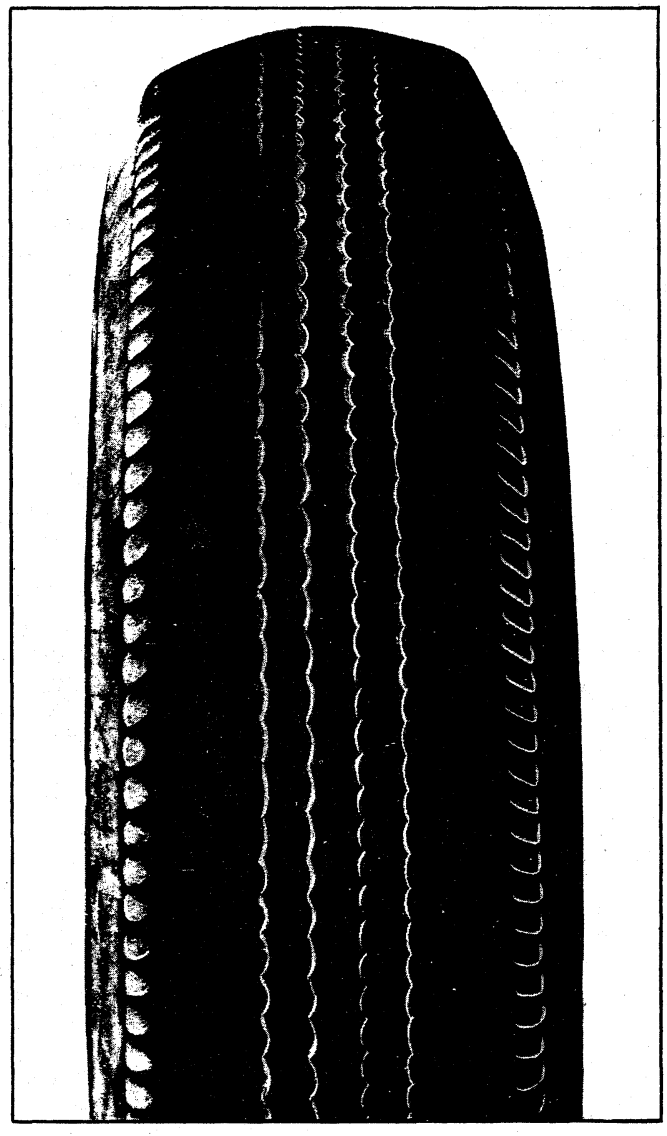


Fig. 4—Cornering Wear

Second, the transfer of weight may also over-load the outside tires so much that they are laterally distorted resulting in excessive wear on the outside half of the tire producing a type of wear like that caused by excessive positive camber.

Cornering wear can be most easily distinguished from abnormal camber wear by the rounding of the outside shoulder or edge of the tire and by the roughening of the tread surface which denotes abrasion.

Cornering wear often produces a fin or raised portion along the inside edge of each row in the tread pattern. In some cases this fin is almost as pronounced as a toe-in fin, and in others, it tapers into a row of tread blocks to such an extent that the tire has a definite step wear appearance.

The only remedy for cornering wear is proper driving habits.

Rotation

To minimize the possibility of tire noise and to equalize tire wear, it is recommended that tires be interchanged every 6000 miles as shown in Figure 5 or more frequently in the case of extremely heavy wear.

NOTE: Rotate Corvette tires at 4000 miles or sooner.

Interchanging tires will effectively prevent undue wear on any particular tire. If tire interchanging is followed as recommended above, all tires will have the same number of miles in each wheel position at the end of the fourth change. When interchanging tires, inspect for signs of abnormal wear, bulging, etc., stones, glass, and nails should be removed before reinstallation. Also, tire pressure must be adjusted (Front and Rear) in accordance with recommendations in the tire inflation table in Specifications, Section 10.

Noise

Noise caused by the normal action of tire treads on various road surfaces is often confused with rear axle gears or other noises in the car.

The determination of whether tires are causing the noise complained of is relatively simple. The car should be driven at various speeds and note taken of part throttle, and sudden acceleration and deceleration. Axle and exhaust noises show definite variations under these conditions, while tire noise will remain constant. Tire noise is, however, most pronounced at speeds of approximately twenty or thirty miles per hour.

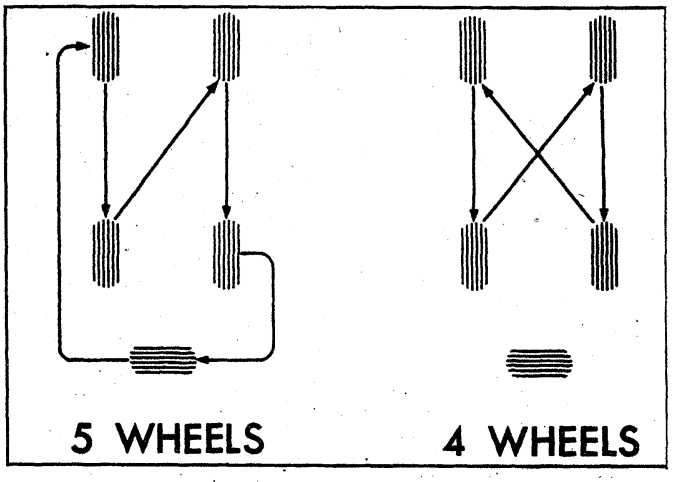


Fig. 5—Tire Rotation

The tires may be further checked by driving the car over smooth pavement with the tires at normal pressure and again over the same stretch of pavement when the tires have been inflated to fifty pounds pressure. Reduce the tires to normal pressure one at a time to determine the faulty tire or tires. This high inflation pressure should immediately be reduced to normal after test. If the noise for which the test is being made is caused by tires, it will noticeably decrease when the tire pressure is increased, whereas axle noise should show no change in volume.

If, on inspection, the tires on the front wheels are found to be creating most of the noise the alignment of the front wheels should be checked. Excessive tire noise usually results from lower than recommended tire pressure, incorrect alignment, uneven tire wear, or defective (thumper) tire.

Cleaning

A great deal of ordinary road dirt which collects on red or white sidewall tires may be sponged off with clear water or a mild soap solution.

A good brand of whitewall tire cleaner, however, is a quicker and more effective cleaner for removing dirt and stains from whitewall tires and in many cases it will remove stains and discoloration that the simpler method fo soap and water will not remove.

Under no circumstances should gasoline, kerosene or any cleaning fluid containing a solvent derived from oil be used to clean whitewall tires. Oil in any form is detrimental to tire rubber and a cleaner with an oil base will discolor or injure whitewall tires.

Change (W/Wheels)

To change the road wheels using the jack that comes with the car, observe the following procedure:

1. Set hand brake and block front wheels if rear wheel is being changed.
2. Remove hub cap or wheel disc and break wheel mounting nuts loose.
3. Place the jack as directed under, General Information, Section 0 and raise car until wheel clears ground.
4. Remove wheel mounting nuts and remove wheel from hub or drum.
5. To replace road wheel, reverse the above instructions. Proper torque on nuts is 55-75 ft. lbs. torque.

CAUTION: On models equipped with discs, index the pilot hole in the disc on the valve stem. (To insure that the anti-rotation notches in wheel disc register on lugs in wheel rim.)

Repair

When a tire loses all or most of its air pressure, particularly when driving at high legal speeds on today's super highways, recommended procedure is to remove it from the wheel for complete inspection to be sure no tire damage has occurred. Punctured tires should be removed from the wheel and permanently repaired from the inside.

Externally applied plug type repairs should be considered temporary and the tire should be permanently repaired as soon as possible.

REPAIRS

Inspection

When a tire is brought in for repairs, the sidewall and tread should be examined for damage or extraordinary wear. Nails or other damaging material should be removed and their places of puncture noted with chalk. If a tank is available, the tire and rim should be submerged for bubble evidence of leaks. Particularly look for leaks around the rim, at the valve and along the tread. Carefully examine the bead and rim at any point where leakage is detected.

If a tank is not available, apply a soapy solution to the tire and look for bubbles or foam evidence of leaks.

As you examine the tire, look for not only punctures and other obvious injuries, but signs of swelling or blistering, especially in the shoulder area. Remove the tire from the rim once your inspection is complete. Take care not to damage the bead or liner. Once the tire is off the rim, examine its interior for signs of damage.

NOTE: A ply separation near a puncture or other injury may not be readily apparent, as the air will escape through the injury. Probing is the only way to detect separation here.

Never Repair a Puncture in a tire with:

1. Ply separation.
2. Chafer fabric injuries on tubeless tires.
3. Broken or damaged bead wires.
4. Flex breaks.
5. Loose cords on the band ply or evidence of having been run flat.
6. Tread separation.
7. Wear below 1/16" depth in major grooves.
8. Cracks which extend into the tire fabric.
9. Any open liner splice which shows exposed fabric.
10. Any tire with a liner showing evidence of having been run under-inflated or under excessive overload.

Rubber Plug Method (Internal Repair)

Preparation of Injury

Thoroughly dry area around injury. Pour vulcanizing fluid on probe tool, and probe injury carefully from outside the tire. Follow the path of the injury to avoid making a second hole in the liner. If hole is too small to probe, a plug is not required. Buff inner liner and pour a small amount of self-vulcanizing fluid over the injury and spread evenly with clean tool or finger.

Repair

1. BUFFING: First scrape the inner tire surface around the injury with a sharp-edged tool. Then buff with a hand buffer or a soft-wire brush. Scrape and buff an area slightly larger than the size of the patch you intend to use. Take care not to damage the liner or expose the tire cords.
2. LUBRICATE the injury from the inside and outside of the tire by pushing the snout of the vulcanizing fluid can into the injury. Then wet the plug insertion tool with fluid and push this through the injury with a twisting motion until the plug tool can be inserted and withdrawn easily.
3. USING a head-type or headless straight plug slightly larger than the size of the hole, place it in eye of insertion tool so one end extends less than 1/4" from tool eye.
4. LUBRICATE PLUG AND TOOL with vulcanizing fluid. Pour the fluid directly from the can to the plug and tool. Take care that no dirt drops onto plug and tool at this point.
5. INSERT PLUG INTO INJURY from inside the tire. Hold and stretch the long end of the plug as it is forced into the injury until one end extends through it.
6. REMOVE TOOL and cut off plug 1/16" above the surface(s). Do not stretch plug while cutting. Do not wash previously repaired surface with solvent before applying vulcanizing fluid.

NOTE: Headless straight plugs should be backed up with either a cold self-vulcanizing patch or a hot patch. Patches are not required with head-type plugs.

Cold Patch Method

1. POUR A SMALL AMOUNT of self-vulcanizing fluid over and around the injury and spread evenly with a clean tool or finger. Allow to dry 5 minutes. Always pour self-vulcanizing fluid directly from the can to keep dirt and other impurities from contaminating the solution remaining in the can. Always use the fluid the manufacturer supplies (or recommends) with the patches, since different brands of fluid vary chemically.
2. WHEN REMOVING BACKING FROM PATCH be careful that the adhesive is not contaminated or disturbed. Then center patch, base side down, over injury. Stitch patch down firmly with the stitching tool. Work from the center out. Take care to stitch down edges to insure proper adhesion.
3. BEFORE REMOUNTING TIRE, inspect rims for sharp edges or burrs. File these down to give you a smooth surface. Clean rim with a wire brush to remove old rubber, rust, dried soap, caked paint, etc. Lubricate beads and rim. Insert core in valve stem. Inflate tire to 40 pounds pressure to fully seat tire beads on rim. Check for leakage with water or soap suds and adjust air pressure to recommended levels.

Hot Patch Method

THE HOT PATCH METHOD utilizes heat to vulcanize the patch to the tire and the plug repair. The steps to be followed are essentially the same as those for the cold patch method. The scraped and buffed area is covered with a light coating of cement of the type specified for the patch being used, the backing is carefully removed from the patch and centered base down over the injury. The clamp is placed over the patch and tightened. Finger tighten only. Do not use a wrench or pliers. Heat is applied, the patch is cured and allowed to cool. When cool, remove clamp.

REMOUNT THE TIRE in accordance with procedures outlined above for cold patches.

Tire Installation Safety Precautions

When tires are mounted on dirty or corroded rims, or when they are not properly centered on rims, the tire bead may "bind" on the rim, and refuse to seat. Allowing pressure to continue to build up within the assembly in

an attempt to seat the tire bead is a DANGEROUS PRACTICE which can result in a broken tire bead, and serious injury to the serviceman.

1. Make sure that rim flanges and bead ledge (especially hump and radius) areas are smooth and clean. Remove any oxidized rubber, dried soap solution, rust, heavy paint, etc. with a wire brush, or, in extreme cases, a file.
2. Lubricate tire beads, rim flanges, and bead ledge areas with a liberal amount of thin vegetable oil soap solution, or approved rubber lubricant.
3. Insure that air pressure build-up during the bead seating process is not allowed to exceed 40 pounds pressure. If beads have not seated by the time pressure reaches 40 pounds, assembly should be deflated, re-positioned on rim, re-lubricated and re-inflated.
4. Make sure valve core is inserted in valve stem prior to inflating.
5. Use an extension gauge with clip on chuck so air pressure build-up can be closely watched and so that you can stand well back from the assembly during the bead seating process.

WHEELS

Valve Assembly

Replace

NOTE: Always use new valve assembly when replacing.

1. Cut or drive old valve assembly out of rim.
2. Clean valve hole and surrounding area on inside of flange with steel wool.

BALANCING WHEELS

The wheel and tire assembly should be removed from vehicles equipped with disc brakes to properly perform balancing operations. This is necessary due to drag of the spring loaded brake shoes on the disc.

Static Balancing (W/Tire)

Static Balance (still balance) is the equal distribution of weight of the wheel and tire assembly about the axis of rotation so that the assembly has no tendency to rotate by itself. Static unbalance causes the pounding action of the front wheels that is called "tramp".

To correct static unbalance (front and rear): The quickest and best methods to correct static unbalance are through the use of wheel balancers which are commercially available. Refer to the Information and instructions included with these balancers.

Dynamic Balancing (W/Tire)

Dynamic Balance (running balance) requires the wheel to be not only in static balance, but balanced and running smoothly while turning on an axis which runs through the centerline of the wheel and tire perpendicular to the axis of rotation.

The quickest and best methods of testing and correcting dynamic unbalance are by the use of dynamic wheel balancers which are commercailly available. These balancers include all necessary information on where and how the balancing weights should be placed. The following information, however, will help in the correction of dynamic balance.

NOTE: Before attempting to balance the wheels, check to be certain that no foreign matter has been trapped in the wheel ventilation slots or in the accessory wheel discs. This is especially important if the vehicle has been run in soft mud and then parked in freezing weather.

When a wheel that is statically unbalanced is dynamically in balance the dynamic balance can be retained while correcting the static balance by installing the corrective weights so that half of the weight required is placed on the inner edge of the rim and the other half on the outer edge of the rim.

Dyanmic unbalance can be corrected without destroying static balance by installing weights so half of weight required for dynamic balance is placed on the rim opposite the heavy point, while the other half is placed 180° away and on the opposite side of the rim.

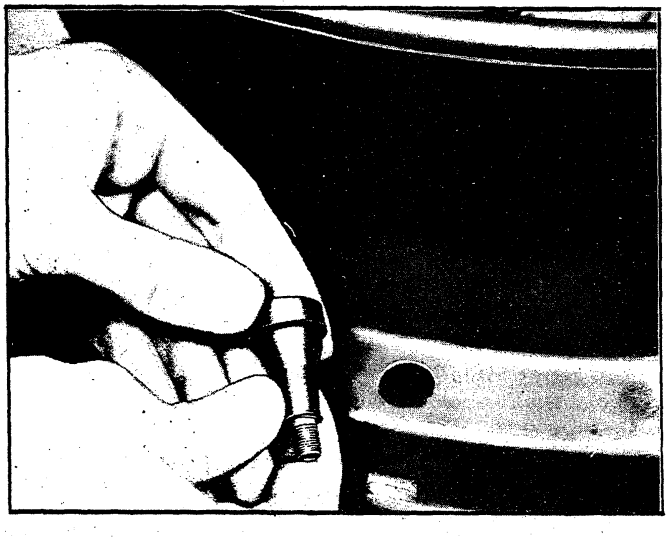


Fig. 6—Installing Valve

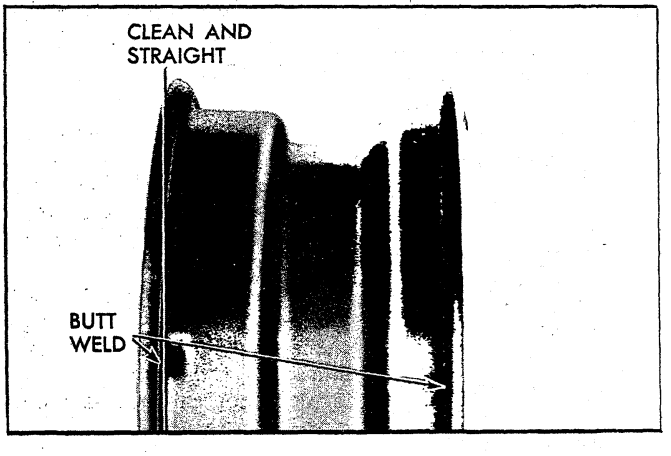


Fig. 7—Rim Inspection

NOTE: Vehicles with wire wheel covers should have the wheels balanced with the wire wheel covers installed on the wheels.

Run Out (W/O Tire)

The wheels should not run out (wobble) more than 1/16" as measured on the side of the rim at the base of the tire. Excessive run-out is the result of a bent wheel, an improperly mounted wheel, worn knuckle bearings or steering connections. These parts should be checked for correct adjustment, proper alignment and wear whenever excessive run-out is encountered.

The wheels should also run concentric with the steering knuckle spindle within 1/16 inch as measured on the tire bead seat of the rim with the tire removed.

Wheel run-out, eccentricity and balance are closely associated with steering and front wheel alignment. Further information on these subjects will be found under "Suspension".

Tread Wear Indicators

A decrease in driving, cornering and braking traction occurs under inclement weather conditions as tires become worn out. Moreover, worn tires have lessened resistance to road hazards. The original equipment tires on Chevrolet vehicles incorporate built-in tread wear indicators (fig. 8) to assist you in determining when tires have been worn to the point of needing replacement. These indicators are molded into the bottom of the tread grooves and will appear as 1/2-inch wide bands when the tire tread depth becomes 1/16 of an inch. When the indicators appear in two or more adjacent grooves, tire replacement due to tread wear is recommended.

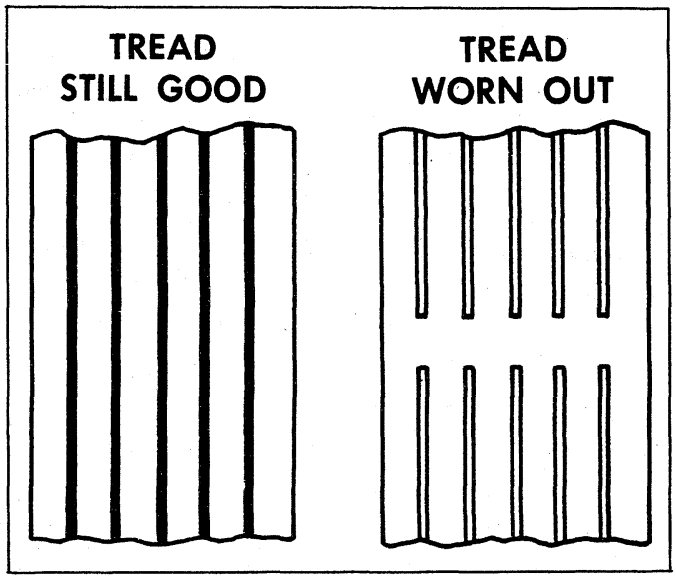


Fig. 8—Tread Wear Indicators

SERVICE OPERATIONS

TIRES

Removal

Dismounting tubeless tires presents no problems if the correct procedures are used and the following precautions observed.

1. Remove the valve cap and valve core. Let out all the air.
2. Press the inner side of the tire into the rim well. Use bead loosening tool or if regular tire irons are used, take particular care not to injure or tear the sealing ribs on the bead.

   CAUTION: Never use tire irons with sharp edges or corners.

3. Using tire irons on the opposite side, remove bead, taking small "bites" around the rim.
4. Turn the tire over, and use two tire irons, one between the rim flange and the bead to pry the rim upward, the other iron to pry outward between the bead seat and the bead.

Installation

Extreme care must be exercised to prevent injury to the sealing bead and circumferential bead when forcing tire over rim.

1. Apply a light film of Ruglyde or other suitable rubber lubricant to sealing bead of tire.

   NOTE: The use of excessive lubrication may lead to rim slippage and subsequent breaking of air seal.

2. Carefully mount the outer bead in usual manner by using tire irons, taking small "bites" around rim, being careful not to injure the tire bead.

   CAUTION: DO NOT use a hammer, as damage to the bead will result.

3. Install the inner bead in the same manner.

   NOTE: If a seal cannot be effected in the foregoing manner with the rush of air it can be accomplished by applying to the circumference of the tire a tire mounting band or heavy sash cord and tightening with the use of a tire iron. On tire mounting machines, bouncing the tire assembly is not required. The tire should be lifted on the rim to force the top tire bead against the top rim flange. The weight of the tire will seat the bottom bead.

4. Coat O.D. of new valve assembly liberally with the mounting compound.
5. Insert assembly through rim from inside (fig. 6). Snap into place, using a pair of slip-joint pliers with one jaw on rim and one jaw on base of valve assembly.

Rim

Repair

1. Straighten the rim if it is bent or dented.
2. Clean rim flange thoroughly with small piece of steel wool or sand paper.
3. Inspect the butt-weld in the rim flange area to make certain there is no groove or high spot (fig. 7).
4. If air loss occurs at valve it can be corrected by replacing valve core or valve assembly.

SECTION 11
CHASSIS SHEET METAL

CONTENTS OF THIS SECTION

	Page
Chevrolet and Chevelle	11-1
Chevy Nova	11-11
Camaro	11-16
Corvette	(See Section 1B)
Special Tools	11-20

CHEVROLET AND CHEVELLE

INDEX

	Page
General Description	11-1
Maintenance and Adjustments	11-1
Hood Adjustment	11-1
Hinges	11-1
Bumpers	11-1
Catch Assembly and Lock	11-1
Sheet Metal Adjustments	11-1
Fenders	11-1
Component Part Replacement	11-2
Battery Tray	11-2
Radiator Support	11-2
Fender Assembly	11-3
Skirt	11-4
Trim	11-4
Hood Assembly	11-4
Lock and Catch	11-4
Trim and Insulation	11-4
Rear Wheel Cover	11-4
Simulated Wood Grain Moulding	11-5

GENERAL DESCRIPTION

The new front end appearance of the 1969 Chevrolet and Chevelle passenger cars affects the servicing and replacement of the chassis sheet metal. Refer to Section 13 for Radiator and Grille service procedures, Section 14 for Bumpers, and Section 1A for Heater and Air Conditioning. Figures 1 and 2 illustrate the Chevrolet and Chevelle sheet metal components.

MAINTENANCE AND ADJUSTMENTS

HOOD ADJUSTMENT

The alignment of the hood is controlled by the position of the hood hinges and the height of the two bumpers located one at each side of the radiator support. The adjustment at the hood lock must be made after the hinges and bumpers are properly adjusted. To align the hood and lock proceed as follows:

HOOD HINGE (Fig. 3)

NOTE: The body mounted portion of the hood hinges are slotted to provide up and down movement. The hood mounted end is slotted to provide forward and rearward movement.

1. Scribe a line around the entire hinge plate to be repositioned.
2. Loosen the appropriate screws and shift the position of the hood into correct alignment using the scribe marks to check amount of movement. Check alignment by tightening screws and closing the hood

HOOD BUMPERS

Adjust hood bumpers so that hood top surface is flush with the fender and grille top surfaces. Refer to Figures 4 and 5 for correct sheet metal adjustment dimensions.

HOOD CATCH AND LOCK

The hood catch assembly (figs. 7, 8, 9 and 10) mounting holes are slotted to provide adjustment for the hood lock bolt. Adjust the hood lock bolt until hood engages securely when closed and hood bumpers are slightly compressed.

SHEET METAL ADJUSTMENTS

For proper operation of doors and hood, and for presentable appearance, adjust front sheet metal shown in Figures 4 and 5.

FENDERS

Fenders are adjustable with shims at the cowl and rocker panel. To add or remove shims, loosen bolts at shim locations (fig. 11 and 12) and carefully apply force with pry bar to provide clearance for shim removal or installation.

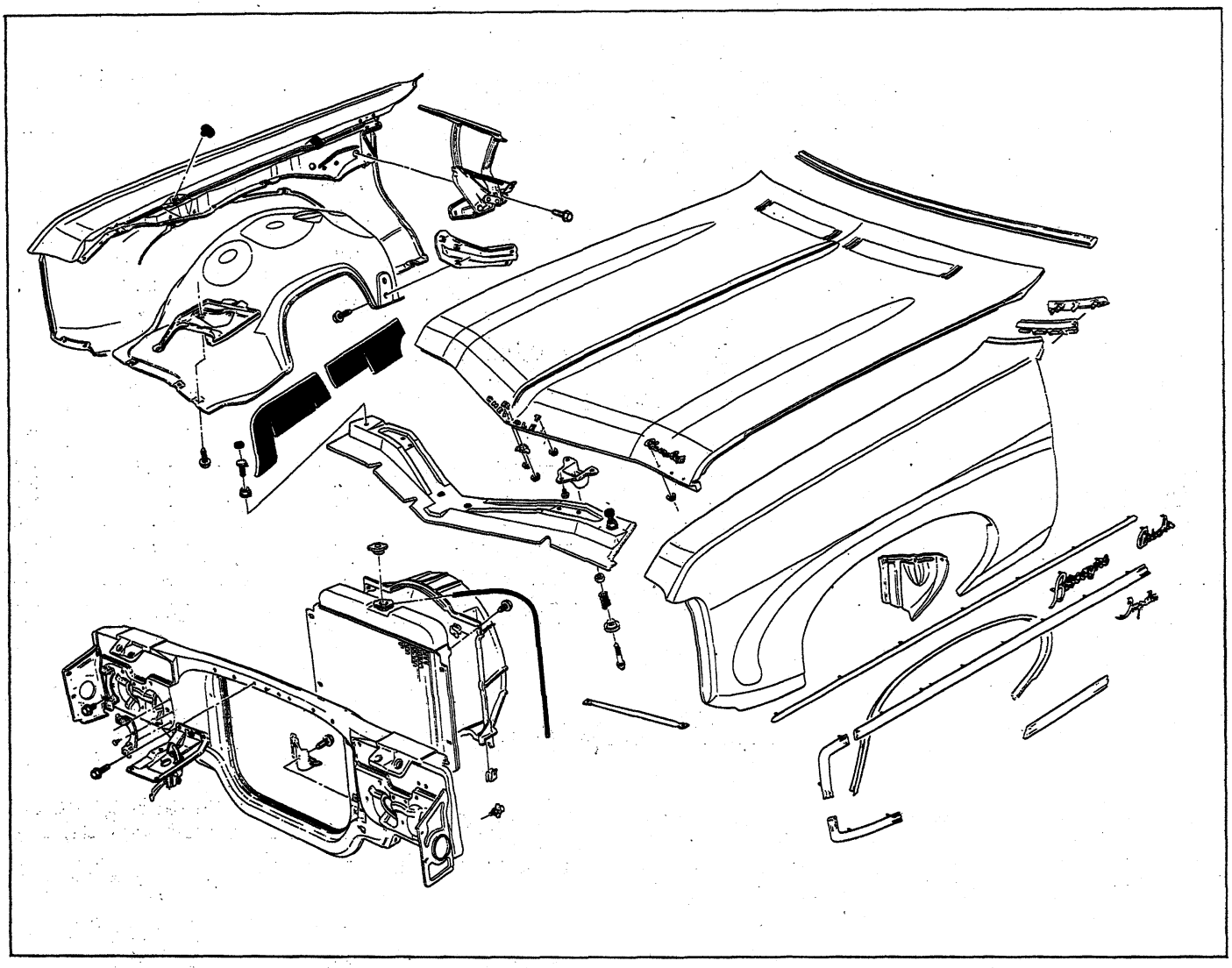


Fig. 1—Front End Sheet Metal—Chevrolet

COMPONENT PART REPLACEMENT

NOTE: When replacing sheet metal components on Chevrolet or Chevelle, note position and attachment of all seals and dust shielding and replace as necessary.

BATTERY TRAY

Removal

1. Disconnect battery cables.
2. Remove screw retaining battery hold down clamp and remove battery from vehicle.
3. Remove screws retaining battery tray to fender skirt and radiator support.
4. On Chevrolet, remove headlamp bezel and remove screw retaining tray to radiator support.
5. Remove battery tray from vehicle.

Installation

Reverse removal procedure.

RADIATOR SUPPORT

Removal

NOTE: Remove battery ground cable.

1. Remove front bumper (Section 14).
2. Remove grille and related components (See Section 13).
3. Remove battery tray as outlined.
4. Remove all electrical components and connections from radiator support.
5. Detach shroud or radiator from radiator support.
6. Remove screws and bolts securing the support to fender braces, extensions, skirts, fenders and frame horns (figs. 13 thru 17).
7. Spread fenders apart sufficient to allow support removal.

Installation

1. Position the radiator support in vehicle, aligning

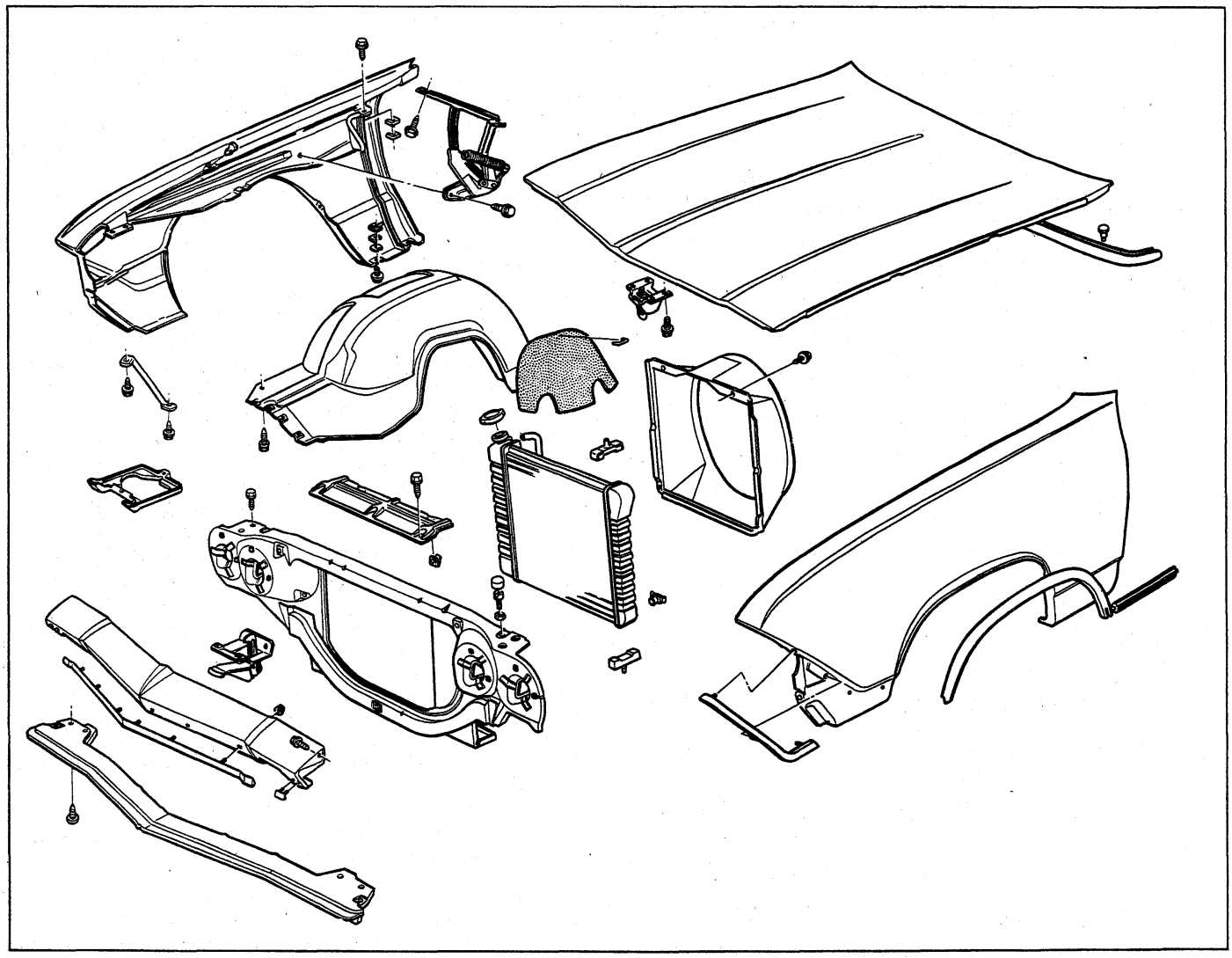


Fig. 2—Front End Sheet Metal—Chevelle

mounting screw and bolt holes with drift punch.
2. Replace all parts removed following removal procedure in reverse order.
3. Install screws and bolts loosely until all are started.
4. Refer to torque specifications in rear of manual for correct torque values.
5. Aim headlamps as outlined in Section 12.

FENDER ASSEMBLY

Removal

NOTE: Disconnect battery ground cable. Also disconnect both cables and remove battery from vehicle if right-hand fender is being removed.

1. Place vehicle on hoist.
2. Remove bumper (See Section 14).
3. Remove hood with hinges from vehicle as outlined in this section.
4. Disconnect header panel (Chevelle only).
5. Remove fender filler (rubber)--Chevrolet only.
6. Remove headlamp bezels and headlamps (See Section 12).
7. Disconnect cables, battery tray (R.H. side) wiring harness clips, load level cylinder, etc., from fender skirt to be removed with fender.
8. Remove fender brace.
9. Remove screws retaining fender to radiator support, skirt, cowl, filler panel, including filler panel extensions and rocker panel. Note number and location of shims removed from locations in Figures 11 and 12.

   NOTE: Retain one or two forward and aft fender screws before final disassembly from vehicle.

10. If applicable, remove radio antenna.
11. Remove final few attaching screws and remove fender from vehicle.

Installation

1. Reverse removal procedures.
2. Refer to removal procedure for location of screws and install screws at rocker panel and cowl and adjust fender before tightening other screws. Always

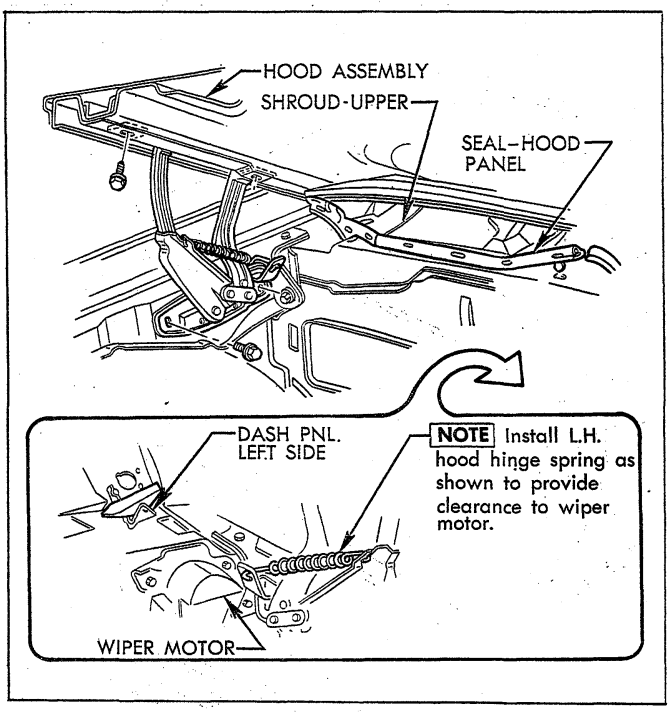


Fig. 3—Hood Hinge—Chevrolet

start adjustment with original amount of shims, then add or remove shims as required.

3. Remove vehicle from hoist.

FENDER SKIRT

Removal

1. Remove fender as outlined.
2. Jack up front end of vehicle and remove wheel.
3. Remove all wires, hoses, accessories, etc. attached to skirt; also remove bolt attaching battery tray bracket to skirt. Remove battery.
4. Remove battery tray bolt attachment.
5. Remove screws securing brace to skirt and dash panel and remove brace.
6. Remove skirt attaching screws and remove skirt from vehicle.

Installation

Install skirt and fender following the removal procedure in reverse order. Refer to torque specifications in rear of manual for correct torque values.

FENDER TRIM

On Chevelle, to gain access to spear molding and emblem retaining nuts, remove skirt to fender flange screws top center rearward and pry skirt forward several inches. Wedge skirt in this position with a wood block and remove nuts from inside fender retaining molding to fender. Emblem attaching hardware is accessible from inside engine compartment.

On Chevrolet, open front door and rear inside door hinge pillar for access to trim retaining nuts. Remaining trim retaining nuts, and emblem retaining nuts are accessible from inside engine compartment.

HOOD ASSEMBLY (Fig. 18)

Hood may be removed either with or without hinges. To shorten aligning time, scribe a mark on hood around the hinge plate. See adjustment procedures in this section for hood adjustment. Hood hinge springs may be easily and safely removed and installed using Tool J-9559 as follows:

1. Remove bolt from Tool J-9559. Open hood far enough to allow passage of tool between hood and fender and insert ends of tool between coils of spring until barrel of tool contacts outer diameter of spring.
2. Open hood full while holding spring (with tool installed) in hand; when hood is in opened position, remove spring as shown in Figure 19.
3. When spring is removed, insert long bolt supplied with J-9559 through holes in ends of tool, passing it through spring, and install nut on bolt.

Spring may be removed from J-9559, or J-9559 may be installed in a new spring by the following method:

1. Place a closed 6 or 8 inch "C" clamp in a vise or fasten it to a heavy bench top (bench should be fastened to floor).
2. Hook one end of spring in clamp and the other end in hook of hoist as shown in Figure 20.
3. Stretch the spring enough to allow insertion of J-9559. Install bolt if spring is not to be installed on hinge at once.

HOOD CATCH AND LOCK (Figs. 7, 8, 9 & 10)

Removal

1. Remove catch plate assembly by removing screws retaining catch to radiator support, center support, and tie bar.
2. Remove lock plate by removing screws retaining lock plate to hood and remove lock plate.

Installation

1. Install lock and catch plate following the removal procedure in reverse order. Refer to torque specifications in rear of manual for correct torque values.
2. Adjust lock and catch plate as outlined under adjustment procedure in this section.

HOOD TRIM AND INSULATION (Fig. 21)

Figure 21 shows the Chevrolet installation details of both the hood ornamentation and insulating pads. The hood emblem and molding retaining nuts may be reached from the underside of the hood panel. Refer to Fig. 22 for Chevelle hood grille and grille emblem.

REAR WHEEL COVER (CAPRICE, AND OPTIONAL ON OTHER CHEVROLET MODELS EXCEPT STATION WAGONS)

Removal and Installation

Lift the skirt (fig. 23) retaining lever (at the bottom inside skirt flange) over the lip of the flange and pull it downward. Pull the skirt downward and out of the opening. To install the skirt: position it inside the opening, insert the rod into the slot, lift the skirt and attach the hook to the wheel opening flange. Hold the skirt from below and behind to assure proper hook attachment then lift the retaining lever up and into the skirt lip. Check to insure cover is firmly engaged to fender.

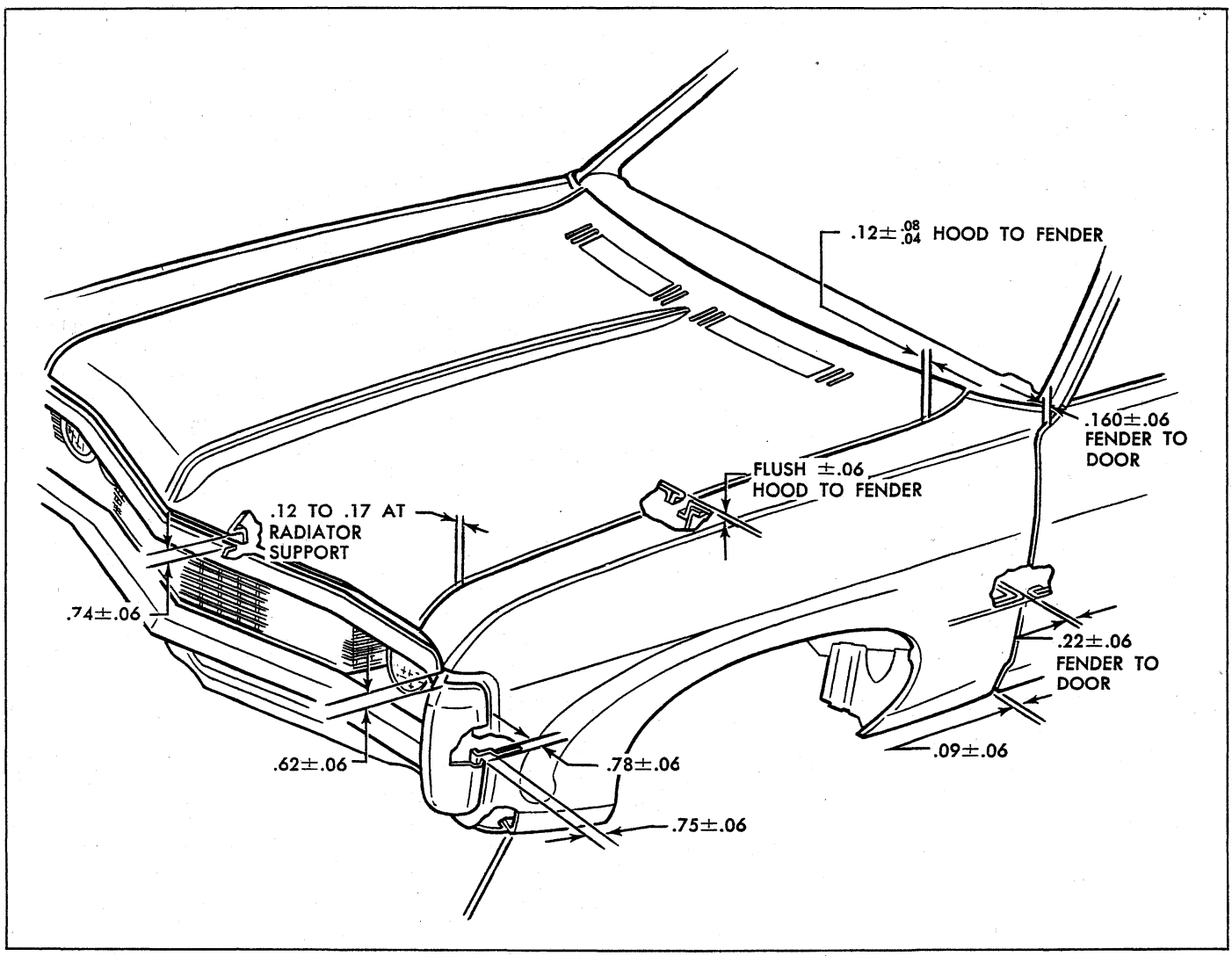


Fig. 4—Sheet Metal Adjustments—Chevrolet

WOOD GRAIN TRANSFER INSTALLATION PROCEDURE—CHEVELLE

1. Wipe clean the entire fender surface to be covered with the transfer with a sponge dampened with Solvent.
2. Wipe cleaned surfaces dry with clean cloth.
3. Apply a bead of adhesive to the fender rear edge weld flange for the entire wrap around width of the transfer.
4. Prior to application of transfer, wet down the complete transfer surface of the fender with a solution of 1/4 oz. of cleaner per gallon of clear water. It is essential that no substitute for this solution be used and that the specified proportions be maintained.
5. While entire area is still wet with solution, remove paper backing from transfer and align upper edge with pierced holes in fender and press on lightly.
6. Start at center of transfer and squeegee outboard from middle to edges removing all air bubbles and wetting solution to assure a satisfactory bond. Use teflon-backed plastic squeegee only.
7. Notch out the transfer at the rear edge and around the wheelhouse opening as necessary to provide secure installation of transfer to fender surface in these areas.
8. Fold the end of the transfer over the rear fender flange, heat to approx. 90°F with heat gun, and press squeegee to secure entire edge surface of transfer to the fender.
   a. Best results are obtained when metal temperature is 70°-90°F. Use heat gun or allow cooling time when metal is outside this approx. temperature range.
   b. The transfer should not be subjected to temperature greater than 175°F and should not be left at or near this temperature for extended periods of time.
   c. Shelf life of the transfer material is 90 days at a temperature not to exceed 105°F.

SIMULATED WOOD GRAIN MOULDING

The wood grain transfer film is a vinyl material with a pressure sensitive adhesive backing. The transfers

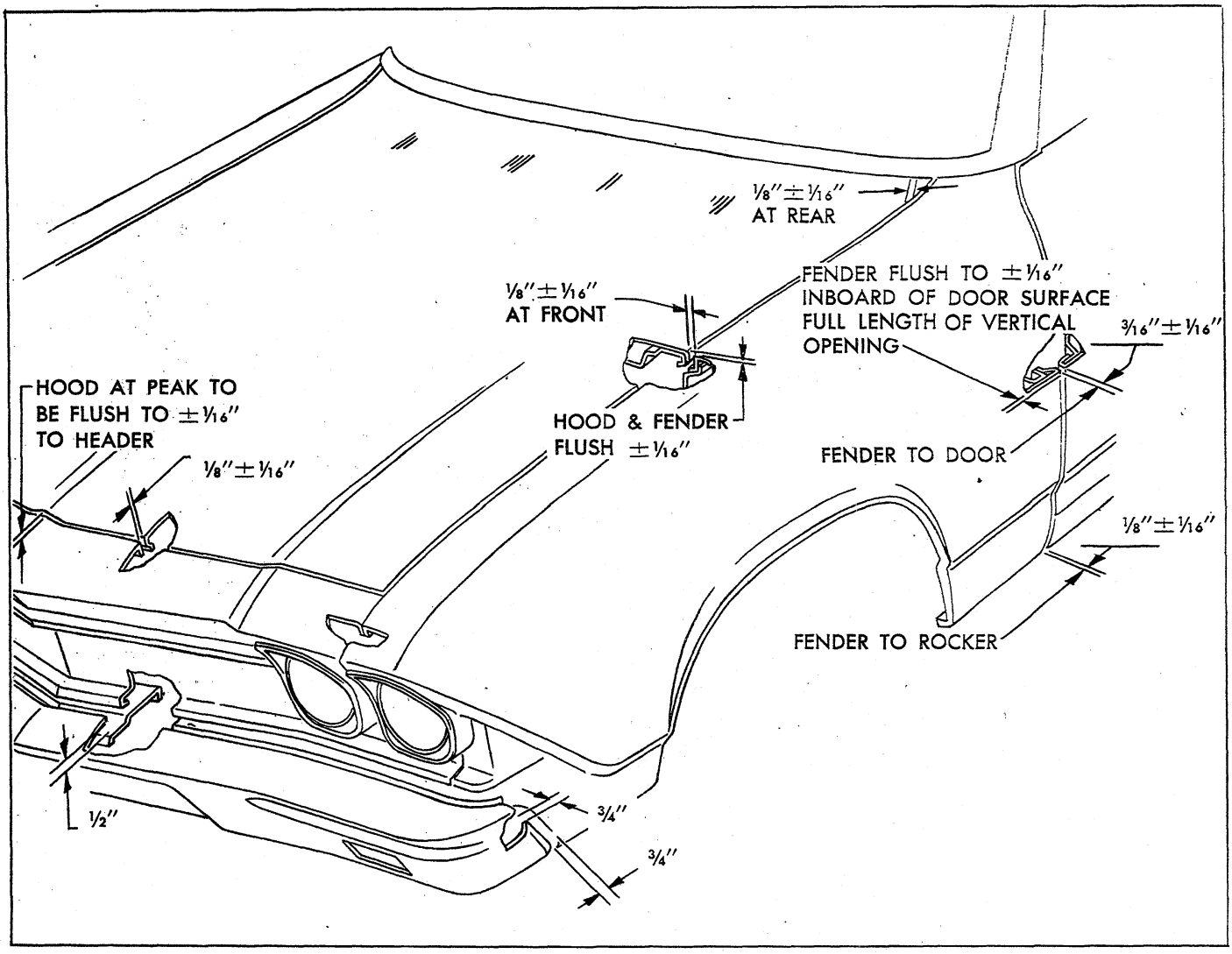


Fig. 5—Sheet Metal Adjustments—Chevelle

are serviced in pre-cut panels. The shelf life of this material is 90 days at a maximum temperature of 105°F.

Removal

Remove the moldings from the affected panel. Remove the transfer film by lifting an edge and peeling the material from the painted surface. Exercise care so as not to damage the paint.

NOTE: Application of heat to the transfer and panel with a heat gun or heat lamp will aid in the removal.

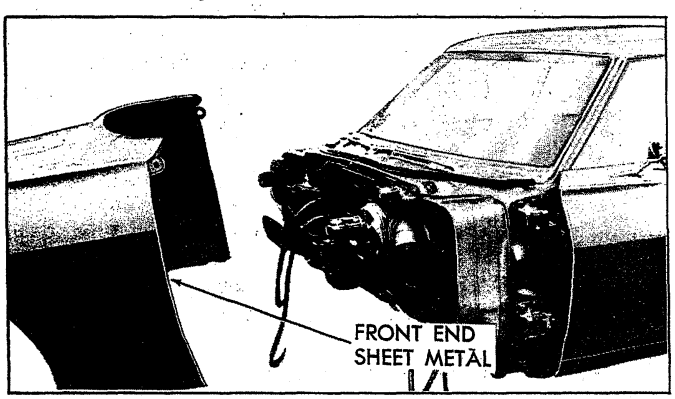


Fig. 6—Sheet Metal Removal

Installation

Preparation of the surface to which the transfer will be applied is very important. In cases where body metal repair has been made it is necessary to prime and color coat these areas to blend with the undamaged surface. Apply the transfer film to color coated panels only, never to bare metal or primer. The surface must be free of any imperfections that might high-light through the film. Remove dirt nibs and other foreign material in the paint by light sanding with 600 grit sandpaper.

The temperature of the body must be maintained at a moderate level between approximately 65 and 90 degrees. Too warm a body will cause the wood grain film to stick prematurely while too cool a body will reduce the adhesion of the wood grain film. Cool the body panel with cool water when too warm and heat the body panel with a heat gun or a heat lamp when too cold. Just prior

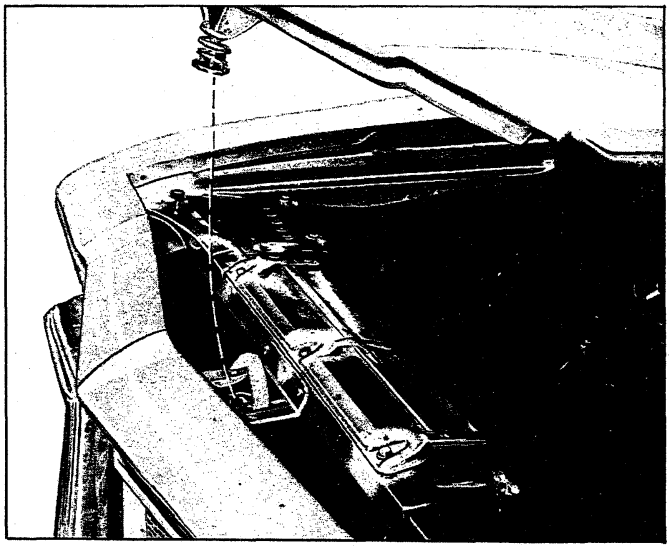


Fig. 7—Hood Catch and Lock Plate—Chevelle

to application of the transfer film clean the painted surface with a non-petroleum base volatile cleaner and allow to dry.

Follow the steps below for easy application of the film.

1. Cut the tape backing the entire width of the transfer at the approximate centerline of the film exercising care not to damage the transfer film.
2. Peel the paper backing from one half of the film.
3. Align the upper edge of the half of the film with the paper backing to the lower edge of the pierced molding holes making sure that the transfer is centered on the panel.
4. Starting at the center of the transfer and using a water dampened rag, press that half of the transfer with the backing removed on to the panel. Work outboard from the middle to the edges. Remove all air bubbles.

NOTE: The transfer can be pulled back from the panel and reinstalled if large air pockets develop. Exercise care not to stretch the material. Small air bubbles may be removed by piercing the film at the bubble with a pin and pressing the bubble down.

5. Remove the backing from the other half of the transfer. Apply this half in the same manner working from the center to the end and from the middle to the upper and lower edges.

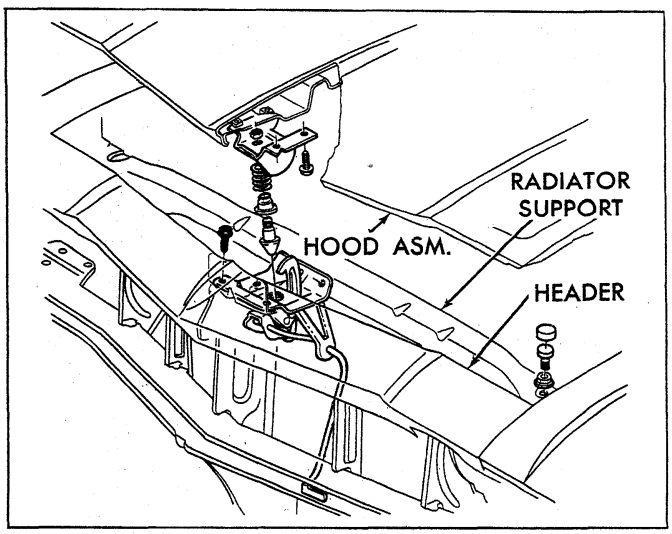


Fig. 8—Hood Catch, Lock Plate and Bumper Components—Chevelle

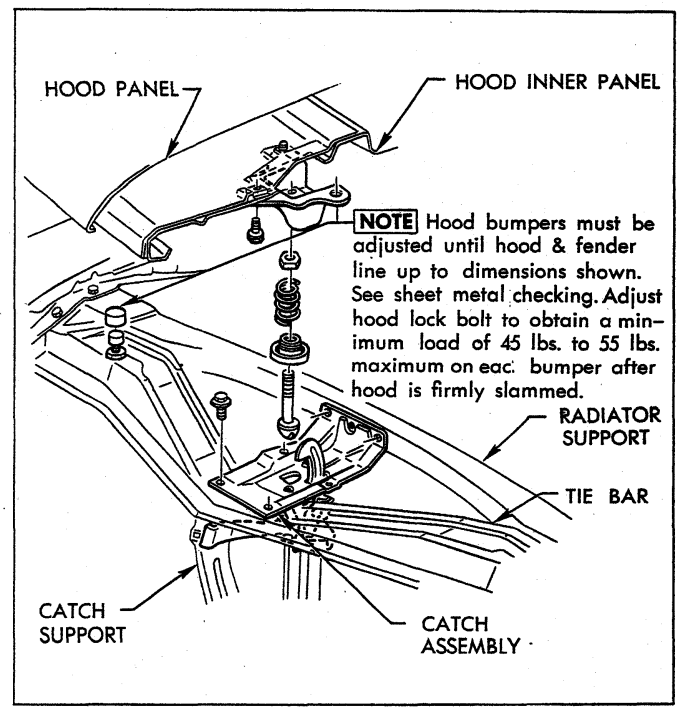


Fig. 9—Hood Catch and Lock Plate Components—Chevrolet

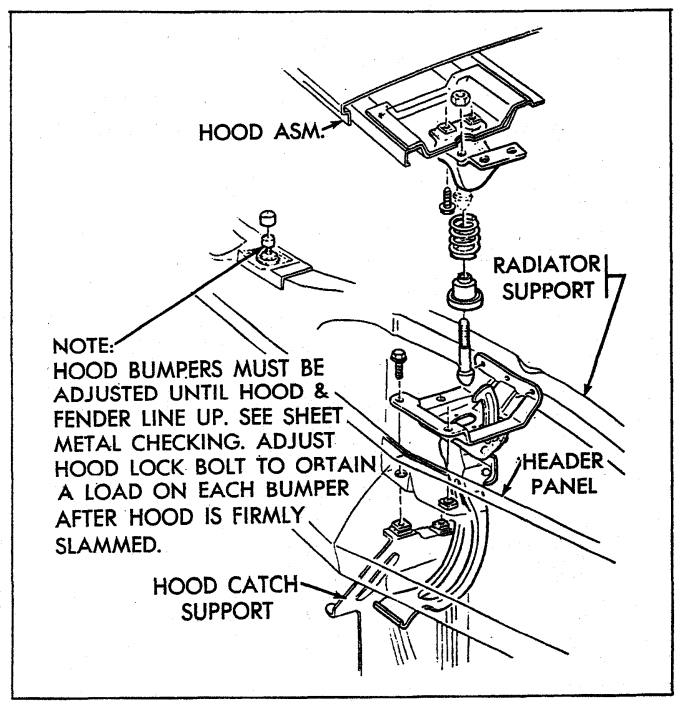


Fig. 10—Hood Catch and Lock Plate Components—(Typical)

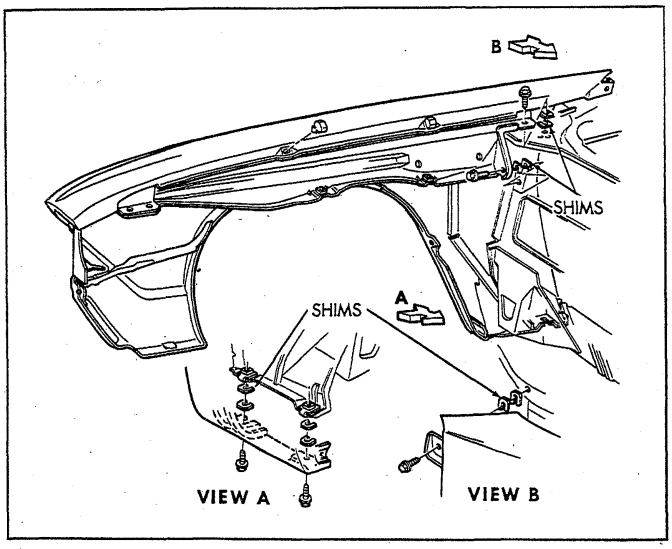


Fig. 11—Fender to Cowl and Rocker Panel Shimming—Chevelle

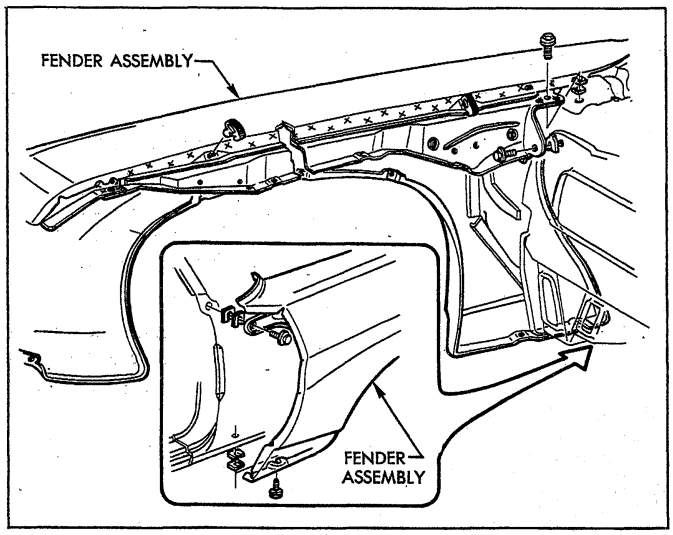


Fig. 12—Fender to Cowl and Rocker Panel Shimming—Chevrolet

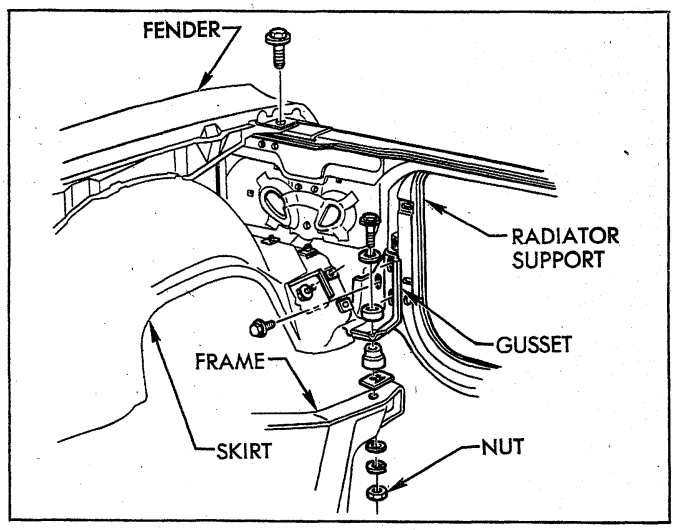


Fig. 13—Chevrolet Radiator Support Attachment to Frame and Fender

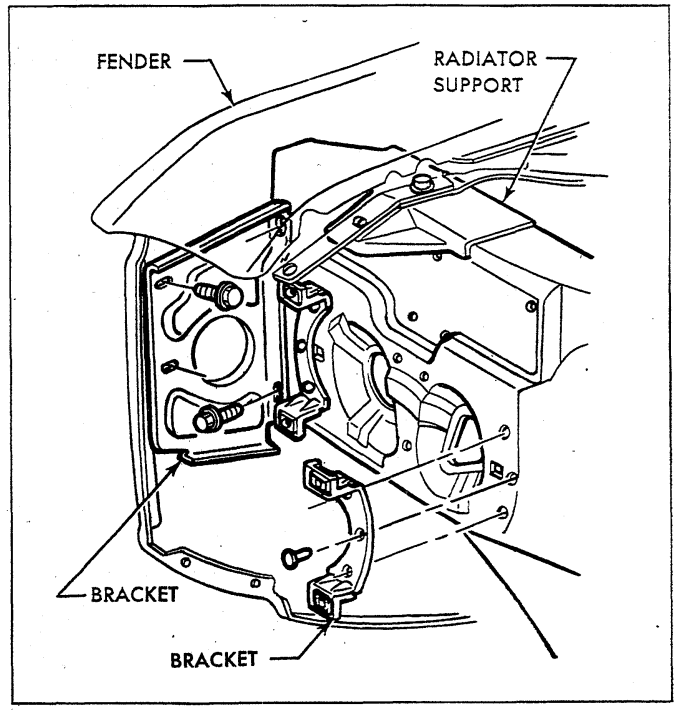


Fig. 14—Chevrolet Radiator Support Attaching Brackets

6. Fold the transfer over the door or quarter edges and press to the hemming flanges. Application of heat with a heat lamp or heat gun will aid in folding the transfer over the edge.

   NOTE: If the transfer film will not adhere to the flange, brush a clear vinyl adhesive to the back edge of the film and reapply.

7. Install the moldings.

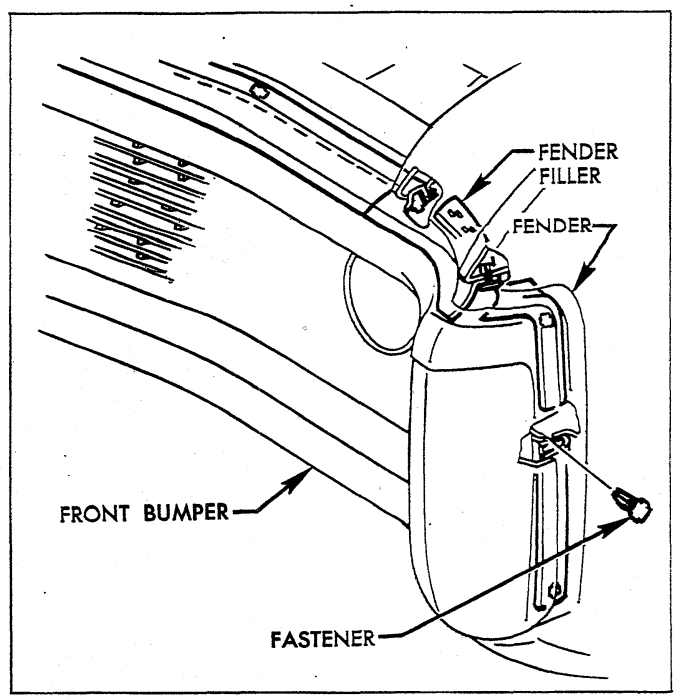


Fig. 15—Chevrolet Hood Panel and Fender Fillers

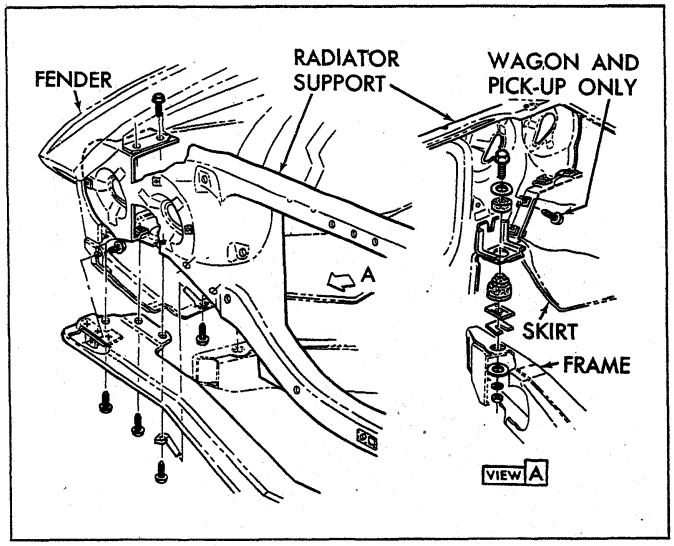


Fig. 16—Chevelle Radiator Support to Frame and Fenders

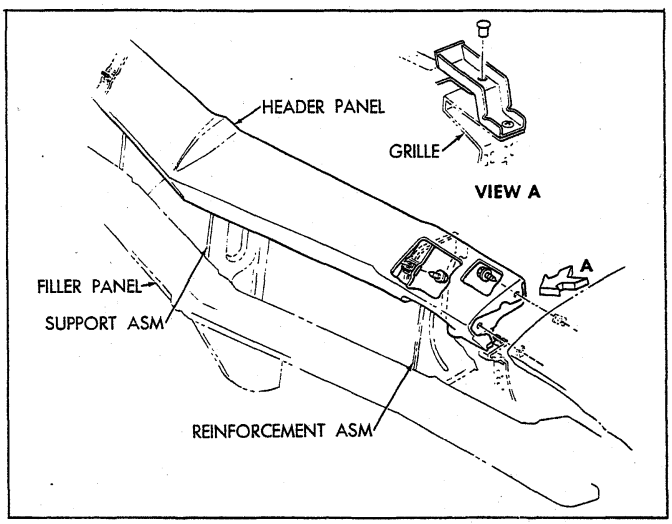


Fig. 17—Header to Fender and Grille—Chevelle

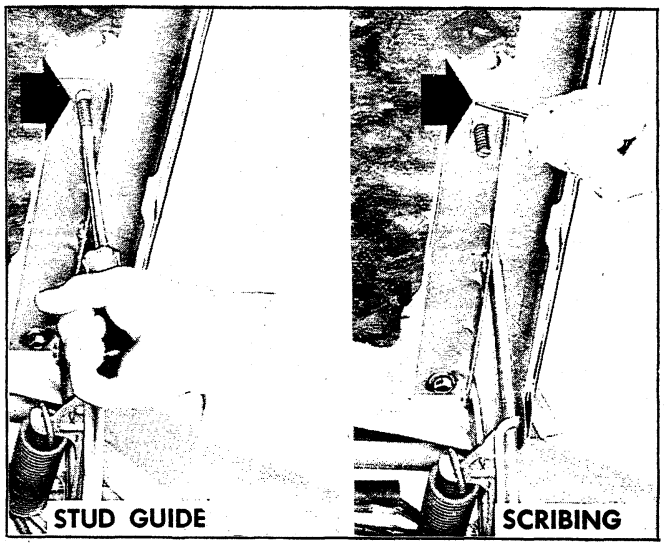


Fig. 18—Hood Replacement

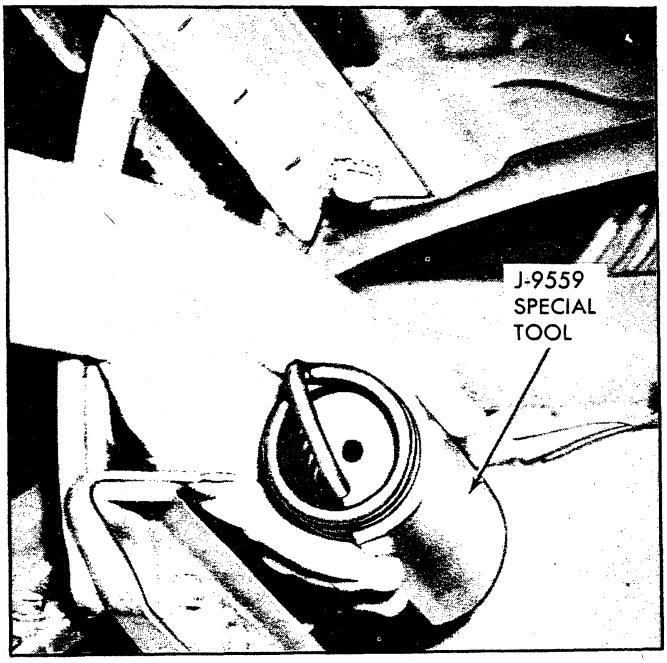


Fig. 19—Removing Spring with J-9559

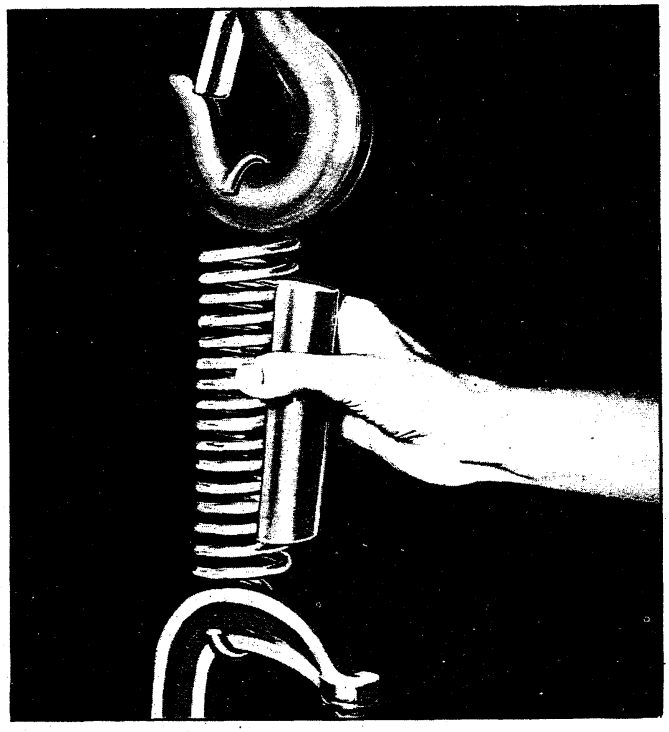


Fig. 20—Installing J-9559 in New Spring

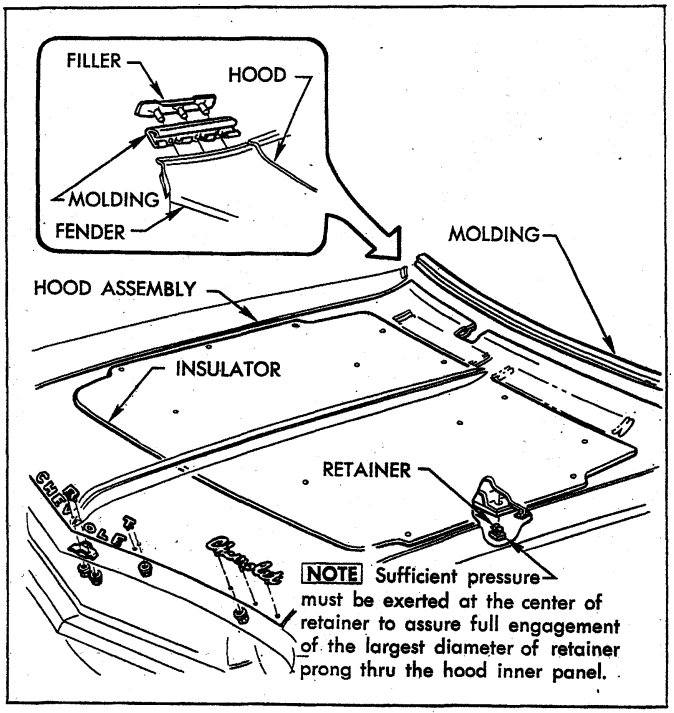


Fig. 21—Hood, Insulator and Molding—Chevrolet

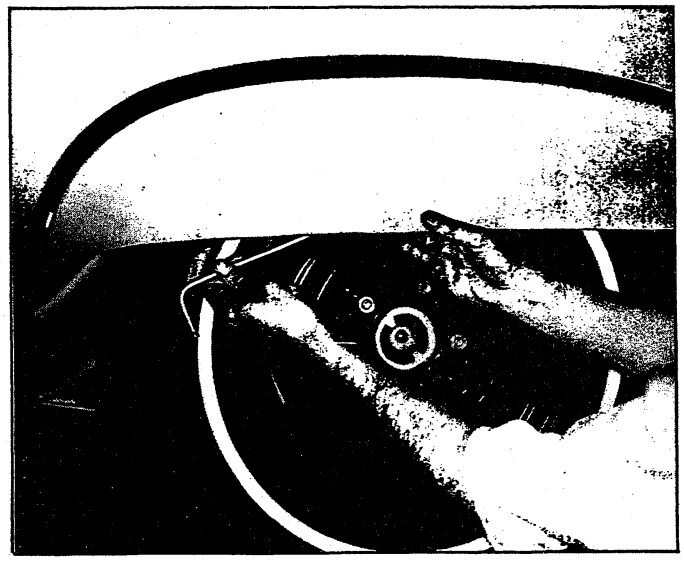


Fig. 23—Removing Rear Wheel Cover

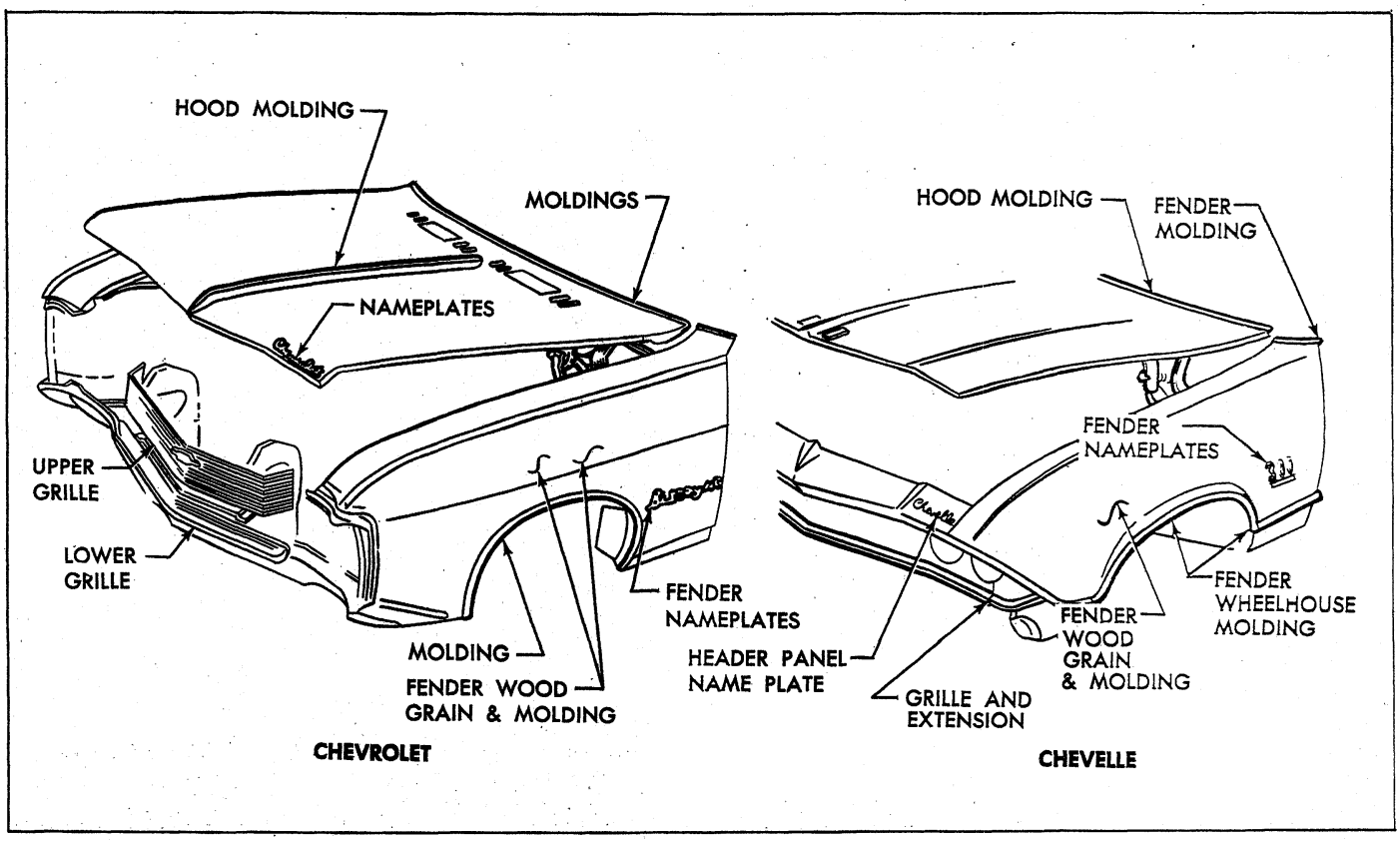


Fig. 22—Front End Moldings, Name Plates and Grilles

CHEVY NOVA

INDEX

	Page
General Description	11-11
Maintenance and Adjustments	11-12
Hood	11-12
Hinge	11-12
Bumpers	11-12
Catch Assembly	11-12
Lock	11-12
Fenders	11-13
Sheet Metal	11-13
Component Part Replacement	11-13
Battery Tray	11-13
Radiator Support	11-13
Fender Assembly	11-13
Trim	11-13
Skirt	
Hood Assembly	11-14
Catch Assembly and Lock	11-15

GENERAL DESCRIPTION

Bolt-on front end sheet metal construction (fig. 24) is similar to that of the Camaro, including "bathtub" type fender skirts which give corrosion protection to outer fender inner surfaces. Fenders and fender skirts are bolted together, and in combination are bolted to the body at the dash and to the radiator support panel. Rubber biscuit mounts are used to attach the radiator support to the frame horns.

Conventional front fenders, grille, bumper and brackets all bolt on to the unit front end structure. The hood is connected to the front end with hinges that are attached to the fender skirts.

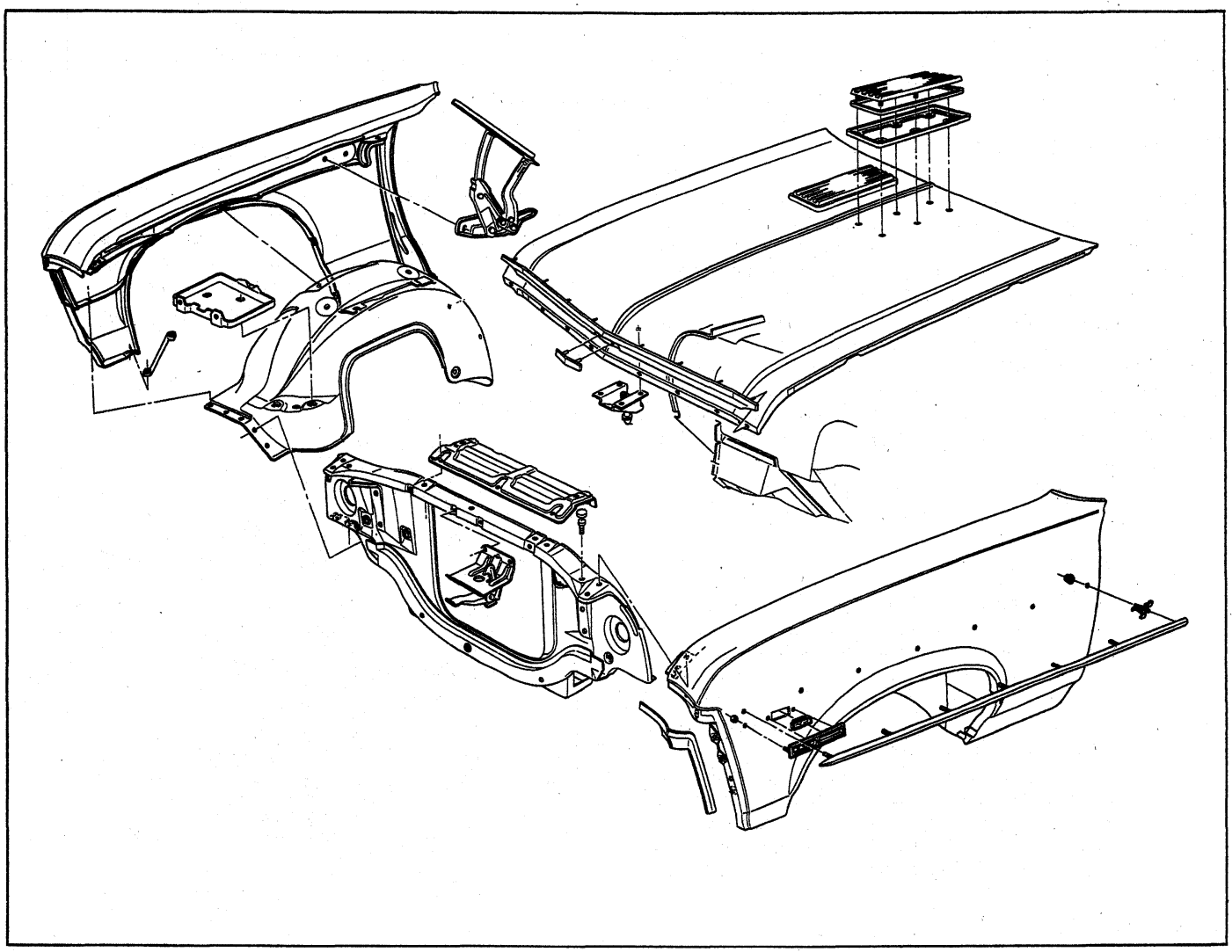


Fig. 24—Front End Sheet Metal—Chevy Nova

MAINTENANCE AND ADJUSTMENTS

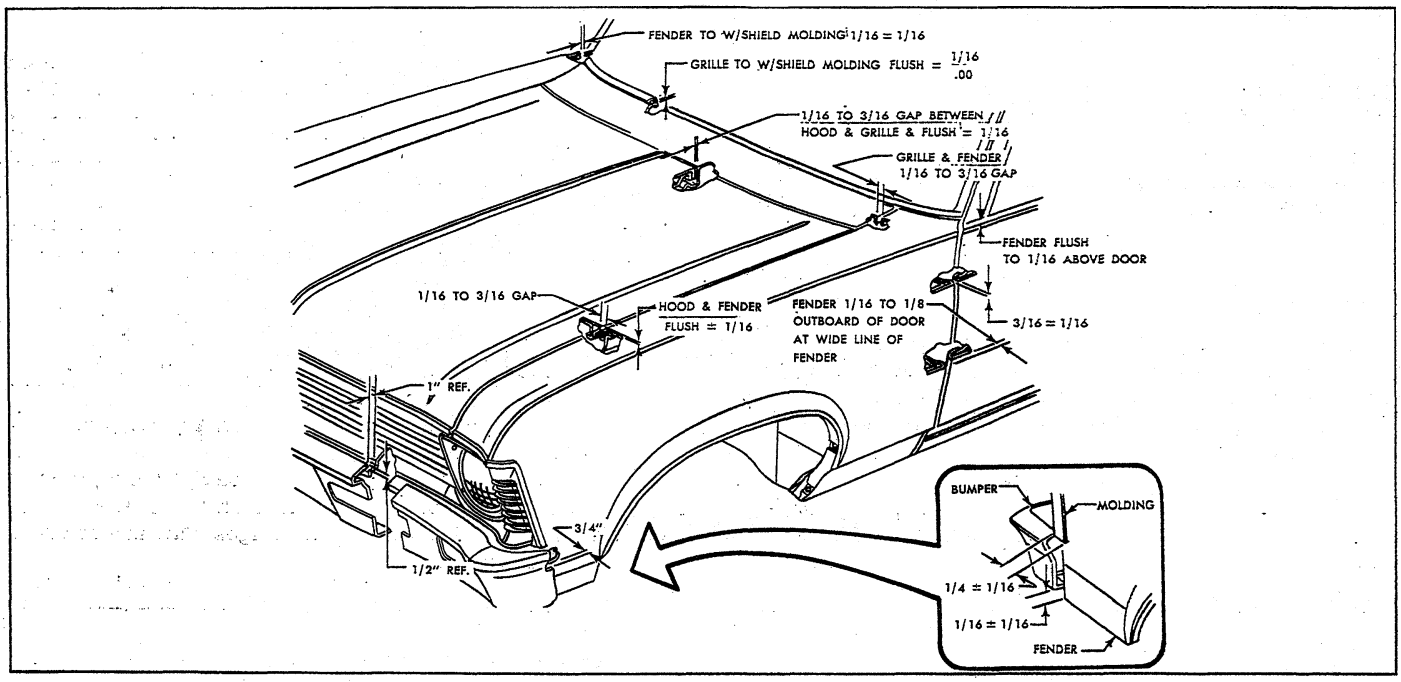


Fig. 25—Sheet Metal Adjustment—Nova (Typical)

HOOD ADJUSTMENT

The alignment of the hood in relation to other sheet metal parts is controlled by the position of the hood hinges and the height of the two bumpers, located one at each end of the radiator support. The adjustments at the hood latch must be made after the hinges and bumpers are positioned to yield the dimensions shown in Figure 25. Latch adjustments are made so that effort required to open and close the hood is reasonable, and hood alignment obtained by hinge and bumper adjustment is maintained when the hood is closed. Note that the hood latch is not designed or intended to correct basic hood alignment faults.

To align the hood and lock, proceed as follows:

HOOD HINGE (Fig. 26)

1. Note that the mounting holes in the body-mounted end of the hinge are slotted to provide up and down movement of the hood assembly while the hood mounted end is slotted to provide fore and aft movement.
2. Scribe a mark around the entire hinge plate which will be involved in the adjustment.
3. Loosen the appropriate screws and shift the position of the hood on the hinge plate the approximate amount to correct misalignment, using the scribed marks to check amount of movement. Check condition of adjustment by tightening cap screws and closing hood.

HOOD BUMPERS

Hood bumpers must be adjusted until hood and fender line up as shown in Figure 25.

HOOD CATCH AND LOCK (Fig. 27)

Hood lock plate mounting holes are slotted to provide fore and aft adjustment of the hood lock bolt. The hood lock bolt itself is adjustable for up and down positioning of the lock bolt head so that its proper engagement in the latch assembly may be provided for. The distance that the lock bolt protrudes out of the lock plate should be

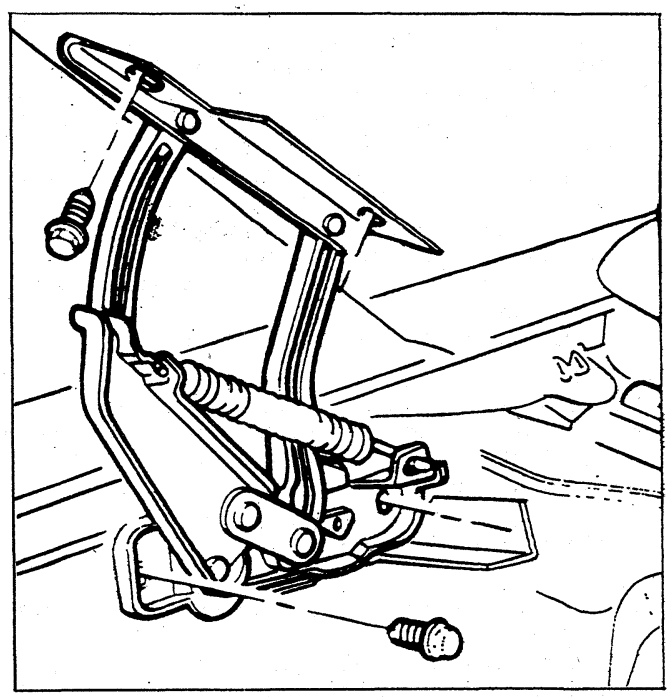


Fig. 26—Hood Hinge—Nova

adjusted so that the hood bumpers are slightly compressed by the fully latched hood and so that the effort required to release the hood catch is reasonable.

SHEET METAL ADJUSTMENTS

For proper operation of doors and hood, and for presentable appearance, adjust front sheet metal to the tolerances shown in Figure 25.

FENDERS

Fenders are adjustable with shims at the cowl and rocker panel. To add or remove shims, loosen bolts at shim locations (fig. 28) and carefully apply force with pry bar to provide clearance for shim removal or installation.

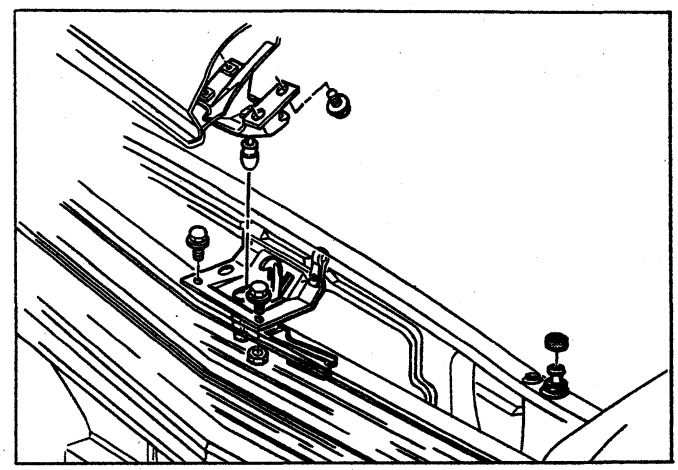


Fig. 27—Hood Lock, Catch and Support—Nova

COMPONENT PART REPLACEMENT

BATTERY TRAY (Fig. 29)

Removal

1. Disconnect battery cables.
2. Remove screw retaining battery hold down clamp.
3. Remove battery from vehicle.
4. Remove screws retaining tray assembly to fender skirt and support, and remove tray from vehicle.

Installation

Reverse removal procedure.

RADIATOR SUPPORT (Fig. 30)

Removal

1. Raise hood, disconnect battery cables, and remove battery.
2. Remove front bumper (Section 14).
3. Remove grille and related components (Section 13).
4. Disconnect horns, horn relay, voltage regulator, wiring harness, and washer bottle from radiator support.
5. Remove screw connecting battery tray to radiator support.
6. Remove shroud from vehicle if so equipped.
7. Remove shroud and radiator (Section 13).
8. Remove screws securing support to frame, skirts, and fenders.
9. Remove radiator support from vehicle.

Installation

Install radiator support following the removal procedure in reverse order. Refer to torque specifications in rear of manual for correct torque values for radiator support, grille, and bumper.

FENDER AND SKIRT ASSEMBLY

Removal

1. Place vehicle on hoist and remove front bumper (Section 14).
2. Remove hood and hood hinges (two men).
3. Disconnect any components attached to fender and skirt such as cruise control, hoses, electrical harness etc.
4. Remove screws securing radiator support to fender and skirt.
5. Remove headlamp bezel and headlamp.
6. Remove screws securing fender and skirt assembly to header panel, headlamp housing and valance panel. Remove screw securing fender extension to valance panel.
7. Remove screws securing fender and skirt assembly to vehicle and remove fender and skirt assembly.
8. If necessary, remove screws attaching fender extension and bumper bracket to fender and remove extension and bracket. Replace fender trim if necessary.

Installation

Install fender and skirt assembly following the removal procedure in reverse order. Refer to torque specifications in rear of manual for correct torque values. Remove from hoist.

HOOD TRIM AND INSULATION (Fig. 34)

Figure 34 shows the installation details of the hood ornament and insulation pad. The insulation and ornament retainers and nuts are accessible from under the raised hood.

COWL VENT GRILLE

Removal

1. Raise hood.
2. Remove windshield wiper arms and disconnect washer hoses from tubes. Remove screws securing washer tubes to cowl vent grille. Pull tubes out from under rubber molding and remove.
3. Remove cowl vent grille retaining screws.
4. Leaving rubber molding in place, remove cowl vent grille from vehicle.

Installation

Install cowl vent grille following removal procedure in reverse order. Refer to Figure 25 for correct sheet metal adjustments.

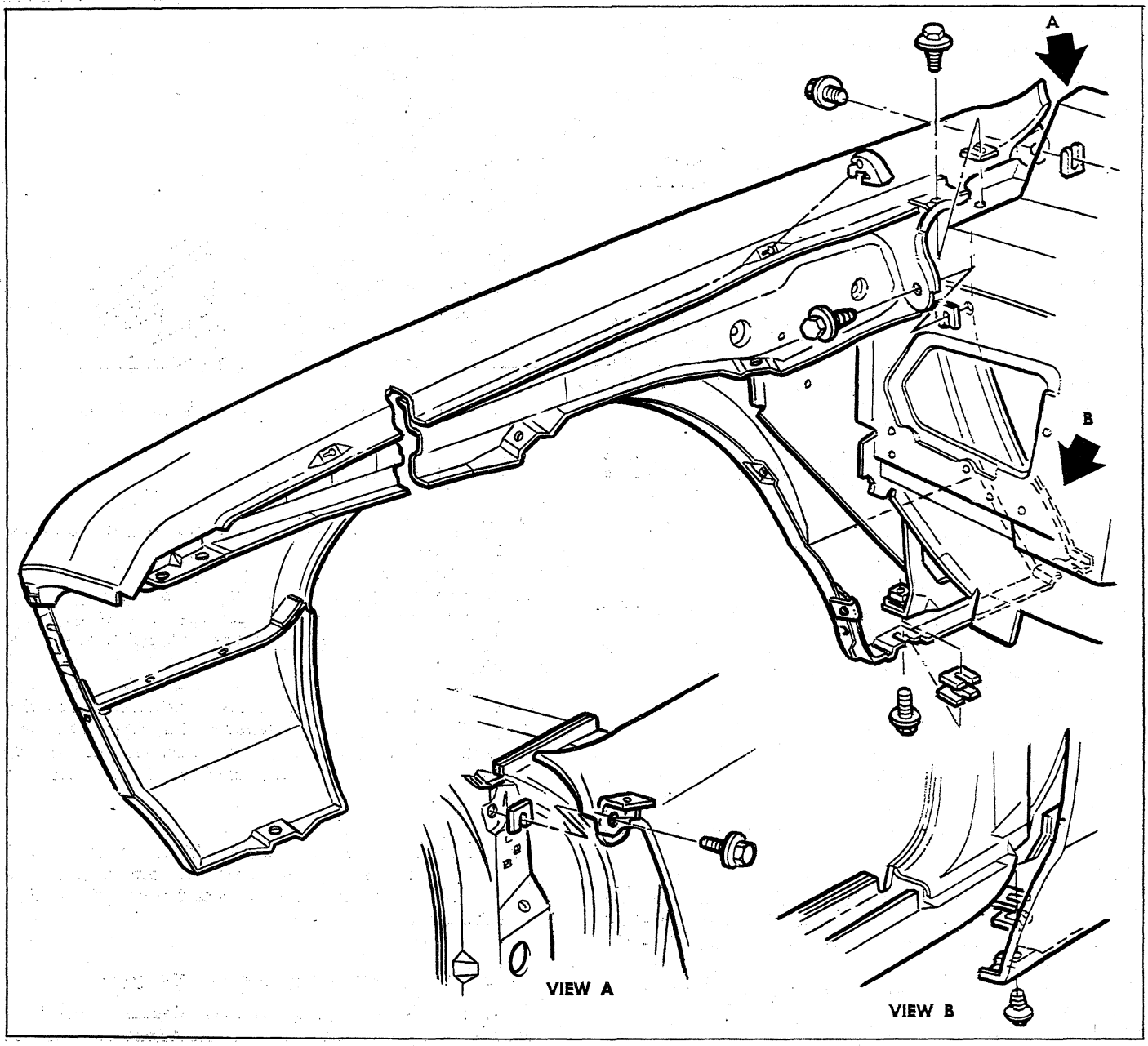


Fig. 28—Front Fender Shimming

HOOD ASSEMBLY

Hood may be removed either with or without hinges. To shorten aligning time, hood hinge plates may be located by scribing a mark on hood and/or body which outlines entire plate. See Maintenance and Adjustments - Hood Hinge for hood adjustment procedure. Hood hinge springs may be easily and safely removed and installed through the use of Tool J-9559 as follows:

1. With hood opened only far enough to allow passage of mechanic's arm between hood and fender, insert ends of J-9559 (through bolt removed) between coils of spring until barrel of tool contacts outer diameter of spring.
2. Open hood fully while still holding spring (with tool installed) in hand; when hood is near fully opened position, spring may be removed.
3. As soon as spring is removed, insert long bolt supplied with J-9559 through holes in end of tool, passing it through spring, and install nut on bolt.

Spring may be removed from J-9559 or J-9559 may be installed in a new spring by the following method:

1. Place a closed 6 or 8 inch "C" clamp in a vise or fasten it to a heavy bench top (bench should be fastened to floor).
2. Hook one end of spring in clamp and the other end in hook of a hoist as shown in Figure 35.
3. Stretch the spring enough to allow insertion of J-9559. Install through bolt if spring is not to be installed on hinge at once.

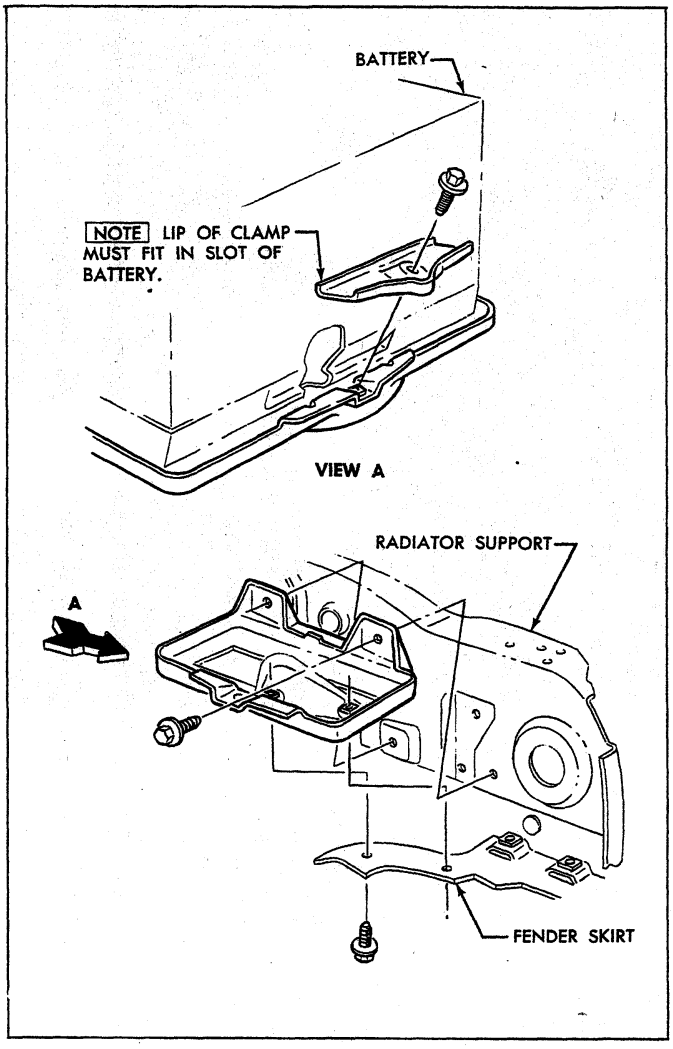


Fig. 29—Battery Tray

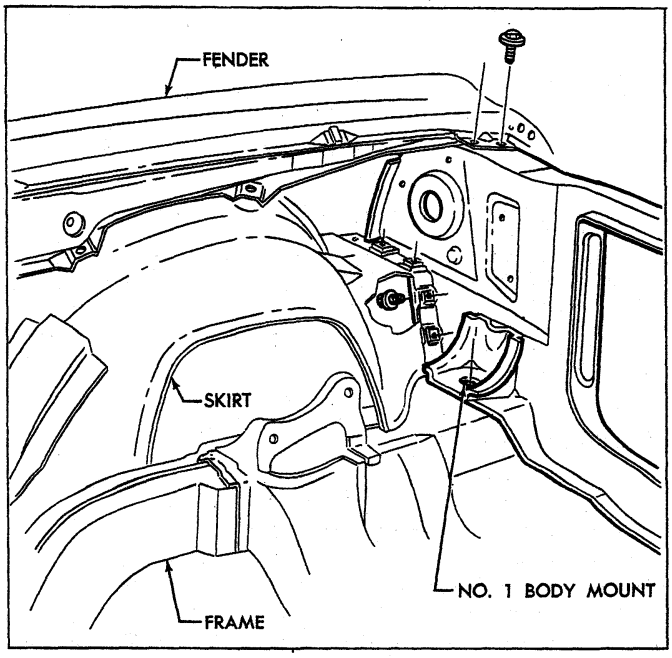


Fig. 30—Radiator Support to Fender and Fender Skirt

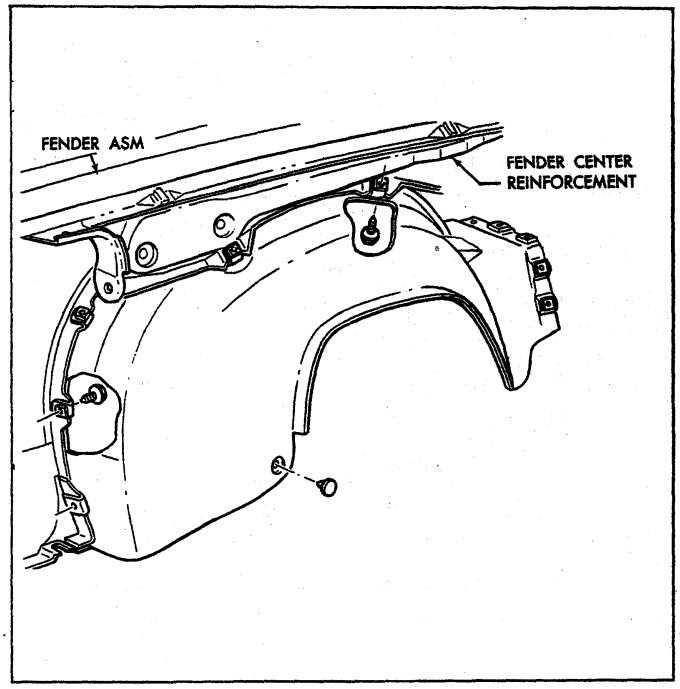


Fig. 31—Fender to Fender Skirt

HOOD CATCH AND LOCK (Fig. 8)

Removal

1. Remove catch assembly as follows:
   a. Remove screws retaining catch assembly to radiator support.
   b. Remove screws retaining catch assembly to catch support assembly.
   c. Remove screws retaining catch assembly to grille upper bar.

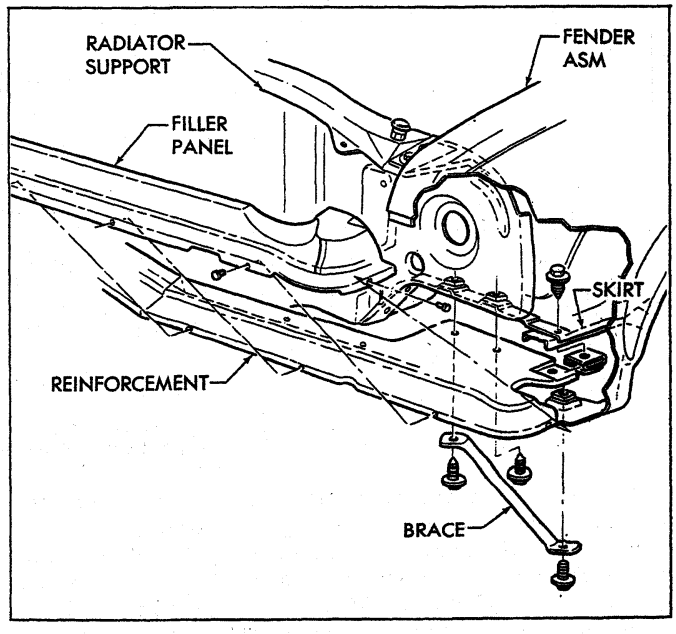


Fig. 32—Front End Filler Panel, Reinforcement and Brace (Typical)

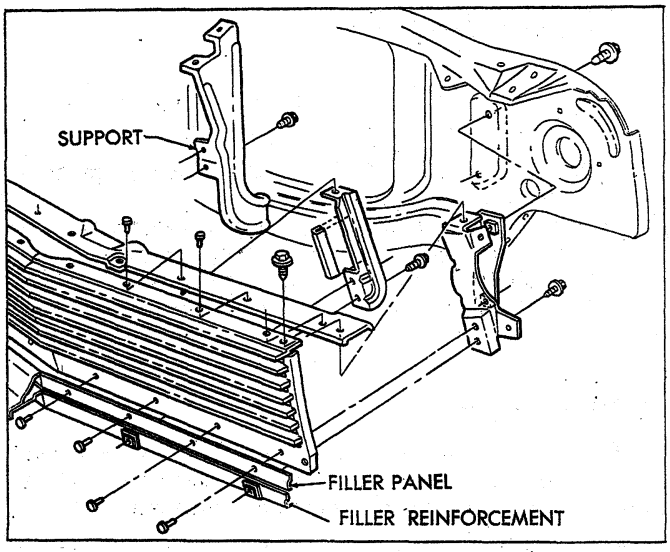


Fig. 33—Grille, Bracket and Reinforcement (Typical)

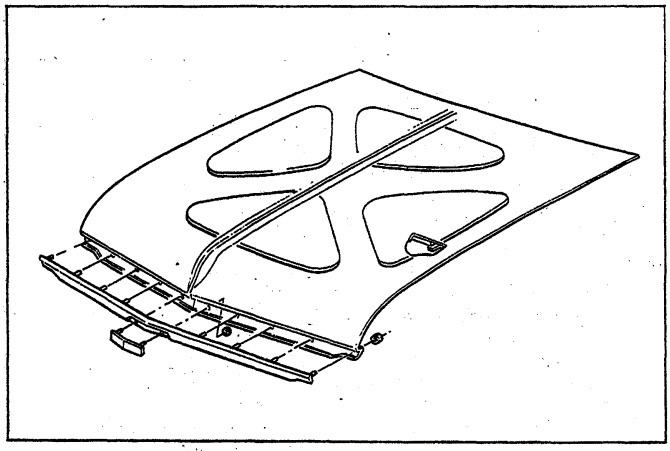


Fig. 34—Hood Insulator, Molding and Emblem

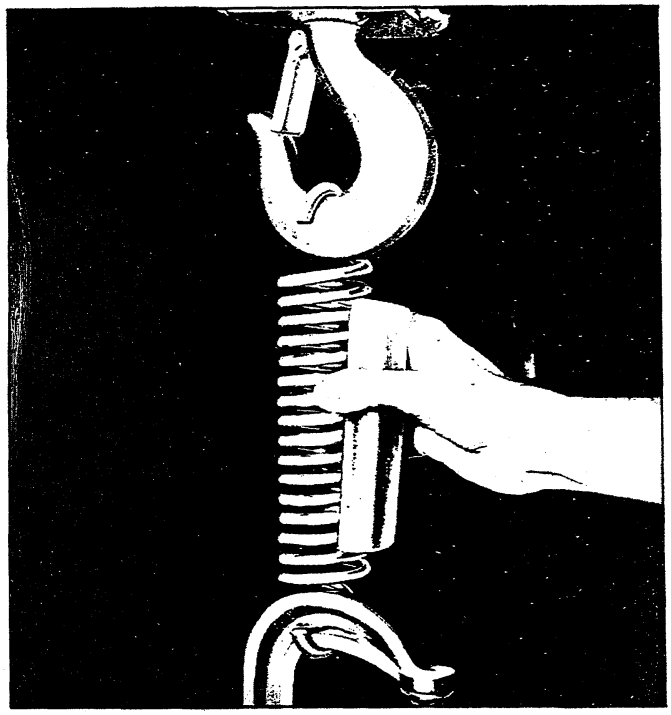


Fig. 35—Installing Tool J-9559 in New Spring

2. Before removing hood lock plate from hood, locate position on hood by scribing around base of lock plate. Remove screws retaining lock plate to hood and remove lock plate from vehicle.

Installation

1. Install both catch and lock assemblies in reverse order of removal procedure.
2. Align as outlined under Maintenance and Adjustments - Hood Catch.

CAMARO

INDEX

	Page
General Description	11-16
Maintenance and Adjustments	11-17
Hood	11-17
Hinge	11-17
Bumpers	11-17
Catch Assembly	11-18
Lock	11-18
Fenders	11-18
Sheet Metal	11-18
Component Part Replacement	11-18
Battery Tray	11-18
Radiator Support	11-18
Fender and Skirt Assembly	11-18
Hood Assembly	11-19
Lock and Catch Assembly	11-19
Trim and Insulation	11-19
Cowl Vent Grille	11-19

GENERAL DESCRIPTION

The Camaro sheet metal components are much the same as other Chevrolet passenger models as shown in Figure 36. The front end design is such that servicing of the fenders and skirts is most efficiently performed by removing the fender and skirt as an assembly. Refer to Section 14 for bumper service procedures, Section 13 for radiator and grille, and Section 1A for air conditioning components.

NOTICE

Front License Plate Mounting Bracket

Some states do not use a front license plate so the bracket is removed. In 1969, the lower right hand attaching screw for the bracket also acts as a hood lock support bracket attachment. Therefore, if the license plate mounting bracket is removed, this screw must be reinstalled.

MAINTENANCE AND ADJUSTMENTS

HOOD ADJUSTMENT

The Camaro hood is adjusted in the conventional manner, by adjustment of the hood bumpers and hinges. The two hood bumpers are located on each side at the top of the radiator support. Do not attempt hood latch adjustments until the hinges and bumpers are correctly adjusted. Latch adjustments are made so that effort required to open and close the hood is reasonable, and hood alignment obtained by hinge and bumper adjustment is maintained when the hood is closed. Note that the hood latch is not designed to correct basic hood misalignment.

HOOD HINGE (Fig. 37)

NOTE: The body mounted portion of the hood hinges are slotted to provide up and down movement. The hood mounted end is slotted to provide forward and rearward movement.

1. Scribe a line around the entire hinge plate to be repositioned.
2. Loosen the appropriate screws and shift the position of the hood into correct alignment using the scribe marks to check amount of movement. Check alignment by tightening screws and closing the hood.

HOOD BUMPERS

Adjust hood bumpers so that hood top surface is flush with fender and header panel top surfaces. See Figure 38 for correct sheet metal adjustment dimensions.

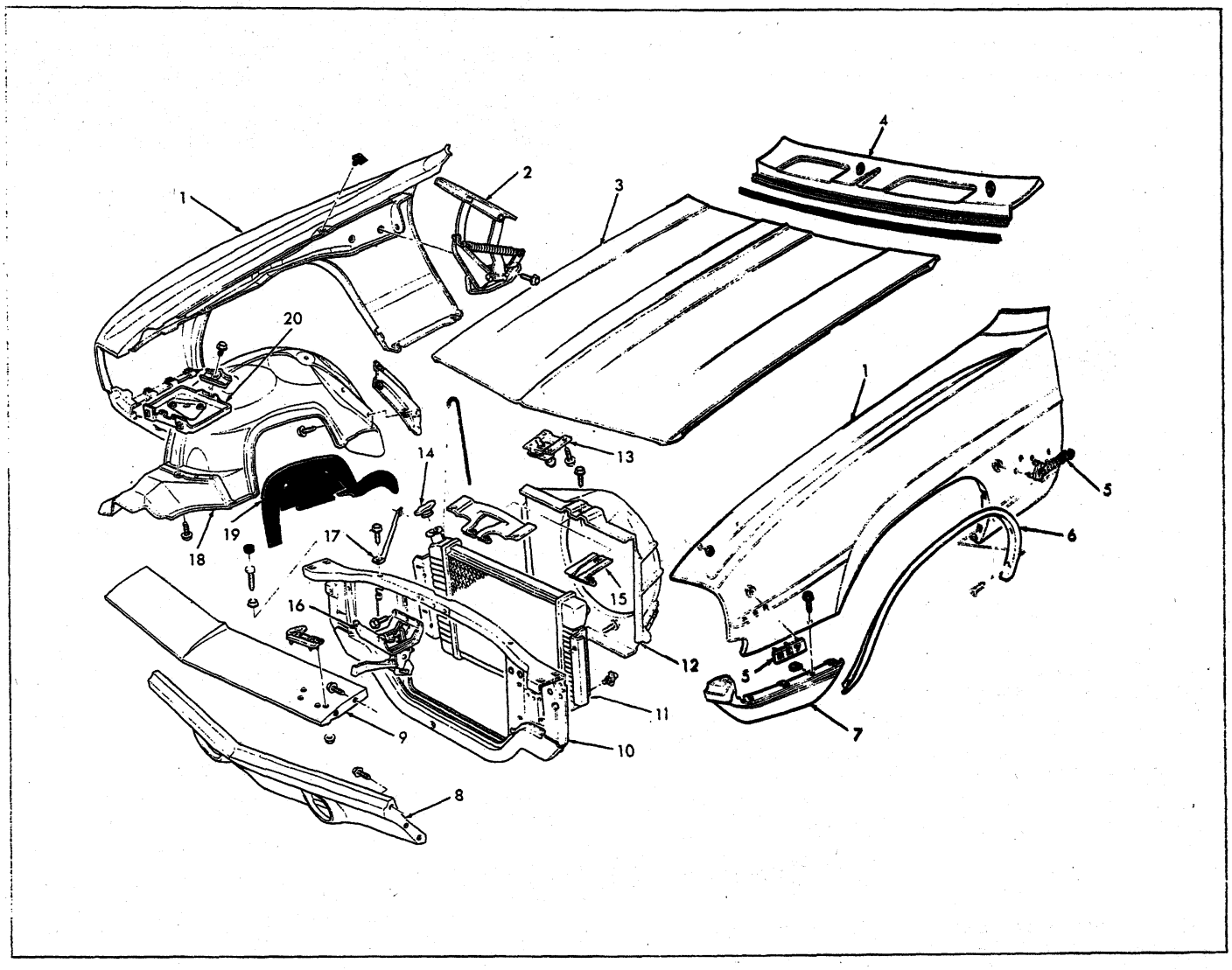


Fig. 36—Front End Sheet Metal—Camaro

1. Fender
2. Hood Hinge
3. Hood
4. Cowl Vent Grille
5. Trim
6. Molding
7. Fender Extension
8. Valance Panel
9. Header Panel
10. Radiator Support
11. Radiator
12. Shroud
13. Hood Lock
14. Radiator Cap
15. Bracket (V-8 Engine Only)
16. Hood Catch
17. Brace
18. Skirt
19. Seal
20. Battery Tray

HOOD CATCH AND LOCK (Fig. 39)

Adjust hood lock bolt so that top surface of hood is flush with top surface of header panel. The distance that the lock bolt protrudes out of the lock plate should be adjusted so that the hood bumpers are slightly compressed by the fully latched hood, and effort required to release the hood catch is reasonable. Close the hood and insure catch engages securely.

FENDERS

Fenders are adjustable with shims at the cowl and rocker panel. To add or remove shims, loosen bolts at shim locations (fig. 40) and carefully apply force with pry bar to provide clearance for shim removal or installation.

SHEET METAL

For proper operation of doors and hood, and for presentable appearance, adjust front sheet metal to the dimensions shown in Figure 38.

COMPONENT PARTS REPLACEMENT

NOTE: When replacing sheet metal components on Camaro, note position and attachment of all seals and dust shielding and replace if necessary.

BATTERY TRAY

Removal

1. Disconnect battery cables and remove battery from vehicle.
2. Remove screws securing battery tray to fender skirt and radiator support.
3. Remove battery tray from vehicle.

Installation

Install battery tray following removal procedure in reverse order.

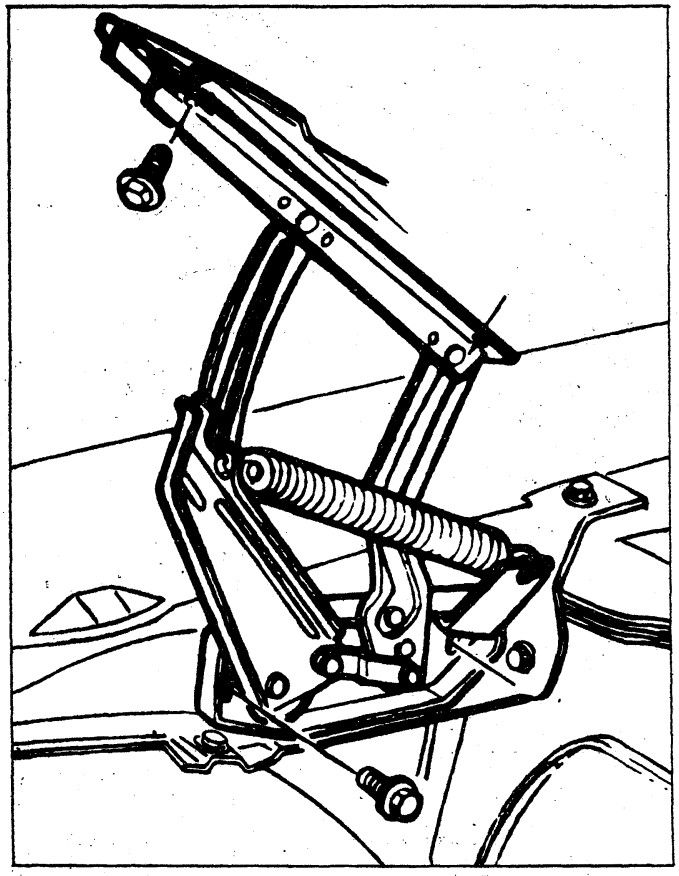


Fig. 37—Hood Hinge—Camaro

RADIATOR SUPPORT

Removal

1. Place vehicle on hoist and raise hood, disconnect battery cables, and remove battery.
2. Remove front bumper (Section 14).
3. Remove grille and related components (Section 13).
4. Disconnect horns, horn relay, voltage regulator, wiring harness, and washer bottle from radiator support.
5. Remove screw connecting battery tray to radiator support.
6. Remove shroud from vehicle if so equipped.
7. Remove shroud and radiator (Section 13).
8. Remove screws securing support to frame, skirts, and fenders.
9. Remove radiator support from vehicle.

Installation

Install radiator support following the removal procedure in reverse order. Refer to torque specifications in rear of manual for correct torque values for radiator support, grille, and bumper. Remove vehicle from hoist.

FENDER AND SKIRT ASSEMBLY

Removal

1. Place vehicle on hoist and remove front bumper (Section 14).
2. Remove hood and hood hinges (two men).
3. Remove bolts securing brace to skirt and dash panel and remove brace (fig. 36).
4. Disconnect any components attached to fender and skirt such as cruise control, hoses, electrical harness etc.
5. Remove screws securing radiator support to fender and skirt.
6. Remove headlamp bezel and headlamp.
7. Remove screws securing fender and skirt assembly to header panel, headlamp housing and valance panel. Remove screw securing fender extension to valance panel.
8. Remove screws securing fender and skirt assembly to vehicle and remove fender and skirt assembly.
9. If necessary, remove screws attaching fender extension and bumper bracket to fender and remove extension and bracket. Replace fender trim if necessary.

Installation

Install fender and skirt assembly following the removal procedure in reverse order. Refer to torque specifica-

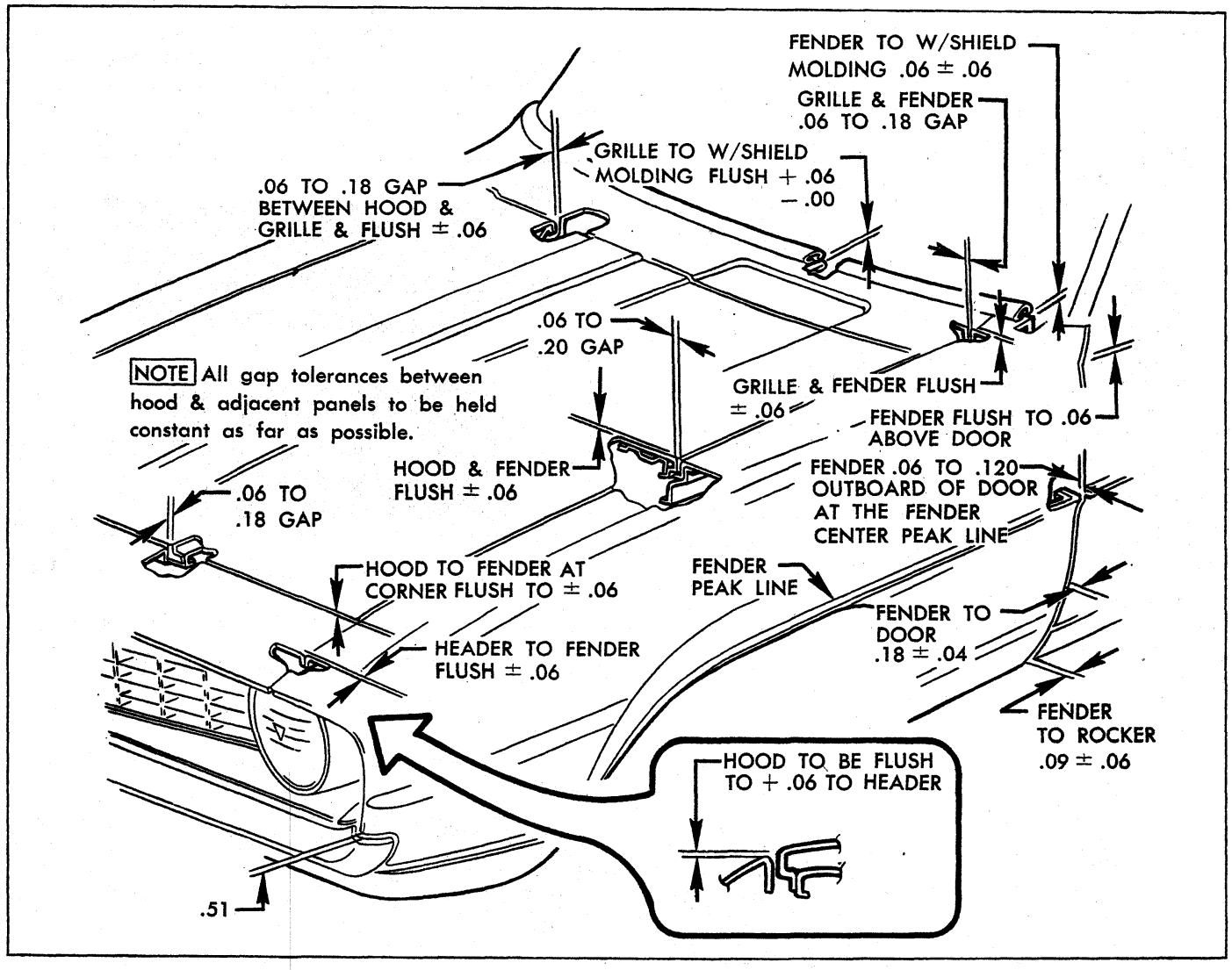


Fig. 38—Sheet Metal Adjustments—Camaro

tions in rear of manual for correct torque values. Remove vehicle from hoist.

HOOD ASSEMBLY

Procedures for hood removal and installation for Camaro are the same as for Chevrolet and Chevelle. Refer to Chevrolet and Chevelle hood removal and installation procedures, Figure 39 for Camaro hood catch, support, and lock plate.

HOOD CATCH AND LOCK (Fig. 39)

Removal

1. Remove catch plate assembly by removing screws retaining catch to header panel, center support, and radiator support.

   NOTE: Before removing hood lock plate from hood, locate position on hood by scribing around base of lock plate.

2. Remove lock plate by removing screws retaining lock plate to hood and remove lock plate.

Installation

Install lock and catch plate following the removal procedure in reverse order. Refer to torque specifications in rear of manual for correct torque values. Adjust lock and catch plate as outlined under adjustment procedure in this section.

HOOD TRIM AND INSULATION

The insulation and ornament retainers and nuts are accessible from under the raised hood.

COWL VENT GRILLE

Removal

1. Raise hood.
2. Remove windshield wiper arms and disconnect washer hoses from tubes. Remove screws securing washer tubes to cowl vent grille. Pull tubes out from under rubber molding and remove.
3. Remove cowl vent grille retaining screws.
4. Leaving rubber molding in place, remove cowl vent grille from vehicle.

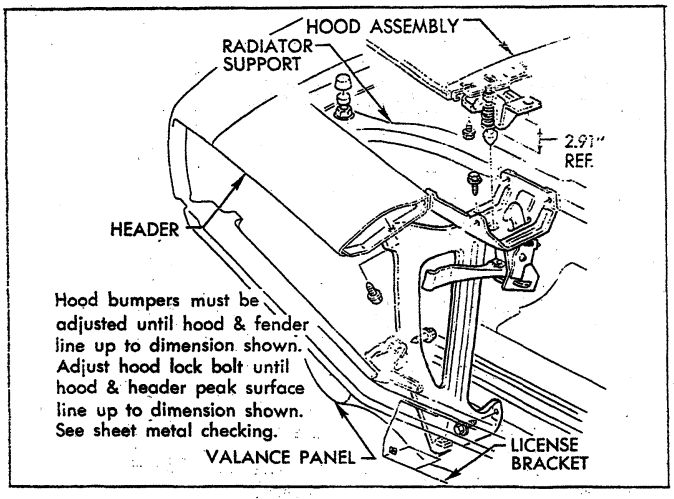


Fig. 39—Hood Catch, Support and Lock Plate—Camaro

Installation

Install cowl vent grille following removal procedure in reverse order. Refer to Figure 38 for correct sheet metal adjustments.

SPECIAL TOOLS

The only special tool required for 1969 chassis sheet metal servicing is the hood spring removal and installation Tool J-9559. See Figure 41.

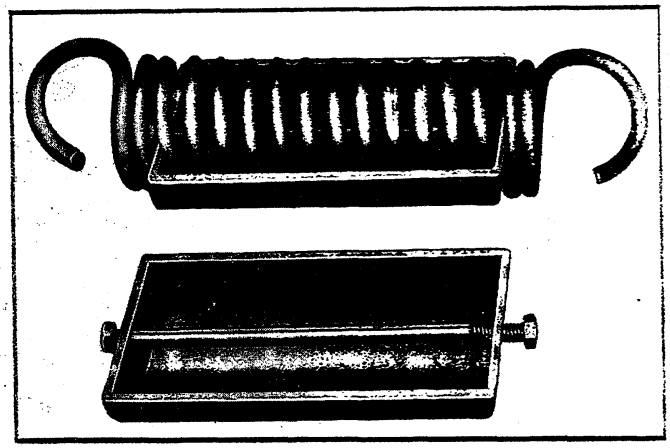


Fig. 41—Special Tools—All Models—J-9559 Hood Spring

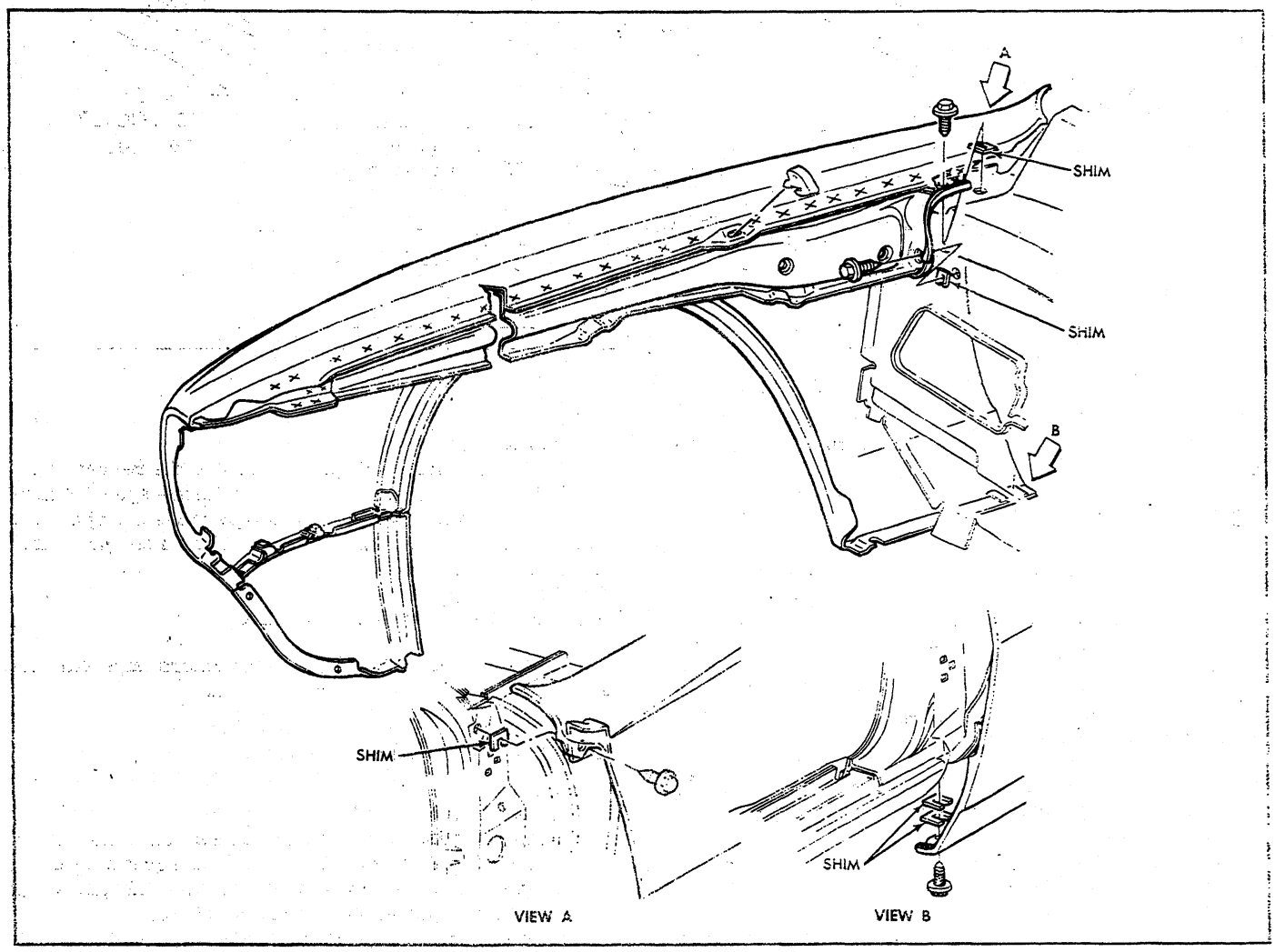


Fig. 40—Fender to Cowl and Rocker Panel Shimming—Camaro

SECTION 12
ELECTRICAL-BODY AND CHASSIS

CONTENTS OF THIS SECTION

	Page
Lighting System	12-1
Instruments and Gauges	12-19
Directional Signal	12-34
Windshield Wipers and Washers	12-35
Concealed Wiper Door—Corvette	12-45
Theft Deterrent System	12-51
Wiring Diagrams	12-53

LIGHTING SYSTEM

INDEX

	Page
General Description	12-1
Maintenance and Adjustments	12-2
Headlamp Panel Adjustments	12-3
Chevrolet	12-3
Camaro	12-3
Corvette	12-4
Service Operations	12-4
Front Lighting	12-4
Headlamp Replacement (All Vehicles)	12-4
Parking Lamp Replacement	12-4
Marker Lamp Replacement	12-5
Vacuum Operated Headlamp Service	12-6
Headlamp Door Panel Chevrolet	12-6
Headlamp Door Panel Camaro	12-6
Headlamp Door Panel Corvette	12-6
Actuator Assembly	12-7
Chevrolet	12-7
Camaro	12-7
Corvette	12-7
Relay Assembly--All	12-7
Vacuum Tank	12-8
Chevrolet	12-8
Camaro	12-8
Corvette	12-9
Vacuum Hose Routing	12-9
Rear Lighting	12-9
Tail Stop, Directional and Backup Lamps	12-9
Bulb Replacement--All	12-9
Lamp Housing Replacement	12-9
License Lamps--All	12-9
Automatic Transmission Quadrant Lamp	12-9
Chevrolet and Chevelle	12-9
Nova and Camaro	12-9
Seat Separator Compartment	12-10
Lamp Replacement	12-10
Courtesy Lamp Replacement	12-10
Ignition Switch	12-10
Lighting Switch Replacement	12-14
Wiper Switch Replacement	12-14
Stoplight Switch Replacement	12-15
Dimmer Switch Replacement	12-16
Backing Lamp Switch Replacement	12-16
Mast Jacket Mounted	12-16
Transmission Mounted	12-17
Neutral Safety Switch Replacement (Automatic)	12-17
Column Shift	12-17
Floor Shift	12-17
Clutch Operated Neutral Start Switch	12-18
Parking Brake Alarm Switch Replacement	12-18
Instrument Panel Compartment Lamp Switch	12-19
Replacement	12-19
Cigarette Lighter Replacement	12-19
Chevrolet, Camaro and Nova	12-19
Chevelle	12-19
Corvette	12-19

GENERAL DESCRIPTION

The lighting system includes the main lighting switch, stop light, dimmer and back lamp switches, headlamps, parking, side marker, stop, tail and directional lamps. It also includes instrument illumination, indicator lamps and the necessary wiring to complete the circuits. Vacuum system components for headlamp operation are now included. A fuse panel provides convenient power taps and fuse clips for the appropriate circuits (fig. 1).

Vacuum actuated headlamp covers standard on Corvettes and optionally offered on Chevrolets and Camaros.

The side marker lamps have clear bulbs (with amber lenses) in the front fenders and with red lenses in the quarter panels on all Chevrolets. In addition the parking and marker lamps will operate in the headlamp switch "park" or "headlights" position the same as license and tail lamps.

NOTE: It is recommended that the battery be disconnected before performing any electrical service other than bulb or fuse replacement.

Camaro, Chevelle, Chevrolet and Nova headlamp housings are new due to revised front end styling. Corvette front end styling is basically carryover.

Camaro and Nova continue to use dual filament single headlamps. The Chevrolet and Camaro Rally Sport headlamps are concealed by a retractable extension of the grille when the lamps are not used. The grille section covering the headlamps slides rearward when the

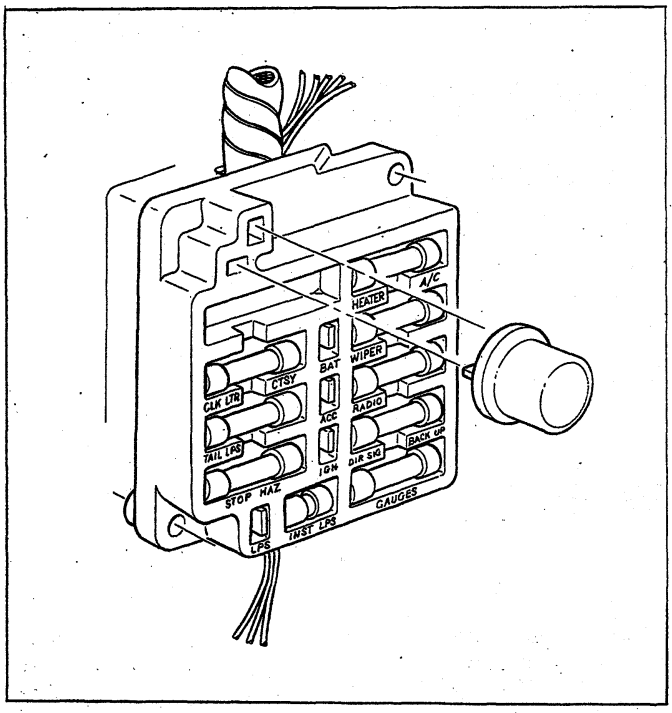


Fig. 1—Fuse Panel Assembly

lamps are turned on; the headlamps are stationary. The covering is retracted by a vacuum operated actuator mounted to the headlamp housing. If the vacuum circuit becomes inoperative, the lamps can be uncovered manually.

Marker lamps are part of the front and rear lighting harnesses.

Power windows can be opened or closed with the ignition switch in the "ACC", accessory, position or the "ON" position.

Fiber optic monitoring systems are standard on Corvettes and optionally available on Camaros, Chevelles, and Chevrolets. Fiber optic conductors are attached to light source housings remotely located from the viewing lens.

The monitoring lens will glow when the EXTERIOR lights are lit. Backup and marker lamps are not monitored.

The fiber optic conductors are multi strand coated plastic bundles, of a precision length having a crimped ferrule on each end.

In addition to fuses, the wiring harness incorporates fusible links to protect the wiring. Links are used rather than a fuse in wiring circuits that are not normally fused, such as the ignition circuit. Fusible links in the Chevrolet wiring are four gauge sizes smaller than the cable it is designed to protect. The links are marked on the insulation with wire gauge size because of the heavy insulation which makes the link appear a heavier gauge than it actually is.

Engine compartment wiring harnesses incorporate several fusible links. The same size wire with special hypalon insulation must be used when replacing a fusible link.

The links are:

1. The pigtail lead at the battery positive cable (except Corvette) is a 14 gauge, brown fusible link protecting the 10 gauge battery charging circuit. This wire is an integral part of the battery cable assembly and servicing requires replacing the complete battery cable assembly. On Corvette models this link is installed as a molded splice at the solenoid "Bat" terminal and servicing requires splicing in a new link.
2. A 16 gauge black fusible link is located at horn relay to protect all unfused wiring of 12 gauge or larger. It is a serviceable piece with an in-line connector and is not integral with the wiring harness.
3. The generator warning light and field circuitry (16 gauge wire) is protected by a fusible link (20 gauge orange wire) used in the "battery feed to voltage regulator #3 terminal" wire. The link is installed as a molded splice in the circuit at the junction block or the solenoid "Bat" terminal (Corvette only) and at the horn relay. Each link is serviced by splicing in a new 20 gauge wire as required.
4. The ammeter circuit on all models is protected by two orange, 20 gauge wire fusible links installed as molded splices in the circuit at the junction block or the solenoid "Bat" terminal (Corvette only) and at the horn relay. Each link is serviced by splicing in a new 20 gauge wire as required.

The wiring harnesses use a standardized color code common to all Chevrolet vehicles. Under the color code, the color of the wire designates a particular circuit. The harness title indicates the type of harness, single or multiple wire, and also describes the location of the harness. The body harness is routed through the vehicle near the center of the body. Composite wiring diagrams are included at the end of this section.

MAINTENANCE AND ADJUSTMENTS

Maintenance of the lighting units and wiring system consists of an occasional check to see that all wiring connections are tight and clean, that the lighting units are tightly mounted to provide good ground and that the headlamps are properly adjusted. Loose or corroded connections may cause a discharged battery, difficult starting, dim lights, and possible damage to generator and regulator. Wire harnesses must be replaced if insulation becomes burned, cracked, or deteriorated. Whenever it is necessary to splice a wire or repair one that is broken, always use solder to bond the splice. Always use rosin flux solder on electrical connections. Use insulating tape to cover all splices or bare wires.

When replacing wires, it is important that the correct size be used. Never replace a wire with one of a smaller gauge size.

Each harness and wire must be held securely in place by clips or other holding devices to prevent chafing or wearing away the insulation due to vibration.

By referring to the wiring diagrams, circuits may be tested for continuous circuit or shorts with a conventional test lamp or low reading volt meter.

HEADLAMP ADJUSTMENT— T-3 HEADLAMPS

HEADLAMP AIMING

The headlamps must be properly aimed in order to obtain maximum road illumination and safety that has been built into the headlighting equipment. With the Guide T-3 type sealed beam units, proper aiming is even more important because the increased range and power of this lamp make even slight variations from recommended aiming hazardous to approaching motorists. The headlamps must be checked for proper aim whenever a sealed beam unit is replaced and after and adjustment or repairs of the front end sheet metal assembly.

Regardless of method used for checking headlamp aim, car must be at normal weight, that is, with gas, oil, water, and spare tire. Tires must be inflated to specified pressures. If car will regularly carry an unusual load in rear compartment, or a trailer, these loads should be on car when headlamps are checked. Some states have special requirements for headlamp aiming adjustment and these requirements should be known and observed.

Horizontal and vertical aiming of each sealed beam unit is provided by two adjusting screws which move the mounting ring in the body against the tension of the coil spring. There is no adjustment for focus since the sealed beam unit is set for proper focus during manufacturing assembly.

HEADLAMP PANEL ADJUSTMENT

Chevrolet (Fig. 2)

Vacuum Door

1. Actuate door shut and check alignment of door bottom edge to sheet metal.
2. Loosen four (4) screws on door--captured nuts allow limited alignment.
3. Turn adjustment screw clockwise (after loosening locknut) to move lower edge of door inward. Recheck alignment after closing door.

Camaro (Fig. 3)

Cover may be aligned with radiator grille through nuts on back of plate assembly (See Figure 3).

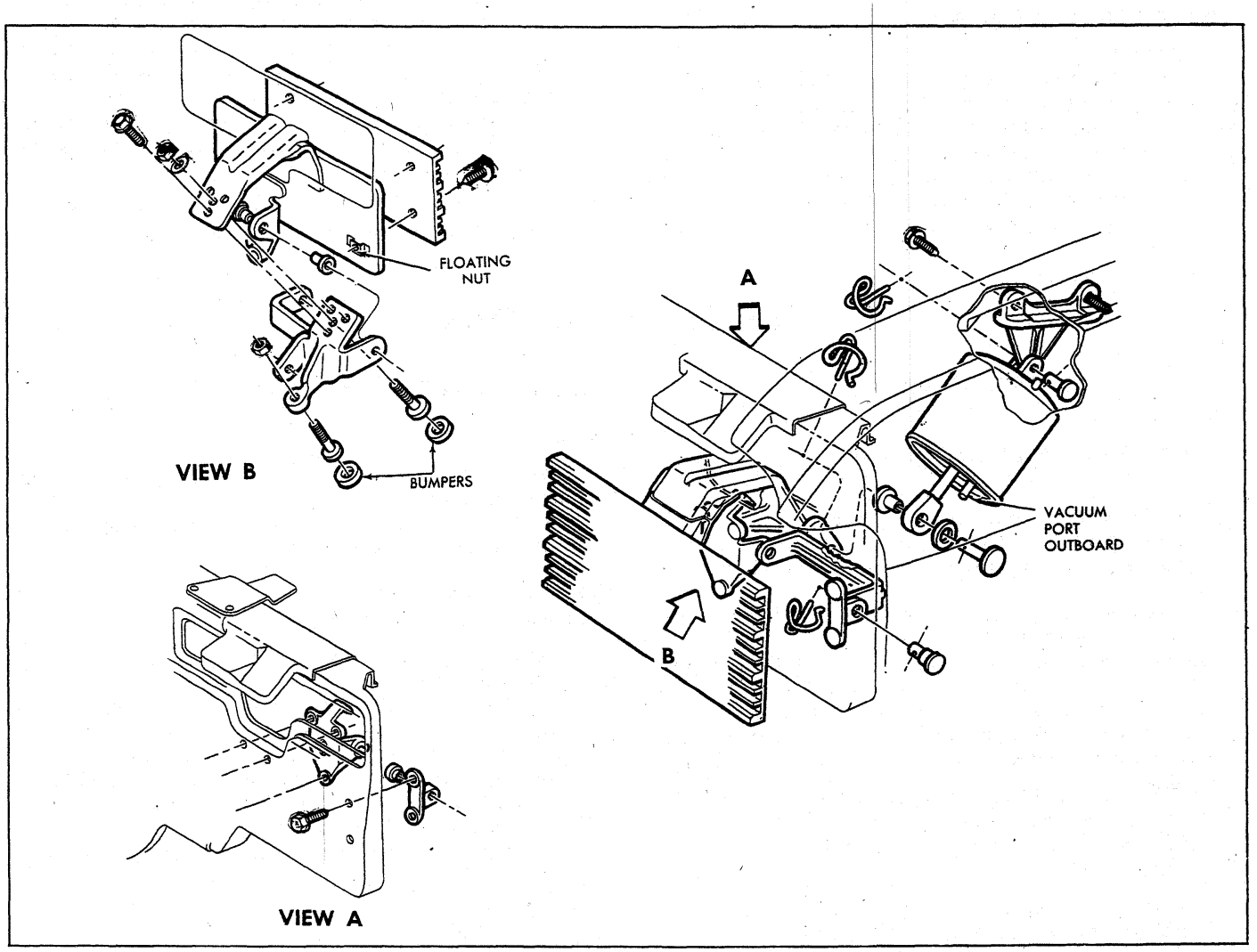


Fig. 2—Headlamp Panel Adjustment (Chevrolet)

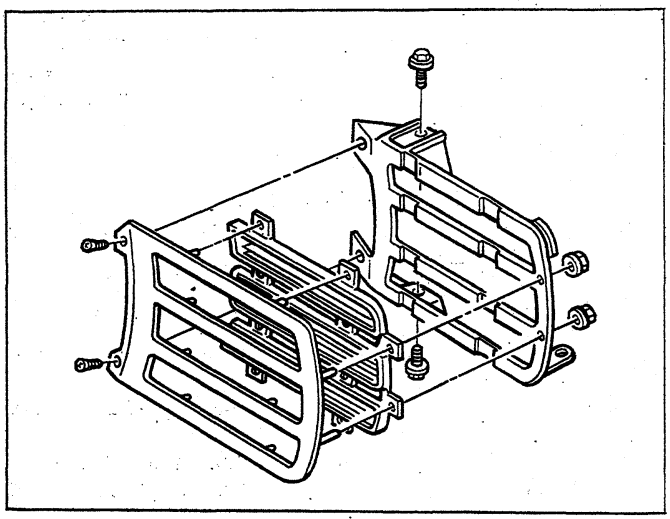


Fig. 3—Headlamp Panel Adjustment (Camaro)

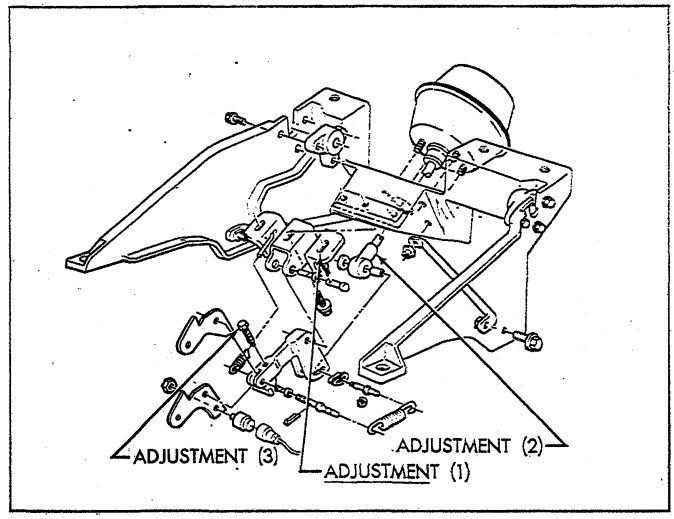


Fig. 4—Headlamp Panel Adjustment (Corvette)

Corvette

Headlamp Housing (Fig. 4)

Alignment Procedure

1. "In-out" loosen screws fastening slotted bracket to underside of headlamp housing assembly.
2. "Down" lamp cover top to opening; by turning hex head screw fastened to top of pivot link.
3. "Open" fully extended actuator with rod.
   a. Remove spring from actuator rod pin.
   b. Remove cotter pin from rod pin.
   c. Turn actuator rod until bushing hole aligns to forward end of slot in connecting link extended position, with engine idling for vacuum.
   d. Shut off engine, retract actuator rod and unscrew rod 1/2 turn to preload actuator rod in link.
4. "Up" (bezel to opening alignment) Loosen jamb nut and turning bumper covered screw up or down to touch then up 1-1/2 turns more. Micro switch on linkage must shut off warning lamp when lights are fully extended.

NOTE: The headlamp housing must be properly aligned before headlamps are aimed.

SERVICE OPERATIONS

FRONT LIGHTING

HEADLAMP REPLACEMENT (Figs. 5 and 6)

1. On Corvette, Chevrolet and Camaro Rally Sport models, open the headlamp panel to the open position.
2. Remove headlamp bezel retaining screws and remove bezel.
3. Disengage spring from the retaining ring and remove two attaching screws.
4. Remove retaining ring, disconnect sealed beam unit at wiring connector and remove the unit.
5. Attach connector to replacement unit and position unit in place making sure the number molded into the lens face is at the top.

   NOTE: In the dual headlamp installation the inboard unit (No. 1) takes a double connector plug, the outboard unit (No. 2) takes a triple connector plug.

6. Position retaining ring into place and install the retaining ring attaching screws and spring.
7. Check operation of unit and install the headlamp bezel.

PARKING LAMP REPLACEMENT

Bulb

1. Remove two lens retaining screws and disengage lens from housing.
2. Replace bulb, check operation of lamp, reinstall lens and retaining screws.

Lamp Housing
Chevrolet, Chevelle, Camaro and Nova

1. Disconnect lamp wire assembly in-line connector from wiring harness.
2. Remove two bolts retaining housing assembly in bumper or valance and remove housing.
3. Remove lens retaining screws, lens and bulb from housing assembly and transfer to new housing unit.
4. Connect lamp wiring assembly to harness assembly, housing and check operation of lamp.
5. Position lamp assembly in place and install retaining bolts.

Lamp Housing
Corvette

1. Reaching through valance air slot remove two nuts

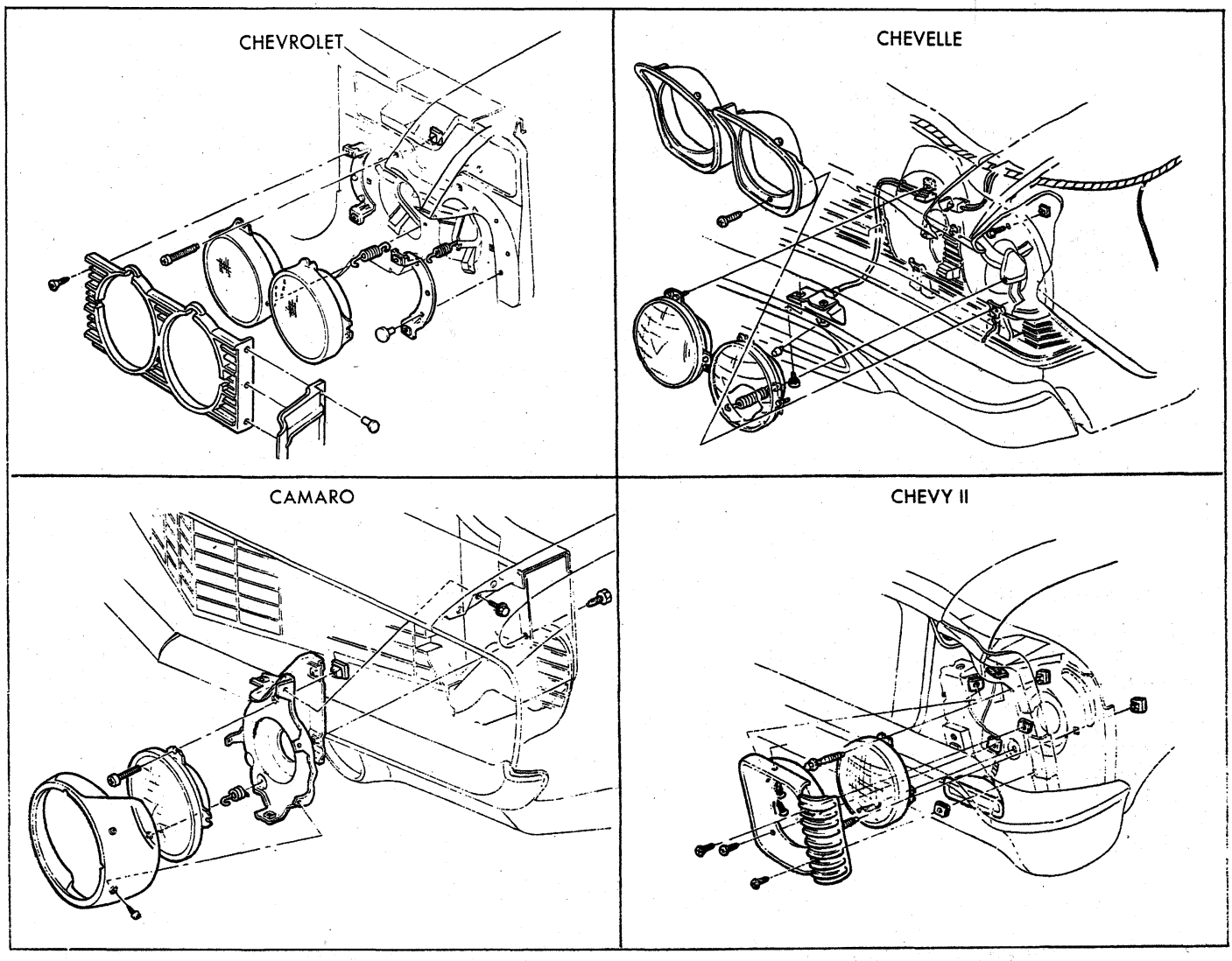


Fig. 5—Headlamp Assembly (Except Corvette)

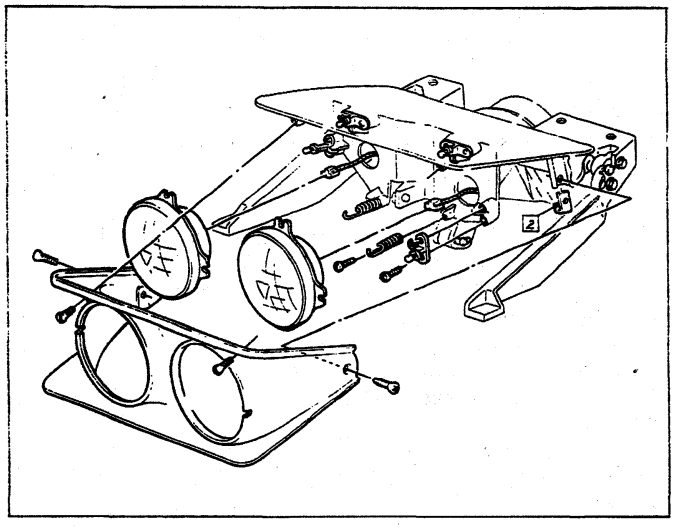


Fig. 6—Headlamp Assembly (Corvette)

fastening lamp assembly to bracket.
2. Disconnect lamp wiring plug from front wiring harness.
3. Transfer lens and bulb to new lamp housing.
4. Install lamp assembly in the bracket and secure with two nuts.
5. Connect lamp wiring harness and check operation.

MARKER LAMP REPLACEMENT (Fig. 7)

1. On Chevrolets remove four screws holding grille extension to body and swing grille extension to one side to gain access to marker lamp retaining nuts.
2. Remove retaining nuts inside fender panel.
3. Pull assembly out from fender and disconnect plug at lamp.
4. Install plug into lamp and install lamp and bezel into fender.
5. Install nuts retaining bezel to fender.
6. On Chevrolets install screws securing grille to extension body.

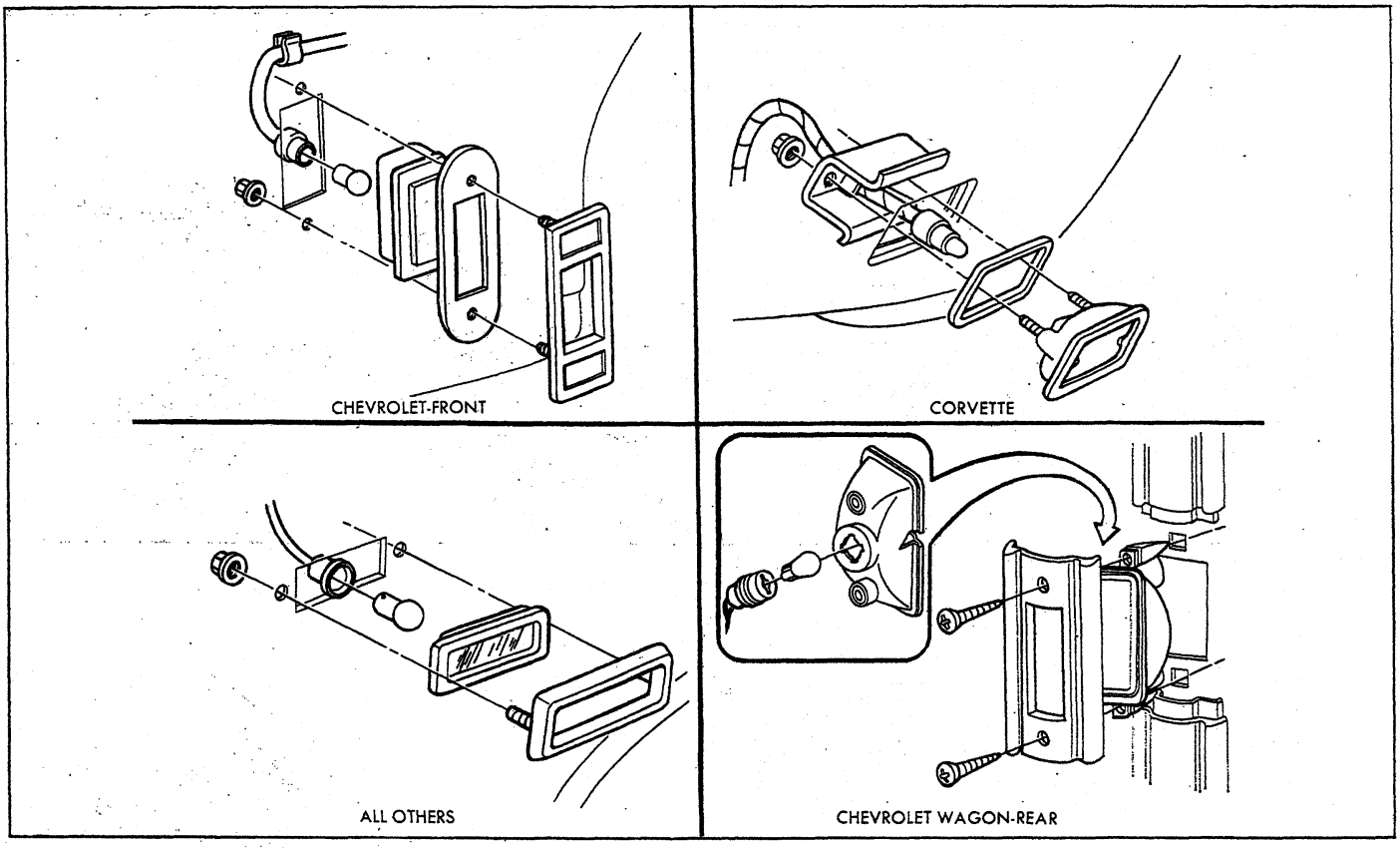


Fig. 7—Marker Lamp Installations

Bulb Replacement—Except Corvette Front

Turn connector plug counter-clockwise 1/4 turn to remove plug containing bulb from lamp assembly.

NOTE: Some A/C equipped cars will need the battery removed for access to the right front marker lamp connector plug.

Corvette Front

Reach through opening under grille and turn plug connector 1/4 turn counter-clockwise to remove and replace bulb inset in plug connector.

VACUUM OPERATED HEADLAMP SERVICE

Headlamp Door (Fig. 2)

Chevrolet

Replacement

1. Actuate headlamp doors open by sliding valve inboard on top of vacuum relay.
2. Remove (4) four screws on lid.
3. Remove (3) three bolts attaching door cover and lift off car.
4. Reverse procedure for assembly.

NOTE: Headlamp cover may be aligned with front sheet metal through captured floating nuts on rear of plate assembly.

Headlamp Door (Fig. 3)

Camaro

Replacement

1. With door closed, remove 2 screws securing cover-to-plate assembly.
2. Open hood, then slide valve inboard on top of vacuum relay. This will allow opening of headlamp cover.
3. Partially open door plate assembly and reach inside of opening to remove nuts attaching cover to hinge and lift off door plate.

NOTE: Spacer installation between hinge and plate assembly.

4. Install cover and plate assembly in the reverse order of removal.

NOTE: Cover may be aligned with radiator grille through captured floating nuts on back of plate assembly.

Headlamp Door (Fig. 8)

Corvette

Replacement

1. Actuate door open.
2. Remove radiator decorative grille and attaching screws.
3. Remove headlamp bezel and apply protective tape to headlamp door opening.

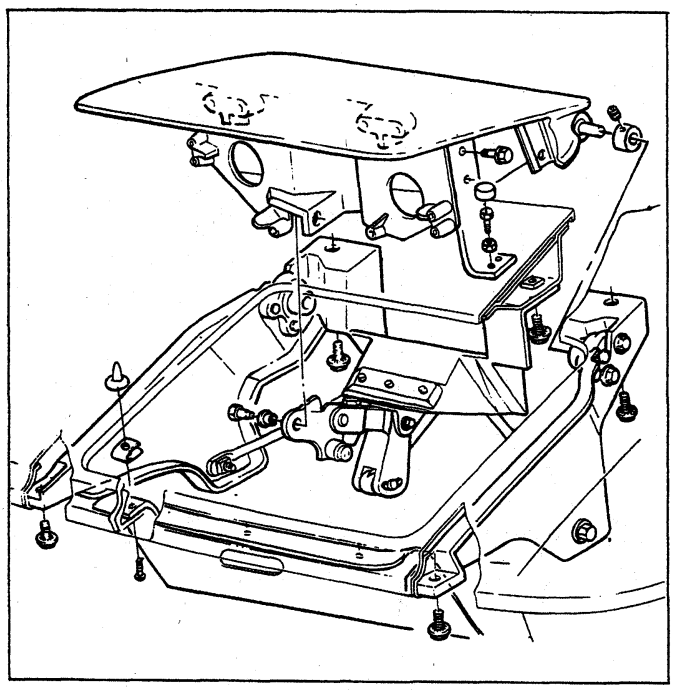


Fig. 8—Headlamp Door—Corvette

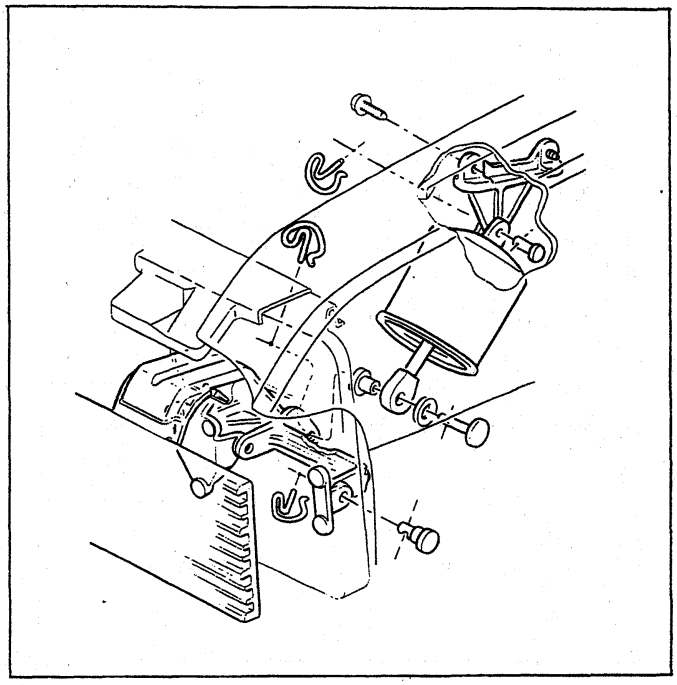


Fig. 9—Actuator Assembly (Chevrolet)

4. Remove headlamp assemblies inner and outer by removing springs with a hooked wire or small vise grips.
5. Remove front screw and bushing attaching headlamp housing to support assembly link.
6. Remove "J" bar from side of headlamp housing extending downward.
7. Reaching in through grille opening, remove three (3) cap screws retaining bearing and headlamp housing assemblies to support assembly.
8. Lift headlamp door assembly forward and out of opening.
9. Transfer remaining door attachments to new door assembly and install assembly in the reverse order of removal.

Actuator Assembly

Chevrolet (Fig. 9)

Replacement

1. Remove vacuum tank (3 bolts).
2. Remove battery for right side actuator.
3. Remove front and rear hoses on actuator.
4. Remove front pivot pin retaining washers and pivot pin.
5. Remove actuator rear pivot pin retainer with pin and lift actuator out of vehicle.
6. Replace actuator and install removed components in the reverse order of disassembly.
7. Check out operation of actuator with applied vacuum.

Actuator Assembly

Corvette (Fig. 4)

Replacement

1. Remove radiator decorative radiator grille and screws.
2. Actuate headlamps partially open and remove long spring on either side of pivot link pin.
3. Remove two (2) vacuum hoses attached to actuator.
4. Remove cotter pin and slide out pivot pin, freeing actuator rod.
5. Remove four (4) nuts from actuator studs and slide actuator down and out grille opening.
6. Reverse removal procedure when replacing actuator.

Actuator Assembly

Camaro—(Rally Sport) (Fig. 10)

Replacement

1. Remove vacuum hoses from actuator and tag hoses as to placement on actuator (ie. front, rear).
2. Place vehicle on hoist and raise.
3. From underside, forward of front fender skirt remove actuator shield.
4. Remove pin retainer and pin at front of actuator.
5. Remove actuator attaching rear bolt and lower actuator assembly from beneath vehicle.
6. Install replacement actuator in reverse order of removal procedure and test operation with applied vacuum.
7. Lower hoist and remove vehicle.

Vacuum Relay—All (Fig. 11)

Replacement

1. Raise hood.
2. Gently remove four (4) hoses from relay.
3. Remove two (2) screws attaching vacuum relay and lift relay from engine compartment.
4. Install vacuum relay in reverse order of removal and check operation of headlamp covers with applied vacuum.

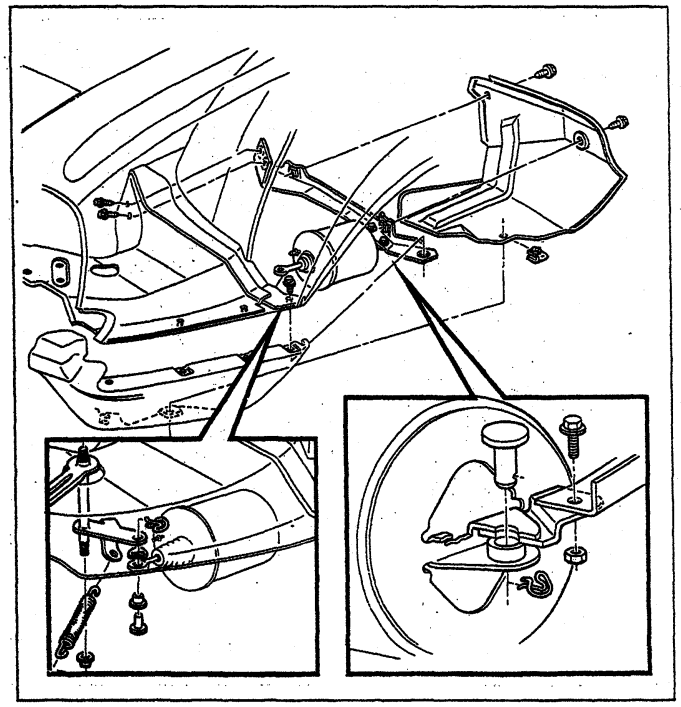


Fig. 10—Actuator Assembly (Camaro)

NOTE: Reinstall color coded hoses on proper fittings. Fittings will be noted as R-Y-G letters on Chevrolet and Camaro. Corvette connectors have molded R-Y-G letters and color striped hoses.

Vacuum Tank

Chevrolet

Replacement

1. Raise hood.
2. Remove vacuum hose from tank.

   NOTE: Record hose strip color and location on tank.

3. Remove screws securing vacuum relay.

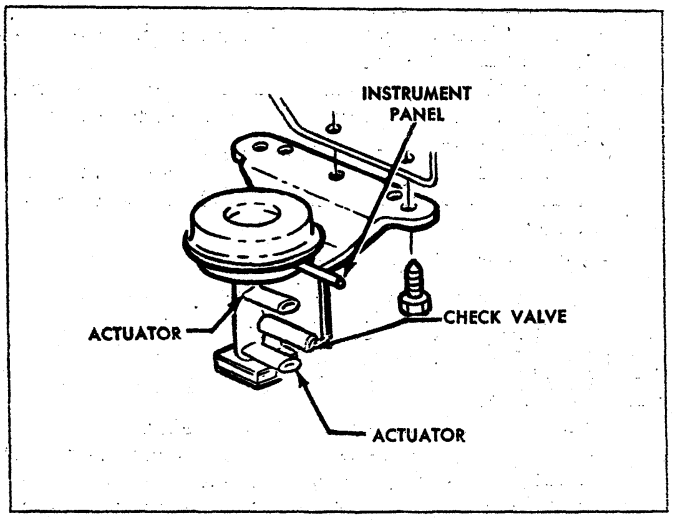


Fig. 11—Vacuum Relay

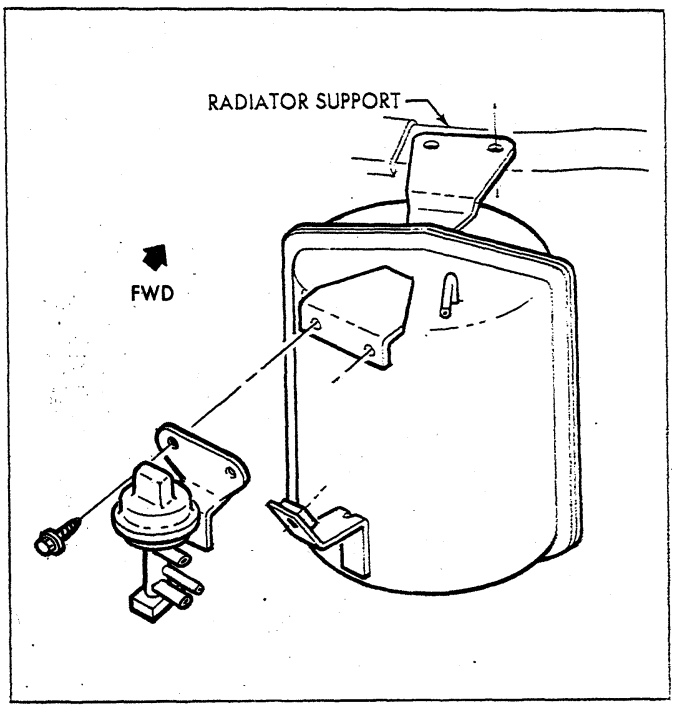


Fig. 12—Vacuum Tank (Chevrolet)

4. Remove two (2) bolts from top of radiator support and lift vacuum tank from engine compartment.
5. Replace vacuum tank and components in the reverse order of removal.
6. Operate headlamp covers by vacuum.

Camaro

Replacement

1. Raise hood and remove washer jar and bracket.
2. Remove (2) screws attaching vacuum relay to tank.
3. Remove vacuum hose attached to tank.
4. From underside of left fender skirt remove two (2) attaching bolts and lift off tank.
5. Install new tank in reverse order of removal procedure and check out operation of headlamp covers with applied vacuum and engine off.

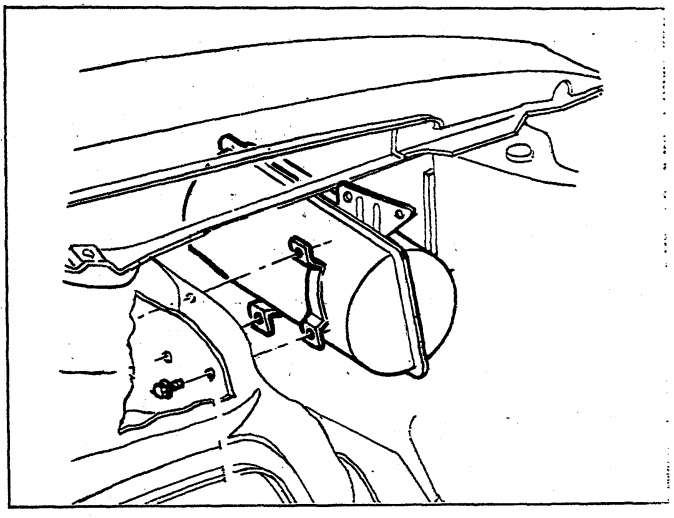


Fig. 13—Vacuum Tank (Camaro)

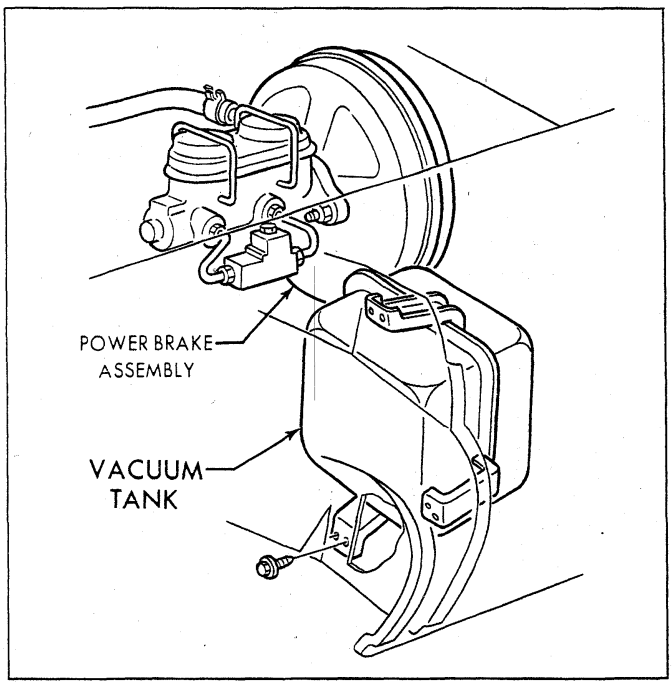


Fig. 14—Vacuum Tank (Corvette)

Corvette

Replacement

1. Raise hood.
2. Remove power brake booster and master cylinder. See Section 5.
3. Remove vacuum hoses from tank noting color stripe and location of hoses. Tape hose ends to keep out contaminants.
4. From underside of left fender skirt remove screw assemblies retaining vacuum tank.
5. Reaching inside engine compartment, lift out tank with integral brackets.
6. Install tank in the reverse order of removal procedure.

Vacuum Hose Routing (Fig. 15)

The vacuum hose routing is similar on all three vehicles (Corvette, Camaro Rally Sport and RPO Chevrolet).

Many vacuum hoses are color stripped and bundeled on Corvettes for ease of assembly. Replacement hoses must not be pinched in routing. Actuator to relay valve hoses are an exact length for each side on Corvette.

Vacuum hoses connect the following headlamp system components: manifold vacuum to check valve, check valve to vacuum tank, check valve to headlamp switch, headlamp switch to relay valve, vacuum tank to relay valve, relay valve to closed side of actuator, relay valve to open side of actuator and manual control valve to relay valve--Corvette.

REAR LIGHTING

TAIL, STOP, DIRECTIONAL AND BACKUP LAMPS

Bulb Replacement (Figs. 16 and 17)

1. Remove lens retaining screws and disengage lens from lamp (except Camaro)
2. Camaro - open trunk - remove plug and bulb from housing.
3. Replace bulb and check operation of unit.
4. Install lens and retaining screws.

Chevrolet—Except Station Wagon (Fig. 16)

Housing Replacement

1. Open trunk and disconnect pigtail connectors of lamps just inside.
2. Poke sealing grommets and lamp connectors through trunk floor pan.
3. Remove lamp lens from bumper face.
4. Lower bumper - See Sec. 14.
5. From back of bumper remove screws retaining lamp to be removed.
6. Lift out lamp assembly and transfer needed components to new lamp housing before installation.
7. Reverse removal procedure when installing replacement lamp housing.

Chevelle, Camaro, Nova, Corvette and Chevrolet Wagon

See Figure 17 for detailed description of removal and installation of the rear lamp housings.

LICENSE PLATE LAMP SERVICE

Lamp Housing

1. Remove the lamp assembly retaining screws and remove lamp assembly from mounting location (rear bumper center face bar most models).
2. Disconnect lamp wiring from chassis harness connector (inside trunk on some models).
3. Force grommet and wiring down through body opening (where applicable) and remove assembly from vehicle.
4. To install replacement unit, insert grommet and wiring through body opening where applicable and connect wiring to chassis harness.
5. Position assembly and install retaining screws. On Corvette models make sure ground wire is properly installed.
6. Check operation of lamp assembly.

Bulb Replacement

1. Remove lens retaining screws and lens.

   NOTE: On Camaro models loosen housing retaining screws.

2. Remove and replace bulb.
3. Position lens and install retaining screws.

AUTOMATIC TRANSMISSION QUADRANT LAMP REPLACEMENT—DASH

All

The quadrant is a part of the instrument panel, and the illumination bulb is serviced with other instrument panel illumination bulbs. On Camaro models fiber optics allow remote illumination of the PRNDL indicator.

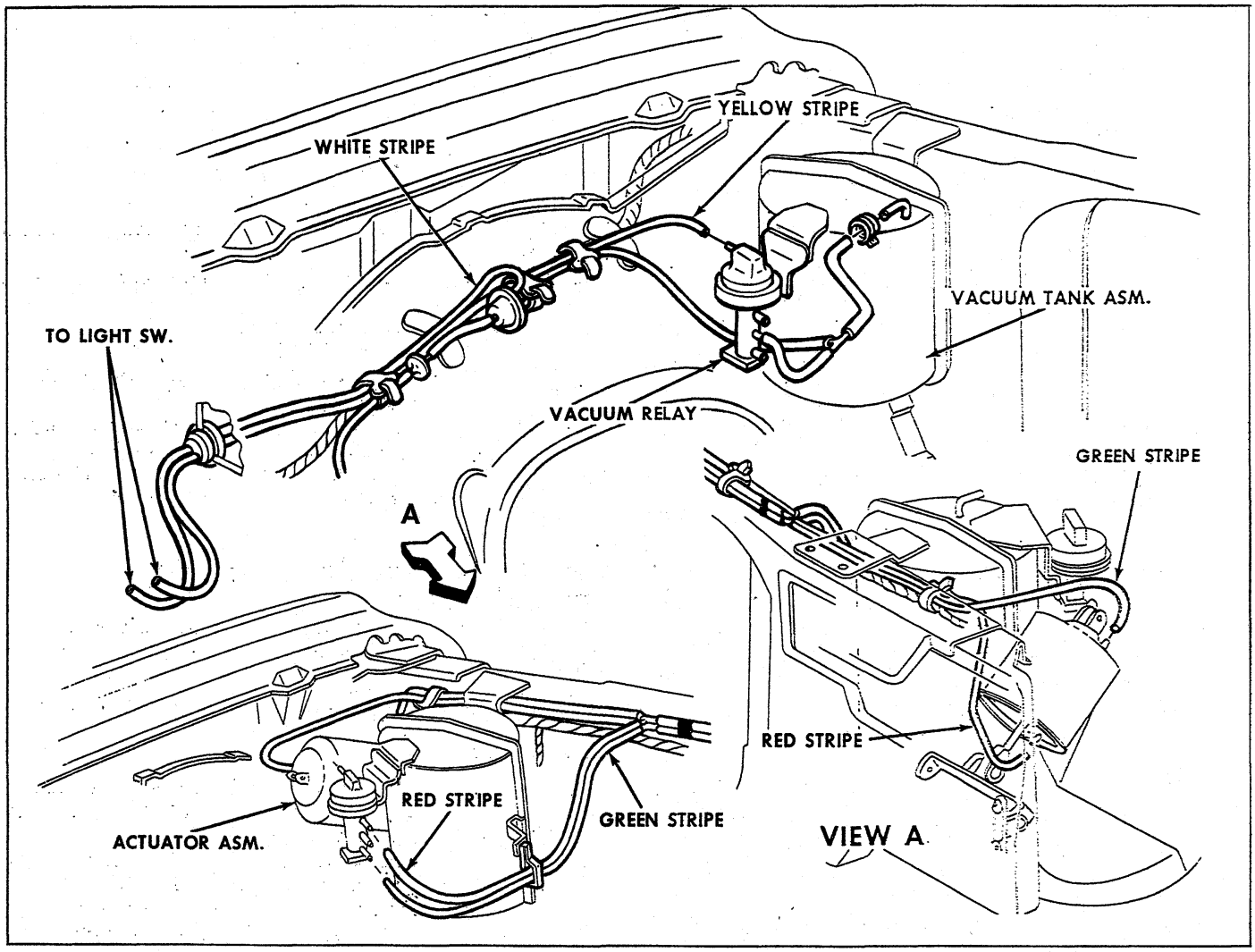


Fig. 15—Vacuum Hose Routing

SEAT SEPARATOR CONSOLE LAMPS

Compartment Lamp Replacement (Fig. 18)

1. Remove (pry up) switch assembly from console opening in the instrument compartment.
2. Remove bulb from the socket.
3. Replace bulb and install switch assembly in console opening.

Courtesy Lamp Replacement (Fig. 18, 19) (Except Camaro)

1. Remove two screws and lens at rear of console.
2. Remove bulb from retainer.
3. Replace the bulb, position the lens and install attaching screws.

Camaro

1. Remove ash tray at rear of console.
2. Remove two (2) screws retaining lens assembly through opening created by removing the ash tray.
3. Pull lens assembly rearward out of console and remove bulb.

Quadrant Lamp Replacement (Fig. 18)

1. Remove Dial Quadrant Trim plate retaining screws and lift trim plate assembly from console opening.
2. Disconnect lamp socket from the retainer and remove bulb from the socket.
3. To install, insert bulb into the socket and snap the socket assembly into the retainer.
4. Position the trim plate assembly into the console opening and install the retaining screws.

IGNITION SWITCH

Due to the integral design relationship of the ignition lock and switch with the energy absorbing steering column service procedures for the ignition lock and switch are covered in Section 9, steering.

LIGHTING SWITCH REPLACEMENT (Fig. 20) (Except Corvette)

1. Disconnect battery ground cable.
2. Pull control knob of headlamps to "ON" position.
3. Reach up under instrument panel and depress the

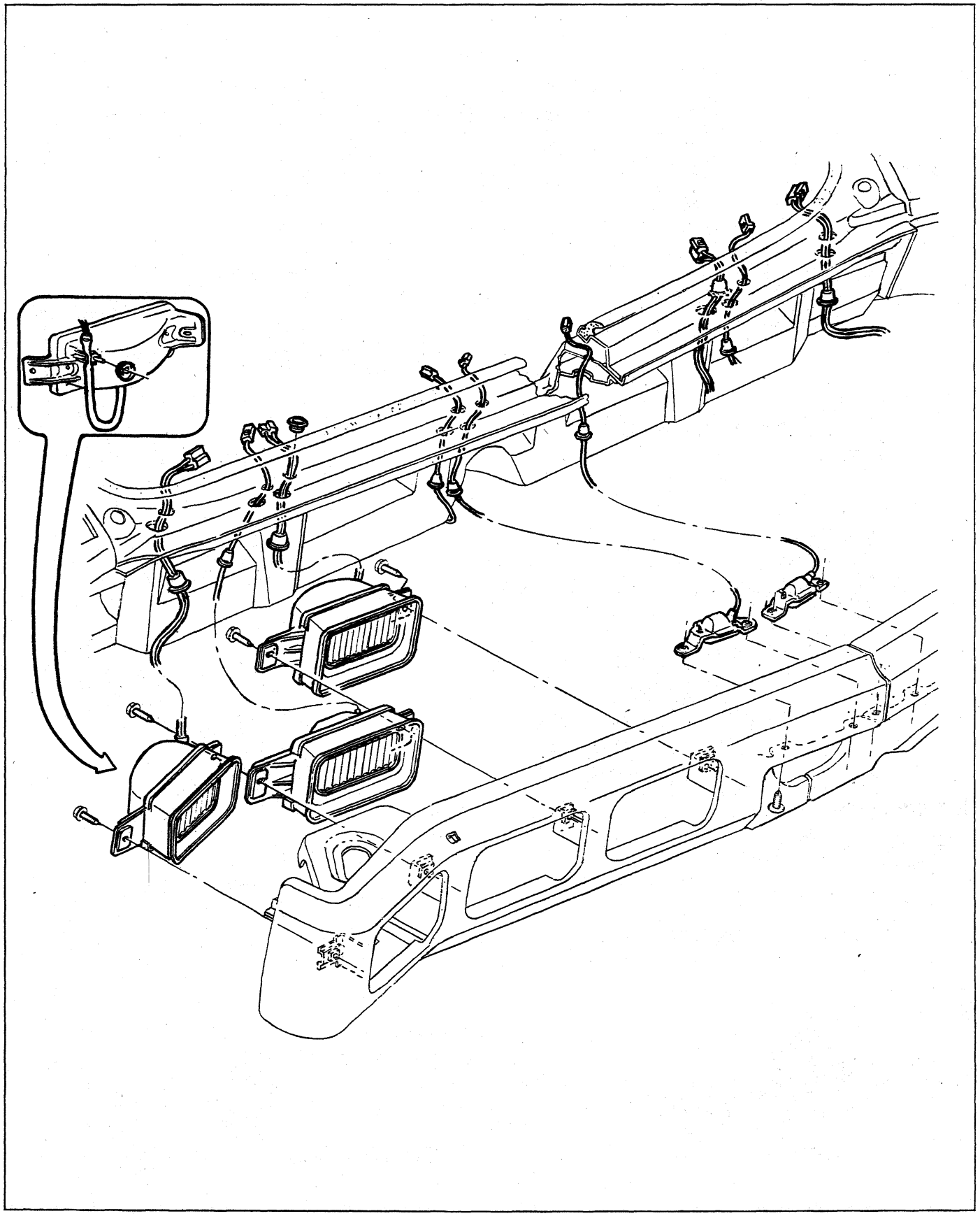


Fig. 16—Rear Lighting Chevrolet (Except Wagon)

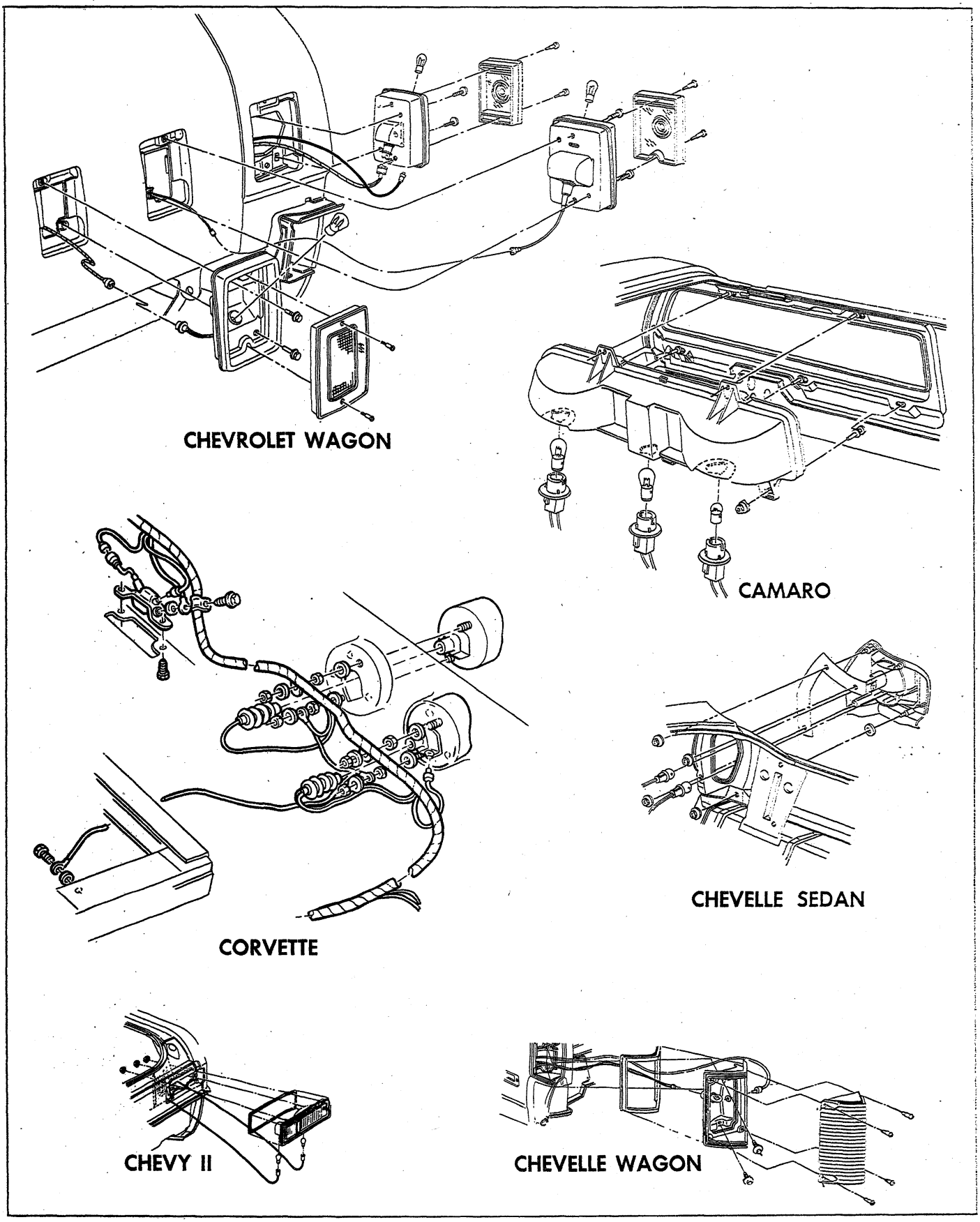


Fig. 17—Rear Lighting (Except Chevrolet)

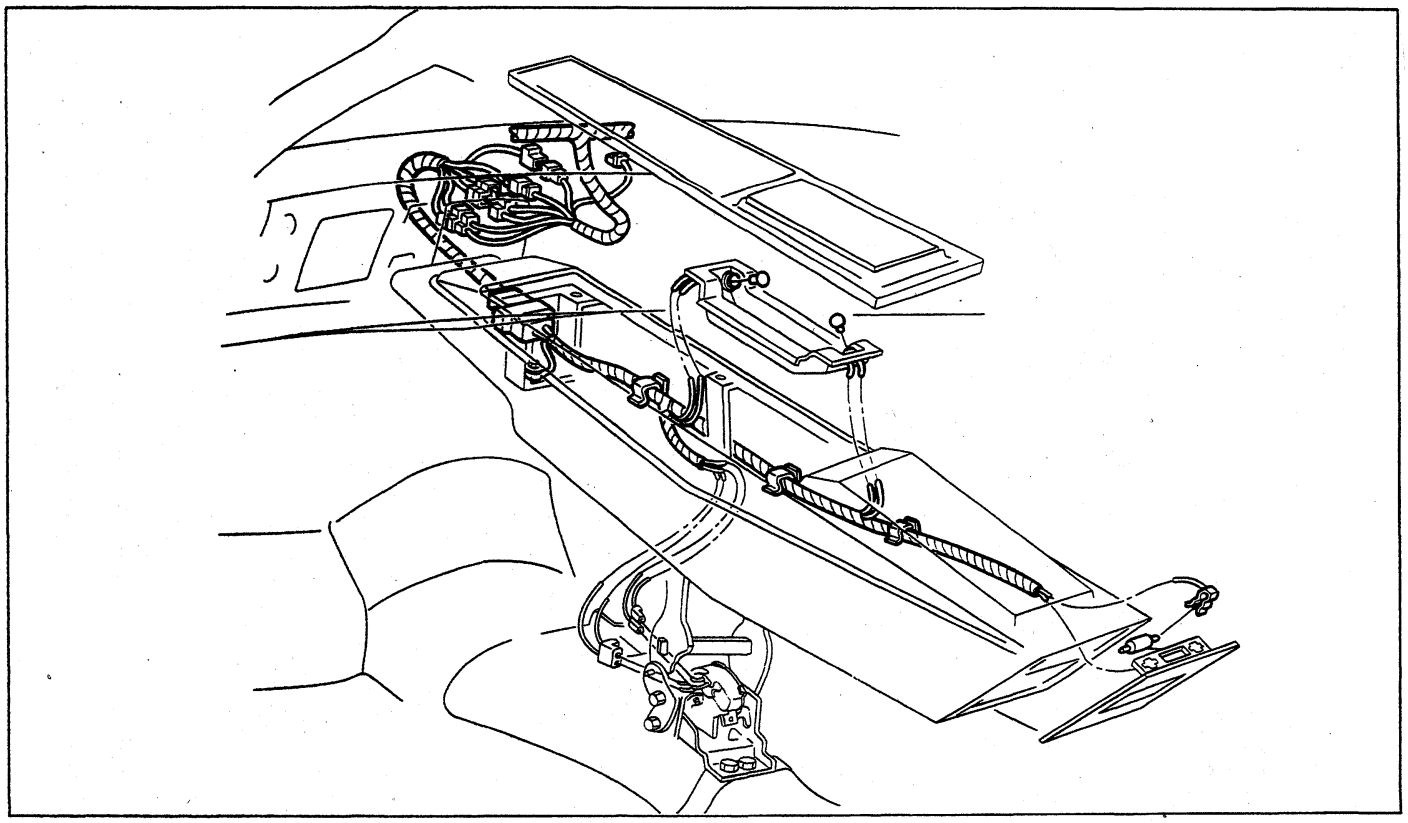


Fig. 18—Seat Separator Wiring (Chevelle)

switch shaft retainer, then remove knob and shaft assembly.

4. Remove ferrule nut and switch assembly from instrument panel.

NOTE: Remove vacuum hoses from Corvette; also Camaro and Chevrolet optional headlamp switches. Tag location of hoses for assembly.

5. Disconnect the multi-contact connector from the lighting switch. A screw driver may be inserte ' in the side of the switch to pry the connector from the switch.
6. Connect the multi-contact connector to the replacement switch. Connect vacuum hoses in correct positions to headlamp switches and complete switch replacement in the reverse order of removal.

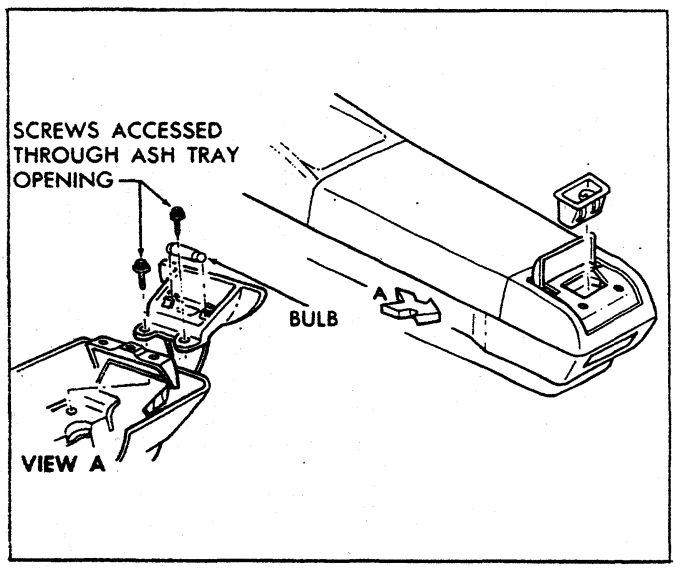


Fig. 19—Removing Camaro Console Bulb

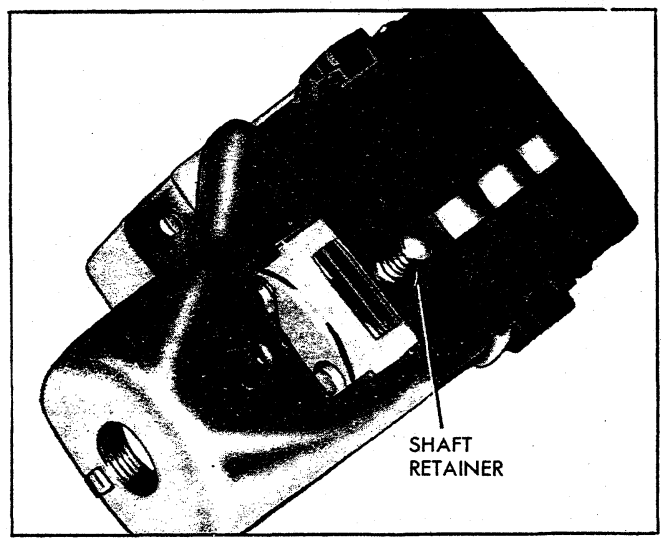


Fig. 20—Shaft Retainer

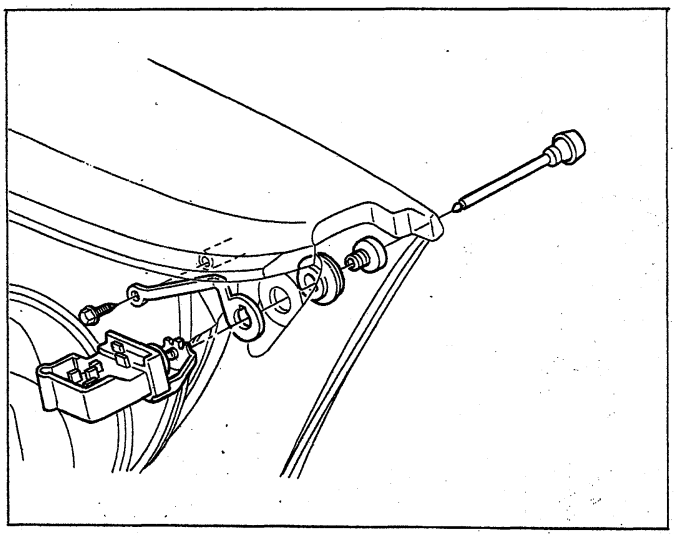


Fig. 21—Corvette Lighting Switch

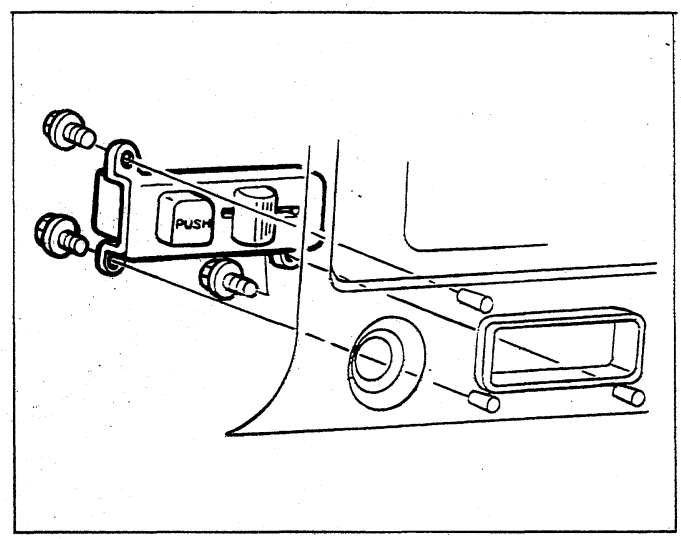


Fig. 22—Wiper-Washer Control (Except Corvette)

LIGHTING SWITCH REPLACEMENT (Fig. 21) (Corvette)

1. Disconnect battery ground cable at battery.
2. Remove screws securing mast jacket trim covers and remove covers for access to steering column to instrument panel mounting bracket.
3. Unclip and remove the left side console forward trim panel so that left side instrument cluster may be lowered for access to the light switch in latter steps.
4. Lower steering column.
5. Remove screws and washers securing left instrument panel to door opening, top of dash, and left side of center instrument panel.
6. Pull cluster assembly down and then tip forward for access to the light switch.
7. Depress the switch shaft retainer and remove the knob and shaft assembly. Remove the switch retaining bezel.
8. Disconnect vacuum hoses from the switch, tagging them for assembly. Pry the connector from the switch and remove the lighting switch.
9. To install replacement switch reverse the 'Removal' steps.

WIPER-WASHER CONTROL (Fig. 22) (Chevrolet)

1. Disconnect battery ground cable.
2. Remove trim plate and A/C lap outlet below steering column.
3. Pull electric connector off rear of wiper switch.
4. Remove (3) three screws from rear of switch and lift wiper out rear of instrument panel.
5. Install wiper-washer control switch in the reverse order of removal, connect battery and check operation of wiper-washer control.

WIPER-WASHER CONTROL (Fig. 22) Chevelle, Camaro and Nova

1. Disconnect battery ground cable.
2. Chevelle only
   a. Remove left side dash air outlet.
   b. Remove headlamp switch, previously covered.
3. Pull electric connector off rear of wiper switch.
4. Remove (3) three screws from rear of switch and lift wiper out rear of instrument panel.
5. Install wiper-washer control switch in the reverse order of removal, connect battery and check operation of wiper-washer control.

WIPER WASHER CONTROL (Fig. 23) Corvette

1. Disconnect battery ground cable.
2. Remove screws from upper portion of center console labeled "Corvette".
3. Remove wiring connector from switch.
4. Remove switch and plate from center console.
5. Grasping the switch arm with a small pair of lock pliers, gently pry the knob off switch then remove screws securing the switch.

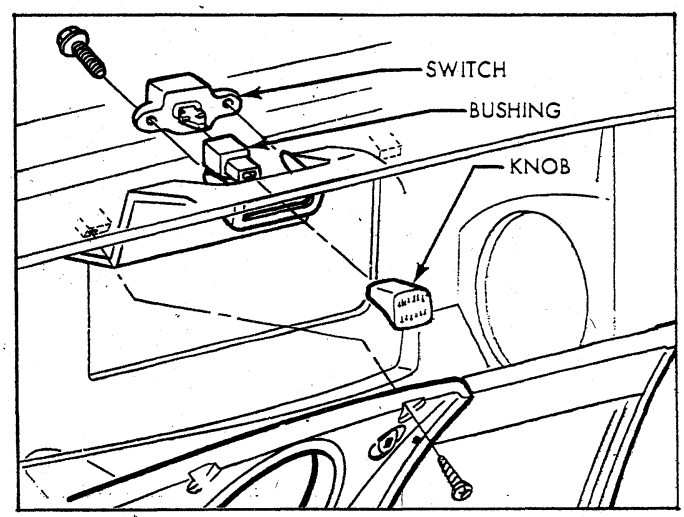


Fig. 23—Wiper Washer Control (Corvette)

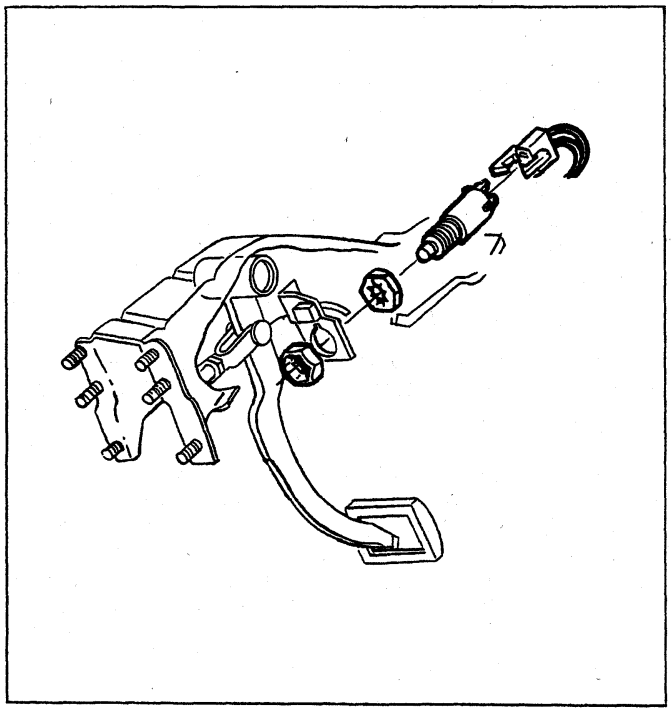


Fig. 24—Stop Light Switch (Except Chevelle)

6. The first step in replacing the switch is to insert a small rod in the switch arm before attempting to push the knob on the arm outside of the trim plate, then follow Steps 1 through 5 in the reverse order of removal.

STOP SWITCH REPLACEMENT (Figs. 24, 25)

1. Disconnect wiring harness connector at switch.

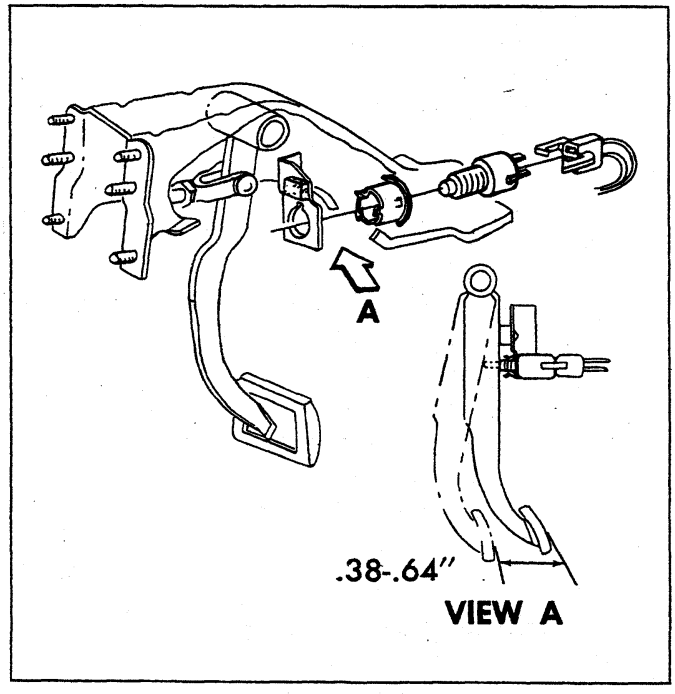


Fig. 25—Stop Light Switch (Chevelle)

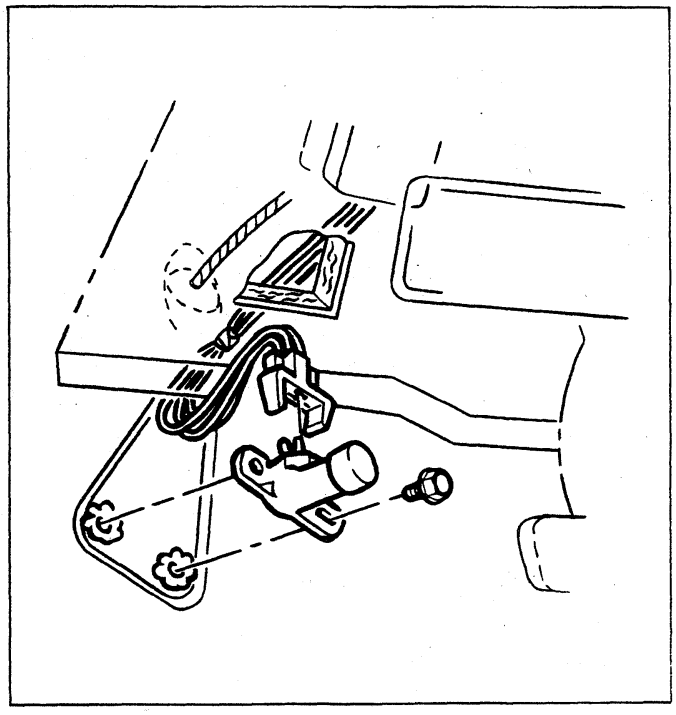


Fig. 26—Dimmer Switch (Typical)

2. Remove retaining nut, if so equipped, and unscrew switch from bracket.
3. Switch installation.
   a. Chevelle models; depress brake pedal and push new switch into clip until shoulder bottoms out.
   b. All other models; install inboard adjusting nut, install switch through bracket and install retaining nut.
4. Plug connector onto switch.
5. Check switch for proper operation. Electrical contact should be made when the brake pedal is depressed 3/8" to 5/8" from fully released position.

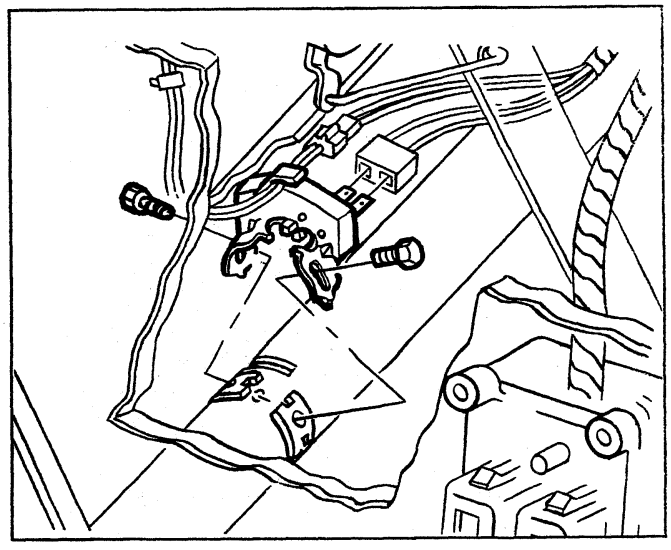


Fig. 27—Backup Lamp Switch on Mast Jacket

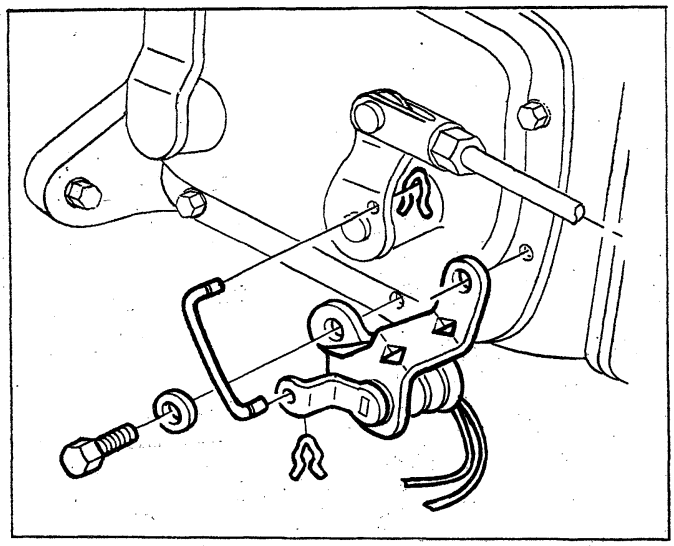


Fig. 28—Backup Switch - Corvette

DIMMER SWITCH REPLACEMENT (Fig. 26)

1. Fold back upper left corner of front floor mat, disengage connector lock fingers, and disconnect multi-plug connector from dimmer switch.
2. Remove two screws retaining dimmer switch to toe pan.
3. Connect multi-plug connector to new switch and check operation. Install new switch to toe pan with two screws. Replace floor mat.

BACKING LAMP SWITCH REPLACEMENT Located on Mast Jacket (Fig. 27)

1. Disconnect wiring connector at switch terminals.
2. Remove switch attaching screws and switch from mast jacket.
3. Position the column shift tube in reverse detent using the 1st-Reverse lower shift lever.
4. Position switch on column with drive tang in slot in shift tube and right side of tang contacting right surface of shift tube slot.
5. Holding switch in position, install the two attaching screws and torque to specifications. (Moving gear

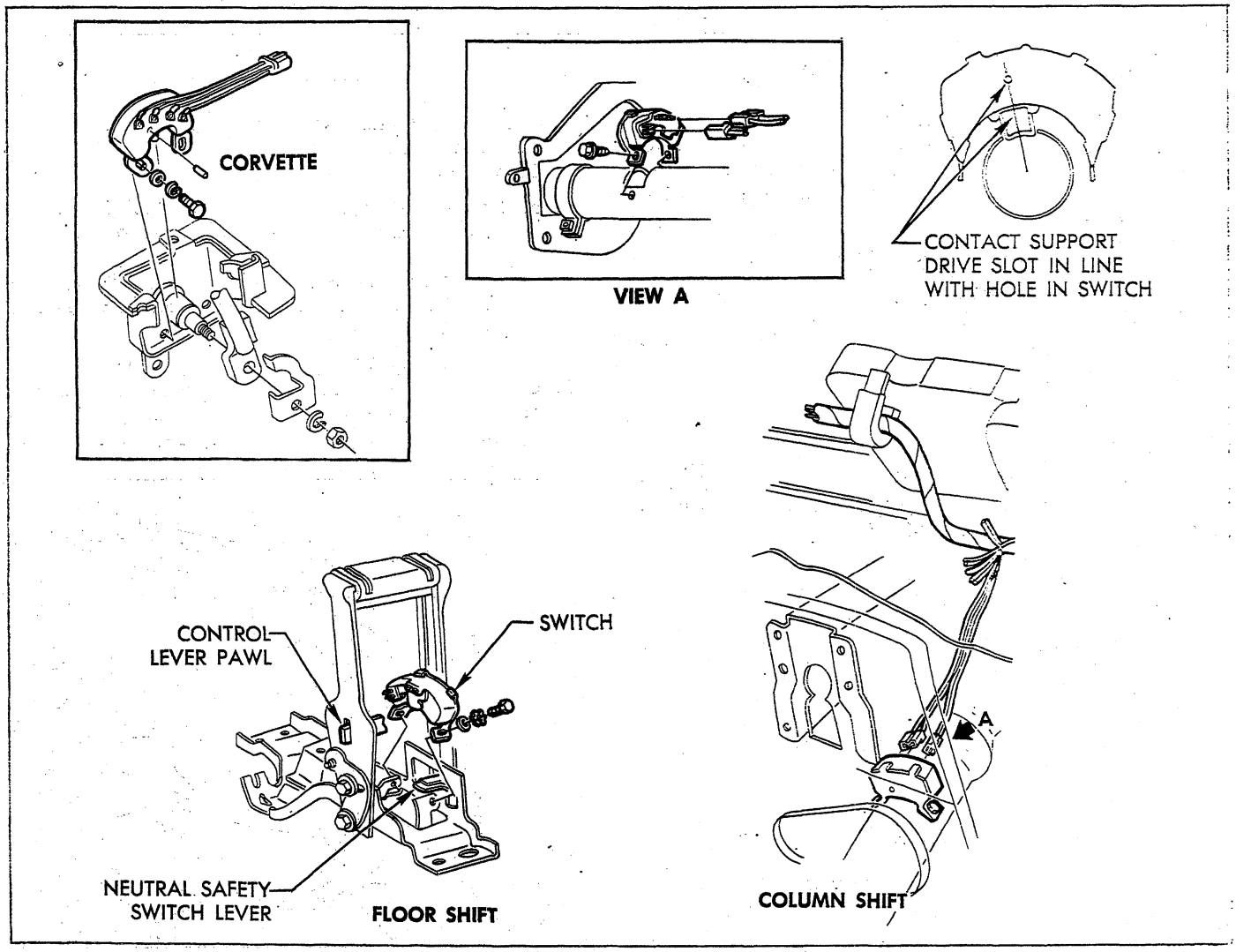


Fig. 29—Neutral Safety Switches

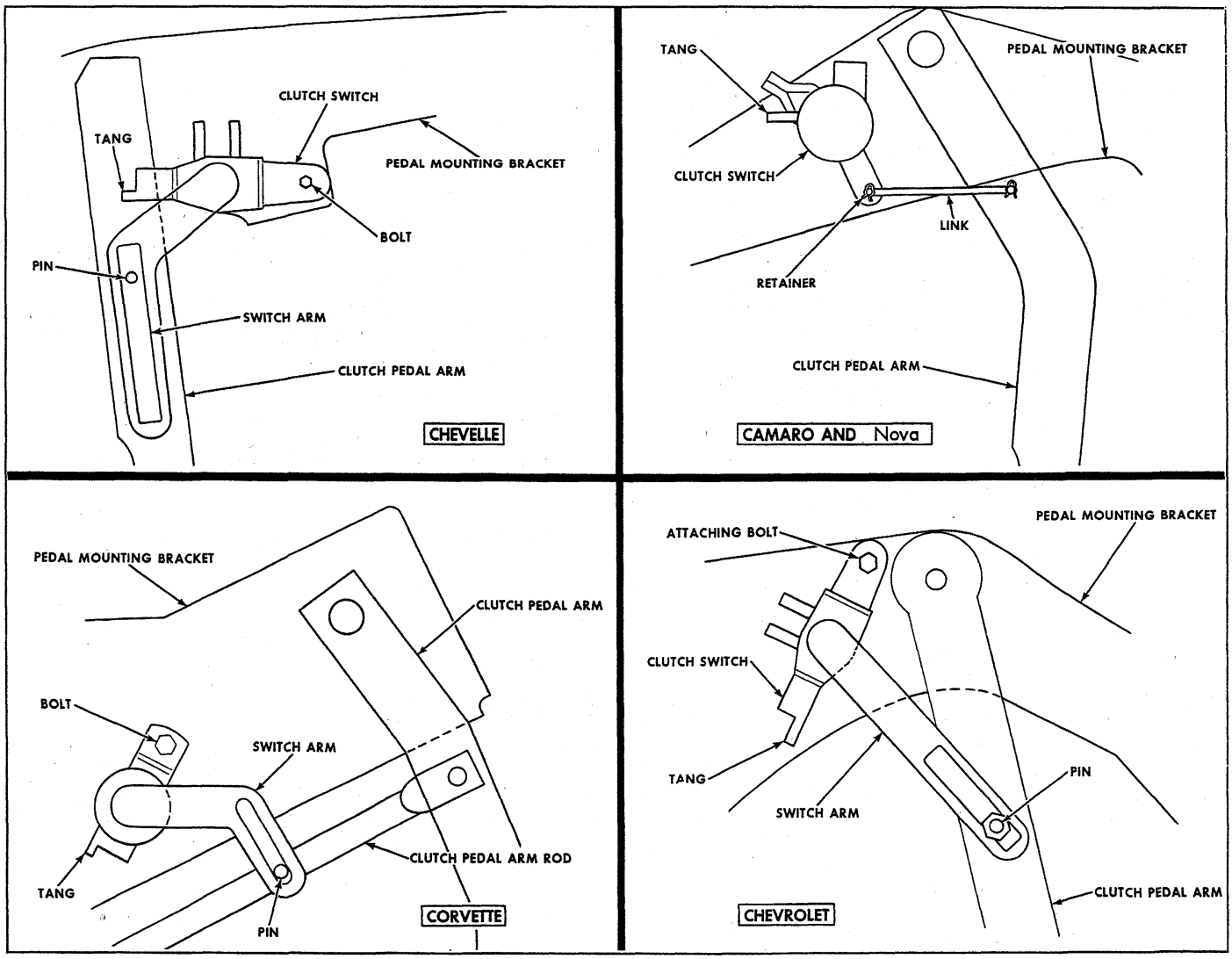


Fig. 30—Clutch Operated Neutral Start Switch

selector lever out of reverse position will break shear pin).
6. Plug wiring connector on switch.
7. Check operation of switch.

Located on Transmission (Fig. 28)

1. Place vehicle on hoist.
2. Disconnect switch wiring from harness wiring at in-line connector.
3. Remove bolt retaining wiring attaching clip to transmission.
4. Remove wire clip retaining reverse lever rod to switch.
5. Remove screws retaining switch and shield assembly to transmission, remove switch.

NOTE: Do not remove transmission-to-bracket retaining bolts.

6. To install, reverse removal procedure and check switch for operation in transmission reverse range.

NEUTRAL SAFETY SWITCH REPLACEMENT

Column Shift (Fig. 29)

1. Disconnect wiring harness connectors at switch terminals.
2. Remove switch retaining screws and switch from mast jacket.
3. To install, position shift lever in drive and locate lever tang against transmission selector plate.
4. Align slot in contact support with hole in switch and insert pin (3/32" dia.) to hold support in place. Switch is now in drive position.
5. Place contact support drive slot over shifter tube drive tang and tighten screws. Remove clamp and pin.
6. Connect wiring harness to switch terminals and check operation of switch.

Floor Shift (Fig. 29)

1. Disconnect shift control lever arm from the control rod.
2. Remove the shift control knob.

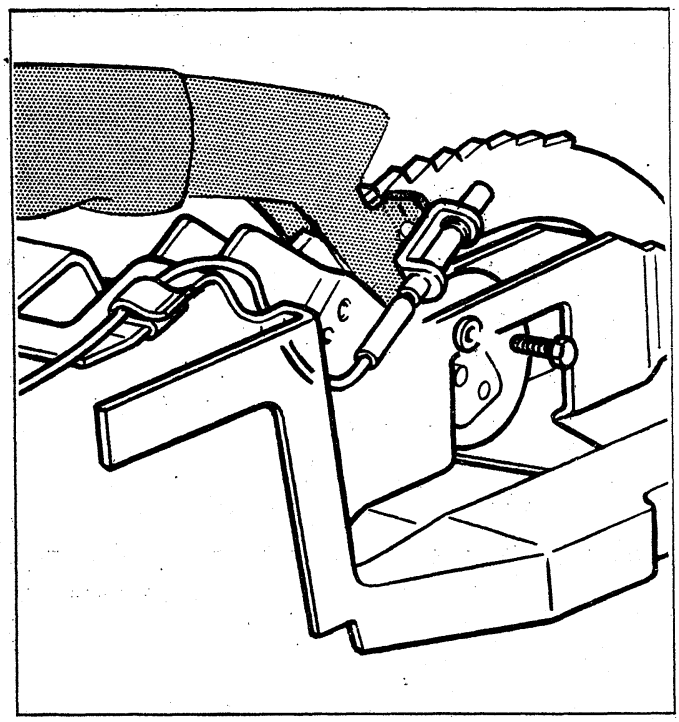


Fig. 31—Parking Brake Alarm Switch (Corvette)

3. Remove Trim Plate retaining screws and trim plate assembly.
4. Remove control assembly retaining screws (See Section 1).
5. Remove control assembly from the seal.
6. Remove switch retaining nuts and switch from the control assembly.
7. To install, position gearshift in "Drive" position align hole in contact support with hole in switch and insert pin (3/32" dia.) to hold support in place.
8. Place the contact support drive slot over the drive tang and tighten switch mounting screws, then remove pin.

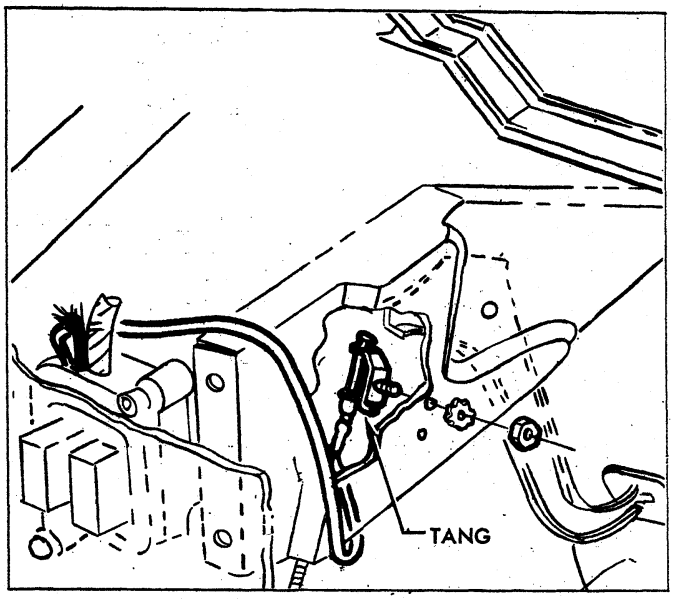


Fig. 32 Parking Brake Switch (Chevrolet, Camaro, Nova)

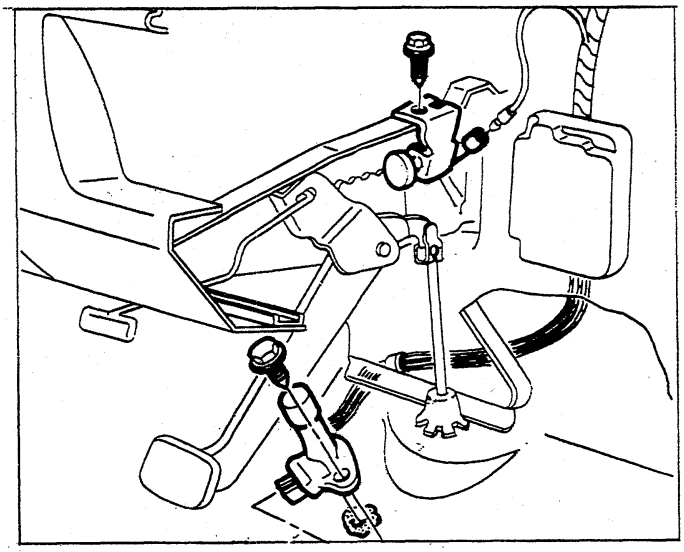


Fig. 33—Parking Brake Switch (Chevelle)

9. Connect wiring harness to switch wiring, and check operation of switch.
10. Install trim plate assembly and shift lever control knob.
11. Connect shift lever arm to the transmission control rod.

CLUTCH OPERATED NEUTRAL START SWITCH (Fig. 30)

The clutch pedal must be fully depressed and the ignition switch in the START position for Vehicle starting.

The switch mounts with a tang and screw to the pedal mounting bracket. The switch lever is moved by a pin or wire link attached to the clutch pedal arm.

Removal

1. Unplug connector from switch.
2. Remove retainer from pins or link on clutch pedal arm.
3. Remove screw fastening switch to pedal support and lift off switch.

Installation

1. Slide switch tang into pedal support.
2. Secure switch to pedal support with screw, switch lever over pins in pedal arm.
3. Install retainer on clutch arm pin or install link in switch lever then fasten with retainer.
4. Install connector on switch.

PARKING BRAKE ALARM SWITCH REPLACEMENT Corvette (Fig. 31)

1. Remove parking brake cover assembly from rear center console.
2. Disconnect wire from brake alarm switch.
3. Remove retaining screw and switch from reinforcement.
4. Position new switch to reinforcement and install retaining screw.
5. Connect switch wire and check operation of switch.
6. Install cover assembly.

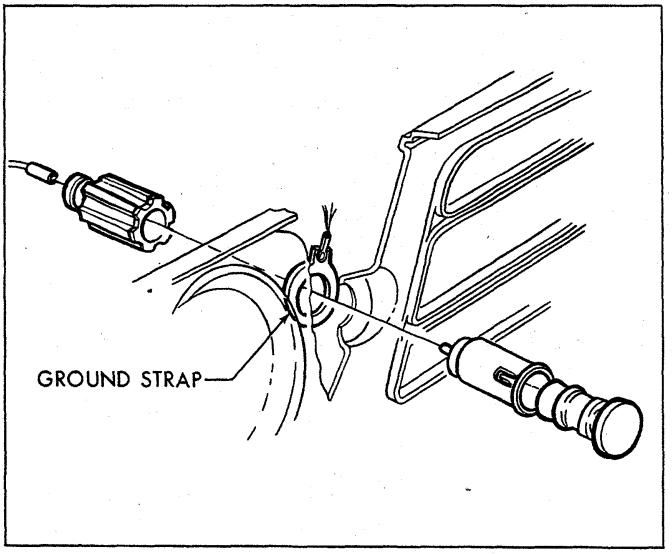


Fig. 34—Cigar Lighter Installation (Except Camaro and Nova)

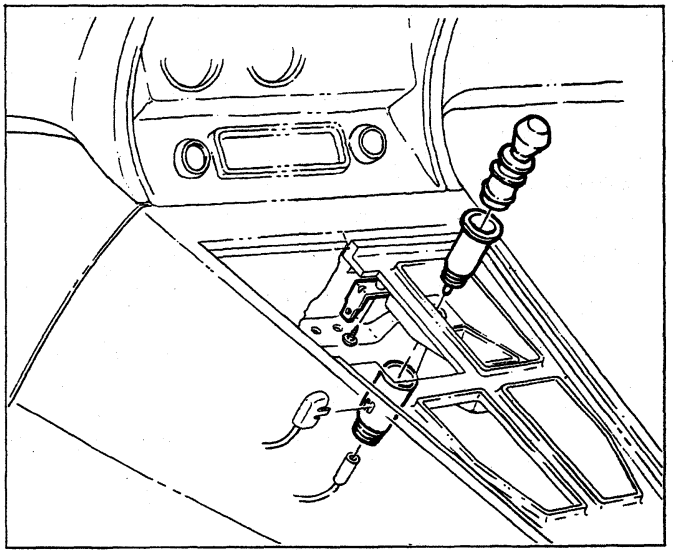


Fig. 35—Cigar Lighter (Corvette)

Chevrolet, Chevelle, Nova and Camaro (Figs. 32 & 33)

1. Disconnect wiring connector at switch terminal.
2. Remove nut and lock washer or retaining bolt and disengage switch from brace.
3. To install, reverse removal procedure.

INSTRUMENT PANEL COMPARTMENT LAMP/SWITCH REPLACEMENT

1. Disconnect battery ground cable.
2. Reach into glove box, depress bulb in end of switch and turn counter-clockwise to remove bulb.
3. Remove switch from socket. Carefully detach wire and terminal from switch.

   NOTE: On some model switches, the wire and terminal cannot be detached from the switch making it necessary to cut and splice the switch wire.

4. Insert wire and terminal into new switch.
5. Push switch into place and install bulb by setting it in place, depressing and turning it clockwise.

CIGARETTE LIGHTER REPLACEMENT

Chevrolet and Chevelle (Fig. 34)

1. Disconnect ground cable from battery under hood.
2. Remove connector from rear of lighter housing.
3. Unscrew retainer from rear of housing assembly and disengage lighter unit from panel.
4. To install, reverse removal procedure.

Camaro and Nova

1. Disconnect ground cable from battery under hood.
2. Remove ash tray and retainer.
3. Unscrew retainer from rear of housing assembly and disengage lighter unit from panel.
4. To install, reverse removal procedure.

Corvette (Fig. 35)

1. Disconnect ground cable from battery.
2. Remove vent control set screws and gear shift trim plate secured by screws.
3. Compress clip for lighter lamp and unplug connector from beneath lighter housing.
4. Unscrew retainer from rear of housing assembly and disengage lighter unit from trim plate.
5. To install, reverse removal procedure.

CHEVROLET INSTRUMENTS AND GAUGES

INDEX

	Page
General Description	12-19
Service Operations	12-20
Instrument Cluster	12-20
Instrument Cluster Lamps	12-20
Speedometer	12-21
Speedometer Cable	12-21
Fuel Gauge	12-21
Clock	12-21
Oil Pressure Indicator	12-22
Generator Indicator	12-22
Temperature Indicator	12-23
Low Fuel Indicator	12-23
Door Ajar Indicator	12-23
Seat Belt Warning Indicator	12-23

GENERAL DESCRIPTION

The new instrument panel on 1969 Chevrolet incorporates an instrument cluster carrier with provisions for A/C and/or heater controls, light switch, cigarette lighter, ash tray, radio, windshield wiper switch and transmission indicator where applicable. A switch for power tops, tail gate windows and rear window defogger is located to the right of the steering column.

Tell-tale lights are in the cluster carrier below the instrument cluster. Access to these bulbs is from the front of the carrier. Removing four snap-in plugs on the front of the carrier by pushing on the left hand side of the plug will expose screws holding the tell-tale bezel plate to the assembly. After these screws are removed, the plate comes free of the carrier giving access to the tell-tale bulbs. The bulb has a wedge base with a snap-in multiple socket.

The instrument cluster is directly lighted from above by five illumination bulbs. Again snap-in sockets with wedge base bulbs are used and access is made from the front of the cluster carrier. Removal of three screws and a cover from the top of the carrier cluster exposes all bulbs.

The instrument cluster is mounted to the back of the carrier and the carrier must be removed to service the gas gauge, speedometer head and clock. Removal of the carrier can only be done by first removing the crash pad.

SERVICE OPERATIONS

INSTRUMENT CLUSTER

Removal and Installation (Figs. 36, 37, 38)

1. Disconnect battery ground cable.
2. Remove glove box for access to instrument panel pad fasteners on right side.
3. Remove A/C center dash outlet.
4. Remove 4 screws above instruments.
5. Pull and gently pry instrument panel pad loose from dash clips.
6. Disconnect and remove stereo tape player.
7. Remove A/C lap cooler from under steering column.
8. Remove 3 hex head screws from underside of dash.
9. Disconnect, PRNDL indicator cable wire on steering column.
10. Disconnect radio receiver electrical attachments.
11. Lower steering column, See Section 9.
12. Remove screws at top of instrument panel and gently lift and tilt panel forward.
13. Disconnect speedo cable, by depressing retaining spring on rear of speedo housing.
14. Remove all electrical connections.
15. Remove 6 (six) screws securing top illumination can.
16. Remove indicator bulb bezel by:
    a. Push in on right side of each cover exposing a screw.
    b. Remove (4) four screws retaining bezel and lift off.
17. Remove 8 (eight) screws from rear of instrument carrier to lift off cluster.
18. Reverse removal procedure for installation of instrument cluster.

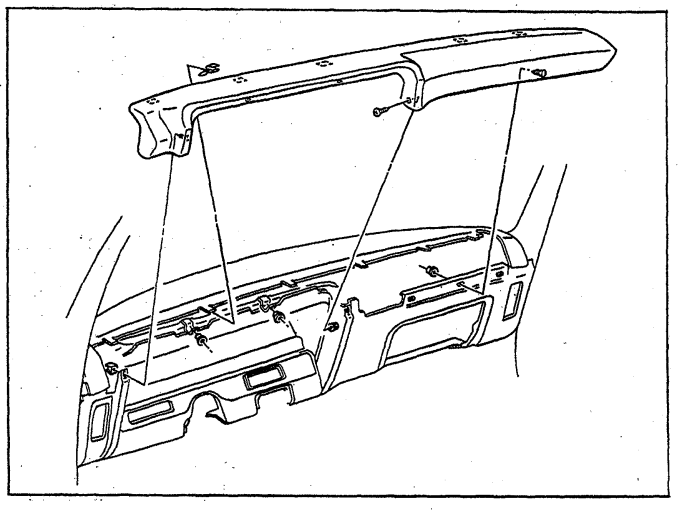


Fig. 36—Instrument Panel Pad - Chevrolet

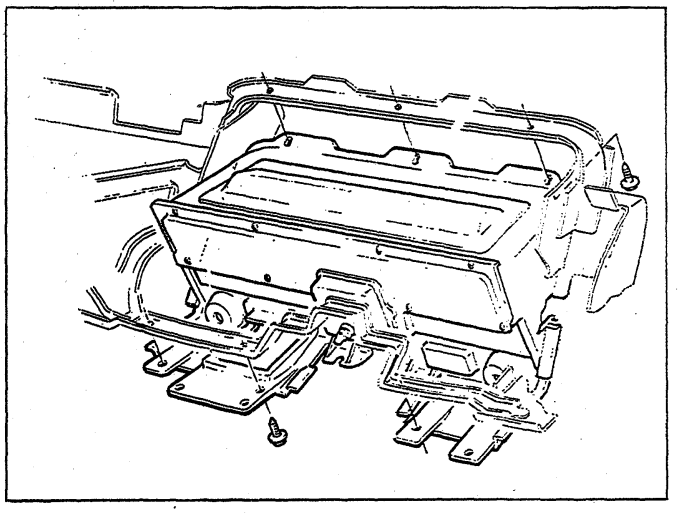


Fig. 37—Instrument Cluster

Instrument Cluster Lamp Replacement (Fig. 39)

1. Remove three (3) screws from the top under side of the Instrument Carrier retaining the illumination lamp light shield.
2. Remove and replace defective wedge base bulb.

NOTE: Wedge base bulbs push in and out without a twisting action.

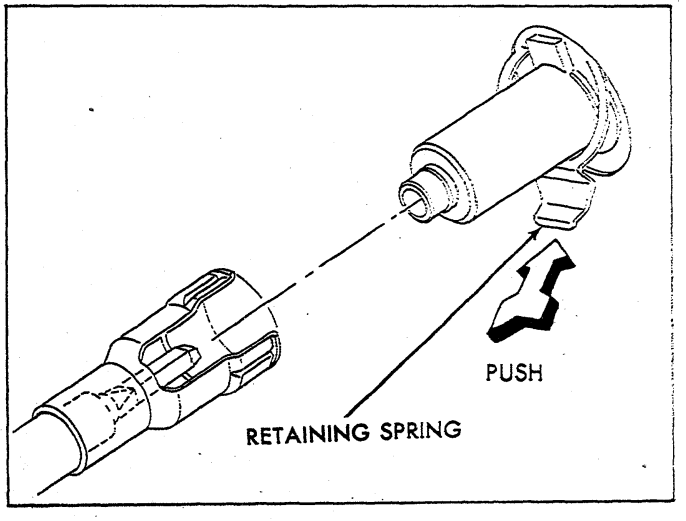


Fig. 38—Speedometer Cable Attachment

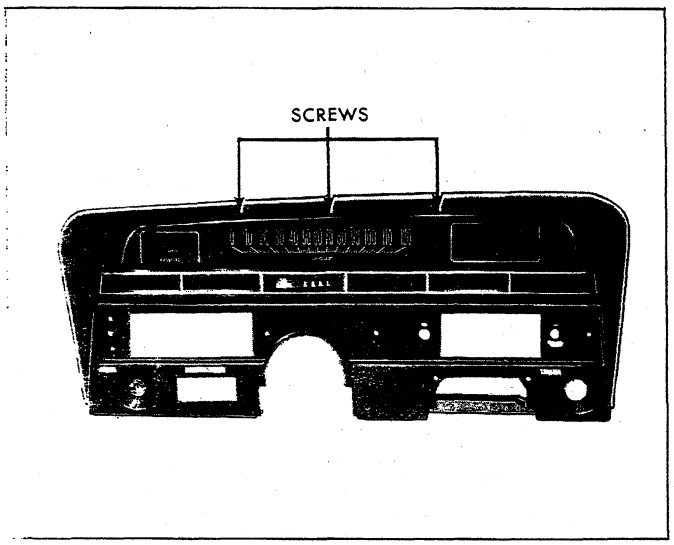


Fig. 39—Instrument Cluster Lamp Replacement

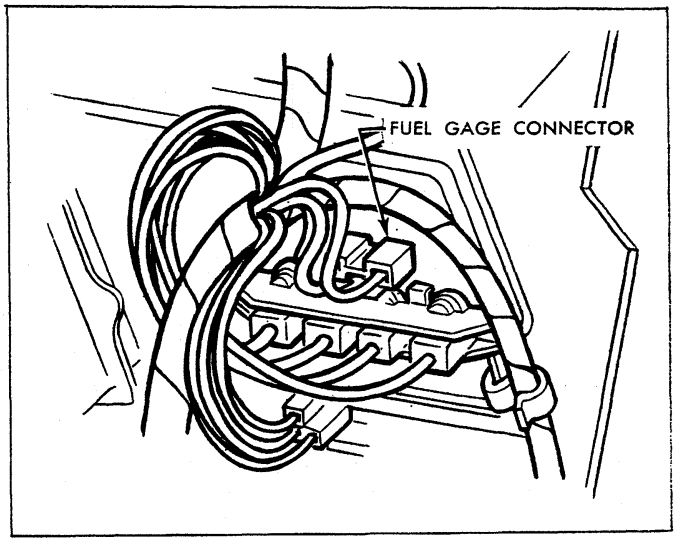


Fig. 40—Gauge Replacement

3. Test bulb illumination.
4. Reinstall shield.

The transmission indicator illumination bulb can be replaced by removing the tell-tale bezel as covered under indicator bulbs replacement. Next, remove the two (2) screws retaining the indicator dial face giving access to the wedge-type bulb. The A/C and/or heater control is illuminated through a push-in socket on the right side of the control head assembly at the rear of the instrument Carrier.

Speedometer Replacement

1. Remove instrument cluster assembly as previously described in this section.
2. Remove two (2) screws securing PRNDL assembly cover from underside of cluster.
3. Remove fuel gauge.
4. Remove clock or cover plate.
5. Place marking tape over all openings in cluster to prevent dirt from entering.

   NOTE: Speedometer assembly servicing should be performed by an authorized AC Speedometer Service Station.

6. To install, reverse the removal procedure. Do NOT kink cable housing.

Speedometer Cable

Replacement or Lubrication

1. Disconnect the speedometer cable from the speedometer head. Remove the old cable by pulling it out from speedometer end of conduit.

   NOTE: If old cable is broken it may be necessary to remove lower piece from transmission end of conduit.

2. Lubricate the lower 3/4 of cable with speedometer cable lubricant and push the cable into the conduit. Connect the upper end to the speedometer head and road test vehicle for proper speedometer operation. DO NOT KINK CABLE HOUSING.

Fuel Gauge Replacement (Fig. 40)

1. Lower instrument carrier as previously described in this section under cluster removal.
2. Remove screws attaching Gauge to rear of cluster and remove gauge assembly.

   NOTE: Observe carefully the stock up of the external parts of the fuel gauge assembly.

3. To install, reverse removal procedure.

Clock Replacement (Fig. 41)

1. Remove screw from clock stem in front of cluster. The screw holds the setting knob onto the winding stem.
2. Lower instrument carrier as previously described in this section under cluster removal. (A/C cars only)
3. Remove electrical plug and mounting screws from rear of cluster, then lift clock out rear of cluster.
4. To install, reverse removal procedure.

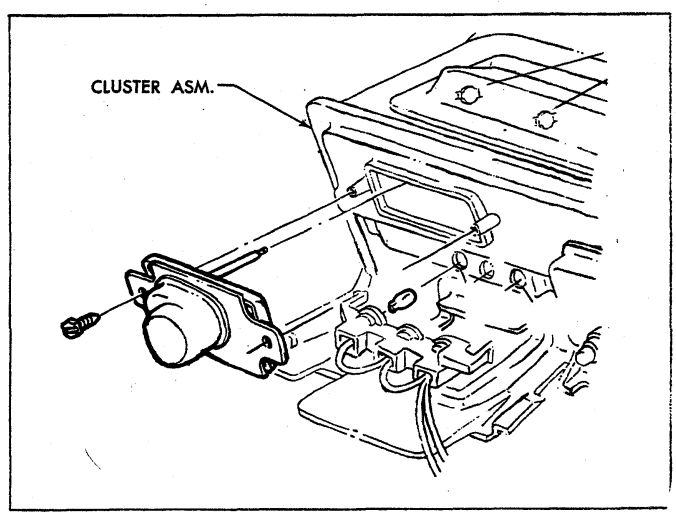


Fig. 41—Clock Replacement

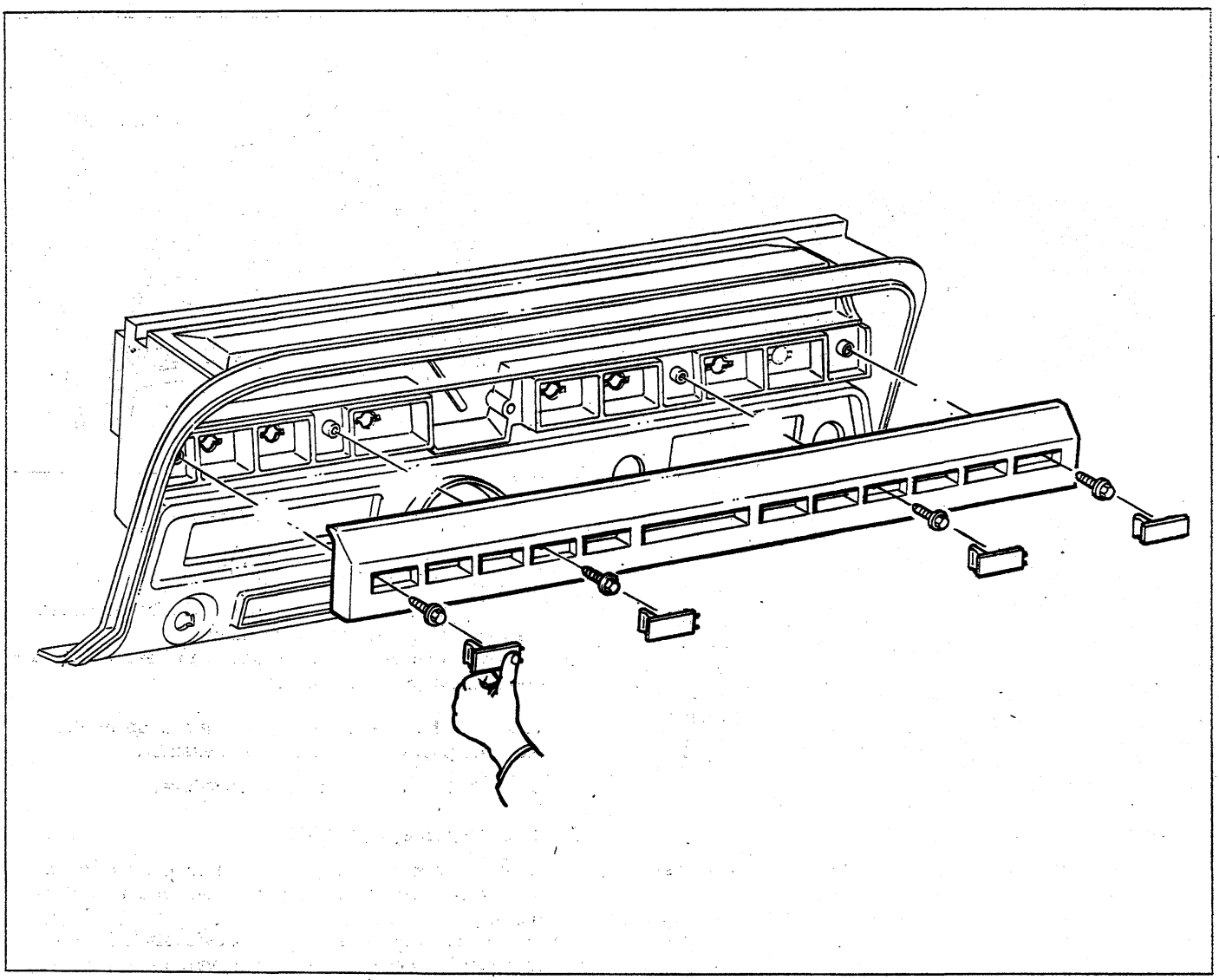


Fig. 42—Indicator Bulb Replacement

INDICATOR BULB REMOVAL (Fig. 42)

1. Remove four (4) screw covers on the indicator bulb bezel by pushing on the left side of the cover.
2. Remove four (4) screws retaining the bezel to the Instrument Cluster and remove bezel.
3. Remove and replace defective wedge base bulb, using a length of hose 5/16" I.D.

   NOTE: Wedge base bulbs push in and out without a twisting action.

4. Test bulb illumination.
5. Reinstall bezel.
6. Set screw covers in place by inserting left edge of cover into bezel slot and pushing on right side of cover, nibs toward the bezel, until cover is firmly seated.

Oil Pressure Indicator

If the light does not come on when the ignition switch is turned on, or if the light comes on and remains on after the engine is started, one or more of the following conditions is indicated:

- Low oil pressure
- High engine temperature
- Defective wiring or switch

Sending Unit Replacement

1. Disconnect wiring harness connector from sender unit terminal (located in block above starter on L-6 engines and at left front of distributor on V-8 engines).
2. Remove sender unit using Tool J-21757 or 12 point socket, replace with new unit and check operation.

Generator Indicator

1. Ignition on, Engine not Running and Telltale Light Off.

- Indicator bulb burned out, replace bulb.
- Open circuit or loose connection in the telltale light circuit.

2. Telltale Light Stays on after Engine is Started. If indicator light does not go out at engine idle speed, refer to Charging Systems under Engine Electrical, Section 6Y.

Temperature (Cooling System) Indicator

The temperature indicator circuit consists of two remotely located units, indicator gauge and engine sender unit. The indicator gauge, located in the instrument panel, consists of a red light which will indicate an overheated engine condition.

Engine Sender Unit Replacement

1. Relieve coolant system pressure by loosening radiator cap.
2. Remove sender unit (located in the left cylinder head on V-8 engines, and in the cylinder head near an exhaust port on L-6 engines). Replace with new unit.
3. Check coolant system level and operation of unit.

Low Fuel Indicator

A semi-conductor unit senses the change in electrical resistance of the fuel system circuitry. The semi-conductor is located behind the fuel gauge and the low level fuel light should come on when the fuel tank has approximately 3 gallons left.

Door Ajar Indicator

The door ajar indicator is actuated by any of the car doors remote jamb switches. The switches are located on the lock pillars.

Seat Belt Indicator

The bulb should glow each time the ignition switch is turned on. The indicator is a thermal switch which automatically shuts off after a short time. The thermal unit is attached to the rear of the instrument cluster, and is not repairable.

CHEVELLE INSTRUMENTS AND GAUGES

INDEX

	Page
General Description	12-23
Service Operations	12-23
Instrument Panel	12-23
Instrument Cluster	12-23
Fuel Gauge, Ammeter, Temp and Clock	12-24
Speedometer	12-26
Speedometer Cable	12-26
Tachometer	
Indicator Lights	12-26
Oil Pressure Indicator	12-26
Generator Indicator	12-26
Temperature Indicator	12-26

GENERAL DESCRIPTION

The Chevelle instrument panel and gauge cluster are new with the cluster contoured in an unusual shallow concave "V" for good visibility and accessibility. Instruments and tell-tale lights are housed in two large round recesses symmetrically arranged over and to either side of the steering column. Radio provision, heater controls, and ash tray are stacked at the right side of the cluster within convenient reach of the driver. For vehicles equipped with optional automatic transmission column mounted shift control, the shift quadrant is mounted in the cluster housing, just above the steering column.

An instrument cluster gauge package is available on some models with V-8 engines. The option replaces the standard tell-tale lights with oil and temperature gauges and an ammeter. In addition a tachometer is mounted in the right instrument cluster.

SERVICE OPERATIONS

INSTRUMENT PANEL ASSEMBLY

Instrument Cluster (Figs. 43 & 44)

Removal

1. Disconnect ground cable from battery.
2. Remove ash tray and retainer.
3. Remove radio knobs, nuts, electrical connections, aerial plug and radio rear support then lift radio out.
4. Remove heater control screws then push control head out of instrument panel.
5. Lowering steering column, see Section 9. Note removal of automatic transmission indicator cable located on steering column, if so equipped.
6. Protect steering column top surface with a cloth.
7. Remove instrument panel retaining screws at top, sides and bottom of panel, also remove any attachments to underside of panel such as speedminder stem, defogger or tail gate control switch.
8. Lift loosened instrument panel up and back slightly, reach behind cluster and remove speedometer cable, then support instrument panel on protected steering column.
9. Remove clips at top of instrument cluster rear cover and remove all connectors at back of cover and oil pressure pipe fitting from rear of oil pressure gauge if so equipped.
10. Remove screws securing twin window clusters to back of instrument panel and remove clusters from instrument panel.

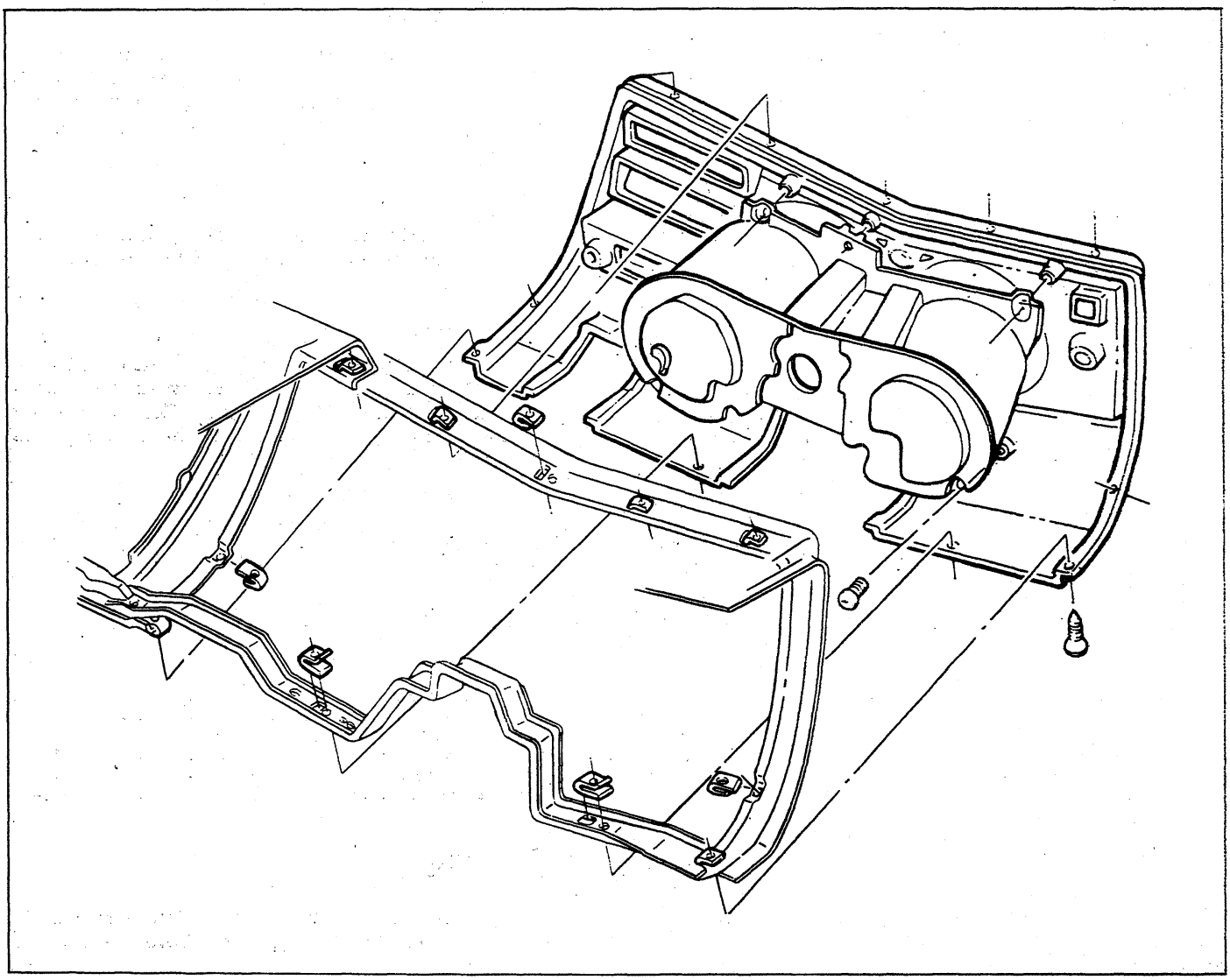


Fig. 43—Instrument Cluster Removal

Installation

1. Install instrument clusters on back of instrument panel and secure with screws.
2. Install all connectors at back of cluster and clips holding harness wire to top of cluster housing, then connect oil pressure pipe fitting to rear of oil pressure gauge if so equipped.
3. Lift instrument panel onto dash and reaching behind instrument panel, connect speedometer cable.
4. Align instrument panel in dash and fasten with screws at top, bottom and sides.
5. Attach speedminder, defogger or tail gate control switches, if so equipped, to underside of instrument panel.
6. Attach steering column in place, see Section 9. Note the attachment of the automatic transmission indicator cable located on the steering column, if so equipped.
7. Install heater control in place and attach with screws.
8. Install radio and support bracket, aerial plug electrical connections. Attach radio to instrument panel with nuts and install knobs.
9. Install ash tray retainer and tray.
10. Connect the ground cable to the battery and lower hood.

Tachometer, Fuel, Oil, Temperature, and Ammeter Gauges (See Fig. 44)

Replacement

1. Remove instrument cluster assembly as previously outlined in this section.
2. Remove screws retaining right rear cover to instrument cluster rear housing.
3. Remove gauge attachment and replace gauge.

Speedometer Replacement

1. Disconnect battery ground cable.
2. Remove instrument cluster assembly as previously outlined in this section.

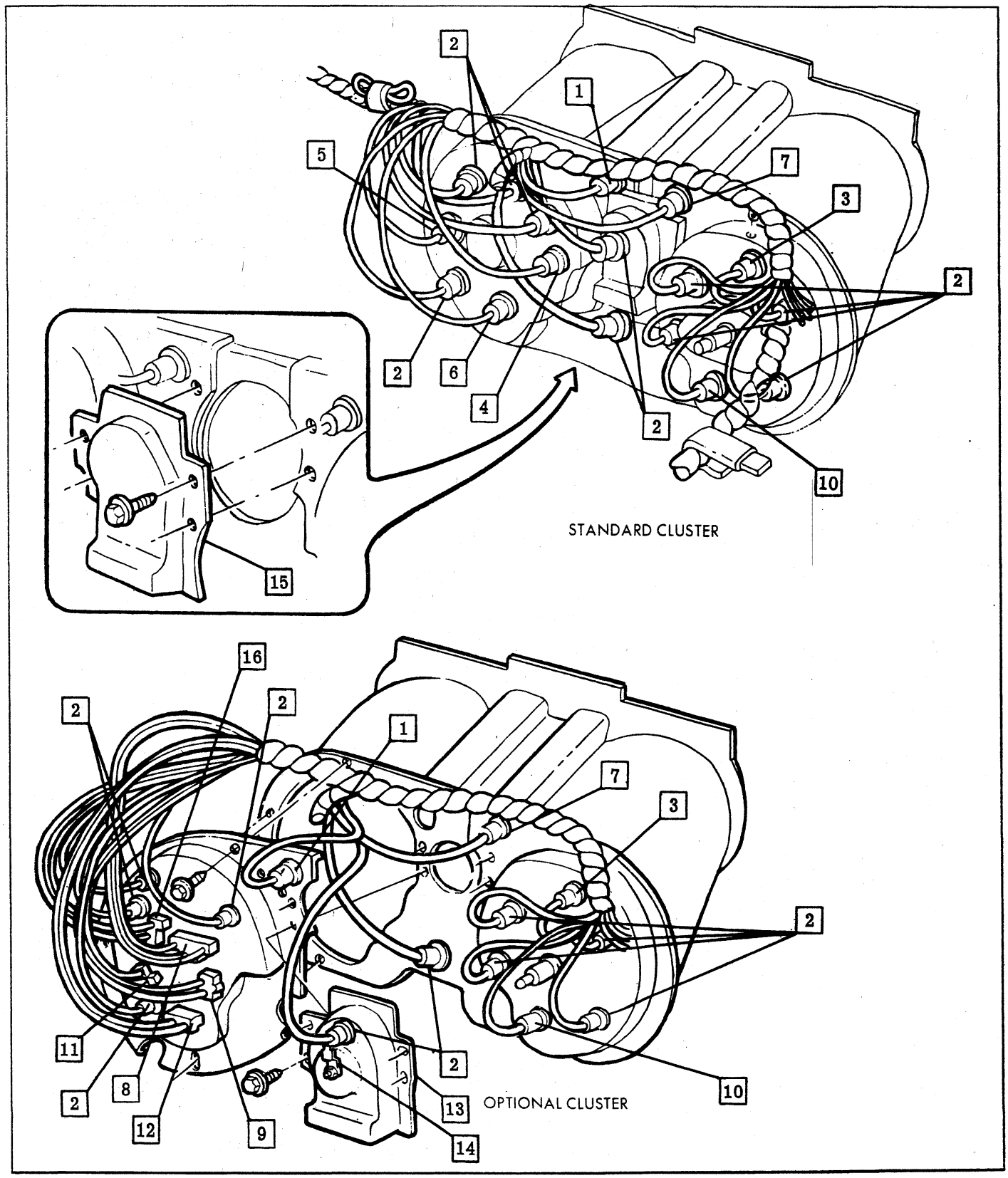


Fig. 44—Instrument Cluster Assembly

1. R.H. Directional Indicator
2. Instrument Cluster Lamp
3. "Bright" Indicator
4. "Gen" Indicator
5. "Temp" Indicator
6. "Oil" Indicator
7. L.H. Directional Indicator
8. Fuel Gauge Connector
9. "Batt" Gauge Connector
10. Brake Alarm Indicator
11. "Temp" Gauge Connector
12. Oil Pressure Gauge Connector
13. Clock Assembly
14. Clock Connector
15. Cover
16. Tach Connector

3. Remove screws attaching cover to rear of cluster housing.
4. Remove screws attaching speedometer assembly to cluster cover and carefully remove speedometer head.

   NOTE: Servicing of the speedometer assembly should be performed by an authorized AC speedometer service station.

5. To install, reverse removal procedure. DO NOT KINK CABLE HOUSING.

Speedometer Cable

Replacement or Lubrication

1. Disconnect the speedometer cable from the speedometer head. Remove the old cable by pulling it out from speedometer end of conduit.

   NOTE: If old cable is broken it may be necessary to remove lower piece from transmission end of conduit.

2. Lubricate the lower 3/4 of cable with speedometer cable lubricant and push the cable into the conduit. Connect the upper end to the speedometer head and road test vehicle for proper speedometer operation. DO NOT KINK CABLE HOUSING.

Clock Replacement

1. Remove clock stem set knob from lens.
2. Remove instrument cluster as previously described in this section.
3. Remove electrical plug from rear of clock.
4. Remove screws retaining clock assembly to cluster rear cover and remove assembly.
5. To install, reverse removal procedure.

Indicator Light Replacement

To replace indicator or cluster bulb, unsnap the proper socket from rear of instrument cluster, remove and replace bulb, and reinsert unit into rear of cluster housing.

NOTE: Instrument panel illumination and turn signal bulbs located directly above the steering column will necessitate a partial removal of the instrument panel as previously outlined in this section.

Oil Pressure Indicator

If the light does not come on when the ignition switch is turned on, or if the light comes on and remains on after the engine is started; one or more of the following conditions is indicated:

- Low oil pressure
- High engine temperature
- Defective wiring or switch

Sending Unit Replacement

1. Disconnect wiring harness connector from sender unit terminal (located in block above starter on L-6 engines and at left front of distributor on V-8 engines).
2. Remove sender unit using Tool J-21757 or 12 point socket, replace with new unit and check operation.

Optional Oil Pressure Sending Unit

The optional oil pressure gauge is operated electrically from a pressure sending switch. The sending switch internally has a variable resistance actuated by mechanical linkage. The sending unit is not repairable.

Generator Indicator

1. Ignition on, Engine not running and Telltale Light Off.
   - Indicator bulb burned out, replace bulb.
   - Open circuit or loose connection in the telltale light circuit.
2. Telltale Light Stays on after Engine is Started.

If indicator light does not go out at engine idle speed, refer to Charging Systems under Engine Electrical, Section 6Y.

Temperature (Cooling System) Indicator

The temperature indicator circuit consists of two remotely located units, indicator gauge and engine sender unit. The indicator gauge, located in the instrument panel, consists of a red light which will indicate an overheated engine condition.

Engine Sender Unit Replacement

1. Relieve coolant system pressure by loosening radiator cap.
2. Remove sender unit (located in the left cylinder head on V-8 engines, and in the cylinder head near an exhaust port on L-6 engines). Replace with new unit.
3. Check coolant system level and operation of unit.

CORVETTE INSTRUMENTS AND GAUGES

INDEX

	Page
General Description	12-26
Service Operations	12-27
Instrument Clusters	12-27
Speedometer/Tachometer Service	12-27
Fuel Gauge	12-28
Temperature Gauge	12-28
Ammeter/Oil Pressure Gauges	12-28
Clock	12-28
Seat Belt and Door Ajar Indicators	12-28
Headlamp-up Indicator	12-28
Instrument Cluster Lamp Replacement	12-28

GENERAL DESCRIPTION

The instrument panel for the Corvette continues the advanced design theme. Instruments are arranged in the center panel and floor console areas. Two large oval housings in the left-hand panel facing the driver contain

160 mph speedometer and 7000 rpm tachometer.

Lighting switches are also located on the driver's side.

The recessed center instrument cluster contains small circular housings for fuel, ammeter, oil pressure and temperature gauges. Radio and windshield wiper controls are also located in the curved cluster.

The floor center console houses the ash tray, lighter, heater, lamp monitoring transmission and optional power window controls.

SERVICE OPERATIONS

Instrument Clusters

Left Hand Side (Fig. 45)

Removal and Installation

1. Disconnect ground cable from battery.
2. Lower steering column, see Section 9.
3. Remove screws and washers securing left instrument panel to door opening, top of dash and left-side of center instrument panel.
4. Unclip and remove floor console left forward trim panel.
5. Pull cluster assembly slightly forward to obtain clearance for removal of speedometer cable housing nut, tachometer cable housing nut, headlamp and ignition switch connectors and panel illuminating lamps.
6. Install by reversing removal procedure, being careful not to kink the speedometer or tachometer cable housings.

Center Instrument Cluster (Fig. 46)

1. Disconnect ground cable from battery.
2. Remove wiper switch trim plate screws and tip plate forward for access to remove switch connector. Lift trim plate out from cluster assembly.
3. Unclip and remove right and left console forward trim pads to gain access to studs at lower edge of cluster assembly.
4. Remove nuts from studs at lower edge of cluster.
5. Remove remaining screws retaining cluster assembly to instrument panel.
6. Remove right instrument panel pad.
7. Remove radio knobs, bezel retaining nuts and one radio support bolt (from behind cluster assembly).
8. Slide radio back towards firewall and pull cluster forward. Reaching behind cluster, disconnect oil pressure line, wiring harness, and bulbs.

   CAUTION: The center instrument cluster trim plate is designed to collapse under impact. Consequently, do not try to deflect the cluster plate forward to gain more access to back of gauges.

9. Lift cluster assembly up and forward for removal.
10. To install cluster assembly in the dash, reverse Removal' procedure Steps 1-9.

Speedometer and/or Tachometer

kemoval and Installation

The left-hand cluster must be removed from the vehicle to service the speedometer or tachometer head assembly. With the cluster removed from the vehicle:

1. Remove odometer reset connector and speedminder connector from rear of speedometer head.
2. Remove the three screws fastening the speedometer or tachometer head to back of cluster and carefully remove speedometer or tachometer head.

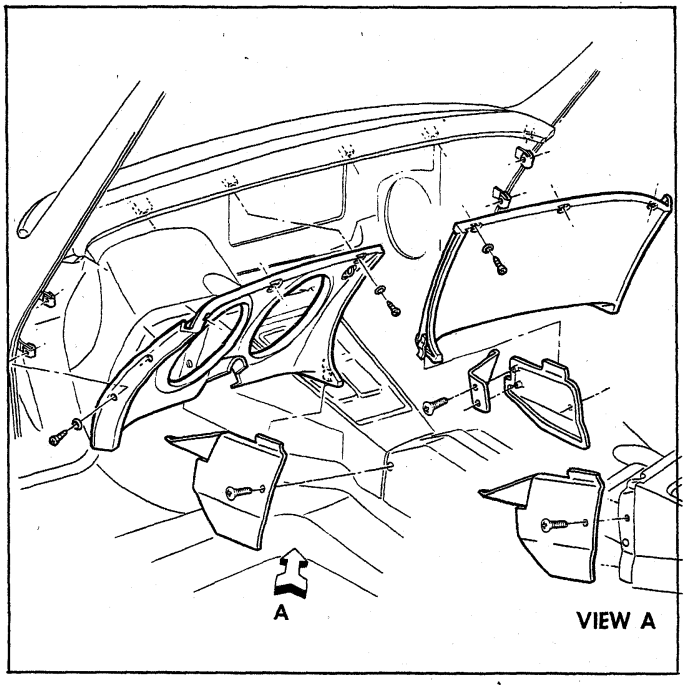


Fig. 45—Instrument Panels - Lower & Trim

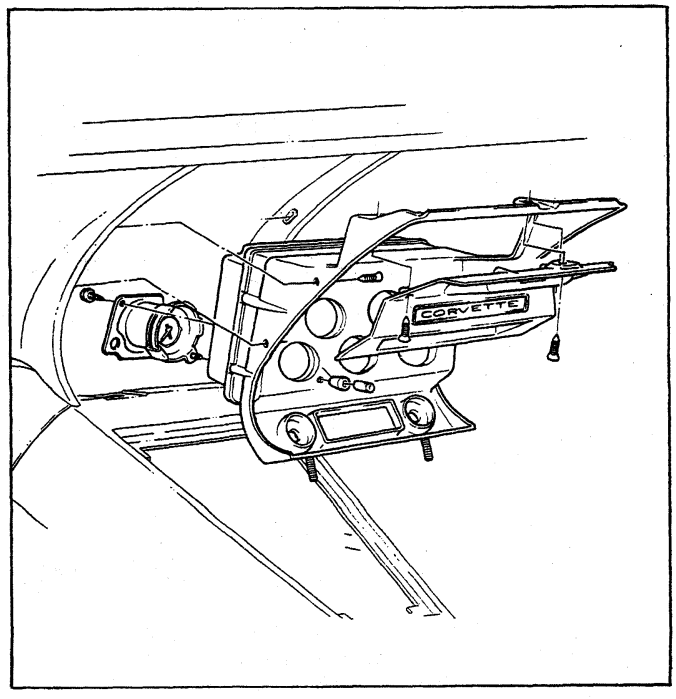


Fig. 46—Center Instrument Cluster

3. Transfer wiper solenoid to rear of tachometer and or speedminder buzzer to the rear speedometer head and fasten appropriate head to cluster bezel.
4. Connect odometer and/or speedminder reset cable to rear of speedometer head.
5. Connect the left-hand cluster as previously described in this section.

Cable Replacement or Lubrication

1. Disconnect the cable from the speedometer or tachometer head. Remove the old cable by pulling it out from speedometer end of conduit.

   NOTE: If old cable is broken it may be necessary to remove lower piece from transmission or distributor end of conduit as applicable.

2. Lubricate the lower 3/4 of cable with AC speedometer cable lubricant and push the cable into the conduit. Connect the upper end to the speedometer or tachometer head and road test vehicle for proper operation. DO NOT KINK CABLE HOUSINGS.

   NOTE: It will be necessary to remove the center instrument panel as previously outlined before further proceeding with instrument removals.

Fuel Gauge

The gasoline fuel gauge circuit consists of an electrical indicator in the instrument cluster and a float-controlled rheostat in the fuel tank.

Since the fuel gauge consists of two remotely located units and connecting wires, it is sometimes difficult to determine which unit is at fault when the gauge fails to operate properly. Center gauge pack removal is necessary to replace the fuel gauge.

NOTE: Be sure to check gas gauge fuse in fuse panel before attempting to trouble shoot for inoperative gauge or tank sending unit.

Temperature Gauge

The temperature indicator requires very little service other than testing for malfunctioning and replacing defective units. Cluster must be removed to service temperature gauge.

Do not attempt to repair either the engine unit or the gauge. When installing new engine unit, do not use thread compound on unit threads, as this will increase electrical resistance of unit and cause faulty reading on gauge.

Ammeter or Oil Pressure Gauge

The ammeter or oil pressure gauge requires very little attention other than keeping ammeter terminals clean and tight. If the oil pressure control line should become restricted it should be blown out or replaced. The cluster must be removed to service these gauges.

Clock

Replacement

1. Remove clock set shaft knob retaining screw and knob from set shaft.
2. Remove screws attaching clock to rear of housing and remove clock from rear of cluster housing.
3. Install clock in the reverse order of removal.

Seat Belt and Door Ajar Indicators

Seat belt indicator is a thermal switch with a push reset. The switch is powered from the fuel gauge terminal. The switch is replaced as a unit.

Door ajar indicator is a bulb with a remote door jamb switch located on the lock pillar.

Head Lamp Up Indicator

An indicator in the center cluster will glow when the headlamps are turned on, but not fully extended into the locked position. The indicator is signaled by a switch on each of the headlamp linkages.

Instrument Cluster Lamp Replacement

1. Loosen either left hand or center instrument cluster as previously described in this section.
2. Reach behind cluster and grasp lamp socket and wiggle socket from cluster.
3. Remove and replace illumination bulb, push lamp socket back into cluster and reinstall instrument cluster in place.

CAMARO INSTRUMENTS AND GAUGES

INDEX

	Page
General Description	12-28
Service Operations	12-29
Instrument Cluster	12-29
Instrument Lamps	12-29
Speedometer - Tachometer	12-29
Clock	12-30
Seat Separator Instrument Console	12-30

GENERAL DESCRIPTION

The Camaro instrument cluster consists of two square units which house the speedometer and fuel gauge assemblies. The left-hand directional signal, high beam, and brake Warning indicators are located under the face of the speedometer bezel, while generator temperature, oil, and right hand directional indicators are grouped under the fuel gauge unit.

A special instrumentation package is available with the eight cylinder engine and center console combination. The special cluster includes: coolant temperature, oil

pressure, fuel, and ammeter gauges, mounted on the seat separator console; a tachometer in the right cluster housing; and a low fuel level indicator in the left instrument cluster. Completing the special instrumentation package is a clock in the center of the cluster.

The instruments and gauges are front loaded in the cluster. Mounting screw access is possible after lens cover removal. Indicator and cluster lamps are replaced by removing the lens cover. The wedge base bulbs are pulled straight out of the cluster using a length of 5/16 I.D. hose.

The brake warning light serves a dual purpose. It functions as an indicator when the parking brake is applied and also if there is a malfunction (loss of hydraulic pressure) in the brake system. Switches which provide the signal to operate the light are located at the parking brake assembly and near the brake master cylinder in the hydraulic lines. Service of the brake pressure differential switch unit is covered in Section 5 of this manual.

Regular maintenance is not required on the instrument cluster or its components other than maintaining clean, tight electrical connections, replacing defective parts and keeping the speedometer cable properly lubricated.

SERVICE OPERATIONS

Instrument Cluster (Figures 47, 48, & 49)

Removal and Installation

1. Disconnect battery ground cable.
2. Remove instrument panel pad.
3. Remove Air Conditioning attachments.
4. Remove radio brace attachments.
5. Lower steering column per section 9.
6. Remove cluster attaching screws.
7. Reaching behind cluster assembly disconnect speedometer cable, speed warning device, wiring, connectors.
8. Remove cluster assembly from carrier opening and remove to bench for further disassembly.
9. To install, reverse removal procedure.

Instrument Cluster Illumination Lamp Replacement (Fig. 50)

1. Remove four (4) screws retaining the lens to the instrument cluster carrier and place the lens with bezel side down to prevent lens scratching.
2. Remove illumination bulb filter and retainer assembly by removing two screws.
3. Remove and replace wedge base bulb using a length of hose 5/16" I.D.

   NOTE: The wedge base bulbs pull straight out. DO NOT TWIST BULB.

4. Test bulb illumination.
5. Reinstall filter, retainer assembly and lens.

Speedometer or Tachometer (Fig. 50)

1. Remove battery ground cable.
2. Remove speedometer cable or tachometer wire from under dash.
3. Remove lens cover screws and place lens aside bezel side down.
4. Remove illumination filter assembly for clearance.
5. Remove screws retaining instrument to cluster and lift out of cluster.

   NOTE: Servicing of the speedometer and tachometer heads should be performed by an authorized AC Speedometer Service Station.

6. To install, reverse the removal procedure. DO NOT KINK CABLE HOUSING.

Speedometer Cable

Replacement or Lubrication

1. Disconnect the speedometer cable from the speedometer head. Remove the old cable by pulling it out from speedometer end of conduit.

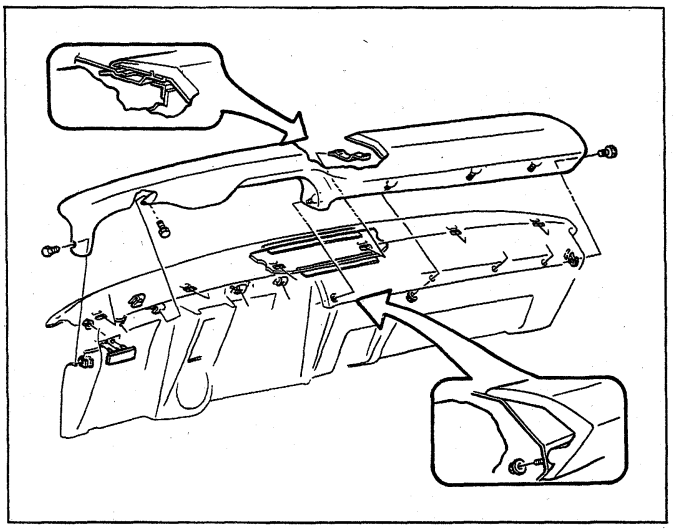


Fig. 47—Instrument Panel Pad - Camaro

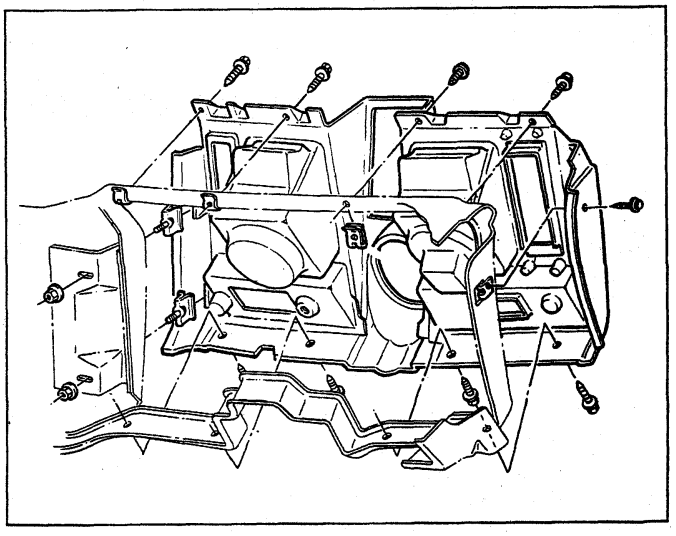


Fig. 48—Instrument Cluster

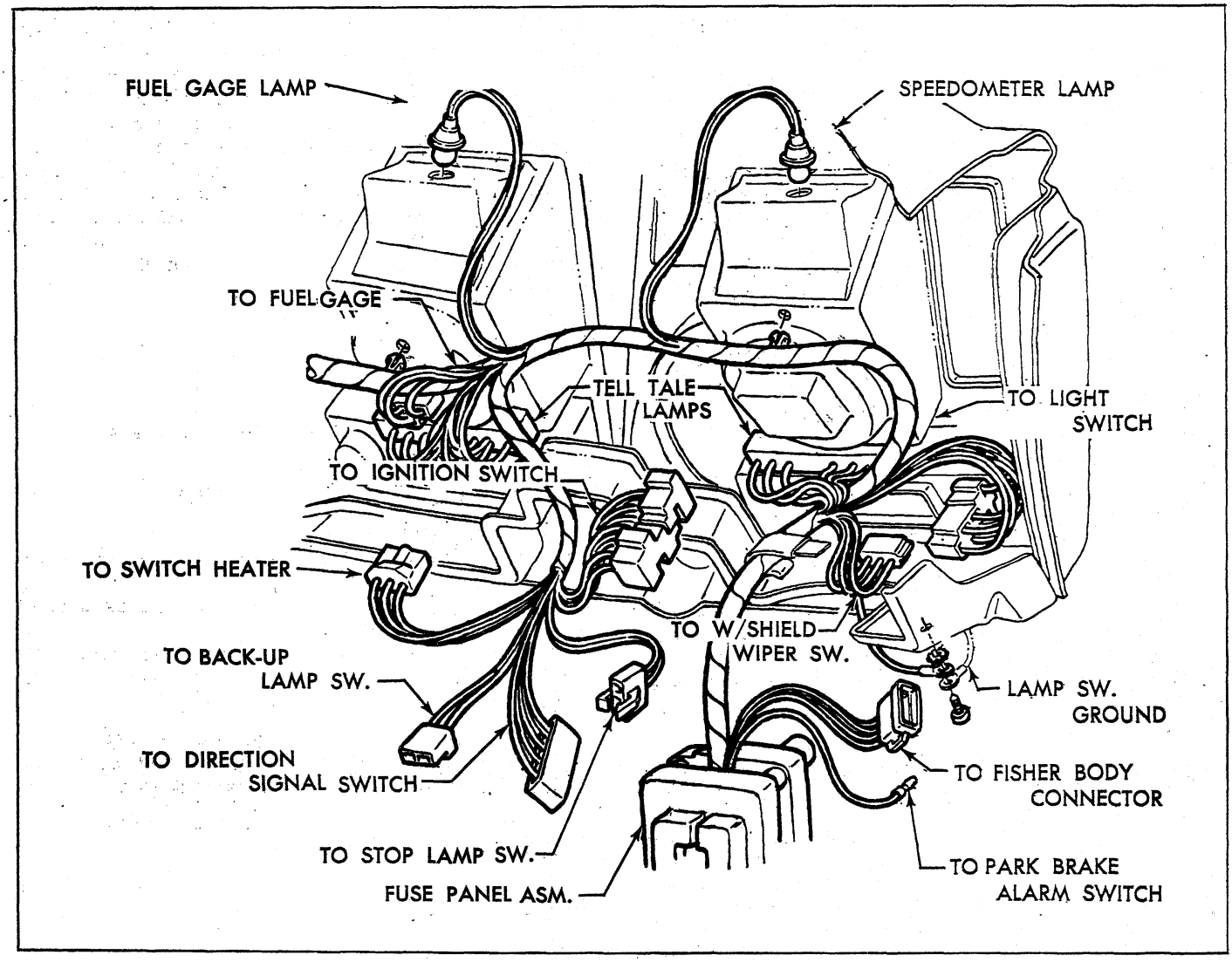


Fig. 49—Instrument Panel Wiring Harness

NOTE: If old cable is broken it may be necessary to remove lower piece from transmission end of conduit.

2. Lubricate the lower 3/4 of cable with speedometer cable lubricant and push the cable into the conduit. Connect the upper end to the speedometer head and road test vehicle for proper speedometer operation.

Fuel Gauge Replacement

1. Remove battery ground cable.
2. Remove gauge connections on back of unit, under dash.
3. Remove lens cover screws and place lens aside, bezel side down.
4. Remove illumination filter assembly for clearance.
5. Remove screws retaining fuel gauge to cluster and lift gauge out front of cluster.
6. To install, reverse removal steps 1 through 5.

Clock Replacement

1. Remove clock winding stem set knob.
2. Remove lens cover screws and place lens on bench, bezel side down.
3. Loosen instrument panel carrier as described previously under cluster removal.
4. Remove two (2) screws securing clock assembly.
5. Install clock in reverse order of removal.

Seat Separator Instrument Console (Fig. 51)

1. Disconnect battery ground cable.
2. Remove cover retaining screws (3) and cover from cluster assembly.
3. Remove three screws retaining each gauge mounting plate to cluster housing.
4. Carefully disengage gauge plate from housing and disconnect oil pipe and all electrical connections at rear of gauges. Use rag to catch oil drips from open oil connection.

NOTE: At this point, with gauge package removed from housing all gauges including the low fuel warning system may easily be serviced.

6. To install assembly, reverse removal procedure.

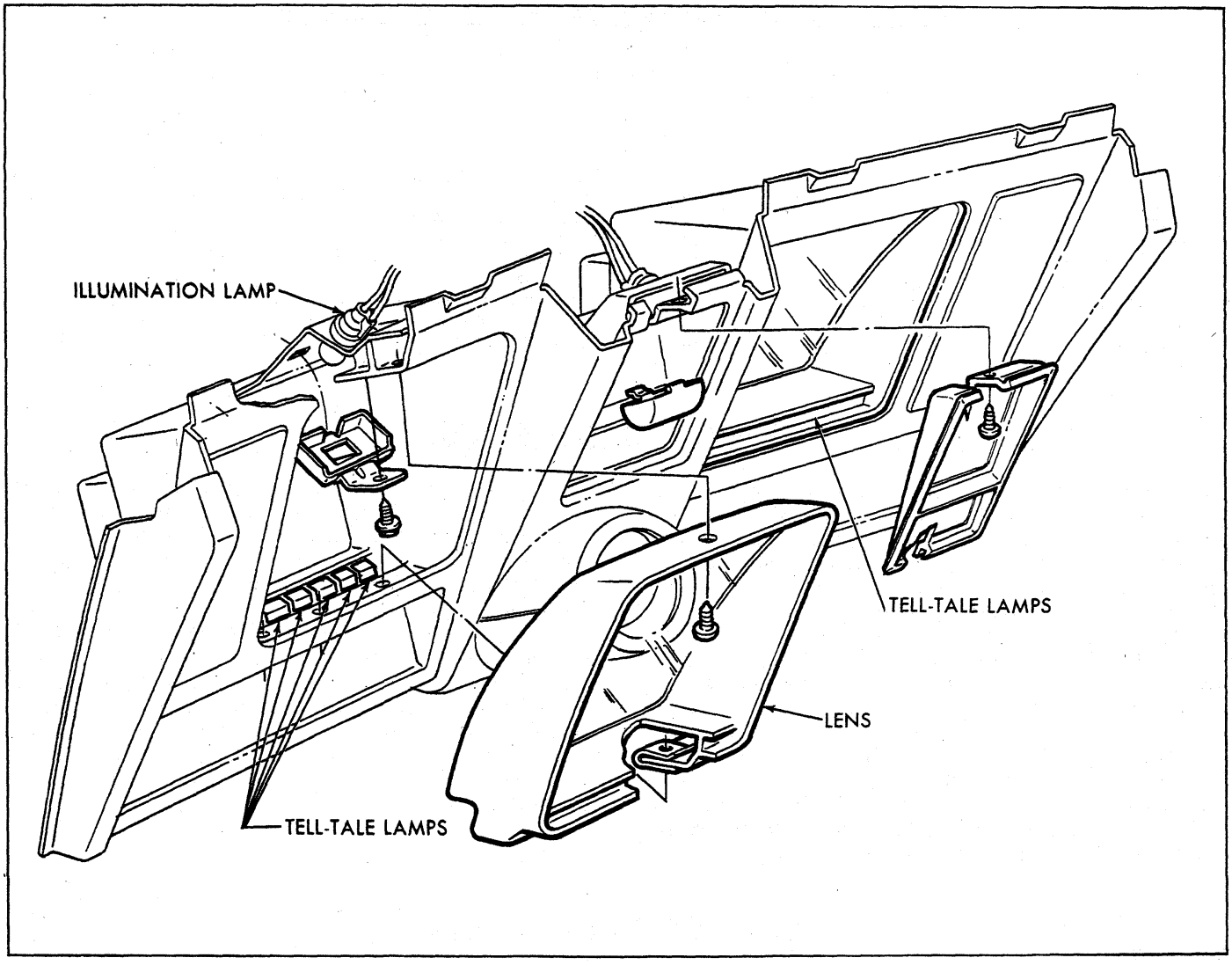


Fig. 50—Instrument Panel Lens Removal

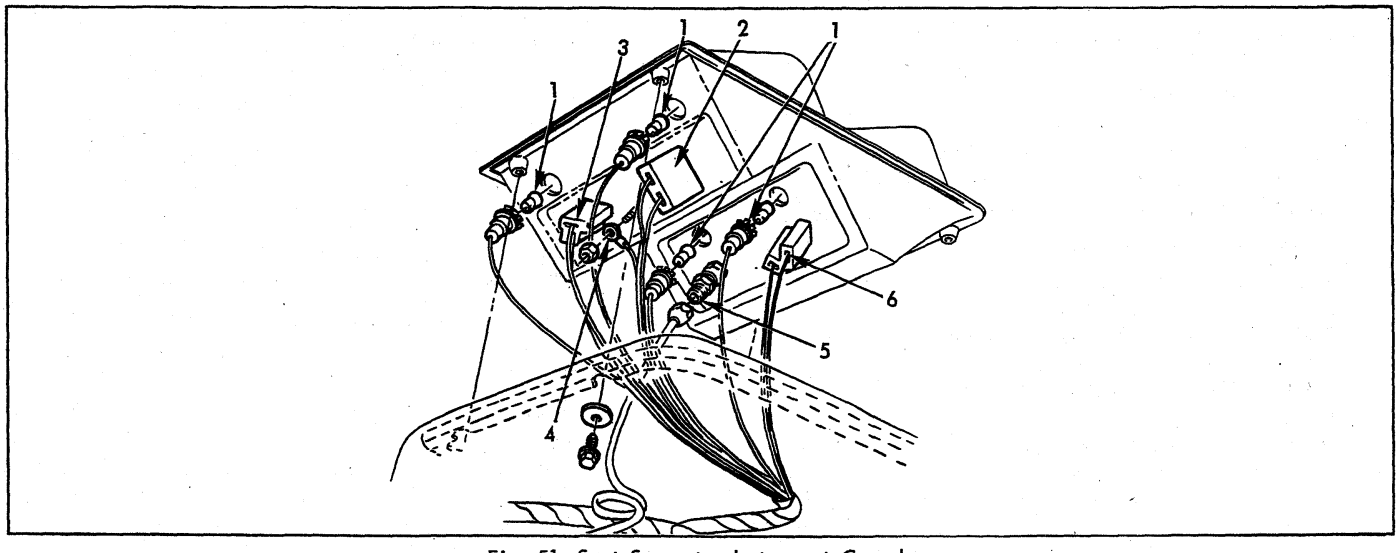


Fig. 51—Seat Separator Instrument Console

1. Cluster Lamps
2. Ammeter Conn.
3. Temp Gauge Conn.
4. Ground Wire
5. Oil Gauge Conn.
6. Fuel Gauge Conn.

NOVA INSTRUMENTS AND GAUGES

INDEX

	Page
General Description	12-32
Service Operations	12-32
Instrument Panel	12-32
Instrument Cluster	12-32
Fuel Gauge	12-32
Clock	12-32
Speedometer	12-33
Speedometer Cable	12-33
Instrument Panel Bulbs	12-33
Printed Circuit	12-33
Oil Pressure Indicator	12-33
Generator Indicator	12-33
Temperature Indicator	12-33
Seat Separator Instrument Console	12-34
Fuel Gauge	12-34
Ammeter	12-34
Temperature Gauge	12-34
Oil Pressure Gauge	12-34
Fuel Warning Unit	12-34

GENERAL DESCRIPTION

The Nova instrument cluster assembly consists of a speedometer, fuel gauge also temperature, generator and oil pressure indicator lamps. Optionally a clock may be located to the right of the speedometer head and a tachometer to the left of the speedometer.

In addition to the instrument indicator lamps, a brake warning lamp is included in the cluster as standard equipment. The indicator is connected to the parking brake and brake pressure differential switches and serves a dual function. It lights when the parking brake is applied and also when the brake pedal is applied, if a malfunction should occur in the brake system due to a loss of hydraulic pressure. Servicing of the hydraulic pressure differential switch is covered in Section 5 of this manual.

Regular maintenance is not required on the instrument cluster or its components other than maintaining clean and tight electrical connections, replacing defective parts and keeping the speedometer cable properly lubricated.

A special instrumentation package is available with the V-8 engine and floor console combination. The special cluster includes coolant temperature, oil pressure, fuel and ammeter gauges mounted forward on the floor mini console. A tachometer replaces the fuel gauge on the left side of the speedometer.

All indicator and cluster illuminating lamps, except the center top bulb above the high beam indicator, may be replaced without removing the cluster from the vehicle. The bulbs are installed in plastic holders which twist-lock into the cluster housing and make contact with the printed circuit.

SERVICE OPERATIONS

INSTRUMENT PANEL

Instrument Cluster (Figures 52 and 53)

Removal and Installation

1. Disconnect battery ground cable.
2. Lower steering column (refer to Steering, Section 9, for complete procedure for lowering jacket).

   NOTE: Apply protective material to the mast jacket to prevent damage to the painted surfaces.

3. Remove three screws above front of heater control securing it to instrument cluster.
4. Remove radio control knobs, washers, bezel nuts and front support at lower edge of instrument cluster. This will allow the radio to remain in the instrument panel.
5. Remove screws at top, bottom and sides of instrument cluster securing it to the instrument panel.
6. Tilt console forward and reach behind to disconnect speedometer cable, speedminder, electrical plug connectors and lift instrument panel out of instrument carrier after removing screws.
7. For installation, reverse removal procedure. DO NOT KINK CABLE HOUSING.

Fuel Gauge—Optional Tachometer Replacement

1. Remove cluster lamps from gauge cover plate and remove terminal nuts attaching circuit to gauge.
2. Carefully move printed circuit away from gauge and remove screws retaining gauge assembly to the cluster housing.
3. Remove gauge assembly from cluster housing and remove three terminal nuts attaching gauge to the cover plate.

   NOTE: Observe carefully, the stack up of the internal parts of the fuel gauge assembly.

4. To install, reverse removal procedure.

Clock Replacement

1. Remove ground cable from battery.
2. Remove radio entirely.
3. Remove clock stem set knob at front of cluster.
4. Remove cluster lamps from rear cluster cover and circuit attaching screws from clock area.
5. Move printed circuit away from clock and remove screws retaining clock to cluster housing.
6. Remove clock from rear of cluster housing.
7. To install, reverse removal procedure.

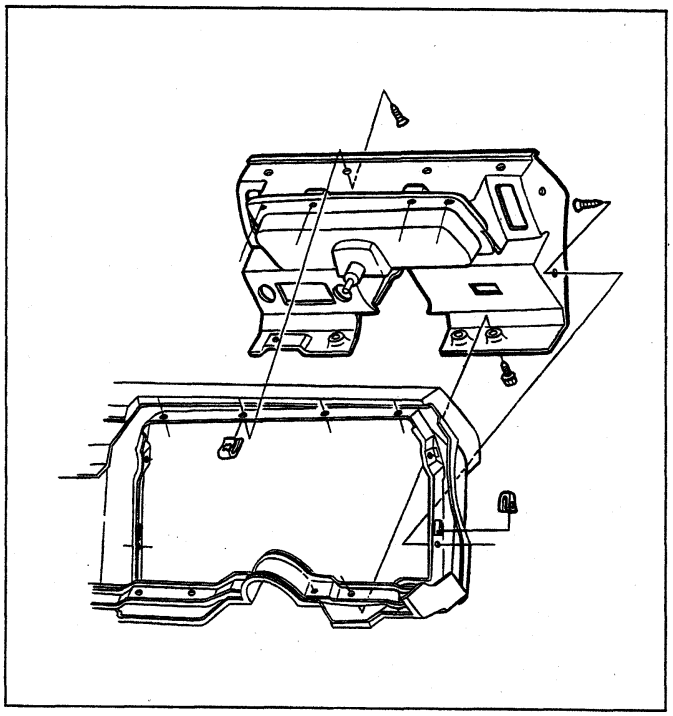


Fig. 52—Instrument Carrier Removal

Speedometer Replacement

1. Remove instrument cluster as previously described in this section.
2. Remove screws retaining rear cover to the cluster assembly. Bend ground strap away from cover and remove cover.
3. Remove screws retaining speedometer to the housing and remove speedometer from rear cover.

   NOTE: Servicing of the speedometer assembly should be performed by an authorized AC Speedometer Service Station.

4. To install, reverse the removal procedure. DO NOT KINK CABLE HOUSING.

Speedometer Cable Replacement or Lubrication

1. Remove radio.
2. Disconnect the speedometer cable from the speedometer head. Remove the old cable by pulling it out from speedometer end of conduit.

   NOTE: If old cable is broken it may be necessary to remove lower piece from transmission end of conduit.

3. Lubricate the lower 3/4 of cable with speedometer cable lubricant and push the cable into the conduit. Connect the upper end to the speedometer head and road test vehicle for proper speedometer operation. DO NOT KINK CABLE HOUSING.

Instrument Panel Bulbs

Left of Steering Column

1. Reach up under dash and twist bulb socket holder loose.
2. Replace bulb in twist socket holder and install in the reverse order of removal.

Right of Steering Column

1. Remove ground cable from the battery.
2. Remove radio, as outlined under clock replacement for access to right hand bulbs.

   NOTE: All bulbs are accessible except the center top bulb above the hi-beam indicator bulb. For this bulb it will be necessary to remove and replace the instrument cluster.

Printed Circuit Replacement (Fig. 53)

1. Remove instrument cluster as previously described in this section.
2. Remove all cluster illuminating and indicator lights from cluster housing.
3. Remove fuel gauge and clock terminal nuts securing printed circuit to housing.
4. Remove four hex head screws retaining printed circuit to the cluster housing and remove the printed circuit.
5. To install, reverse removal procedure.

   CAUTION: The retaining screws and terminal nuts are part of the grounding circuit and must be installed to provide the proper ground connections for the printed circuit.

Oil Pressure Indicator

If the light does not come on when the ignition switch is turned on, or if the light comes on and remains on after the engine is started, one or more of the following conditions is indicated.

- Low oil pressure
- Defective wiring or switch

Sending Unit Replacement

1. Disconnect wiring harness connector from sender unit terminal (located in block above starter on L-6 engines and at left front of distributor on V-8 engines).
2. Remove sender unit.
3. Replace with new unit and check operation.

Generator Indicator

1. Ignition on, engine not running and indicator light off:
   - Indicator bulb is burned out, replace bulb.
   - Open circuit or loose connection in the indicator light circuit.
2. Indicator light stays on after engine is started:
   - If indicator light does not go out at engine idle speed, refer to Charging System Tests in Section 6Y, Engine Electrical.

Temperature (Cooling System) Indicator

The temperature indicator circuit consists of two remotely located units, indicator lamp and sending unit. The indicator lamp, located in the instrument cluster is a single red light which will indicate an overheated engine condition.

Engine Sender Unit Replacement

1. Relieve coolant system pressure by loosening radiator cap.

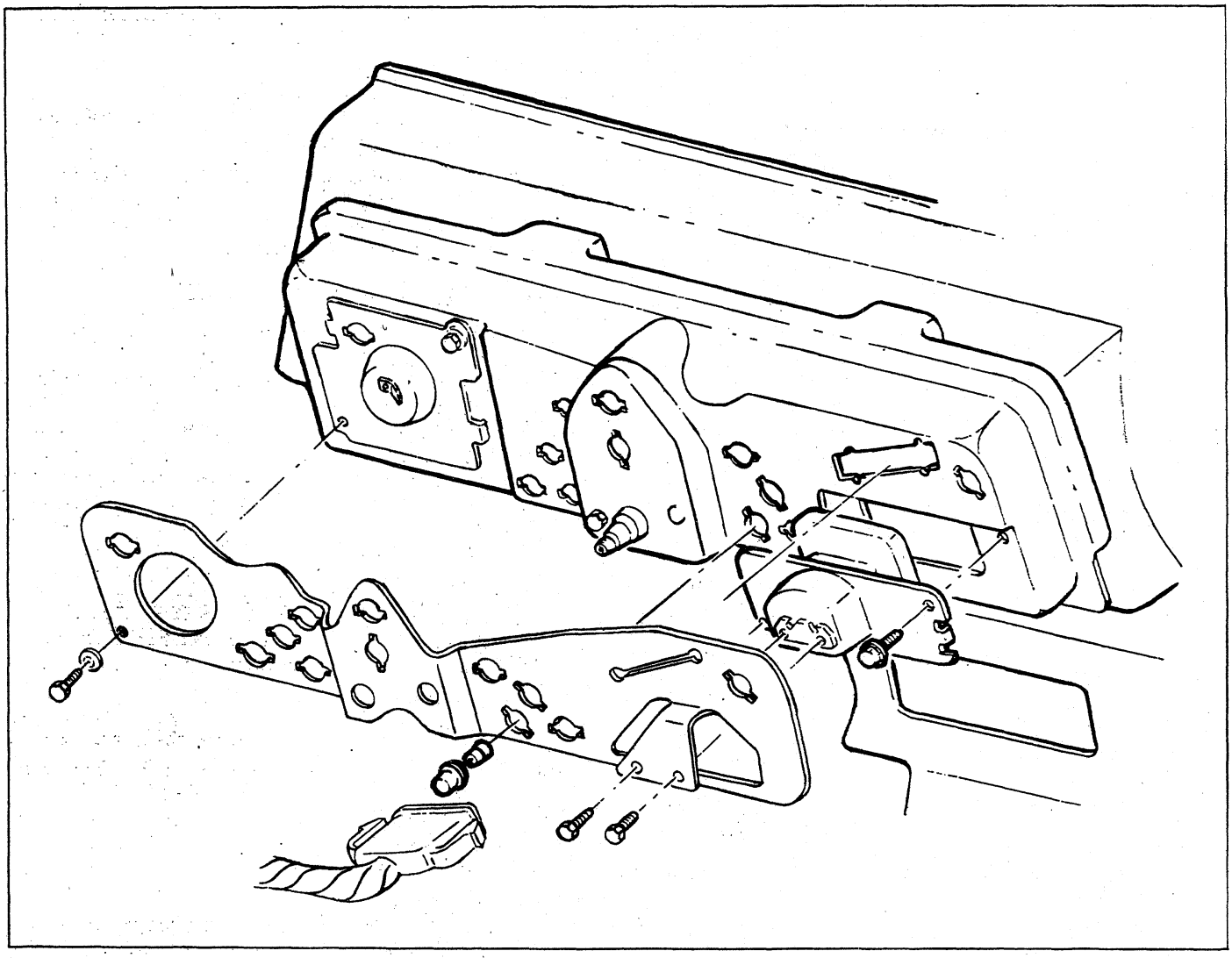


Fig. 53—Instrument Cluster

2. Remove sender unit (located in the left cylinder head on V-8 engines, and in the cylinder near an exhaust port on L-6 engines). Replace with new unit.
3. Check coolant system level and operation of unit.

Seat Separator Instrument Console (Fig. 51)

(Fuel, Ammeter, Temperature, Oil Pressure Gauges, Low Fuel Warning Unit)

1. Disconnect battery ground cable.
2. Remove cover retaining screws (3) and cover from cluster assembly.
3. Remove three screws retaining each gauge mounting plate to cluster housing.
4. Carefully disengage gauge plate from housing and disconnect oil pipe and all electrical connections at rear of gauges.

   NOTE: At this point, with gauge package removed from housing all gauges including the low fuel warning system may easily be serviced.

5. To install assembly, reverse removal procedure.

DIRECTION SIGNAL

Due to the integral design relationship of the signal switch, hazard warning switch, ignition lock warning switch, ignition lock, ignition switch and the energy absorbing steering column, service procedures for the directional signal and hazard warning switches are covered in Section 9, Steering.

Different signal flasher units are used in Chevrolet models depending on the number of lamps to be operated. The turn signal flasher is mounted to the instrument panel lower lip.

NOTE: Remove cigarette lighter connection before removing flasher connection.

A hazard warning flasher is mounted in the fuse panel block. Normally the hazard flasher will not flash when the brake pedal is depressed.

WINDSHIELD WIPERS AND WASHERS

INDEX

	Page
Headlamp Washer	12-35
Wiper Transmission Assembly	12-35
Removal and Installation	12-35
Wiper Motor Assembly	12-35
Removal and Installation	12-35
Non-Depressed Park Wiper	12-35
Wiper Motor Assembly	12-35
Disassembly	12-35
Inspection	12-37
Assembly	12-37
Washer Pump Unit	12-38
Removal and Installation	12-39
Disassembly and Assembly	12-39
Depressed Park 2-Speed Wiper - Chevrolet - Chevelle - Corvette	12-40
Motor Section	12-40
Gear Box Section	12-42
Washer Pump Unit	12-44
Corvette Wiper Cover Panel System	12-45

HEADLAMP WASHERS

Headlamp washers are standard on Corvette, Camaro rally sport and Chevrolet with optional headlamp covers. Headlamp washers are optional on other models.

The headlamp washer system only operates with the headlamps turned on and the windshield washer button held in the depressed position. A solenoid mounted to the wiper motor diverts washer fluid through hoses to the nozzles mounted on the low beam headlamp bezel.

WIPER TRANSMISSION ASSEMBLY

Removal and Installation (Fig. 54)

1. Make sure wiper motor is in Park position.
2. Open hood.

   NOTE: On Corvettes only--Remove rubber plug from front of wiper door actuator then insert a screw driver, pushing internal piston rearward to actuate wiper door open.

3. Remove wiper arm and blade assemblies from the transmission. On articulated left-hand arm assemblies, remove carburetor type clip retaining pinned arm to blade arm.
4. Remove plenum chamber air intake grille, or screen, if so equipped.
5. Loosen nuts retaining drive rod ball stud to crank arm and detach drive rod from crank arm.
6. Remove transmission retaining screws, or nuts, then lower and drive rod assemblies into plenum chamber.
7. Remove transmission and linkage from plenum chamber through cowl opening.
8. To install, reverse removal procedure. Make sure wiper blade assemblies are installed in the Park position (± 3/8" from stop of reveal moulding on recessed wiper arms).

WIPER MOTOR ASSEMBLY

Removal

1. Make sure that the wiper motor is in the park position.
2. Disconnect washer hoses and electrical connectors from the wiper motor assembly.
3. Remove the plenum chamber grille on Chevy II, Camaro, and Corvette models. On Chevrolet models, remove the plastic access cover.
4. Loosen the nuts which retain the drive link to the crank arm ball stud on Chevrolet models. On all other models, remove the nut which retains the crank arm to the motor assembly.
5. On Corvette models, it is necessary to remove the ignition shield and distributor cap to gain access to the motor retaining screw assemblies or nuts.

   NOTE: Remove left bank secondary leads from the cap and mark both cap and leads for aid in reinstallation.

6. Remove the three motor retaining screw assemblies or nuts and remove the motor.

Installation

1. Check sealing gaskets at motor and retaining screws. Replace if necessary.
2. Make sure that the wiper motor is in the park position prior to installation.
3. Reverse 'Removal' Steps 2-6.

NON-DEPRESSED PARK WIPER

Nova, Camaro, Chevelle

The Type "E" two-speed electric windshield wiper assembly (fig. 55) incorporates a non-depressed type (blades park approximately 2" above windshield molding) motor and gear train. The rectangular, 12 volt, compound wound motor is coupled to a train consisting of a helical drive gear at the end of the motor armature shaft, an intermediate gear and pinion assembly, and an output gear and shaft assembly. The crank arm is attached to the output gear shaft.

Two switches, connected in parallel, control the starting, stopping and parking of the Type "E" wiper motor. The manually operated start, stop switch is located on the instrument panel, while the cam operated park switch is located in the wiper gear box.

WIPER MOTOR ASSEMBLY

Disassembly

Gear Box (Fig. 56)

1. Remove the two washer pump mounting screws (fig. 57) and lift pump off washer.
2. Remove washer pump drive cam as required (fig. 58). The cam is pressed on the shaft but can be

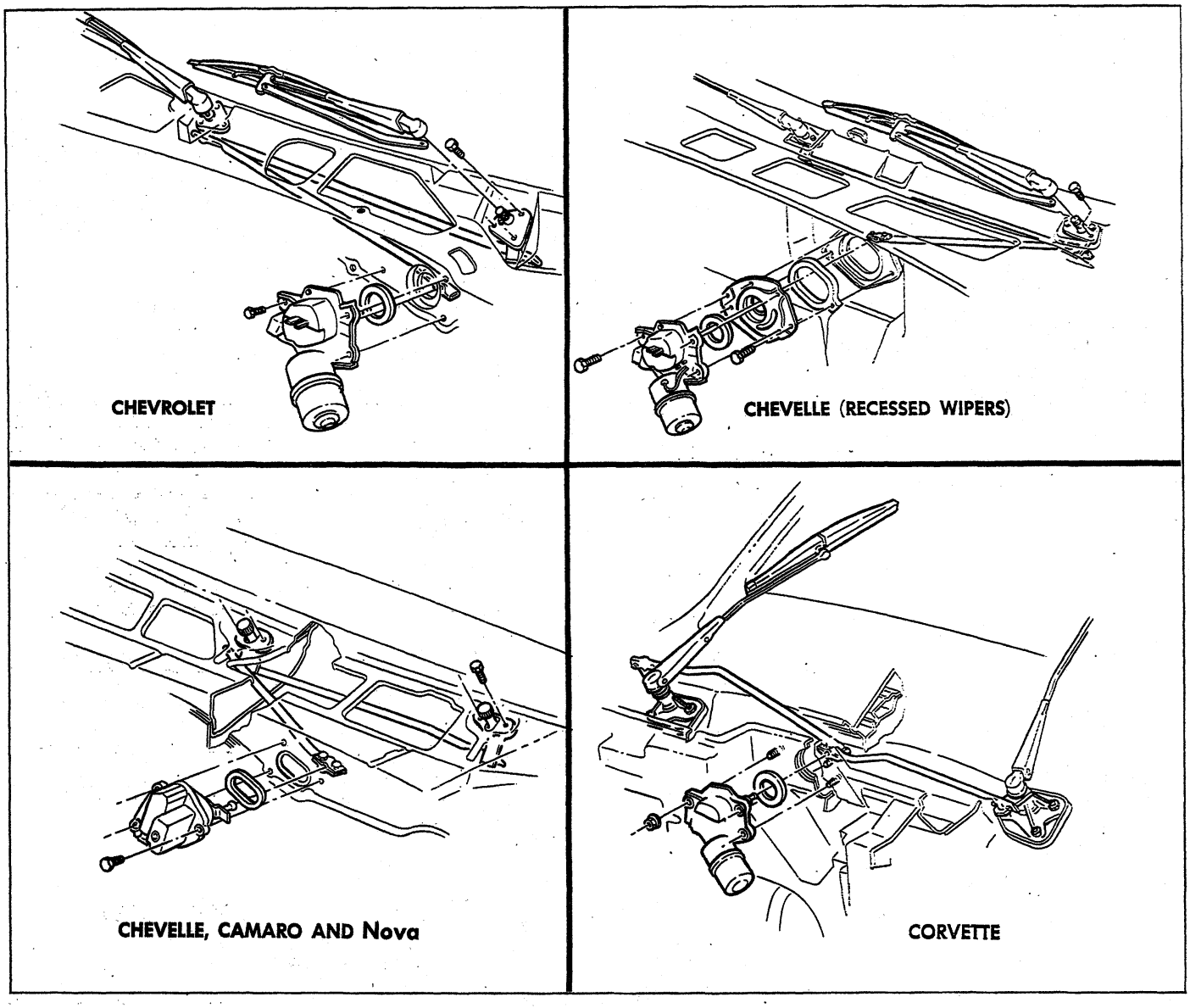


Fig. 54—Wiper and Motor Linkage

wedged off by using two screw drivers between cam and plate.

3. Clamp crank arm in a vise and remove crank arm retaining nut.

   CAUTION: Failure to clamp crank arm may result in stripping of wiper gears!

4. Remove crank arm, seal cap, Tru-Arc retaining ring, and end-play washers.

   NOTE: Seal cap should be cleaned and repacked with a water-proof type grease before reassembly.

5. Drill out gear box cover staking tabs with a 9/32" drill, then remove cover with loosened tabs from gear train.

   NOTE: Screws, nuts and lock washers for reassembling cover to wiper are contained in a service repair package.

6. Remove output gear and shaft assembly, then slide intermediate gear and pinion assembly off shaft.
7. If necessary, remove terminal board and park switch assembly as follows:

   a. Unsolder motor leads from terminals. Code motor leads for reassembly purposes.
   b. Drill out rivets securing terminal board and park switch ground strap to mounting plate.

   NOTE: Screws, nuts and washers for attaching a replacement terminal board-park switch assembly are included with the replacement assembly.

Motor (Fig. 56)

1. Follow Steps 1 through 7b under gear box disassembly.
2. Remove motor through bolts, tap motor frame lightly, and remove motor from mounting plate.

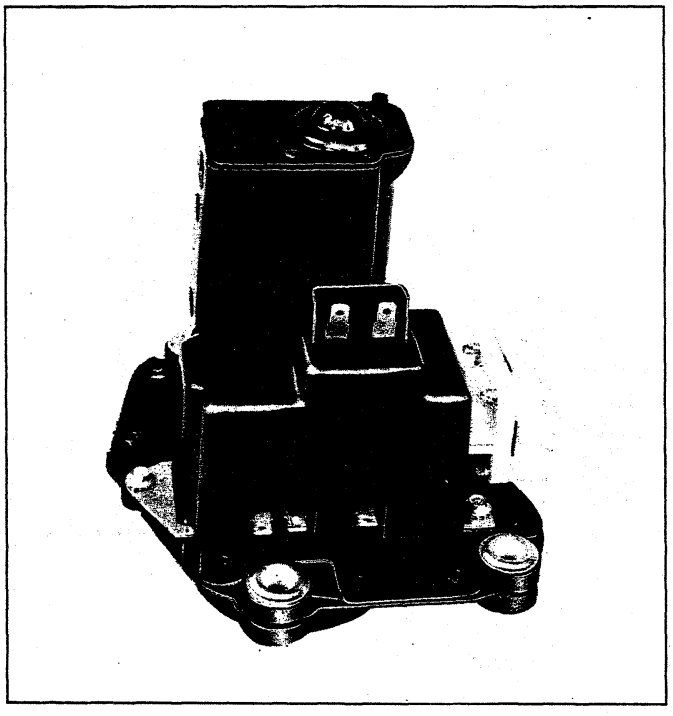


Fig. 55—Non-Depressed Park Wiper

3. Remove brush spring tension slide armature and end plate from motor frame. Pull end plate from armature.

   NOTE: Thrust plug located between armature shaft and end plate.

4. Remove end play adjusting washers from armature, noting arrangement for proper reinstallation.

Inspection

Check and inspect all parts for serviceability, replace as necessary. All parts can be replaced individually except motor frame and field, which is serviced as an assembly. Service kits also provide screws, nuts and washers to replace gear cover and terminal board rivets.

Assembly

Refer to Figure 56 for exploded view of motor and gear train.

Motor

Reassemble motor using reverse of disassembly procedures.

NOTE: Armature end play is controlled by end play washers. See Figure 59 for proper assembly of end play washers. Lubricate armature shaft bushings with light machine oil.

Gear Box

1. Assemble gear box using reverse of disassembly procedure.

   NOTE: Lubricate gear teeth with Delco Cam and Ball Bearing lubricant or equivalent. Be sure cover is properly located over dowel pins and be sure to reinstall ground strap.

2. Place wiper in park position (fig. 60) and install crank arm on output shaft, rotate crank so alignment marks line up with those on cover.

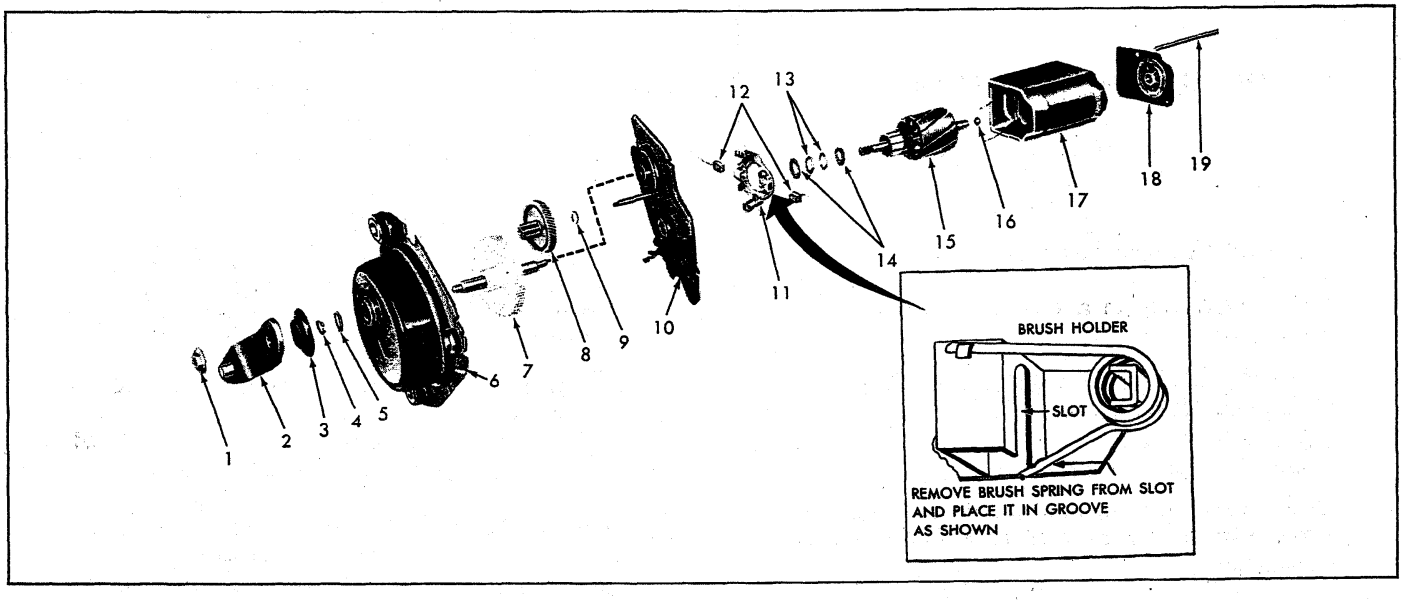


Fig. 56—Wiper Motor and Gear Box Assembly

1. Nut
2. Crank Arm
3. Seal Cap
4. Retaining Ring
5. Washer
6. Gear Box Cover
7. Output Gear and Shaft Assembly
8. Intermediate Gear
9. Wave Washer
10. Gear Box Housing
11. Brush Plate Assembly and Mounting Brackets
12. Brushes
13. Wave Washers
14. Flat Washers
15. Armature
16. Thrust Plug
17. Frame and Field
18. End Plate
19. Tie Bolts (Two Required)

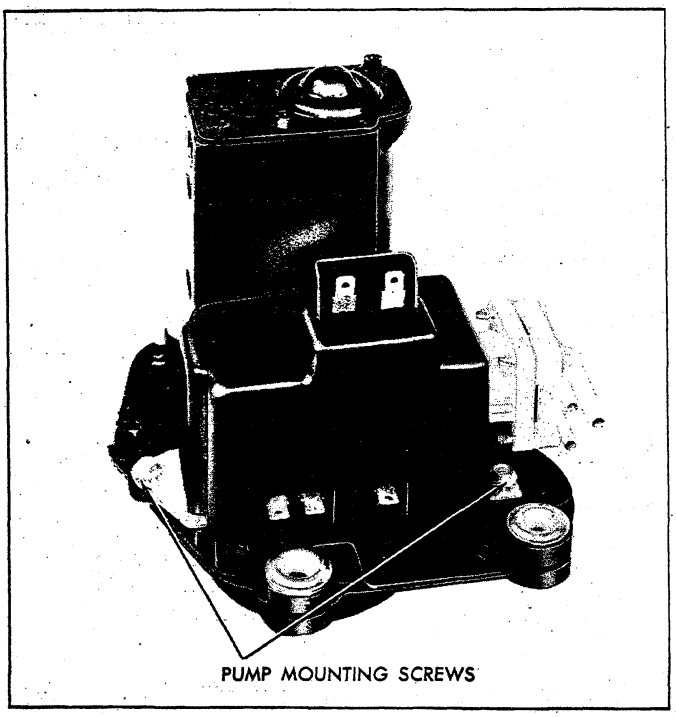


Fig. 57—Washer Pump - Attach Screws

3. Replace retaining nut, place crank arm in vise, tighten retaining nut.

WINDSHIELD WASHER PUMP

The windshield washer pump used on the 2-speed Type "E" wiper motor assembly is a positive displacement type pump employing a piston, piston spring and valve arrangement. The pumping mechanism is actuated by a four lobe cam and driven directly by the wiper motor (fig. 61). Thus, when the wiper is operated, this cam is always turning with the gear. Programming is accomplished electrically and mechanically by a relay assembly and ratchet wheel arrangement.

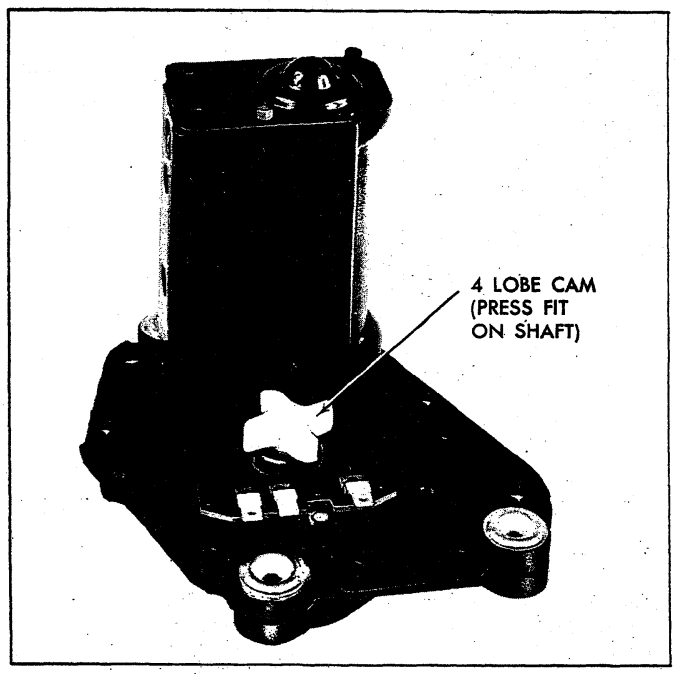


Fig. 58—Washer Pump Drive Cam

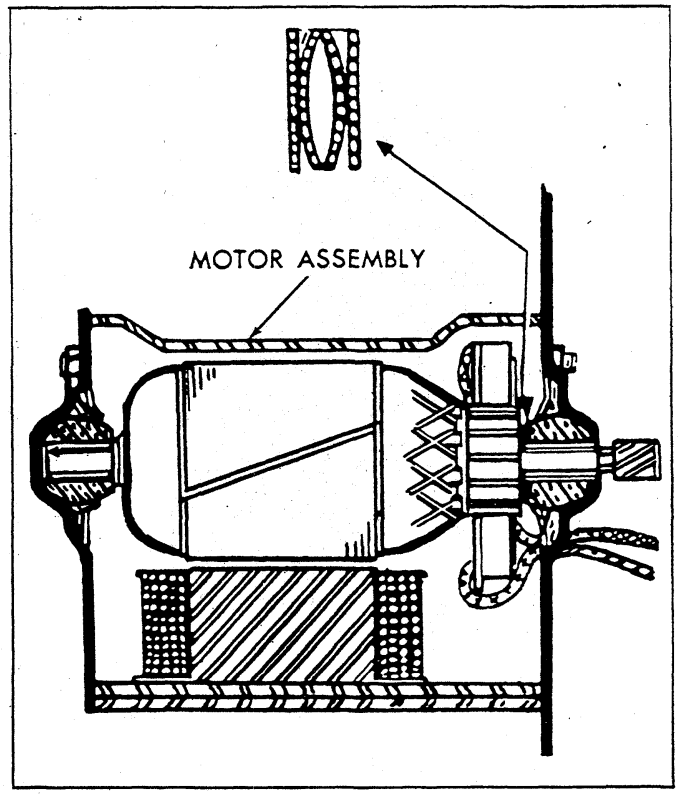


Fig. 59—End Play Wave Washer Installation

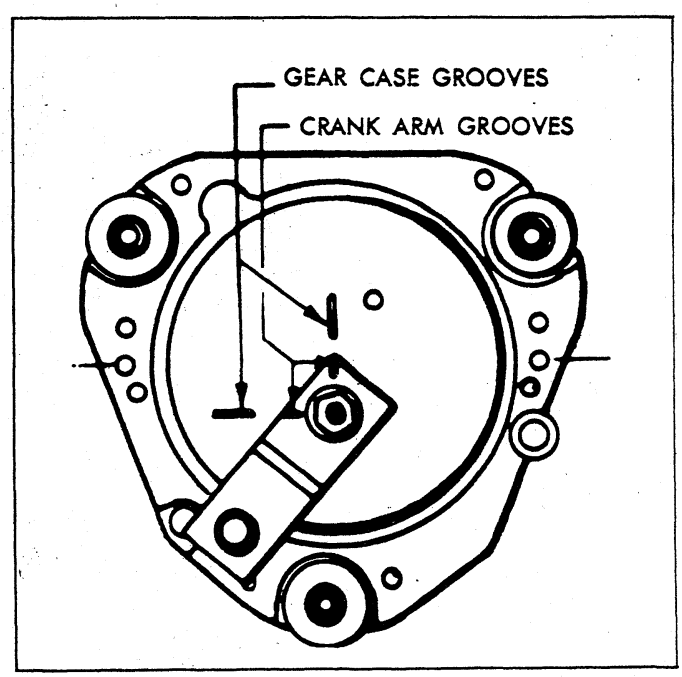


Fig. 60—Wiper Crank Arm in Park Position

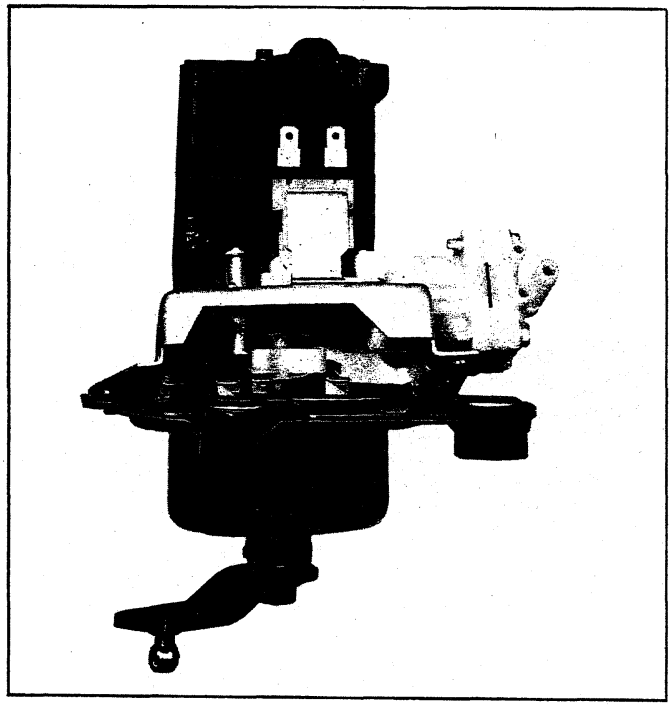


Fig. 61—Washer Pump Drive Cam and Actuator

REMOVAL AND INSTALLATION

Removal of the washer pump from the wiper motor consists of:

1. Disconnect wiring harness and washer hoses from washer.
2. Remove the two pump-to-wiper retaining screws and remove washer from wiper (fig. 57).
3. Reverse removal procedure to install assembly.

DISASSEMBLY—ASSEMBLY (Figs. 62, 63)

Solenoid Assembly—Ratchet Dog

1. Remove the ratchet dog retaining screw. Hold the spring loaded solenoid plunger in position and carefully lift the solenoid assembly and ratchet dog off the frame of the pump.
2. Separate the ratchet dog from solenoid mounting plate as required.

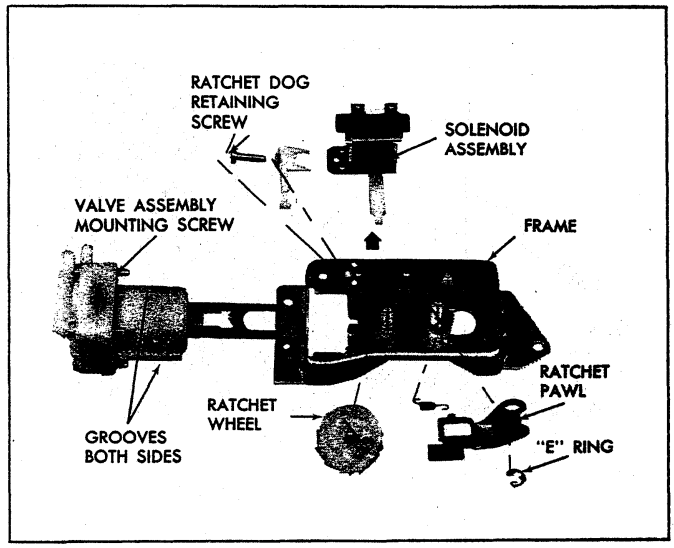


Fig. 63—Washer Pump—Exploded View

Ratchet Pawl

1. Disconnect ratchet pawl spring.
2. Remove ratchet pawl retaining ring and slide ratchet pawl off cam follower shaft.

Ratchet Wheel

1. Follow step 1 under solenoid - ratchet dog disassembly.
2. Move ratchet wheel spring out of shaft groove and slide ratchet wheel off its shaft.

Pump and Actuator Plate Assembly

1. Remove solenoid assembly - ratchet dog, ratchet pawl and ratchet wheel as outlined in their respective procedures.

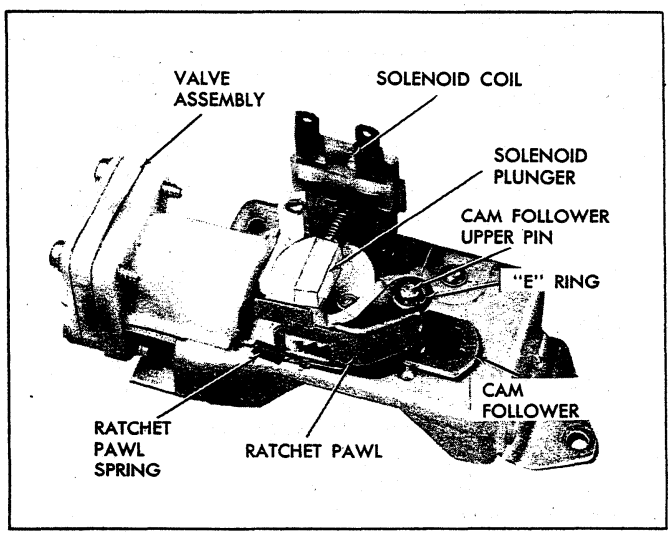


Fig. 62—Washer Pump Mechanism

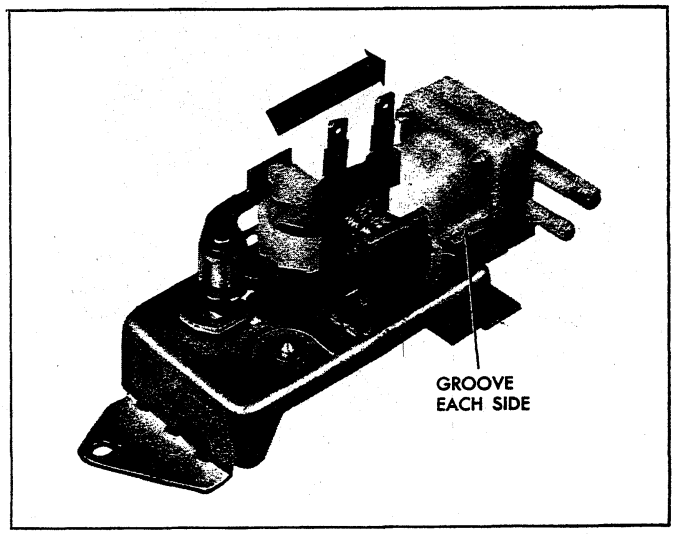


Fig. 64—Releasing Pump from Lockout Position

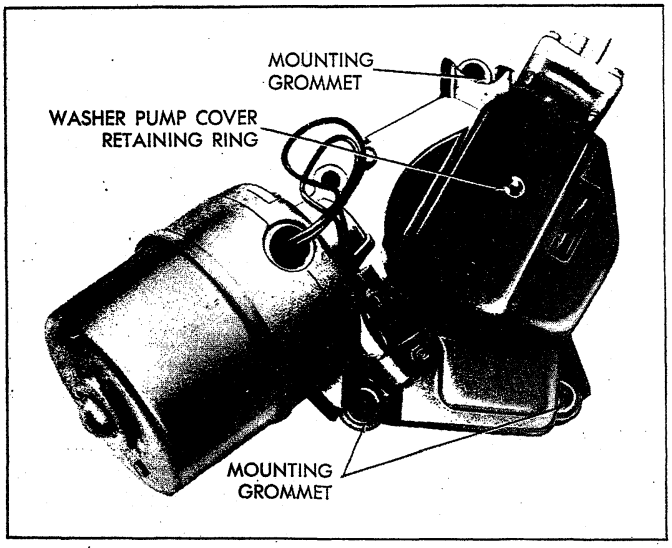


Fig. 65—Depressed Park 2-Speed Wiper (Except Corvette)

2. To separate the pump and pump actuator plate from the frame, pull the pump housing in the direction of the arrow until the grooves in the housing clear the frame. Then remove the actuator plate from the ratchet wheel and cam follower shafts.

Valve Assembly

1. Remove the four (4) screws that attach the valve assembly to the pump housing.

   CAUTION: During re-assembly be sure gasket between housing and valve plate is properly positioned in the housing and valve plate grooves. Also be sure triple "O" ring is properly installed between valve body and pipe assembly.

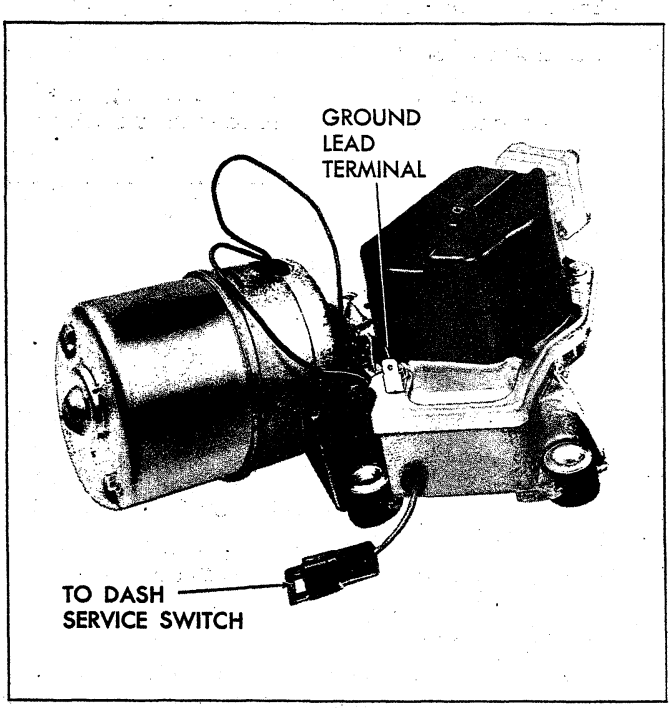


Fig. 66—Depresses Park Wiper—Corvette

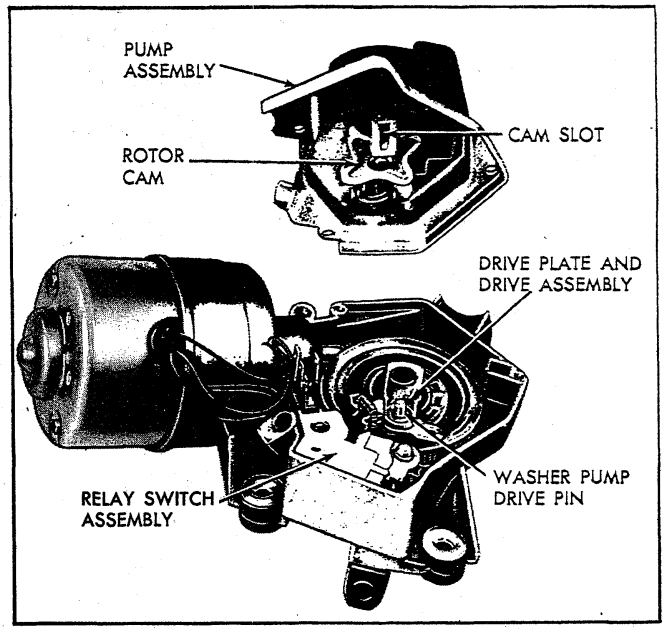


Fig. 67—Wiper and Washer Mechanism

2. Assemble washer pump in the reverse order of disassembly.

DEPRESSED PARK 2-SPEED WIPER

Chevelle, Chevrolet and Corvette

The Type "C" two speed electric wiper assembly (fig. 65, 66) incorporates a depressed park type (blades park against step on windshield lower molding when the motor is turned off) motor and gear train. The wiper has a compound wound 12 volt motor and a gear box section containing the gear mechanism and relay control. The motor armature is fitted with a worm gear which drives the main gear assembly and crank arm.

The relay control, consisting of a relay coil, relay armature and switch assembly, is located in the gear box section and controls the starting and stopping of the wiper through a latching mechanism (fig. 67).

An electric washer pump is mounted on the gear box section of the wiper and is driven by the wiper unit gear assembly (fig. 67).

The overhaul procedures for the wiper are broken down into three major areas: The motor section, gear box section and washer pump section. Each section may be serviced independently of the other.

WIPER MOTOR ASSEMBLY

Disassembly

NOTE: Motor section may be disassembled independently of the gear box.

Brush Plate and Circuit Breaker Removal

1. Scribe a reference line along the side of the casting and end cap to insure proper re-assembly.
2. Remove the two motor thru bolts.
3. Feed exposed excess length of motor leads thru the casting grommet and carefully back the case and

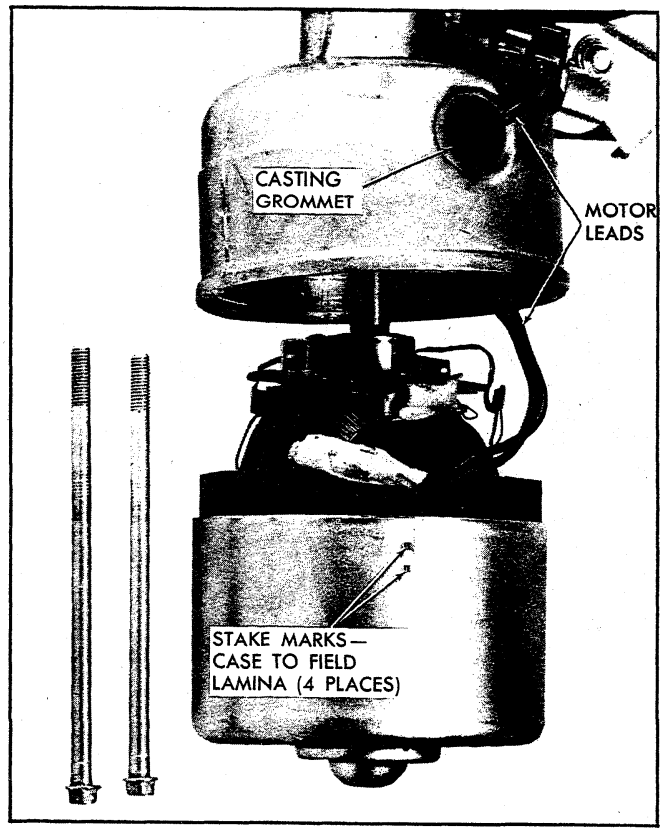


Fig. 68—Wiper Motor Separation

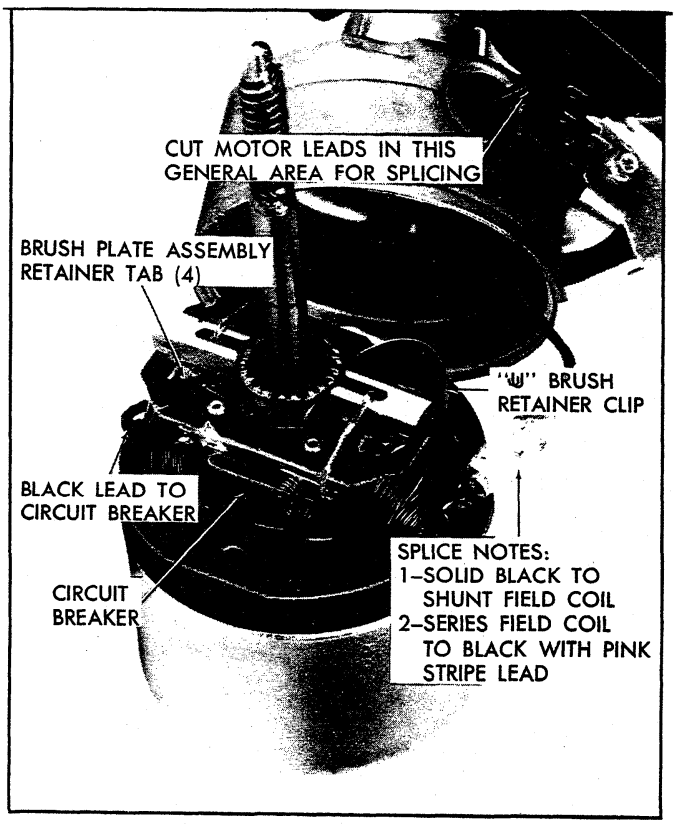


Fig. 69—Circuit Breaker

field assembly plus the armature away from the casting (fig. 68).

NOTE: It may be necessary to remove the armature end play adjusting screw and insert a rod thru the opening in order to apply pressure against the end of the armature.

4. Unsolder the black lead from circuit breaker (fig. 72).
5. Straighten out the 4 tabs that secure the brush plate to the field coil retainers (fig. 69).

CAUTION: Be careful not to break any of the retainer tabs.

6. Install "U" shaped brush retainer clip over brush holder that has brush lead attached to circuit breaker (fig. 70).
7. Holding the opposite brush from that retained in Step 6, carefully lift the brush holder off the mounting tabs far enough to clear the armature commutator (fig. 70).
8. Allow the brush, held in Step 7, to move out of its holder. Remove the brush spring and lift the brush holder off the armature shaft.

Armature Removal

1. Follow Steps 1 thru 8 under brush plate removal.
2. Lift armature out of case and field assembly.
3. Remove thrust ball from end of armature shaft as required and save for reassembly.

NOTE: Thrust ball may be easily removed with a magnet.

Case and Field Assembly Removal

1. Remove brush plate and armature.
2. The end case and field assembly is serviced as a unit. To free the field and case assembly, cut the solid black and black with pink stripe leads in a location convenient for splicing - preferably near the wiper terminal board. Refer to Figure 68.
3. Remove steel thrust plate and rubber disc from case bearing as required.

Assembly

1. If new field and case assembly is being installed, splice the black and black with pink stripe leads of the new field with the corresponding leads of the wiper.
2. Install the rubber thrust disc, steel thrust disc and felt lubricating washer in the case assembly bearing in the order indicated.
3. Lubricate end of armature shaft that fits in case bearing. Next, install thrust ball in end of shaft.
4. Assembly armature in the case and field assembly.
5. Position the partially assembled brush plate over the armature shaft far enough to allow re-assembly of the remaining brush in its brush holder; then position the brush plate assembly on the mounting tabs in the position shown in Figure 70.

NOTE: Circuit breaker ground lead will not reach circuit breaker terminal if brush plate is positioned wrong.

6. Center the brush plate mounting holes over the mounting tabs and bend the tabs toward the brush holders as required to secure the brush plate in position.

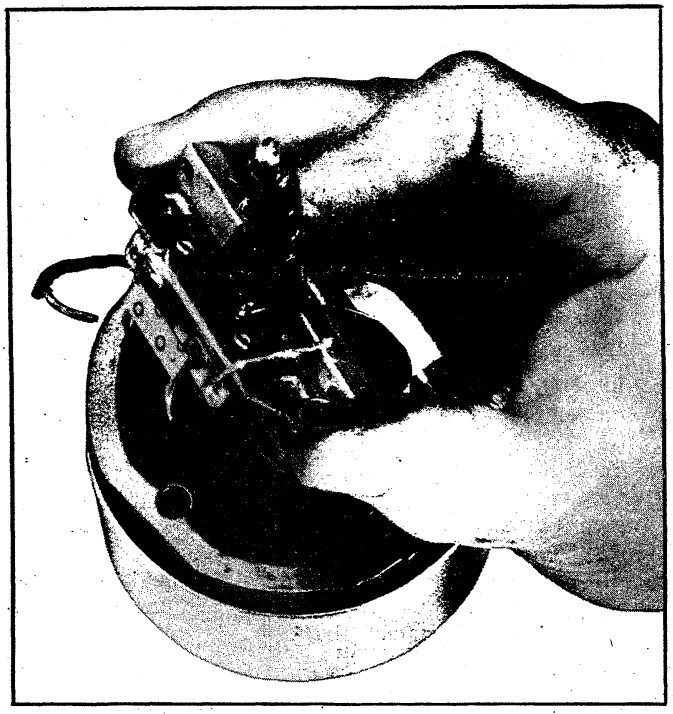


Fig. 70—Removing Brush Holder

CAUTION: Be sure tabs are centered in brush plate mounting holes.

7. Remove brush retainer clips and resolder circuit breaker ground lead to circuit breaker. Refer to Figure
8. If new case and field assembly is used, scribe a line on it in the same location as the one scribed on the old case. This will insure proper alignment of the new case with the scribed line made on the housing (Step 1 under Brush Plate Removal).
9. Position armature worm shaft inside the housing and, using the scribed reference marks, line up as near as possible the case and field assembly with the housing.
10. Maintaining the armature in its assembled position in the case, start the armature worm shaft through the field and housing bearing until it starts to mesh with the worm gear. At the same time carefully pull the excess black and black with pink stripe leads thru the housing grommet.

    CAUTION: It may be necessary at this point to rotate armature slightly before the armature worm will engage with worm gear teeth.

11. Rotate the case as required to align the bolt holes in the case with those in the housing.
12. Secure the case to the housing with the two tie bolts.
13. Adjust armature end play.

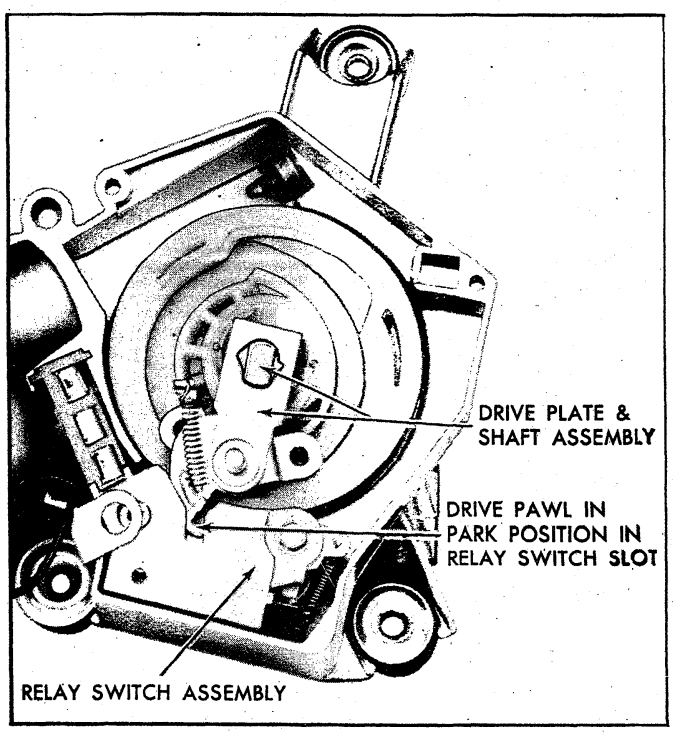


Fig. 71—Drive Pawl in Full Park Position

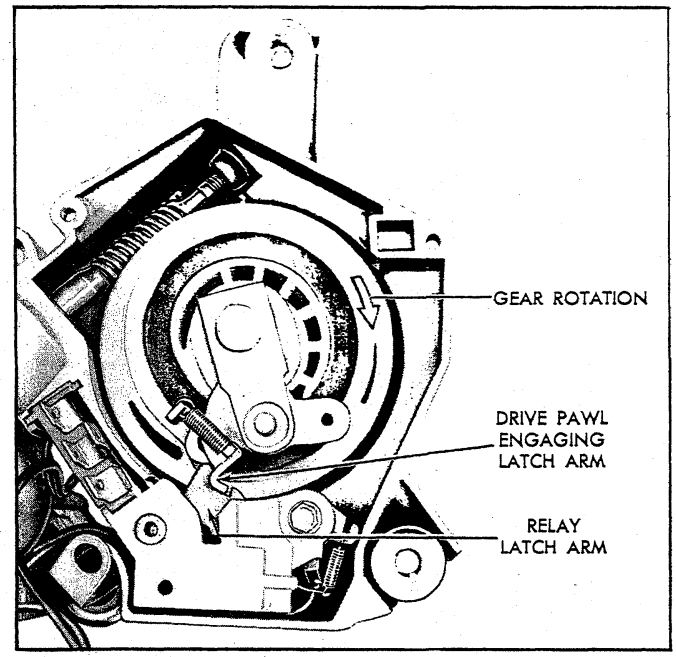


Fig. 72—Relay Assembly

Gear Box Section

The gear box section is subdivided into two areas, (A) the relay control and latching mechanism and (B) the drive gear mechanism.

A—Relay Switch and Latch Assembly—Terminal Board Removal

1. Remove screws retaining washer pump assembly to wiper unit.
2. If wiper pawl is in full park position (drive pawl located in magnetic switch assembly slot, fig. 71), it becomes necessary to remove gear assembly first (see Gear Assembly Removal).

   If wiper gear mechanism is not in park position (drive pawl away from latch arm, fig. 72), proceed to Step 3.

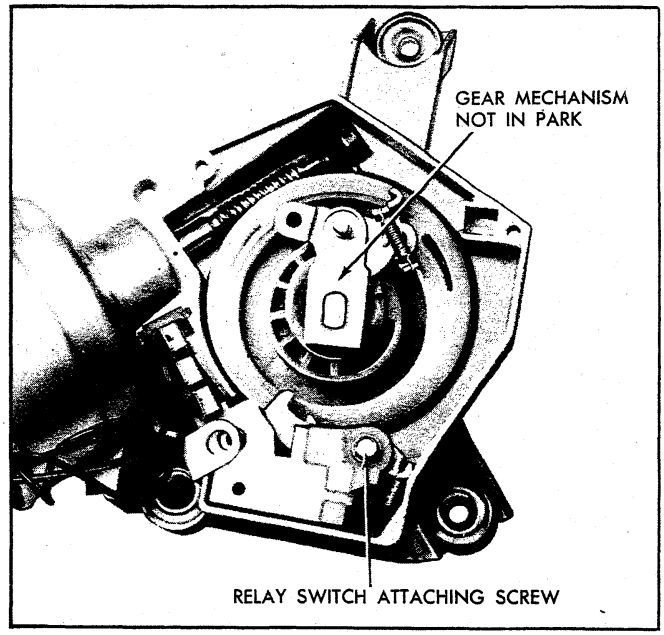


Fig. 73—Drive Gear not in Park Position

3. Remove relay-switch attaching screw (fig. 73) and carefully lift the relay-switch assembly out of the gear box. Unsolder leads from switch terminals as required. Refer to figures 74, 75 when resoldering leads.
4. To remove terminal board assembly simply slide it out of housing and unsolder leads as required.

Relay Switch—Latch and Terminal Board Assembly

1. Resolder leads to wiper terminal board as required (fig. 74, 75).
2. Slide terminal board into wiper housing being careful to position the terminal board resistor lead as shown in Figure 76.
3. Resolder leads to relay switch assembly as required (fig. 74, 75).
4. Position relay-switch assembly in housing.

   CAUTION: Be very careful to route leads in such a manner as to avoid having them pinched between relay and wiper housing.

5. Install relay-switch mounting screw.
6. Assemble gear box cover and washer pump assembly to wiper being careful that the ground strap is properly connected. Refer to Figure 67 for assembly of washer pump to gear housing.

B-Drive Gear Disassembly (Fig. 77)

1. Remove washer pump assembly.
2. Remove crank arm retaining nut, crank arm, rubber seal cap, retaining ring, shim washers, shield and spacer washer in the order indicated.
3. Slide gear assembly out of housing (fig. 78).
4. Slide drive plate and shaft out of gear and remove the drive pawl, lock pawl and coil spring as required.

Drive Gear—Assembly

1. Position drive pawl on drive plate as shown in Figure 79.

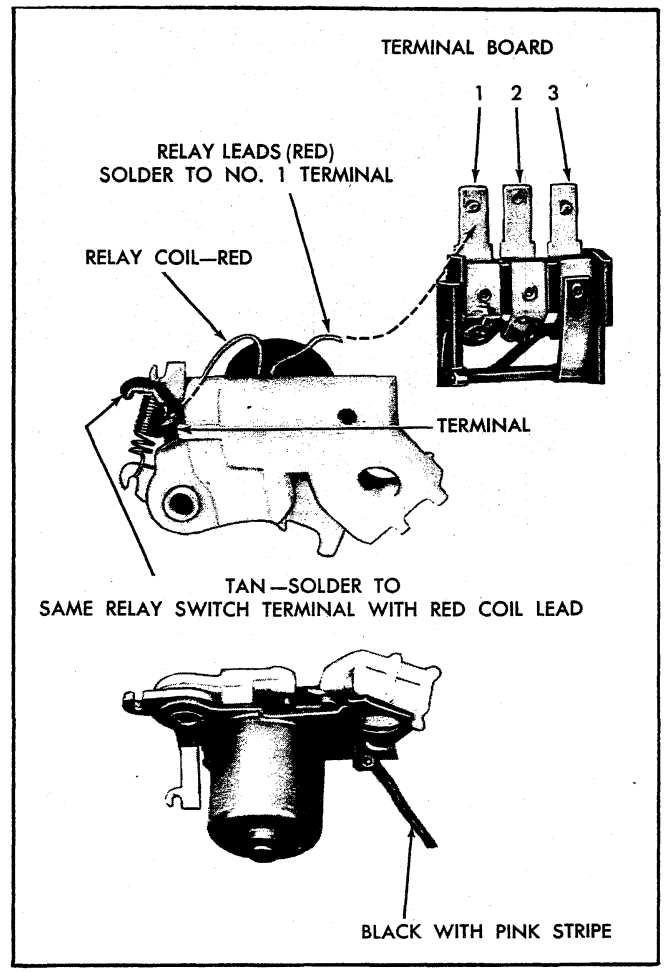


Fig. 74—Relay Assembly Wiring (Except Corvette)

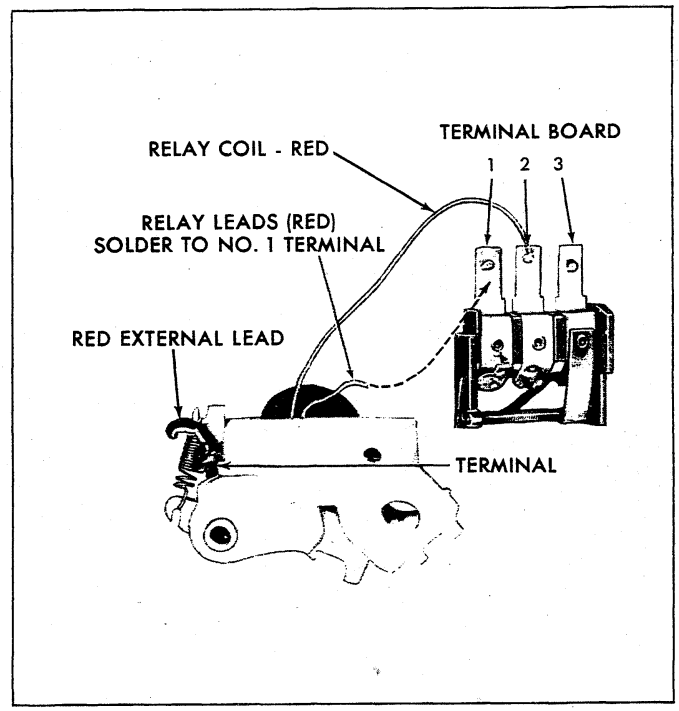


Fig. 75—Relay Assembly Wiring (Corvette)

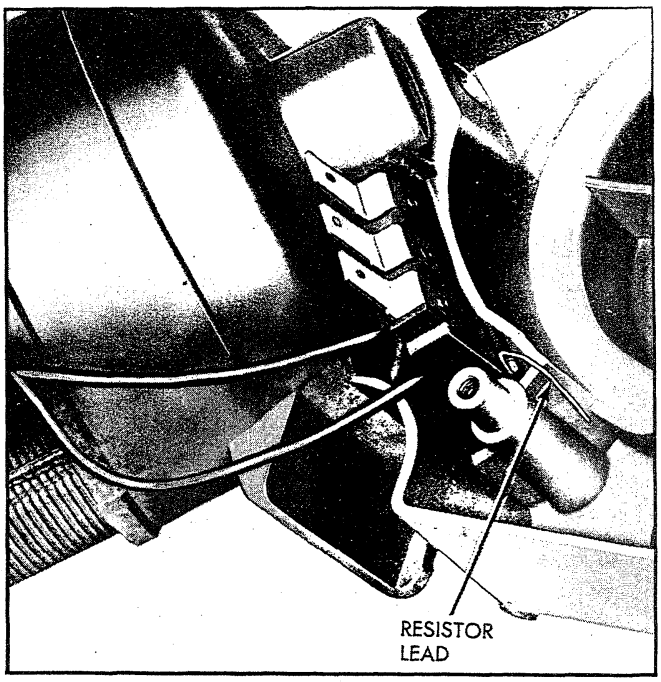


Fig. 76—Terminal Broad Resistor

2. Assemble lock pawl over drive pawl as shown in Figure 79.
3. Slide gear and tube over the drive shaft (fig. 80). (Move drive and lock pawls as required to allow their respective pins to fit in the gear guide channel, fig. 81).
4. Holding the gear, manually rotate the drive plate until the drive and lock pawl guide pins snap into their respective pockets in the gear (fig. 81).
5. Reinstall coil spring between lock and drive pawls (fig. 81).

   IMPORTANT: Be very careful to maintain lock and drive pawl guide pins in their respective pockets during Step 6.

6. Assemble inner spacer washer over gear shaft and assemble gear mechanism in housing so that it is positioned with respect to the housing in the approximate location shown in Figure 78.
7. Reassemble the outer spacer washer, shield, shim washers as required to obtain .005" max. end play, snap ring and rubber seal cap in the order indicated. Refer to Figure 77.
8. Operate wiper to "park" or "off" position and install crank arm.
9. Reassemble washer pump to wiper (fig. 67).

Washer Pump Unit

The washer pump and/or valve assembly may be removed from the wiper assembly as a unit; therefore, it is not necessary to remove the wiper assembly from the vehicle if only the washer pump and/or valve assembly required service.

When the pump is removed from the wiper assembly, all working parts are readily accessible and may easily be serviced as necessary (fig. 82). An exploded view of the washer pump is shown in Figure 83.

Removal of Pump Assembly

1. Raise vehicle hood.
2. Disconnect washer hoses and electrical connections from assembly.

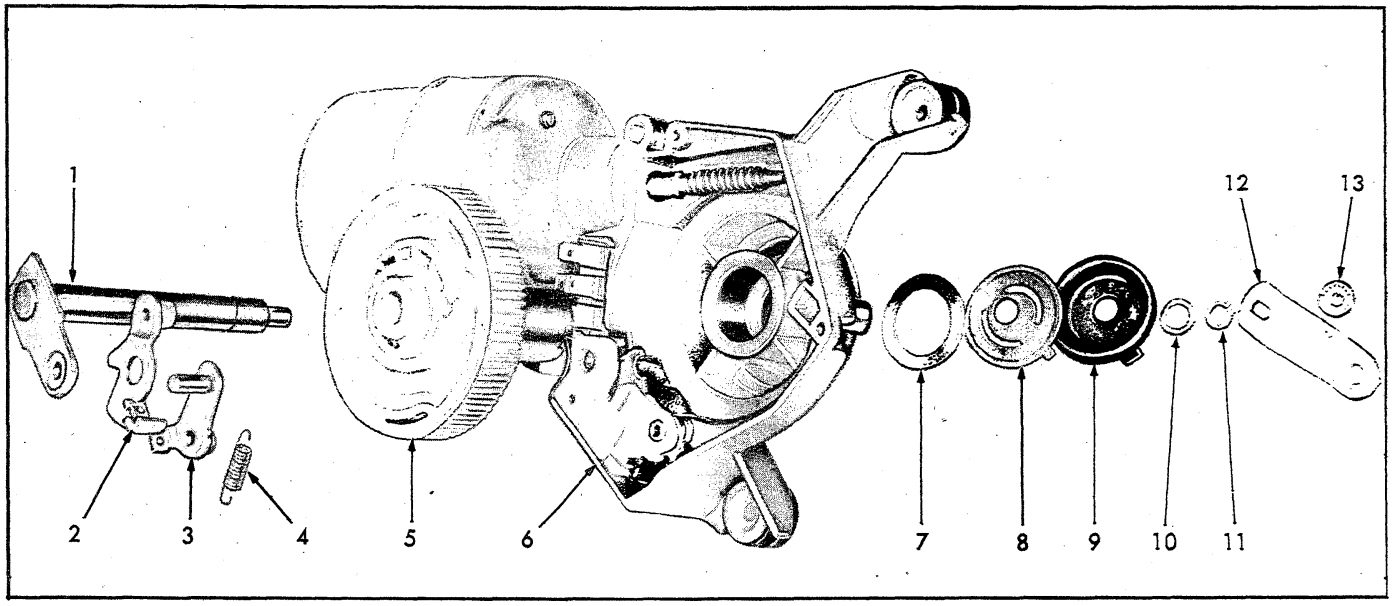


Fig. 77—Drive Gear Mechanism Assembly

1. Drive Gear Shaft
2. Drive Pawl
3. Lock Pawl
4. Coil Spring
5. Drive Gear
6. Relay Assembly
7. Spacer
8. Shield
9. Seal
10. Washer
11. Snap Ring
12. Crank Arm
13. Nut

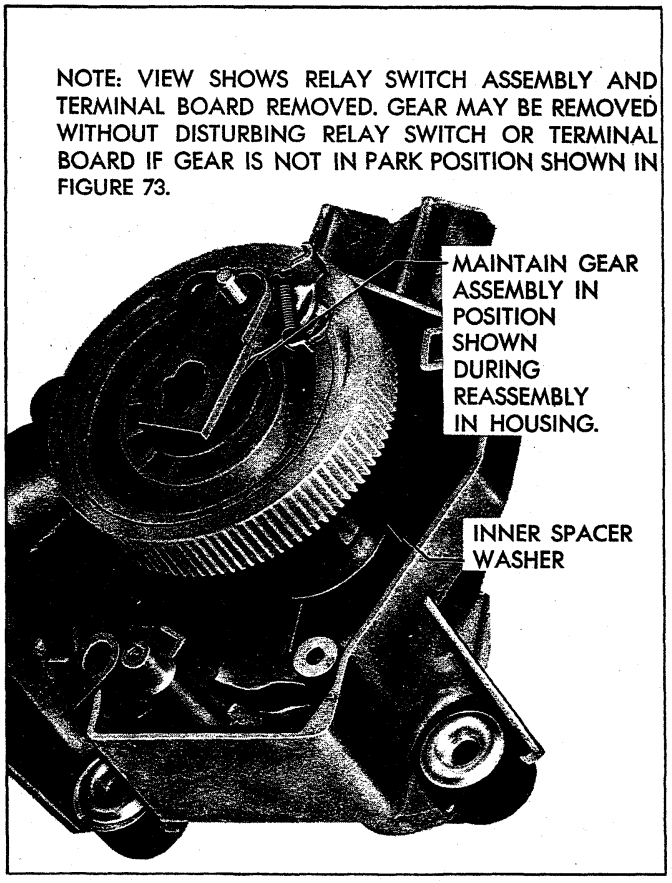


Fig. 78—Removing Gear Assembly

3. Remove 3 screws securing washer pump and cover to wiper assembly. Remove pump from wiper gear box.

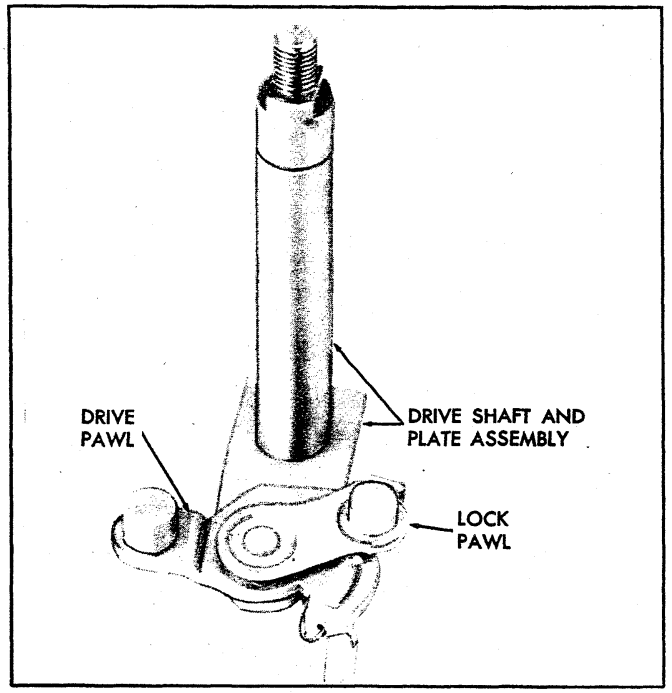


Fig. 79—Lock and Drive Pawl Assembly

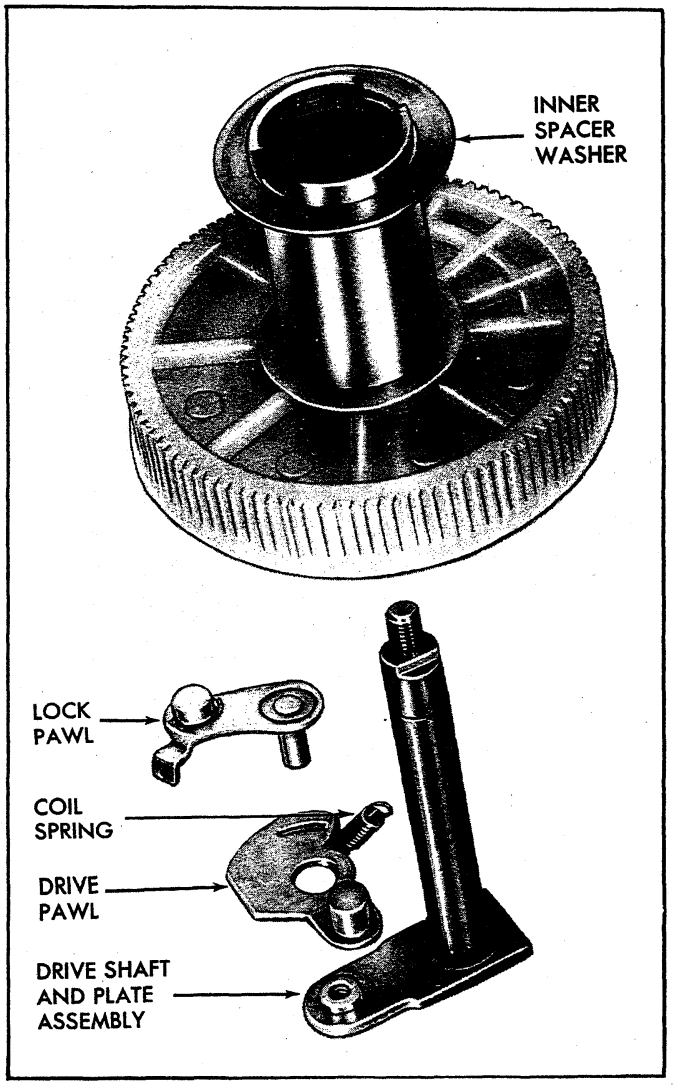


Fig. 80—Drive Gear and Shaft Assembly

CORVETTE WIPER COVER PANEL SYSTEM (Figs. 84, 85, 86)

CORVETTE WINDSHIELD WIPER SYSTEM

The system is a double articulating, overlapping type in which the blades park under a concealing lid. The wiper motor is electric and the lid is vacuum operated. The movements of each are programmed to prevent damage to system components.

Vacuum Components for Wiper Door Operation (Fig. 84)

1. The vacuum reserve tank and check valve, to store vacuum for door operation, is located under rear of left fender near cowl.
2. The vacuum relay valve, to route vacuum to proper side of door actuator for opening or closing cycle, is located under rear of right front fender. This valve is operated by vacuum on a spring loaded diaphragm.
3. A vacuum control solenoid, used to activate or deactivate the vacuum relay when the wiper switch is turned on or off, is mounted on the tachometer housing under the dash.

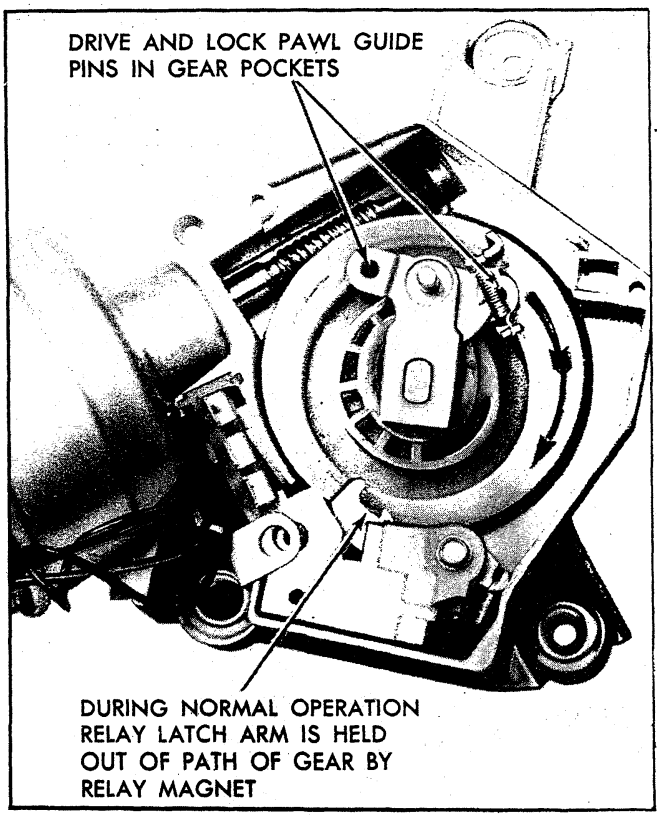


Fig. 81—Drive and Lock Pawl Guide Pins in Pockets

4. A manual vacuum valve in series with the solenoid is used to open the door for service procedure. This valve located under steering column should also be used to keep the door open when frequent but intermittent wiper use is desirable.
5. Interlock Switch - Actuated by wiper arm - prevents wiper door closing till blades park - located in plenum - right side.
6. Hoses constitute the remainder of the vacuum system components. The tank and check valve are common with the headlamp vacuum system.

Electrical Components of the Wiper System (Fig. 85)

1. Wiper motor - with an integral relay. The motor has separate leads to external ground for completing the armature and field circuits.
2. Wiper switch on dash is used to provide the wiper system with off, low and high speed conditions. This switch is a grounding switch.
3. A limit switch, operated by the wiper door as it reaches open position, is mounted on the engine side of the cowl near the wiper motor. This switch is used to interrupt the motor armature ground circuit until the wiper door is fully open. When limit switch completes this circuit, the motor will operate.
4. A rotary service switch mounted under the steering column, is used to stop the wiper blades in a serviceable position on the windshield. This switch should never be left open for more than short service periods because it does not allow the motor to come to a park position.

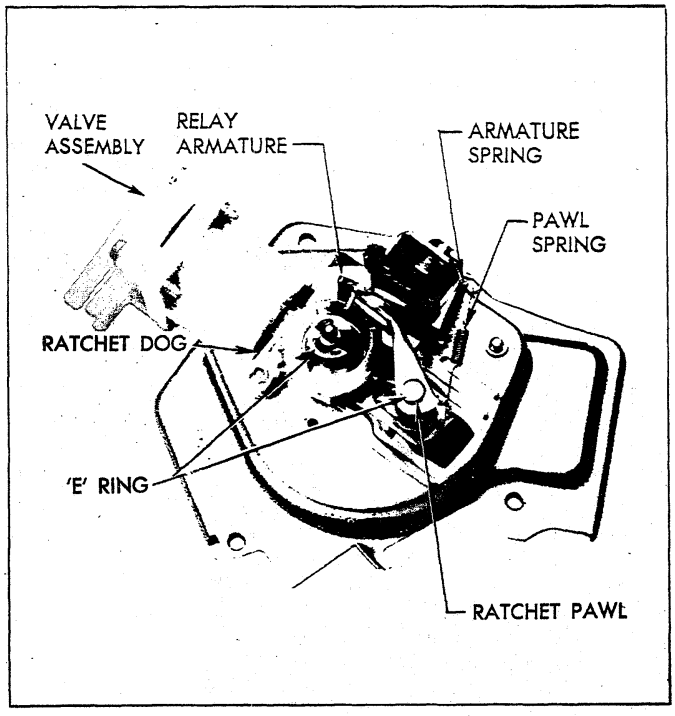


Fig. 82—Washer Pump Assembly

5. An external relay completes the motor field circuit to ground at the wiper switch or through a ground-wire. This relay is used to return the wipers to slow speed and allow the blades to park for door closing if the ignition is turned off while the wiper switch is in high speed position.

   This relay is mounted under the front of the floor console and is accessible after removing the slide out trim at the right front side.
6. Vacuum control solenoid is an electrically controlled vacuum switch as outlined under vacuum components.
7. Windshield wiper fuse in fuse panel -- controls the feed circuit for the external relay, the motor relay and the washer solenoid. The yellow wires are protected by this fuse and are hot any time the ignition switch is on.
8. Fuse link at horn relay protects feed (red) wire to wiper. This lead is always hot.

Vent Grille and Windshield Wiper Cover Panel

Removal

1. Raise hood then remove ground cable from battery behind driver's seat.
2. Remove eight screws located in the vent grille.
3. Move the vent grille forward and up to remove.
4. If vacuum is present in system, open cover panel by pulling downward wiper cover panel switch. If panels do not open, remove plug at front of vacuum actuator and insert a screw driver into the hole. Press in on actuator piston until cover panel raises to the opened position.

   NOTE: The actuator rubber plug is functional in the vacuum system. It must be replaced immediately.
5. Remove four bolts with bushings retaining cover

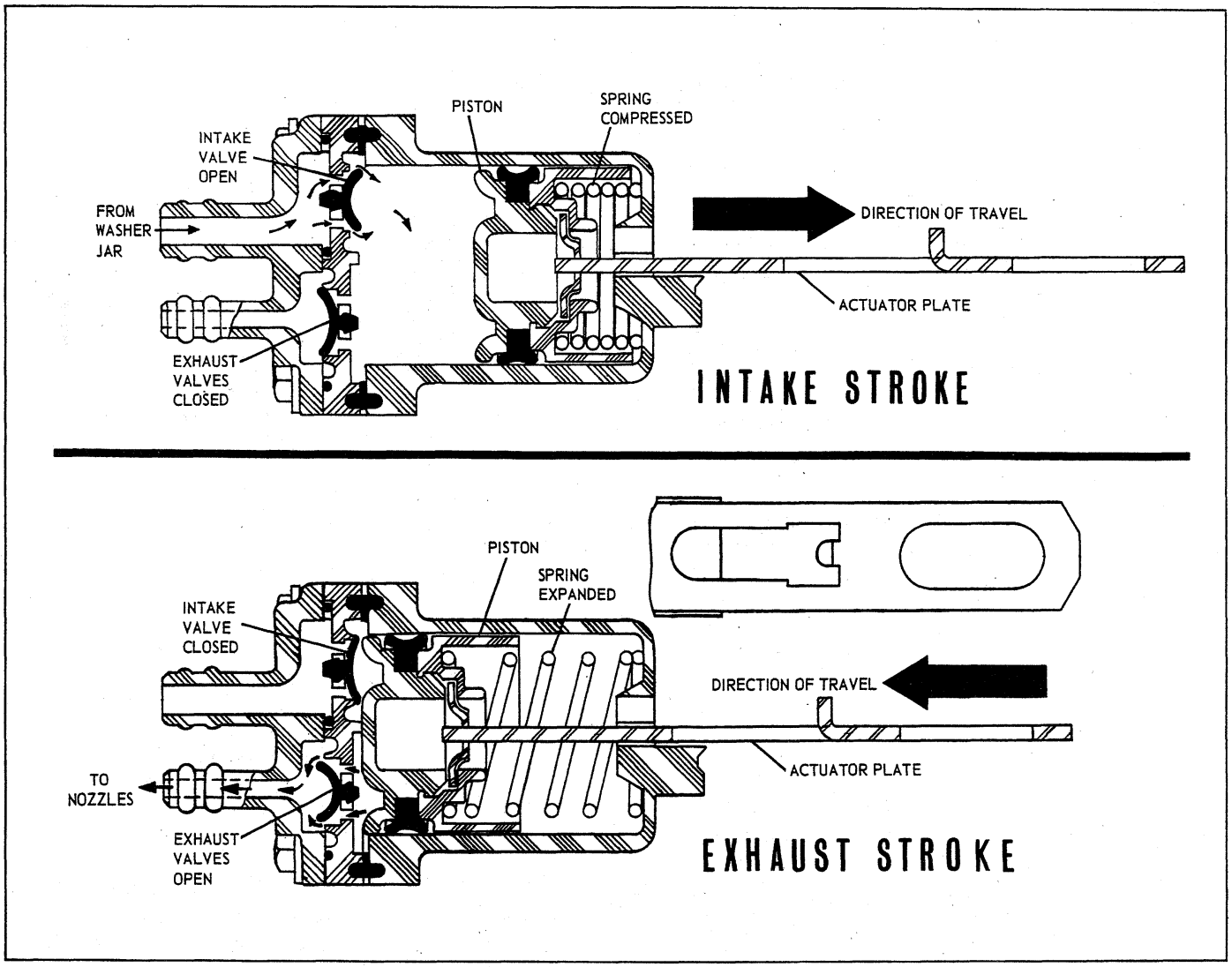


Fig. 83—Cross Section of Windshield Washer Pump Valve

panel to control assembly arms and lift panel from vehicle.

Installation

1. With actuator rod in the EXTENDED position place cover panel over actuator arms and install bushings and bolts.
2. With actuator in the closed position align vent grille to the mounting brackets and install screws retaining vent to the brackets. Connect ground cable to battery.
3. Actuate system and check both panels for alignment as follows:
   a. The cover panel to windshield adjustment is made at two stop screws "D" located on the rear outboard links of the control assembly under the cover panel. Loosen locking nuts and turn screws to adjust underside of cover panel (at reveal moulding clip) to a .060" gap at the windshield center. The adjustment stop screws seat against plastic pads mounted on top of the plenum.
   b. The grille panel has elongated screw holes allowing fore and aft adjustment.
   c. Up and down alignment of the entire control assembly with vent grille and cover panel attached is possible at the firewall mounting of the control assembly nuts "E".

Wiper Cover Panel Bumpers

Replacement

1. Remove eight screws securing vent grille and lift grille off.
2. Reaching beneath wiper cover panel, with an offset phillips head screw driver, remove and replace soft bumpers if less than 3/16" thick.
3. Install and align vent grille.

Actuator Assembly (View C)

Replacement

1. Remove vacuum hoses from the actuator assembly.
2. Loosen locking nut from turnbuckle rod nut.
3. Remove two (2) nuts, bolts, washers, and bushings attaching actuator assembly to bracket.
4. Rotate actuator assembly to remove from engine compartment.
5. Reverse removal procedure for installation.

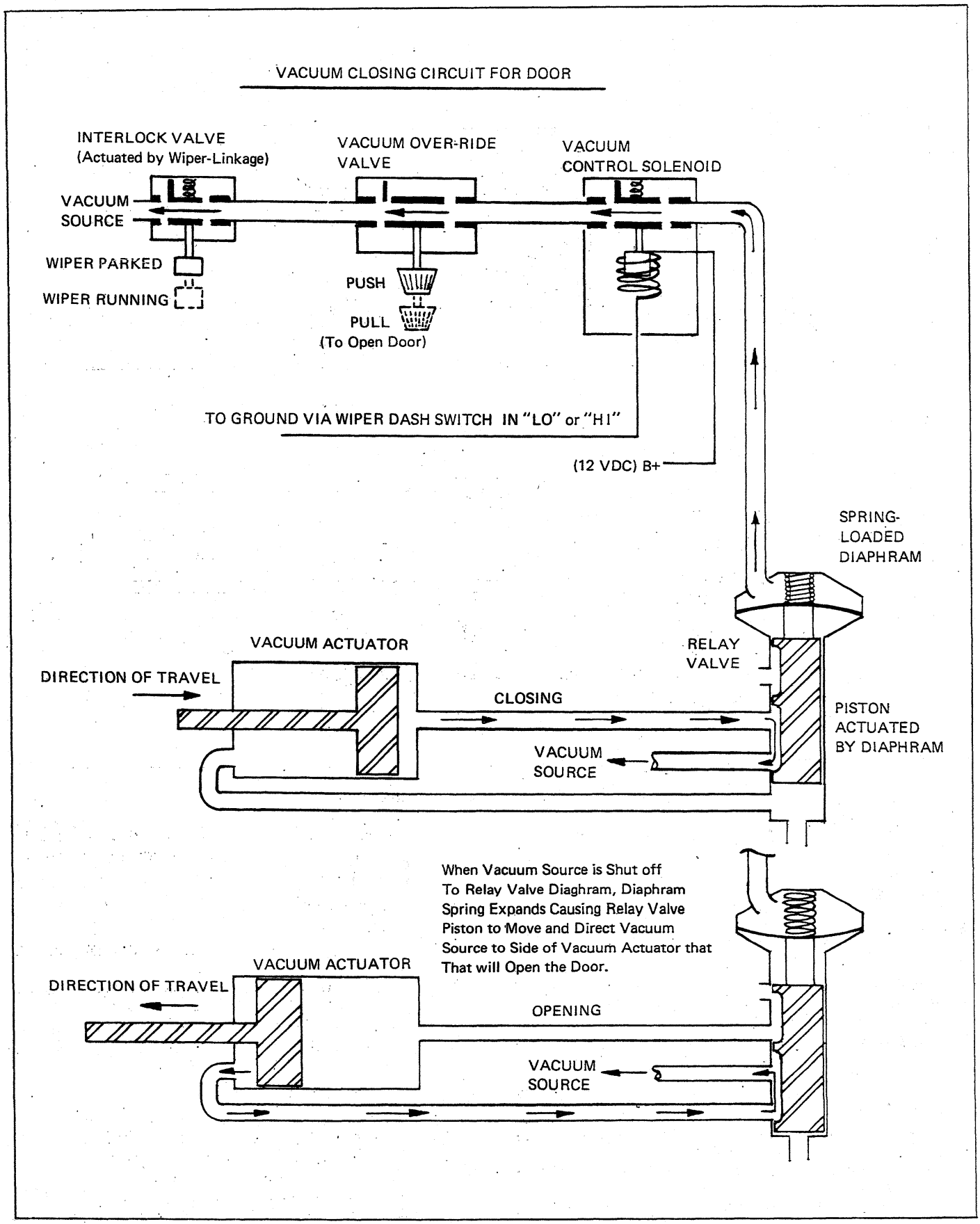


Fig. 84—Corvette Wiper Door Vacuum Diagram

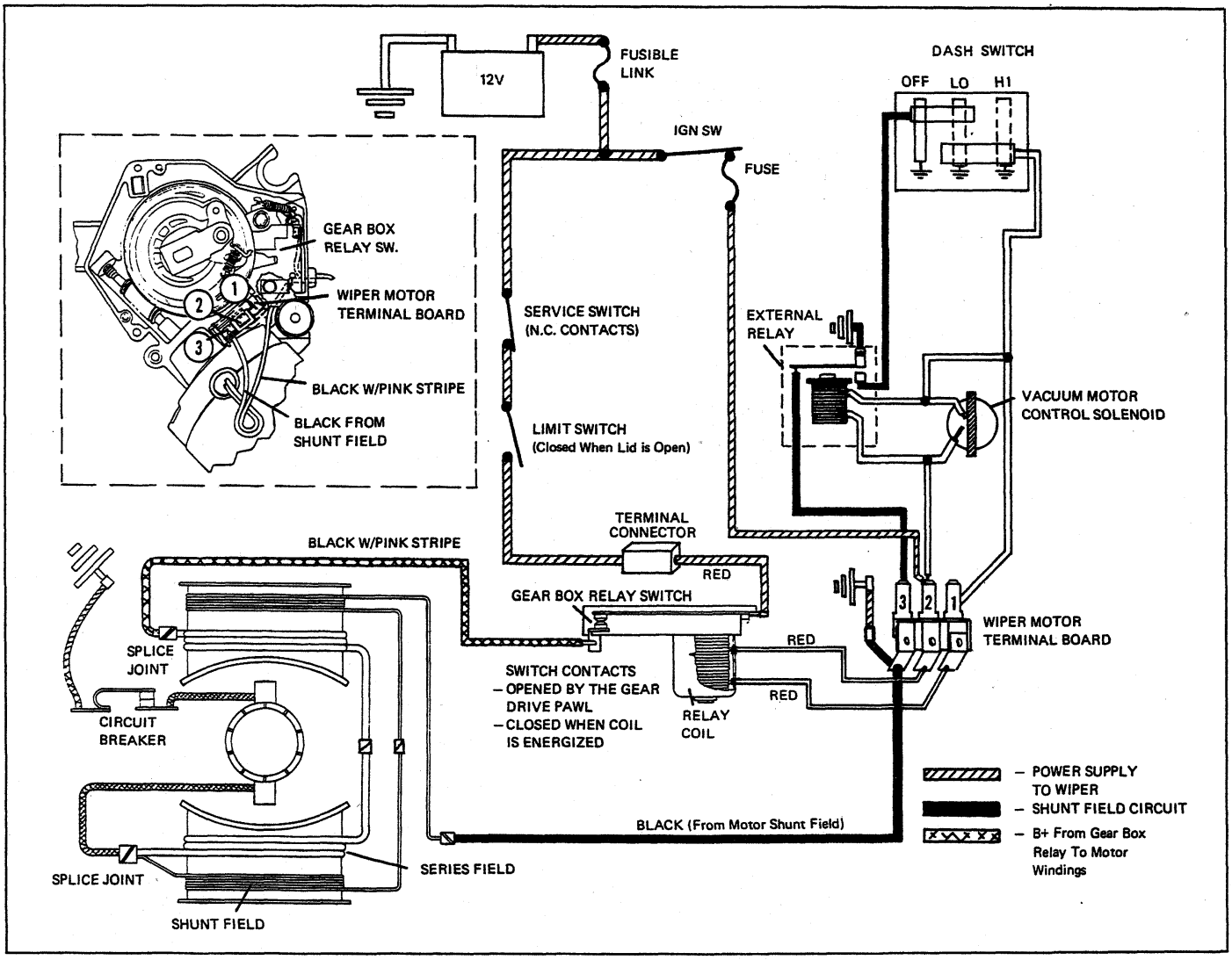


Fig. 85—Corvette Wiper Door Electrical Circuit

Limit Switch (View B)

Replacement

1. Remove eight screws located in the vent grille and lift off grille.
2. Remove bolt and bushing from rod.
3. Remove two bolts retaining bracket-to-plenum panel and remove assembly.
4. Remove bolt retaining switch to assembly and remove switch.
5. Reverse procedure for installation.

Control Assembly

Replacement

1. Remove eight screws securing vent grille and lift grille off.
2. Remove screw and bushings (View B) securing limit switch link to control assembly.
3. Remove wiper cover panel actuator as previously described.
4. Remove four nuts and reinforcements from outboard studs on control assembly mounted to firewall.
5. Rotate entire control assembly, including wiper cover panel, forward and up for removal and further bench disassembly.
6. Reverse removal procedure for installation.
7. Vent grille and cover panel vertical alignment to fenders is possible at nuts "E". Cover panel to windshield gap of .060" is adjusted at screws "D".

Vacuum Relay (View A)

Replacement

1. Remove screws securing wiper vacuum relay to inner fender panel.
2. Transfer four hoses from removed relay to new relay. Note hose color stripe and match letter on pipe of relay (G-Green, Y-Yellow, R-Red).

Manual Overide Vacuum Switch

For opening wiper cover panel located beneath steering column.

Replacement

1. Remove screw retaining switch and push switch rearward to release from bracket.
2. Transfer vacuum joses to new switch.
3. Place new switch in position and secure with screw.

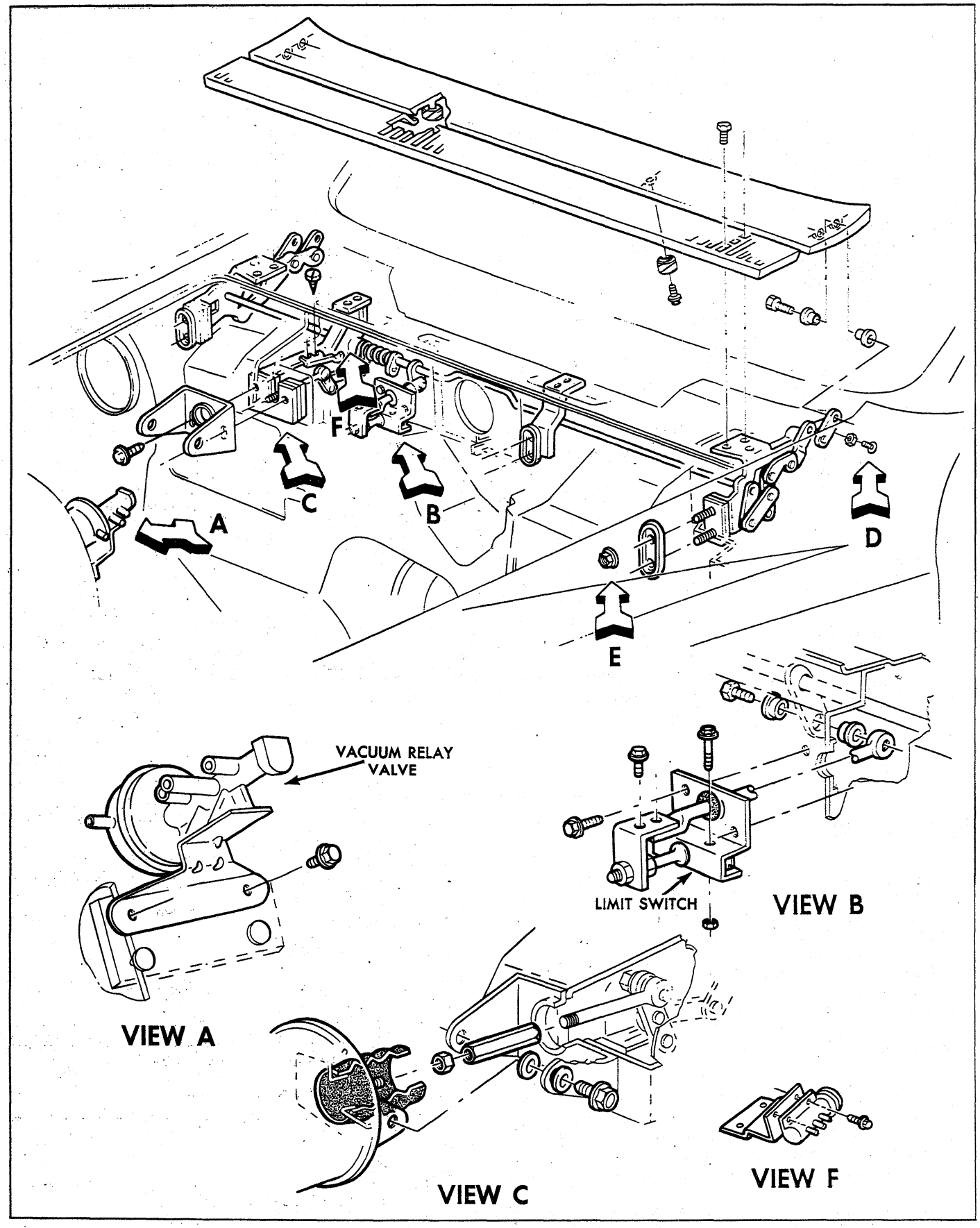


Fig. 86—Corvette Wiper Cover Panel System

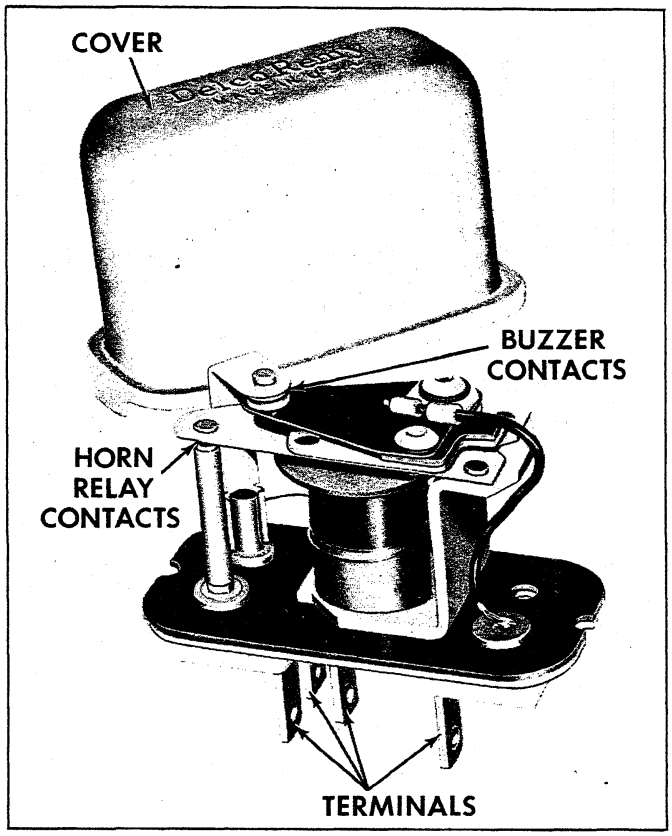


Fig. 87—Horn Relay Buzzer

Interlock Valve (View F)

Replacement

1. Raise cover panel by vacuum or remove eight (8) screws securing vent grille.
2. Remove 3 hoses and 2 screws from interlock switch and lift off.
3. Install new switch, secure with washers and screws and attach hoses.
4. Reinstall grille or actuate cover closed.

Vacuum Control Solenoid

Replacement

1. Disconnect ground cable from battery.
2. Lower steering column, See Section 9.
3. Remove screws and washers securing left instrument panel to door, opening, top of dash and left side of center instrument panel.
4. Unclip and remove floor console left forward trim panel.
5. Pull cluster slightly forward for access to solenoid valve mounted on rear of tachometer housing.
6. Remove and replace solenoid valve and reinstall cluster in reverse order of removal.

HORN RELAY-BUZZER (Figs. 87, 88) (Theft Deterrent System)

The horn relay-buzzer is constructed to incorporate both the horn relay and reminder buzzer into one assembly. A typical assembly is shown in Figure 87.

Buzzer Operation

The horn relay-buzzer operates when the driver's door is opened to remind the vehicle driver that the ignition key has been left in the switch. A typical circuit is shown in Figure 88. The operation is explained as follows:

With the key fully inserted into the ignition switch, the No. 4 terminal on the horn relay-buzzer is connected to ground through the door switch when the driver's door is opened. Current then flows from the battery through the coil winding, the buzzer contacts, the ignition switch, and door switch to ground. The winding magnetism causes the buzzer contacts to open, which opens the winding circuit, and the contacts then re-close. This cycle then repeats many times per second to give the buzzing sound. Closing the door, or removing the key, will stop the buzzer action.

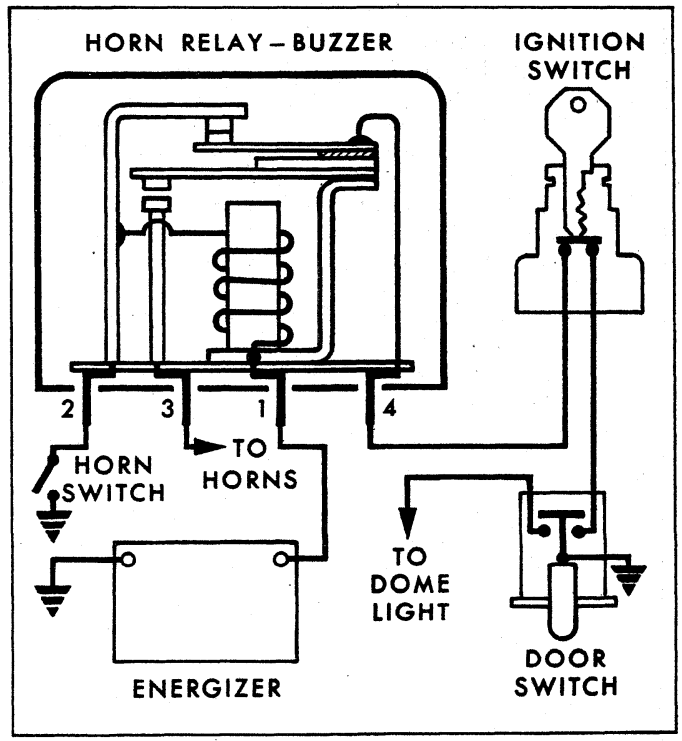


Fig. 88—Wiring Schematic - Horn Relay-Buzzer

Horn Operation

When the horn switch is closed, the coil winding is connected to ground, and the armature moves toward the core to close the horn relay contacts. The horns are then connected to the battery, and operate accordingly. With the horn switch closed, the buzzer contacts remain separated. The horn relay-buzzer can be checked.

Although the terminal type and location may vary between models, the numerical designation on all models is standardized. When making electrical checks for improper operation, proceed as follows:

Buzzer Check:

1. Insure that the key is fully inserted into the ignition switch.
2. Open the driver's door, and observe the dome lamp.
3. If both the dome lamp and buzzer fail to operate, check the door switch for defects.

4. If the dome lamp is on, but the buzzer fails to operate, remove the horn relay-buzzer from its mounting and identify the No. 1 and No. 4 terminals.
5. Connect a jumper lead from the No. 4 terminal to ground. Slide a prod into the wiring harness connector to make contact if the terminals are of the slip-on type.
6. If now the buzzer operates, check the ignition switch wiring and ignition switch for defects.
7. If the buzzer does not operate, connect a voltmeter from the No. 1 terminal to ground.
8. If the reading is zero, the circuit is open between this point and the battery.
9. If a voltage reading is obtained, replace the horn relay-buzzer.

Horn Relay Check:

1. Remove the horn relay-buzzer from its mounting, and identify the No. 2 and No. 3 terminals.
2. Connect a jumper from the No. 2 terminal to ground. Slide a prod into the wiring harness connector to make contact if the terminals are of the slip-on type.
3. If the horns operate, check the No. 2 terminal wire and horn switch for defects.
4. If the horns do not operate, leave the No. 2 terminal connected to ground, and connect a voltmeter from the No. 3 terminal to ground.
5. If a reading is obtained, check the horn wiring and horns for defects.
6. If no reading is obtained, replace the horn relay-buzzer.

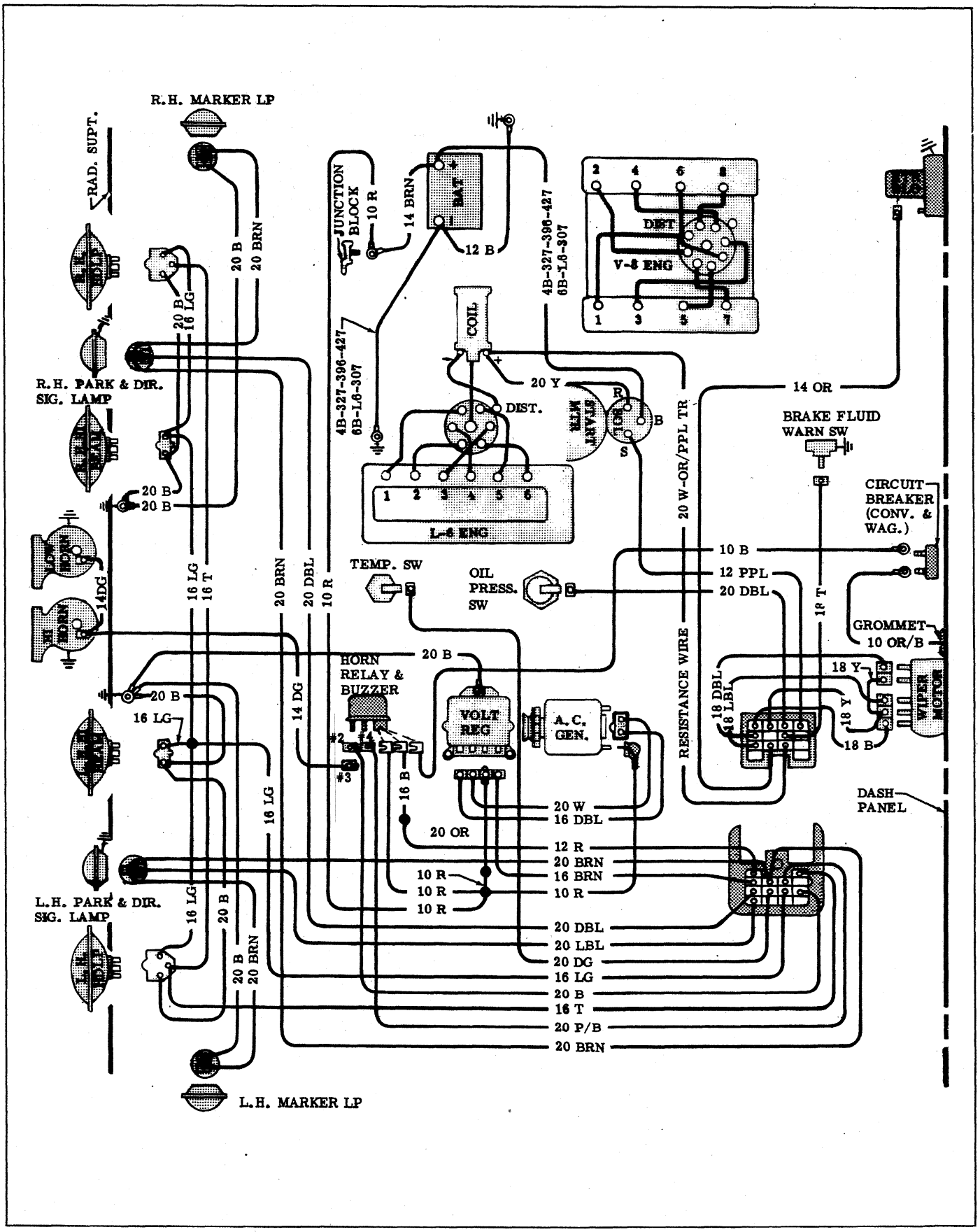


Fig. 89—Front Lighting & Engine Compartment—Chevrolet

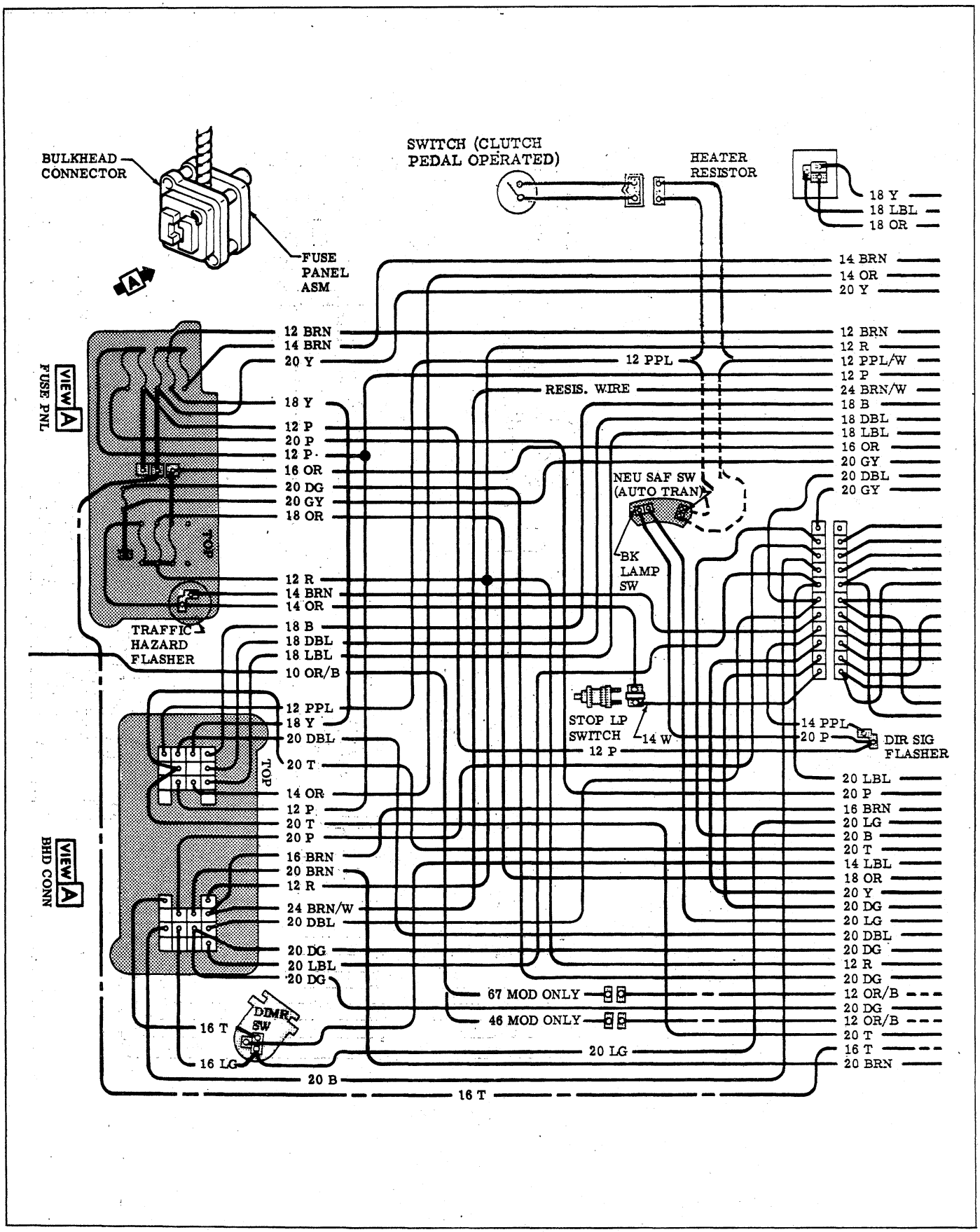


Fig. 90—Fuse Panel - Chevrolet

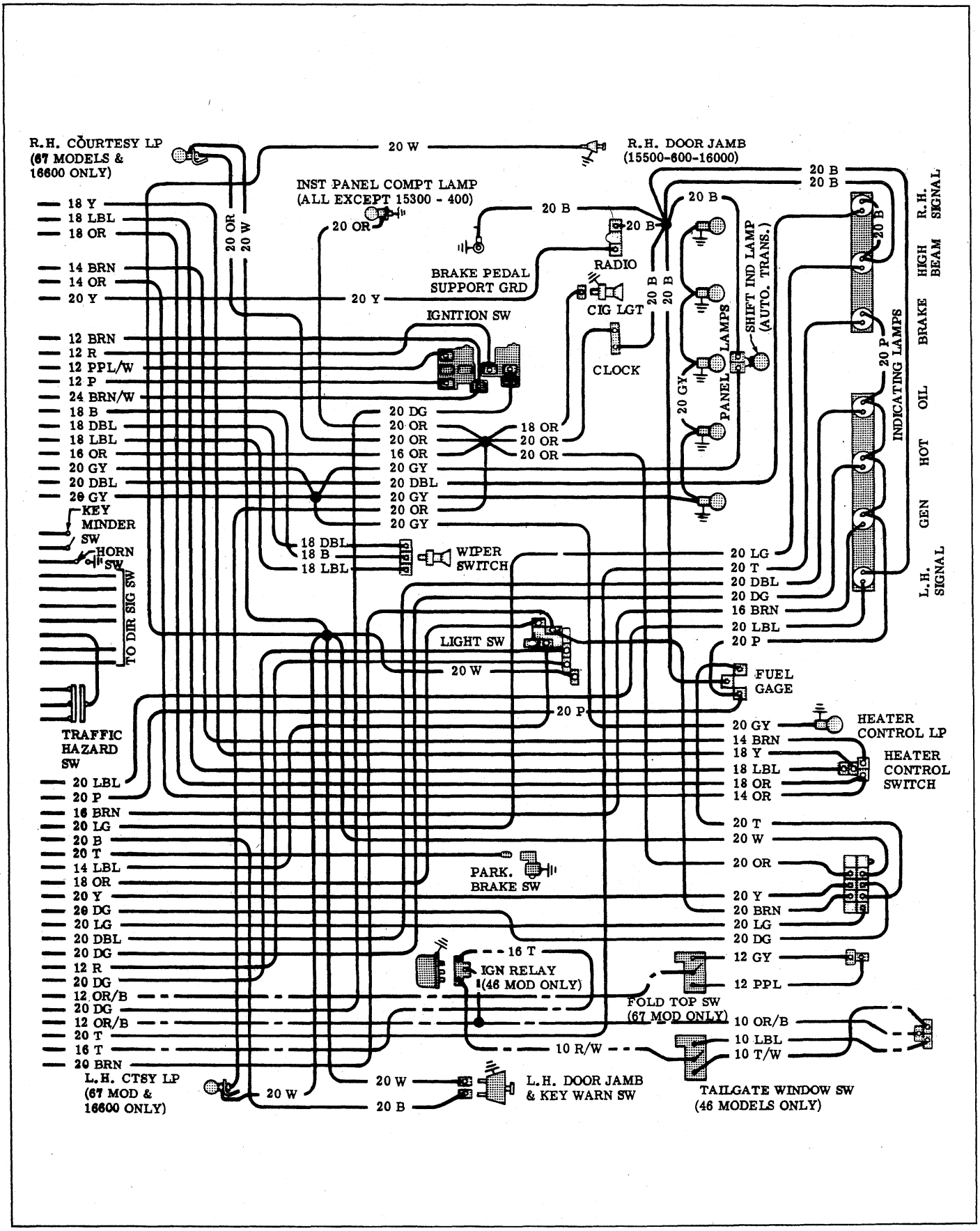


Fig. 91—Instrument Panel - Chevrolet

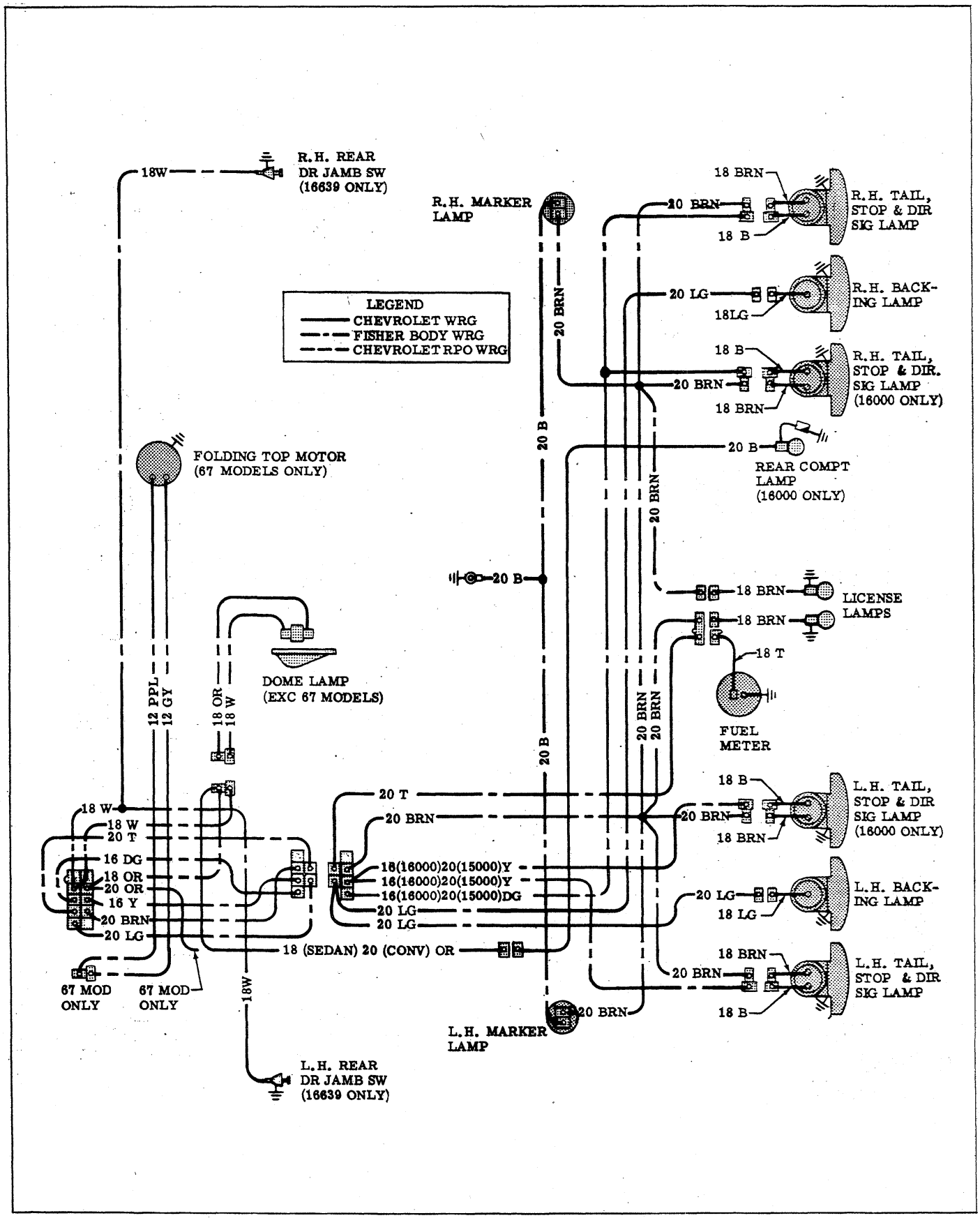


Fig. 92—Body and Rear Lighting (Exc. Wagon) Chevrolet

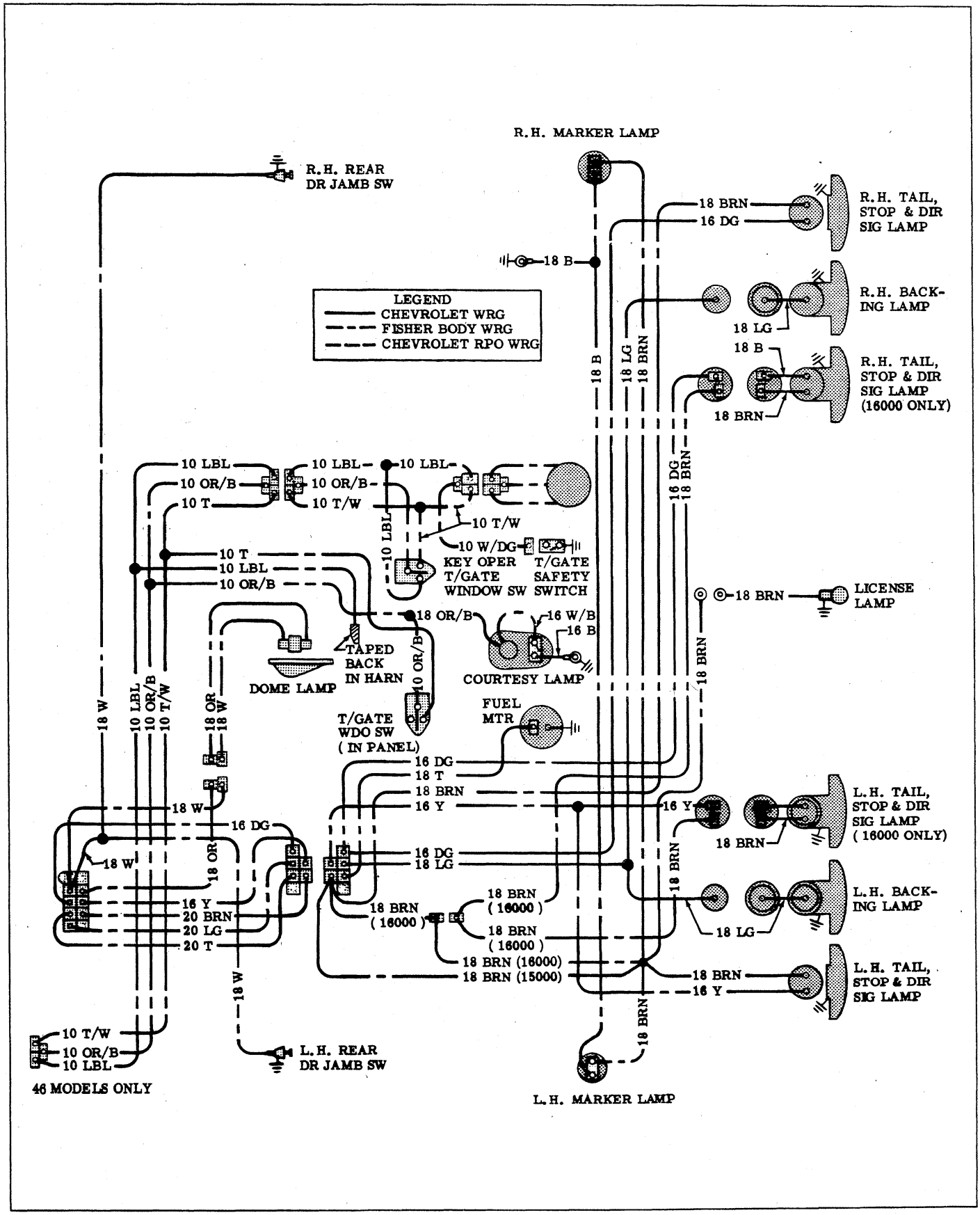


Fig. 93—Body and Rear Lighting (Wagon) - Chevrolet

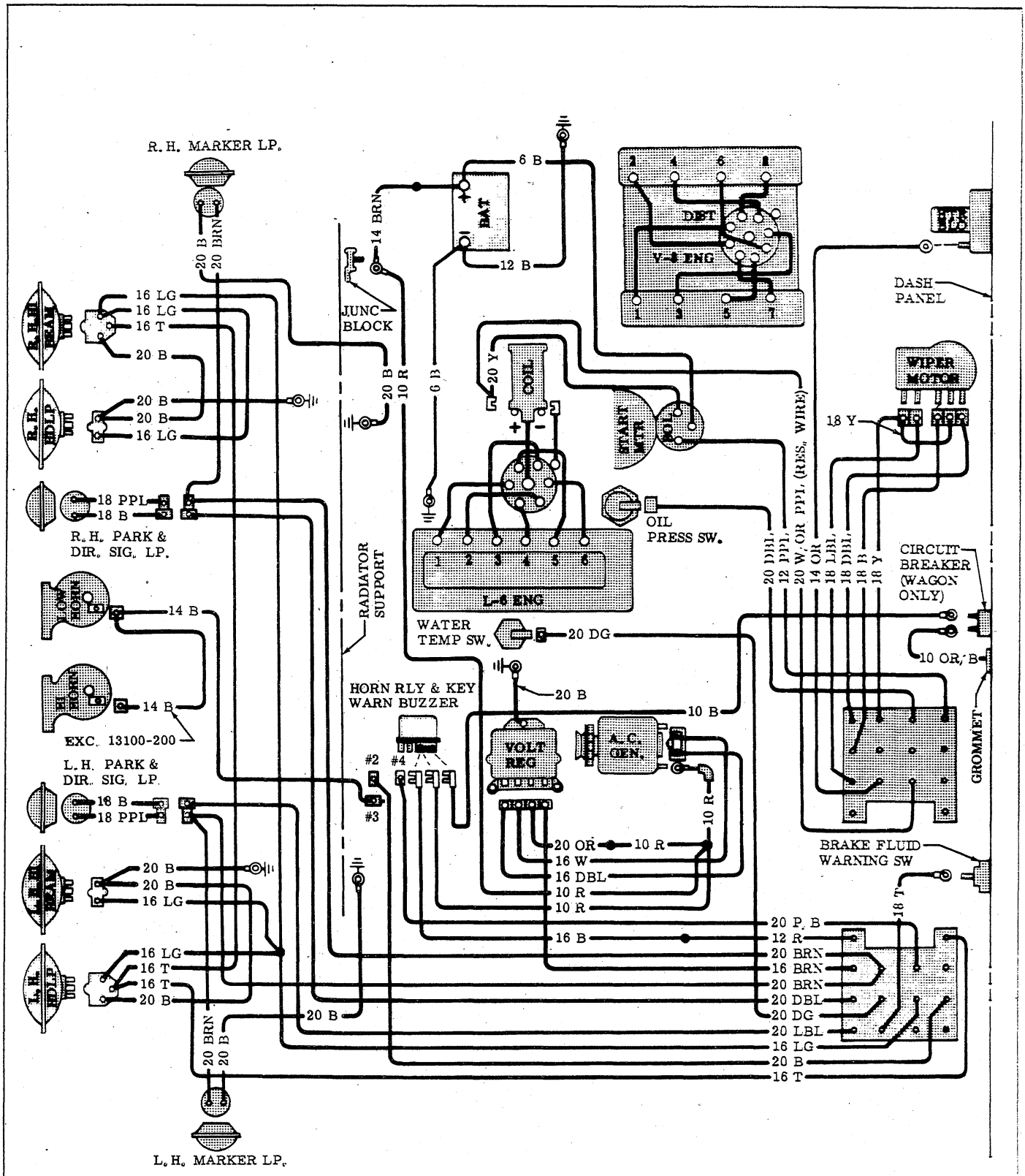


Fig. 94—Front Lighting and Engine Compartment - Chevelle

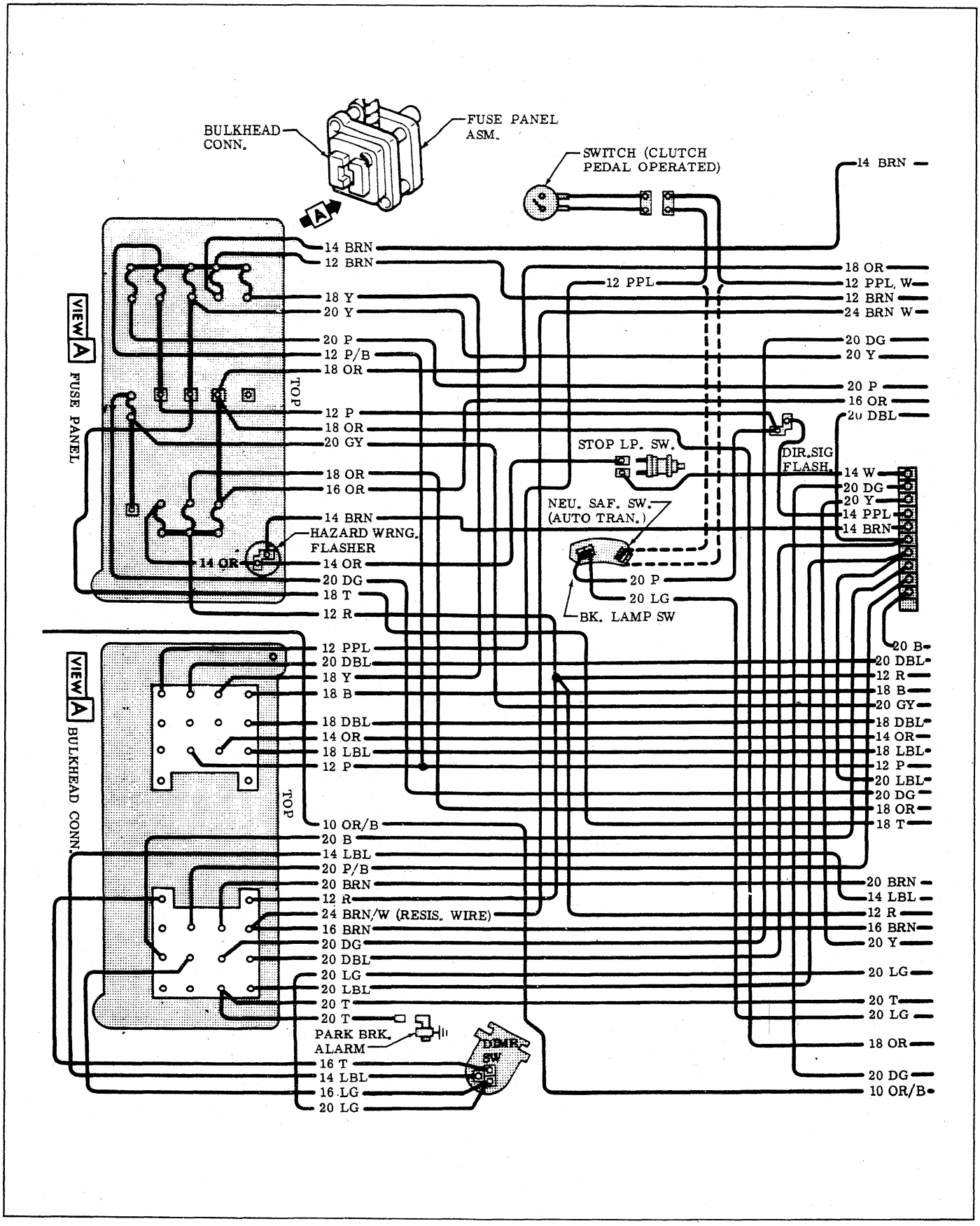


Fig. 95—Fuse Panel - Chevelle

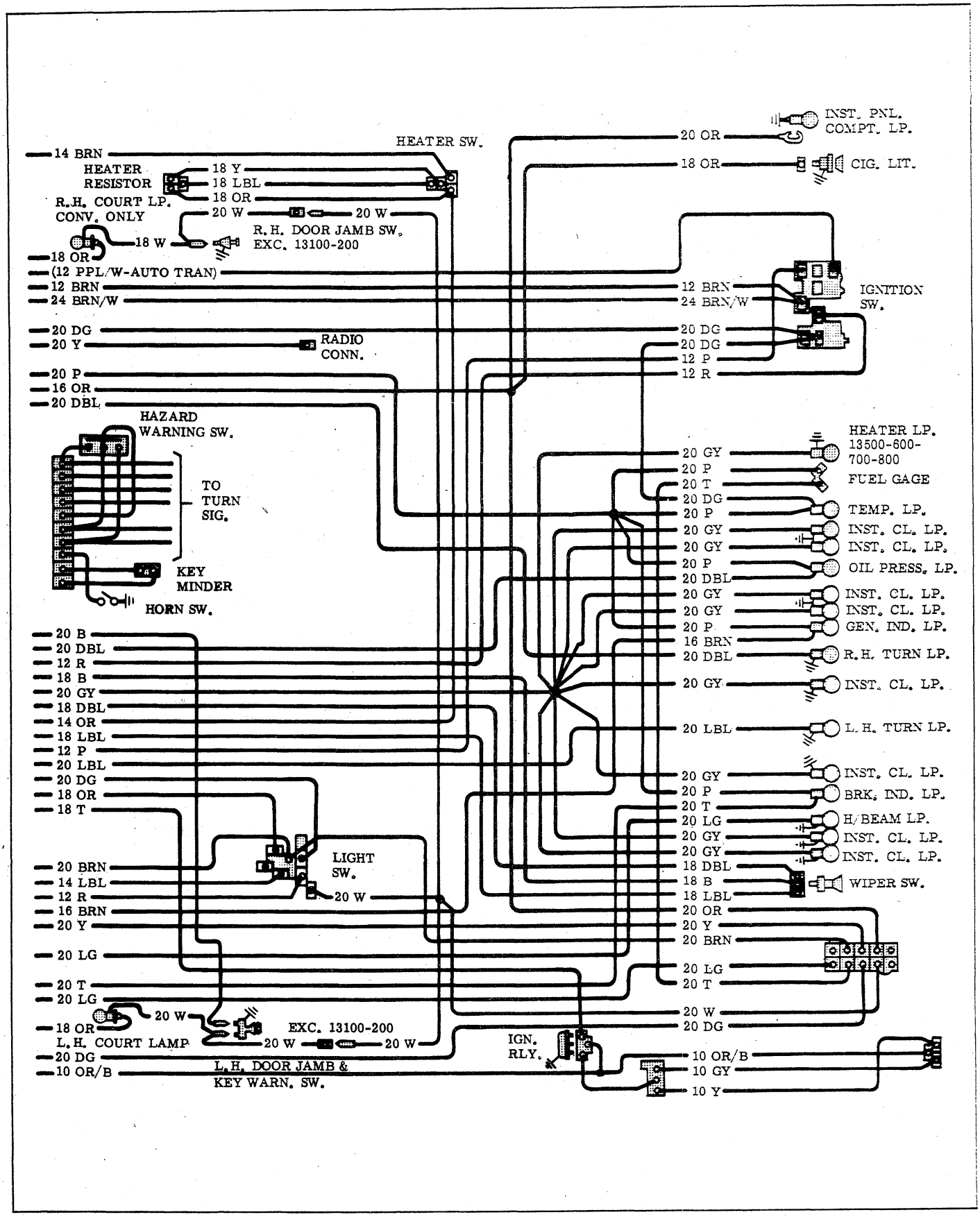


Fig. 96—Instrument Panel - Chevelle

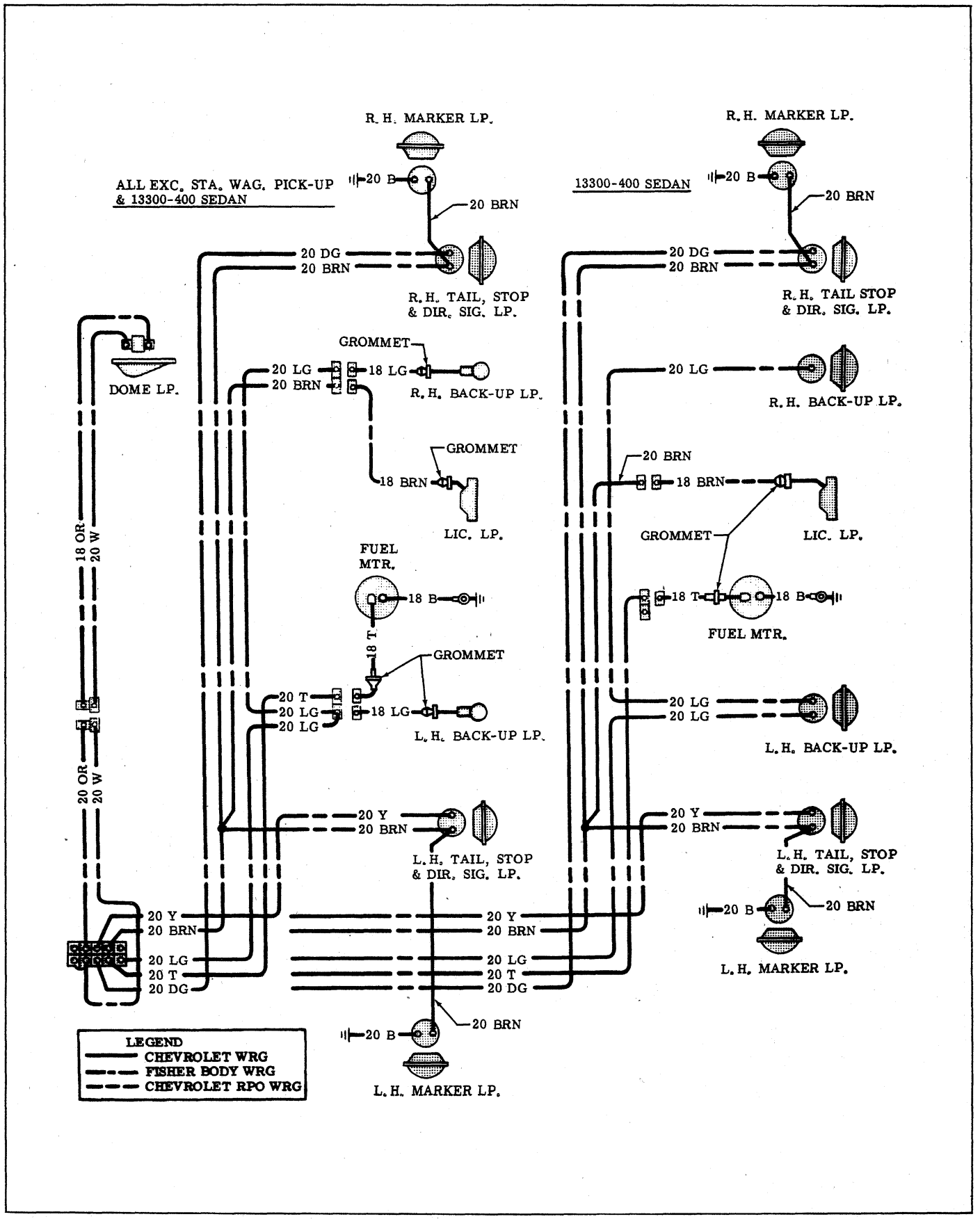


Fig. 97—Body & Rear Lighting (Exc. P.U. & Wagon) - Chevelle

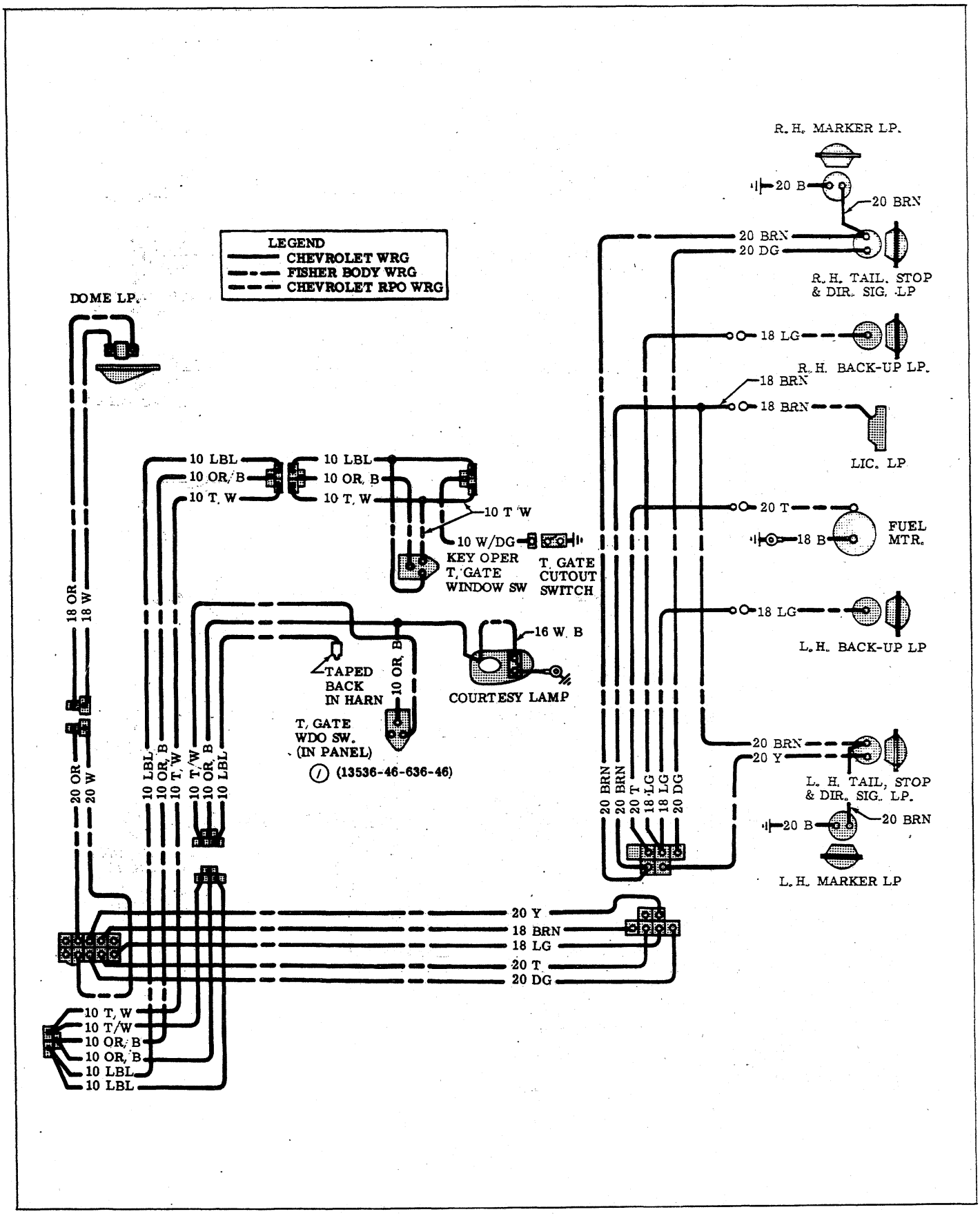


Fig. 98—Body & Rear Lighting (Wagon) - Chevelle

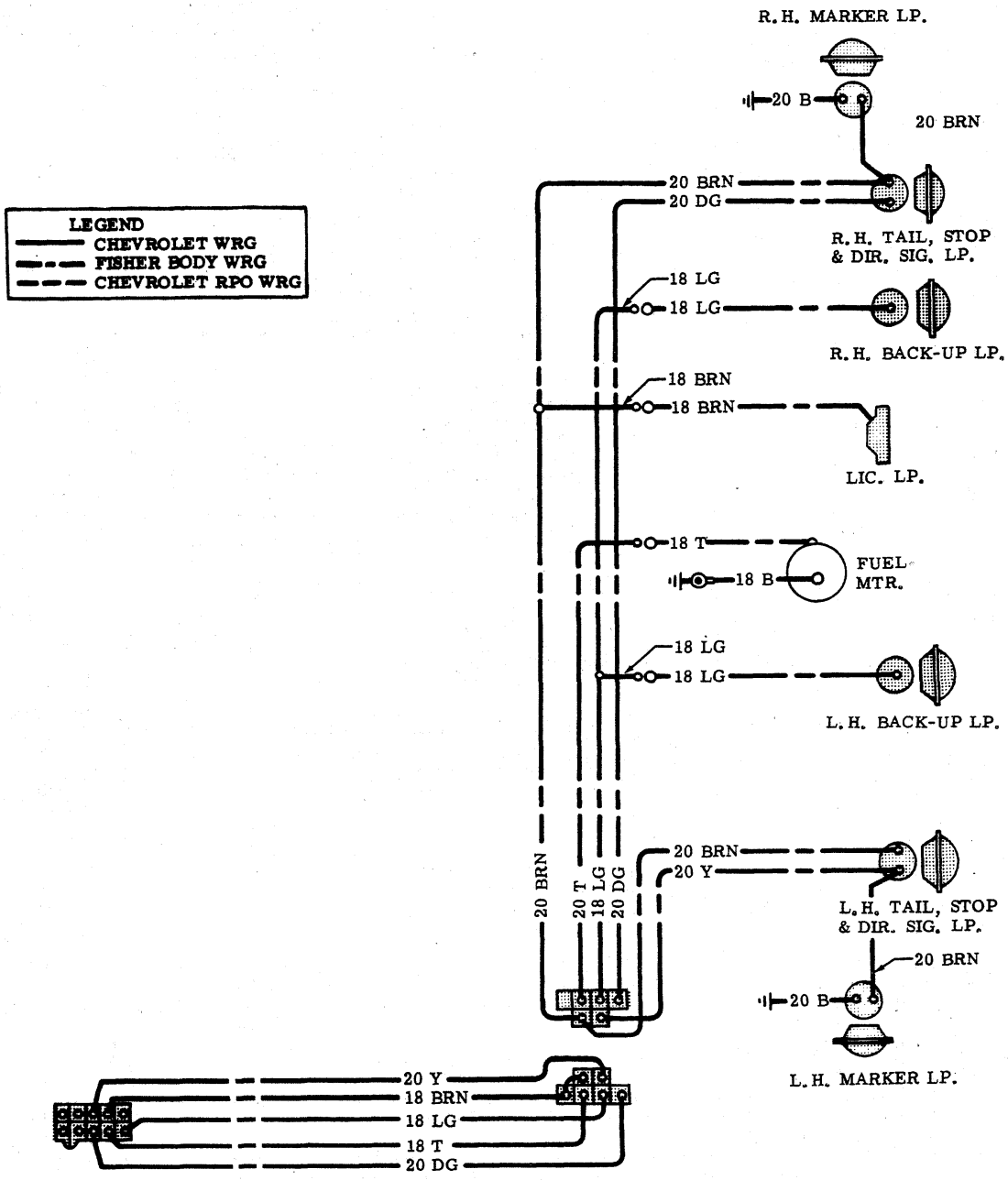


Fig. 99—Body & Rear Lighting (Pick-Up) - Chevelle

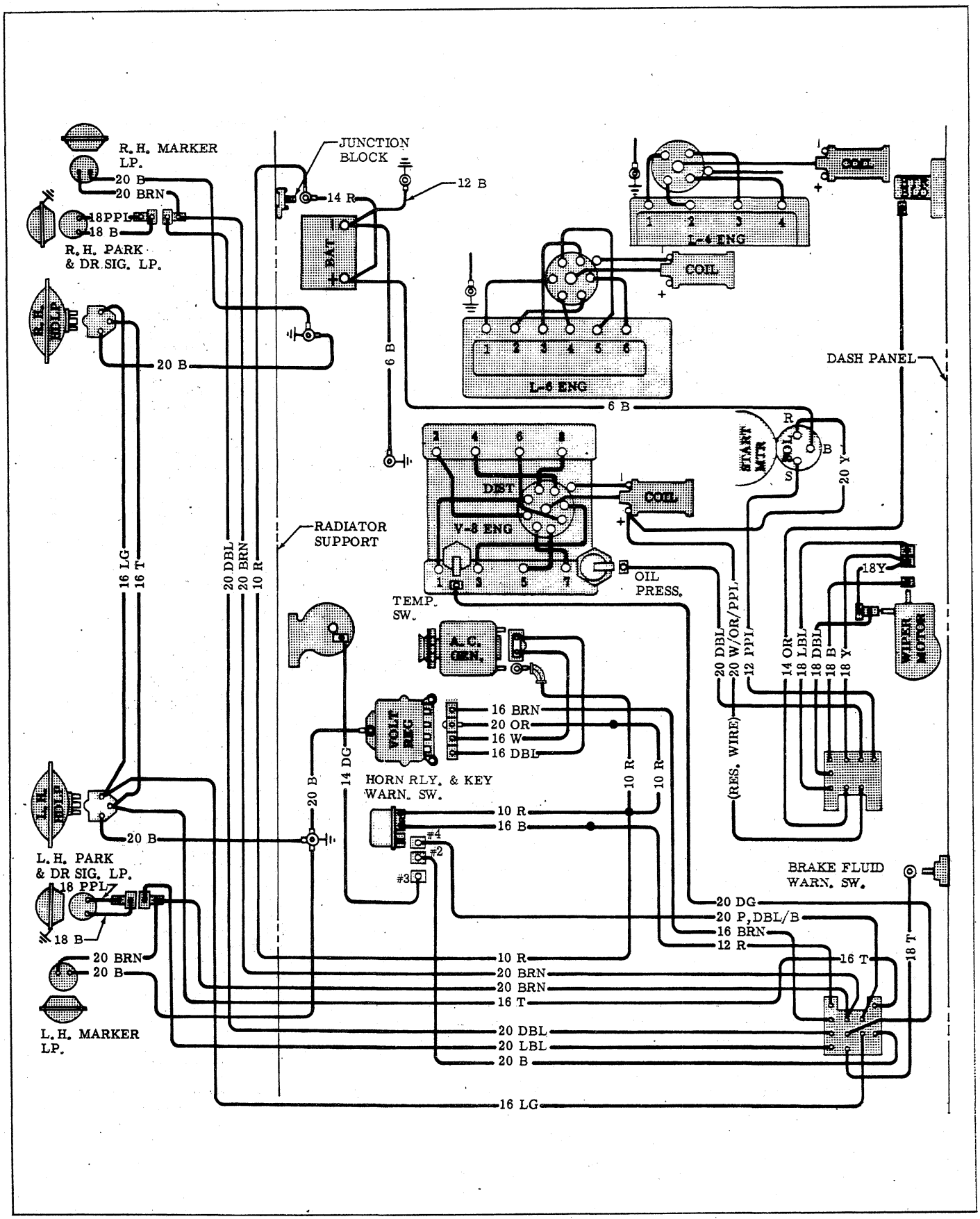


Fig. 100—Front Lighting & Engine Compartment - Nova

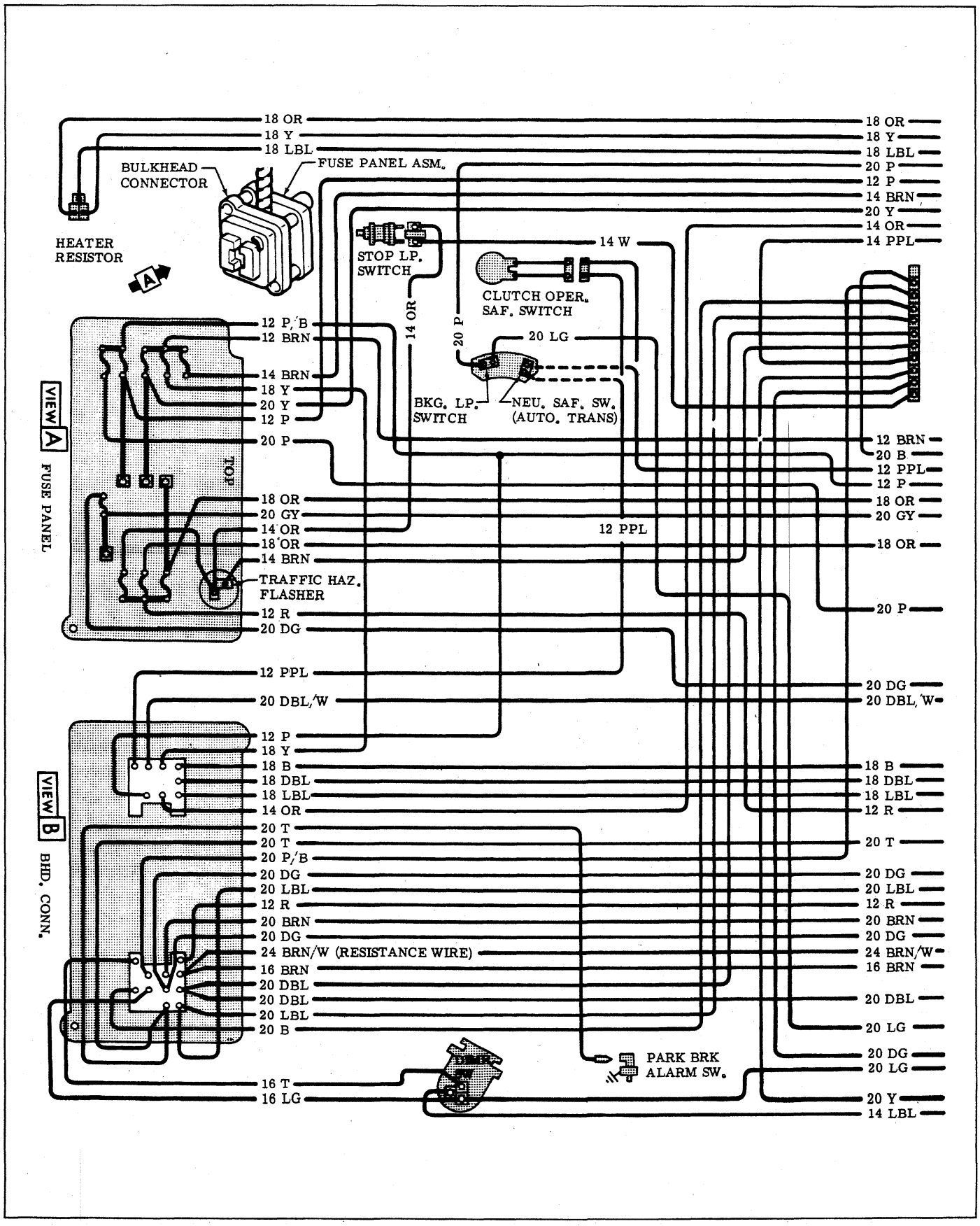


Fig. 101—Fuse Panel - Nova

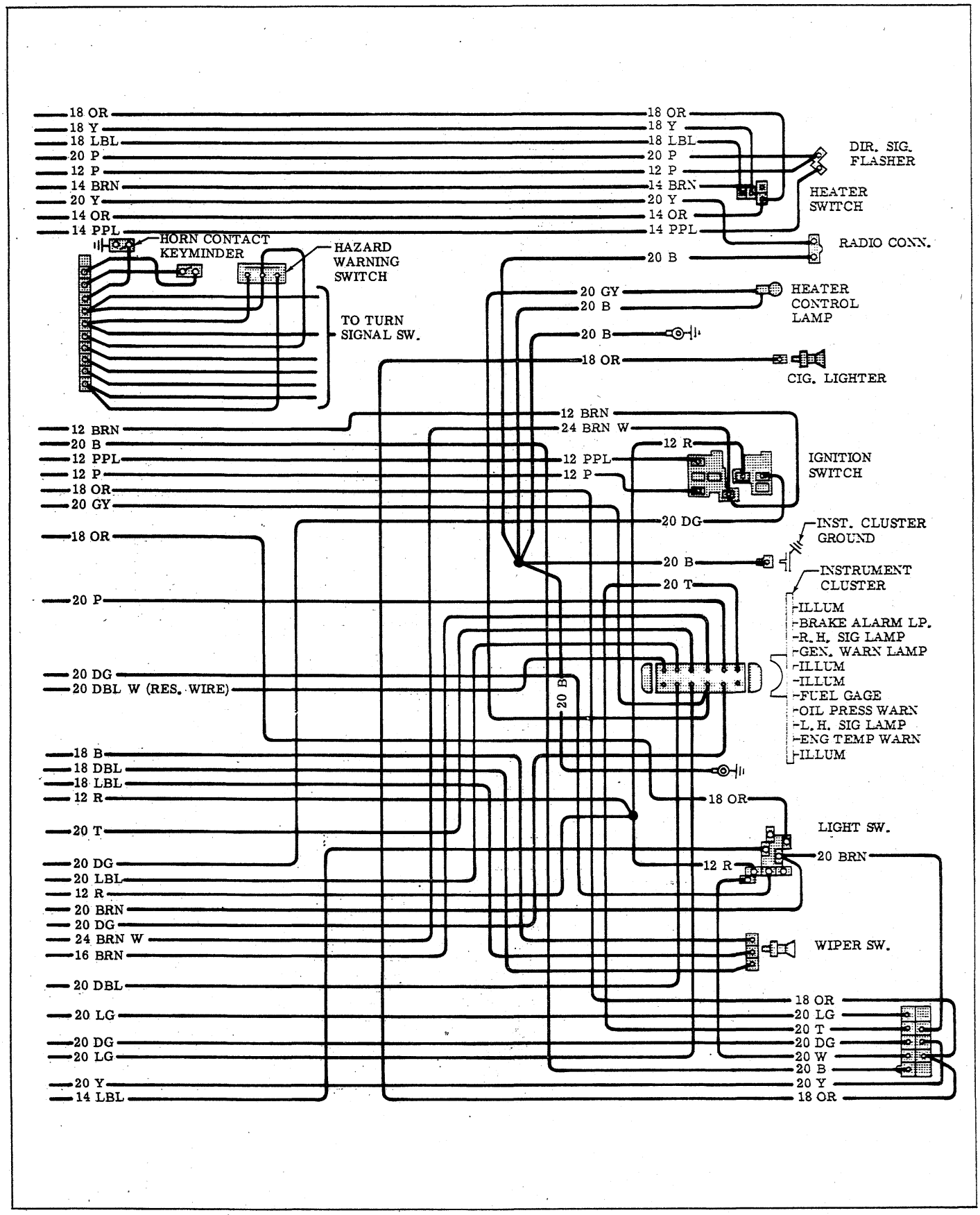


Fig. 102—Instrument Panel - Nova

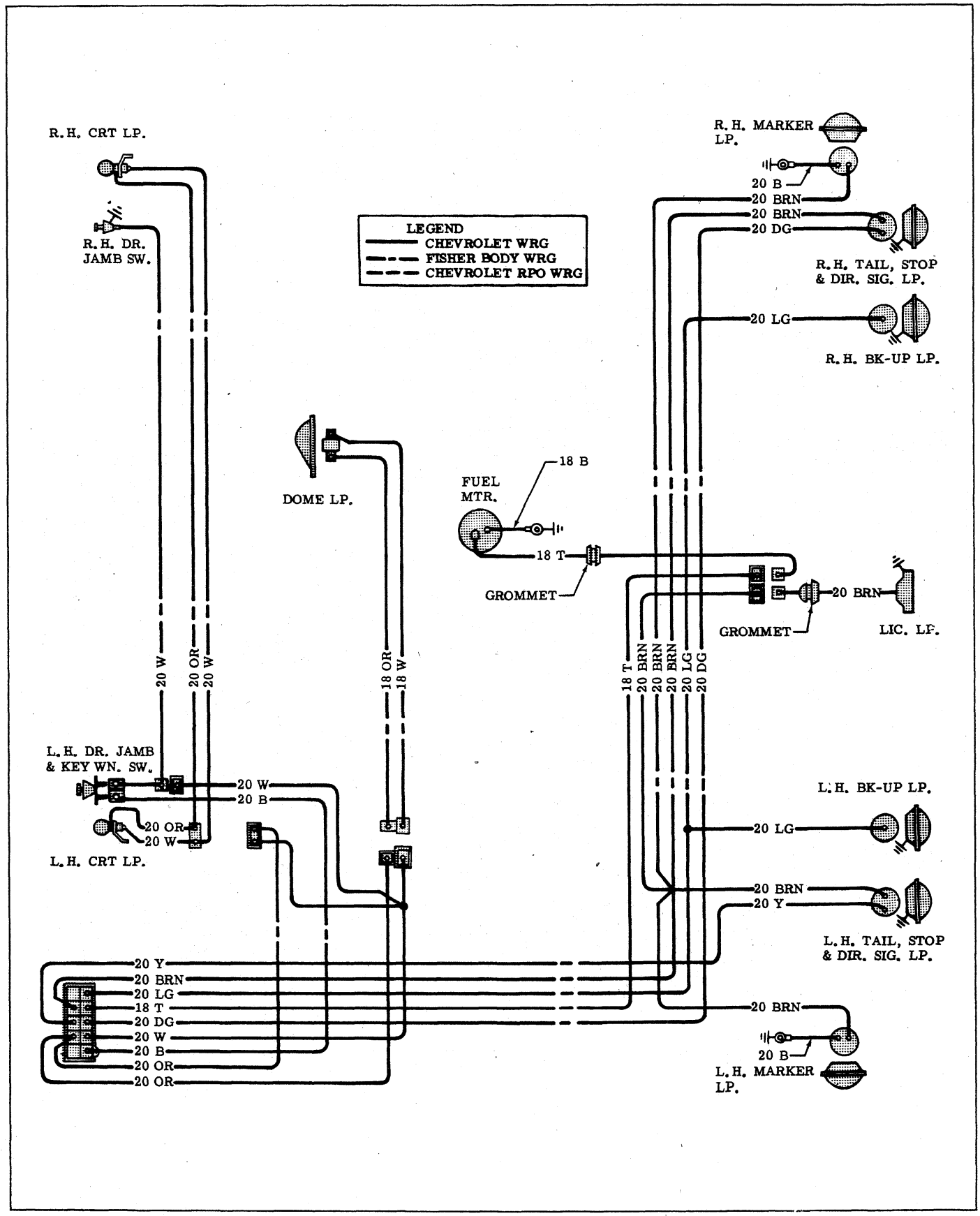


Fig. 103—Body & Rear Lighting - Nova

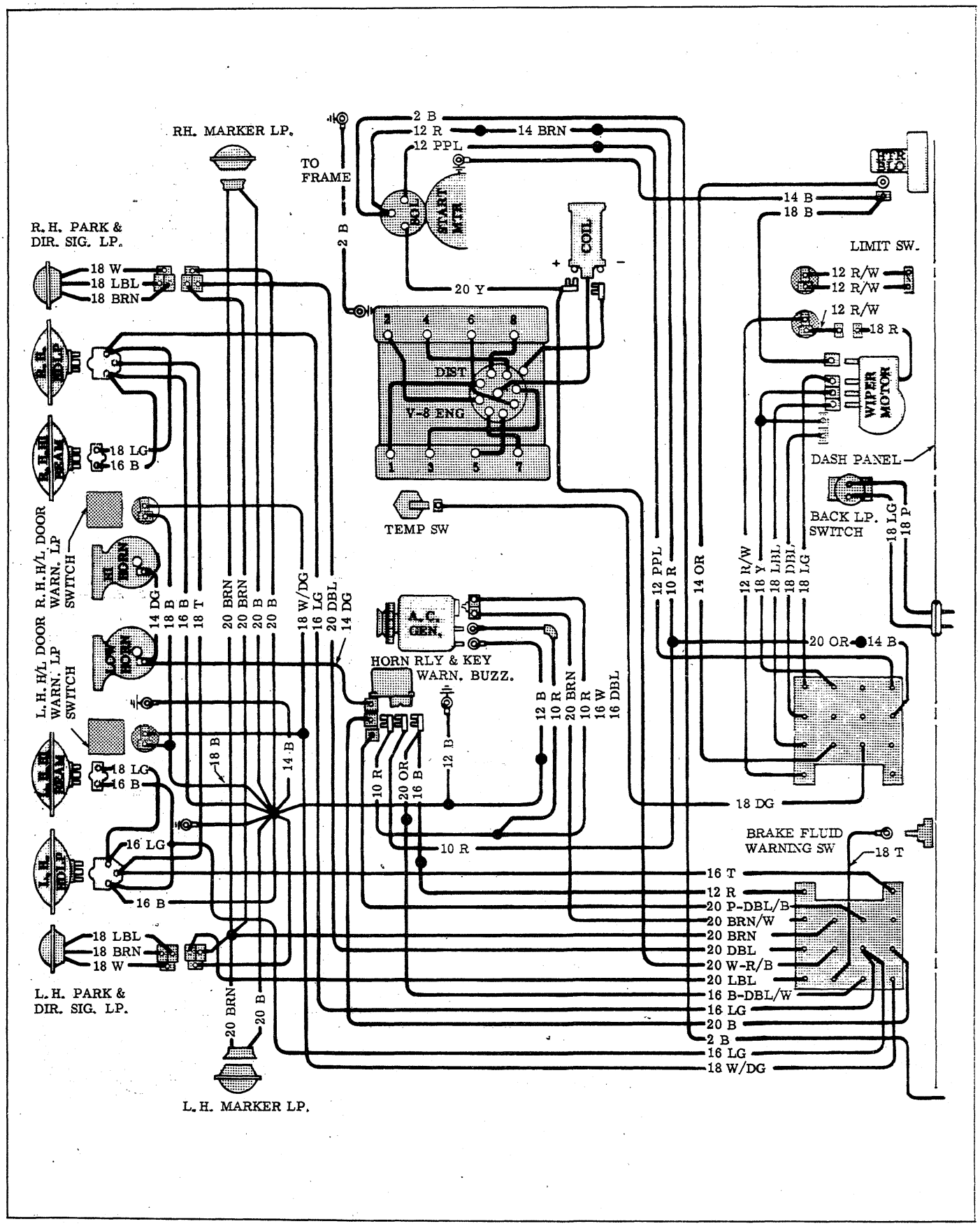


Fig. 104—Front Lighting and Engine Compartment - Corvette

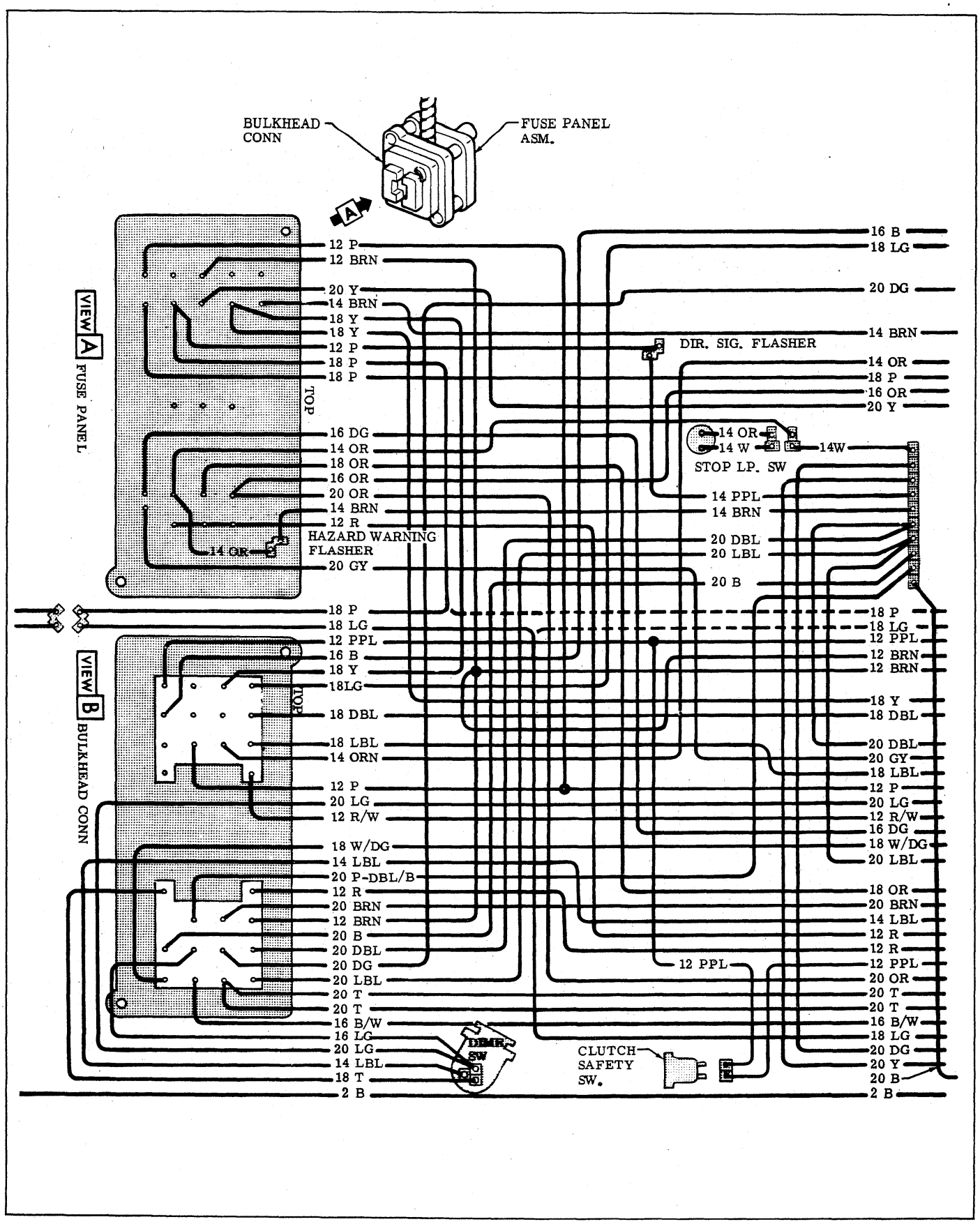


Fig. 105—Fuse Panel - Corvette

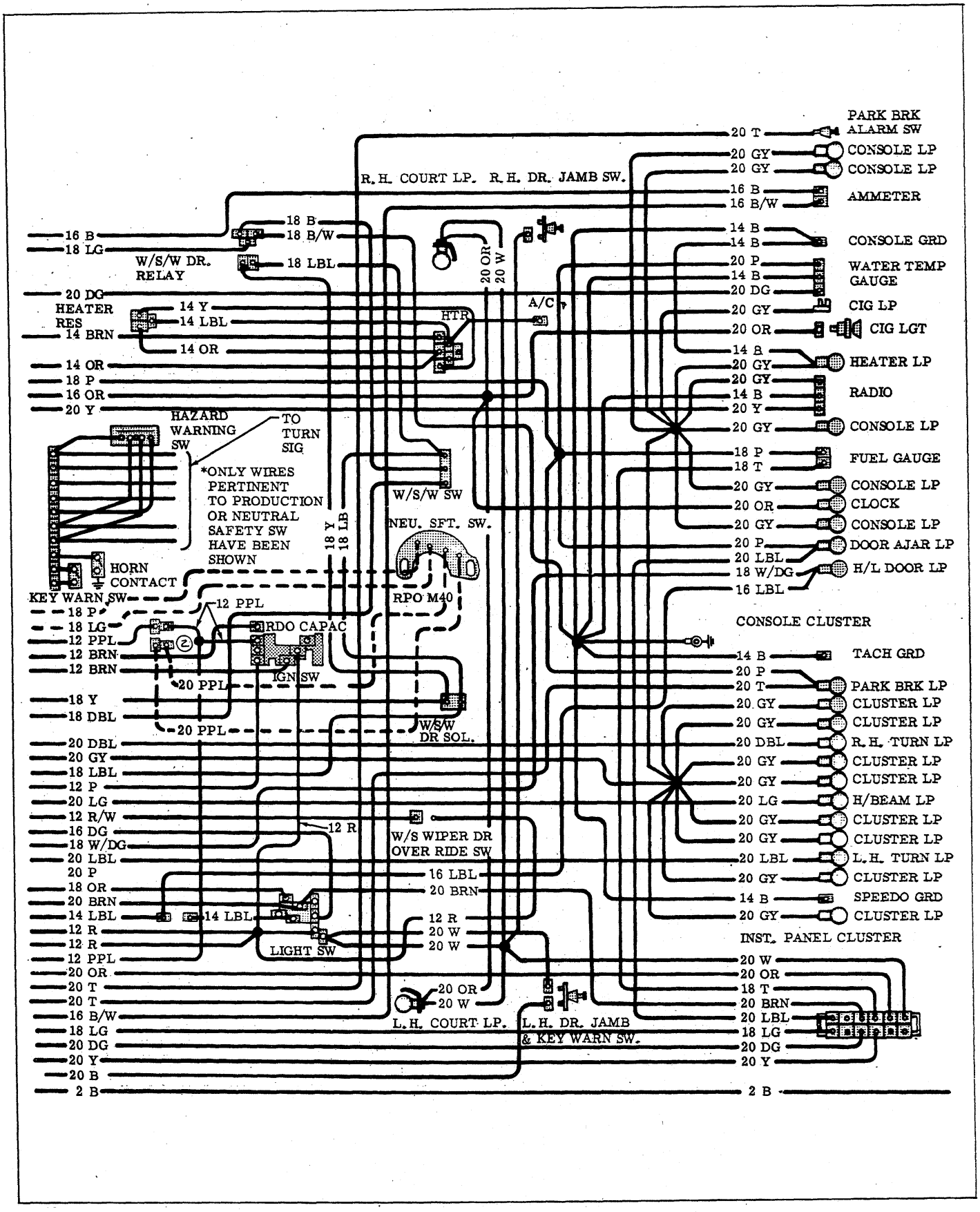


Fig. 106—Instrument Panel - Corvette

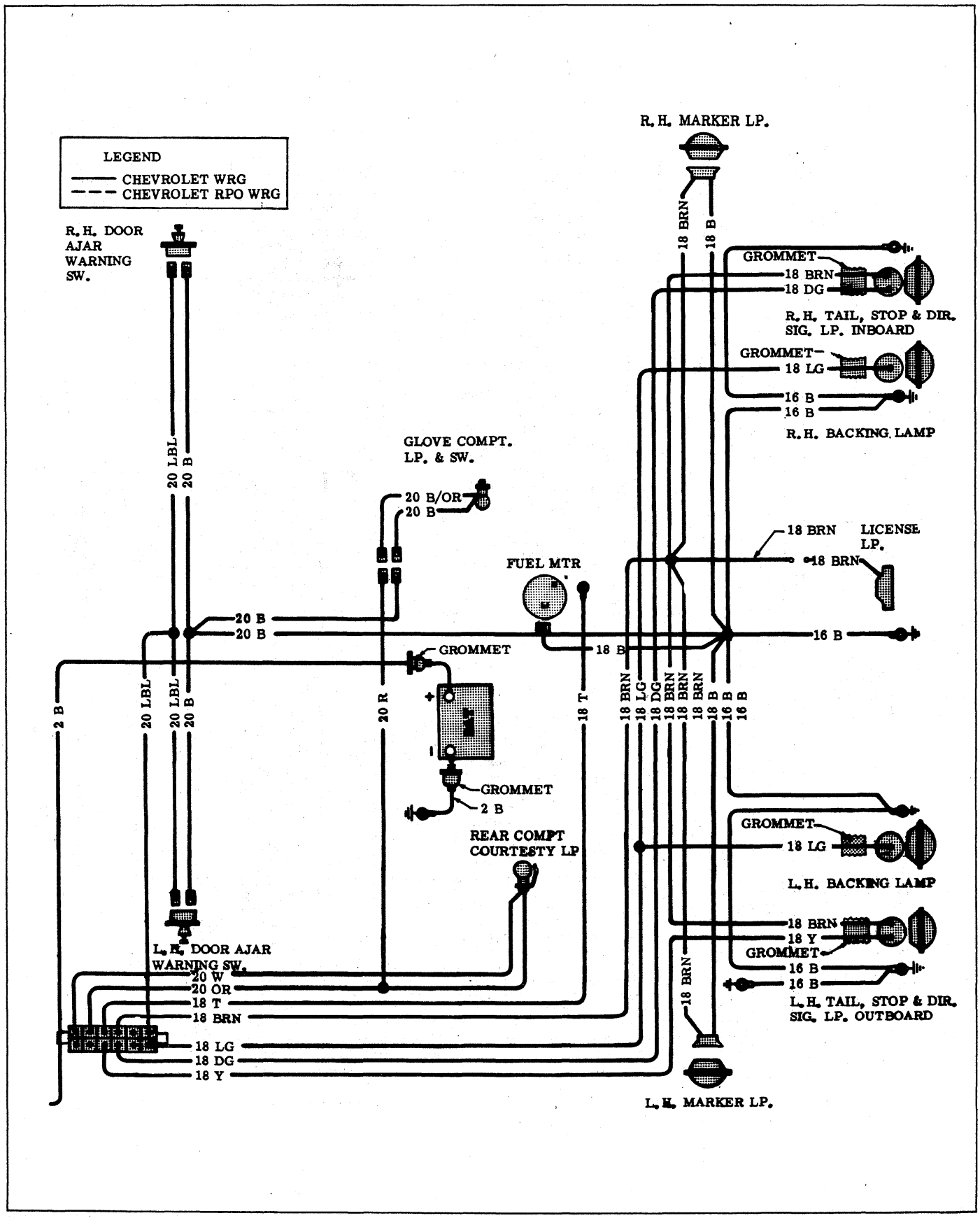


Fig. 107—Body & Rear Lighting - Corvette

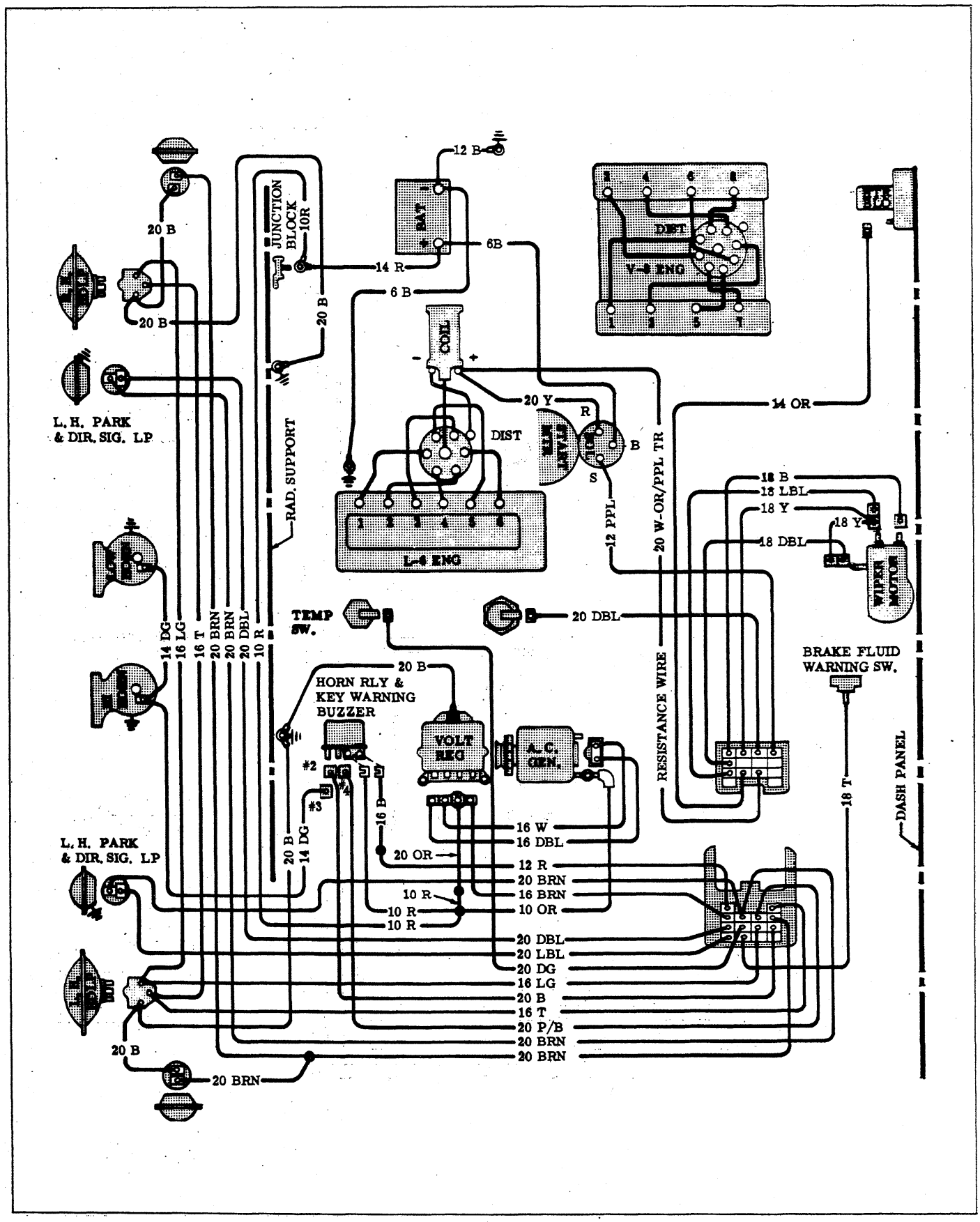


Fig. 108—Front Lighting & Engine Compartment - Camaro

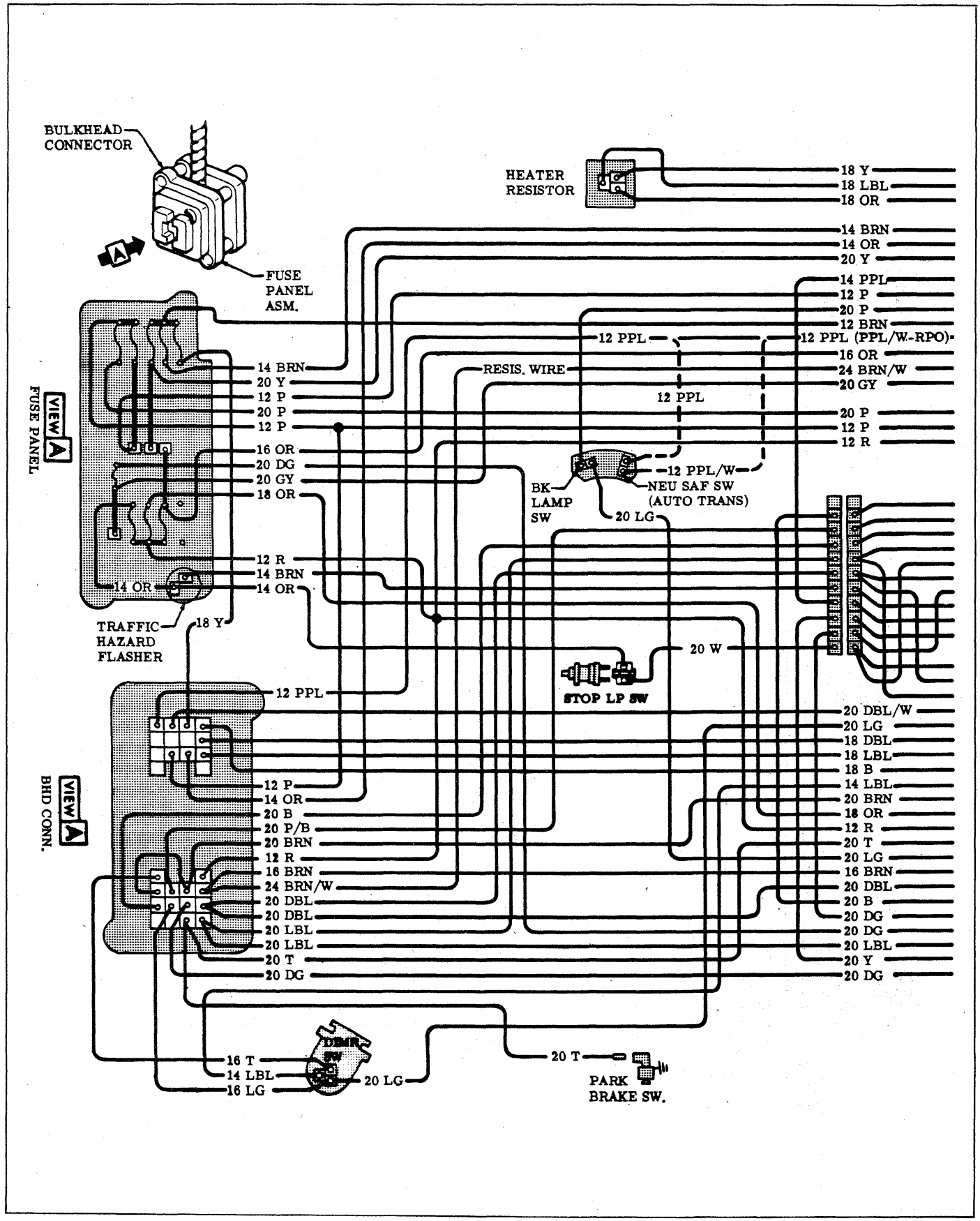


Fig. 109—Fuse Panel - Camaro

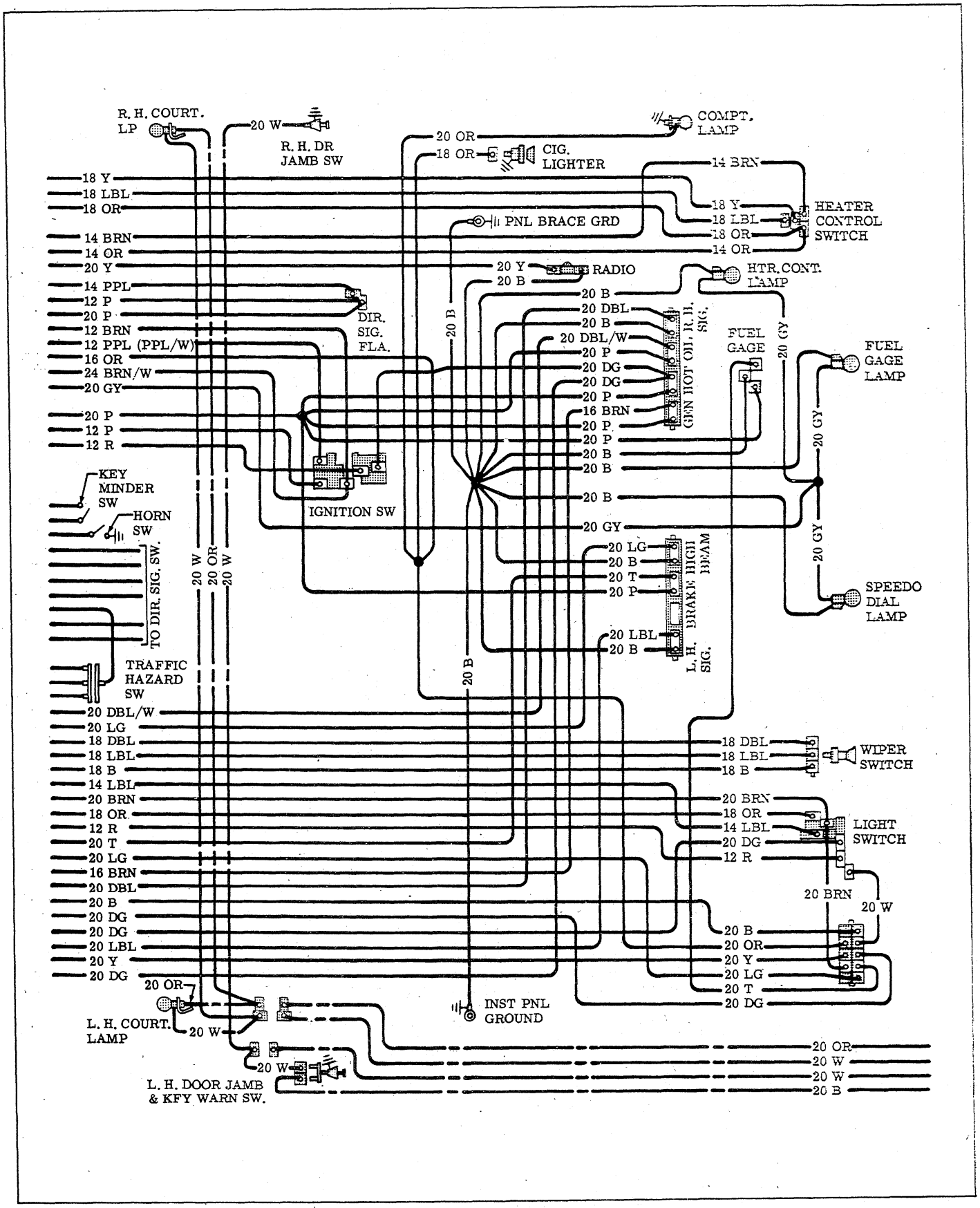


Fig. 110—Instrument Panel - Camaro

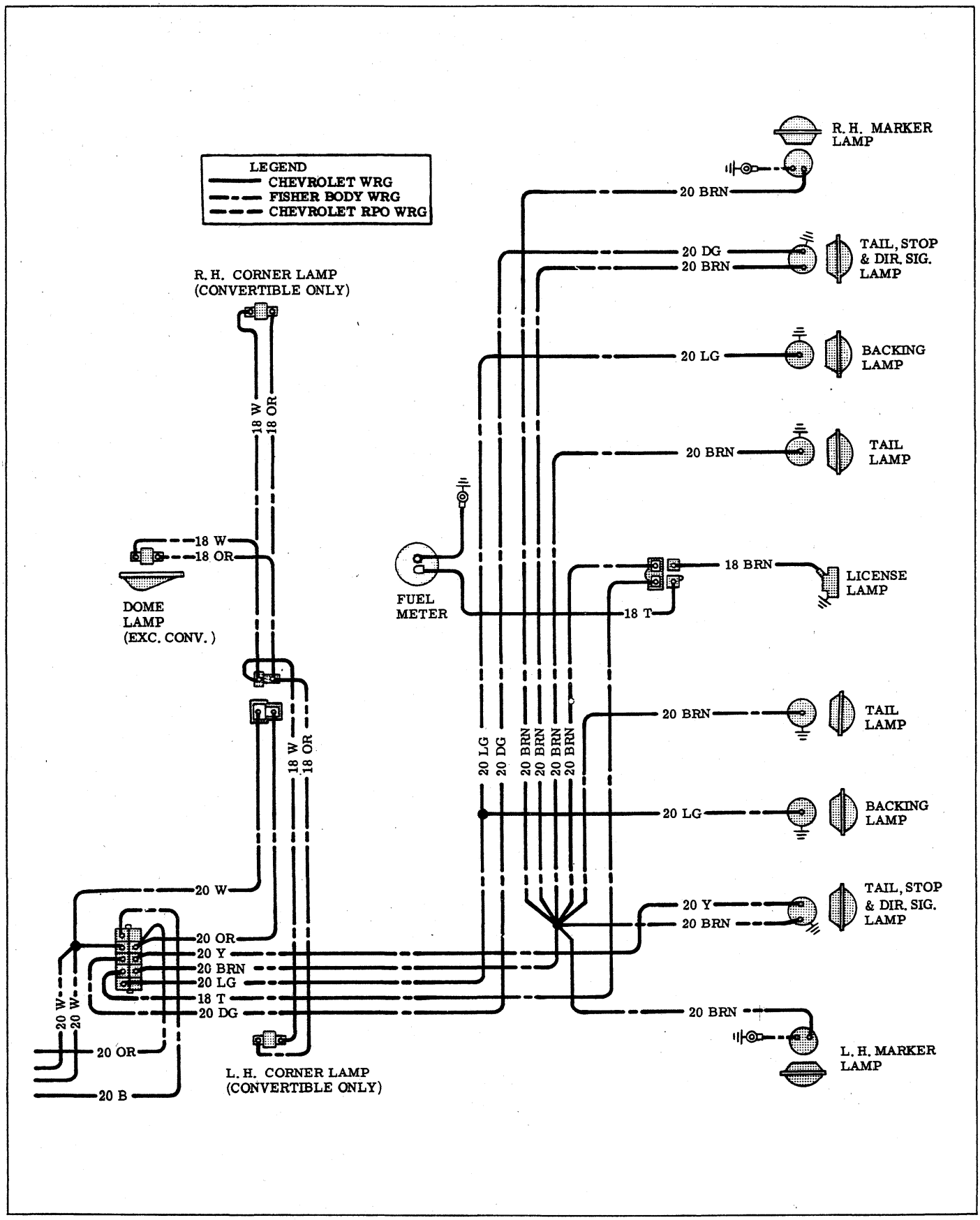


Fig. 111—Body & Rear Lighting - Camaro

SECTION 13

RADIATOR AND GRILLE

CONTENTS OF THIS SECTION

	Page
Radiator	13-1
Grille	13-5

RADIATOR

INDEX

	Page
General Description	13-1
Component Part Replacement	13-1
Radiator—Vehicles With No Fan Shroud (Except Corvette)	13-1
Radiator—Vehicles With Fan Shroud (Except Corvette)	13-1
Aluminum Radiator—Corvette	13-2
Copper Radiator—Corvette	13-2
Engine Fan Shroud (All Vehicles)	13-2

GENERAL DESCRIPTION

Radiator assemblies are of copper-brass core construction with the exception of the Corvette 427 L88 and 350 V-8 engines with manual transmission. All Chevrolet models, plus the Nova 4-cylinder use downflow radiators. All other models incorporate the crossflow design radiator. All radiators will incorporate a drain cock except the Corvette copper radiator which will have a drain plug. Radiator assemblies are attached to the radiator support or radiator mounting box by cap screws and/or brackets.

Fan shrouds are attached to the radiator, radiator support panel or radiator support brackets by cap screws and/or clips.

With the conventional downflow design radiator, coolant level should be one inch below the bottom of filler neck when cold. With the crossflow design, coolant level should be three inches below the bottom of the filler neck when cold.

COMPONENT PART REPLACEMENT

RADIATOR—VEHICLES WITH NO FAN SHROUDS (EXCEPT CORVETTE)

Removal

1. Raise hood and drain radiator.
2. Disconnect radiator inlet and outlet hoses and automatic transmission coolant lines, if so equipped.
3. Chevrolet--Remove radiator to radiator support or radiator to radiator mounting box screws and remove radiator from vehicle.
   Chevelle and Nova L-6--Remove radiator mounting panel to radiator support screws and remove panel. Lift radiator up out of vehicle.
   Nova L-4--Remove radiator to radiator mounting box screws and lift radiator out of vehicle.
   Camaro--Remove radiator fan guard to radiator support screws and remove guard. Remove radiator to radiator support screws. Lift radiator up out of vehicle.

Installation

NOTE: Refer to Figures 1 through 4 for radiator assembled positions for each vehicle.

Reverse removal procedures, fill cooling system and check for leaks.

RADIATOR—VEHICLES WITH FAN SHROUDS (EXCEPT CORVETTE)

Removal

1. Raise hood and drain radiator.
2. Disconnect radiator inlet and outlet hoses and Powerglide coolant lines, if so equipped.
3. Chevrolet--Remove shroud to radiator screws, lift shroud out of lower clips and hang shroud over engine fan. Remove radiator to radiator support screws and lift radiator up out of vehicle.
   Chevelle and Nova--Remove radiator mounting panel screws to radiator support and fan shroud and remove panel; lift shroud out of lower radiator clips and hang shroud over engine fan. Lift radiator up out of vehicle.
   Camaro--Remove shroud to radiator support bracket screw. Lift shroud up out of lower radiator clips and hang shroud over engine fan. Remove radiator to radiator support screws and remove radiator.

Installation

NOTE: Refer to Figures 1 through 4 for radiator assembled positions for each vehicle. Reverse removal procedures, fill cooling system and check for leaks.

ALUMINUM RADIATOR—CORVETTE

Removal (Fig. 5)

1. Raise hood and drain radiator (install a bolt in hole of hood support bracket for safety purposes).
2. Remove radiator inlet and outlet hoses and supply tank hose at radiator connection.
3. Remove shroud to radiator support bracket screws if so equipped.
4. Remove shroud to radiator baffle bracket screws. Rest shroud on engine fan.
5. Remove radiator upper support bracket screws and carefully lift radiator from vehicle.

Installation

Refer to Figure 5 for radiator assembled position. Reverse removal procedures, fill cooling system and check for leaks.

COPPER RADIATOR—CORVETTE

Removal (Fig. 5)

1. Raise hood and drain radiator (install a bolt in hole of hood support bracket for safety purposes).
2. Remove radiator inlet and outlet hoses at radiator connection and transmission coolant lines, if so equipped.
3. Remove shroud to radiator support bracket screws. Remove shroud to radiator baffle bracket screws or radiator support and rest shroud on engine fan.
4. Remove radiator upper support screws and tilt support. Carefully lift radiator up out of vehicle.

Installation

Refer to Figure 5 for radiator assembled position. Reverse removal procedures, fill cooling system and check for leaks.

ENGINE FAN SHROUD (ALL VEHICLES)

Replacement

1. In most instances, it will be necessary to remove the

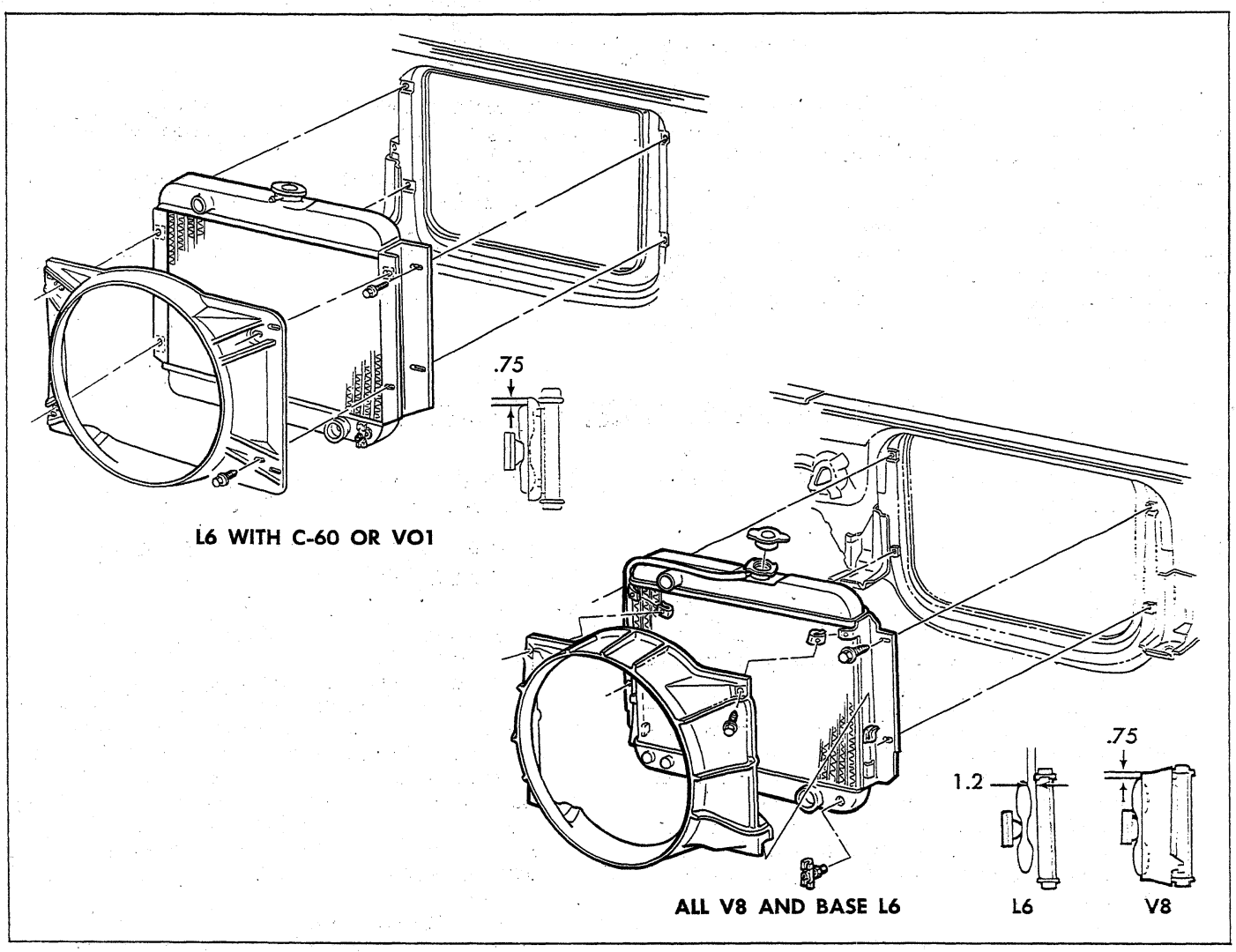


Fig. 1—Radiator and Shroud—Chevrolet

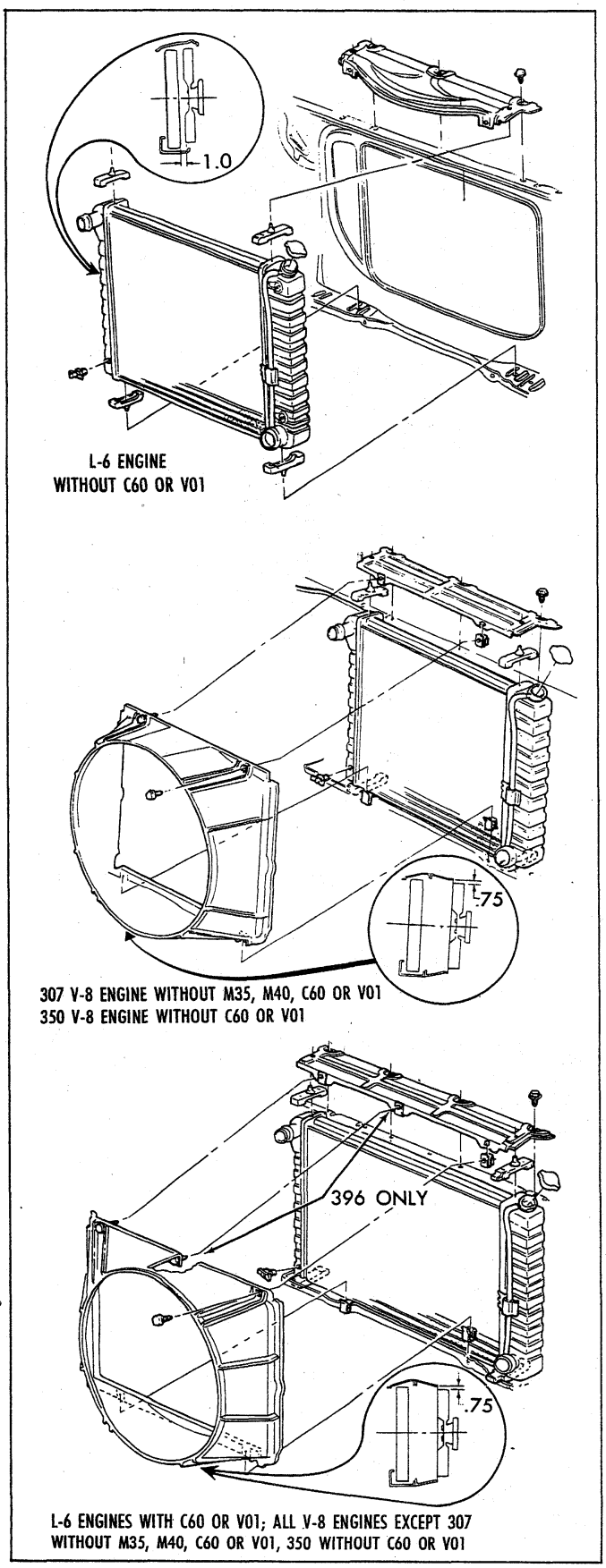


Fig. 2—Radiator and Shroud—Chevelle

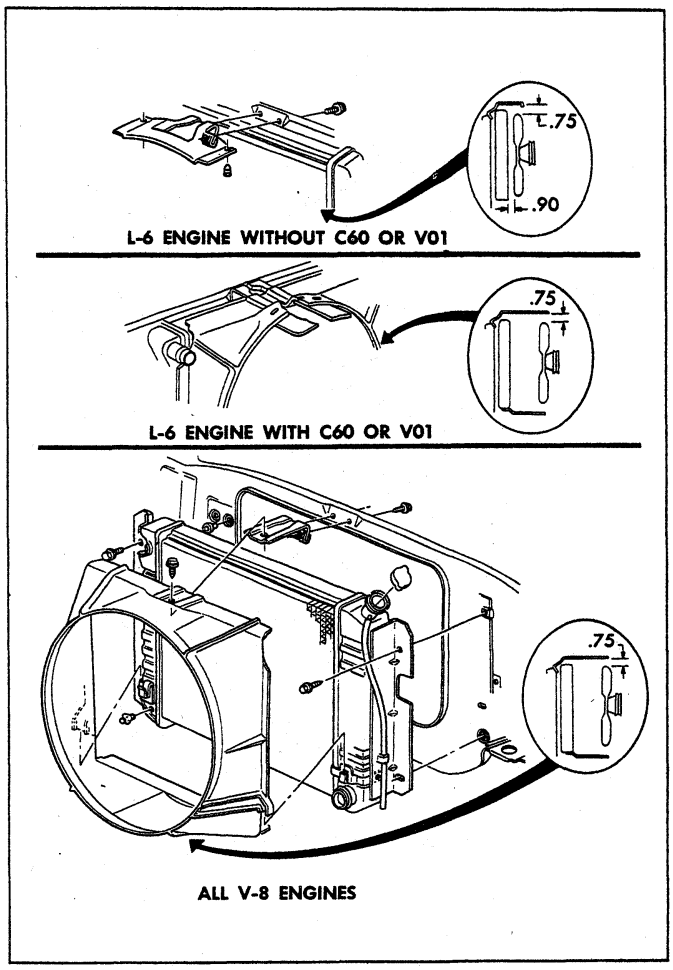


Fig. 3—Radiator and Shroud—Camaro

engine fan before clearance can be obtained to remove the fan shroud.

2. All vehicles except Corvette--Remove engine fan shroud to radiator or radiator mounting panel screws. If vehicle is so equipped, lift shroud out of lower radiator clips and remove from vehicle.
   Corvette--Remove radiator as outlined under "Radiator--Corvette". Shroud can then be removed by tilting rearward, then lifting up to clear fan blades.
3. To install, reverse the removal procedure.

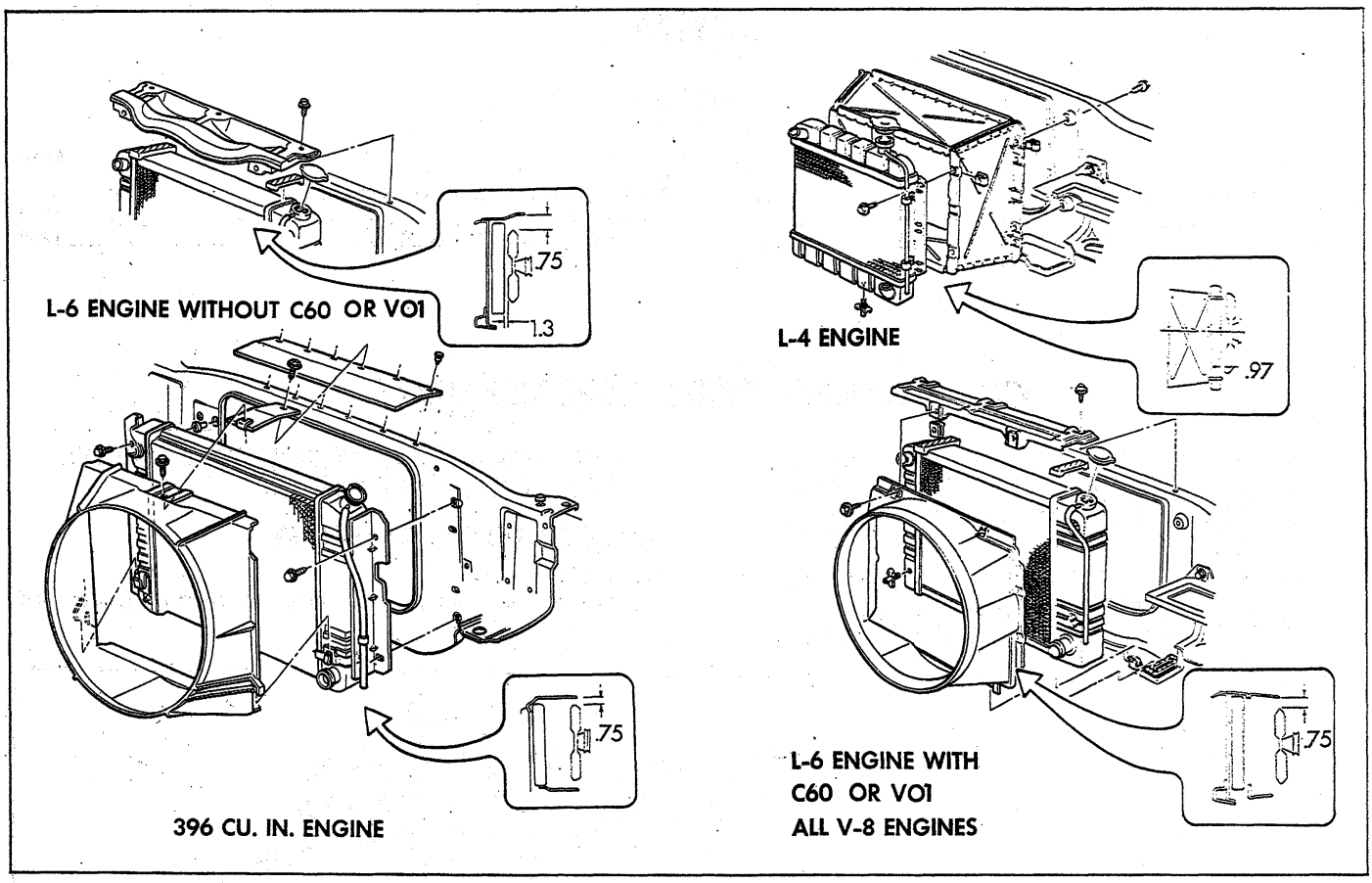


Fig. 4—Radiator and Shroud—Nova

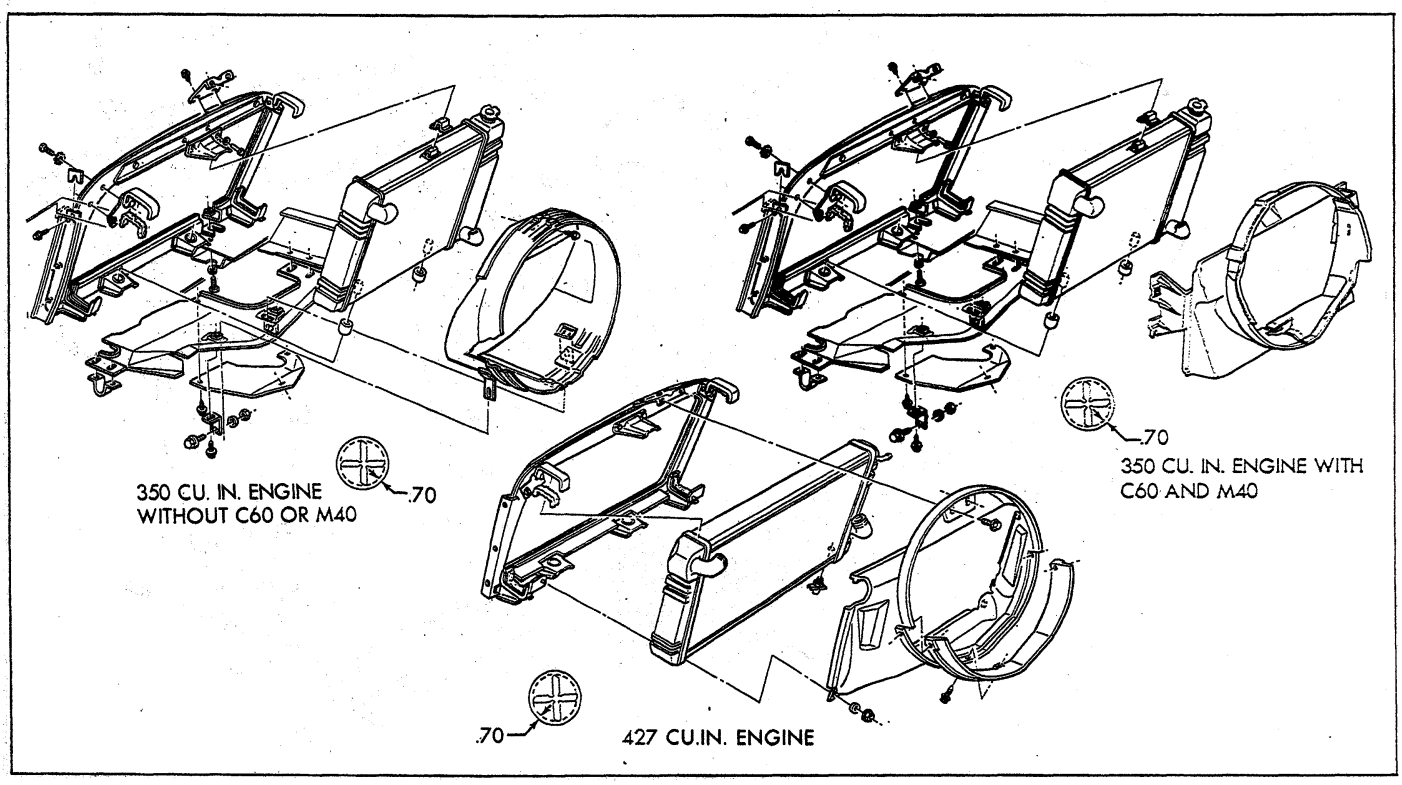


Fig. 5—Radiator and Shroud—Corvette

GRILLE

INDEX

	Page
Component Part Replacement	13-5
Grille Assembly—Chevrolet	13-5
Grille Assembly—Chevelle	13-6
Grille Assembly—Nova	13-6
Grille Assembly—Camaro (Standard Headlamps)	13-7
Grille Assembly—Corvette	13-7

COMPONENT PART REPLACEMENT

CAUTION: CERTAIN PARTS OF THE GRILLE ARE MADE OF PLASTIC ON CHEVROLET, CHEVELLE, NOVA, CAMARO AND CORVETTE FOR 1969.

DO NOT USE EXCESSIVE HEAT IN THESE AREAS AS DISTORTION COULD RESULT.

DO NOT USE HARSH CHEMICALS TO CLEAN THE GRILLE AREA AS DISTORTION AND OR PAINT PEEL COULD RESULT.

GRILLE ASSEMBLY—CHEVROLET

Removal (Fig. 6)

1. Remove screws holding upper grille to support and remove grille.

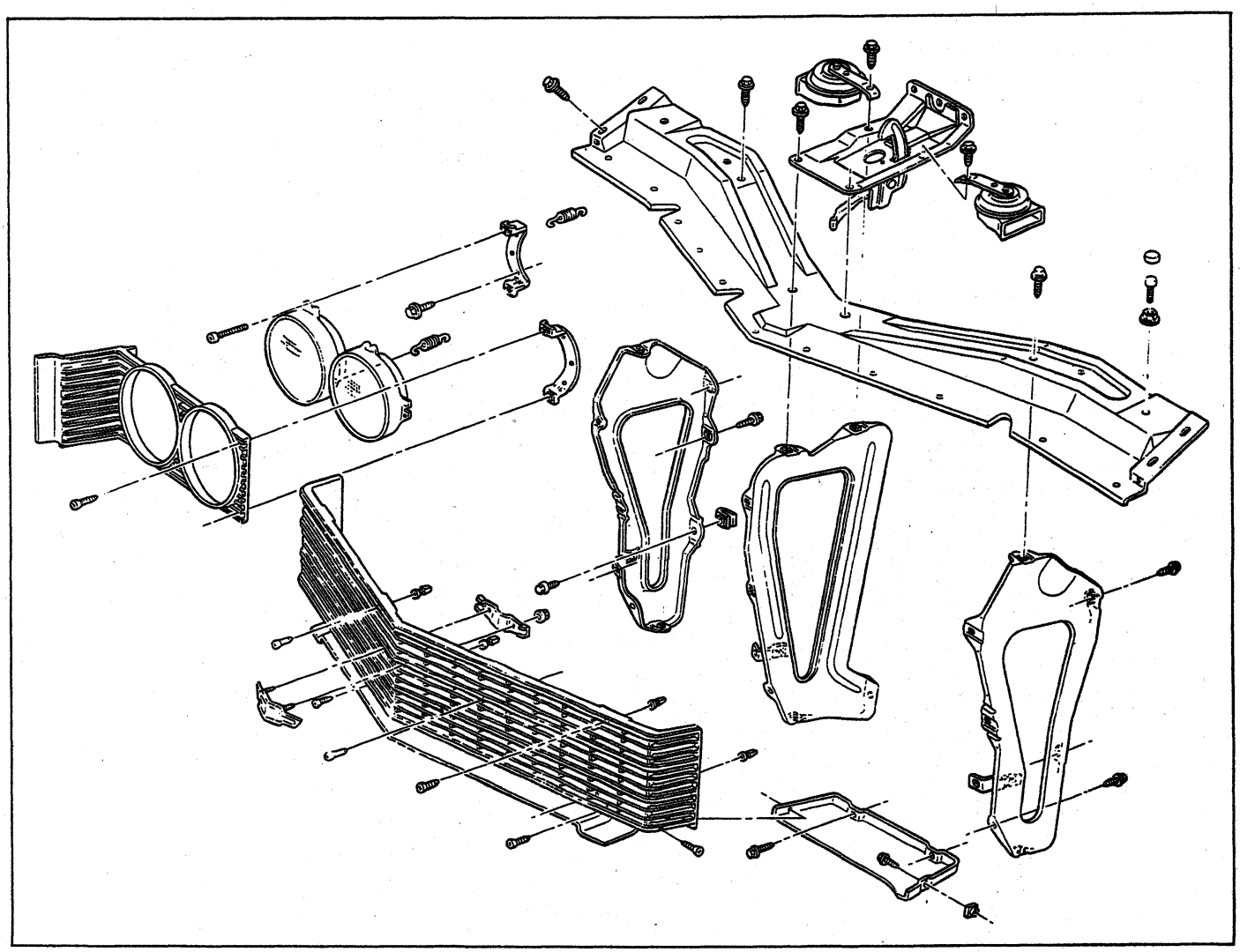


Fig. 6—Grille Assembly—Chevrolet

2. Remove screws holding lower grille to support and remove grille.
3. Remove screws holding grille support to radiator support, if necessary.

Installation

Install the upper and lower grille following removal in the reverse order.

GRILLE ASSEMBLY—CHEVELLE

Removal (Fig. 7)

1. Raise hood and disconnect battery leads.
2. Remove headlamp bezels.
3. Remove screws securing grille to support and remove grille.
4. Remove grille extension by removing screws on extension face and remove nuts from inner fender panel if so equipped.

NOTE: It may be easier to get to inner panel nuts by removing outer headlamp bulbs.

Installation

Install grille and related parts following the removal procedure in reverse order.

GRILL ASSEMBLY—NOVA

Removal (Fig. 8)

1. Raise hood, disconnect battery cables and remove battery assembly.
2. Remove screws attaching hood lock catch to radiator support, grille and hood catch support and remove catch from vehicle.
3. Remove front bumper (See Section 14).
4. Remove hood lock support to filter panel screws.
5. Remove headlamp bezel screws and remove bezels from vehicle.
6. Remove filler panel to fender screws.
7. Remove grille outer support to radiator support screws and remove grille, grille supports, filler panel and filler panel support as an assembly.
8. Damaged components can be replaced by removing screws and rivets.

Repair

If any components removed are undamaged, they may be used for the new grille installation. Where rivets were removed, new attachments can be made using screws, patent clips or rivets.

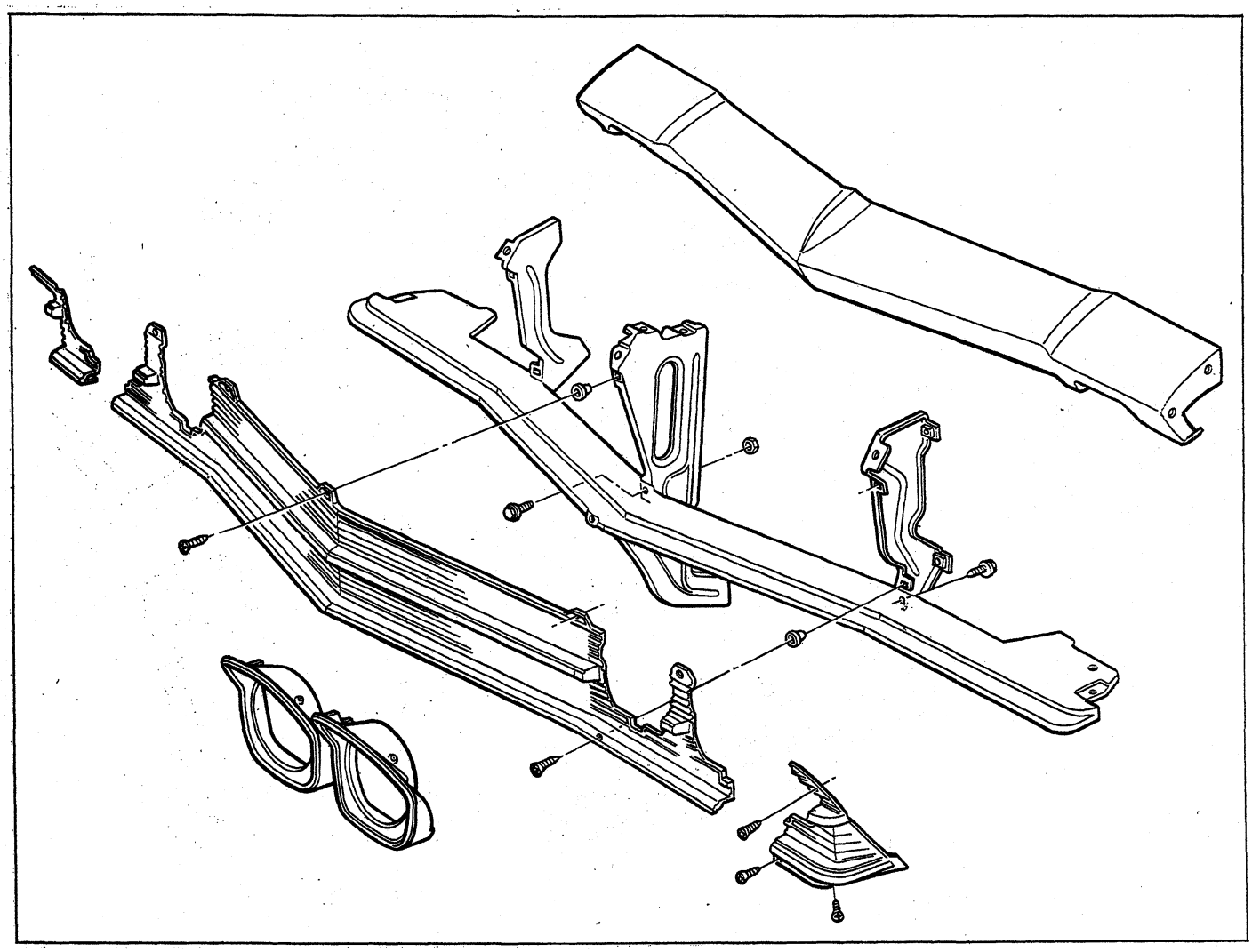


Fig. 7—Grille Assembly—Chevelle

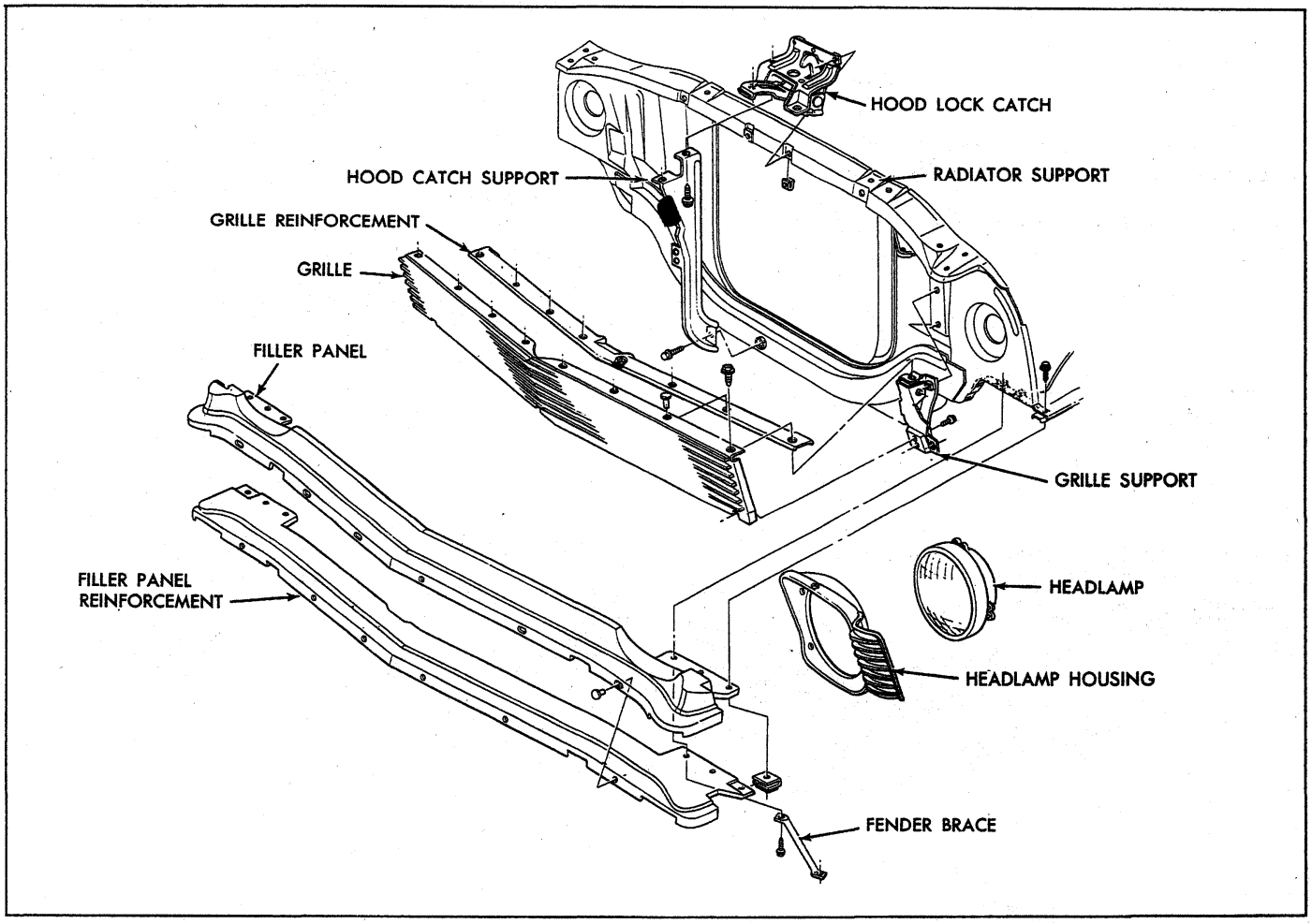


Fig. 8—Grille Assembly—Nova

Installation

Install grille and related components following the removal procedure in reverse order.

GRILLE ASSEMBLY—CAMARO

Removal (Fig. 10)

1. Remove front bumper (See Section 14).
2. Remove screws holding lower portion of grille to body. Remove screws from inner surface of grille to body and remove grille.

Installation

Install grille in the reverse order of removal and install bumper.

GRILLE ASSEMBLY—CORVETTE

Removal (Fig. 9)

1. Remove left and right hand parking lamps.
2. Remove screws attaching left and right grilles and remove grilles from vehicle.
3. Remove license plate bracket.
4. Remove four screws securing center grille assembly and remove grille from vehicle.

Installation

Install grilles and related components following the removal procedure in reverse order.

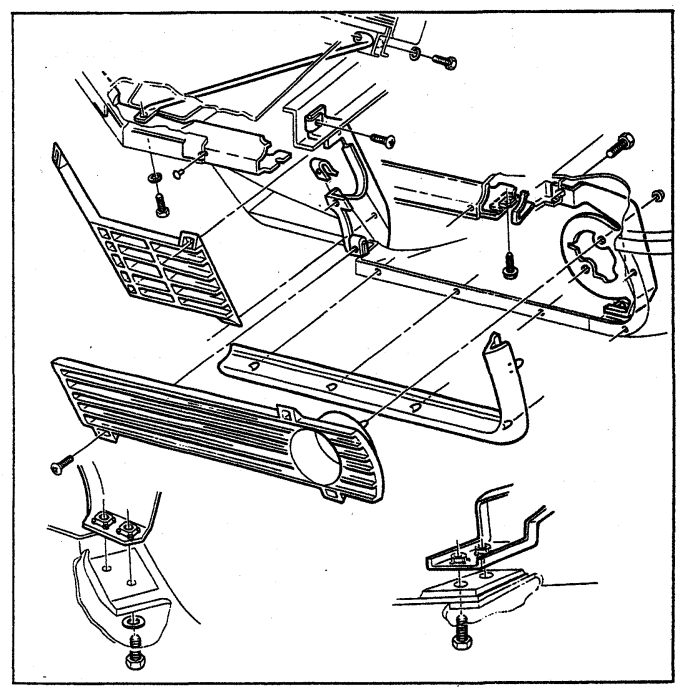


Fig. 9—Grille Assembly—Corvette

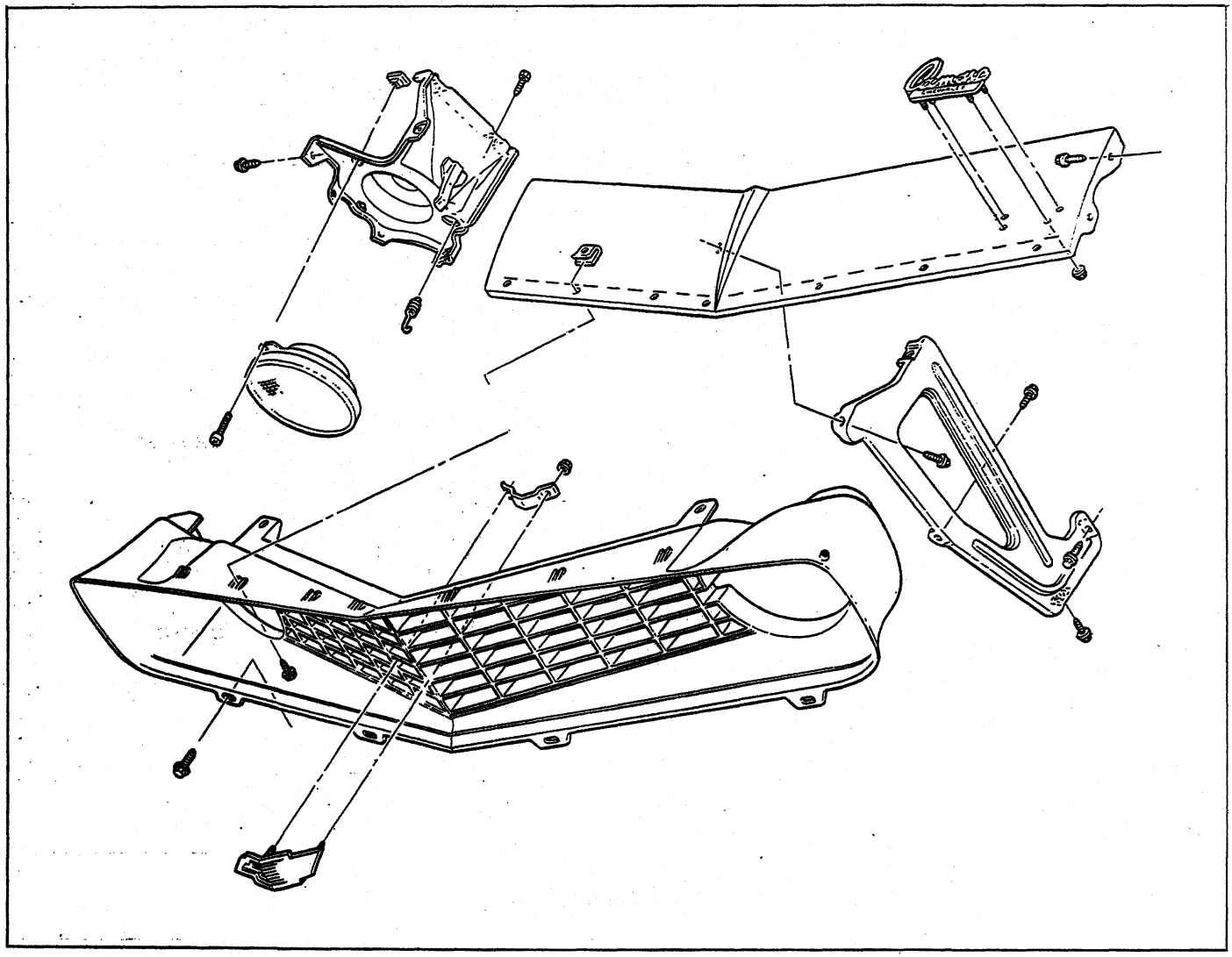


Fig. 10—Grille Assembly—Camaro

SECTION 14

BUMPERS

INDEX

	Page
Chevrolet	
Service Operations	14-1
Front Bumper Assembly	14-1
Removal	14-1
Disassembly	14-1
Installation	14-1
Rear Bumper Assembly (All Except Wagon)	14-1
Removal	14-1
Disassembly	14-3
Assembly	14-3
Installation	14-3
Rear Bumper—Wagon	14-3
Chevelle	
Service Operations	14-3
Front Bumper Assembly	14-3
Removal	14-3
Disassembly	14-3
Assembly	14-3
Installation	14-3
Rear Bumper Assembly	14-3
Removal	14-3
Disassembly	14-3
Assembly	14-3
Installation	14-3
Nova	
Service Operations	14-5
Front Bumper Assembly	14-5
Removal	14-5
Disassembly	14-5
Assembly	14-5
Installation	14-5
Rear Bumper Assembly	14-5
Removal	14-5
Disassembly	14-6
Assembly	14-6
Installation	14-6
Camaro	
Service Operations	14-6
Front Bumper Assembly	14-6
Removal	14-6
Disassembly	14-6
Assembly	14-6
Installation	14-7
Rear Bumper Assembly	14-7
Removal	14-7
Disassembly	14-7
Assembly	14-7
Installation	14-7
Corvette	
Service Operations	
Front Bumper Assembly	14-7
Removal	14-7
Installation	14-7
Rear Bumper Assembly	14-7
Removal	14-7
Installation	14-7

CHEVROLET

SERVICE OPERATIONS

FRONT BUMPER (Fig. 1)

Removal

1. Raise hood and disconnect battery.
2. Remove upper grille assembly by removing screws holding grille to support. Remove lower grille.
3. Remove parking lamps (2 screws each) and carefully place out of the way.
4. Remove valance panel by removing bolts at fender brace and lower front edge. Remove center bolt.
5. Remove bolts holding bumper bracket to frame and remove bumper.

Disassembly

Remove bolts attaching bumper to brackets and separate. Reverse procedure for assembly.

Installation

1. Position bumper in place with brackets attached and install bolts and nuts.
2. Install valance panel.
3. Install parking lamps to valance panel.
4. Install upper grille assembly. Install lower grille assembly.
5. Connect battery.

VALANCE PANEL (REAR)

Removal

1. Remove bolts at lower fender rear section and center brace.

Installation

Reverse removal procedure.

REAR BUMPER (EXCEPT STATION WAGON Fig. 2)

Removal

1. Open hood and disconnect the battery.
2. Open trunk and remove bolts hoding bumper brace.
3. Disconnect tail lamp wires and push through hole in body.
4. Raise vehicle on hoist.
5. Remove bolts holding lower portion of bumper to body and lower bumper to floor.

NOTE: Remove fiber optic conductor before lowering the bumper if the vehicle is so equipped.

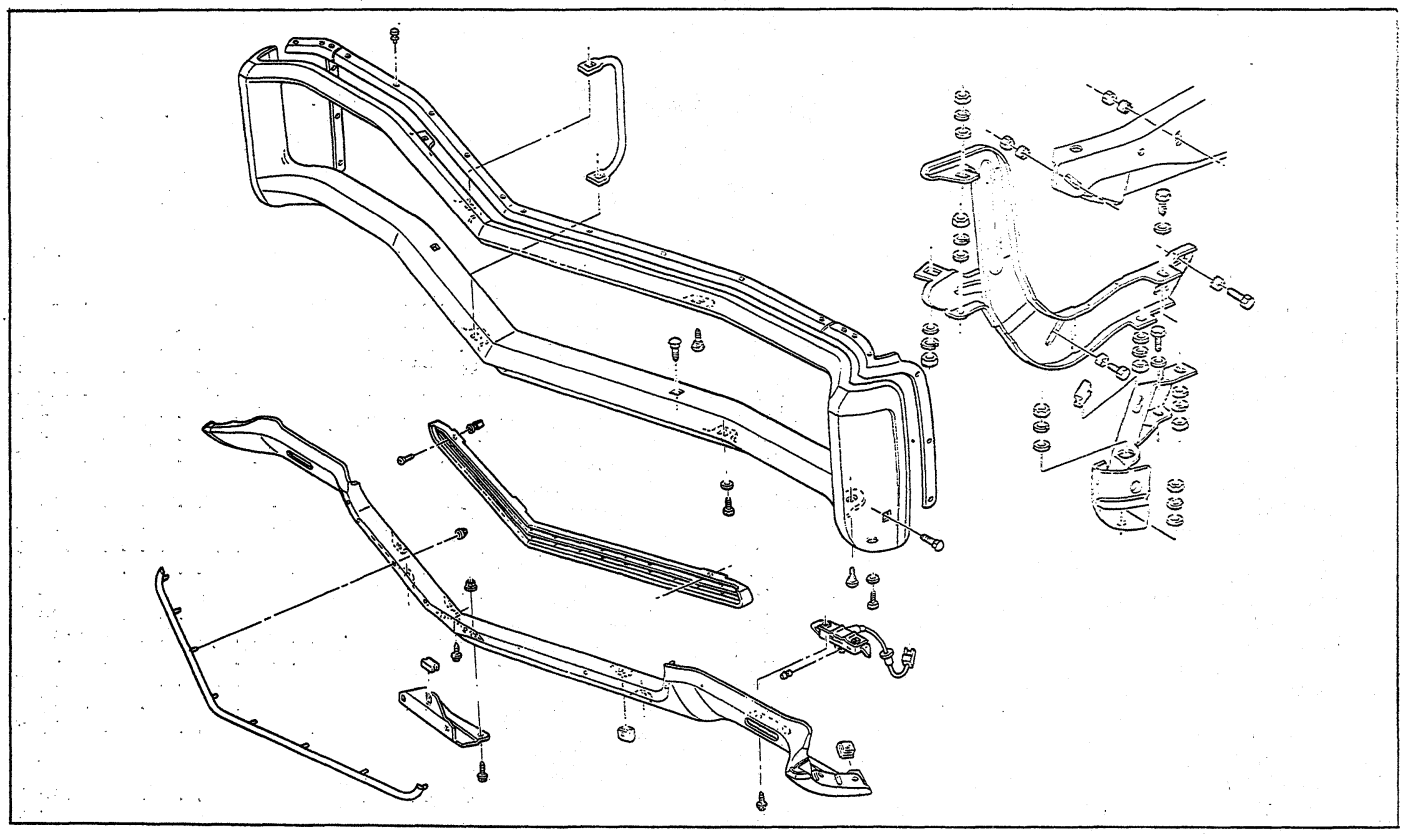


Fig. 1—Front Bumper—Chevrolet

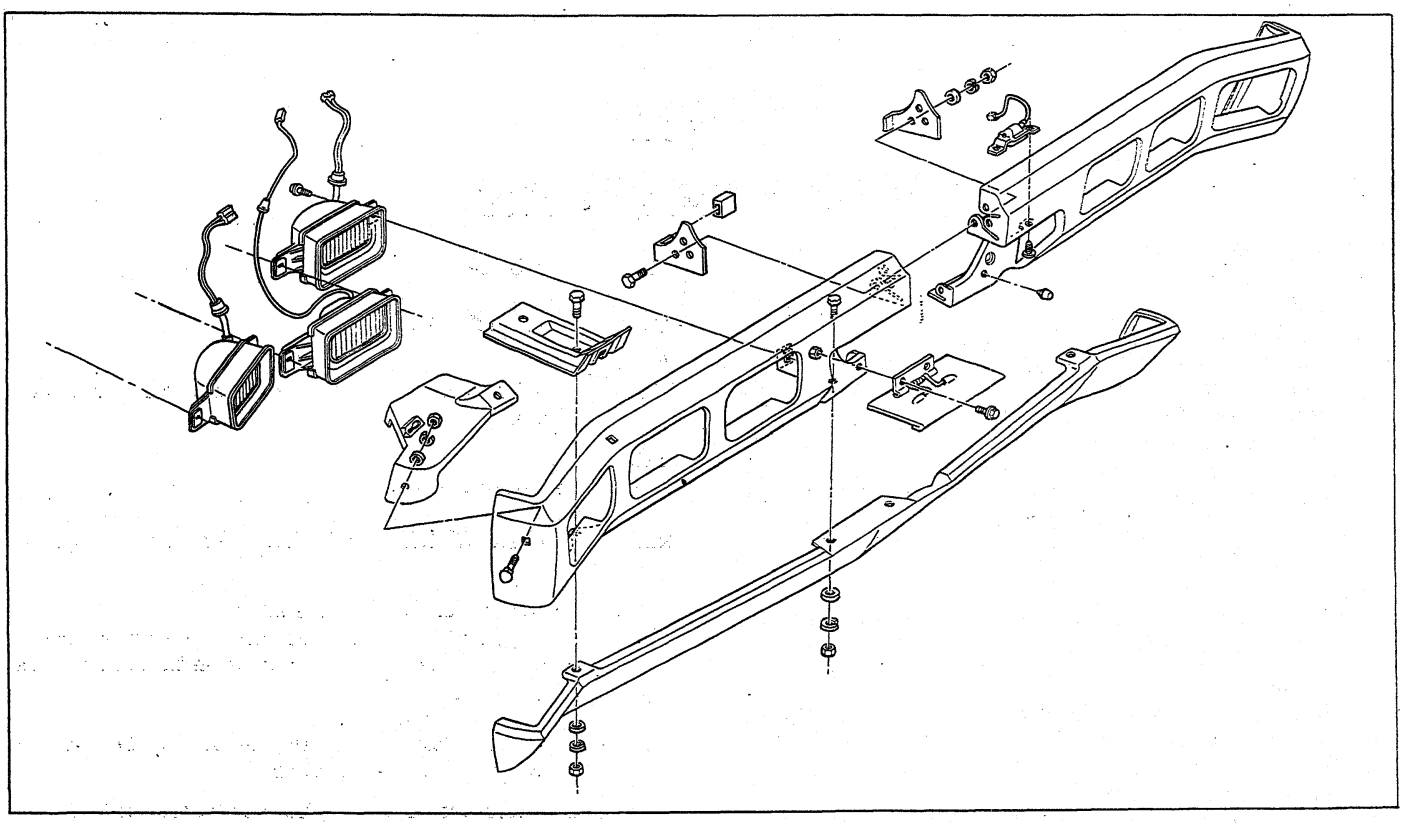


Fig. 2—Rear Bumper—Chevrolet

Disassembly
1. Remove tail lamps.
2. Remove license plate door.
3. Remove bumper brackets.
4. Remove bumper bolts at center of bumper.

Assembly

Assemble the rear bumper in the reverse order of the disassembly. Tighten all bolts and screws.

Installation
1. Position bumper and loosely install lower bolts.
2. Install fiber optic conductor if so equipped.
3. Lower vehicle and install bolts in the trunk area.
4. Push the tail lamp wires through the holes provided and connect wiring.
5. Tighten all bolts and screws.
6. Lower the vehicle to the floor and connect the battery.

REAR BUMPER—CHEVROLET WAGON (Fig. 3)

Removal
1. Disconnect license plate lamp.
2. Remove rubber pads from upper surface of bumper (19 screws).
3. Lift L.H. rubber pad with spring clip from hinge assembly.
4. Remove rubber step pad from bumper (2 screws).
5. Place vehicle on hoist.
6. Remove L.H. and R.H. lower bolts to body.
7. Remove center and R.H. bolts through body rear cross sill into bumper (underneath vehicle).

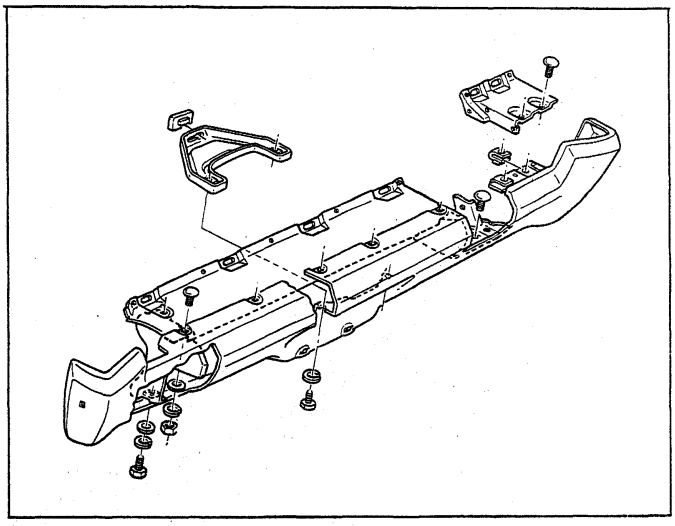


Fig. 3—Rear Bumper—Chevrolet Wagon

8. Remove six (6) bolts from body at upper flange of bumper upper extension panel.
9. Carefully lower bumper to floor.

Installation
1. Reverse above procedure, being careful to align the bumper to the body so step pad and bumperette assembly clear each other.
2. Lower vehicle to the floor.

CHEVELLE

SERVICE OPERATIONS

FRONT BUMPER (Fig. 4)

Removal
1. Raise hood and disconnect battery.
2. Remove screws holding parking lamps to bumper and carefully place lamps out of the way.
3. Remove bolts holding bumper brackets to frame and remove bumper. (Take note of the direction of the toothed washer).

Disassembly and Assembly

Remove bumper brackets from bumper--Install bumper brackets.

Installation
1. Install bumper to frame with bolts and washers taking note of the direction of the toothed washer. Tighten all bolts and nuts.
2. Install parking lamps to bumper.
3. Connect battery.

REAR BUMPER (Figs. 5 and 6)

Removal
1. Disconnect battery. Disconnect license plate lamp and pull through opening in trunk area.
2. Remove bolts holding bumper brackets to body and remove bumper (on Station Wagon and Pick-up brackets attach to the frame).

Disassembly
1. Remove license lamp.
2. Remove license plate door if so equipped.
3. Remove brackets and braces.
4. Remove reflector if so equipped.

Assembly
1. Attach all brackets and tighten nuts and bolts.
2. Attach license plate door if so equipped.
3. Attach reflectors if so equipped.
4. Tighten all bolts, nuts and screws.

Installation

Follow removal procedure in reverse except on the swing gate station wagon.

SWING GATE STATION WAGON (Fig. 7)

When aligning bumper to frame, be sure that the step pad and the bumperette are aligned so that they clear each other.

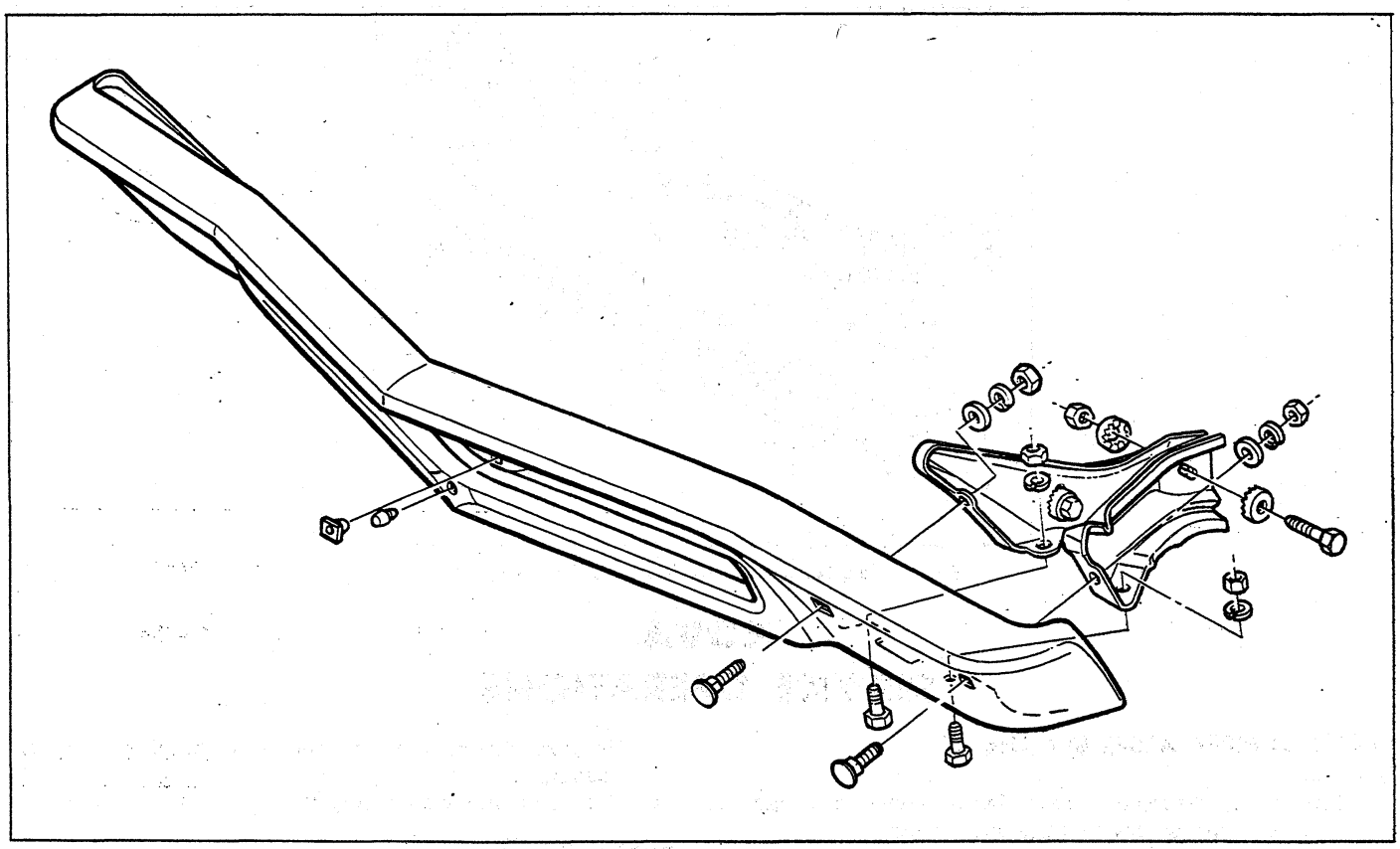


Fig. 4—Front Bumper—Chevelle

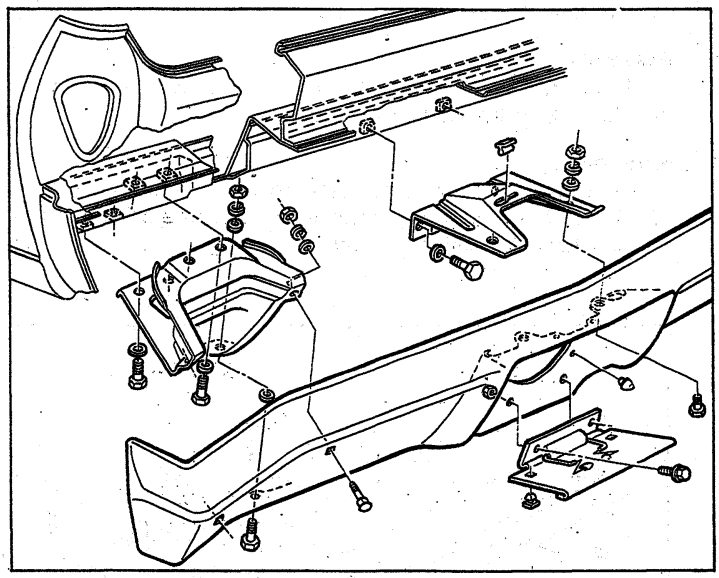


Fig. 5—Rear Bumper—Chevelle

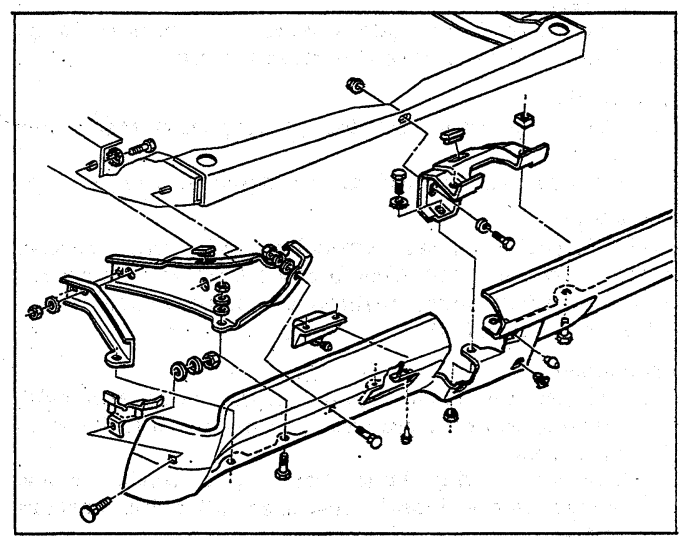


Fig. 6—Rear Bumper—Chevelle (Wagon and Pick-Up)

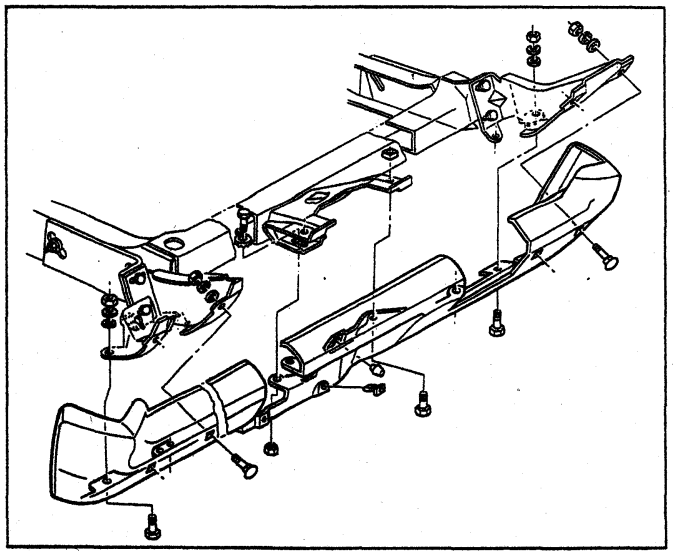


Fig. 7—Rear Bumper—Chevelle (Swing Gate Wagon)

NOVA
SERVICE OPERATIONS

FRONT BUMPER ASSEMBLY (Fig. 7)

Removal

1. Lift hood, disconnect park lamp wiring and pass grommet with wiring through sheet metal.
2. Place vehicle on hoist.
3. Remove bolts retaining brackets and braces to frame.
4. Disconnect fiber optic conductor to parking lamp.
5. Remove bumper assembly from vehicle.

Disassembly

1. Remove screws securing parking lamp assemblies to bumper.
2. Remove brackets and braces bolted to bumper face.

Assembly

Attach parking lamp assemblies and tighten screws firmly. Assemble the front bumper brackets and braces loosely. Tighten nuts, washers and bolts securely after all bolts are installed.

Installation

1. Position the front bumper on the frame assembly, aligning holes in brackets and braces with those in the frame.
2. Connect parking lamp fiber optic conductor and wiring before loosely installing all bolts, washers and nuts.
3. Align bumper assembly to front end sheet metal and tighten attachments.
4. Remove vehicle from hoist.

REAR BUMPER ASSEMBLY (Fig. 8)

Removal

1. Disconnect license lamp wiring inside trunk and push grommet with connector through floor pan.
2. Place vehicle on hoist.
3. Remove bolts fastening bumper brackets to frame side rails.
4. Remove fiber optic conductor from license lamp housing.
5. Remove bumper assembly from vehicle.

Disassembly

1. Remove license lamp from bumper.
2. Remove door assembly from bumper.
3. Remove brackets and braces.

Assembly

Attach license lamp and door assemblies securely to face bar. Bolt brackets to bumper firmly.

Installation

1. Position rear bumper assembly to frame side rail.
2. Push bumper lamp wiring connector and grommet up through trunk floor pan.

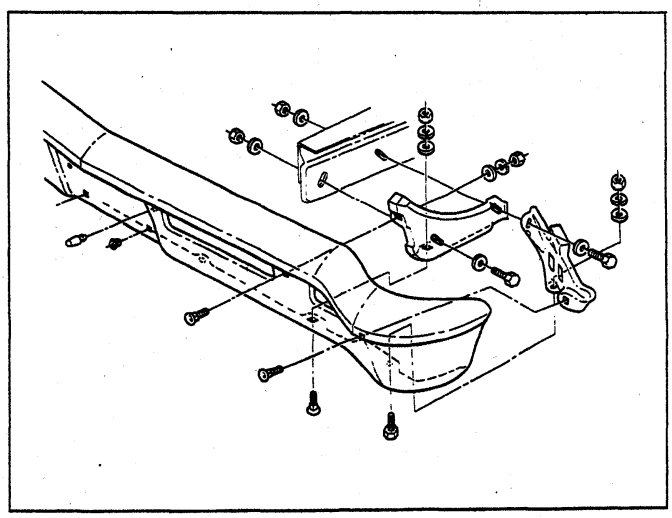


Fig. 8—Front Bumper—Nova

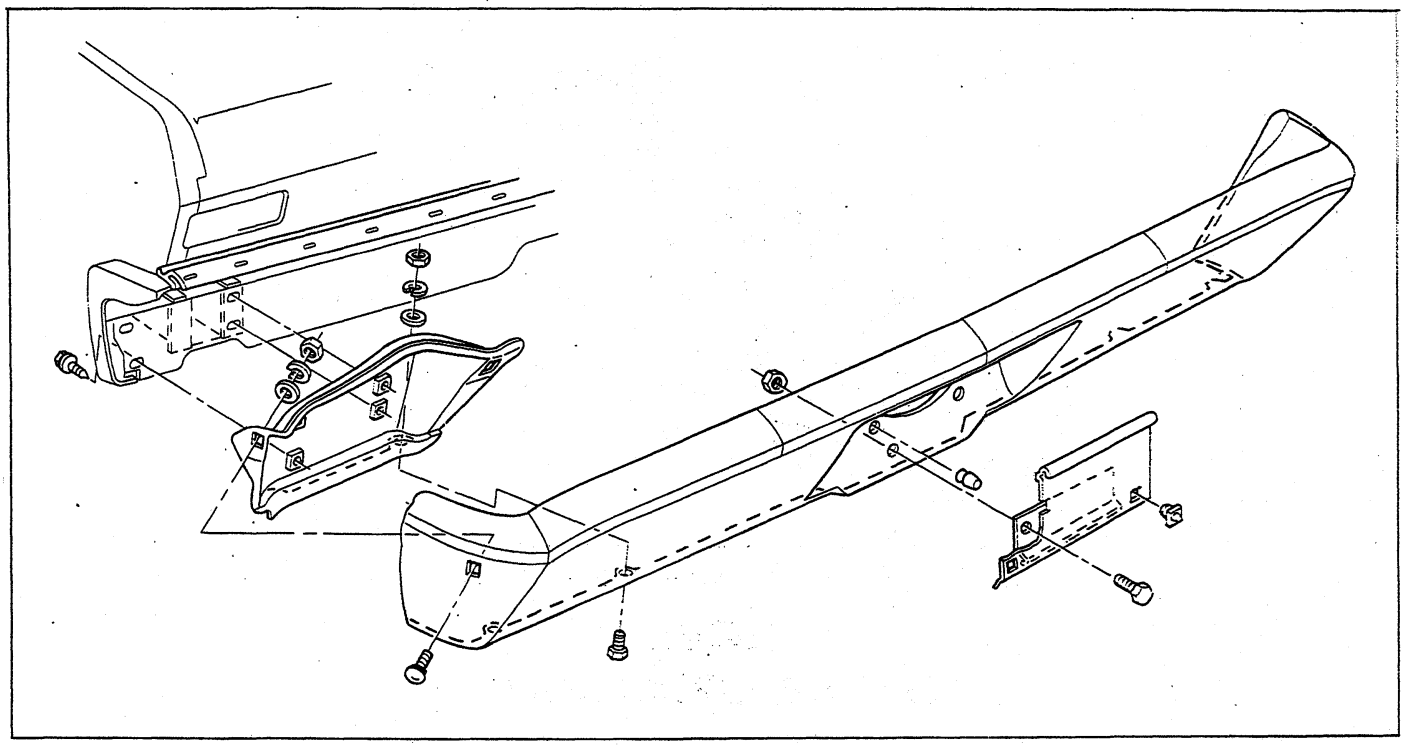


Fig. 9—Rear Bumper—Nova

3. Connect fiber optic conductor to lamp housing.
4. Loosely install bolts into bracket assemblies until bumper is aligned with sheet metal.
5. Tighten all mounting bolts securely and remove vehicle from hoist.
6. Connect bumper lamp wiring inside trunk.

CAMARO

SERVICE OPERATIONS

FRONT BUMPER (Fig. 10)

Removal

1. Remove bumper from frame extension and body.
2. Remove frame extension if necessary.

Disassembly and Assembly

Remove outer bracket from bumper--Replace outer bracket and tighten all bolts and nuts before assembling bumper to car.

Installation

1. Install frame extension to frame if removed.
2. Install bumper to frame and body and tighten all bolts and nuts.

NOTE: The optional "urethane" bumper is installed closer to the body than is the standard steel bumper.

The new "urethane" bumper can be repaired if it becomes damaged. Follow directions on the repair "patch" very carefully. When painting the new "urethane" bumper be sure you are in a clean area and follow directions on the paint kit.

REAR BUMPER (Fig. 11)

Removal

1. Raise hood and disconnect battery.
2. Open trunk and disconnect license plate lamp.
3. Remove bolts securing bumper guards to body.
4. Remove bolts to bumper brace from inside trunk area and remove bumper--pull license plate wire through.

Disassembly

1. Remove bolts securing brackets to face bar.
2. Remove bumper guards from face bar.

Assembly

Assemble the rear bumper guards and brackets following disassembly procedure.

Installation

1. Install bolts inside trunk to bumper brackets.
2. Push license plate wire through hole and connect wire.
3. Install bolts to body securing bumper guards.
4. Connect battery.

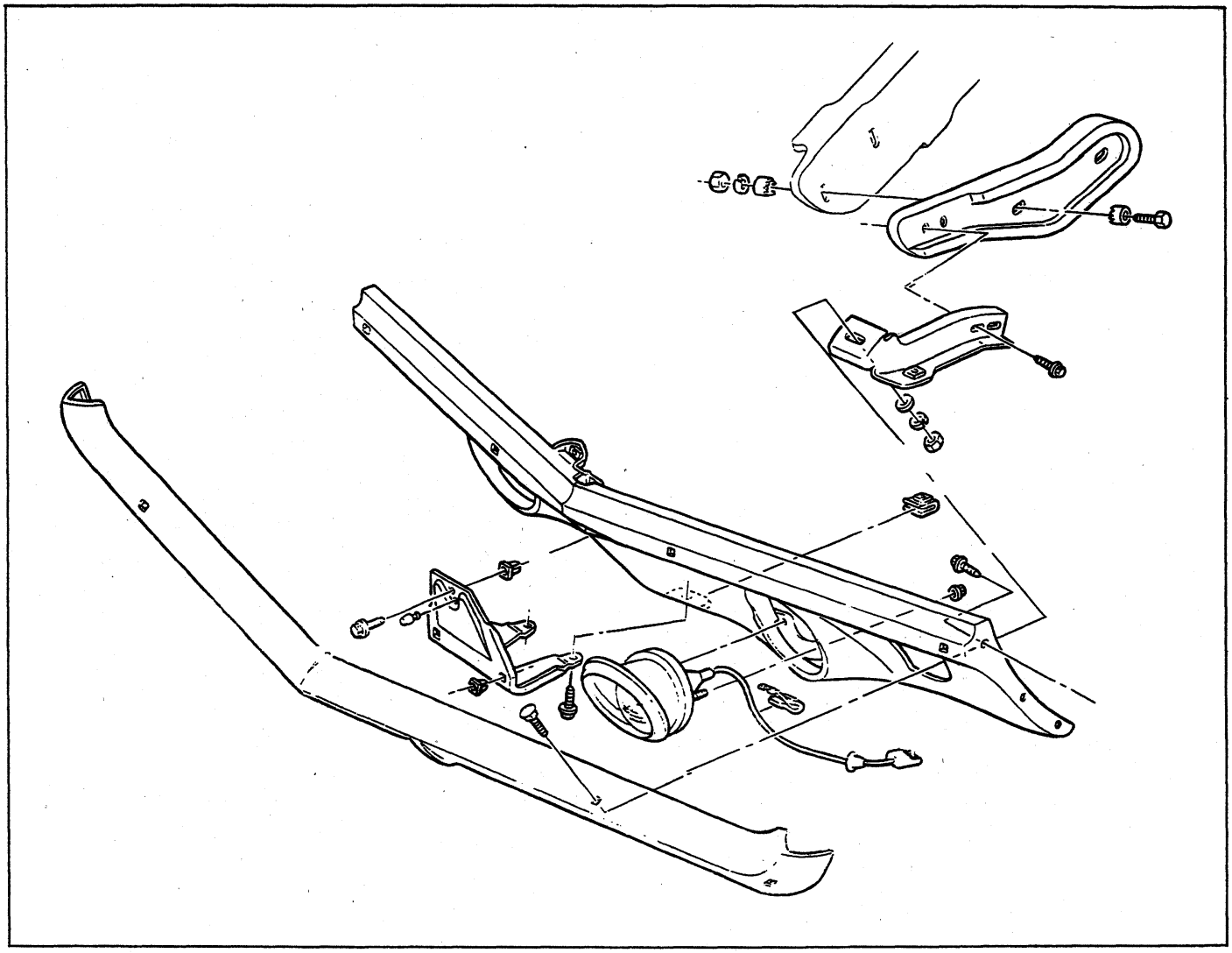


Fig. 10—Front Bumper—Camaro

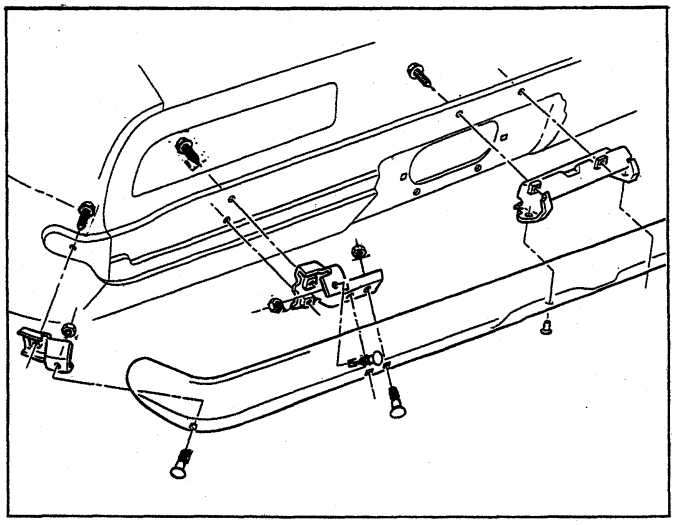


Fig. 11—Rear Bumper—Camaro

CORVETTE

SERVICE OPERATIONS

FRONT BUMPER ASSEMBLY (Fig. 12)

The face bar and bumper guards may be removed, without the brace, bracket or license plate assembly being disturbed.

Removal

1. Place vehicle on hoist.
2. Remove both decorative radiator grills.
3. Remove bolts attaching face bar to brackets and braces.
4. Remove bolts attaching lower edge of bumper guards to crossmember.
5. Lift off bumper assembly including face bar and guards.
6. Separate bumper guards from face bar.
7. Note shim and washer locations when disassembling component parts of the bumper assembly for ease of installation.

Replacement

1. Assemble face bar to bumper braces loosely with bolts.
2. Assemble bumper guards to bumper face bar and frame crossmember loosely.
3. Align bumper to sheet metal and tighten outer bolts of face bar first then center bolts and finally bumper guard to frame bolts.
4. Install decorative radiator grilles.
5. Remove vehicle from hoist.

REAR BUMPER (Fig. 13)

Figure 13 shows an exploded view of the rear bumper assembly installation on the vehicle. The following procedure covers the left hand bumper assembly only; the right hand assembly sequence is identical.

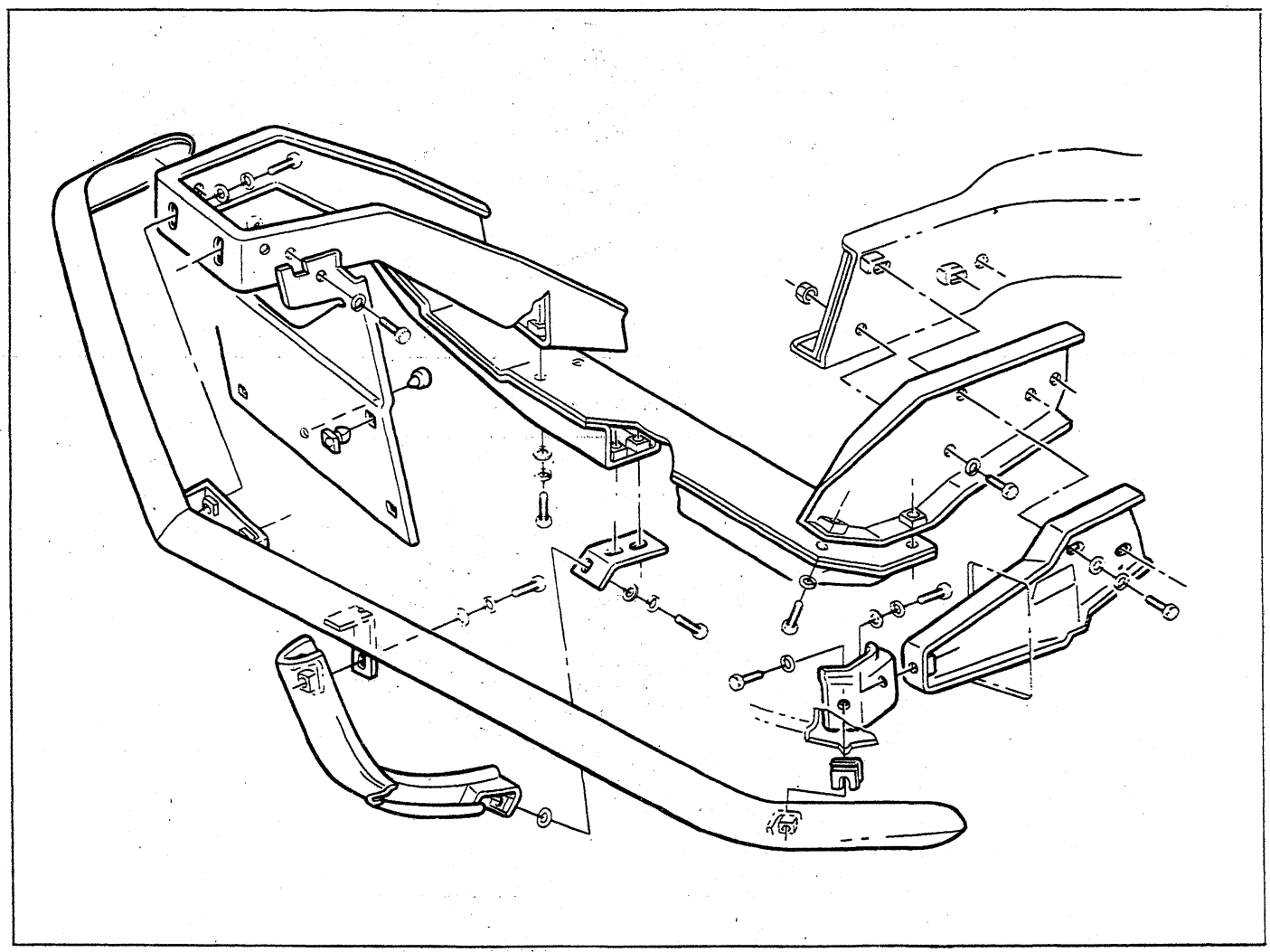


Fig. 12—Front Bumper—Corvette

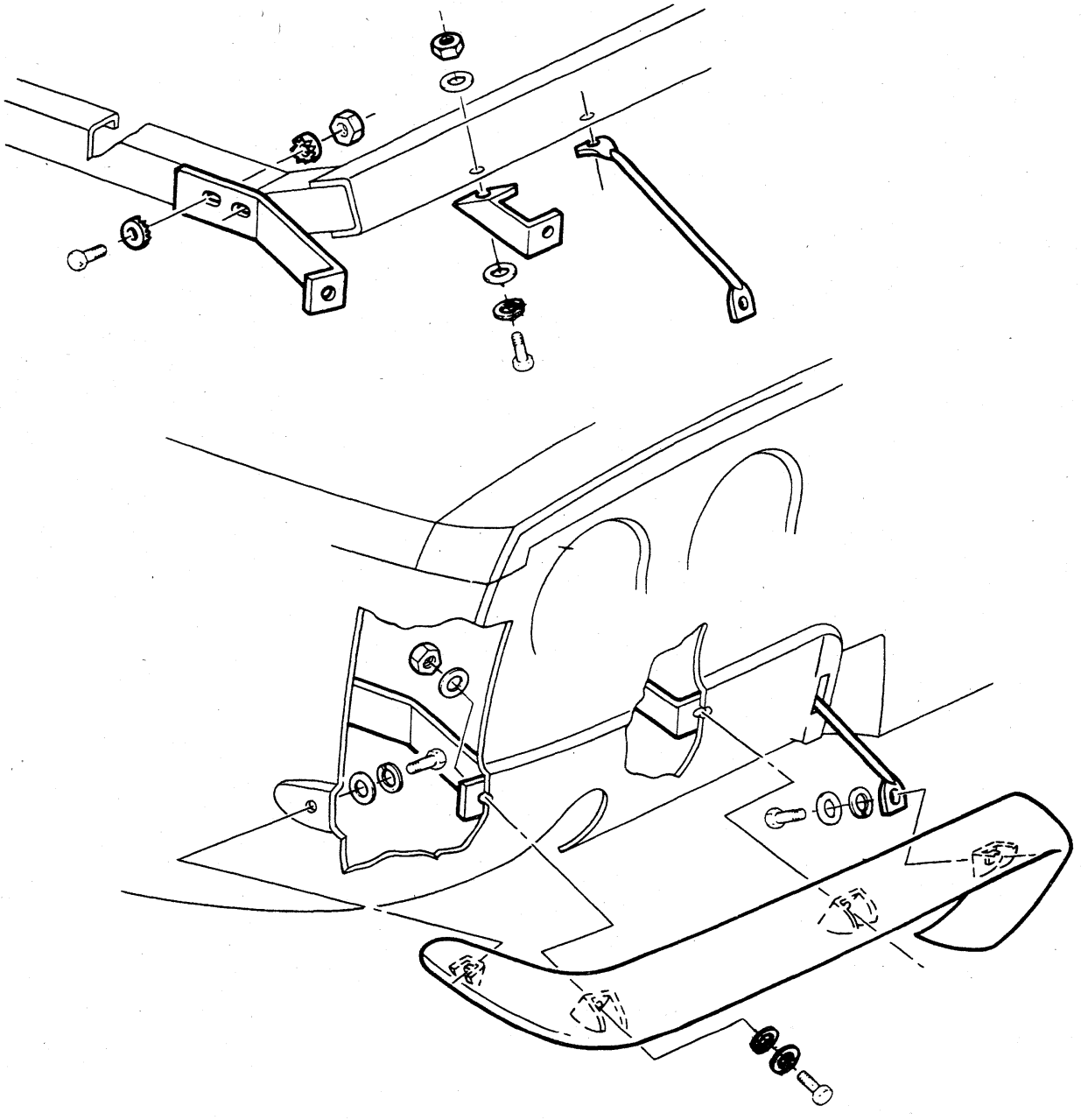


Fig. 13—Rear Bumper—Corvette

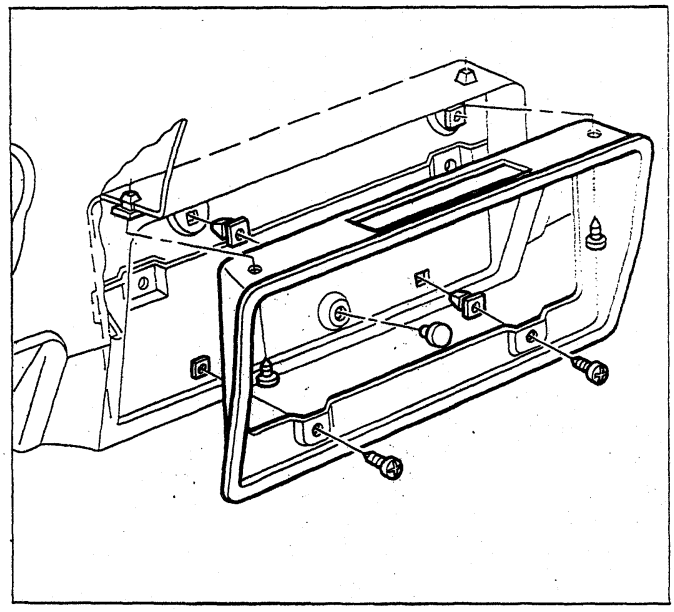


Fig. 14—Rear License Plate Housing

Removal—Replacement

1. Place vehicle on hoist.
2. From beneath vehicle remove bolts, washers and nuts fastening bumper assembly to braces and rods. Start disassembly from outboard bolts.
3. Remove braces and rods from frame assembly.

Installation—Replacement

Connect rear bumper braces and rods to frame loosely. Install all bolts, washers and nuts before tightening any attachments. Tighten all bolts after aligning rear bumpers to sheet metal.

Rear License Plate Housing (Fig. 14)

The rear license plate housing may be lifted from the vehicle by removing the license plate and housing retaining screws.

SECTION 15

ACCESSORIES

CONTENTS OF THIS SECTION

	Page
Cruise Master	15-1
Automatic Level Control	15-10
Radio Removal	15-16

CRUISE MASTER

INDEX

	Page
General Description	15-2
System and Component Operation	15-2
Service Operations	15-6
System Checks	15-9

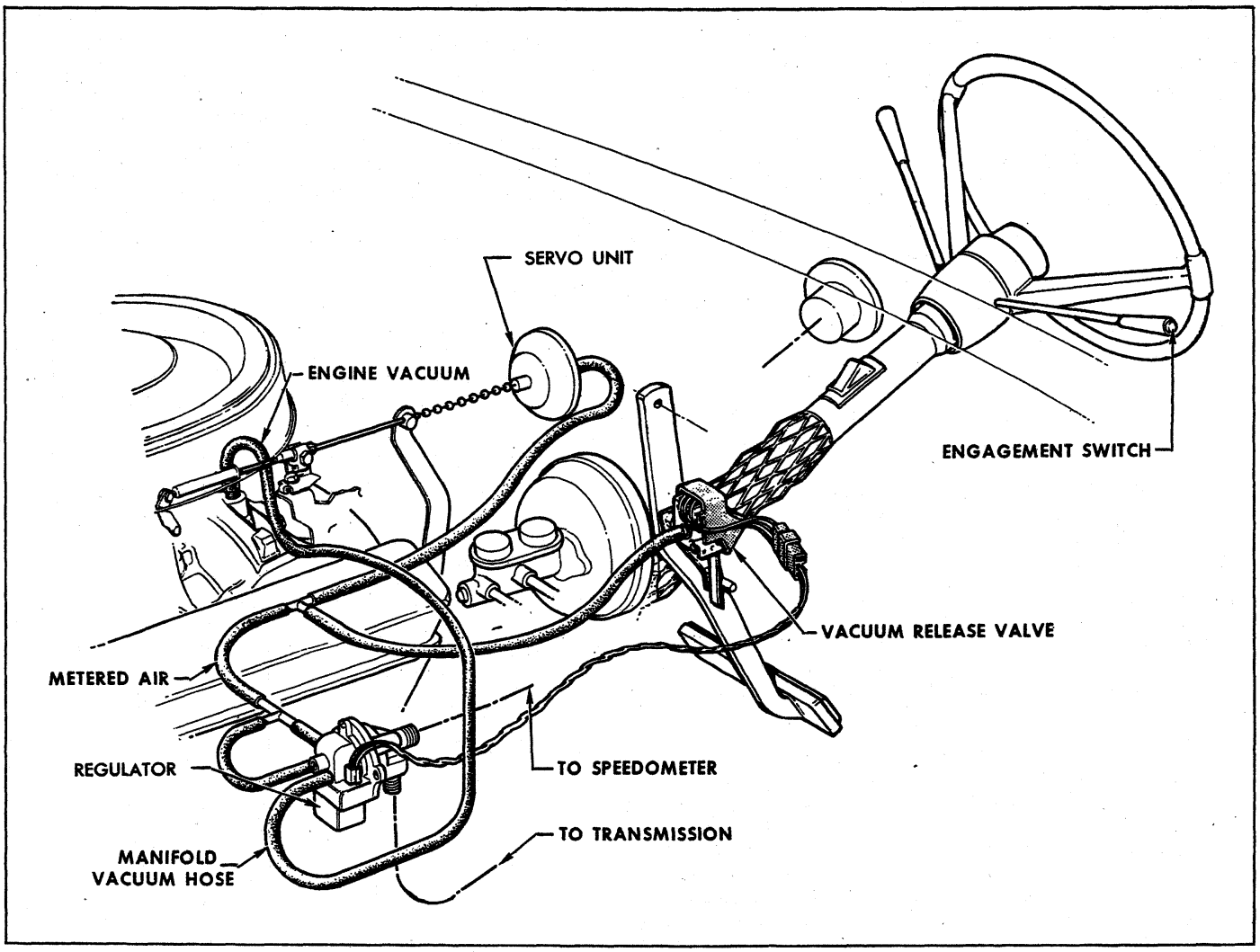


Fig. 1—Cruise Master System

GENERAL DESCRIPTION

The Cruise Master is a speed control system which employs engine manifold vacuum to power the throttle Servo unit. The Servo moves the throttle when speed adjustment is necessary by receiving a varying amount of controlled vacuum from the Regulator unit. The speedometer cable from the transmission drives the Regulator, and a cable from the Regulator drives the instrument panel speedometer. The engagement of the Regulator unit is controlled by an Engagement Switch located at the end of the turn signal lever. Two brake release switches are provided: an Electric Switch disengages the Regulator unit and a Vacuum Switch decreases the vacuum in the Servo unit to quickly return the throttle to idle position.

The operation of each unit of the system and the operation of the entire system under various circumstances is described below. Figure 1 show the location of the system components within the vehicle.

COMPONENT OPERATION

ENGAGEMENT SWITCH

This switch, located within the turn signal knob, has three positions. In the fully released position, the switch passes current through resistance wire to effect a "hold in" magnetic field in the Regulator solenoid. This current is sufficient only to hold the solenoid in place once it has been actuated by the "pull in" circuit. Depressing the button partially allows current to flow to the Regulator solenoid at full voltage which causes the solenoid to pull in. Depressing the button fully opens the circuit to both the resistance and standard solenoid feed wires and the solenoid becomes de-activated.

During vehicle operation the three switch positions have the following functions:

Released

a. System not engaged: No function of the system will occur although a small current is flowing through the solenoid via the resistance wire.
b. System engaged: The small current flowing through the resistance wire is holding the solenoid in the engaged position.

Partially Depressed

Full voltage is applied to the solenoid (vehicle speed over 35 MPH) which sets the Regulator to maintain the vehicle speed at the time of Regulator engagement.

Fully Depressed

No electricity flows to the solenoid and the Regulator is inactive. This position is used by the driver when he desires to raise or lower his controlled speed. He may accelerate to his new speed, press the button fully (regulator releases previously set speed) and release the button. Upon releasing the button, it passes through the partially depressed position and the solenoid is "pulled in", then into released position which provides "hold in" current. The driver may also press the button fully with no pressure on the accelerator pedal. In this case the regulator releases control of the throttle which returns to idle and the car slows. When the button is released the solenoid is pulled in and held in respectively and the regulator resumes speed control at the speed of the vehicle during the moment of button release (at vehicle speeds over 35 MPH).

BRAKE RELEASE SWITCHES

Two brake release switches are employed in the Cruise Master System. When the brake pedal is depressed, an Electric Release Switch cuts off the voltage supplied to the engagement switch, hence cuts off power to the Regulator unit. The Regulator is then disengaged and requires Engagement Switch operation to return it to operation. A Vacuum Release Switch operates simultaneously with the electric release switch whenever the brake pedal is depressed. This switch opens a port to atmospheric pressure which rapidly bleeds down the vacuum in the Servo unit thereby returning the throttle to the idle position.

SERVO UNIT

The Servo unit is a vacuum actuated, variable position diaphragm assembly, which operates the carburetor throttle when the system is in operation. It is powered by controlled vacuum from the Regulator and operates the throttle linkage via the bead chain. The Servo has a port on the sealed side of the diaphragm housing. When controlled vacuum is applied to this port, atmospheric pressure moves the diaphragm which pulls on the bead chain opening the carburetor throttle.

REGULATOR

The Regulator is a device which has two primary functions. First, it is a vacuum switch which, when engaged by the driver, supplies vacuum to a "Tee" fitting. Second, it meters a small variable quantity of air to the "Tee" fitting where it blends with vacuum, thus providing the power unit with controlled vacuum which will

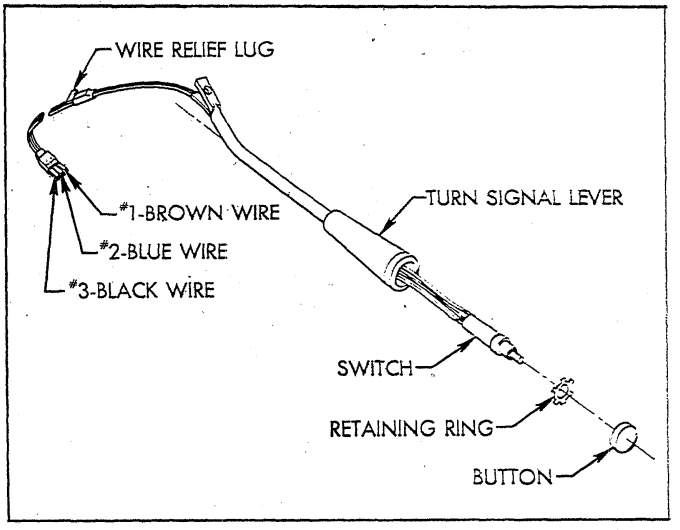


Fig. 2—Cruise Master Engagement Switch

maintain the selected speed. If the Regulator begins to supply less bleed air (vehicle speed decreasing) the vacuum in the chamber increases and the diaphragm moves toward the vacuum port. If the Regulator begins to supply more bleed air (vehicle speed increasing), the vacuum in the chamber drops and the diaphragm moves away from the vacuum port. In operation, at cruise speed, a proper balance of air and vacuum is blended at the "Tee" fitting and is imposed upon the Servo unit to maintain an "on speed" cruise condition. See Fig. 3 & 8.

An additional function of the Regulator is to drive the speedometer. Since the car speed is sensed by a speedometer-like mechanism within the unit, the speedometer cable from the transmission drives the Regulator which drives a second cable (at a one to one ratio) to the speedometer.

The Regulator is electrically engaged and disengaged through operation of the Engagement Switch and the Electric Brake Release Switch. It has two subassemblies which make up the unit: one being the magnetic speed sensing assembly and the other being the solenoid actuated vacuum switch, air bleed and filter, and low limit speed switch assembly. See Fig. 8.

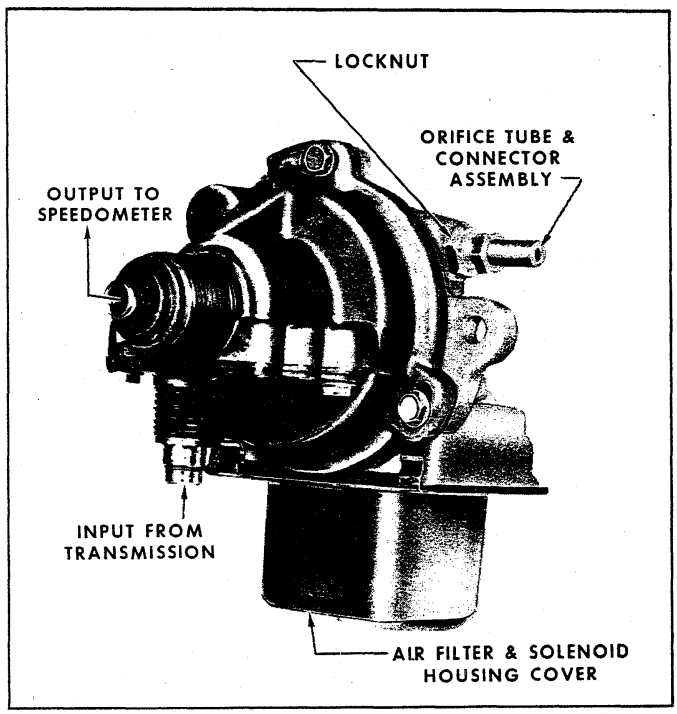


Fig. 3—Regulator Unit

Magnetic Speed Sensing Assembly

The speed sensing assembly operates in the same manner as a speedometer unit except that instead of rotating a needle through an angle proportional to the vehicle speed, it rotates a rubber drum which is clutched to the air bleed valve when the system is in operation. The assembly is driven by the speedometer cable from the transmission which turns a disk shaped ferrite magnet.

Facing the magnetic disk is the driven copper disk mounted on a shaft with the rubber drum mounted on the same shaft. A spiral hairspring connects the shaft to the housing and allows it to rotate through an angle which is proportional to car speed. If the car doubled its speed, the shaft would rotate to twice its previous angle as may be seen by noting the operation of a speedometer. The driven disk is sandwiched between the magnetic disk and a field plate. The field plate forms a returning path for the magnetic field from the magnetic disk.

The input shaft drives both the magnetic disk and the speedometer drive cable.

Vacuum Switch, Air Bleed and Filter, and Low Limit Speed Switch

The end of the shaft from the speed sensing assembly with the rubber drum extends into the air bleed metering assembly. This rubber drum has a tang extending from its surface which allows a set of points to close at a specific car speed. When the car reaches about 35 mph, the rubber drum has rotated far enough (moved by the brass driven disk in the magnetic field) so that its tang has allowed a spring loaded electrical point to contact another point. These points are in series with the solenoid coil so that under 30 mph, no Regulator operation is possible.

Surrounding the rubber drum is a "U" shaped spring clip which is held spread away from the drum by the nose or cam of the solenoid when the solenoid is in the relaxed position. The rubber drum and this clip comprise the speed clutch of the regulator. When the solenoid is energized, the solenoid nose moves toward the drum and releases the ends of the clip. The clip springs inward and attaches itself by friction to the drum. Now, any change in car speed will rotate the drum and move the "U" clip just as a speedometer moves its needle. The top of the "U" clip is attached to the air bleed valve. The clip moves a sleeve which slides on the orifice tube thereby covering and uncovering air ports in the wall of the tube (the tube inner end is plugged) whenever car speed changes from the speed at which the solenoid was energized. The direction of drum rotation is such that resulting bleed valve operation will cause the Servo to decrease engine power if the car exceeds the preset speed and increase engine power if car speed decreases. The air which passes out the orifice tube enters the Regulator through the openings in the solenoid housing, passes through the oil wetted polyurethane filter, and then enters the orifice tube ports.

When the solenoid is de-energized, the nose retracts and cams the ends of the "U" clip outward so that it releases the rubber drum.

The solenoid also operates a vacuum switch simultaneously with the clutching and declutching of the "U" clip. The solenoid operated vacuum valve slides over two ports in the Regulator wall. One port is connected to manifold vacuum and the other is connected to a "Tee" fitting. When the solenoid is de-energized, the valve closes the manifold vacuum port and opens the "Tee" port to the inside of the Regulator case. When the solenoid is energized, the valve connects manifold vacuum to the "Tee" fitting, at which point air is blended to the proper proportion and impressed upon the Servo unit according to the dictates of the Regulator.

During system operation the following events occur:

1. Car speed below 30 MPH--no function of the pull-in circuit because the rubber drum has not rotated far

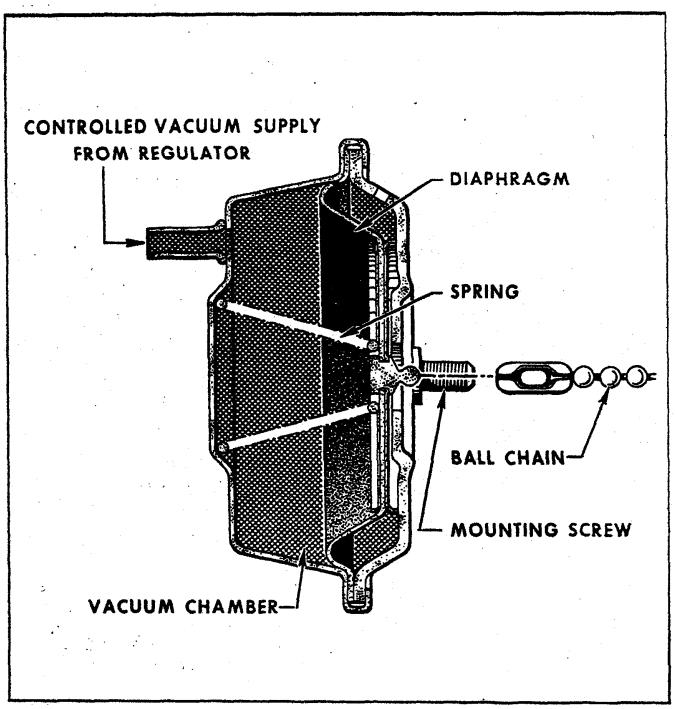


Fig. 4—Servo Unit

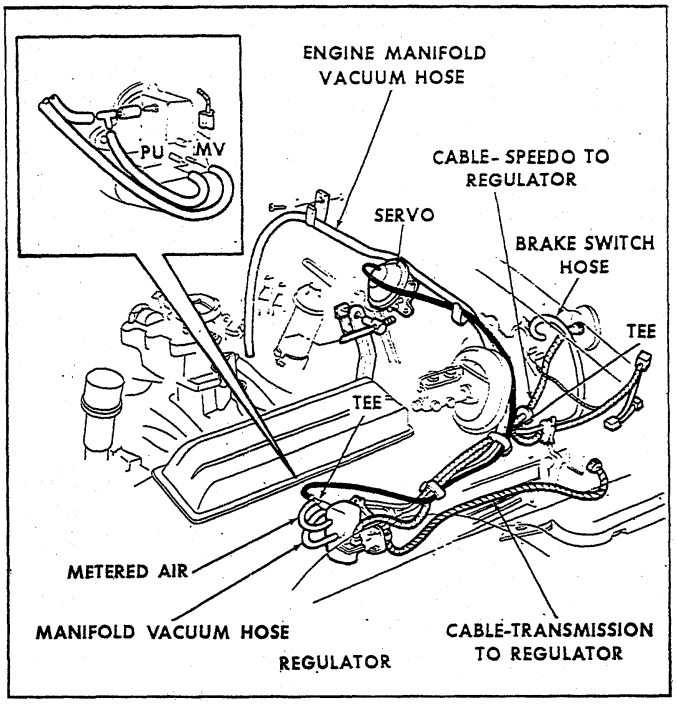


Fig. 6—Servo, Regulator and Hose Routing

enough to close the solenoid points. No pull-in current can flow through the solenoid coil. The solenoid coil is receiving a small current via the 40 ohm resistance wire unless the brake pedal is depressed, engagement switch fully depressed, or the ignition switch is "off".

2. Car speed above 35 MPH--the tang on the rubber has closed the solenoid points. The pull-in circuit is now ready for engagement.
3. Driver partially presses Engagement Switch--full voltage flows through the solenoid to pull it into operation. Solenoid cam tension on the "U" clip is released and the clip grips the rubber drum. Simultaneously, the vacuum switch applies manifold vacuum to the "Tee" fitting. Here the vacuum is blended with air being introduced from the Regulator. The balance of air and vacuum is impressed upon the Servo to provide for initial throttle positioning.
4. Driver releases the Engagement Switch--current flows to the solenoid through the 40 ohm wire and since the solenoid is "pulled in", the reduced current flow is sufficient to hold it in position.
5. The car begins to ascend a hill--car speed drops slightly (very slightly) and the magnetic force on the driven disk of the speed sensor is decreased. The disk rotates slightly (as would a speedometer shaft because of hairspring tension) turning the rubber drum.

Since the "U" clip is gripping the drum, it moves the air bleed valve in that direction which covers the

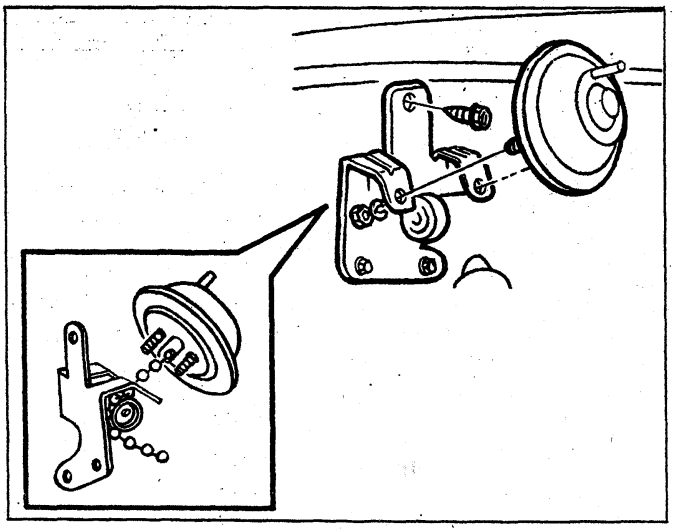


Fig. 5—Servo Mounting

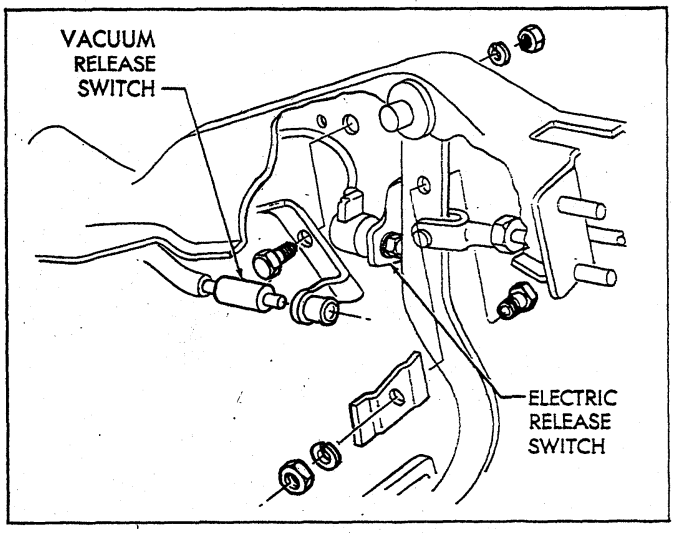


Fig. 7—Release Switches and Brackets

air bleed ports more. With less air bleeding into the "Tee" fitting a higher vacuum level is achieved at the Servo diaphragm, opening the throttle angle to correct for the underspeed condition.

6. The car begins to descend a hill--car speed increases slightly and the air bleed valve moves in that direction which uncovers the air bleed ports. With more air bleeding into the "Tee" fitting, a lower vacuum level is achieved at the Servo diaphragm decreasing the throttle angle to correct for the overspeed condition.
7. Driver accelerates by pressing accelerator pedal--car speed increases and the system responds by moving the diaphragm to decrease throttle opening. Since a bead chain is used, the chain merely relaxes and has no effect on throttle operation. After the driver releases pressure from the pedal, the throttle will close until car speed decreases to the pre-set speed. At that point the Regulator bleeds less air to the "Tee" fitting which opens the throttle enough to maintain the pre-set speed. The system returns to a stable condition.
8. Driver desires higher controlled speed, presses accelerator until new speed is reached, and depresses Engagement Switch fully and releases button --speed sensing assembly tries to turn would decrease the throttle opening until the driver fully depresses the Engagement Switch. Then the current is cut off to the solenoid which retracts; the solenoid cam expands the "U" clip releasing its grip on the rubber drum. The drum and disk assembly then rotates to a new position because of the higher car speed. When the solenoid retracts, it also shuts off vacuum to the "Tee" fitting and opens the vacuum port to atmospheric pressure within the Regulator thereby bleeding down the Servo toward the relaxed position. As the driver releases the Engagement Switch, "pull-in" and "hold-in" of the solenoid occurs, respectively. The system is now engaged to maintain the car speed at the time of Engagement Switch release.
9. Driver desires lower cruising speed, presses Engagement Switch fully, waits until car speed decreases to desires speed then releases Switch--when the Engagement switch is fully depressed the solenoid is de-energized causing the vacuum switch to bleed down the Servo to idle throttle position and the "U" clip of the air bleed valve is released from the rubber drum. The drum and disc assembly is free to rotate to a position which corresponds to vehicle speed as the car slows. When the driver releases the Engagement Switch, the unit "pulls in" and "holds-in" the normal manner. The air bleed valve is clutched to the rubber drum at the car speed corresponding to switch release. Vacuum is again applied to the "Tee" fitting and throttle control is assumed by the Regulator to maintain the car speed at the time of switch release.
10. With system in operation, driver applies brakes--simultaneously the Vacuum Release and Electric Release Switches operate. The Vacuum Switch bleeds air into the Servo. The vacuum is reduced in the Servo and the throttle returns to idle position. The Electric Release Switch cuts off power to the entire system and the solenoid is de-energized. If the driver removes his foot from the brake pedal the

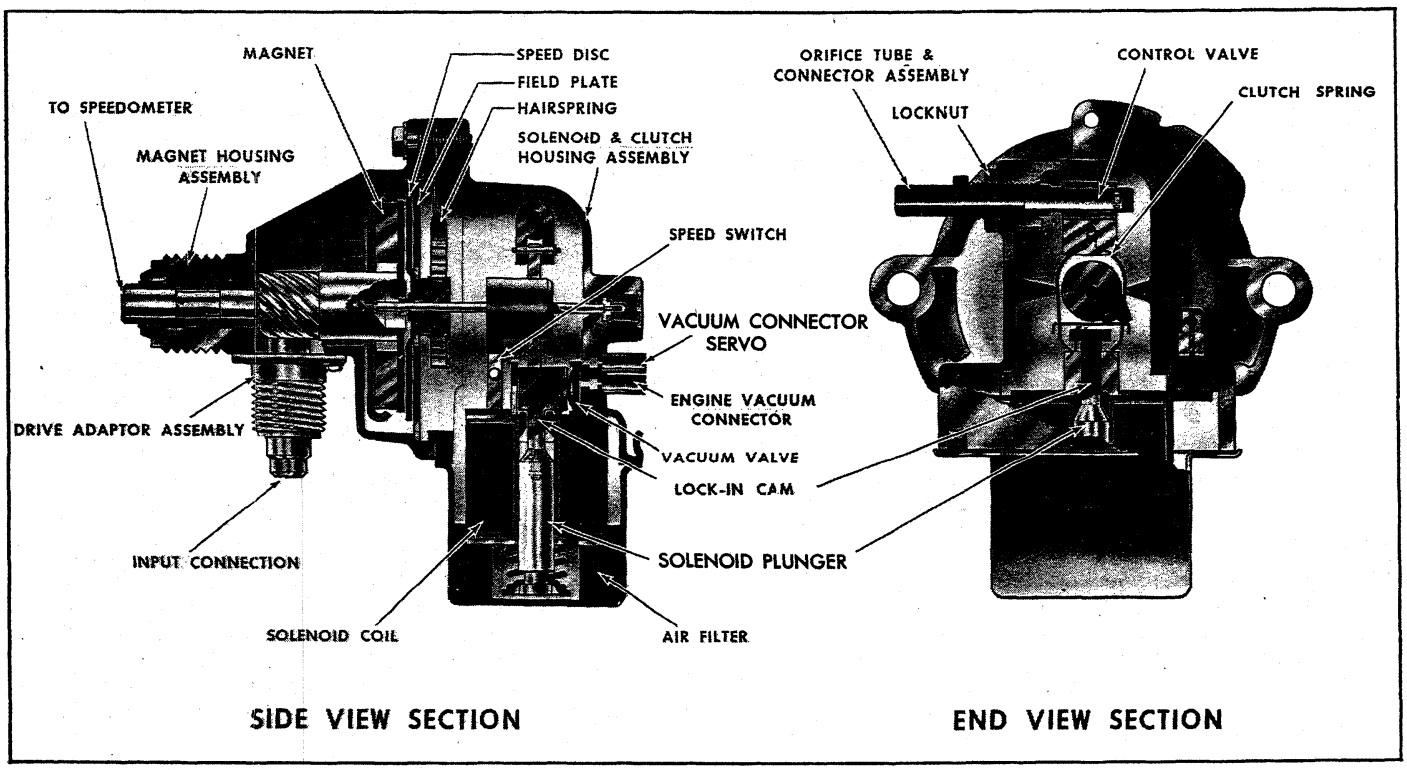


Fig. 8—Regulator Cross Section

Electric Switch again feeds voltage to the Engagement Switch and the Vacuum Switch seals the air bleed line. The unit will not re-engage since it receives only a small current through the 40 ohm resistance wire. If vehicle speed is below 30 MPH the system may not be re-engaged since the tang on the rubber drum has opened the low limit switch points in the Regulator.

SERVICE OPERATIONS

The components of the Cruise Master system are designed to be replaced should they become inoperative.

The Regulator is calibrated in such a manner during manufacturing that overhaul operations are impractical. However, one adjustment may be made to the Regulator to correct speed drop or increase at the time of engagement.

BRAKE RELEASE SWITCHES

Electric

Service - An inoperative switch must be replaced. Switch replacement is identical to standard brake lamp switch replacement.

Adjustment - The brake switch plunger must clear the pedal arm when the arm is moved 1/4 inch measured at the switch (fig. 7).

Vacuum

Service - An inoperative (sticking, plugged, or leaking) switch must be replaced. Switch replacement is similar to brake switch replacement. Be certain that the hose to the switch is connected firmly and is not cracked or deteriorated.

Adjustment - The brake switch plunger must clear the pedal arm when the arm is moved 5/16 inch measured at the switch (fig. 7).

ENGAGEMENT SWITCH

Service - The engagement switch is serviced only by replacement of the turn signal lever assembly.

Removal

1. Disconnect battery ground cable.
2. Disconnect cruise master engagement switch wiring harness plug on steering column.
3. Remove plastic protector from cruise master wiring harness on column.
4. Remove turn signal lever (See Section 9, turn signal steps 1-5).
5. Connect a 15" piece of piano wire to cruise master wiring harness plug, for installation, before easing turn signal lever assembly up and out of column.

Installation

1. Attach new engagement switch harness plug to piano wire routed through column.
2. Pull piano wire gently, routing new switch assembly harness down column.
3. Install turn signal lever per Section 9, Turn Signal Replacement, Reverse Steps 1-5.
4. Slide plastic wiring protector over harness and up column.
5. Connect cruise master wiring harness on column.
6. Attach battery ground cable.

SERVO

Service - If the Servo unit is found to be defective, replacement is required. Note the condition of the hoses and replace any which are cracked or deteriorated.

Adjustment Adjust the bead chain so that it is as tight as possible without holding the throttle open when the carburetor is set at its lowest idle throttle position. When connecting the bead chain (engine stopped) manually set the fast idle cam at its lowest step and connect the chain so that it does not hold the idle screw off the cam. If the chain needs to be cut, cut it three beads beyond the bead which pulls the linkage.

REGULATOR

Maintenance A defective regulator, that is one which is not simply out of adjustment, must be replaced. During replacement, check the hoses which connect to the regulator and replace any which are cracked or deteriorated.

Adjustment

One regulator adjustment is possible: Engagement-Cruising Speed Zeroing (to remove any difference between engagement and cruising speed).

> **NOTE:** No regulator adjustment should be made, however, until the following items have been checked or serviced:

1. Bead chain properly adjusted.
2. All hoses in good condition, properly attached, not leaking, not pinched or kinked.
3. Electric and vacuum release switches properly adjusted.

Engagement—Cruising Speed Zeroing

If the cruising speed is lower than the engagement speed, loosen the orifice tube locknut (see fig. 8) and turn the tube outward; if higher, turn the tube inward. Each 1/4 turn will alter the engagement-cruising speed difference one mph. Tighten the locknut after adjustment and check the system operator at 60 MPH.

ELECTRICAL SYSTEM CHECK OUT

1. Check fuse and connector.
2. Check electric brake switch as follows: Unplug connector at switch. Connect ohmmeter at points A and B on brake switch. The ohmmeter must indicate infinity when the pedal is depressed and continuity when pedal is released. The cruise release brake switch (electric) is adjusted as is the standard stop light brake switch. Replace electric brake switch if needed.
3. Check engagement switch and connecting wiring as follows: Unplug engagement switch connector (brown, blue, black) at electrical wiring harness

connector and perform the following tests. (See fig. 9).

Test #1 - Connect ohmmeter between terminal #1 (brown wire) and terminal #2 (blue wire). Continuity shall be maintained until switch is depressed all the way in.

Test #2 - Connect ohmmeter between terminal #1 (brown wire) and terminal #3 (black). No continuity shall be shown; however, when the button is depressed halfway, continuity shall be indicated. When the button is pressed all the way down, no continuity shall be shown.

Test #3 - Connect ohmmeter between terminal #2 (blue wire) and terminal #3 (black). Button released, no continuity; however, when the button is depressed partially and fully, continuity shall be shown.

4. Disconnect engage switch wire harness connector from the main harness connector (red, brown/white, and white wires). Connect ohmmeter between point C (brown/white stripe wire in main wire harness) and ground. Make sure the regulator is well grounded to the chassis. The ohmmeter should read between 42 and 49 ohms. If a resistance either above or below the value indicated is shown, then disconnect the connector from the regulator and measure the resistance of the brown/white stripe wire from point C to D. It should measure 40 ohms ± 2 ohms.

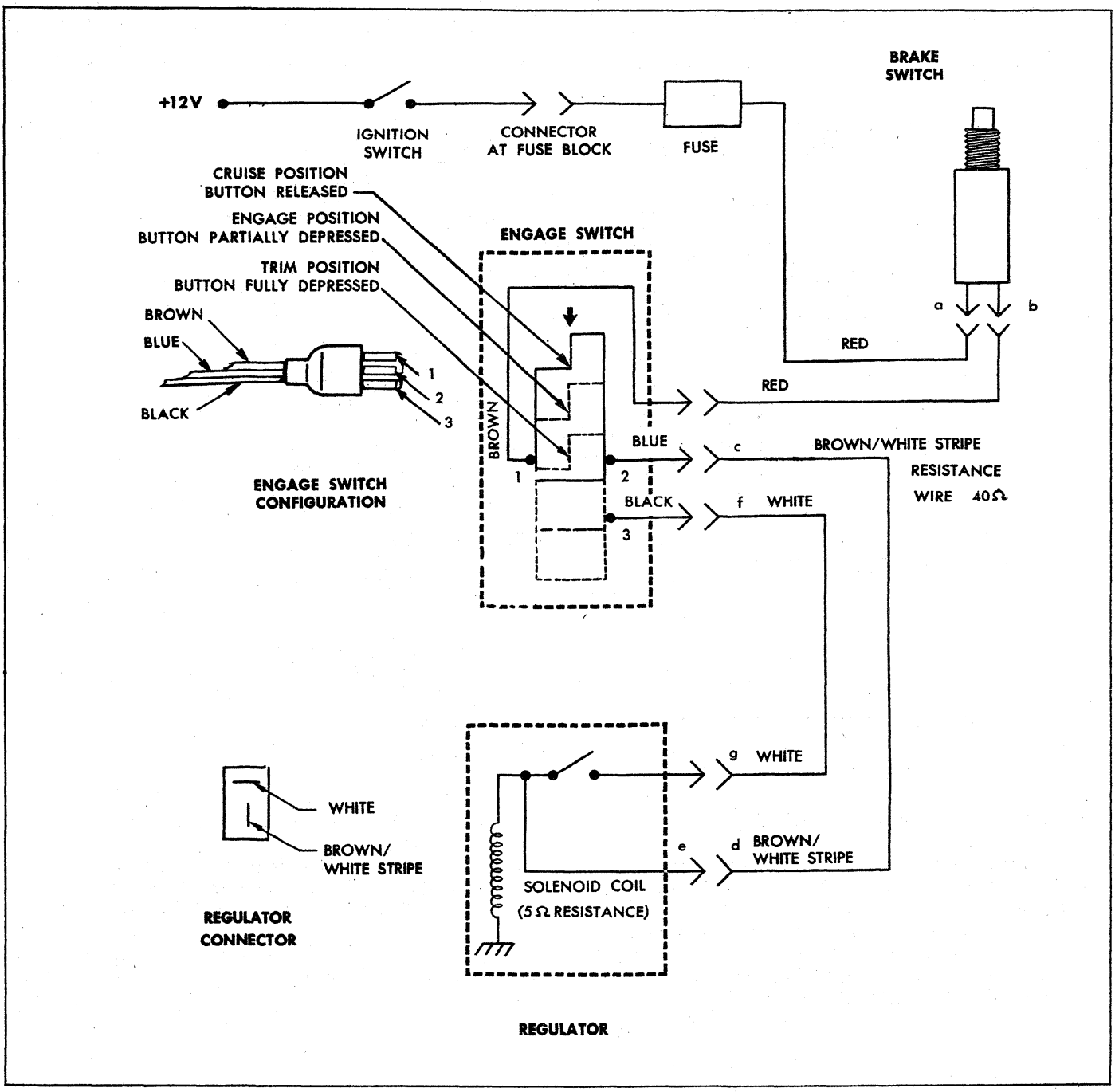


Fig. 9—Cruise Master Wiring Diagram

If a resistance either above or below the value indicated is shown, the main wiring harness should be replaced. Note: When disconnecting or reconnecting the main wiring harness connector from the regulator, care should be exercised so as not to damage the blade connectors or the wiring harness. The disconnect may be facilitated by prying carefully on the plastic connector with a small blade screw driver.

When measuring the solenoid coil circuit resistance between Point E (Hold Terminal) to ground the ideal ohmic resistance should be between 5 and 6 ohms. A reading of less than 4 ohms indicates shorting in the coil circuit. A reading of more than 7 ohms indicates excessive resistance in the coil circuit. Either extremity indicates replacement of the regulator assembly. The white main harness wiring from Point F to G should also be checked for continuity.

Engagement Switch Test

BUTTON POSITION	TERMINALS		
	1 TO 2	1 TO 3	2 TO 3
Cruise (released)	closed	open	open
Engage (partially depressed)	closed	closed	closed
Trim (fully depressed)	open	open	closed

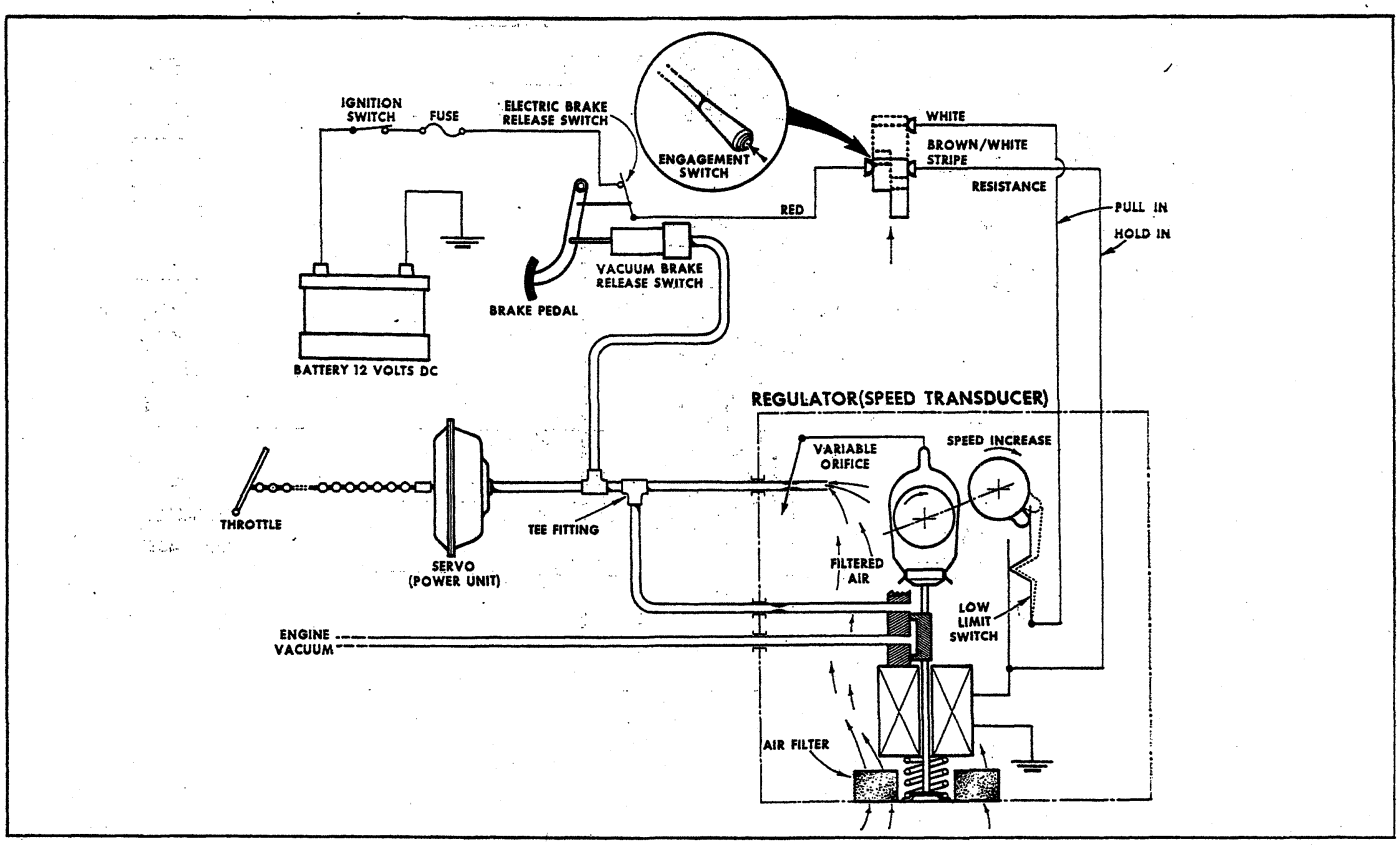


Fig. 10—Vacuum and Electrical Diagram

Servo and Vacuum System Check Out

To determine the condition of the diaphragm, remove hose from servo unit and apply 14 inches of vacuum to the tube opening and hold in for one minute. The vacuum shall not leak down more than 5 inches of vacuum in one minute. If leakage is detected, replace servo. To utilize engine as a vacuum source, proceed as follows:

1. DISCONNECT SERVO BEAD CHAIN and hose from servo then connect engine vacuum directly to the servo fitting.
2. Note position of servo diaphragm.
3. Start engine - the diaphragm should pull in.
4. Clamp off engine vacuum supply line and check for leakage.

The cruise release brake switch (vacuum) and connecting hoses can likewise be checked using a vacuum pump.

CRUISE MASTER SYSTEM CHECKS

PROBLEM	CAUSE	CORRECTION
Will not engage—System Inoperative	Brake Switch Circuit Open Clutch Switch Circuit Open	Check connections—adjust or replace switch. Refer to Electrical Check Out.
	Fuse blown	Replace fuse—if it blows again, check for: 1. Engage Switch stuck in the center of travel—Refer to Electrical Check Out. 2. Incorrect wiring—Refer to Electrical Check Out. 3. Short to ground—Refer to Electrical Check Out. Make necessary corrections.
	Defective Engage Switch	Replace as needed—Refer to Electrical Check Out.
	Vacuum leak in Servo and/or Brake Switch and connecting lines. Vacuum hose not connected to vacuum switch.	Vacuum test and repair or replace as needed. Refer to Servo and Vacuum System Check Out.
	Vacuum release switch misadjusted (always open)	Readjust switch.
	Crossed hose at regulator	Reroute hoses.
	Open in wiring harness	Repair or replace as needed.
	Pinched or plugged hose that is connected to the Servo.	Free or replace hose.
	Defective Regulator	Replace Regulator.
Does not cruise at engagement speed	Orifice Tube misadjusted	Adjust as required.
System hunts, pulses, or surges	Bead Chain loose	Tighten Bead Chain.
	Kinked or deteriorated hoses (air leak)	Repair or replace.
	Defective and/or improperly positioned Drive Cables and/or Casing Assemblies	Repair or replace as needed.
	Defective Regulator	Replace Regulator.
System does not disengage—with brake pedal	Brake and/or Vacuum Switch-misadjusted or defective	Adjust or replace as required. Refer to Servo and Vacuum System Check Out and Electrical Check Out.
	Red wires (which should be connected to the pedal switch(es)) connected to the fuse block	Reroute wires to stoplight switch.
System steadily accelerates or applies full throttle when engaged	Manifold vacuum connected directly to Servo	Reroute hose.
	Defective Regulator	Replace Regulator.
Cannot adjust speed downward with Engage Button	Defective Engagement Switch or Wiring	Replace as needed. Refer to Electrical Check Out.
Does not engage or engages lower than limits referred to in "Driver Operation"	Defective Regulator	Replace Regulator.
Slow throttle return to idle after brake is depressed.	Pinched air hose at vacuum release switch	Free or replace hose.
System operates correctly, but constant vacuum bleed when system is disengaged.	Crossed vacuum hoses at regulator	Reroute hoses.
High engine idle speed—independent of carburetor adjustments. Constant air bleed through system.	Tight Servo Chain	Loosen chain adjustment.
Constant drain on battery.	Power lead connected to "Fused Battery" terminal of fuse block	Reroute to "Fused IGN" terminal.
System can be engaged at idle by depressing switch, but will drop out when switch is released. Solenoid can be heard when switch is depressed when the vehicle is standing still.	Wires reversed at regulator	Reverse wires—See Fig. 10.

AUTOMATIC LEVEL CONTROL

INDEX

	Page
General Description	15-10
System Checks and Adjustments	15-11
Service Operation	15-13

GENERAL DESCRIPTION

The optional automatic level control is used only in conjunction with the Superlift Shock Absorber option. The pneumatic level control system automatically maintains correct rear trim height of a car under varying load conditions.

The Superlift Shock Absorber option alone, consists of the two shock absorbers with pressure lines to a "Tee" where a fill valve is located. The shocks are inflated with (or deflated of) compressed air (at any gas station) to obtain the vehicle level desired with any given load change.

The automatic leveling system is added to the Superlift Shock Absorbers and supplies its own compressed air. The system (fig. 11) consists of a vacuum operated air compressor with pressure regulator and integral storage tank, vacuum line to engine, air intake filter, air lines, and a height control valve.

The COMPRESSOR is a two-stage, vacuum actuated type, requiring no lubrication. Vacuum supply is taken from engine carburetor base. High pressure air is supplied to the reservoir tank by the second stage of the two-stage compressor. The first stage intake stroke draws air at atmospheric pressure through a oneway check valve located in the end of the first stage housing under the first stage housing cover. On the first stage compression stroke, the intake valve is closed and the oneway check valve in the second stage end of the piston is opened. This allows the air from the first stage cylinder to flow through the hollow piston into the second stage cylinder for high pressure compression. The second stage compression stroke closes the check valve in the piston and opens the check valve in the end of the second stage housing.

The intake and compression strokes are controlled by a sliding distributor valve that is actuated through an arm that is tripped by the piston as it nears the end of each stroke. Each time the arm actuates the distributor valve, a different set of holes are covered in the first stage housing. The distributor valve controls the flow of intake manifold vacuum and air under atmospheric pressure, alternately to opposite sides of the compressor diaphragm.

As the compressor cycles, the reservoir air pressure gradually increases causing a back pressure on the second stage piston until it equals the push of pressure against the diaphragm. At this point, a balanced condition is reached and the unit stops operating. After reservoir pressure drops due to system air usage, the compressor again begins to cycle and replenish the reservoir.

Pressure balance will depend upon the prevailing manifold vacuum and atmospheric pressure. Both are affected by altitude above or below sea level. Balance pressure will vary from approximately 150 to 275 psi.

NOTE: After completion of work on this system or when servicing other parts of the car and the system is deflated, inflate the reservoir to 140 psi or maximum pressure available through the compressor service valve.

The PRESSURE REGULATOR VALVE is preset and limits the reservoir outlet pressure to approximately

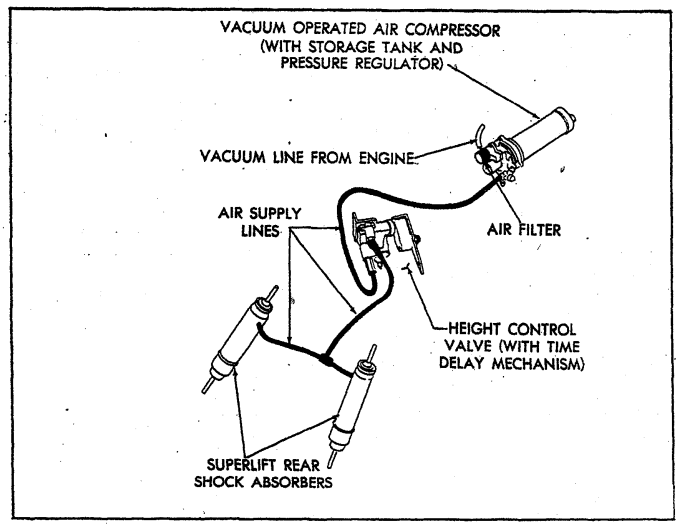


Fig. 11—Automatic Level Control Schematic

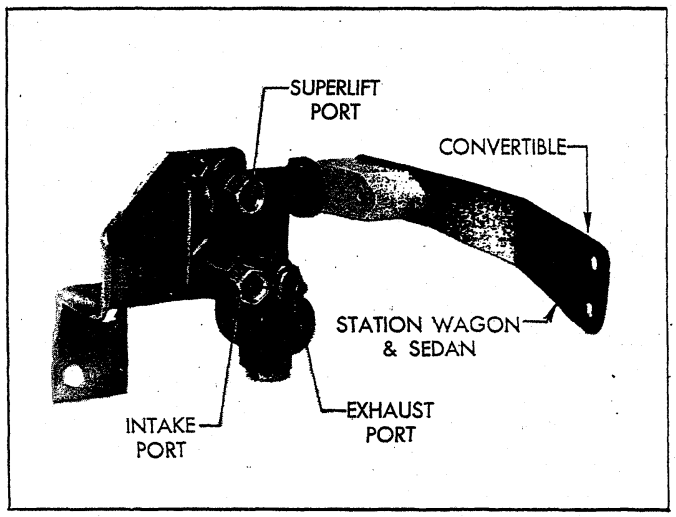


Fig. 12—Height Control Valve

125 psi to avoid damage to the height control valve and Superlift shocks.

The HEIGHT CONTROL VALVE, which is mounted on the frame, senses rear car height through a link attached to the right rear upper control arm. When load is added to the car, the overtravel lever is forced up causing an internal lever to open the intake valve. When this valve is open high pressure air is admitted to the Superlift shocks. As the car raises to level, the intake valve shuts off.

When load is removed from the car, the overtravel lever is forced down causing the internal arm to open the exhaust valve. As the car lowers to the level position, the exhaust valve shuts off.

A four to eighteen second time delay mechanism, which is built into the height control valve, prevents air transfer due to normal ride movements. The overtravel lever, which pivots around the control valve shaft, rides off the flat side of the control valve shaft and does not have time to react to the rapid changes or normal ride motions.

During changes due to loading, the time delay mechanism will allow the overtravel shaft to open either the intake or exhaust valve as required, since this is not a rapid movement.

The SUPERLIFT shock absorber is essentially a conventional hydraulic unit with a pliable nylon reinforced neoprene boot acting as an air chamber.

The unit will extend when inflated and retract when deflated by the control valve.

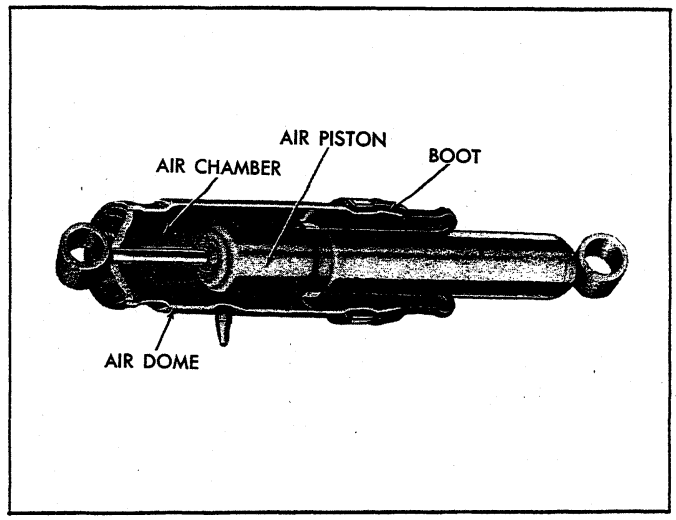


Fig. 13—Superlift Absorber

An eight to fifteen psi air pressure is maintained in the Superlift at all times to minimize boot friction. This is accomplished by a check valve in the exhaust fitting on the control valve. Neither shock absorber function nor conventional ride motions thru rear coil springs is impaired in the event of accidental air pressure loss.

A combination of steel tubing and reinforced rubber hose is used for air lines throughout the system.

CHECKS AND ADJUSTMENTS

SYSTEM TEST

A complete system test includes on and off-the-car component tests.

On the car tests are:

- Quick check of Automatic Level Control System
- Compressor output test
- Regulator test and adjustment
- Control valve test
- Time delay test
- Line and fitting leak test
- Trim adjustment

Off-the-car operations include:

- Control valve replacement
- Compressor repair
- Component leak tests
  - a. Compressor, reservoir, and regulator
  - b. Control valve
  - c. Superlifts

Quick Check-On Car (Reservoir Pressure at 150 PSI)

1. Fill the fuel tank or simulate at the rate of 6 lbs./gal. - otherwise car should be empty.
2. Turn engine off.
3. Add a 2 passenger load to the rear bumper or tailgate. Maintain the load until the car lifts or AT LEAST 20 SECONDS.
4. After car lifts remove the load and observe until the car lowers.

Automatic Level Control Test Gauge

NOTE: To service the Automatic Level Control it will be necessary to secure Gauge Set J-22124 or make up the following test gauge. If the connectors indicated are not readily available others may be substituted.

1. Collect the following parts:
   a. Fill Valve, J-21999
   b. A tee which has three 1/8" female taper pipe threads
   c. An adapter which has a 1/4" female taper pipe thread on one end and a 1/8" male taper pipe thread on the other end.
   d. Air Pressure Gauge, J-4872
   e. Two metal sleeves, rubber seals and the tube nuts
   f. A length of 1/8" tubing.
   g. Two male connectors which have a 1/8" male taper pipe thread on one end and a 3/8-24 straight thread male fitting on the other end.
2. Assembly
   a. Connect Fill Valve, J-21999, (female end) at male connector 3/8-24 straight thread fitting.
   b. Connect other end of male connector to tee.
   c. Connect adapter to tee.
   d. Connect pressure regulator to adapter.
   e. Connect second male connector to tee, (1/8 inch male pipe thread fitting).

f. Install tubing to connector; other end of tubing will go on unit to be checked.

NOTE: Make certain all fittings are air tight.

Compressor Output Test—On Car

1. With all accessories off, run the engine until fast idle screw is off the fast idle cam. Turn off ignition.
2. Deflate system through service valve, then remove high pressure line at regulator adapter and connect test gauge.
3. Inflate reservoir to 70 psi through service valve.
4. Observe test gauge for evidence of compressor air leak.
5. If leaking, proceed to leak test-compressor reservoir, and regulator. If not leaking, continue this test.
6. With engine running at slow idle, observe reservoir build-up for five minutes. Reservoir pressure should build up to a minimum of 90 psi.
7. If compressor fails to cycle, make sure the vacuum and air intake lines are open and unobstructed before removing compressor for repair.
8. If build-up is too slow, proceed to repair compressor.
9. Satisfactory build-up indicates system problem to be in the control section. However, again observe the test gauge for evidence of an air leak and proceed accordingly.

Regulator Test and Adjustment

Performance test the regulator with a known good compressor on the car.

1. Deflate system through service valve and disconnect line at pressure regulator valve. Install test gauge on regulator valve high pressure fitting.
2. Inflate system through service valve to maximum available pressure.

   NOTE: If available pressure is less than 140 psi, start engine to build-up reservoir to this pressure.

3. Regulated pressure should build-up to and hold steady at 100-130 psi on test gauge.
4. Check regulated pressure by momentarily (not more than one second) depressing valve core on test gauge and observe gauge reading.
5. If regulated pressure now reads less than 100 psi, replace regulator assembly.
6. If regulated pressure exceeds 130 psi, replace regulator assembly.

Control Valve Test

Exhaust (Superlifts Inflated)

1. Disconnect control valve lever from link.
2. Hold lever down in exhaust position until Superlifts deflate or for a minimum of 18 seconds.
3. If Superlifts deflate, perform Intake Check.
4. If Superlifts do not deflate, remove exhaust adapter from control valve and hold lever down as in Step 2. Replace adapter, O-ring and filter if this deflates Superlifts.
5. Replace control valve if none of the above steps solve problem.

Intake (Reservoir Pressure 125 psi Minimum)

1. Disconnect overtravel lever from link.
2. Hold lever up in intake position until Superlifts inflate or for a minimum of fifteen seconds.
3. If Superlifts inflate and hold, proceed to Time Delay Check.
4. If Superlifts inflate and then leak down, perform leak test on lines and fittings and then on Superlifts and control valve. Repair or replace as indicated.

Time Delay Test (Reservoir Pressure 125 psi Minimum)

1. Record rear trim height of empty car (rear bumper to ground).
2. Add weight equivalent to two passenger load to rear of car. Car should begin to level in 4-18 seconds.
3. Remove weight. After 4-18 seconds car should begin to settle.
4. Replace valve if time delay is not within the 4-18 seconds.

Trim Adjustment—On Car

Trim adjustment should be performed with a full fuel tank (or the equivalent in load at the rate of 6 lbs./gallon), but no other load.

Abbreviated Adjustment

1. Fill the compressor at the service valve with the available air line pressure.
2. Disconnect link from height control valve lever. Move the height control valve lever upward until air fills the Superlifts.
3. Move lever downward and hold until air stops escaping from the exhaust port of the height control valve. The Superlifts will now automatically hold 8 to 15 psi.
4. Let lever go to its neutral position and loosen the lever adjustment nut.
5. Assemble the link to the height control valve lever and tighten the lever adjustment nut.

   NOTE: Do not move control valve lever and overtravel body while tightening nut.

Leak Tests

Compressor, Reservoir and Regulator

1. Remove assembly intact.
2. Connect test gauge to regulator. Inflate reservoir through service valve to 80-110 psi.
3. Route an 8" rubber hose between vacuum and vent ports, (fig. 14).
4. Submerge in water and observe for air leaks at:
   Reservoir weld seam.
   Reservoir to compressor O-ring.
   Regulator to compressor O-ring.
   Regulator boot-defective internal O-ring.
   Diaphragm between first and second stage housings. Tightening through bolts may correct the leak.
   Cover gasket and retainer screw. A few bubbles here is not a leak. A continuous stream indicates defective compressor check valves.
   Service valve.
   Test gauge connections.
5. Correct any leaks detected by either tightening screws or replacing parts.

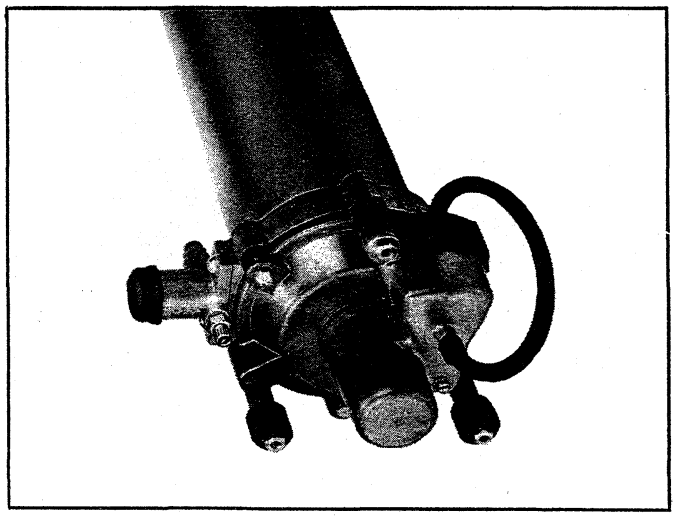


Fig. 14—Assembly Leak Test Procedure

Control Valve

1. Remove control valve unit from car.
2. Clean exterior of control valve thoroughly.
3. Connect test gauge and air pressure souce to intake adapter and open air pressure (80-110 psi).
4. Submerge unit in water. No air should escape if overtravel lever is in "neutral" position. If bubbles escape from Superlift port, replace control valve.
5. Shut off air pressure and detach test gauge from air intake port. Plug intake port with Fill Valve, J-21999 (female end).
6. Connect test gauge to Superlift port and open air pressure.
7. With overtravel lever in "neutral" position no air should escape. If bubbles escape from exhaust port, replace control valve.
8. If air escapes around edge of cover plate, tighten screws on replace gasket.
9. Remove control valve from water. Actuate overtravel lever to expel any water from unit.
10. Shut off air pressure and remove line from Superlift port.

Lines and Fittings

1. Disconnect overtravel lever from link.
2. Hold lever up in intake position for maximum Superlift inflation and release.
3. Leak check all connections with a soap and water solution.

Superlifts

1. Disconnect lines and remove unit from car.
2. Inflate individually to 50-60 psi utilizing Fill Valves J-21999. Submerge in water and observe unit for leaks.
3. Install Superlifts.

SERVICE OPERATIONS

CONTROL VALVE

Removal

1. Deflate system using service valve.
2. Disconnect two air lines at leveling valve intake and Superlift ports.
3. Disconnect link from overtravel lever by removing one nut and lock washer.
4. Remove two screws securing leveling valve to frame and remove leveling valve.

Installation

1. Install control valve with two screws, with time delay mechanism down.
2. Secure link to overtravel lever with one nut and lock washer. On all station wagons series the link is secured to the lower hole. On all other series cars with standard springs, the link is secured to the upper hole.
3. Connect air lines at control valve intake and Superlift port.
4. Inflate reservoir to 140 psi or maximum pressure available through service valve.

COMPRESSOR, RESERVOIR AND REGULATOR

Removal and Installation

1. Disconnect air lines at compressor end.
2. Disconnect pressure line at compressor head.
3. From wheel side of fender skirt, remove two screws from bracket on compressor end.
4. Remove nut and washer from reservoir stud at bracket and remove assembly from vehicle.
5. Remove compressor end mount bracket.
6. Reverse Steps 1-5 for installation, then leak check fittings.

COMPRESSOR, RESERVOIR AND REGULATOR

Disassembly Into Major Components (Fig. 15)

The compressor is a precision-built mechanism. All parts should be carefully handled and assembled. Take care to prevent entrance of dirt or foreign matter. DO NOT LUBRICATE as unit is designed to run dry.

1. Remove compressor as described above.
2. Remove three flexible mounts and three adapters.
3. Remove reservoir retaining through bolt, cover retaining screw and cover gasket that secure cover and gasket to first stage housing. Remove cover and discard gaskets.
4. Remove two regulator retaining screws, regulator assembly and O-ring from second stage housing. Discard O-ring.
5. Remove three nuts at reservoir flange and two through bolts that enter from flanged side of reservoir. Separate reservoir and O-ring. Discard O-ring.
6. Remove three compressor retaining through bolts that secure second stage housing to first stage housing.
7. Slide second stage (small diameter) housing straight off piston.
8. Disconnect arm tension spring from swivel arm.
9. Remove arm pivot screw and actuating arm.
10. Slide piston assembly straight out of first stage housing.

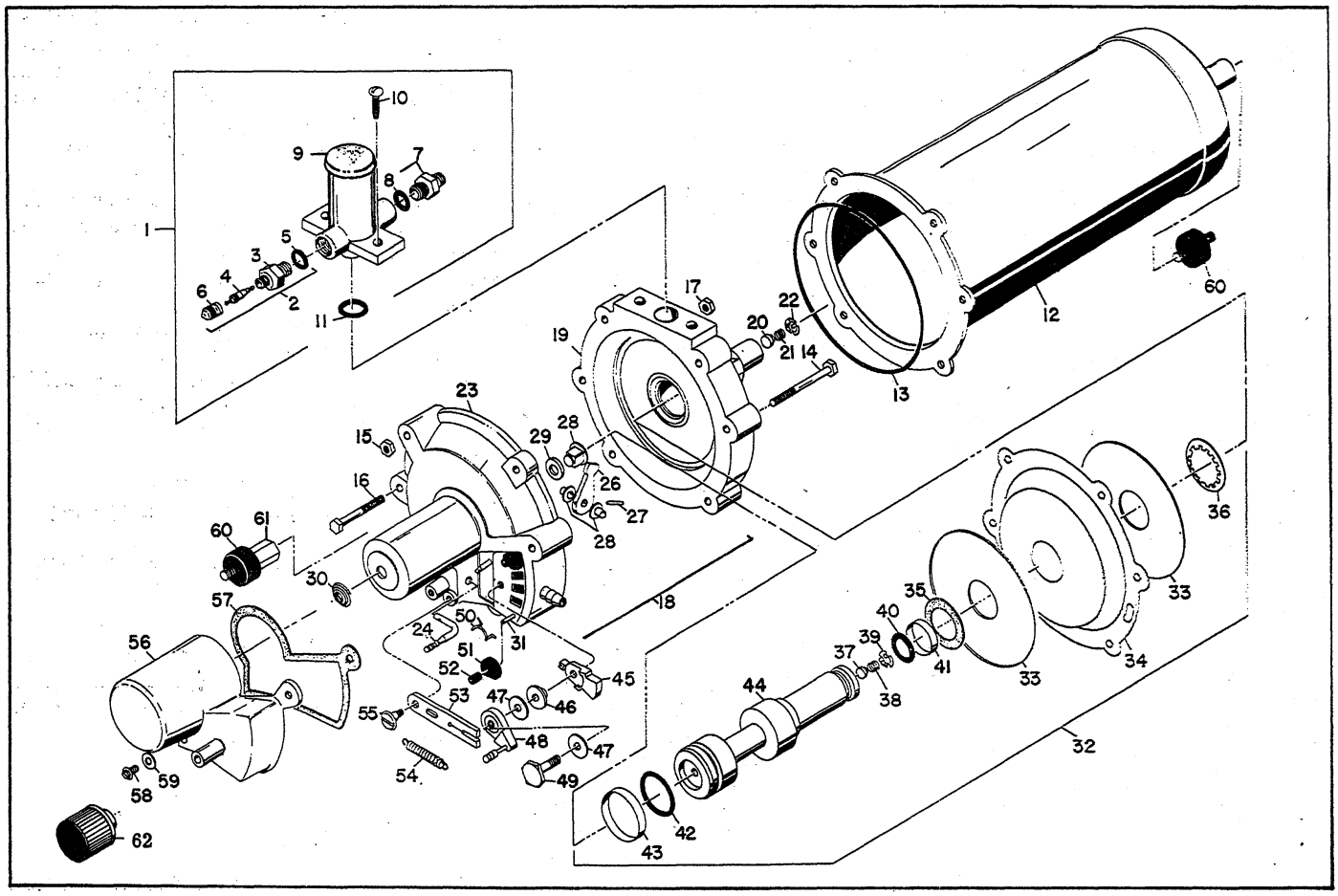


Fig. 15—Compressor, Regulator and Reservoir Exploded View

1. Regulator Assembly
2. Adapter Assembly
3. Adapter
4. Valve Core
5. "O" Ring
6. Cap
7. Adapter Assembly
8. "O" Ring
9. Boot
10. Screw, Regulator Retaining
11. "O" Ring, Regulator to Compressor
12. Reservoir
13. "O" Ring, Reservoir to Compressor
14. Thru Bolt, Reservoir Retaining
15. Nut, Thru Bolt Reservoir
16. Thru Bolt, Compressor Retaining
17. Nut, Thru Bolt Compressor
18. Compressor Assembly
19. Housing, 2nd. Stage
20. Check Valve
21. Spring
22. Expansion Plug Retainer
23. Housing, 1st Stage
24. Arm, Swivel
25. Bushing
26. Arm, Rocker
27. Pin, Rocker Arm Retaining
28. Intake Valve
29. Washer
30. Spring, Intake Valve Retaining
31. Pin, Bushing Retaining
32. Piston Assembly
33. Plate, Diaphragm
34. Diaphragm
35. Washer (.760-.765 I.D.)
36. Retainer, Diaphragm
37. Check Valve
38. Spring
39. Expansion Plug Retainer
40. "O" Ring (.357-.367 I.D.)
41. Seal (.569-.571)
42. "O" Ring (.732-.742 I.D.)
43. Seal (.943-.945)
44. Piston
45. Distributor Valve
46. Bushing, Distributor Valve
47. Washer (.160-.163 I.D.)
48. Arm Assembly, Distributor
49. Screw
50. Spring, Valve Tension
51. Bushing, Distributor Valve Stop
52. Bushing, Arm Assembly Stop
53. Arm Actuating
54. Spring, Arm Tension
55. Screw, Arm Pivot
56. Cover
57. Gasket
58. Screw, Cover Retaining
59. Gasket, Cover
60. Mount, Flexible
61. Adapter
62. Filter

Disassembly, Inspection and Assembly of Major Components (Fig. 15)

Diaphragm

1. Inspect diaphragm for holes, looseness or other defects and replace if necessary.
2. Remove diaphragm retainer with diagonal pliers and discard.
3. Remove diaphragm plate, diaphragm, second diaphragm plate and corprene washer from piston.
4. Install new corprene washer, old plate, new diaphragm with outer lip toward second stage side, (fig. 15) and second plate. Plates should be installed so that lip on each plate faces away from diaphragm.
5. Use a 13/16 inch deep socket as a pilot for the new diaphragm retainer. Press against the piston shoulder on first stage side, (fig. 16) to position diaphragm retainer. The wood blocks used in the illustration are each 3/4" x 3/4" x 12".

NOTE: Position diaphragm retainer securely to effect air tight seal against corprene washer.

Seals

1. Inspect seals for evidence of excessive wear or

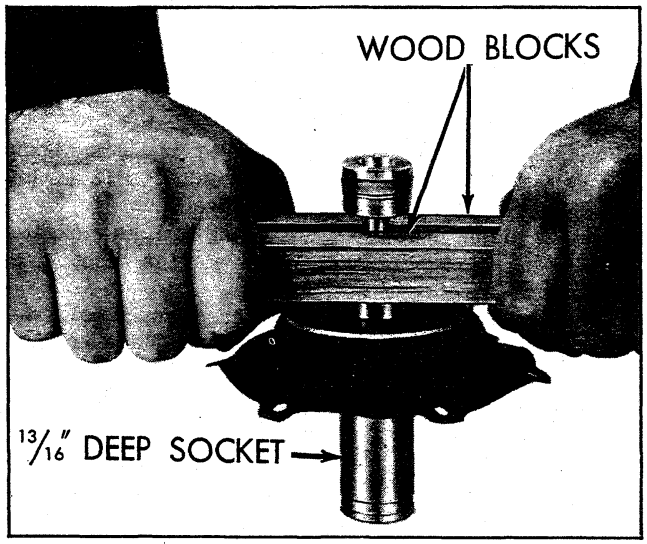


Fig. 16—Installing Diaphragm Retainer

coring. If necessary replace seals and O-rings.
2. Remove seals and O-rings from piston.
3. Install new O-rings by rolling into groove. Relieve any resulting twist.
4. Install new seals using a piece of .020" shim stock, (fig. 17). Make sure shim stock has no sharp edges that may cut seal. Do not stretch seal more than necessary to install. Seals should be installed so they are not twisted.

Distributor Valve Mechanism and Intake Valve (First Stage Housing)

NOTE: Actuate distributor valve with finger. Valve tension spring should press against distributor valve, holding it against either stop. If valve action is not free and positive, it will be necessary to rebuild using new parts in Distributor Valve and Arm Package. If action is free and positive and upon disassembly there are no damaged parts, parts may be re-used.

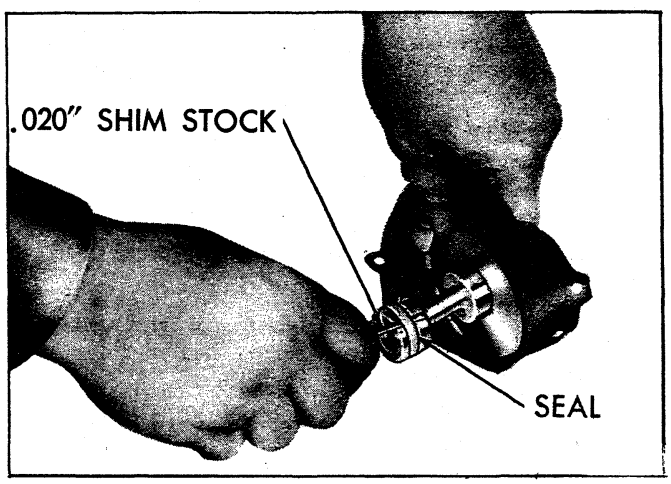


Fig. 17—Installing Seal

Disassembly

1. Remove screw, washer, distributor arm assembly, washer, and distributor valve bushing.
2. Remove two arm assembly stop bushings and two distributor valve stop bushings.
3. Carefully remove distributor valve being careful not to distort valve tension spring.
4. Remove valve tension spring from housing boss, again being careful not to distort valve tension spring.
5. Remove intake valve retaining spring, intake valve and washer using pocket knife.
6. If necessary, remove rocker and swivel arms. Position pin for removal by prying with screw driver, (fig. 18). Grip pin with water pump pliers and remove pin. Remove swivel arm, rocker arm and bushings.

Cleaning and Inspection

1. Clean all parts in clean solvent except distributor arm assembly and blow dry with compressed air.
2. Inspect distributor valve for cracks. Discard if damaged.
3. Inspect all other parts for wear or damage.

Assembly

1. If removed, position bushings in first stage housing and install rocker arm and swivel arm. Align hole in rocker arm with swivel arm and install rocker arm retaining pin, small end first.

   NOTE: If distributor mechanism failed to function properly or one or more parts were found defective, use new parts in distributor valve and arn package during remaining build-up.

2. Install washer on intake valve and install in first stage housing with intake valve retaining spring.
3. Install longer leg of valve tension spring into boss

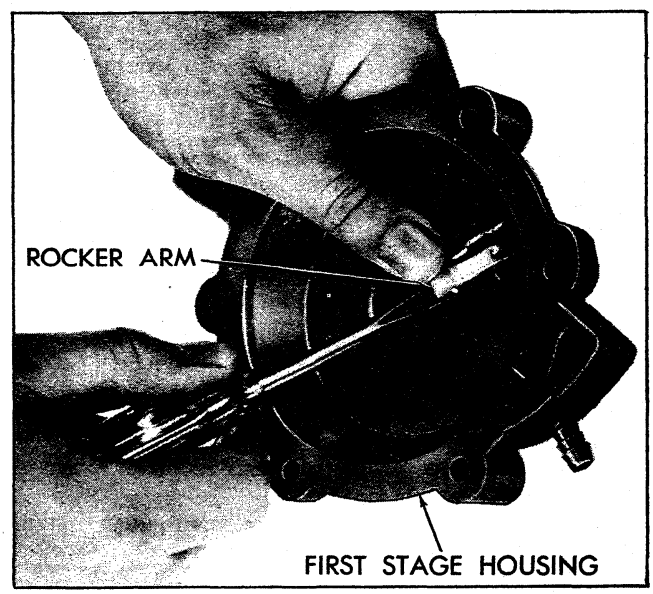


Fig. 18—Removing Rocker Arm

on first stage housing being careful not to distort valve tension spring.
4. Position distributor valve being careful not to distort valve tension spring.
5. Install two distributor valve stop bushings and two arm assembly stop bushings.
6. Install distributor valve bushing, washer, distributor arm assembly, and washer and secure with screw. Tighten to 12 in. lbs.

NOTE: Do not install remaining parts at this time as rocker arm must be free to permit entrance of piston into first stage housing.

Check Valve Replacement (Second Stage Piston)

1. Pry out expansion plug retainer on second stage piston (with pointed tool) and remove spring and check valve.
2. Pour a small amount of clean solvent through bore in piston and blow dry with compressed air. Check valve seat should be smooth and clean.
3. Install new check valve and spring.
4. Insert new expansion plug retainer and tap in until it bottoms.

Check Valve Replacement (Second Stage Housing)

1. Pry out expansion plug retainer on second stage housing (with pointed tool) and remove spring and check valve.
2. Clean second stage housing with clean solvent and blow dry with compressed air. Check valve seat should be clean and smooth.
3. Install new check valve and spring.
4. Insert new expansion plug retainer and tap in until it bottoms.

COMPRESSOR, RESERVOIR AND REGULATOR

Assembly From Major Components

1. Slide piston assembly straight into first stage (large diameter) housing.
2. Install actuating arm and secure to first stage housing with arm pivot screw, tightening to 12 in. lbs.
3. Connect arm tension spring to swivel arm.
4. Rotate piston in first stage housing to align elongated hole in diaphragm with vent port in first stage housing.
5. Install three compressor retaining through bolts that secure second stage housing to first stage housing. Housing will align one way only. Nuts are positioned in counterbores in second stage housing. Tighten to 28 in. lbs.
6. Install new O-ring on second stage housing. Wash inside of reservoir in clean solvent and blow dry with compressed air. Install reservoir on second stage housing with three nuts, tightening to 28 in. lbs. Install two reservoir retaining through bolts, tightening to 28 in. lbs. Through bolt heads should be positioned against reservoir. Leave out through bolt that secures cover.
7. Install new O-ring on regulator and secure regulator with two regulator retaining screws, tighten to 35 in. lbs. Service valve should be on same side as first stage housing.
8. Install new gasket, cover, and secure with cover retaining screw and new cover gasket. Tighten cover retaining screw to 35 in. lbs. Install through bolt so head is positioned against reservoir. Tighten through bolt to 28 in. lbs.
9. Install three adapters and flexible mounts.
10. Proceed to compressor output test on car.

RADIO

INDEX

	Page
Removal (Except Corvette)	15-16
Removal (Corvette Coupe)	15-16
Removal (Corvette Convertible)	15-17

The following removal procedures cover Delco Radios. The information is meant as an aid in servicing area related components. Further information on removal or servicing Delco products is covered in Delco information bulletins and service manuals.

RADIO

Removal (Except Corvette Fig. 19)

1. Remove battery ground cable.
2. Remove ash tray and ash tray housing on Chevelle and Chevrolet.
3. Remove knobs, controls, washers, trim plate and nuts from radio bushings.
4. Remove hoses from center air conditioning distribution duct as necessary.
5. Disconnect all leads to radio.
6. Remove screw from radio rear mounting bracket and lower radio.
7. To install, reverse the removal procedure and attach battery ground cable.

Corvette Coupe Radio

Removal

1. Disconnect battery ground cable.
2. Remove left and right door sill plates and kick pads. Disconnect radio to speaker connectors (left and right side).
3. Remove right side dash pad.
4. Remove right & left console forward trim pads.
5. Remove one (1) bolt securing heater floor outlet duct to center distributor assembly.
6. Remove floor outlet duct by pulling it through left hand opening.
7. From front of console, tape radio push buttons in depressed position. From rear of console, disconnect electrical connector, brace and antenna lead-in.

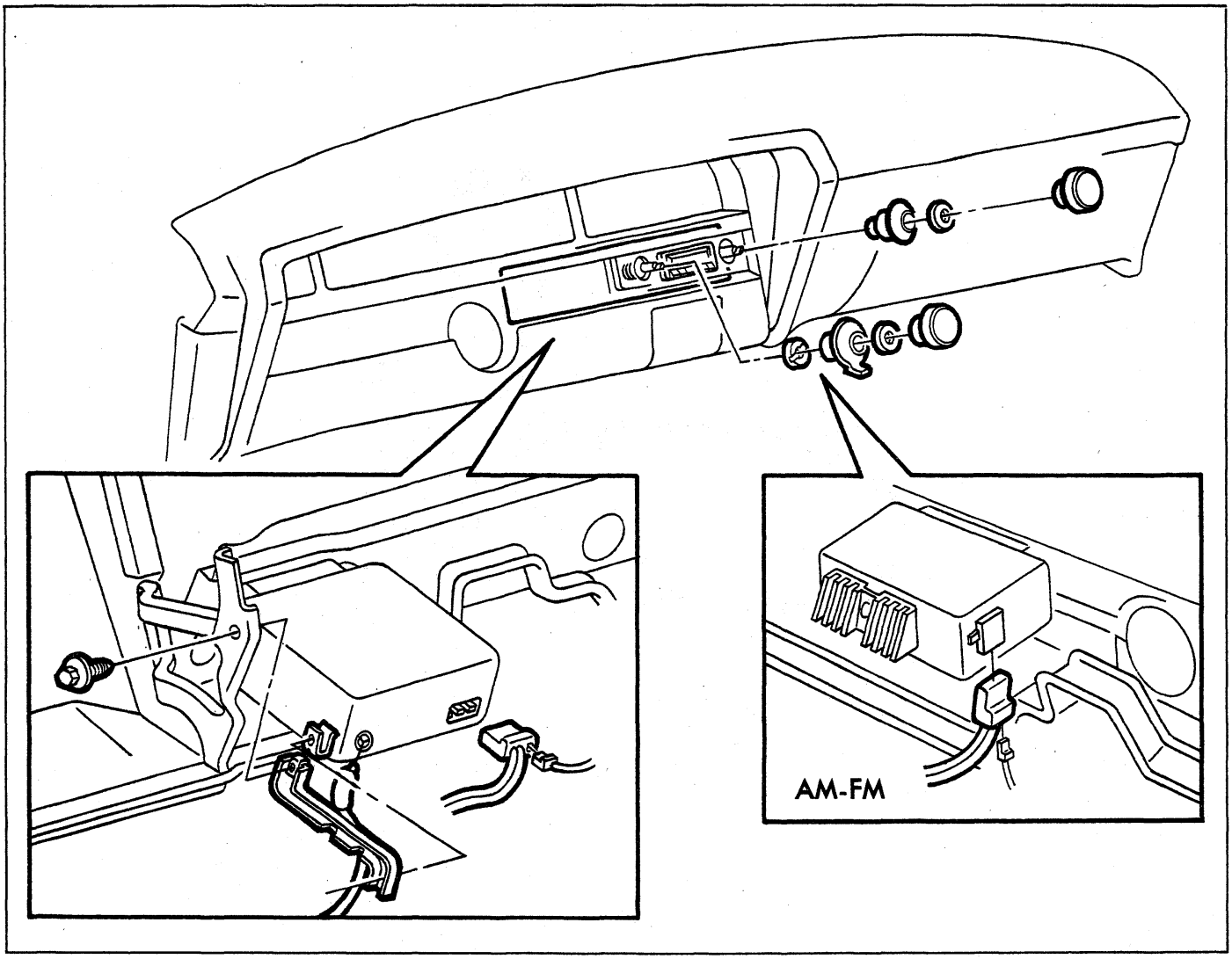


Fig. 19—Radio Mounting - Typical (Except Corvette)

8. Remove radio knobs and bezel retaining nuts. Push radio assembly forward (towards front of car). From rear of console, tip back of radio up and remove from right side opening.
9. To install, reverse 'Removal' steps 1-8.

Corvette Convertible Radio

Removal

1. Disconnect battery ground cable.
2. Remove right instrument panel pad.
3. Disconnect speaker connectors.

   NOTE: On some vehicles it may be necessary to remove the kick pads to access speaker connectors.

4. Remove wiper switch trim plate screws and tip plate for access to switch connector. Remove switch connector and trim plate from cluster assembly.
5. Unclip and remove right and left console forward trim pads. Remove forwardmost screw on right and left side of console.
6. Inserting a flexible drive socket between the console and the metal horseshoe brace, remove the nuts from the two studs on the lower edge of the console cluster.
7. Remove remaining screws retaining cluster assembly to instrument panel.
8. From rear of console, disconnect radio electric connector, brace and antenna lead-in.
9. Remove radio knobs and bezel retainng nuts.
10. Pull top of console forward (toward rear of car). Separate radio from console and remove it from the right side opening.

    NOTE: The center instrument cluster trim plate is designed to collapse under impact. Consequently, do not try to deflect the cluster plate forward to gain more access to remove the radio. Also use care so as not to damage the plastic oil pressure line when pulling console forward.

11. To install, reverse Steps 1-10.

SPECIAL TOOLS

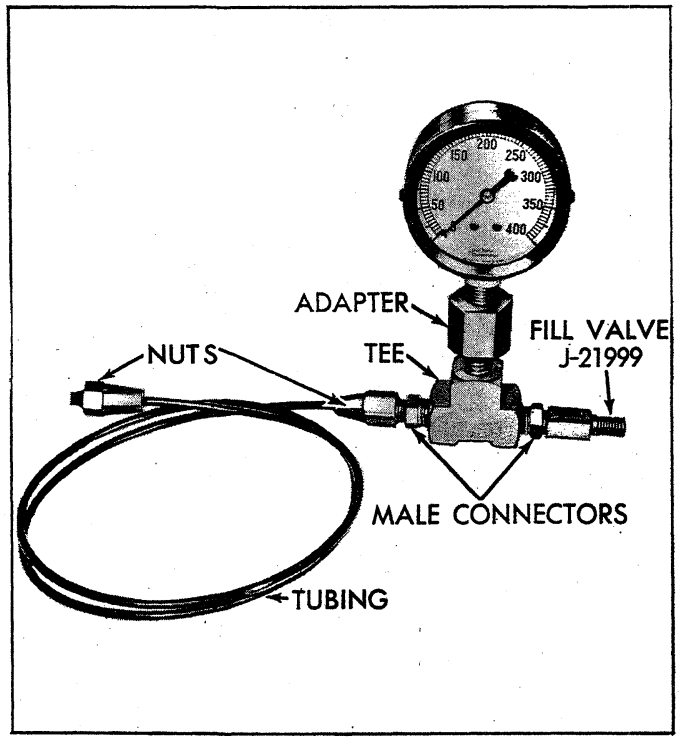


Fig. 20—Test Gauge Set J-22124

SPECIFICATIONS

HEATING AND AIR CONDITIONING

SECTION 1A

Compressor	
Make	Frigidaire
Type	6 Cylinder Axial
Displacement	
Four-Season (Except Corvette) and Comfortron	12.6 Cu. In.
Corvette Four-Season and All GM Chevrolet Air Conditioner	10.8 Cu. In.
Rotation	Clockwise
Compressor Suction and Discharge Connector Bolt Torque	25 ft. lbs.
Compressor Clutch Coil	
Ohms (at 80°F.)	4.18-4.38
Amps (at 80°F.)	2.86 @ 12 Volts
Torques	
Rear Head to Shell Stud Nut	23 lb. ft.
Shaft Mounting Nut	15 lb. ft.
Belt Tension	See Tune-Up Chart

System Capacities	
Refrigerant	R-12
Four-Season (Except Corvette) and Comfortron Systems	3 lbs., 12 oz.
Corvette Four-Season	3 lbs., 4 oz.
GM Chevrolet Air Conditioning Systems	3 lbs.
Compressor Oil	525 Viscosity
All Systems	11 oz.

Fuses	Fuse Block	In Line
Comfortron Systems	25 amp.	30 amp.
Four-Season Systems	25 amp.	30 amp.
GM Chevrolet Air Conditioning	25 amp.	—

FRONT SUSPENSION

SECTION 3

WHEEL ALIGNMENT SPECIFICATIONS (Vehicle at Curb Weight)

	Chevrolet	Chevelle	Chevy Nova	Corvette	Camaro
Caster*	Pos. 3/4° ± 1/2°	(SS and El Camino) Neg. 1/2° ± 1/2° (All others) Neg. 1° ± 1/2°	Pos. 1/2° ± 1/2°	(Manual Steering) Pos. 1° ± 1/2° Power Steering Pos. 2-1/4° ± 1/2°	Pos. 1/2° ± 1/2°
Camber*	Pos. 1/4° ± 1/2°	Pos. 1/2° ± 1/2°	Pos. 1/4° ± 1/2°	Pos. 3/4° ± 1/2°	Pos. 1/4° ± 1/2°
Steering Axis Inclination	7-1/2° ± 1/2°	8-1/4° ± 1/2°	8-3/4° ± 1/2°	7° ± 1/2°	8-3/4° ± 1/2°
†Toe-In (Total)	@ 1/8" to 1/4"	1/8" to 1/4"	1/8" to 1/4"	3/16" to 5/16"	1/8" to 1/4"
Wheel Bearing Adjustment Preload End Movement	12 ft. lbs. zero .001" to .008"	12 ft. lbs. zero .001" to .008"	12 ft. lbs. zero .000" to .004"	12 ft. lbs. zero .001" to .008"	12 ft. lbs. zero .001" to .008"

* Must not vary more than 1/2° from side to side.
@ Toe-in (Total) should be 5/16" to 7/16" after rebuild using new bushings and ball joints.
† Adjust Toe-in with steering gear on straight ahead location after camber and caster have been set. Any change in caster and camber settings will affect toe; always recheck and set toe to specifications.

RIDING HEIGHT MEASUREMENT

Chevrolet	Sedans	4-3/8" ± 1/2"
	Coupes and Convertible (incl SS)	4-1/16" ± 1/2"
	Station Wagons	4-5/8" ± 1/2"
Chevelle	Sedan	2" ± 1/2"
	Coupes and Convertible	2-3/16" ± 1/2"
	S.S. Coupes and Convertible	2-7/8" ± 1/2"
	Station Wagons	2-3/4" ± 1/2"
	Pickup	2-11/16" ± 1/2"
Chevy Nova	Sport Coupes	2-1/4" ± 1/2"
	Sedans	2-5/8" ± 1/2"
Camaro	Coupes and Convertible	2-7/16" ± 1/2"
Corvette	Sport Coupes	2-1/2" ± 1/2"
	Convertible	2-1/2" ± 1/2"

BOLT TORQUES

TORQUES	Chevrolet	Chevelle	Chevy Nova	Corvette	Camaro
Spherical Joint Upper Stud Nut	50 ft. lbs.	50 ft. lbs.	50 ft. lbs.	50 ft. lbs.	50 ft. lbs.
Lower Stud Nut	85 ft. lbs.	80 ft. lbs.	80 ft. lbs.	80 ft. lbs.	65 ft. lbs.
Stud to Control Arm Nuts (Service)	25 ft. lbs.	25 ft. lbs.	25 ft. lbs.	20 ft. lbs.	25 ft. lbs.
Lower Forging Nut	40 ft. lbs.	—	—	40 ft. lbs.	—
Steering Arm Attaching Nuts	50 ft. lbs.	85 ft. lbs.	65 ft. lbs.	—	85 ft. lbs.
Shock Absorber Upper Shaft Nut	8 ft. lbs.	8 ft. lbs.	8 ft. lbs.	8 ft. lbs.	8 ft. lbs.
Lower Attachment	20 ft. lbs.	20 ft. lbs.	20 ft. lbs.	15 ft. lbs.	20 ft. lbs.
Bracket to Spring Tower	—	—	9 ft. lbs.	—	—
Stabilizer Bar Frame Bracket Bolts	15 ft. lbs.	15 ft. lbs.	15 ft. lbs.	10 ft. lbs.	15 ft. lbs.
Link Nuts	15 ft. lbs.	15 ft. lbs.	15 ft. lbs.	15 ft. lbs.	8 ft. lbs.
Strut Rod Rod to Arm Nut	70 ft. lbs.	—	—	—	—
Adjustment Nut	80 ft. lbs.	—	—	—	—
Lower Control Arm Inner Pivot Nuts	115 ft. lbs.	80 ft. lbs.	80 ft. lbs.	—	85 ft. lbs.
Upper Control Arm Attaching Nuts	50 ft. lbs.	50 ft. lbs.	50 ft. lbs.	50 ft. lbs.	50 ft. lbs.
Collar Bolts	45 ft. lbs.	45 ft. lbs.	50 ft. lbs.	40 ft. lbs.	45 ft. lbs.
Brake Anchor Pin Drum Brakes	130 ft. lbs.	130 ft. lbs.	130 ft. lbs.	—	130 ft. lbs.
Brake Anchor Bolt Disk Brakes	120 ft. lbs.	120 ft. lbs.	120 ft. lbs.	120 ft. lbs.	120 ft. lbs.
Lower Control Arm Cross Shaft Bolts Front	—	—	—	70 ft. lbs.	—
Rear	—	—	—	95 ft. lbs.	—
Wheel Stud Nuts	65 ft. lbs.	65 ft. lbs.	65 ft. lbs.	65 ft. lbs.	65 ft. lbs.

REAR SUSPENSION

REAR AXLE

SECTION 4

CHEVROLET, CAMARO, CHEVELLE AND NOVA

Gear Blacklash . . (.005"-.008" preferred) .003"-.010"
Axle Shaft End Play . . . . . .002"-.020"
Pinion Bearing Preload (in. lbs.)
New 20-30
Used 5-15
Lubricant Capacity
Large Carrier . . . . . 4.9 pints
Small Carrier . . . . . 4.5 pints
Bolt Torques (Ft. Lbs.)
Carrier Cover 20
Ring Gear 50
Differential Bearing Caps 55
Filler Plug 20
Differential Pinion Lock 20

CORVETTE

Gear Backlash. .(.005"-.008" preferred). . .003"-.010"
Pinion Bearing Preload (in. lbs.)
New 20-25
Used 5-15
Lubricant Capacity . . . . . 3-3/4 pints
Bolt Torques (Ft. Lbs.)
Carrier Cover 50
Ring Gear 50
Differential Bearing Caps 55
Filler Plug 20
Differential Pinion Lock 20

TORQUE (FT. LBS.)

	Chevrolet	Chevelle	Chevy Nova	Camaro	Corvette
Spring Retainer	25		40	40	70
Upper Control Arm Front Bracket	55				
Upper Control Arm Front Bushing	70	80			
Rear Bushing	70	80			
Lower Control Arm Front Bushing	105	80			50
Rear Bushing	105	80			
Shock Absorber Upper	12	12	18	10	50
Upper Bracket				10	
Lower	65	65	45	45	35
Leaf Spring Front Eye Bolt			75	75	
Rear Shackle Bolts			50	50	
Leaf Spring Front Mtg. Bracket			25	25	
Tie Rod Attaching Nuts	80				
Stud to Axle Bracket	110				
Universal Joint Companion Flange	14	14	14	14	14
Transmission Yoke					15
Wheel Stud Nuts	70	65	65	65	75
Axle Drive Shaft to Spindle					75
to Yoke					15

TORQUE (FT. LBS.) (CONT'D)

	Chevrolet	Chevelle	Chevy Nova	Camaro	Corvette
Stabilizer Shaft Bracket to Frame					120
Bracket to Torque Arm					120
Link Bushings					25
Rebound Bumper to Frame					20
Crossmember to Carrier					60
Carrier Front Support to Crossmember					65
Front Bolt					50*
Rear Bolt					50*
Drive Spindle Nut					100*
Drive Spindle Support to Torque Arm					30
Strut Rod to Spindle Support					75*
Bracket to Carrier					35
Camber Cam					65
Torque Arm Pivot					50
Torque Arm				Install nut to expose hole (Corvette only) then insert cotter pin.	
Wheel Alignment # Camber (Degrees)					Neg. 7/8° ± 1/2°
Toe-In (Per Wheel)					1/32" to 3/32"

@Station Wagon All 4-Link System
*Plus additional torque necessary to line up cotter pin hole.
#Camber must not vary more than 1/2 degree from side to side. Toe setting must be made after camber is set.

RIDING HEIGHT

Model	Height (in.)
Chevy Nova and Camaro	5-1/2" ± 3/8"
Chevrolet (Except Sport Coupe and Convertible)	6-1/2" ± 3/8"
Sport Coupe and Convertible	6" ± 3/8"
Chevelle - Sedan	5" ± 3/8"
- Coupe and Convertible	4-13/16 ± 3/8"
- SS Coupe and Convertible	4-5/8" ± 3/8"
- 2 Seat Wagon and Pickup	5-7/8" ± 3/8"
- 3 Seat Wagon	6" ± 3/8"

All settings are made at curb weight.

BRAKES

(SECTION 5)

TORQUE SPECIFICATIONS

		Chevrolet	Chevelle	Chevy Nova	Camaro	Corvette
Main Cylinder to Dash Booster Nuts		24 ft. lbs.	24 ft. lbs.	24 ft. lbs.	24 ft. lbs.	24 ft. lbs.
Push Rod to Clevis Nut		14 ft. lbs.	14 ft. lbs.	14 ft. lbs.	14 ft. lbs.	14 ft. lbs.
Primary Cylinder Brake Pipe Nut		120 in. lbs.	120 in. lbs.	120 in. lbs.	120 in. lbs.	120 in. lbs.
Secondary Cylinder Brake Pipe Nut		100 in. lbs.	100 in. lbs.	100 in. lbs.	100 in. lbs.	100 ft. lbs.
Vacuum Cylinder To Dash Nuts		25 ft. lbs.	25 ft. lbs.	25 ft. lbs.	25 ft. lbs.	25 ft. lbs.
Brake Line To Frame Screw		100 in. lbs.	100 in. lbs.	100 in. lbs.	100 in. lbs.	100 in. lbs.
Brake Shoe Anchor Pin		140 ft. lbs.	140 ft. lbs.	140 ft. lbs.	140 ft. lbs.	—
Caliper Mounting Bolt		30 ft. lbs.	30 ft. lbs.	30 ft. lbs.	Single Piston 30 ft. lbs. Four Piston 70 ft. lbs.	70 ft. lbs.
Caliper Housing Bolt		—	—	—	Four Piston Design 130 ft. lbs.	130 ft. lbs.
Drum Brake Drum Size	Front	11.00 x 2.75	9.5 x 2.5	9.5 x 2.5	9.5 x 2.5	—
	Rear	11.00 x 2.00	9.5 x 2.0	9.5 x 2.0	9.5 x 2.0	
Disc Brake Disc Size		11.75 x 1.25	11.00 x 1.0	11.00 x 1.0	11.00 x 1.0	11.75 x 1.25 11.75 x 1.25

ENGINE

SECTION 6

GENERAL DATA:																								
Type	IN LINE			V8																				
Displacement	153	230	250	302	307	327		350				396				427								
Horsepower @ rpm	90 @ 4000	140 @ 4400	155 @ 4200	290 @ 5800	200 @ 4600	210 @ 4600	235 @ 4800	255 @ 4800	300 @ 4800	350 @ 5600	370 @ 5800	265 @ 4800	325 @ 4800	350 @ 5200	375 @ 5600	335 @ 4800	390 @ 5400	400 @ 5400	425 @ 5600	430 @ 5200	435 @ 5800			
Torque @ rpm	152 @ 2400	220 @ 1600	235 @ 1600	290 @ 4200	300 @ 2400	320 @ 2400	325 @ 2800	365 @ 3200	380 @ 3200	380 @ 3600	N.A. @ N.A.	400 @ 2800	410 @ 3200	415 @ 3400	415 @ 3600	470 @ 3200	460 @ 3600	460 @ 3600	460 @ 4000	450 @ 4400	460 @ 4000			
Bore	3-7/8"			4"	3-7/8"			4"				4-3/32"				4-1/4"								
Stroke	3.25"		3.53"	3"	3.25"			3.48"								3.76"								
Compression Ratio	8.5:1			11.0:1	9.0:1	9.0:1		9.0:1	10.25:1	11.0:1		9.0:1	10.25:1		11.0:1	10.25:1			11.0:1	12.0:1	11.0:1			
Firing Order	1-3-4-2	1-5-3-6-2-4		1-8-4-3-6-5-7-2																				
CYLINDER BORE:																								
Diameter	3.8745"-3.8775"			3.9995" - 4.0025"	3.8745" - 3.8775"	3.9995"-4.0025"						4.0925"-4.0995"				4.2495"-4.2525"								
Out of Round — Production	.005" (Max.)			.001" (Max.)																				
Out of Round — Service	.002" (Max.)																							
Taper — Production — Thrust Side	.0005" (Max.)																							
Taper — Production — Relief Side	.0005" (Max.)			.001" (Max.)																				
Service	.005" (Max.)																							
PISTON:																								
Clearance — Production	.0005"-.0015"			.0024" .0030"	.0005"-.0011"			.0024"-.0030"				.0010"-.0018"			.0036" .0044"	.0012"-.0020"			.0037" .0043"	.0058" .0066"	.004" .0048"			
Clearance — Service	.0025" (Max.)			.0050" (Max.)	.0025" (Max.)			.0050" (Max.)				.0025" (Max.)			.0065" (Max.)	.0025" (Max.)			.0065" (Max.)	.0085" (Max.)	.0065" (Max.)			
PISTON RING:																								
COMPRESSION — Clearance Groove — Production — Top	.0012"-.0027"							.0012"-.0032"				.0017"-.0032"												
COMPRESSION — Clearance Groove — Production — 2nd	.0012"-.0032"							.0012"-.0027"				.0017"-.0032"							.0012" .0032"	.0017"-.0032"				
COMPRESSION — Clearance Groove — Service	Hi Limit Production .001"																							
COMPRESSION — Gap — Production — Top	.010"-.020"			.013" .023"	.010" .020"	.013"-.023"				.010"-.020"		.010"-.020"												
COMPRESSION — Gap — Production — 2nd	.010"-.020"			.013" .025"	.010" .020"	.013"-.025"				.013"-.023"		.010"-.020"												
COMPRESSION — Gap — Service	Hi Limit Production .01"																							
OIL — Groove Clearance — Production	.000"-.005"											.0005"-.0065"												
OIL — Groove Clearance — Service	Hi Limit Production .001"																							
OIL — Gap — Production	.015"-.055"											.010"-.030"												
OIL — Gap — Service	Hi Limit Production .01"																							

Displacement		153	230	250	302	307	327		350				396				427					
Horsepower		90	140	155	290	200	210	235	255	300	350	370	265	325	350	375	335	390	400	425	430	435
PISTON PIN:																						
Diameter		.9270"-.9273"											.9895"-.9898"									
Clearance	Production	.00015"-.00025"									.00045" .00055"		.00025"-.00035"			.00030" .00040"	.00025"-.00035"			.00030" .00040"	.00045" .00055"	.00030" .00040"
	Service	.001" (Max.)																				
Fit in Rod		.0008"-.0016"①				.0001" .0008"②	.0008"-.0016" ①														.0001" .0008"②	.0008" .0016"①
CRANKSHAFT:																						
Main Journal	Diameter	All 2.2983"-2.2993"					#1-2-3-4 2.4479"-2.4488" #5 2.4479"-2.4488"						#1-2 2.7484" 2.7493" #3-4 2.7481" 2.7490" #5 2.7478" 2.7488"			#1 2.7484" 2.7493" #2-3-4 2.7481" 2.7490" #5 2.7478" 2.7488"	#1-2-3-4 2.7481"-2.7490" #5 2.7478"-2.7488"					
	Taper Production	.0002" (Max.)																				
	Taper Service	.001" (Max.)																				
	Out of Round Production	.0002" (Max.)																				
	Out of Round Service	.001" (Max.)																				
Main Bearing Clearance	Production	All .003"-.0029"			All .0008" .0030"		#1-2-3-4 .0008"-.0020" #5 .0018"-.0034"						#1-2 .0010"-.0022" #3-4 .0013"-.0025" #5 .0015"-.0031"				#1-2-3-4 .0013"-.0025" #5 .0015"-.0031"					
	Service	.004" (Max.)																				
Crankshaft End Play		.002"-.006"					.003"-.011"						.006"-.010"									
Crank-pin	Diameter	1.999"-2.000"					2.099"-2.100"						2.199"-2.200"			2.1985" 2.1995"	2.199"-2.200"			2.1985"-2.1995"		
	Taper Production	.0003" (Max.)																				
	Taper Service	.001" (Max.)																				
	Out of Round Production	.002" (Max.)																				
	Out of Round Service	.001" (Max.)																				
Rod Bearing Clearance	Production	.0007"-.0027"			.0007" .0028"	.0007" .0027"	.0007"-.0028"						.0009"-.0025"			.0014" .0030"	.0009"-.0025"			.0014"-.0030"		
	Service	.004" (Max.)																				
Rod Side Clearance		.0085"-.0135"					.009"-.013"						.015"-.021"			.019"-.025"	.015"-.021"			.019"-.025"		

① Interference ② Clearance

Displacement			153	230	250	302	307	327		350				396				427					
Horsepower			90	140	155	290	200	210	235	255	300	350	370	265	325	350	375	385	390	400	425	430	435
CAMSHAFT:																							
Lobe Lift ± .002"		Intake	.1712"	.1896"	.2217"	.3234"	.260"					.300"	.3234"	.2343"		.2714"	.3057"	.2714"			.3057"	.3286"	.3057"
		Exhaust	.1712"	.1896"	.2217"	.3234"	.2733"					.306"	.3234"	.2343"		.2714"	.3057"	.2714"			.3057"	.3412"	.3057"
Journal Diameter			1.8682"-1.8692"											1.9482"-1.9492"									
Camshaft Runout			.0015" (Max.)																				
VALVE SYSTEM:																							
Lifter			Hydraulic			Mech.	Hydraulic						Mech.	Hydraulic			Mech.	Hydraulic			Mechanical		
Rocker Arm Ratio			1.75:1			1.50:1								1.70:1									
Valve Lash		Intake	One Turn Down From Zero Lash			.030"*	One Turn Down From Zero Lash						.030"*	One Turn Down From Zero Lash			.024"*	One Turn Down From Zero Lash			.024"*	.022"*	.024"*
		Exhaust	One Turn Down From Zero Lash			.030"*	One Turn Down From Zero Lash						.030"*	One Turn Down From Zero Lash			.028"*	One Turn Down From Zero Lash			.028"*	.024"*	.028"*
Face Angle (Int. & Exh.)			45°																				
Seat Angle (Int. & Exh.)			46°**																				
Seat Runout (Int. & Exh.)			.002" (Max.)																				
Seat Width		Intake	1/32" - 1/16"																				
		Exhaust	1/16" - 3/32"																				
Stem Clearance	Production	Int.	.0010"-.0027"											.0010"-.0025"									
		Exh.	.0015"-.0032"				.0010"-.0027"							.0012"-.0027"									
	Service		Hi Limit Production +.001" Intake - .002" Exhaust																				
Valve Spring (Outer)	Free Length		2.08"	1.92"	1.90"	2.03"								2.11"		2.09"					2.21"	2.09"	
	Pressure lbs. @ in.	Closed	78-86 @ 1.66"	54-64 @ 1.66"		76-84 @ 1.70"								84-96 @ 1.88"		94-106 @ 1.88"					69-81 @ 1.88"	94-106 @ 1.88"	
		Open	170-180 @ 1.26"	170-184 @ 1.33"	180-192 @ 1.27"	194-206 @ 1.25"								210-230 @ 1.46"		303-327 @ 1.38"					181-205 @ 1.32"	303-327 @ 1.38"	
	Installed Height ± 1/32"		1 21/32			1 5/32								1 7/8									
Valve Spring (Inner)	Free Length		N.A.																		2.12"	N.A.	
	Pressure lbs. @ in.	Closed	N.A.																		37-45 @ 1.78"	N.A.	
		Open	N.A.																		92-110 @ 1.22"	N.A.	
	Installed Height ± 1/32"		N.A.																		1 3/4	N.A.	
Damper	Free Length		1.94"	N.A.		1.94"								1.94"-2.00"							2.07"-1.95"	1.94"-2.00"	
	Approx. # of Coils		4	N.A.		4								3 3/4							4 1/3	3 3/4	

*Engine at operating temperature and running.

**Aluminum Heads 45°

ENGINE TORQUES

Size	Usage	In Line			V-8					
		153	230	250	302	307	327	350	396	427
1/4-20	Camshaft Thrust Plate	80 lb. in.								
	Crankcase Front Cover	80 lb. in.								
	Flywheel Housing Pans	80 lb. in.								
	Oil Filler Bypass Valve				80 lb. in.					
	Oil Pan (To Crankcase)				80 lb. in.					
	Oil Pan (To Front Cover)	55 lb. in.							80 lb. in.	
	Oil Pump Cover	70 lb. in.			80 lb. in.					
	Rocker Arm Cover				55 lb. in.				50 lb. in.	
11/32-24	Connecting Rod Cap	35 lb. ft.								
5/16-18	Camshaft Sprocket				20 lb. ft.					
	Clutch Pressure Plate	20 lb. ft.								
	Oil Pan (To Crankcase)	125 lb. in.			65 lb. in.				135 lb. in.	
	Oil Pump	115 lb. in.								
	Push Rod Cover	80 lb. in.								
	Water Pump	15 lb. in.								
3/8-16	Clutch Pressure Plate				35 lb. ft.					
	Distributor Clamp	20 lb. ft.								
	Flywheel Housing	30 lb. ft.								
	Manifold (Exhaust)				20 lb. ft. ①					
	Manifold (Exhaust to Inlet)	25 lb. ft.								
	Manifold (Inlet)				30 lb. ft.					
	Manifold Clamp (L6 Outer)	20 lb. ft.								
	Manifold Clamp (All Others)	30 lb. ft.								
	Thermostat Housing	30 lb. ft.								
	Water Outlet	20 lb. ft.								
	Water Pump				30 lb. ft.					
3/8-24	Connecting Rod Cap				45 lb. ft.				50 lb. ft.	
7/16-14	Cylinder Head				65 lb. ft.				80 lb. ft. ③	
	Main Bearing Cap	65 lb. ft.			75 lb. ft. ②					
	Oil Pump				65 lb. ft.					
	Rocker Arm Stud								50 lb. ft.	
7/16-20	Flywheel				60 lb. ft.				65 lb. ft.	
	Torsional Damper				60 lb. ft.			60 lb. ft.		
	Connecting Rod Cap								70 lb. ft. ④	
1/2-13	Cylinder Head	95 lb. ft.								
	Main Bearing Cap								105 lb. ft.	
1/2-14	Temperature Sending Unit	20 lb. ft.								
1/2-20	Torsional Damper								85 lb. ft.	
	Oil Filter	Hand Tight			25 lb. ft.					
	Oil Pan Drain Plug	20 lb. ft.								
14mm	Spark Plug	25 lb. ft.								

① Inside bolts on 302-307-350 engines 30 lb. ft.
② Outer bolts on engines with 4 bolt caps 65 lb. ft.
③ Aluminum head short bolts 65 lb. ft. long bolts 75 lb. ft.
④ RPO L88 & ZL1

TUNE UP CHART

Every 12,000 miles—Have engine tune-up operations performed to maintain maximum engine performance and fuel economy.

ENGINE	Type	In Line																							
	Displacement	153	230	250	302	307	327		350				396				427								
	Horsepower	90	140	155	290	200	210	235	255	300	350	370	265	325	350	375	335	390	400	425	430	435			
Compression (1)		130			190	150	160					190	160				150								
SPARK PLUG	Make & Number	Standard	AC-R46N			AC R43	AC R45S	AC R45S	AC 45S	AC-R44			AC R43	AC R44N	AC R43N		AC R44N	AC-R43N			AC-R 43XL	AC-R 43N			
		Cold	AC-R44N			AC-R 42-1C	AC R44S	AC R44S	AC 44S	AC-R43			AC-R 42-1C	AC R43N	AC RC42N		AC R43N	AC-RC42N			AC-R 42XL	AC-R C42N			
	Gap	.035																							
DISTRIBUTOR (A)	Point Dwell	31° - 34°			28° - 32°																				
	Point Gap	.016" (Used) .019" (New)																							
	Arm Spring Tension	19 - 23 Ounces															28 - 32 oz.			19 - 23 oz.					
	Condenser	.18 - .23 Microfarad																							
	TIMING (2) Synchro.	TDC			4°B	2°B	2°A		TDC (7)		4°B		TDC	4°B	TDC	4°B					12°B (6)	4°B			
	TIMING (2) Auto.	4°B			—	2°B			4°B		—		4°B								—	4°B			
Drive Belts	Fan & P/S	50 lb. Min. 75 ± 5 lbs. (Used) 125 ± 5 lbs. (New) Using Strand Tension Gauge																							
	A/C Compressor	65 lb. Min. 95 ± 5 lbs. (Used) 140 ± 5 lbs. (New) Using Strand Tension Gauge																							
	A.I.R. Pump	35 lb. Min. 55 ± 5 lbs. (Used) 75 ± 5 lbs. (New) Using Strand Tension Gauge																							
Air Cleaner		(3)																							
Valve Lash	Inlet (4)	Hydraulic			.030	Hydraulic - One Turn Down From Zero Lash															.024	.022	.024		
	Exhaust (4)	Hydraulic			.030	Hydraulic - One Turn Down From Zero Lash															.028	.024	.028		
Idle rpm (5)	Synchro.	750	700		900	700		700			750	700	800		750	800	800*	800*	750	1000	750				
	Auto.	600	550 (8)		—	600					—	600			750 (8)	600	600*	600*	750 (8)	—	750 (8)				
Fuel Pump (B)	Pressure	3 to 4-1/2			5 to 6-1/2								5 to 8-1/2												
	Volume	One Pint in 30 - 45 Seconds																							
Crankcase Vent		Service at 12,000 Miles																							

(A) 6 Cylinder Engine—Rotate cam lubricator 180° at 12,000 mile intervals—Replace at 24,000 mile intervals.

8 Cylinder Engine—Change cam lubricator end for end at 12,000 mile intervals—Replace at 24,000 mile intervals.

(B) Replace filter element located in carburetor inlet every 12 months or 12,000 miles whichever occurs first.

(1) PSI at cranking speed, throttle wide open - Maximum variation, 20 lbs. between cylinders.

(2) At idle speed with vacuum advance line disconnected and plugged. A = A.T.D.C.; B = B.T.D.C.

(3) **CAUTION:** In addition to its function of filtering air drawn into the engine through the carburetor, the air cleaner also acts as a flame arrestor in the event the engine backfires. Because backfiring may cause fire in the engine compartment, the air cleaner should be installed at all times unless its removal is necessary for repair or maintenance services.

Paper Element Type—First 12,000 miles, inspect element for dust leaks, holes or other damage, replace if necessary. If satisfactory, rotate element 180° from original installed position. Replace element at 24,000 miles. Element must not be washed, oiled, tapped or cleaned with an air hose. If so equipped, replace "Bowtie" filter every 24,000 miles.

Polyurethane Type—Every 12,000 miles clean element in suitable solvent such as Kerosene, squeeze out all solvent, then soak in engine oil and squeeze out. Then squeeze in a clean dry cloth to remove excess oil.

Flame Arrestor—Every 12,000 miles—Clean the arrestor (located in the base of the air cleaner) with kerosene or a suitable solvent. Dry with compressed air.

(4) Mechanical - Set with engine at operating temperature and running.

(5) Automatic Transmission - Set idle with transmission in drive.
Air Conditioned Vehicles - Set idle with air conditioning turned "OFF" except on specifications indicated by *.

(6) Adjust timing at 800 rpm.

(7) Corvette 4°B

(8) Idle solenoid is used to obtain these settings.

Carburetor	ROCHESTER																				
	M	MV			2GV (1-1/4)				2GV (1-1/2)								4MV				
Engine Displacement (Horsepower)	153 (95)	230 (140)	230 (140) ①	230 (140)	307 (200)	307 (200) ①	307 (200)	307 (200) ①	327 (235)	327 (235) ①	327 (235)	327 (235) ①	396 (265)	396 (265)	396 (265) ①	396 (265) ①	350 (255) (300)	350 (255) (300)	350 (325)	396 (325) (350) 427 (335) (390)	396 (325) (350) 427 (335) (390)
Transmission	All	Auto.	Man.	Man.	Man.	Man.	Auto.	Auto.	Auto.	Auto.	Man.	Man.	Man.	Auto.	Man.	Auto.	Man.	Auto.	Man.	Man.	Auto.
Part Number	7029008	7029014	7029015	7029017	7029101	7029103	7029110	7029112	7029102	7029104	7029127	7029129	7029117	7029118	7029119	7029120	7029203	7029202	7029207	7029215	7029204
Float Level	1/4	1/4	1/4	1/4	27/32	27/32	27/32	27/32	3/4	3/4	3/4	3/4	3/4	3/4	5/8	5/8	7/32	7/32	3/16	1/4	1/4
Float Drop		———			1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	———				
Accelerator Pump		———			1-1/8	1-1/8	1-1/8	1-1/8	1-13/32	1-13/32	1-13/32	1-13/32	1-13/32	1-13/32	1-13/32	1-13/32	5/16	5/16	5/16	5/16	5/16
Idle Vent	.50	.50	.50	.50	.020	.020	.020	.020	.020	.020	.020	.020	.020	.020	.020	.020	3/8	3/8	3/8	3/8	3/8
Fast Idle — Mechanical	.100	.100	.100	.100	One Turn												Two Turns				
Fast Idle — Running	2400 RPM				1800 - 2400 RPM												2400 RPM				
Carburetor Choke Rod	.150	.170	.200	.200	.060	.060	.060	.060	.085	.085	.085	.085	.085	.085	.085	.085	.100	.100	.100	.100	.100
Choke Vacuum Break	—	.245	.275	.275	.100	.100	.100	.100	.215	.215	.215	.215	.215	.215	.215	.215	.245	.180	.245	.245	.180
Choke Unloader	—	.350	.350	.350	.215	.215	.215	.215	.275	.275	.275	.275	.275	.275	.275	.275	.450	.450	.450	.450	.450
Thermostat Choke Rod	—	②	②	②	②	②	②	②	②	②	②	②	②	②	②	②	③	③	③	③	③
Air Valve Spring	———																7/16	7/16	13/16	13/16	13/16
Secondary Closing	———																.020	.020	.020	.020	.020
Secondary Opening	———																.070	.070	.070	.070	.070
Secondary Lockout	———																.015	.015	.015	.015	.015
Main Metering Jet — Primary	.095	.104	.105	.105	.052	.052	.051	.051	.058	.058	.061	.061	.070	.067	.070	.067	.067	.067	.066	.071	.071
Throttle Bore — Primary	1-11/16"				1-7/16"				1-11/16"								1-3/8"				
Throttle Bore — Secondary	———																2-1/4"				
Air Valve Dashpot	———																.015	.015	.015	.015	.015
Metering Rod	.080	.070	.090	.090																	

① Air Conditioning
② Bottom of rod should be even with top of hole.
③ Top of rod should be even with bottom of hole.

Carburetor		HOLLEY					
		2300			4150		
		Prim.	Sec.	Prim.			
Engine Displacement (Horsepower)		427 (400) (435)	427 (400) (435)	427 (400) (435)	302 (290)	350 (370) 396 (375) 427 (425)	427 (430)
Transmission		Man.	All	Auto.	Man.	All	All
Part Number (Mfg. Number)		3940329 (R-4055-1A)	3902353 (R-3659-A)	3940930 (R-4056-1A)	3923289 (R-4053-A)	3959164 (R-4346)	3955205 (R-4296-A)
Float Level — Mechanical — Primary		.350			.350		
Float Level — Mechanical — Secondary		———			.50	.50	.50
Float Level — Final		Use Sight Plug					
Accelerator Pump		.015					
Idle Vent		.085	-	.085	———		
Fast Idle — Mechanical		.025					
Fast Idle — Final		2200 RPM					
Choke Vacuum Break		.275	-	.250	.300	.300	.350
Choke Unloader		.250	-	.250	.350	.350	.350
Thermostat Choke Rod		③	-	③	③	③	③
Secondary Stop		Closed			1/2 Turn Open		
Main Metering Jet	Primary	#63	#76	#61	#68	#68	④
	Secondary	-	-	-	#76	#76	⑤
Throttle Bore	Primary	1-1/2"	1-3/4"	1-1/2"	1-11/16"	1-9/16"	1-3/4"
	Secondary	———			1-11/16"	1-9/16"	1-3/4"

④ Throttle side #82 Choke side #78
⑤ Throttle side #80 Choke side #82

ENGINE ELECTRICAL

SECTION 6Y

BATTERY

Application	153L-4, 194, 230, 250L-6 & 307 V-8	327, 350, 396 & 427 V-8	Corvette (All)
Ground	Neg.	Neg.	Neg.
Plates	54	66	78
Cranking Power @ 0°F. (Watts)	2300	2900	3250
Capacity at 20 Hour Rate (Amp/Hr.)	45	61	62

GENERATOR

Model No.	Application	Field Amp. Draw	Hot Output Amps.	Cold Output Volts
1100825*	Corvette 350 & 427 V-8 w/AC and w/K-66	2.2.-2.6	61	14
1100833*	Corvette 427 V-8 w/o AC or K-66	2.2.-2.6	42	14
1100834	All with 307, 327, 350, 396 and 427 V-8's. L-6 except with A.I.R. and/or N-40	2.2.-2.6	37	14
1100836	All L-6 with A.I.R. and/or N-40	2.2.-2.6	37	14
1100837	Chevrolet, Chevelle & Camaro with RPO L-72, L-78 & Z-28	2.2.-2.6	37	14
1100839	307, 327, 350, 396 & 427 V-8's w/RPO K-79. L-6 except w/A.I.R., N-40, & A/C	2.2.-2.6	42	14
1100841	L-6 w/K-79, A.I.R. and/or N-40	2.2.-2.6	42	14
1100843	All V-8's w/AC, L-6 w/AC but w/o N-40 or A.I.R.	2.2.-2.6	61	14
1100845	All L-6 w/AC and N-40 or A.I.R.	2.2.-2.6	61	14
1100846	All RPO K-85 w/A.C.	2.2.-2.6	63	14
1100847	All RPO K-85 w/o A/C	2.2.-2.6	61	14
1100859*	Corvette 350 V-8 w/o A/C or K-66	2.2.-2.6	42	14

*10-SI Integral System Delcotron.

COIL

Ignition Coil Application		L-4 & L-6	V-8 (Non-Transistor)	V-8 (Transistor)
Primary Resistance-Ohms		1.41-1.63	1.77-2.05	.41-.51
Secondary Resistance-Ohms		3,000-20,000	3,000-20,000	3,000-20,000
Ignition Resistor:	Type		Fixed (In Wiring Harness)	
	Ohms	1.8	1.35	.43 & .68

REGULATOR

Regulator Model		1119515	1119519
Application		Base	Service Only
Field Relay:	Air Gap	.015	.015
	Point Opening	.030	.030
	Closing Voltage	1.5-3.2	1.5-3.2
Voltage Regulator:	Air Gap	.067	.067
	Point Opening	.014	.014
Voltage Setting		13.8-14.8 @ 85°F.	13.8-14.8 @ 85°F.

STARTING MOTOR

Model No.	Application		Delco-Remy Spec. No.	Free Speed			Ring Gear Dia.-In.
				Volts	Amperes	RPM	
1108365**	Chevrolet	250 L-6 w/3 spd. PG, or M-40	3573	9	53-69*	6400-8600	12-3/4
	Chevelle & Camaro	230 & 250 L-6 w/3 spd. P.G., or M-40					
	Chevy Nova	153 L-4 w/3 spd.					
1108366	Chevy Nova	153 L-4 w/PG.	3573	9	53-69*	6400-8600	12-3/4
1108367	Chevrolet	327 V-8 (2 bbl) w/3 spd., PG or M-40.	3573	9	53-69*	6400-8600	12-3/4
	Chevelle & Chevy Nova	307 V-8 (2 bbl) w/3 spd., PG or M-40					
	Camaro	302 V-8 (All) w/3 spd, 4 spd. PG or M-40					
1108361	Chevrolet, Camaro & Chevy Nova	350 V-8 (2 bbl) w/3 spd., 4 spd., PG, or M-40	2438	9	55-85*	3100-4900	12-3/4
	Chevrolet, Camaro & Chevy Nova	350 V-8 (4 bbl) w/PG or M-40					
1108338	Chevrolet & Chevelle	350 V-8 (2 bbl) w/Hvy Dty Clutch	2438	9	55-85*	3100-4900	14
	Chevrolet & Corvette	350 V-8 (4 bbl) w/3 spd., 4 spd., or M-40					
	Chevelle & Camaro	350 V-8 (4 bbl) w/3 spd., & 4 spd.					
1108418	Chevrolet	396 V-8 (2 bbl) w/3 spd., 4 spd., or M-40	3563	9	54-80*	6800-9400	14
		427 V-8 (4 bbl) w/3 spd., 4 spd. or M-40					
	Chevelle Camaro & Chevy Nova	396 V-8 (4 bbl) w/3 spd., 4 spd. or M-40					
1108382	Chevrolet	327 V-8 (2 bbl) w/M-40 or Hvy Dty Clutch	3573	9	53-69*	6400-8600	14
1107372	Chevrolet	250 L-6 w/3 spd., 4 spd & Hvy Dty Clutch	3533	9	55-95*	3000-4800	14
1108400	Corvette	427 V-8 (4 bbl) w/3 spd., 4 spd., or M-40	3563	9	54-80*	6800-9400	14
1108351	Corvette	427 V-8 (4 bbl) w/4 spd.	3563	9	54-80	6800-9400	12-3/4

*Includes Solenoid
**Incorporates molded armature design.

DISTRIBUTORS

Engine Description and Availability	Ignition Distributor (Product Part No.)	Centrifugal Advance (Crank Degrees @ Engine RPM)	Vacuum Advance (In Crank Degrees)	Point Dwell Setting	Ignition Timing BTDC at Engine Idle	Trans.	Engine Idle Setting (RPM)	Original Equipment Spark Plug
L-4 - 153 Cu. In. - 90 HP Nova	1110457	C-4693 0 @ 900 RPM 17° @ 1700 RPM 28° @ 3700 RPM	C-3933 0 @ 7" Hg. 24° @ 15" Hg.	31°-34°	TDC	Manual	750	AC R46N (5611068)
L-4 - 153 Cu. In. - 90 HP Nova	1110458	C-4674 0 @ 900 RPM 14° @ 1700 RPM 24° @ 3600 RPM	C-3933 0 @ 7" Hg. 24° @ 15" Hg.	31°-34°	4° BTDC	Automatic	600	AC R46N (5611068)
L-6 - 230 Cu. In. - 140 HP Nova, Camaro, Chevelle	1110459	C-4685 0 @ 1000 RPM 7° @ 1200 RPM 21° @ 2100 RPM 36° @ 4600 RPM	C-3912 0 @ 7" Hg. 23° @ 16" Hg.	31°-34°	TDC	Manual	700	AC R46N (5611068)
L-6 - 230 Cu. In. - 140 HP Nova, Camaro, Chevelle	1110460	C-4678 0 @ 1000 RPM 17° @ 2100 RPM 32° @ 4600 RPM	C-3912 0 @ 7" Hg. 23° @ 16" Hg.	31°-34°	4° BTDC	Automatic	500	AC R46N (5611068)
L-6 - 250 Cu. In. - 155 HP Nova, Camaro, Chevelle, Chevrolet	1110463	C-4686 0 @ 900 RPM 9° @ 1220 RPM 21° @ 1950 RPM 32° @ 4200 RPM	C-3912 0 @ 7" Hg. 23° @ 16" Hg.	31°-34°	TDC	Manual	700	AC R46N (5611068)
L-6 - 250 Cu. In. - 155 HP Nova, Camaro, Chevelle, Chevrolet	1110464	C-4672 0 @ 900 RPM 17° @ 1950 RPM 28° @ 4200 RPM	C-3912 0 @ 7" Hg. 23° @ 16" Hg.	31°-34°	4° BTDC	Automatic	500	AC R46N (5611068)
V-8 - 302 Cu. In. - 290 HP Camaro	1111480	C-4704 0 @ 1250 RPM 22° @ 2200 RPM 32° @ 4400 RPM	C-3036 0 @ 8" Hg. 15° @ 15.5" Hg.	28°-32°	4° BTDC	Manual	900	AC R43 (5611540)
V-8 - 307 Cu. In. - 200 HP Nova, Chevelle	1111481	C-4680 0 @ 1000 RPM 10° @ 1600 RPM 28° @ 4300 RPM	C-3064 0 @ 6" Hg. 15° @ 12" Hg.	28°-32°	2° BTDC	Automatic Manual	600 700	AC R45 (5610926)
V-8 - 327 Cu. In. - 2-bbl. 210 HP Camaro 235 HP Chevrolet	1111482	C-4739 0 @ 1000 RPM 10° @ 1400 RPM 32° @ 4300 RPM	C-3954 0 @ 6" Hg. 15° @ 12" Hg.	28°-32°	2° ATDC	Manual	700	AC R45 (5610926)
V-8 - 327 Cu. In. - 2-bbl. 210 HP Camaro 235 HP Chevrolet	1111483	C-4740 0 @ 900 RPM 12° @ 2000 RPM 28° @ 4300 RPM	C-3954 0 @ 6" Hg. 15° @ 12" Hg.	28°-32°	2° BTDC	Automatic	600	AC R45 (5610926)
V-8 - 350 Cu. In. RPO LM1 255 HP - Chevrolet, Chevelle, Nova, Camaro	1111955	C-4741 0 @ 900 RPM 17° @ 1900 RPM 22° @ 2000 RPM 32° @ 4400 RPM	C-3968 0 @ 7" Hg. 13° @ 17" Hg.	28°-32°	4° BTDC	Automatic	600	AC R44 (5611062)
V-8 - 350 Cu. In. RPO LM1 255 HP - Chevrolet, Chevelle, Nova, Camaro	1111956	C-4742 0 @ 900 RPM 10° @ 1200 RPM 21° @ 2000 RPM 32° @ 4400 RPM	C-3977 0 @ 7" Hg. 24° @ 13" Hg.	28°-32°	TDC	Manual	700	AC R44 (5611062)
V-8 - 350 Cu. In. - 250 HP RPO L-65 Chevrolet, Chevelle, Camaro, Nova	1111486	C-4730 0 @ 800 RPM 3° @ 1000 RPM 15° @ 1800 RPM 36° @ 4100 RPM	C-3968 0 @ 7" Hg. 13° @ 17" Hg.	28°-32°	TDC	Manual	700	AC R44 (5611062)
V-8 - 350 Cu. In. - RPO L-65, 250 HP Chevrolet, Chevelle, Camaro, Nova	1111487	C-4731 0° @ 900 RPM 2° @ 1100 RPM 8° @ 1400 RPM 32° @ 4400 RPM	C-3968 0 @ 7" Hg. 13° @ 17" Hg.	28°-32°	4° BTDC	Automatic	600	AC R44 (5611062)
V-8 - 350 Cu. In. - 300 HP Corvette - Base Engine	1111490 (Tach Drive)	C-4499 0 @ 900 RPM 9° @ 1200 RPM 15° @ 1500 RPM 30° @ 5100 RPM	C-3954 0 @ 8" Hg. 10° @ 17" Hg.	28°-32°	4° BTDC	Automatic Manual	600 700	AC R44 (5611062)

DISTRIBUTORS (CONT'D)

Engine Description and Availability	Ignition Distributor (Product Part No.)	Centrifugal Advance (Crank Degrees @ Engine RPM)	Vacuum Advance (In Crank Degrees)	Point Dwell Setting	Ignition Timing BTDC at Engine Idle	Trans.	Engine Idle Setting (RPM)	Original Equipment Spark Plug
V-8 - 350 Cu. In. - 300 HP RPO L48, Camaro, Nova Chevelle, Chevrolet	1111488	C-4692 0 @ 950 RPM 14° @ 1400 RPM 20° @ 1800 RPM 30° @ 4700 RPM	C-3954 0 @ 10" Hg. 10° @ 17" Hg.	28°-32°	TDC	Manual	700	AC R44 (5611062)
V-8 - 350 Cu. In. - 300 HP RPO L48, Camaro, Nova, Chevelle, Chevrolet	1111489	C-4636 0 @ 900 RPM 9° @ 1300 RPM 15° @ 1700 RPM 26° @ 4700 RPM	C-3954 0 @ 10" Hg. 10° @ 17" Hg.	28°-32°	4° BTDC	Automatic	600	AC R44 (5611062)
V-8 - 350 Cu. In. - 350 HP RPO L-46, Corvette	1111493	C-4732	C-3955 0 @ 7" Hg. 15° @ 12" Hg.	28°-32°	8° BTDC	Manual	750	AC R44 (5611062)
V-8 - 396 Cu. In. - 265 HP RPO L-66, Chevrolet	1111949	C-4727 0° @ 900 RPM 11° @ 1300 RPM 22° @ 2000 RPM 38° @ 4200 RPM	C-3036 0 @ 8" Hg. 15° @ 15.5" Hg.	28°-32°	TDC	Manual	700	AC R44N (5611065)
V-8 - 396 Cu. In. - 265 HP RPO L-66, Chevrolet	1111950	C-4717 0 @ 900 RPM 3° @ 1100 RPM 17° @ 1900 RPM 34° @ 4300 RPM	C-3036 0 @ 8" Hg. 15" @ 15.5" Hg.	28°-32°	4° BTDC	Automatic	600	AC R44N (5611065)
V-8 - 396 Cu. In. 325 HP RPO L-35, Chevelle, Camaro V-8 - 427 Cu. In. - 335 HP RPO LS1, Chevrolet	1111497	C-4626 0 @ 900 RPM 9° @ 1250 RPM 17° @ 2000 RPM 32° @ 5000 RPM	C-3036 0 @ 8" Hg. 15° @ 15.5" Hg.	28°-32°	4° BTDC	Manual Automatic	800 600	AC R44N (5611065)
V-8 - 396 Cu. In. - 350 HP RPO L-34, Chevelle, Camaro, Nova	1111498	C-4690 0 @ 900 RPM 13° @ 1275 RPM 21° @ 2000 RPM 36° @ 5000 RPM	C-3036 0 @ 8" Hg. 15° @ 15.5" Hg.	28°-32°	TDC	Manual	800	AC R44N (5611065)
V-8 - 396 Cu. In. - 350 HP RPO L-34, Chevelle, Camaro, Nova	1111499	C-4626 0 @ 900 RPM 9° @ 1250 RPM 17° @ 2000 RPM 32° @ 5000 RPM	C-3064 0 @ 6" Hg. 15° @ 12" Hg.	28°-32°	4° BTDC	Automatic	600	AC R43N (5611066)
V-8 - 396 Cu. In. - 375 HP RPO L-78, Chevelle, Camaro, Nova	1111499	C-4626 0 @ 900 RPM 9° @ 1250 RPM 17° @ 2000 RPM 32° @ 5000 RPM	C-3064 0 @ 6" Hg. 15° @ 12" Hg.	28°-32°	4° BTDC	Manual	750	AC R43N (5611066)
V-8 - 427 Cu. In. - Corvette RPO L36 - 390 HP RPO L68 - 400 HP	1111926 (Tach Drive)	C-4733 0 @ 800 RPM 8° @ 1250 RPM 17° @ 2000 RPM 26° @ 3800 RPM	C-3955 0 @ 7" Hg. 12° @ 12" Hg.	28°-32°	4° BTDC	Automatic Manual	600 800	AC R43N (5611066)
V-8 - 427 Cu. In. - Corvette RPO L71 - 435 HP RPO L89 - 435 HP	1111928 (Transistor Ign. System Tach Drive)	C-4637 0 @ 900 RPM 2° @ 1100 RPM 30° @ 3800 RPM	C-3036 0 @ 8" Hg. 15° @ 15.5" Hg.	—	4° BTDC	All	750	AC R43N (L71) (5611066) AC 43XL (L89) (5611542)
V-8 - 427 Cu. In. - Corvette 430 HP	1111927 (Transistor Ign. System Tach Drive)	C-4699 0 @ 1200 RPM 16° @ 1900 RPM 29° @ 5000 RPM	None	—	12° BTDC	Manual	1000	AC R43XL (5611542)
V-8 - 427 Cu. In. - 390 HP Chevrolet - RPO L36	1111925	C-4733 0 @ 800 RPM 8° @ 1250 RPM 19° @ 2000 RPM 26° @ 3800 RPM	C-3036 0 @ 8" Hg. 15° @ 15.5" Hg.	28°-32°	4° BTDC	Manual Automatic	800 600	AC R44N (5611066)

#Set in Neutral with Manual Transmissions and in Drive with Automatic Transmissions.

TRANSMISSION AND CLUTCH

SECTION 7

THREE SPEED (SAGINAW)

Clutch Gear Retainer to Case Bolts	22 ft. lbs.
Side Cover to Case Bolts	22 ft. lbs.
Extension to Case Bolts	45 ft. lbs.
Overdrive Attaching Lower Left Hand Bolt (Marked X)	30 ft. lbs.
Shift Lever to Shifter Shaft Bolts	20 ft. lbs.
Lubrication Filler Plug	15 ft. lbs.
Transmission Case to Clutch Housing Bolts	55 ft. lbs.
Crossmember to Frame Nuts	25 ft. lbs.
Crossmember to Mount and Mount to Extension Bolts	40 ft. lbs.

THREE SPEED (MUNCIE)

Clutch Gear Retainer to Case Bolts	18 ft. lbs.
Side Cover to Case Bolts	18 ft. lbs.
Extension to Case Bolts	45 ft. lbs.
Shift Lever to Shifter Shaft Bolts	20 ft. lbs.
Lubrication Filler Plug	15 ft. lbs.
Transmission Case to Clutch Housing Bolts	55 ft. lbs.
Crossmember to Frame Nuts	25 ft. lbs.
Crossmember to Mount and Mount to Extension Bolts	40 ft. lbs.
Transmission Drain Plug	30 ft. lbs.

FOUR SPEED (SAGINAW)

Clutch Gear Retainer to Case Bolts	22 ft. lbs.
Side Cover to Case Bolts	22 ft. lbs.
Extension to Case Bolts	45 ft. lbs.
Shift Lever to Shifter Shaft Bolts	20 ft. lbs.
Lubrication Filler Plug	15 ft. lbs.
Transmission Case to Clutch Housing Bolts	55 ft. lbs.
Crossmember to Frame Nuts	25 ft. lbs.
Crossmember to Mount and Mount to Extension Bolts	40 ft. lbs.

FOUR SPEED (MUNCIE)

Clutch Gear Bearing Retainer to Case Bolts	25 ft. lbs.
Cover to Case Bolts	20 ft. lbs.
Extension and Retainer to Case Bolts-(Upper)	20 ft. lbs.
-(Lower)	30 ft. lbs.
Lubrication Filler Plug	30 ft. lbs.
Shift Lever to Shifter Shaft Nut	20 ft. lbs.

POWERGLIDE AND TORQUEDRIVE

Transmission Case to Engine	35 ft. lbs.
Transmission Oil Pan to Case	8 ft. lbs.
Transmission Extension to Case	25 ft. lbs.
Speedometer Driven Gear Fitting Retainer	4 ft. lbs.
Servo Cover to Transmission Case Bolts	20 ft. lbs.
Front Pump to Transmission Case Bolts	15 ft. lbs.
Front Pump Cover to Body Attaching Bolts	20 ft. lbs.
Pinion Shaft Lock Plate Attaching Screws	2-1/2 ft. lbs.
Governor Body to Hub Attaching Bolts	7 ft. lbs.
Governor Hub Drive Screw	8 ft. lbs.
Governor Support to Transmission Case Bolts	10 ft. lbs.
Valve Body to Transmission Case Bolts	15 ft. lbs.
Valve Body Suction Screen Attaching Screws	2-1/2 ft. lbs.
Upper Valve Body Plate Bolts	5 ft. lbs.
Lower to Upper Valve Body Attaching Bolts	15 ft. lbs.
Inner Control Lever Allen Head Screw	2-1/2 ft. lbs.
Parking Lock Pawl Reaction Bracket Attaching Bolts	10 ft. lbs.
Oil Cooler Plugs at Transmission Case	5 ft. lbs.
Pressure Test Point Plugs	5 ft. lbs.
Low Band Adjustment Locknut	15 ft. lbs.
Converter to Engine Bolts	35 ft. lbs.
Under Pan to Transmission Case	7-1/2 ft. lbs.
Oil Cooler Pipe Connectors to Transmission Case or Radiator	10 ft. lbs.
Oil Cooler Pipe to Connectors	10 ft. lbs.
Vacuum Modulator to Transmission Case	15 ft. lbs.
Oil Pan Drain Plug	20 ft. lbs.
Converter Drain Plug (Taxies)	20 ft. lbs.
Parking Brake Lock & Range Selector Inner Lever Allen Head Screw	2-1/2 ft. lbs.

TURBO HYDRA-MATIC—350

Pump Cover to Pump Body	17 ft. lbs.
Pump Assembly to Case	18-1/2 ft. lbs.
Valve Body and Support Plate	130 in. lbs.
Parking Lock Bracket	29 ft. lbs.
Oil Suction Screen	40 in. lbs.
Oil Pan to Case	130 in. lbs.
Extension to Case	25 ft. lbs.
Modulator Retainer to Case	130 in. lbs.
Inner Selector Lever to Shaft	25 ft. lbs.
Detent Valve Actuating Bracket	52 in. lbs.
Converter to Flywheel Bolts	35 ft. lbs.
Under Pan to Transmission Case	110 in. lbs.
Oil Pan Drain Plug	20 ft. lbs.
Transmission Case to Engine	35 ft. lbs.

TURBO HYDRA-MATIC—400

Pump Cover Bolts	18 lb. ft.
Parking Pawl Bracket Bolts	18 lb. ft.
Center Support Bolt	23 lb. ft.
Pump to Case Attaching Bolts	18 lb. ft.
Extension Housing to Case Attaching Bolts	23 lb. ft.
Rear Servo Cover Bolts	18 lb. ft.
Detent Solenoid Bolts	7 lb. ft.
Control Valve Body Bolts	8 lb. ft.
Bottom Pan Attaching Screws	12 lb. ft.
Modulator Retainer Bolt	18 lb. ft.
Governor Cover Bolts	18 lb. ft.
Manual Lever to Manual Shaft Nut	8 lb. ft.
Manual Shaft to Inside Detent Lever	18 lb. ft.
Linkage Swivel Clamp Nut	43 lb. ft.
Converter Dust Shield Screws	93 lb. ft.
Transmission to Engine Mounting Bolts	28 lb. ft.
Converter to Flywheel Bolts	33 lb. ft.
Rear Mount to Transmission Bolts	40 lb. ft.
Rear Mount to Crossmember Bolt	40 lb. ft.
Crossmember Mounting Bolts	25 lb. ft.
Oil Cooler Line	113 lb. In.
Line Pressure Take-Off Plug	13 lb. ft.
Strainer Retainer Bolt	10 lb. ft.

STEERING

SECTION 9

STANDARD STEERING

Item			Chevrolet	Chevelle	Nova		Camaro		Corvette	
Steering Gear	Type		Recirculating Ball							
	Ratio		All	All	Reg.	N44	Reg.	N44	Z28 & N44	Road	Fast
		Gear	24:1	24:1	24:1	24:1	24:1	24:1	20:1	16:1	16:1
		Overall	30.8:1	28.7:1	28.3:1	21.4:1	28.3:1	28.3:1	17.9:1	20.2:1	17.6:1
Linkage	Type		Parallel Relay Rod							
	Location		Rear	Front	Rear					
	Tie Rods		2							

POWER STEERING—PUMP

Vehicle	Constant Ratio Steering	Variable Ratio Steering
Chevrolet	1000-1100 (Exc. 396 - 427) 1100-1200 (396 - 427)	1350 - 1450 (All)
Chevelle	900-1000	-
Nova	900-1000	-
Camaro	-	1200 - 1300 (L-6) 1350 - 1450 (V-8)
Corvette	870-1000	-

POWER STEERING—GEAR

Vehicle	Constant Ratio				Variable Ratio			
	Regular		Fast		Regular		Fast	
	Gear	Overall*	Gear	Overall*	Gear	Overall*	Gear	Overall*
Chevrolet	17.5:1	21.3:1	-	-	16.1:1 to 12.4:1	19.5:1	-	-
Chevelle	17.5:1	21.6:1	-	-	-	-	-	-
Nova	17.5:1	20.7:1	17.5:1	15.6:1	-	-	-	-
Camaro	-	-	-	-	16.1:1 to 12.4:1	15.5:1	16.1:1 to 12.4:1	14.3:1
Corvette	-	-	16:1	17.6:1	-	-	-	-

*On Center

ADJUSTMENT SPECIFICATIONS— STANDARD STEERING

Adjustment	Torque to Turn Worm Shaft
Worm Bearing Preload	5 - 8 Lb. In.
Sector Lash Adjustment	4 - 10 Lb. In. in excess of above
Total Steering Gear Preload	16 Lb. In. Maximum

ADJUSTMENT SPECIFICATIONS—POWER STEERING

	Chevrolet, Chevelle, Camaro and Chevy Nova
Ball Drag	3 Lb. In. Max.
Thrust Bearing Preload	1/2 - 2 Lb. In. in excess of valve assy. drag
Over Center Preload	3 - 6 Lb. In. in excess of above
Total Steering Gear Preload	14 Lb. In. Max.
	Corvette
Worm Bearing Preload	4 to 7 lb. in.
Sector Lash Adjustment	4 to 10 lb. in. excess of above
Total Steering Gear Preload	14 lb. in Max.

TORQUE CHART

	Chevrolet	Chevelle	Nova	Camaro	Corvette
Steering Gear Mounting Bolts	70 lb. ft.	70 lb. ft.	68 lb. ft.	68 lb. ft.	30 lb. ft.
Pitman Shaft Nut	140 lb. ft.				
Steering Wheel Nut	35 lb. ft.				
Steering Wheel Nut-Tilt	35 lb. in.	35 lb. in.	35 lb. in.	35 lb. in.	—
Steering Coupling Nuts	18 lb. ft.				
Steering Coupling Clamp Bolts	30 lb. ft.		30 lb. ft.	30 lb. ft.	—
Tie Rod End Nut	35 lb. ft.				
Tie Rod Clamp Nut	130 lb. in.				
Idler Arm Mounting Nut	35 lb. ft.				
Steering Wheel to Hub Nut (Simulated Wood Wheel)	25 lb. in.		25 lb. in.		
Floor Pan Cover Screws	35 lb. in.				
Floor Pan Cover Clamp Screws	35 lb. in.				
Dash Panel Bracket to Column Screws	15 lb. ft.				
Dash Panel Bracket to Dash Nuts	20 lb. ft.				
Power Steering Pump Pulley Nut	60 lb. ft.				
Power Steering Pump Mounting Bolts	20 lb. ft.				
Power Steering Pump Mounting Stud Nut	25 lb. ft.				
Power Cylinder to Relay Rod Nut	—	—	—	—	45 lb. ft.
Power Cylinder to Frame Bracket	—	—	—	—	25 lb. ft.
Control Valve to Pitman Arm	—	—	—	—	45 lb. ft.
Control Valve Clamp Bolt	—	—	—	—	20 lb. ft.

WHEELS AND TIRES

SECTION 10

CHEVROLET TIRE USAGE

Engines and Body Styles		Without Disc Brakes		With Disc Brakes	
		Standard	Optional	Standard	Optional
All Engines	All Body Styles Except Wagons	8.25 x 14	8.25 x 14-8 Pr. G78 x 14 8.25 x 15 8.25 x 15-8 Pr. G70 x 15 G78 x 15	8.25 x 15	8.25 x 15-8 Pr. G70 x 15 G78 x 15
427 V-8 With Z24 Option	Impala 2-Door Sport Coupe Impala 2-Door Custom Coupe Impala 2-Door Convertible	—	—	G70 x 15	—
All Wagons	Brookwood and Townsman 2-Seat Wagons	8.55 x 14 Or 8.85 x 14	8.85 x 14 8.55 x 14-8 Pr. 8.55 x 15 8.55 x 15-8 Pr. 8.55 x 14-8 Pr. 8.55 x 15-8 Pr.	8.55 x 15 Or 8.55 x 15-8 Pr.	8.55 x 15-8 Pr.
Six-Cylinder Engines	Townsman 3-Seat Wagon	8.85 x 14	8.55 x 14-8 Pr. 8.55 x 15-8 Pr.	8.55 x 15-8 Pr.	—
All V-8 Engines	Townsman 3-Seat Wagon All Kingswood and Kingswood Estate Wagons	8.85 x 14 Or 8.55 x 14-8 Pr.	8.55 x 14-8 Pr. 8.55 x 15-8 Pr. 8.55 x 15-8 Pr.	8.55 x 15-8 Pr.	—

All tires are 4-ply rating, 2 ply unless otherwise specified.

CHEVELLE TIRE USAGE

Engines and Body Style		Standard	Optional
L-6 307 V-8	Sedan, Coupe Convertibles	7.35 x 14	7.75 x 14, F70 x 14, F78 x 14
	El Camino Except with 396 V-8		
350 V-8	Sedan, Coupes		
350 V-8	Sport Sedan Convertible, El Camino	7.75 x 14	F70 x 14, F78 x 14
396 V-8	SS Coupe and Convertible	F70 x 14	—
396 V-8	El Camino	G70 x 14	—
L-6	Station Wagon Nomad	7.75 x 14 or 8.25 x 14	8.25 x 14, 8.25 x 14-8 Pr. F78 x 14, G78 - 14
	All Other L-6	8.25 x 14	8.25 x 14-8 Pr., G78 x 14
307 V-8	All 2 Seat	8.25 x 14	8.25 x 14-8 Pr. G78 x 14
	All 3 Seat w/Dual Action Tailgate	8.25 x 14 or 8.25 x 14-8 Pr.	
350 V-8	2 Seat w/Std. or Dual Action Tailgate Except Concours and Concours Estate w/Dual Action Tailgate	8.25 x 14 or 8.25 x 14-8 Pr.	
	Concours and Concours Est Wag w/Dual Action Tailgate and All 3 Seat Models	8.25 x 14-8 Pr.	—

All Tires are 4-ply rating, 2 ply unless otherwise specified.

CAMARO TIRE USAGE

Engines and Body Style		Standard	Optional
All	All Except SS and Z-28 Option	E78 x 14	F70 x 14
All	SS Models	F70 x 14 (White Letters)	F70 x 14 White or Red Stripe
302 V-8	Z-28 Option	E70 x 15	—

NOVA TIRE USAGE

Engines and Body Style		Standard	Optional
All	All Except SS Models	7.35 x 14	E70 x 14
All	SS Models	E70 x 14	—

All Tires are 4-ply rating, 2 ply unless otherwise specified.

1. Tire inflation pressures may increase as much as six (6) pounds per square inch (PSI) when hot.
2. For continuous high speed operation (over 75 MPH) increase tire inflation pressure 4 pounds per square inch over the recommended pressures up to a maximum of 32 pounds per square inch cold for 4 ply rating tires, or 40 pounds per square inch cold for 8 ply tires. Sustained speeds above 75 mph are not recommended when the 4 pounds per square inch adjustment would require pressures greater than the maximums stated above.
3. Cold tire inflation pressure: after vehicle has been inoperative for three (3) hours or more, or driven less than one (1) mile.
   Hot tire inflation pressure: after vehicle has been driven ten (10) miles or more at 60-70 MPH.
4. Station Wagon loads should be distributed as far forward as possible.
5. Vehicles with luggage racks do not have a vehicle load limit greater than specified.
6. When towing trailers, the allowable passenger and cargo load must be reduced by an amount equal to the trailer tongue load on the trailer hitch.

CORVETTE TIRE USAGE

Tire Usage and Recommended Tire Inflation Pressures
Pounds per Square Inch (PSI) Cool

Models	Full Rated Load	Tire Ply	Tire Usage	Standard Inflation Pressure For All Loads Including Full Rated And Continuous High Speed Operation (Over 75 MPH)	
				Front	Rear
All Models	1 to 2 Passengers + 150 Lbs. Luggage (450 Lbs. Load)	4 ply rating-2 ply*	F70-15 Nylon	24	24

*Optional tires are not available.

1. Tire inflation pressures may increase as much as six (6) pounds per square inch (PSI) when hot.
2. Cold tire inflation pressure: after vehicle has been inoperative for three (3) hours or more, or driven less than one (1) mile.
   Hot tire inflation pressure: after vehicle has been driven ten (10) miles or more at 60-70 MPH.
3. Vehicles with luggage racks do not have a load limit greater than specified above.

BODY AND CHASSIS ELECTRICAL

SECTION 12

LAMP USAGE	CANDLE POWER	BULB NUMBER
Headlamp Unit		
Chevrolet, Chevelle & Corvette		
Outer - High Beam	37 1/2 Watts	4002
Outer - Low Beam	55 Watts	4002
Inner - High Beam only	37 1/2 Watts	4001
Chevy Nova & Camaro		
High Beam	55 Watts	6012
Low Beam	45 Watts	
Parking Lamp and Directional Signal		
All Exc. Camaro & Corvette	3-32	1157
Camaro & Corvette	3-32	1157NA
Tail, Stop and Directional Signal	3-32	1157
Backing Lamp	32	1156
Instrument Illumination Lamps		
Chevrolet and Camaro	2	194
Chevelle and Corvette	2	1895
Chevy Nova	3	168
Temperature Indicator		
Chevrolet, Camaro and Chevy Nova	2	194
Chevelle	2	1895
Oil Pressure Indicator		
Chevrolet, Camaro & Chevy Nova	2	194
Chevelle	2	1895
Generator Indicator		
Chevrolet, Camaro & Chevy Nova	2	194
Chevelle	2	1895
Hi-Beam Indicator		
Chevrolet, Camaro and Chevy Nova	2	194
Chevelle	2	1895
Corvette	2	1895
Directional Indicator		
Chevrolet, Camaro & Chevy Nova	2	194
Chevelle	2	1895
Corvette	2	1895
Cigarette Lighter Lamp		
Corvette	1	1445
Warning Lamps		
Corvette - Door Ajar	2	1895
Headlamps Up	2	1895
Seat Belts	2	1895
Heater or A/C Control Panel		
Chevelle	1	1445
Chevrolet, Camaro & Chevy Nova	2	1895
Corvette	2.5	1816
Glove Box Lamps		
Chevrolet, Chevelle, Chevy Nova, Camaro & Corvette	2	1895
Dome and Courtesy Lamps		
Cartridge Type (All)	12	211
Bayonet Type (Exc. Corvette)	6	631
Corvette	6	90

LAMP USAGE (Cont'd.)	CANDLE POWER	BULB NUMBER
Seat Separator-Compartment Lamp	1	1445
-Courtesy Lamp	6	212
Side Marker-Front	2	194
Side Marker-Rear	2	194
License Plate Lamp (Exc. Corvette)	4	67
Corvette	4	97
Radio Dial Lamp		
Chevrolet, Chevelle, Chevy Nova & Camaro	2	1893
Corvette	2	1893
Brake Alarm Lamp		
Chevrolet, Camaro & Chevy Nova	2	194
Chevelle & Corvette	2	1895
Clock Lamp (Corvette)	2	1895
Camaro	3	168
Luggage Compartment Lamp	15	1003
Map Lamp (Mirror)	6	562
Underhood	15	93

FUSES AND CIRCUIT BREAKER

A circuit breaker in the light control switch protects the headlamp circuit, thus eliminating one fuse. A separate 30 amp circuit breaker mounted on the firewall protects the power window, seat and top circuits. The under hood and spot lamp circuit is also protected by a separate 15 amp in-line fuse. Where current load is too heavy, the circuit breaker rapidly opens and closes, protecting the circuit until the cause is found and eliminated.

Fuses located in the Fuse Panel under the instrument panel are:

Wiper/Washer, 3 Spd A/T Downshift	SAE/SFE	25 Amp.
Back-up Lamp, Turn Signal, Cruise Master, Defogger	SAE/SFE	20 Amp.
Heater - Air Conditioning	3AG/AGC	25 Amp.
Radio, Power Window	3AG/AGC	10 Amp.
Tail, Marker and Fender Lamps	SAE/SFE	20 Amp.
Instrument Lamps (Camaro, Chevy Nova, Chevrolet and Chevelle	SAE/SFE	4 Amp.
Instrument Lamps (Corvette)	1AG/AGA	5 Amp.
Gauges and Tell-Tale Lamps	3AG/AGC	10 Amp.
Stop and Hazard	SAE/SFE	20 Amp.
Clock, Lighter, Courtesy Lamps, Dome and Luggage Lamps	SAE/SFE	20 Amp.

In-Line Fuses:

Air Conditioning High Blower Speed Fuse located in wire running from horn relay to A/C Relay		
Comfortron and Four Season	SAE	30 Amp.
Universal & All Weather (Chevy Nova)	SAE	20 Amp.

Fusible Links:

Pigtail lead at battery positive cable (except Corvette)	14 gauge brown wire
Molded splice at Solenoid "Bat" terminal (Corvette only)	14 gauge brown wire
Molded splice Located at the horn relay	16 gauge black wire
Molded splice in Voltage Regulator #3 terminal wire	20 gauge orange wire
Molded splice in Ammeter circuit (Both sides of meter)	20 gauge orange wire

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WINDSHIELD WIPERS

Non-Depressed Park	Two Speed
Operation	
Test Voltage	12 V.
Gear Ratio	36:1
Crank Arm Rotation	CCW
Current Draw	
No Load	3.6 Max.
Dry W/S	4.5 Max.
Stall	12 Max.
Crank Arm Speed (rpm's)	
Low	34 Min.
Hi	65 Min.

Depressed Park-Chevrolet, Chevelle (Opt.) and Corvette	Two Speed
Operating Voltage	12 VDC
Gear Ratio	45:1
Crank Arm Rotation (Looking at Crank Arm)	
Counter Clockwise Crank Arm Speed (No Load)	
Lo	34 rpm/min.
Hi	65 rpm/min.
Current Draw (amperes)	
No load (low speed)	4.5
Installed in Car (dry windshield)	5.0
Stall	15 Max.
Shunt Field Resistance (ohms)	5-6 ohms

WASHER PUMP

Number of "squirts" at full pressure	12
Pressure (psi)	11-15
Coil Resistance (ohms)	20

RADIATOR AND GRILLE

SECTION 13

TORQUE SPECIFICATIONS

	Chevrolet	Chevelle	Chevy Nova	Camaro	Corvette
Radiator Support Screw	19 ft. lbs.	19 ft. lbs.	19 ft. lbs.	19 ft. lbs.	150 in. lbs.
Radiator Fan Shroud To Retainer Screw	50 in. lbs.	50 in. lbs.	50 in. lbs.	50 in. lbs.	Steel - 20 ft. lbs. Plastic - 100 in. lbs. Lower Screw 45 in. lbs.
Radiator Drain Cock	110 in. lbs.	110 in. lbs.	110 in. lbs.	110 in. lbs.	
Grille to Support Screw	12 in. lbs.	12 in. lbs.	18 ft. lbs.	—	18 in. lbs.
Grille to Upper Support Screw	—	—	18 ft. lbs.	15 in. lbs.	—
Grille to Lower Support Screw	—	—	30 in. lbs.	35 in. lbs.	—
Emblem to Grille Nut	25 in. lbs.	30 in. lbs.	—	25 in. lbs.	—

BUMPERS

SECTION 14

TORQUE SPECIFICATIONS

	Chevrolet	Chevelle	Chevy Nova	Camaro	Corvette
Front Bumper to Bracket Nuts	25 ft. lbs.	—	30 ft. lbs.	20 ft. lbs.	30 ft. lbs.
Bumper Bracket To Frame	70 ft. lbs.	70 ft. lbs.	70 ft. lbs.	—	55 ft. lbs.
Bumper Bracket To Brace	30 ft. lbs.	—	30 ft. lbs.	—	—
Bumper Bracket Brace to Bumper	30 ft. lbs.	—	30 ft. lbs.	22 ft. lbs.	25 ft. lbs.
Bumper Center Support to Bumper	20 ft. lbs.	—	—	—	30 ft. lbs.
Bumper to Brace Nuts (Lower)	—	38 ft. lbs.	—	—	—
Bumper to Brace Nuts (Face Bar)	—	25 ft. lbs.	—	—	—
Bumper Center Support To Frame	—	—	—	—	30 ft. lbs.
Rear Bumper to Bracket Bolts	30 ft. lbs.	30 ft. lbs.	30 ft. lbs.	18 ft. lbs.	45 ft. lbs.
Bracket to Body Nuts	50 ft. lbs.	38 ft. lbs.	30 ft. lbs.	25 ft. lbs.	30 ft. lbs.
Center Support To Bumper	55 in. lbs.	38 ft. lbs.	—	18 ft. lbs.	45 ft. lbs.
Center Support To Body	20 ft. lbs.	38 ft. lbs.	—	25 ft. lbs.	—
Rear Bumper to Bracket (Wagon)	20 ft. lbs.	30 ft. lbs.	—	—	—
Bumper Bracket to Frame (Wagon and P.U.)	—	70 ft. lbs.	—	—	—
Rear Bumper to Body (Wagon)	50 ft. lbs.	—	—	—	—
Rear Bumper to Bracket-Center-(Wagon)	50 ft. lbs.	30 ft. lbs.	—	—	—
Rear Bumper Bracket To Frame	—	—	—	—	70 ft. lbs.
License Plate Bezel To Body (Rear)	—	—	—	—	13 in. lbs.
Gas Tank Door To Bumper	18 ft. lbs.	18 ft. lbs.	—	—	—

ACCESSORIES

SECTION 15

CRUISE MASTER

Solenoid Resistance	5 ohms ± 1/4 ohm
Solenoid Wire Resistance	40 ohms
Maximum allowable Vacuum Leakage Rate for Servo Unit	5 inches of Vacuum Per Minute
Operational Test Speed	60 MPH

WEIGHTS AND MEASURES

LINEAR MEASURE

1/12 foot (ft.) ..... = 1 inch (in.)
12 inches ..... = 1 foot
3 feet ..... = 1 yard (1 yd.)

AREA MEASURE

1/144 square foot (sq. ft.) .. = 1 square inch (sq. in.)
144 square inches ..... = 1 square foot
9 square feet ..... = 1 square yard (sq. yd.)

LIQUID MEASURE

1/16 pint (pt.) ..... = 1 ounce (oz.)
1 pint ..... = 16 ounces
2 pints ..... = 1 quart (qt.) = 32 ounces
4 quarts ..... = 1 gallon (gal.)
31 1/2 gallons ..... = 1 barrel (bbl.)

DRY MEASURE

1/2 quart (qt.) ..... = 1 pint (pt.)
2 pints ..... = 1 quart (qt.)
8 quarts ..... = 1 peck (pk.)
4 pecks ..... = 1 bushel (bu.)
105 quarts ..... = 1 barrel

CUBIC MEASURE

1,728 cubic inches ..... = 1 cubic foot
27 cubic feet ..... = 1 cubic yard

COMMON WEIGHT

16 ounces ..... = 1 pound
100 pounds ..... = 1 hundred weight (cwt.)
2000 pounds ..... = 1 ton

COMMON U.S.A. EQUIVALENTS

LENGTH

1 inch ..... = 25.4001 millimeters
1 millimeter ..... = 0.03937 inches
1 foot ..... = 0.304801 meters
1 meter ..... = 3.28083 feet
1 yard ..... = 0.914402 meters
1 meter ..... = 1.093611 yards
1 mile ..... = 1.609347 kilometers
1 kilometer ..... = 0.621370 miles

LIQUID CAPACITY

1 quart ..... = 0.94633 liters
1 liter ..... = 1.05671 quarts
1 gallon ..... = 3.78533 liters
1 liter ..... = 0.26418 gallons

DRY CAPACITY

1 quart ..... = 1.1012 liters
1 liter ..... = 0.9081 quarts
1 peck ..... = 8.810 liters
1 liter ..... = 0.11351 pecks

DRILL SIZES

Letter Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches
Z	0.413	1	0.2280	28	0.1405	55	0.0520
Y	0.404	2	0.2210	29	0.1360	56	0.0465
X	0.397	3	0.2130	30	0.1285	57	0.0430
W	0.386	4	0.2090	31	0.1200	58	0.0420
V	0.377	5	0.2055	32	0.1160	59	0.0410
U	0.368	6	0.2040	33	0.1130	60	0.0400
T	0.358	7	0.2010	34	0.1110	61	0.0390
S	0.348	8	0.1990	35	0.1100	62	0.0380
R	0.339	9	0.1960	36	0.1065	63	0.0370
Q	0.332	10	0.1935	37	0.1040	64	0.0360
P	0.323	11	0.1910	38	0.1015	65	0.0350
O	0.316	12	0.1890	39	0.0995	66	0.0330
N	0.302	13	0.1850	40	0.0980	67	0.0320
M	0.295	14	0.1820	41	0.0960	68	0.0310
L	0.290	15	0.1800	42	0.0935	69	0.0292
K	0.281	16	0.1770	43	0.0890	70	0.0280
J	0.277	17	0.1730	44	0.0860	71	0.0260
I	0.272	18	0.1695	45	0.0820	72	0.0250
H	0.266	19	0.1660	46	0.0810	73	0.0240
G	0.261	20	0.1610	47	0.0785	74	0.0225
F	0.257	21	0.1590	48	0.0760	75	0.0210
E	0.250	22	0.1570	49	0.0730	76	0.0200
D	0.246	23	0.1540	50	0.0700	77	0.0180
C	0.242	24	0.1520	51	0.0670	78	0.0160
B	0.238	25	0.1495	52	0.0635	79	0.0145
A	0.234	26	0.1470	53	0.0595	80	0.0135
		27	0.1440	54	0.0550		

GAGES

GAGE NO.	U. S. STANDARD GAGE* Approx. Thickness—Inches	AMERICAN WIRE or B & S GAGE Thickness—Inches
0000000	0.490	
000000	.460	0.5800
00000	.429	.5165
0000	.398	.4600
000	.368	.4096
00	.337	.3648
0	.306	.3248
1	.2757	.2893
2	.2604	.2576
3	.2451	.2294
4	.2298	.2043
5	.2145	.1819
6	.1991	.1620
7	.1838	.1443
8	.1685	.1285
9	.1532	.1144
10	.1379	.1019
11	.1225	.0907
12	.1072	.0808
13	.0919	.0720
14	.0766	.0641
15	.0689	.0571
16	.0613	.0508
17	.0551	.0453
18	.0490	.0403
19	.0429	.0359
20	.0368	.0320
21	.0337	.0285
22	.0306	.0253
23	.0276	.0226
24	.0245	.0201
25	.0214	.0179
26	.0184	.0159
27	.0169	.0142
28	.0153	.0126
29	.0138	.0113
30	.0123	.0100
31	.0107	.00893
32	.0100	.00795
33	.0092	.00708
34	.0084	.00630
35	.0077	.00561
36	.0069	.00500
37	.0065	.00445
38	.0061	.00397
39	.0057	.00353
40	.0054	.00314
41	.0052	
42	.0050	
43	.0048	
44	.0046	

DECIMAL EQUIVALENTS

1/64	.015625
1/32	.03125
3/64	.046875
1/16	.0625
5/64	.078125
3/32	.09375
7/64	.109375
1/8	.125
9/64	.140625
5/32	.15625
11/64	.171875
3/16	.1875
13/64	.203125
7/32	.21875
15/64	.234375
1/4	.25
17/64	.265625
9/32	.28125
19/64	.296875
5/16	.3125
21/64	.328125
11/32	.34375
23/64	.359375
3/8	.375
25/64	.390625
23/32	.40625
27/64	.421875
7/16	.4375
29/64	.453125
15/32	.46875
31/64	.484375
1/2	.5
33/64	.515625
17/32	.53125
35/64	.546875
9/16	.5625
37/64	.578125
19/32	.59375
39/64	.609375
5/8	.625
41/64	.640625
21/32	.65625
43/64	.671875
11/16	.6875
45/64	.703125
23/32	.71875
47/64	.734375
3/4	.75
49/64	.765625
25/32	.78125
51/64	.796875
13/16	.8125
53/64	.828125
27/32	.84375
55/64	.859375
7/8	.875
57/64	.890625
29/32	.90625
59/64	.921875
15/16	.9375
61/64	.953125
31/32	.96875
63/64	.984375
1	