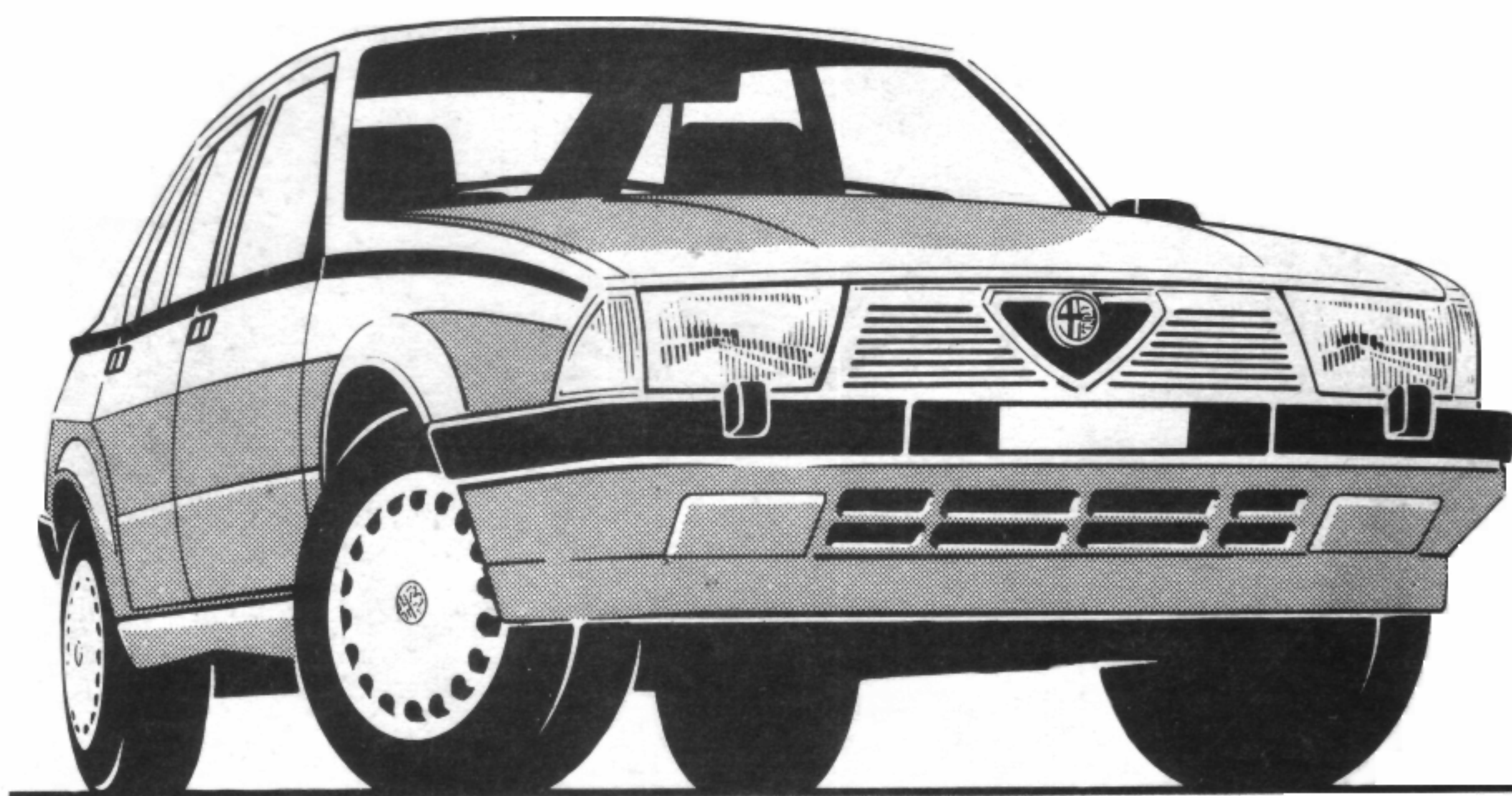


WORKSHOP MANUAL

75 Twin Spark S



**VERSION WITH
CATALYTIC CONVERTOR**

DIREZIONE ASSISTENZA TECNICA

Alfa Romeo 

FORWARD

This publication is for vehicles equipped with catalytic convertor, Lambda sensor and fuel vapour emission control system.

*The manual complements the basic workshop manuals **ALFA 75** and petrol engines.*

In addition to specific topics related to the model in question, procedures that have been modified with respect to the basic version, are included in this manual. Slight changes, however, have only been mentioned and should be referred to in the basic text.

PA371100000000	ALFA 75	→	GR.	<i>These signs indicate that the corresponding group (see quick reference index) of the basic manual should be referred to for all topics not expressly dealt with in this manual.</i>
PA3467B0000000	petrol engines	→	GR.	

QUICK REFERENCE INDEX

COMPLETE CAR	GR. 00
ENGINE MAIN MECHANICAL UNIT	GR. 01
ENGINE FUEL SYSTEM	GR. 04
ENGINE IGNITION, STARTER, CHARGING	GR. 05
ENGINE COOLING SYSTEM	GR. 07

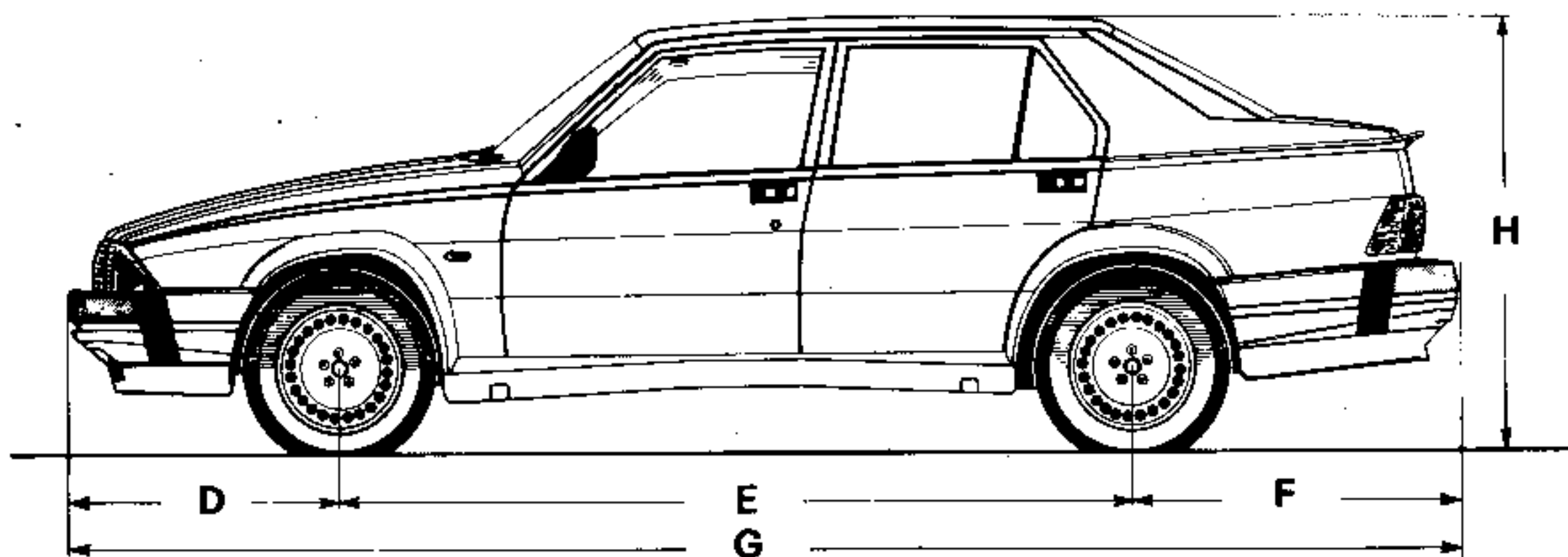
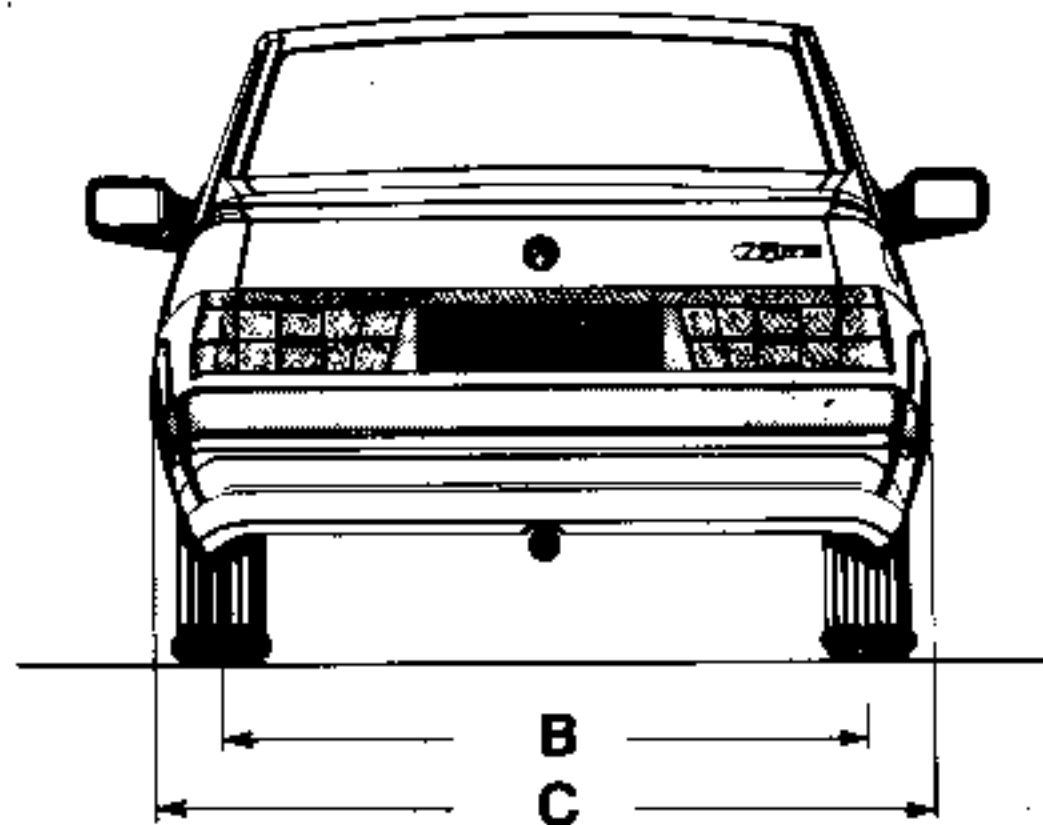
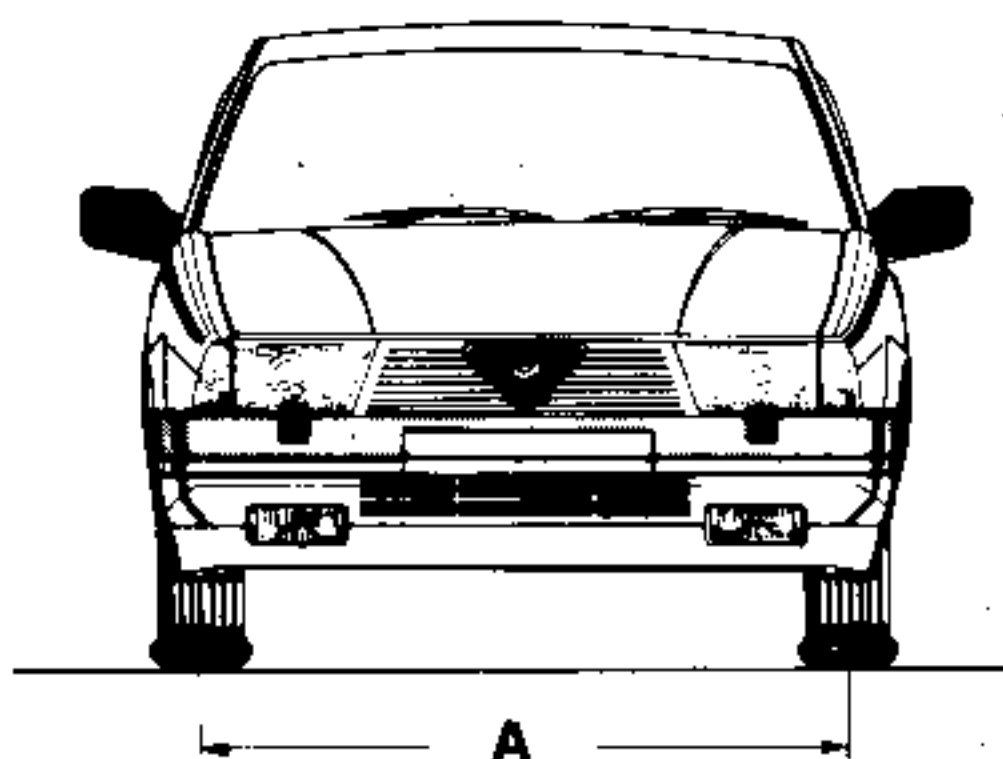
GROUP 00

CONTENTS

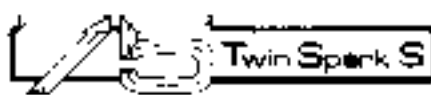
GENERAL VIEWS	00-3	Cylinder compression test	00-25
Dimensions	00-3	Fuel system	00-25
Weights and loads	00-4	Check and adjustment of the	
Wheels and tires	00-4	accelerator	00-25
IDENTIFICATION DATA	00-5	Check of fuel system pressure and	
IDENTIFICATION LABELS	00-5	tightness of system	00-26
Position of labels	00-5	Trouble diagnosis procedure for the	
Vehicle identification codes	00-6	checking of the tightness of fuel	
INSTRUCTIONS FOR PRE-DELIVERY		injection system	00-26
INSPECTION	00-7	Check of the tightness of the	
MAINTENANCE	00-9	fuel vapour emission (evaporation)	
VEHICLE MAINTENANCE SCHEDULE ...	00-10	system	00-27
FLUIDS AND LUBRICANTS		Check the tightness of the air	
SCHEDULE DIAGRAM	00-12	intake system downstream from	
RECOMMENDED FUEL AND		the air flow gauge	00-27
LUBRICANTS	00-13	Checking, cleaning and replacement	
Fuel	00-13	of the fuel filter	00-27
Fluids and lubricants	00-13	Replacement of the fuel filter	00-28
APPROXIMATE REFILL CAPACITIES	00-14	Check of the idle r.p.m.	00-28
ENGINE MAINTENANCE	00-15	Check of exhaust emissions (CO)	
Engine main mechanical unit	00-15	with the engine running on idle	00-28
Changing of oil and oil filter - Check		Exhaust system	00-29
of lubrication system tightness	00-15	Replacement of the Lambda sensor	
Tightening of cylinder head nuts	00-15	and the catalyser	00-29
Check and adjustment of valve		Engine ignition	00-30
clearances	00-16	Check of ignition timing	00-30
Check of timing chain tension and		Check, cleaning and/or replacement	
setting of timing	00-19	of the spark plugs; firing order	00-30
Checking and restoring of good		Engine cooling	00-30
working order of the timing		Check of antifreeze mixture level and	
variator	00-21	cooling system tightness check	00-30
Adjustment of tension and		ELECTRICAL CHECKS USING THE	
replacement of alternator drive		TROUBLE DIAGNOSIS TESTING	
belt	00-24	INSTRUMENT	00-32
Adjustment of tension and		FAULT FINDING	00-38
replacement of power steering		IGNITION AND INJECTION WIRING	
pump drive belt	00-24	DIAGRAM (MOTRONIC ML4.1)	00-71
Adjustment of tension and		TECHNICAL DATA AND	
replacement of air conditioner		SPECIFICATIONS	(*)
compressor drive belt	00-24	SPECIAL SERVICE TOOLS	00-73

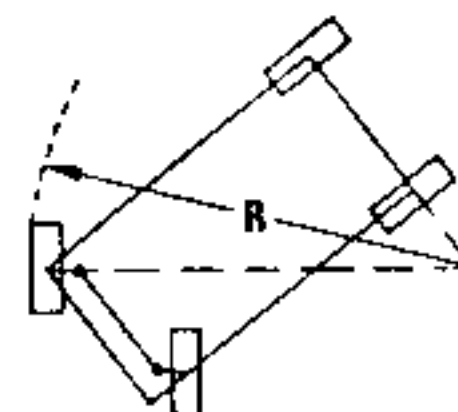
GENERAL VIEWS

DIMENSIONS



Unit: mm

Model	Dimensions	A	B	C	D	E	F	G	H Max	R(*)
		1376 (1)	1362 (1)	1660	825	2510	995	4330	1400	5050
		1396 (2)	1382 (2)							



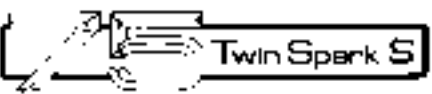
(1) With rims 5 1/2J x 14"

(2) With rims 6 1/2J x 14"

(*) Radius of the circumference described in correspondence with ground from driving wheel outer edge, with full steering lock.

COMPLETE CAR

WEIGHTS AND LOADS

		Model	
Weights and loads			
Max weight allowed	(kg)		1595
Kerb weight	(kg)		1170
Carrying capacity	(kg)		425
Max allowed gross weight per axle	Front		850
	Rear		990
Max towing gross weight	(kg)		1200
Max vertical load on tow hook	(kg)		60
Seating capacity	Front		2
	Rear		3

WHEELS AND TYRES

		Model	
Rims and tyres			
Rims		5 1/2J x 14" (1)	6 1/2J x 14" (2)
Tubeless tyres		195/60 VR14"	
Inflating pressure [kg/cm²] (3)	N	A	1,8
		P	2,0
	C	A	2,0
		P	2,2

A: Front

P: Rear

N: With reduced load and normal speed

C: At full load and high speed

V: Up to 230 km/h

(1) Rims with 4 securing screws

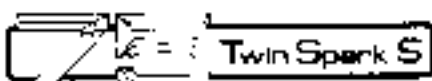
(2) Rims with 5 securing screws

(3) Pressure measured on cold tyres

WARNING:

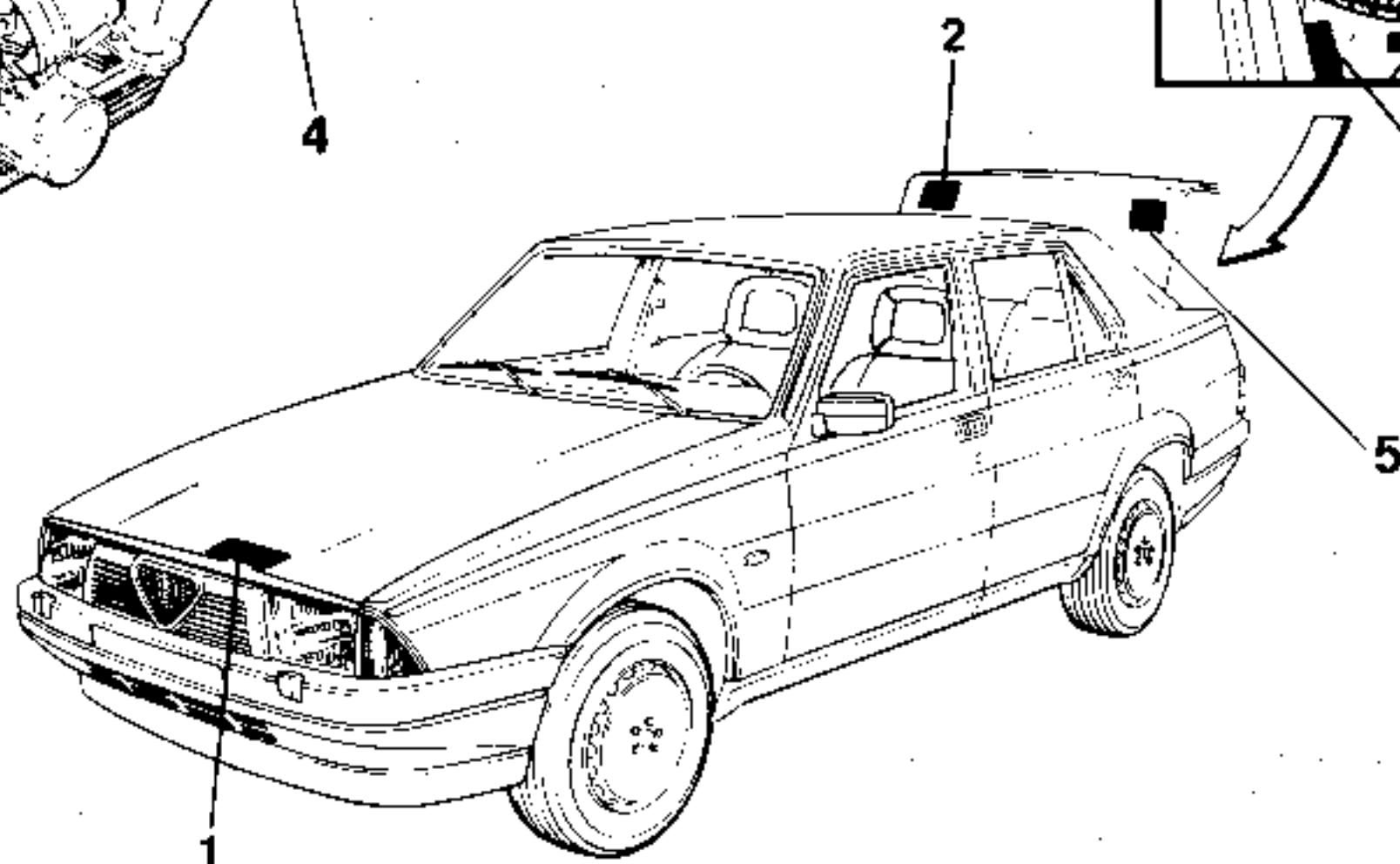
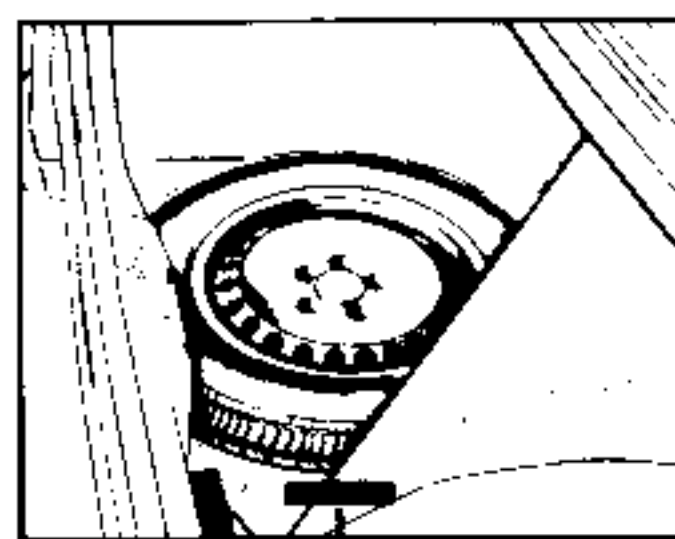
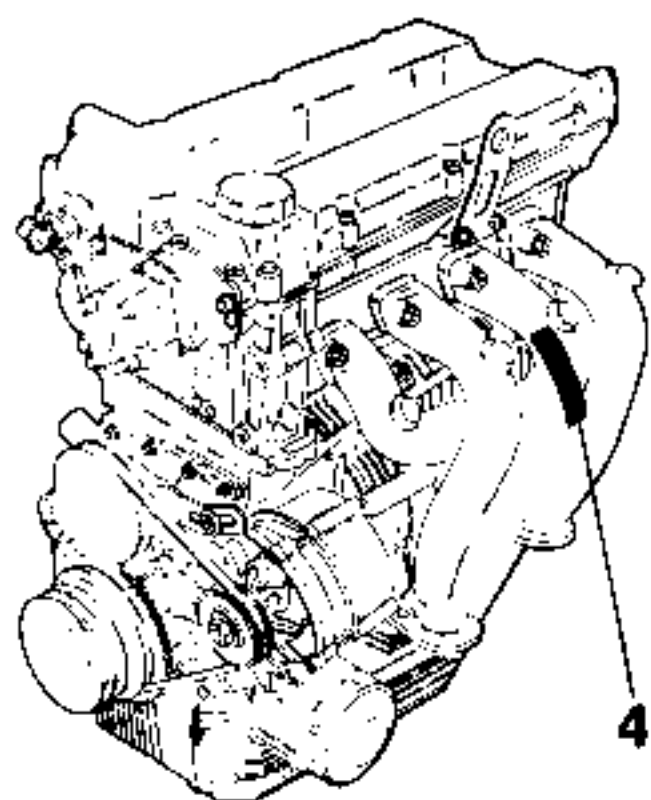
The wheel nuts must be tightened to a torque of 98 N·m (10 kg·m)

IDENTIFICATION DATA

Model				
Body			4 — door saloon	
Drive			LH	RH
Identification No.		— on identification label	161.30	—
Chassis No.	Type approval No.	— on identification label	162.B4	
		— on rear right side of luggage compartment floor	162.B40	
	Serial No.	— on rear right side of luggage compartment floor	from 00.001.001	
Engine No.	Type and serial No.	— on left rear side of engine block	062.24 from 000.001	

IDENTIFICATION LABELS

POSITION OF LABELS



1. Identification label
(identification No. and type approval number)
2. Paint products label
3. — Label on luggage compartment floor (type approval number)
— stamped on sheet panel (serial number)
4. Label on engine block, left rear side
(engine type and serial number)
5. Lubrication label

VEHICLE IDENTIFICATION CODES

A. Chassis numbering

It is composed of two groups of numbers and/or reference identifications.

(1) Z A R (2a) 162.B30 (2b) ★ 00.001.001 (3)

- (1) Manufacturer identification characters.
- (2) Number of «Type and version approved».
It is composed of six figures, subdivided as follows:
 - (2a) Basic type number: it is assigned to each vehicle having a common design type.
 - (2b) Type variation number: identifies the variations of the basic type.

- (3) Serial number: is assigned individually to each vehicle as it is produced.

- (4b) Type variation number: identifies, with the basic type, vehicles with various modifications.

For servicing purposes quote the identification number only (4).

ALFA LANCIA INDUSTRIALE S.p.A.		
Kg.		
Kg.		
1-	Kg.	
2-	Kg.	
162.B4 TIPO VERSIONE	062.24 TIPO MOTORE	161.30 CODICE INTERNO

161.30
(4a) (4b)
(4)

B. Engine numbering

062.24 000.001
(1) (2)

- (1) Type number (e.g.: 062.24 engine 2000 with ML4.1 Motronic fuel injection).
- (2) Engine serial number: is assigned individually to each vehicle as it is produced.

- (4) Identification number: (on identification label).
It is composed of five figures, subdivided as follows:
 - (4a) Basic type code: it is assigned to each vehicle having a common design type and distinguishes the various models.

INSTRUCTIONS FOR PRE-DELIVERY INSPECTION

This chapter lists and describes the pre-delivery operations required for the vehicles:



As regards the technical specifications related to each operation and the lubricant products (and similar) to be employed, refer to the «Technical Data and Specifications» present in each section.

CAUTION:

Pre-delivery inspection of a new vehicle, prior to customer delivery, consists of carrying out all the checking operations and tests described below in order to detect and thus eliminate any faults which may exist.

It goes without saying, however, that when Dealer personnel pick up the vehicle, they should perform a visual check in order to:

- a. **make sure the vehicle is in normal driving condition, especially as regards level of fluids and controls.**
- b. **detect any dents or scratches on body or other damage to the upholstery.**
- c. **make sure nothing is missing, especially factory supplied accessories spare tyre and any parts that are to be fitted on vehicle as part of pre-delivery completion.**

If, as a consequence of the checks, topping up is required, proceed accordingly; this operation is to be considered as part of pre-delivery inspection. In the event of interventions (faults) other than those indicated, carry out the adjustments according to the current technical and administrative procedures.

As each operation is being carried out, the relevant card must be filled out and filled together with the other documents of the sold vehicle.

The pre-delivery card included in the Instruction Book supplied to the customer is to be duly filled out as evidence of the scrupulous execution of the pre-delivery checks.

OPERATIONS TO BE CARRIED OUT IN THE ENGINE COMPARTMENT

Coolant

- With engine cold check the level in the header tank.
Top up to the max. level with the specified coolant, if necessary.

Engine oil

- Check that the level is up to the «MAX» level on the dipstick (carry out this operation after having parked the vehicle on a flat surface and after the engine has been off for a few minutes). If required top up with specified oil.

Power steering oil

- Check that the level is up to the «MAX» mark on the plug stick (before carrying out the check, with engine idling, rotate the steering wheel completely in both directions in order to carry out bleeding).

Brake and clutch fluid

- Check that the level is up to the «MAX» mark in the reservoir.
If required, top up with specified fluid, remembering that tins must be opened only at the moment of use.
Be sure to perform this operation with utmost care and cleanliness.

Battery electrolyte

- Check that the electrolyte covers the upper edge of the plates by 5 mm, if not top up with distilled water.

Windscreen washer liquid

- Check that the relative tank is completely full, if not top up with the appropriate solution.

Engine electric fan

- Connect together the electric leads of the thermal switch and check that the electric fan functions correctly.
- Check that the leads are firmly connected to the thermal switch.

Check ignition advance

- Connect the stroboscopic gun to the 1st spark plug on the respective ignition distributor; connect the negative and positive leads of the gun to the relative terminals of the battery.
- Connect an electronic rev. counter to the engine.
- Start engine, warm it up to running temperature and with the engine idling, check the fixed ignition advance.

Check the tightness of the air intake ducts

- In order to detect any air loss in the whole air intake system, disconnect the flexible tube downstream from the constant idling regulation actuator and blow in air with a compressed air gun.
- Completely open the butterfly valve and brush or spray soapy water on all the joints.
The formation of bubbles or foam indicates air loss.

Check of CO percentage on idle (with Lambda sensor disconnected)

The reading of CO values (carbon monoxide) must be carried out using exclusively NDIR type analysers, connecting them to the exhaust tube.

The check is to be carried out with the engine completely warmed up (after the electric fan has come on and then gone off) and with the engine idling.

OPERATIONS TO BE CARRIED OUT ON EXTERIOR OF VEHICLE AND IN THE PASSENGER COMPARTMENT

Exterior cleaning

- After dewaxing, to be carried out using specified methods and products, wash the exterior of the vehicle with water-shampoo solution, rinse and dry. Complete cleaning by eliminating any residual dirt using appropriate products.

Paintwork

- Check all painted surfaces visually and remove accidental or manufacturing flaws, if any.

Exterior moldings and fittings

- Visually check all exterior fittings of the vehicle: bumpers, moldings, grills, headlamps, lettering and emblems making sure they are all securely fitted and are not spotted or dented.

Doors and hoods

- Visually check that all weatherstrips are correctly fitted and are not damaged out of shape or dirty.
- Also see that doors and hoods are correctly aligned and centred with respect to their respective relevant openings.

Factory issued accessories

- Check the presence of the following: tool kit, spare wheel, jack, Instructions Booklet, Service Booklet and Service Centre Guide.

Locks, hinges, window opening

- Check correct functioning of door locks (closing, locking and opening from inside and outside). Similarly check the functioning of engine and luggage compartment hood locks.
- Check that door and hood hinges operate smoothly and noiselessly.

- Check that windows open and close all the way noiselessly and without sticking.

Interior finishings

- Check all upholstery (roof, carpets, panels etc.) removing any stains or scratches.

Seats safety belts and accessories

- Check that seats run freely on their tracks, noiselessly and without sticking. Also check that seat and head-rest adjustment devices function correctly.
- Check inside and outside rear-view mirrors making sure they adjust easily and stay firmly in place when set; also check snap switch on mirror for day/night driving.
- Check that seat belts and relative retractors are in good working order.
- Check the maneuverability of the sunvisors, ashtrays, glove compartment and any other standard accessories.

Heating and air conditioning system

- Check that the heater and the air inlet covers and flaps (opening and closing) function correctly.
- Check that the electric fan functions correctly at the various speeds.
- For vehicles with air conditioning, start the engine and check that, when the appropriate control in the vehicle is operated, this determines the closure of the electromagnetic coupling and consequently the operation of the compressor.

Lights, indicators, electrical accessories

- With ignition key set to «MARCIA», check the functioning of internal and external vehicle lights and where appropriate the relative instrument panel indicator lamps: front and rear lights, number plate lights, direction indicators, flashing hazard lights, stop lights, head-lamp high and low beam, head-lamp flashing, reversing lights, engine and luggage compartment lights, passenger compartment light

(manual and door operation) and the switch-off timer for these, front and rear spot lamps instrument panel cluster lights and relative adjustment rheostat (or rheostats) and glove compartment lights.

- Check the functioning of the following instrument panel warning lights: alternator, fuel reserve, oil pressure, brake fluid level, hand brake on, rear window heater on, engine temperature. Check the functioning of the Alfa Romeo Control lamps. These all come on simultaneously when the ignition key is set in the «MARCIA» position and then go out after a few seconds.
- Check that horns, cigar lighters, door locking device, power window controls and front seat electrical adjustment controls all function correctly.

Windscreen wipers, windscreen and head-lamp washers

- After fitting the wiper blades, check that the wipers function correctly at different speeds and on intermittent functioning.
- Operate the windscreen washer and check for an even spray from the jets and that the spray is correctly directed towards the upper part of the windscreen.
- Check that the spray is correctly directed towards the head-lamps (only where required by Regulations).

Tyre pressure

- Check and if necessary restore normal running pressure of tyres to specified values. Adopt the highest value for the spare wheel.

Tightening of wheel nuts or screws

- By means of a spanner, check that the wheel nuts are completely tightened. Check also that the nuts are appropriate for the type of vehicle or rim, as indicated in the Spare Parts Catalogue.

OPERATIONS TO BE CARRIED OUT ON UNDERSIDE OF VEHICLE

Speed gear-differential oil change

- Remove filler plug and check that the lubricant level reaches the lower rim of the relative hole.
Top up if necessary and re-fit filler plug.

Leakages

- Check visually for leaks or traces of leaks in the following systems: fuel and exhaust emission, power steering, brakes, clutch, engine cooling.
- Check for oil leaks from engine, gear-box and differential.

ENGINE CONTROLS AND TEST

Engine controls

- Check that the accelerator pedal functions without sticking and that with the pedal right down, the accelerator butterfly valve is completely open.

Engine starting and functioning

- Check that the engine starts normally. With the engine warmed up check that the engine runs smoothly at the correct specified r.p.m.

Dashboard instruments

- With the engine running, check the functioning of all electrically operated instruments: rev. counter, speedometer, oil pressure gauge, water temperature gauge, fuel level gauge, clock, Alfa Romeo Control.

Brake clutch and speed-gear controls

- With engine running, push the brake pedal and check that after the initial empty stroke, the pedal stops hard without elasticity.
Check that the handbrake lever functions normally.
- With the engine running, press down the clutch pedal and check that all speeds can be shifted without sticking or noise.

MAINTENANCE

The maintenance operations consists of checking and restoring the efficiency of some parts of the vehicle which are most likely to become worn or out-of adjustment as a result of normal use (1).

A list of the various operations to be performed at different intervals, as shown in the chart that follows, is contained in the coupons in the Service Book which accompanies each vehicle. These coupons have

to be stamped by the Service Organisation Agency to show that the specified maintenance operations have been carried out. Just as for pre-delivery inspection, should topping up or change of fluids or lubricants - as already described in the text - become necessary, they will be considered as part of maintenance operations.
Should faults other than those listed be encountered, they must be repaired or adjusted

according to current technical and administrative procedures.

(1) It should be noted that the presence of the catalyser entails perfect engine maintenance as a principal element affecting the life of the catalyser itself.

VEHICLE MAINTENANCE SCHEDULE

No.	OPERATION	A (1)	km/1000																				Notes
			10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	
1	Change engine oil, filter and check lubrication system tightness	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	(2) E
2	Change speed-gear differential oil	X			X			X					X				X					X	
3	Check speed-gear differential oil level		X			X					X				X				X				
4	Check and if necessary top up the level of the windscreen and head lamp washer liquid and check the functioning of the wash/wipe system	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	(3)
5	Check the level of brake and clutch fluid	X	X	X		X	X	X			X	X			X	X	X		X	X	X		
6	Change the brake and clutch fluid				X				X					X				X				X	(4)
7	Check power steering oil level	X		X	X				X			X		X		X		X		X		X	
8	Check the antifreeze mixture level and inspect the cooling system for leaks	X	X	X	X	X	X	X			X	X			X	X	X		X	X	X		(3) E
9	Change the antifreeze mixture and inspect the cooling system for leaks				X				X					X				X				X	(5) E
10	Check tightness of nuts and bolts	X																					
11	Check front wheel toe-out and adjust if necessary	X																					
12	Check the good condition of drive shaft and steering box protective boots	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
13	Check power brake vacuum intake hose for wear and inspect brake system	X		X		X			X				X			X		X		X		X	
14	Check brake pads for wear and if necessary replace		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	(6)
15	Check handbrake travel and if necessary adjust	X		X		X			X				X		X		X		X			X	
16	Check tyre pressures	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	(3)
17	Check correct tightness of nuts, bolts and screws on induction and exhaust manifolds, oil sump and front engine cover	X																					E
18	Tighten cylinder head nuts	X																					E
19	Check and if necessary adjust accelerator cable	X																					
20	Check and adjust valve clearance. Check timing and tension of timing chain	X		X		X		X	X		X		X		X		X	X		X		X	E
21	Check good condition and tensioning of alternator, air conditioner compressor and power steering pump (if fitted) drive belts	X		X				X				X			X					X			E

COMPLETE CAR

No.	OPERATION	A (1)	km/1000																Notes				
			10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160		170	180	190	200
22	Replace alternator, air conditioner compressor and power steering pump (if fitted) drive belts				X					X			X				X					X	E
23	Check fuel delivery and fuel vapour (evaporation) recycling system for leaks	X		X	X		X		X		X		X		X		X			X		X	E
24	Check and clean air filter cartridge		X	X		X		X		X		X		X		X			X				(7) E
25	Replace air filter cartridge			X	X		X		X		X		X		X		X		X			X	E
26	Check air intake system downstream from air flow gauge for leaks	X		X	X		X		X		X		X		X		X		X			X	E
27	Replace fuel filter				X					X								X				X	E
28	Check exhaust emissions	X		X	X		X		X		X		X		X		X		X			X	E
29	Check and clean spark plugs		X	X		X		X		X		X		X		X		X		X			E
30	Replace spark plugs			X	X		X		X		X		X		X		X		X			X	E
31	Check and top up if necessary battery electrolyte. Tighten and grease terminal connections	X		X	X		X		X		X		X		X		X		X			X	(3)
32	Check and if necessary adjust head lamp setting	X																					
33	Lubricate door and hood hinges and if necessary adjust strikers. Grease front and rear hood catches	X		X	X		X		X		X		X		X		X		X			X	
34	Check under body and bodywork			X	X		X		X		X		X		X		X		X			X	
35	Test vehicle	X		X	X		X		X		X		X		X		X		X			X	
36	Check oxygen content of exhaust gases (Lambda sensor)										X											X	E
37	Replace exhaust gas catalyser (silencer box)										X											X	E

E = Maintenance connected with exhaust emission control

(1) A = 1000 + 1500 km

(2) To be carried out every 6 months in any case. Check oil level frequently when refuelling

(3) Check frequently when refuelling

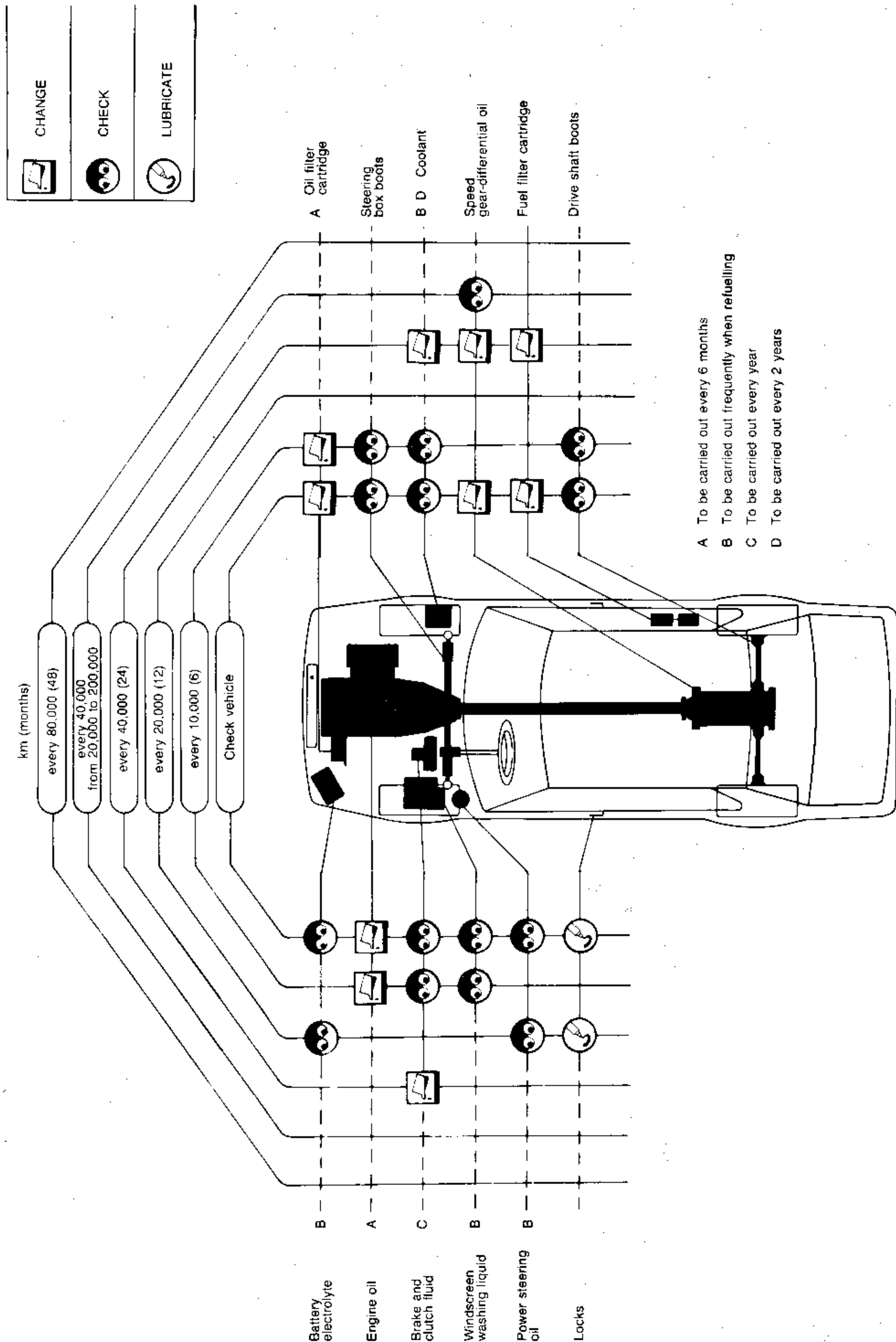
(4) To be carried out every year, in any case

(5) To be carried out every two years, in any case

(6) To be carried out with greater frequency when driving under particular stress conditions, for sports driving or on hilly roads

(7) Check with greater frequency when driving in dusty regions

FLUIDS AND LUBRICANTS SCHEDULE DIAGRAM



RECOMMENDED FUEL AND LUBRICANTS

FUEL

For correct engine functioning the use of **unleaded petrol** with the following characteristics is recommended:

Octane rating (Research Method)
R.O.N. ≥ 95

CAUTION:

To avoid permanent damage to the exhaust gas catalyser, never use, neither in case of emergency nor in small quantities, conventional petrol with lead.

To prevent the tank from being accidentally filled with lead petrol, the filler inlet tube has been designed in such a way as to permit the insertion of only those special delivery hoses fitted exclusively to unleaded fuel delivery pumps.

Should the fuel tank be filled with even a small quantity of lead petrol, do not start the engine, but proceed to the complete emptying of the fuel tank and the fuel delivery system.

FLUIDS AND LUBRICANTS

As for the corresponding model in the basic text, with vacuum fuel intake, except for the table concerning the type of oil to be used, which is to be modified as follows:

Type	Application	Classification	Name			Notes
			AGIP	IP	Others	
OIL	Engine - 01	SAE S E ASTM S E API SF	Sint 2000 SAE 10W50	SINTIAX SAE 10W40		Ambient temperature —18°C ÷ 40°C
	Gear box differential 13 - 17	SAE J 306 a API GL-5	Rotra SX SAE 75W90	Pontiax HDS SAE 75W90		Ambient temperature —40° ÷ 150°C
	Front suspension - 21	SAE J 306 a API GL-5	Rotra SX SAE 75W90	Pontiax HDS SAE 75W90		Ambient temperature —40° ÷ 150°C
	Steering box/wheel - 23	DEXRON B	ATF DEXRON B 11297	DEXRON FLUID B 11297		
	Air conditioner - 80				SUNISO 4 G SUNISO 5 DS	

APPROXIMATE REFILL CAPACITIES

Approximate refill capacities		Model	
Fuel tank	l		49
Fuel reserve	l		8
Engine oil sump	kg	With filter	5
		Without filter	4,5
Cam shaft support sumps (*)	kg		0,415
Gear box-differential oil	kg		2,05
Power steering system oil	kg		0,8
Coolant	Min Temp —30°C	Concentrated antifreeze	1,2
		Distilled water	6,8
		Antifreeze ready to use	8
	Min Temp —45°C	Concentrated antifreeze	2,65
		Distilled water	5,35
		Antifreeze ready to use	8

(*) Change oil only when dismantling. The quantity is only approximate, fill up to the level.

ENGINE MAINTENANCE

ENGINE MAIN MECHANICAL UNIT

CHANGING OF ENGINE OIL AND OIL FILTER - CHECK OF LUBRICATION SYSTEM TIGHTNESS

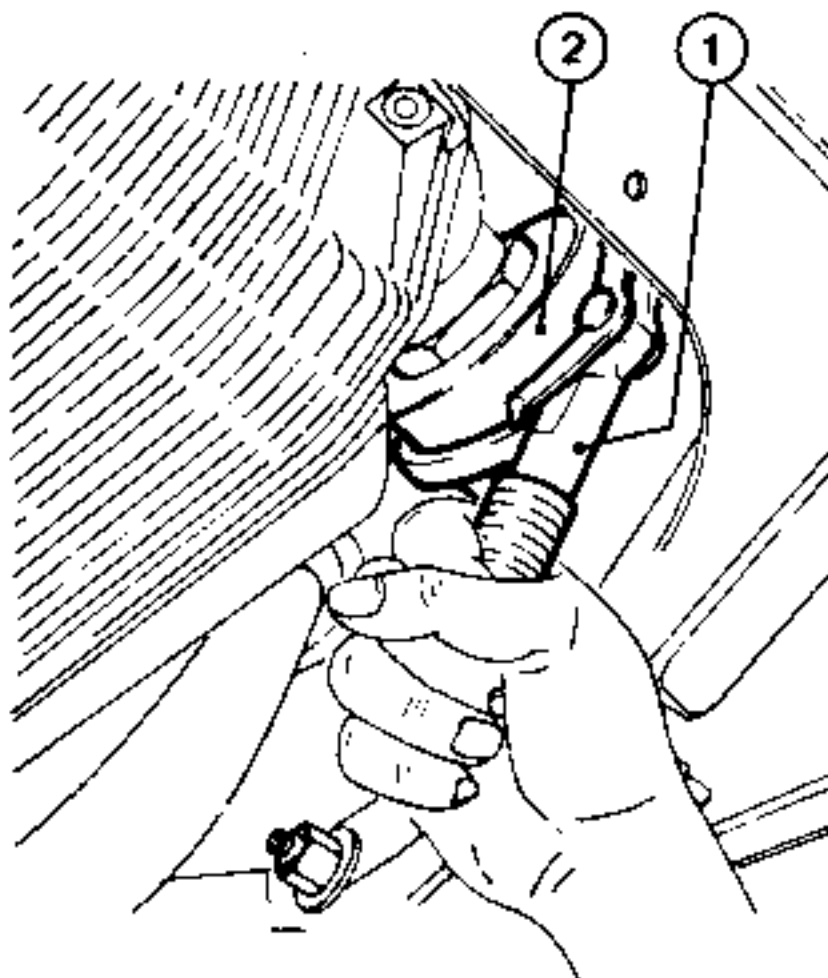
a. With the engine warmed up, remove the oil filler cap (1), the dipstick (2) and unscrew the oil sump plug (3). Let the oil drain off completely for at least 15 minutes.

CAUTION:

- The presence of whitish substances in the oil is caused by the leakage of coolant liquid (water) into the oil. Identify the cause and proceed to preventive measures.
- An extremely low viscosity of the oil indicates that it has been diluted by the fuel.

1. Oil filler cap
2. Oil dipstick
3. Oil sump plug

b. Using the appropriate wrench (1), dislodge the oil filter (2) and remove it, working from beneath the vehicle.



1. Wrench for removal of filter
2. Oil filter

c. When all the oil has drained off, clean the drain plug and screw it back on to the oil sump with the relative gasket.
 d. Moisten the oil filter gasket with oil and fit it, screwing it on completely by hand.
 e. Fill the engine with the recommended oil type and using the indicated quantity.

ENGINE OIL

Type: AGIP SINT 2000 10W50
 IP SINTIAX 10W40

Quantity	5.0 kg
Sump to maximum level mark	4.5 kg
Filter capacity	0.5 kg
Difference between maximum and minimum levels on dipstick	1.15 kg
Cylinder head support sumps (*)	0.415 kg

(*) Filling to be carried out for each sump, if dismantled.

f. Check the oil level on the dipstick.
 g. Replace the filler cap and start the engine

allowing it to idle for approximately two minutes.

h. Check that there are no oil leaks. If necessary tighten or replace any part which is poorly sealed.

i. Switch engine off and wait a few minutes.

j. Remove dipstick and clean it. Insert the dipstick again, remove it and check that the oil level reaches the MAX reference mark.

CAUTION:

Checking of the oil level is to be carried out with the vehicle parked on a level surface.

TIGHTENING OF CYLINDER HEAD NUTS

1. As per maintenance coupon

a. Remove the timing system cover following the procedure indicated in the paragraph «Check and adjustment of valve clearances», point 1.
 b. With the engine cold, loosen the nuts by one turn, one at a time, following the sequence indicated in the figure. Moisten the surfaces between nut and washer and tighten to the specified torque.

T : Tightening torques

86 ÷ 88 N·m
 (8.8 ÷ 9 kg·m)

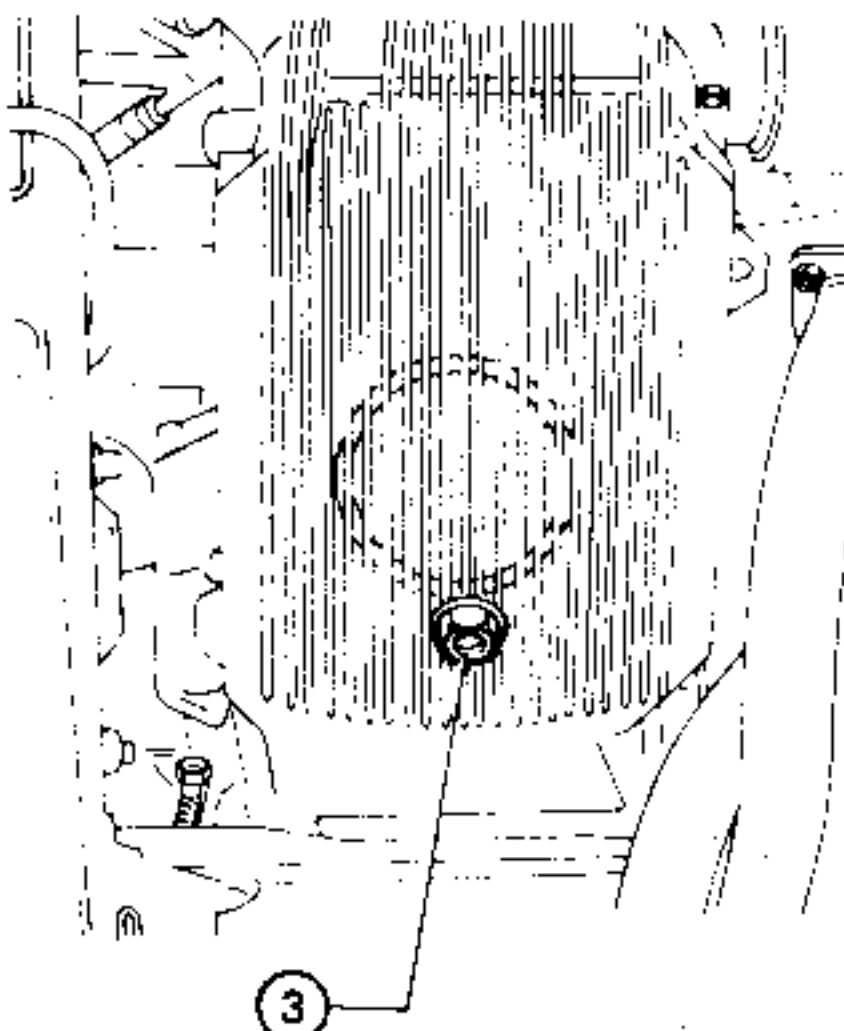
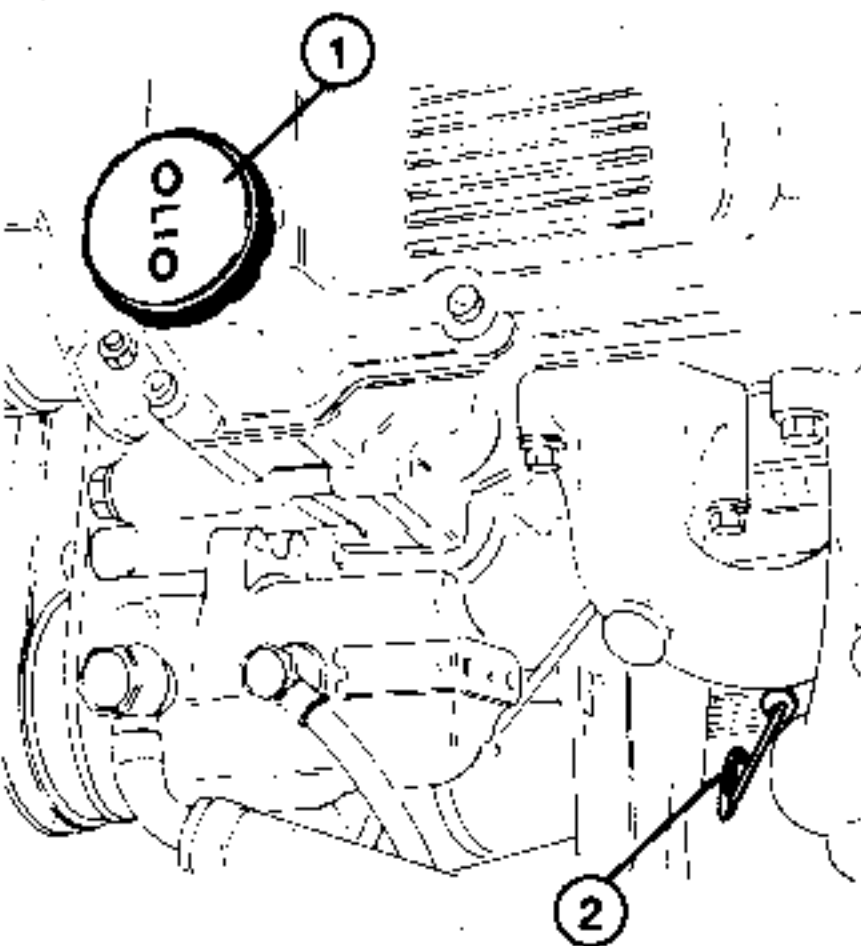
c. Refit timing system cover following the reverse procedure to that employed for the removal.

2. When reassembling cylinder head

a. Lubricate washers nuts and threads and with the engine cold, tighten the nuts gradually to the specified torque following the sequence indicated in the figure.

T : Tightening torque

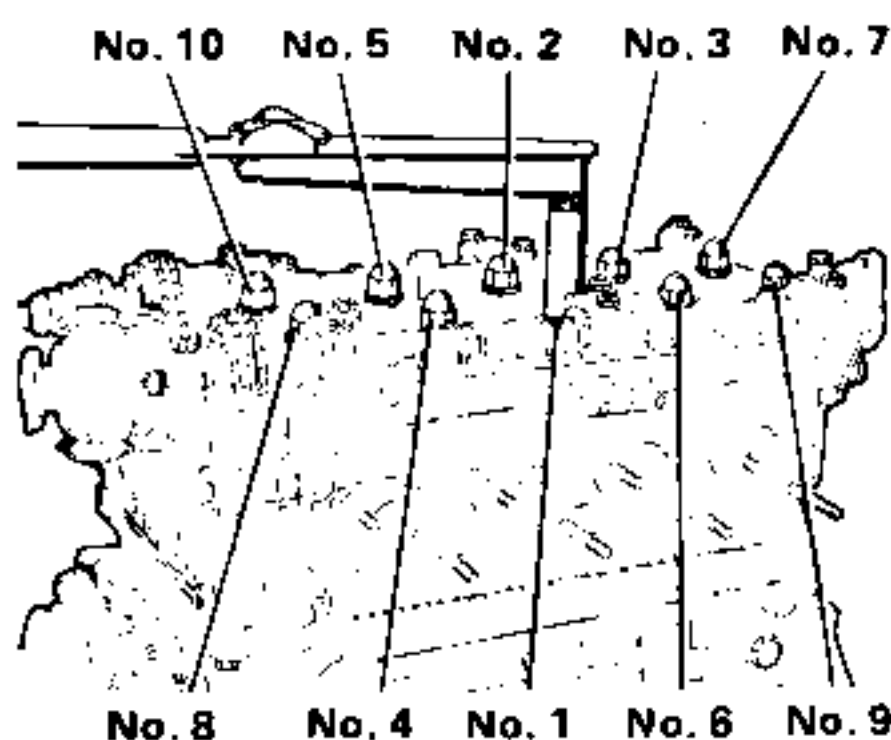
77 ÷ 79 N·m
 (7.9 ÷ 8.1 kg·m)



b. Run the engine to normal running temperature and tighten the nuts, without loosening them to the specified torque, following the sequence indicated in the figure.

T : Tightening torque
 $82 \div 83 \text{ N}\cdot\text{m}$
 $(8.4 \div 8.5 \text{ kg}\cdot\text{m})$

c. After approximately 1000 km proceed, with the engine cold, as indicated at point 1.

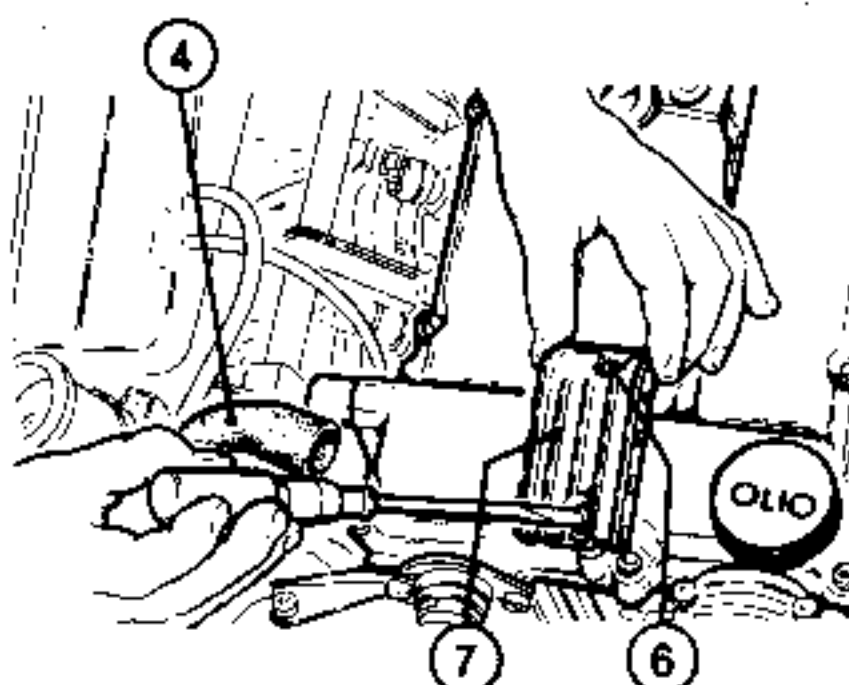
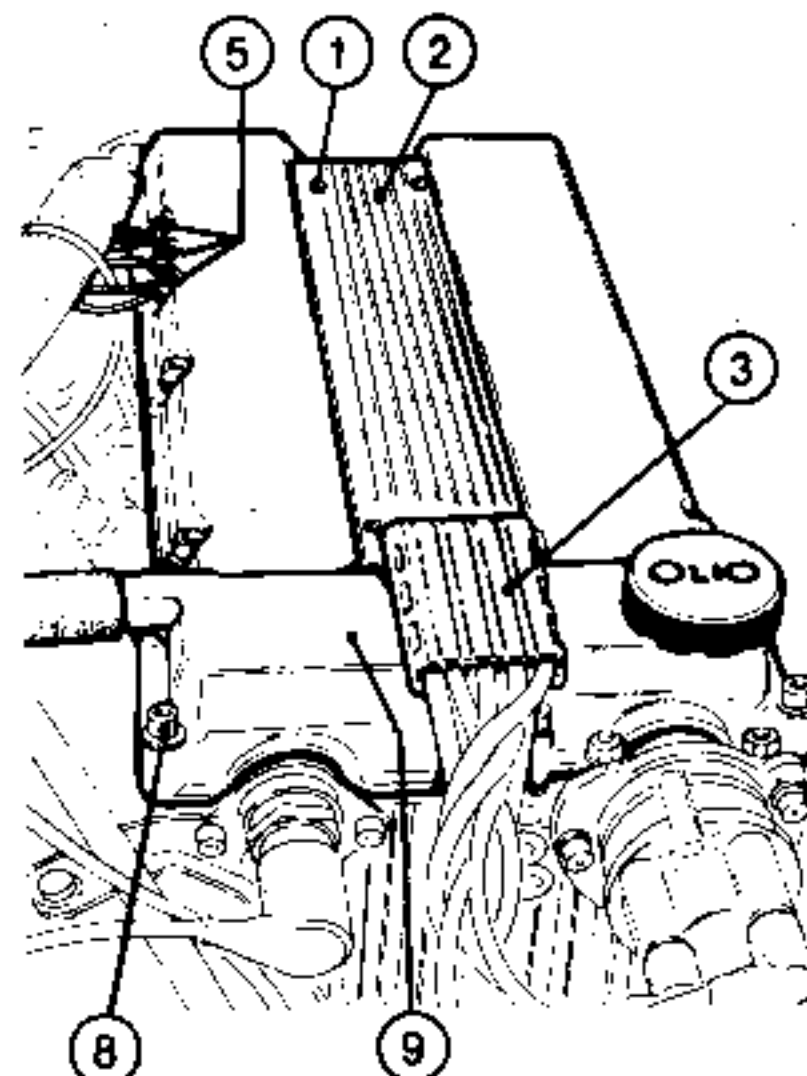


CHECK AND ADJUSTMENT OF VALVE CLEARANCES

The following operations must be carried out with the engine cold

1. Removal of the timing system cover

- Disconnect the negative terminal of the battery.
- Unscrew the four screws (1) and remove the spark plug cover (2).
- Remove the spark plug lead holding cover (3) and disconnect the leads from the spark plugs.
- Disconnect the oil vapour breather tube (4) from the timing system cover.
- Disconnect the fuel injection wiring ground leads (5), removing the three relative fixing screws on the timing system cover.
- Unscrew the screws (6) and remove the spark plug wiring container (7).
- Unscrew the thirteen screws (8) and remove the timing system cover (9) with the relative gaskets and oil retaining half rings.



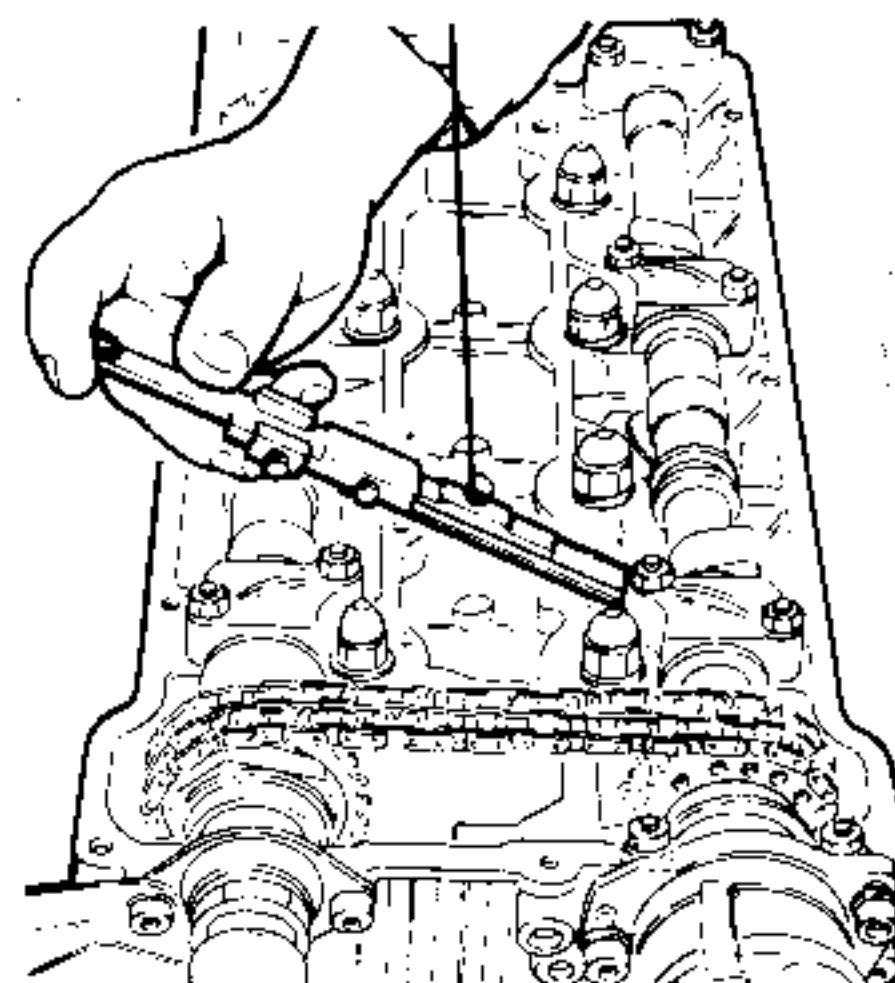
- Screws
- Spark plug cover
- Spark plug lead holding cover
- Oil vapour breather tube
- Fuel injection wiring grounds
- Screws
- Spark plug wiring container
- Screws
- Timing system cover

2. Valve clearance measurements

- Clean the spark plug seats, remove the spark plugs and plug the holes to prevent foreign matter from entering.
- With the engine cold and using feeler gauge C.6.0168, check that the clearance between the resting radius of the cams and the crowns of the cups lies between the specified values:

Valve clearances (with engine cold)
 Intake: $0.400 \div 0.450 \text{ mm}$
 Exhaust: $0.450 \div 0.500 \text{ mm}$

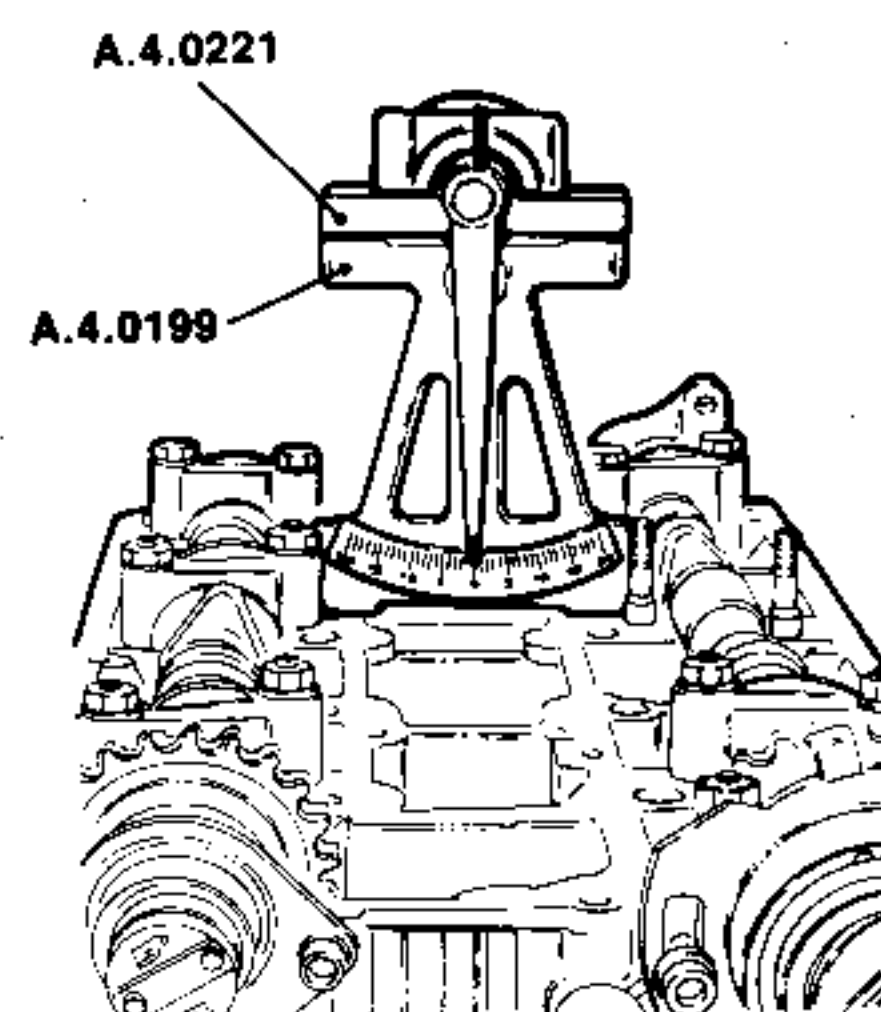
C.6.0168



c. Should the clearances lie outside the specified values, proceed to adjust them following the procedure indicated in the following point 3.

3. Adjustment of valve clearance

- Rotate the drive shaft until the notches on the cam shaft (1) are aligned with the notches on the relative caps (2).
- To check that the position of the notches on the caps coincides with the correct specified angle value, remove the caps using the tool A.4.0199 equipped with the appropriate plate A.4.0221 check respective angle values.

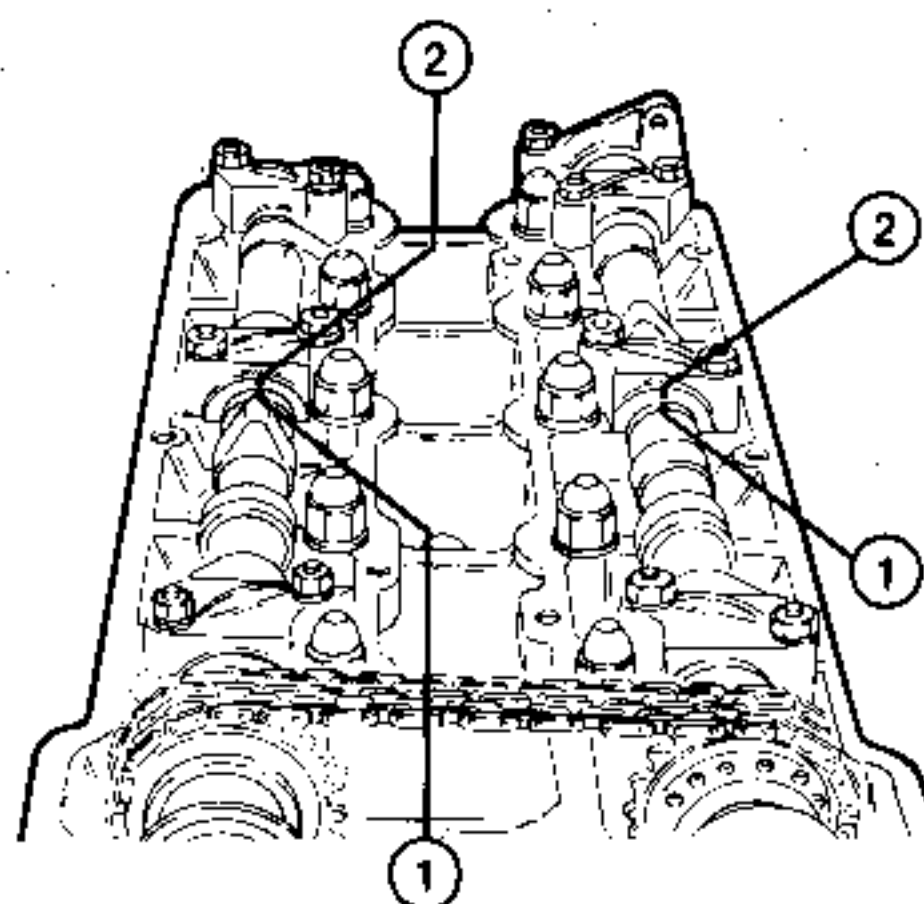


Angle position of notches on cam shaft caps

intake shaft cap:
 $+2^\circ 40'$

exhaust shaft cap:
 $-13^\circ 15'$

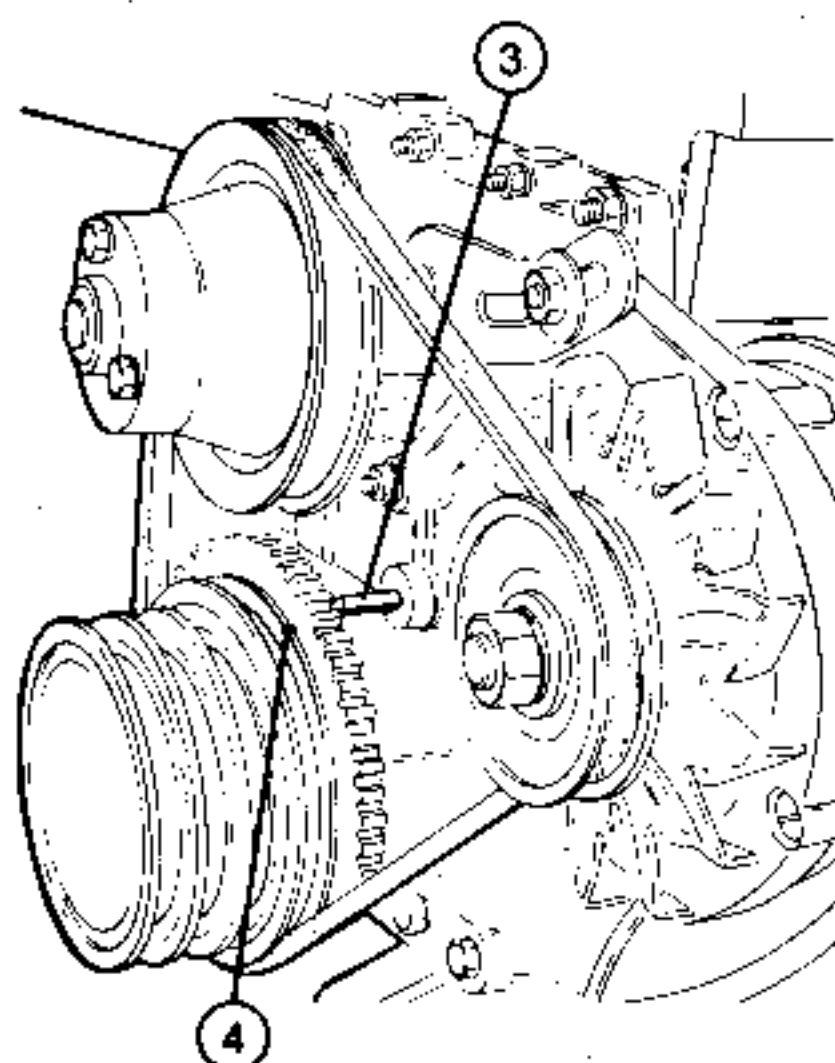
- Should the notch not coincide with the specified value, mark a new notch on the cap in the correct position.
- Reassemble the camshaft caps and rotate the drive shaft until the notches on the cam shaft are aligned with the new notches marked on the respective caps.



- 1. Cam shaft notches
- 2. Cap notches

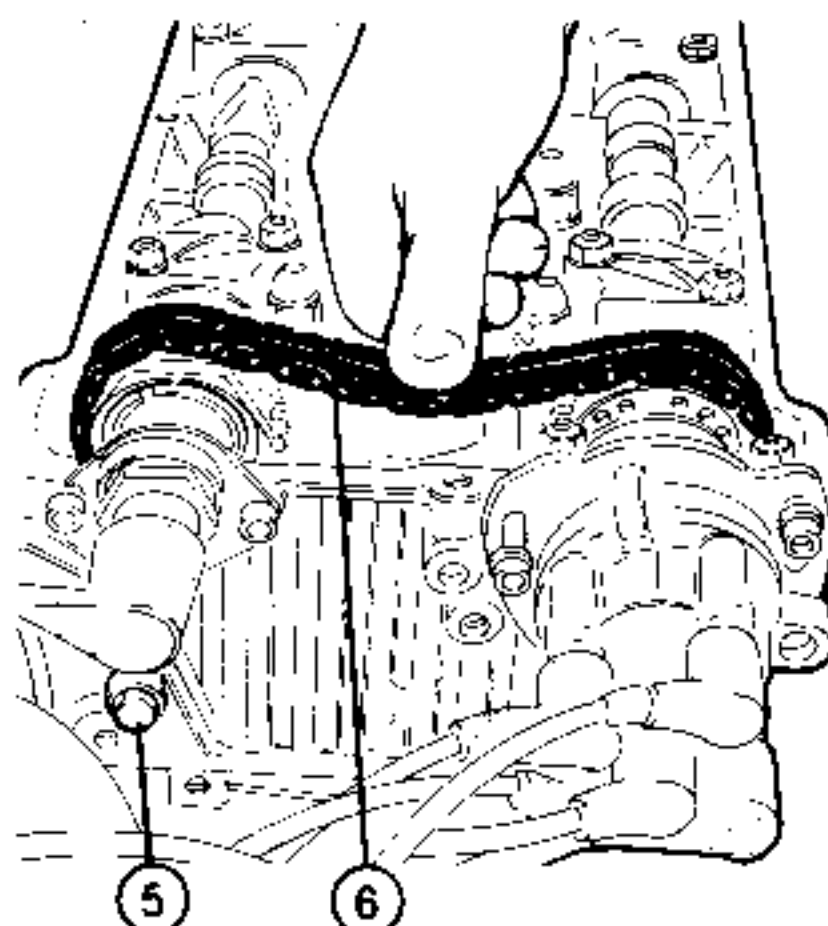
NOTE:

When in this position, the fixed index point (3) on the water pump must be aligned with the reference notch (4) stamped on the front drive shaft pulley (Number 1 cylinder at Top Dead Centre position on the explosion stroke).



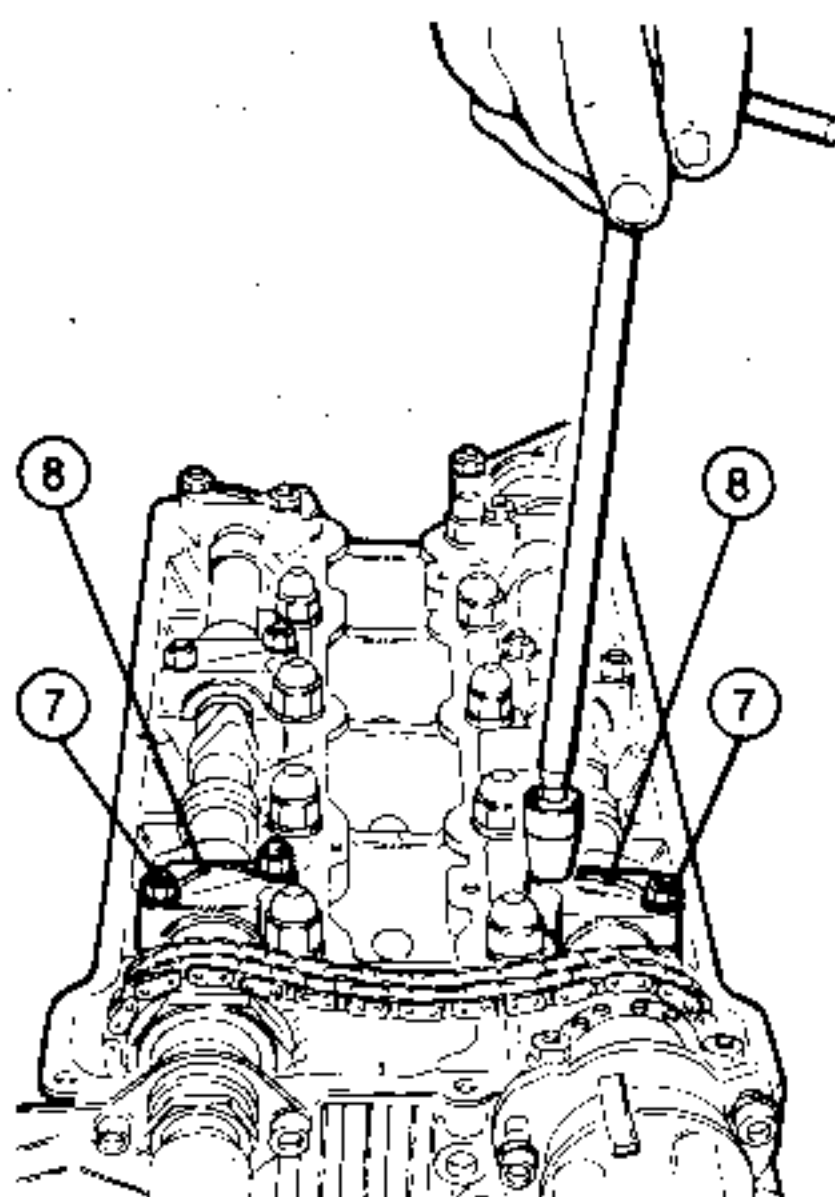
- 3. Fixed index point
- 4. Pulley notch

- b. Loosen the chain tensioner securing screw (5).
- c. Press the timing chain (6) downwards so as to overcome the tension of the chain tensioner spring and lock the chain tensioner in this position.



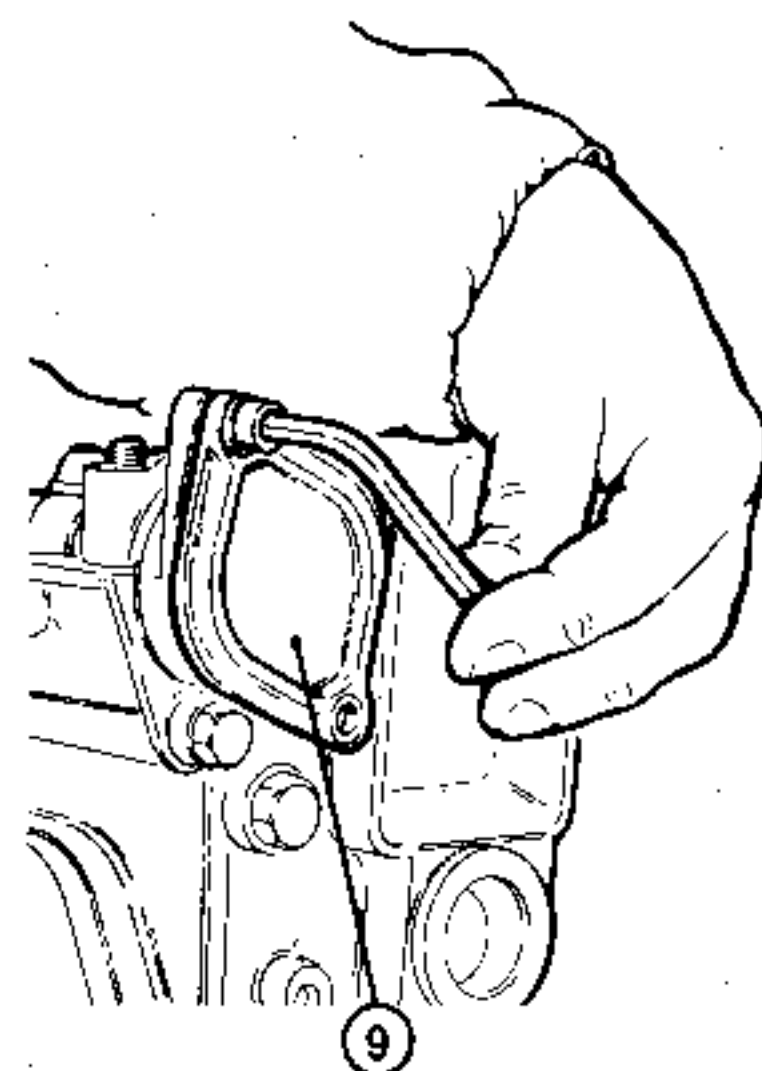
- 5. Chain tensioner locking screw
- 6. Timing chain

- d. Loosen the nuts (7) and remove the cam shaft caps (8) being careful not to move the position of the chain with respect to the gears.



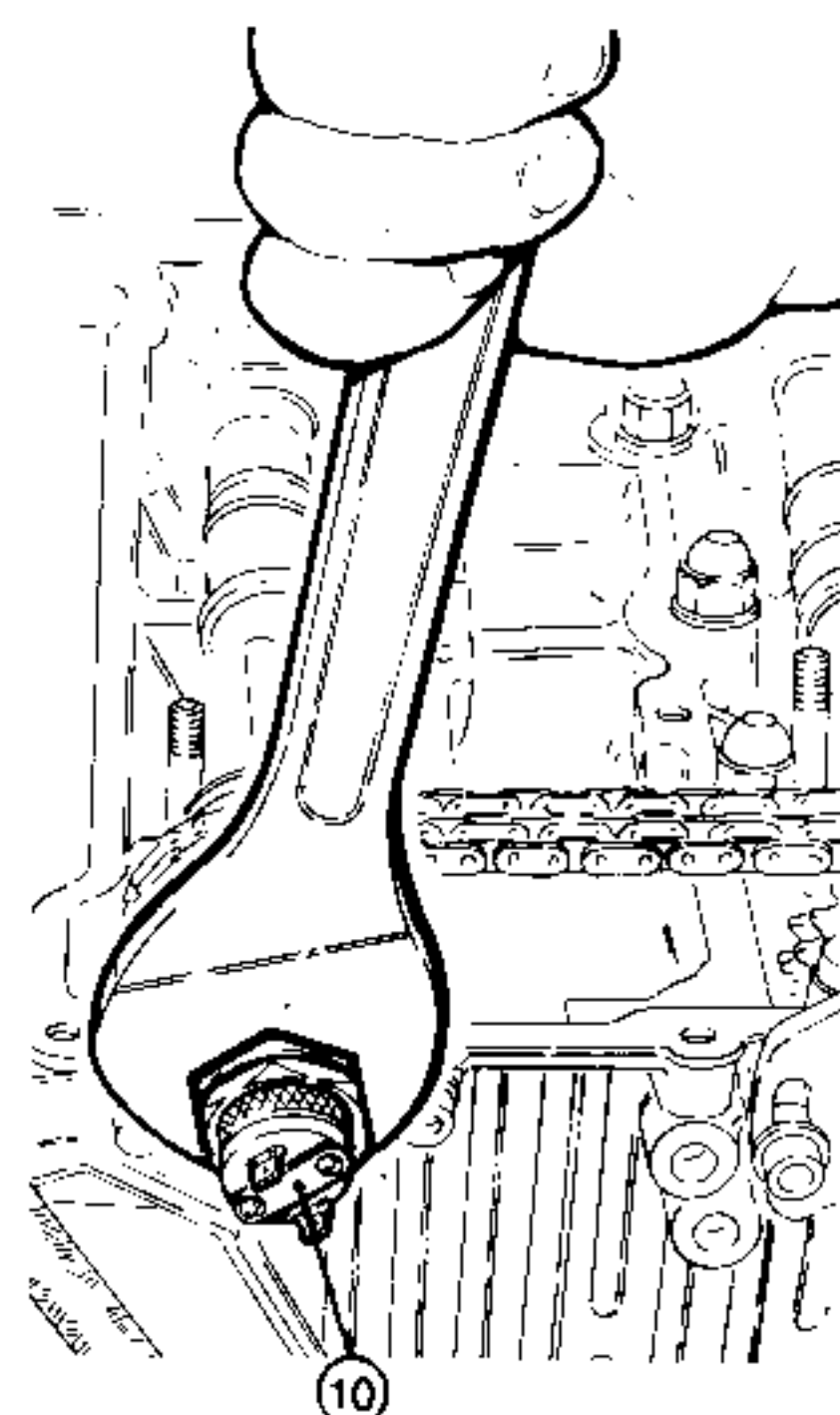
- 7. Cap securing nuts
- 8. Cam shaft caps

- e. Remove the rear cover (9) on the cam shaft support, exhaust side.



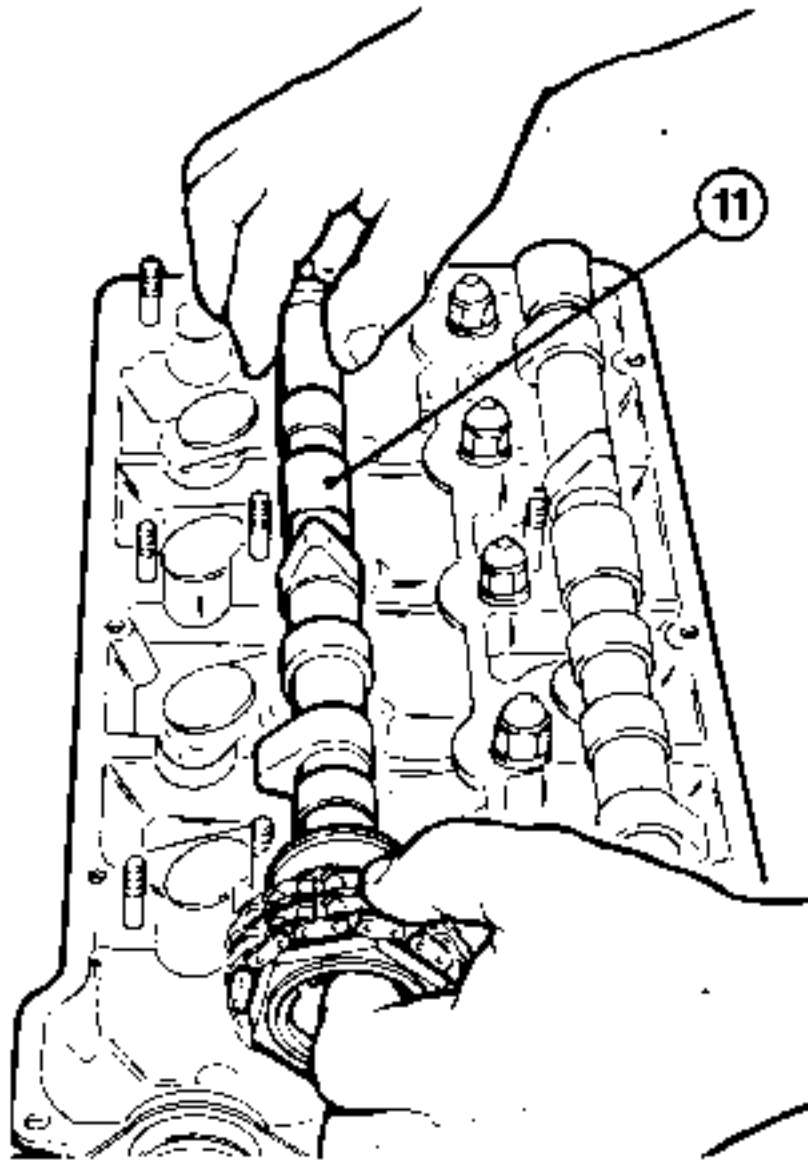
- 9. Rear cover

- f. Remove the protective rubber cover and disconnect the power supply leads to the electric magnet of the timing variator (10) and remove the electric magnet itself, unscrewing it.



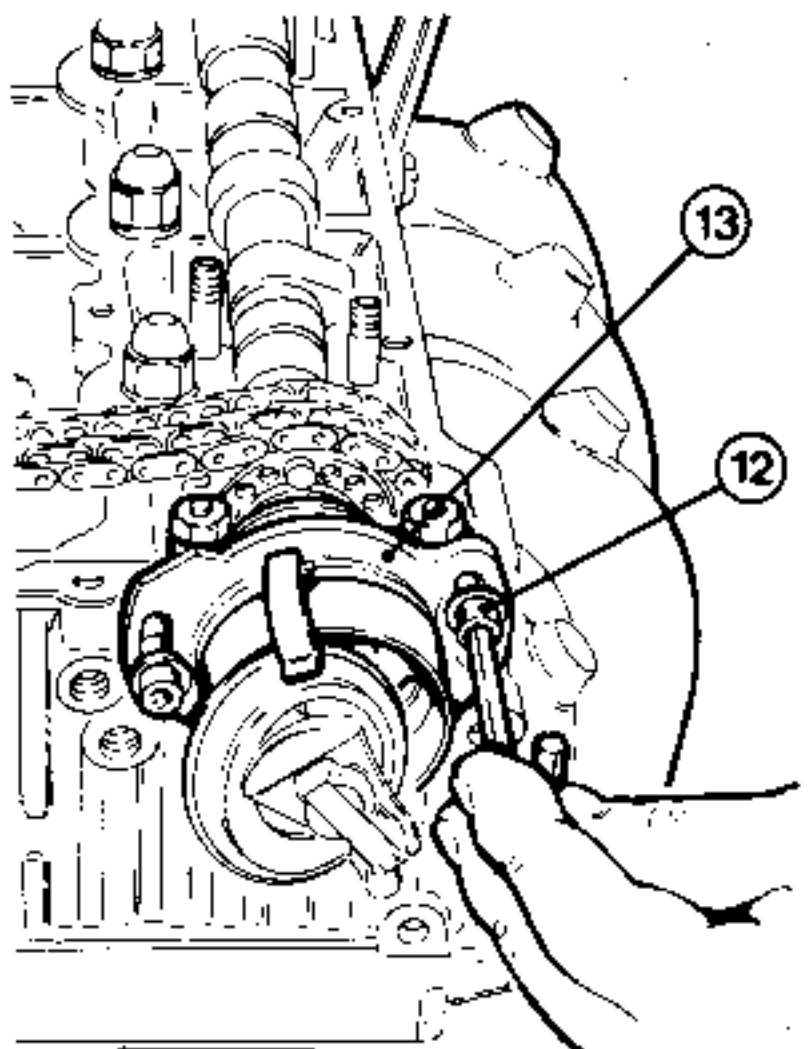
- 10. Timing variator electric magnet

g. Remove the intake side cam shaft (11) with the chain and rest it on the centre part of the cylinder head, being careful not to move the chain with respect to the gears.



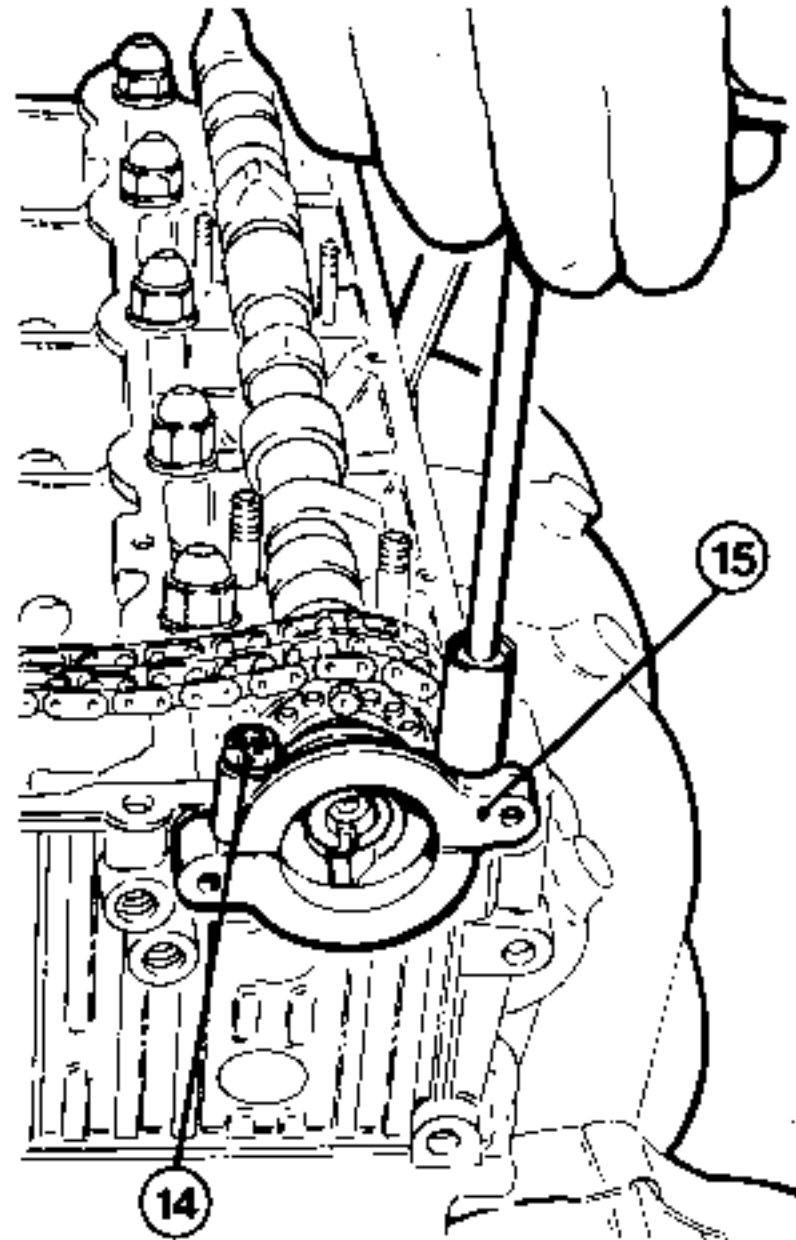
11. Intake side cam shaft

h. Unscrew the securing screws (12) and remove the distributor (13).



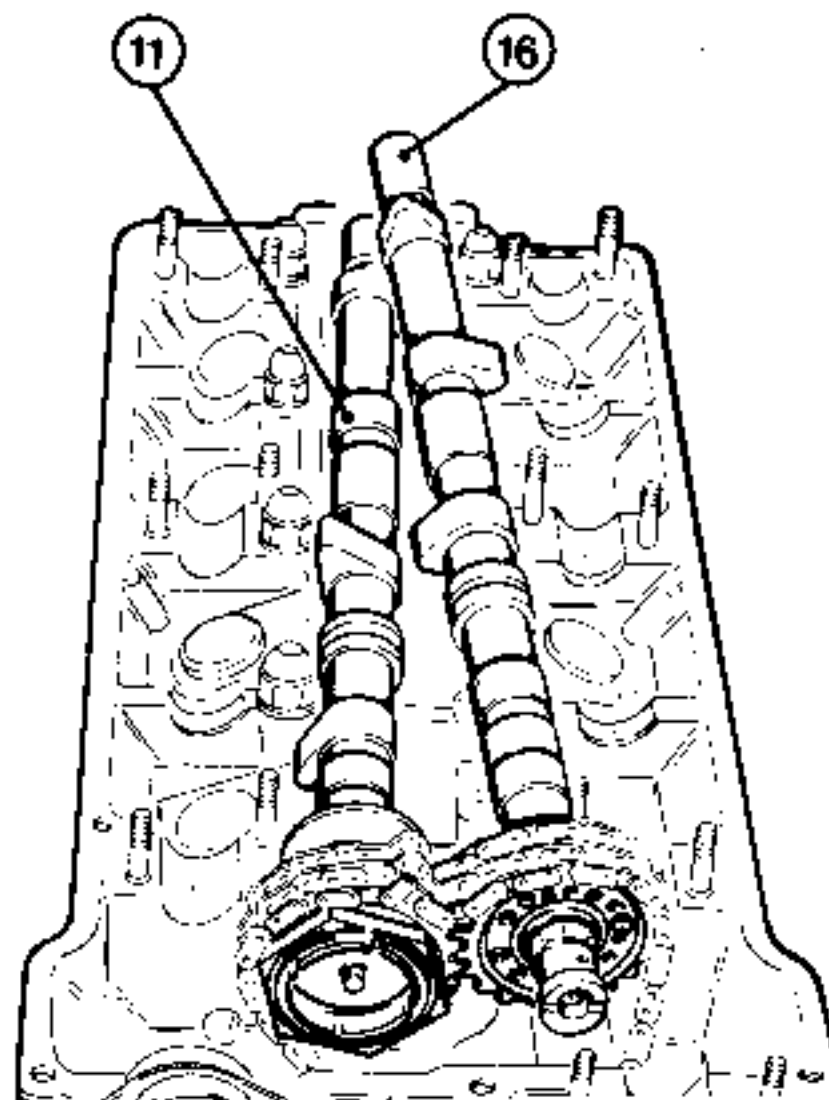
12. Distributor securing screws
13. Distributor

i. Remove the two nuts (14) and remove the distributor support flange (15).



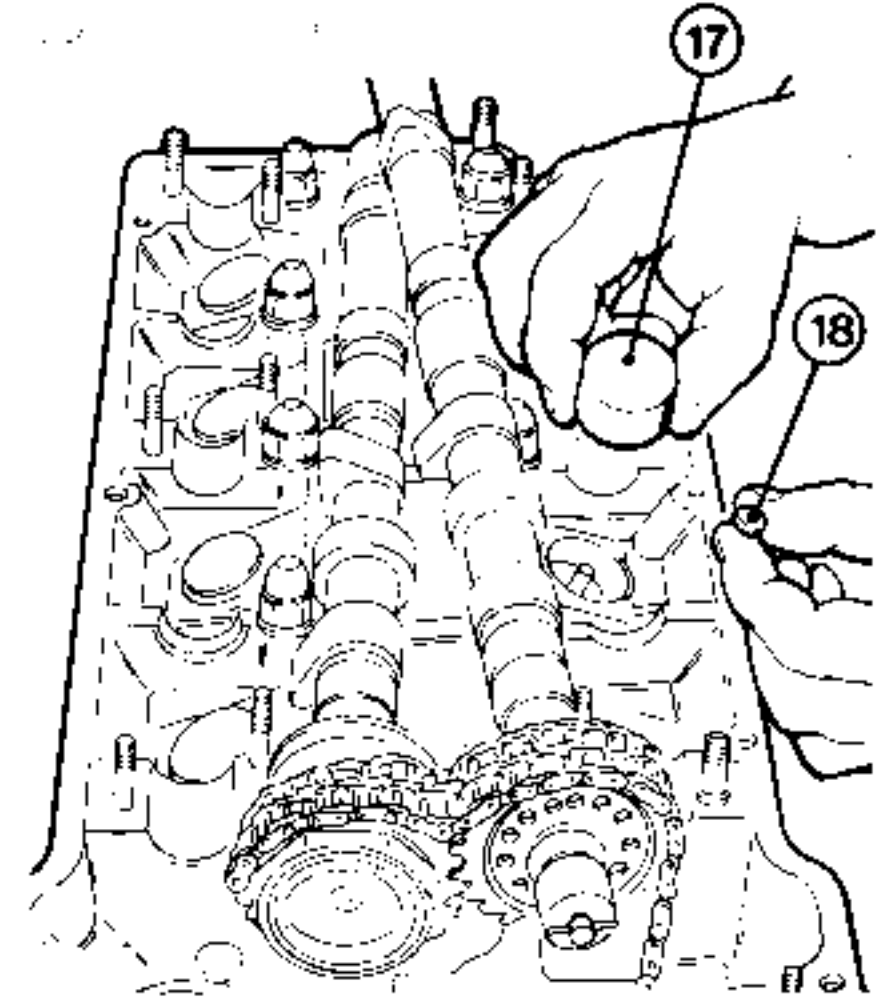
14. Flange securing nuts
15. Distributor support flange

j. Remove the exhaust side cam shaft (16) with the chain and rest it on the centre part of the cylinder head, being careful not to move the chain with respect to the gears.



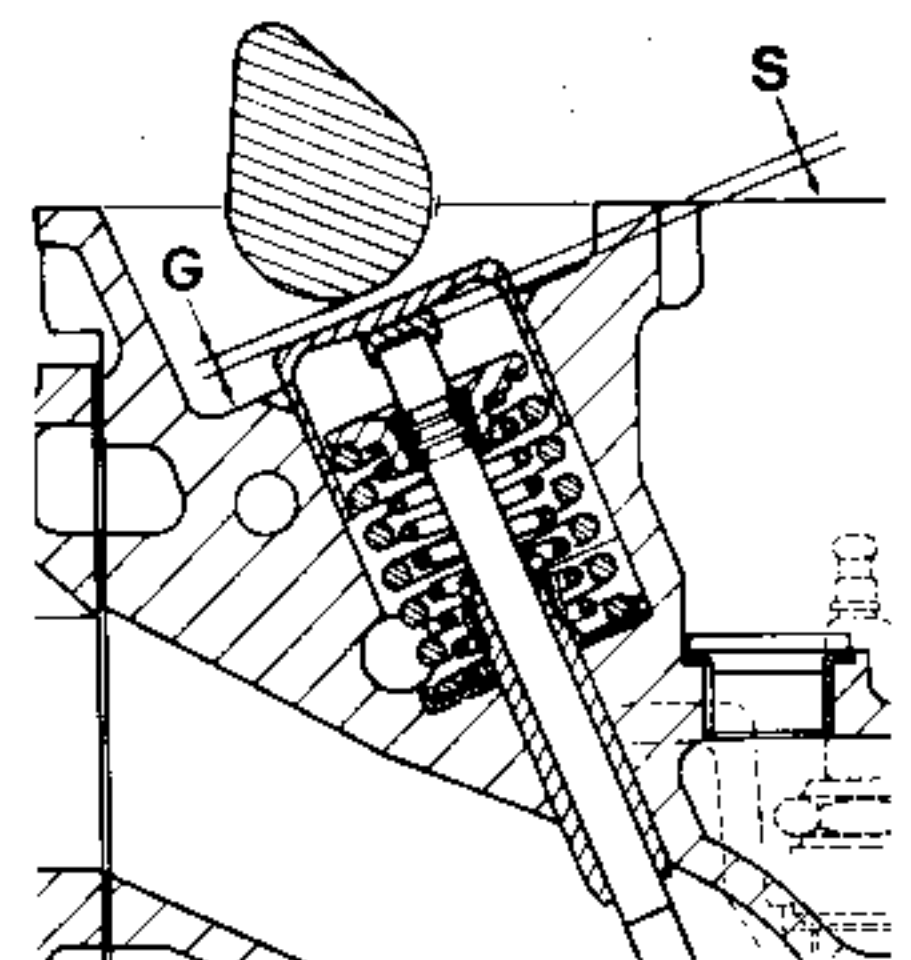
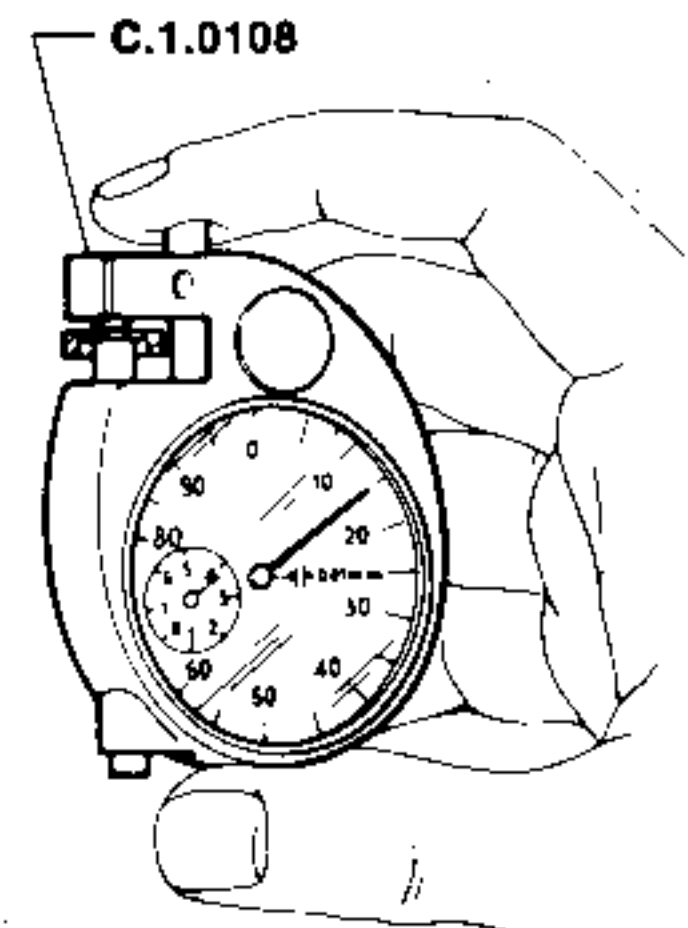
11. Intake side camshaft
16. Exhaust side camshaft

k. Withdraw the valve cup (17) and the valve clearance adjusting cap (18).



17. Valve cup
18. Adjustment cap

l. Measure the thickness S with the thickness gauge C.1.0108. Select a new cap of suitable thickness; caps are available with thickness from 1.3 mm to 3.5 mm with increments of 0.025 mm.

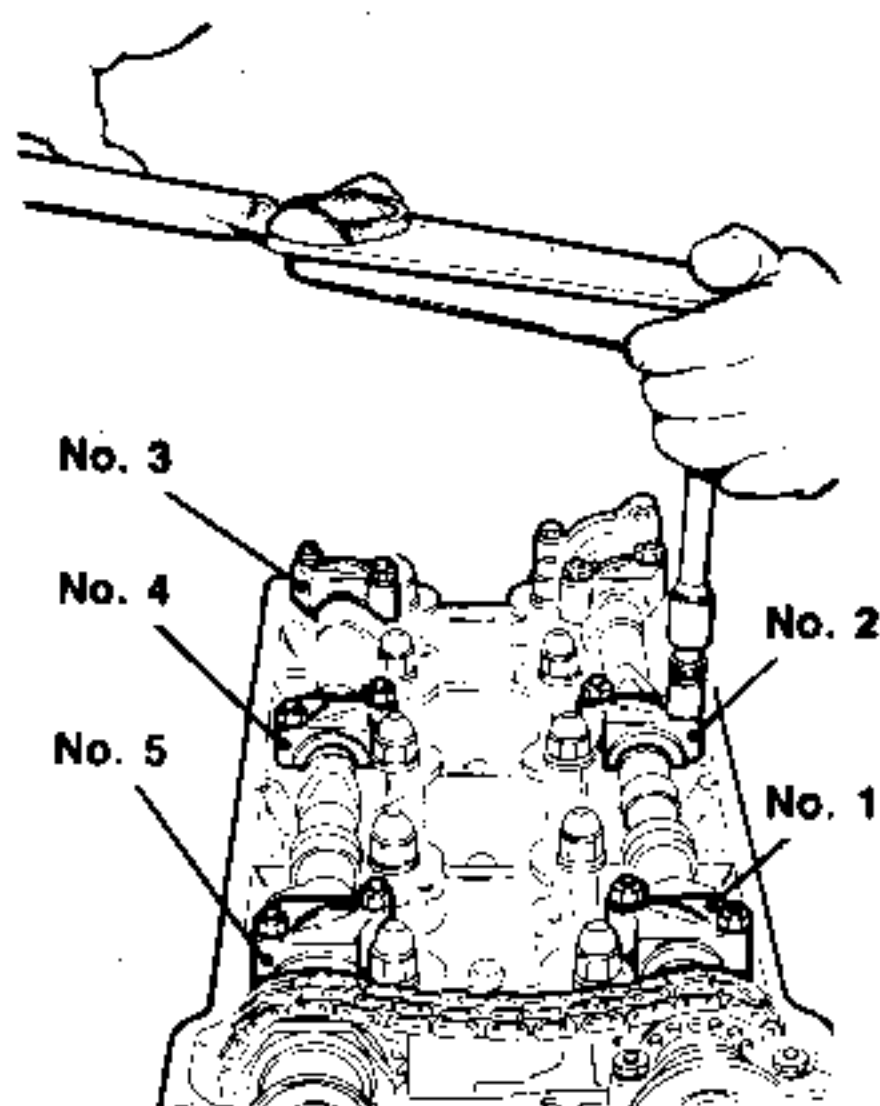


G. Valve clearance
S. Thickness of adjustment cap

m. Reassemble the valve cup (after lubricating with engine oil), the cam shafts and the chain.

n. Fit the distributor support flange and the cam shaft caps, being careful to respect the numbering stamped on these.

T : Tightening torque
Cam shaft cap securing nuts (in oil)
 $20 \div 25 \text{ N}\cdot\text{m}$
($2.0 \div 2.5 \text{ kg}\cdot\text{m}$)



o. Fit the rear cover (9) on the exhaust side cam shaft support.
p. Fit the timing variator electric magnet, screwing it in the support flange. Adjust the position of this so that the distance between the operating valve of the variator and the mobile core of the electric magnet is $0.1 \div 0.4 \text{ mm}$.
q. Tighten the locking nut to the specified torque.

T : Tightening torque
Electric magnet securing nut
 $12.7 \div 14.7 \text{ N}\cdot\text{m}$
($1.2 \div 1.4 \text{ kg}\cdot\text{m}$)

r. Fit the ignition distributor without locking the relative securing screws.
s. Proceed to the tensioning of the timing chain, check the valve clearances again and then proceed to the setting of the timing (see paragraph «Check of timing chain tension and setting of timing».)
t. Position carefully the oil retaining half rings and the gaskets between cylinder head and the timing system cover.
u. Refit the timing cover working in reverse order with respect to the procedure followed for dismantling. Tighten the tim-

ing system cover securing screws to the specified torque:

T : Tightening torque
Timing system cover securing screws
 $10 \div 14 \text{ N}\cdot\text{m}$
($1.0 \div 1.4 \text{ kg}\cdot\text{m}$)

CHECK OF TIMING CHAIN TENSION AND SETTING OF TIMING

1. Check of timing chain tension
a. Remove cylinder head cover (see paragraph «Check valve clearance adjustment» point 1).
b. Loosen the chain tensioner securing screws.
c. Engage the highest speed, move the vehicle backwards and forwards and, keeping the chain stretched, lock the chain tensioner securing screw.
d. Position carefully the oil retaining half rings and the gaskets between the cylinder head and the timing system cover.
e. Refit the timing system cover by reversing the order of removal. Tighten the timing system cover securing bolts to the specified torque:

T : Tightening torque timing system cover securing bolts
 $10 \div 14 \text{ N}\cdot\text{m}$
($1.0 \div 1.4 \text{ kg}\cdot\text{m}$)

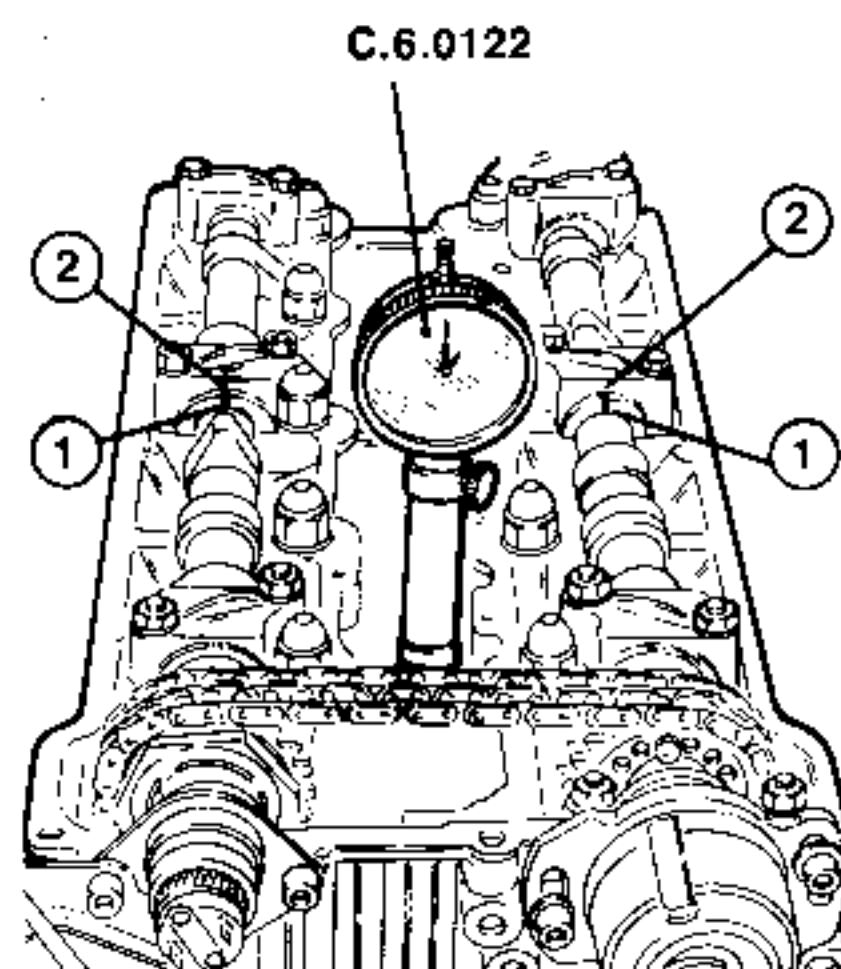
2. Setting of timing

The check must be carried out with the valve clearance at the specified values and the timing chain normally tensioned.

a. Remove the timing system cover (see paragraph «Check and adjustment of valve clearances» point 1).
b. Clean the spark plug seating of the 1st cylinder, remove spark plug and insert tool C.6.0122 fitted with comparator, into spark plug support hole.
c. Engage the highest gear and move the vehicle backwards and forwards until the pointer on the comparator inverts its direction of rotation (piston No. 1 at T.D.C. with valves closed).
d. Make sure that the notches on the cam

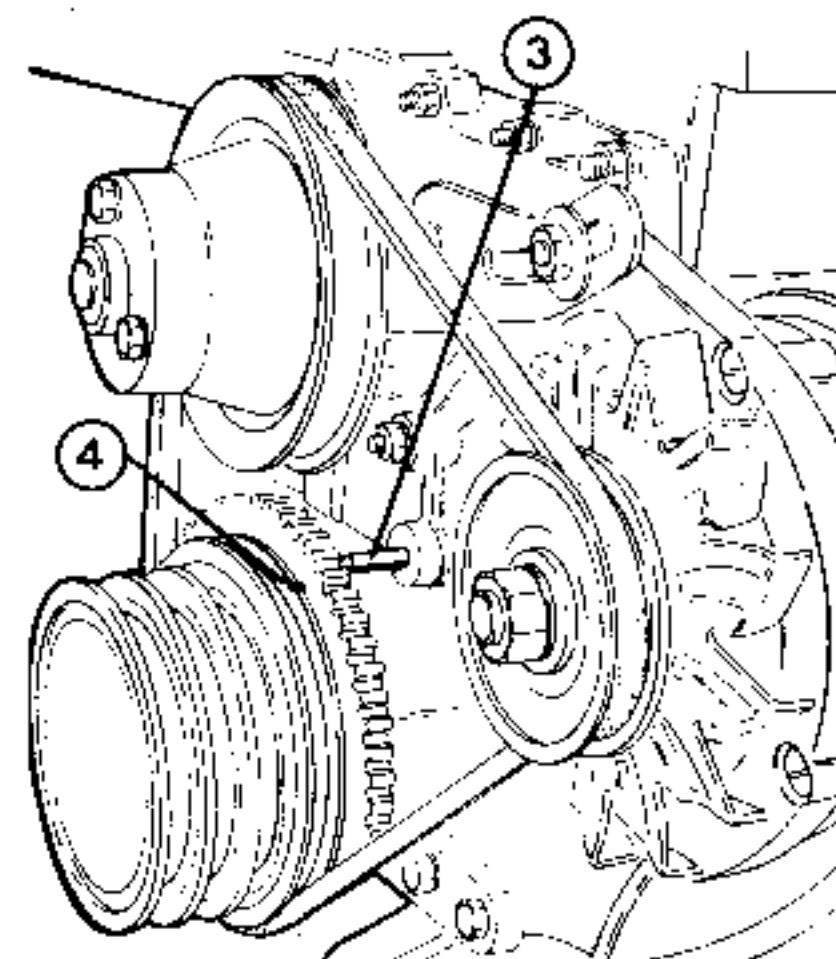
shafts (1) are aligned with the those on the caps (2), when the cams of the No. 1 cylinder are facing outwards.

To check that the notches marked on the caps are correctly positioned, proceed as indicated at point 3 of the paragraph «Check and adjustment of valve clearance».



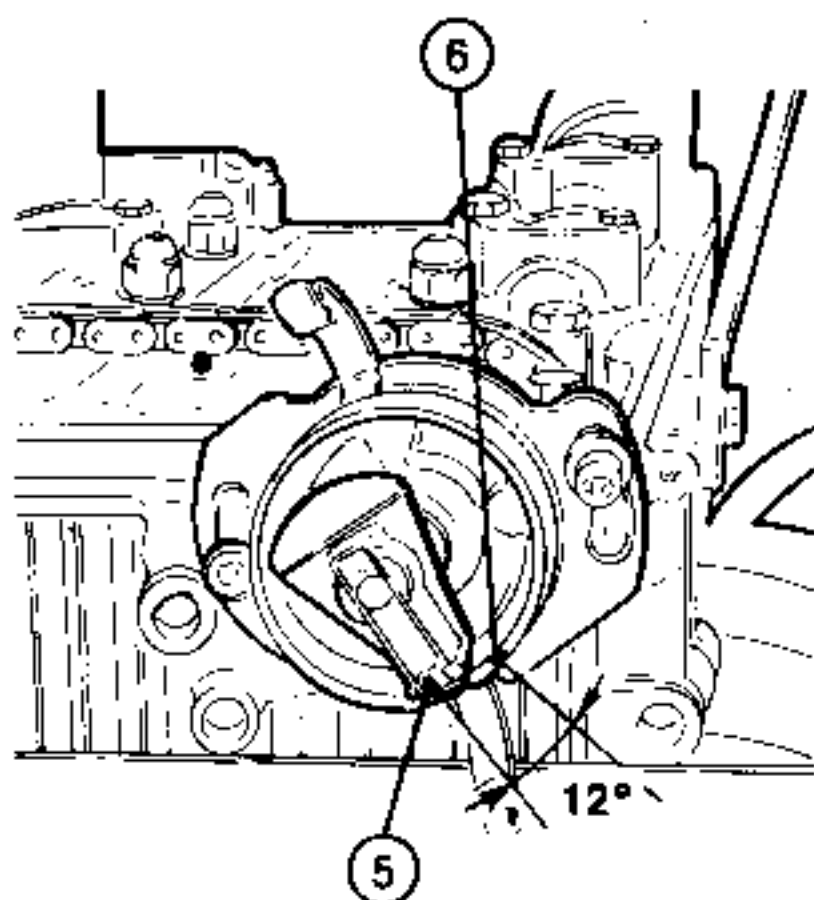
1. Cam shaft notches
2. Cap notches

e. Check also that the fixed index point (3) on the water pump is aligned with the reference notch (4) stamped on the drive shaft front pulley and on the ring gear (phonic wheel).



3. Fixed index point
4. Notch on drive shaft front pulley and ring gear

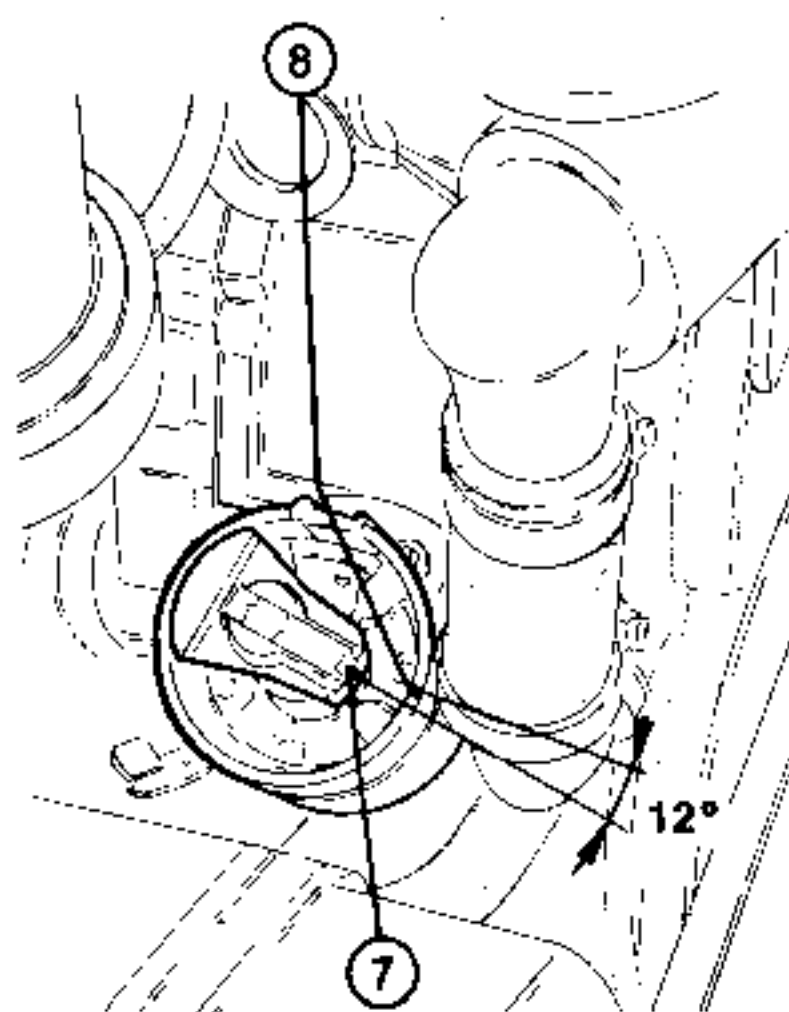
f. Make sure that the centre line of the distributor rotor arm on the cylinder heads (5) is correctly positioned with respect to the notch on the distributor casing (6) as indicated in the figure.



12° equivalent to a distance
of 5 ÷ 6 mm

- 5. Distributor arm centre line
- 6. Reference notch on the distributor casing

g. Check that the centre line of the distributor rotor arm (7) on the front cover of the engine is correctly positioned with respect to the notch on the distributor casing (8) as illustrated in the figure.

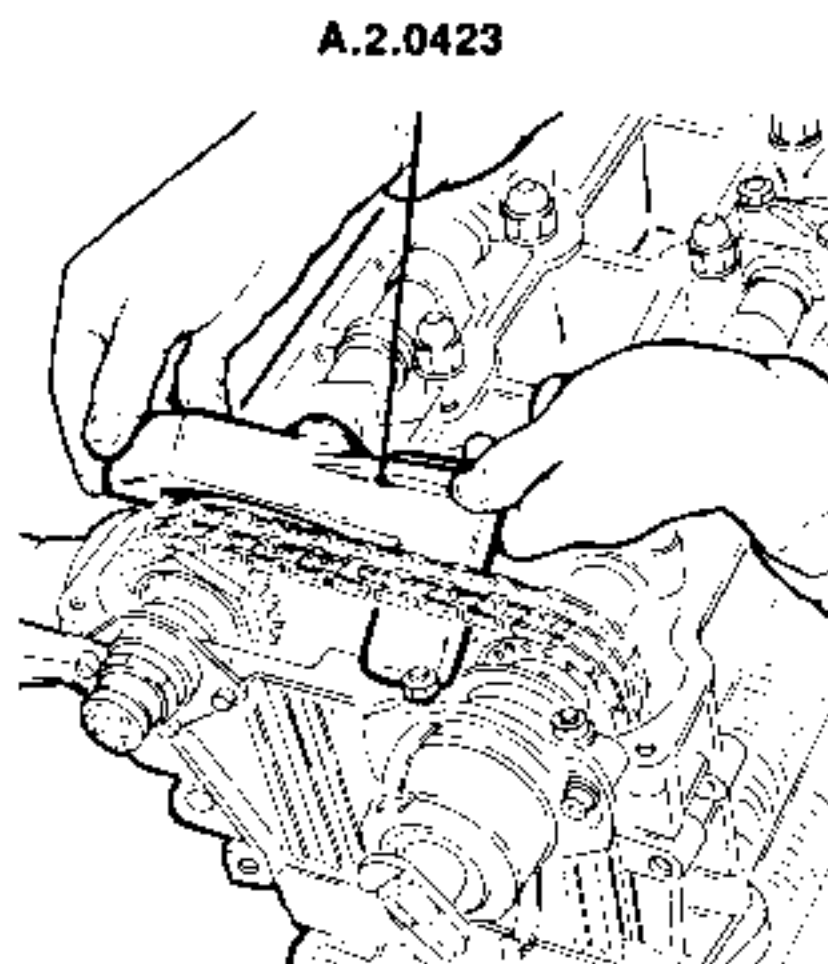


12° equivalent to a distance
of 5 ÷ 6 mm

- 7. Distributor arm centre line
- 8. Reference notch on distributor casing

h. If the notches on the cam shafts are not correctly aligned with the notches on the respective caps, proceed as follows:
i. **Cam shaft intake side**
1. Remove tool C.6.0122.

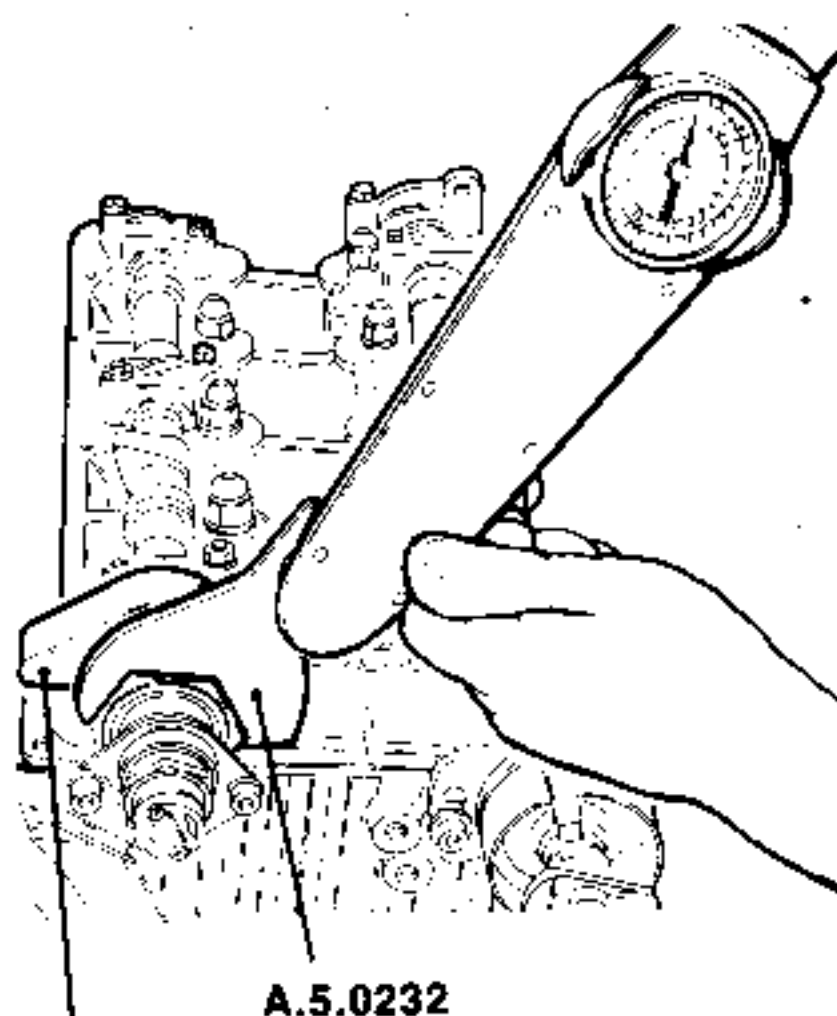
2. Engage the highest speed and move the vehicle backwards and forwards so as to be able to insert the timing variator blocking tool A.2.0423.



3. Loosen the timing variator securing nut by not less than 1/8 of a turn, using the spanner A.5.0232.

CAUTION:

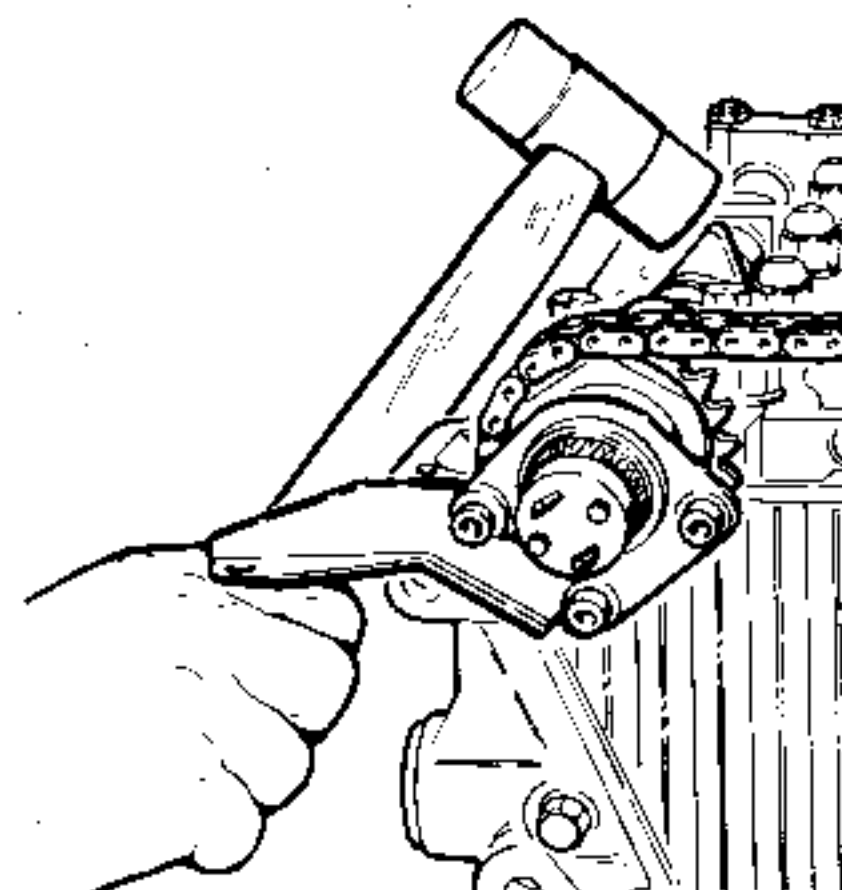
The above operation must be carried out with the utmost care so as to avoid uncoupling the front coupling.



A.2.0423

4. Unblock the cam shaft by removing tool A.2.0423.
5. Set the No. 1 cylinder in the T.D.C. position with valves closed (cams of No. 1 cylinder facing outwards).

6. Replace the tool C.6.0122 in the spark plug seating hole in order to be sure of the T.D.C. position.
7. Unscrew further the timing variator securing nut, previously loosened, until the gear of the front coupling is disengaged.
8. Using a synthetic resin mallet, rotate the cam shaft until the notches are aligned.



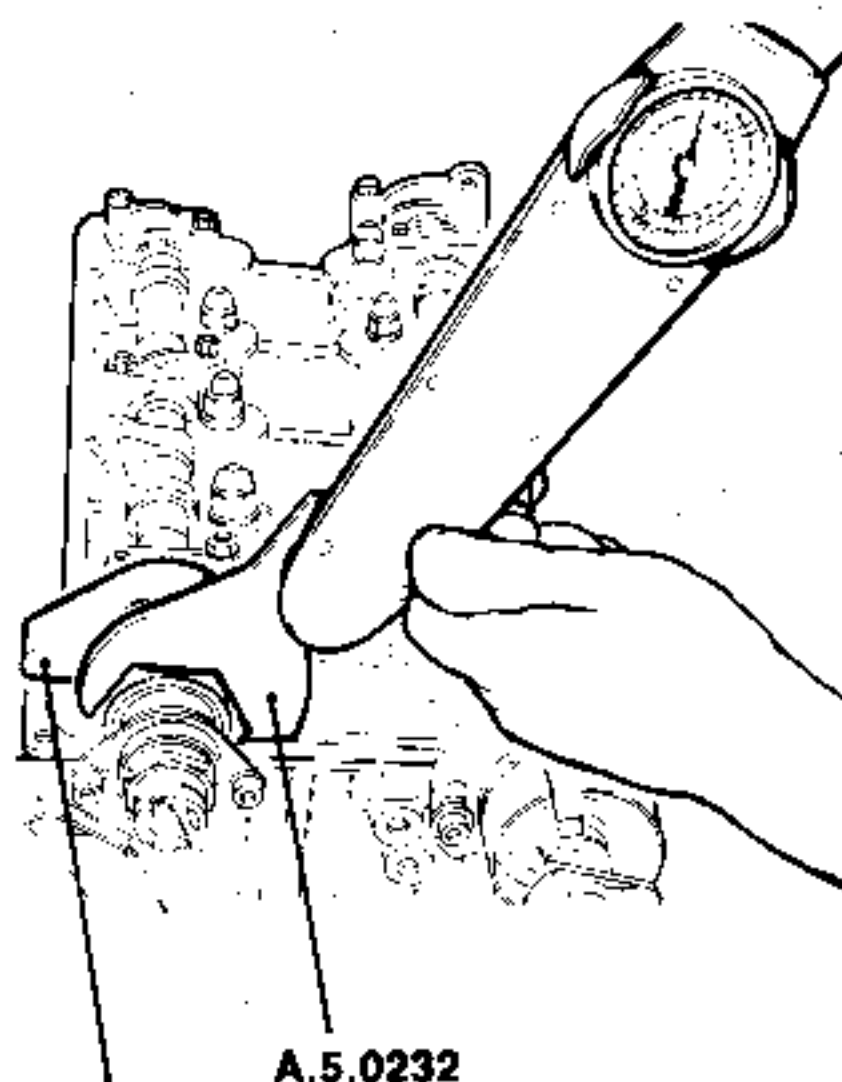
9. Tighten the nut until the gear on the front coupling is blocked.
10. Block the timing variator using tool A.2.0423.
11. Fully tighten the nut using tool A.5.0232 to a torque of
88 ÷ 96 N·m
(8.8 ÷ 9.6 kg·m);

corresponding to:

(108 ÷ 117 N·m)

(11 ÷ 12 kg·m)

on the axis of the nut.



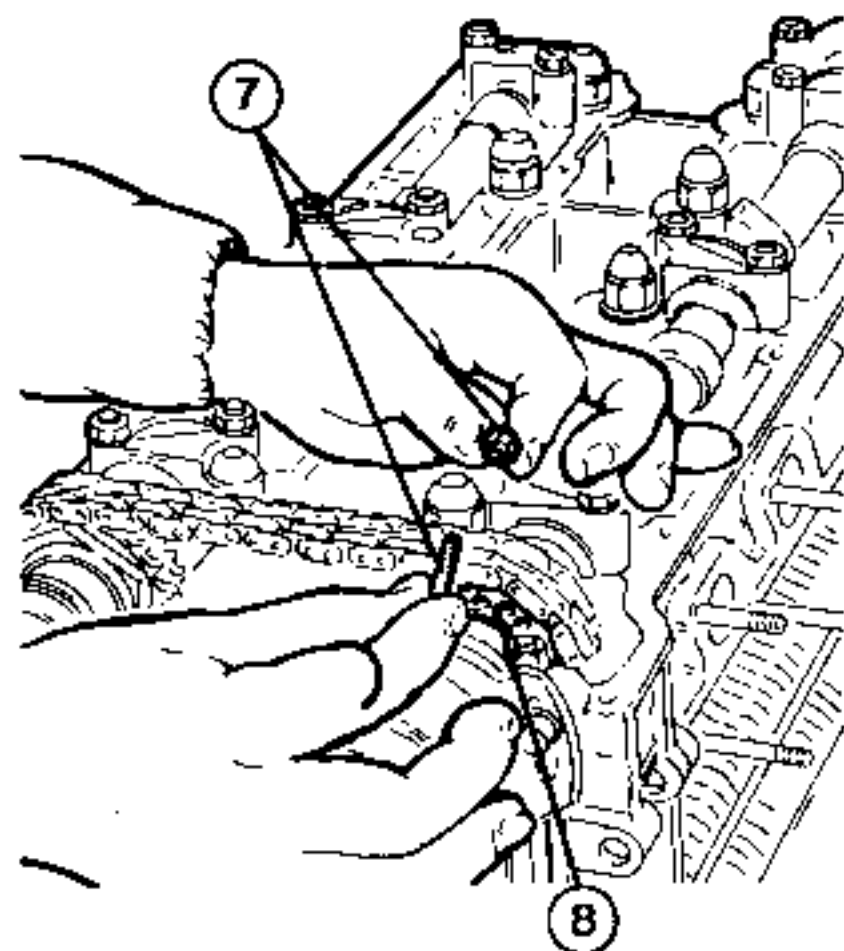
A.2.0423

A.5.0232

12. Unblock the timing variator by removing tool A.2.0423.

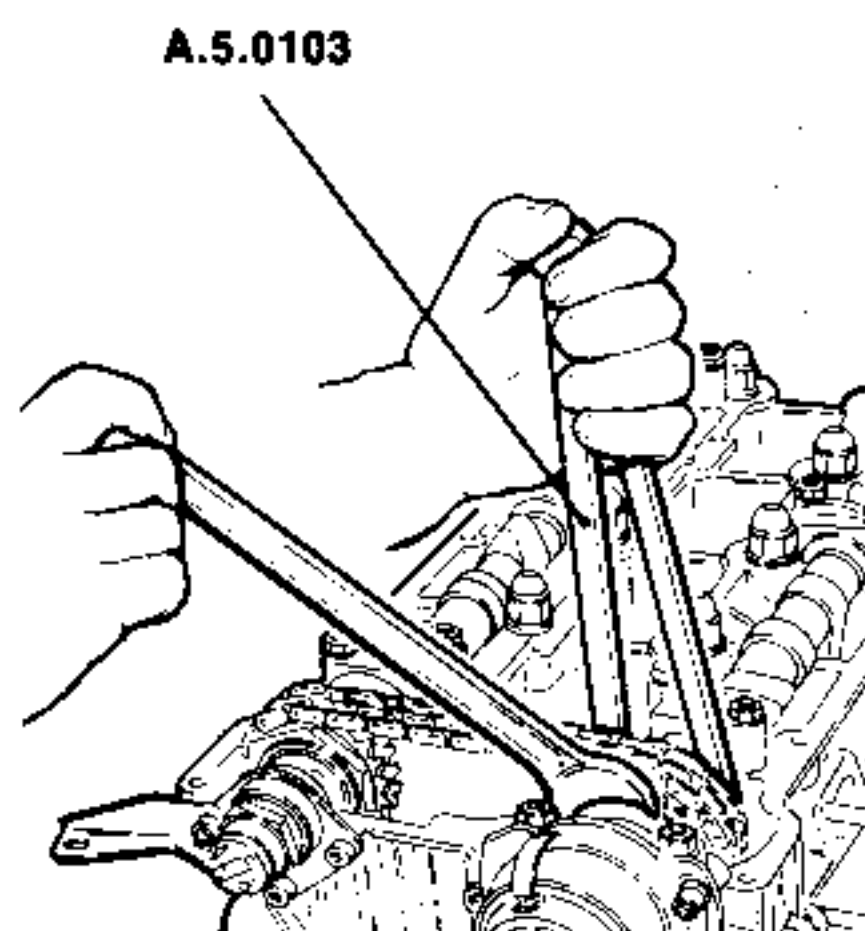
j. Cam shaft exhaust side

13. Remove the bolt (7) that secures the gear (8) to the sleeve on the cam shaft.



7. Bolt
8. Cam shaft gear

14. Lift the locking edge of the nut and using the tool A.5.0103 to hold the gear, loosen the nut securing the gear to the cam shaft.
15. Using tool A.5.0103, turn the cam shaft without moving the chain, until the notches are aligned.



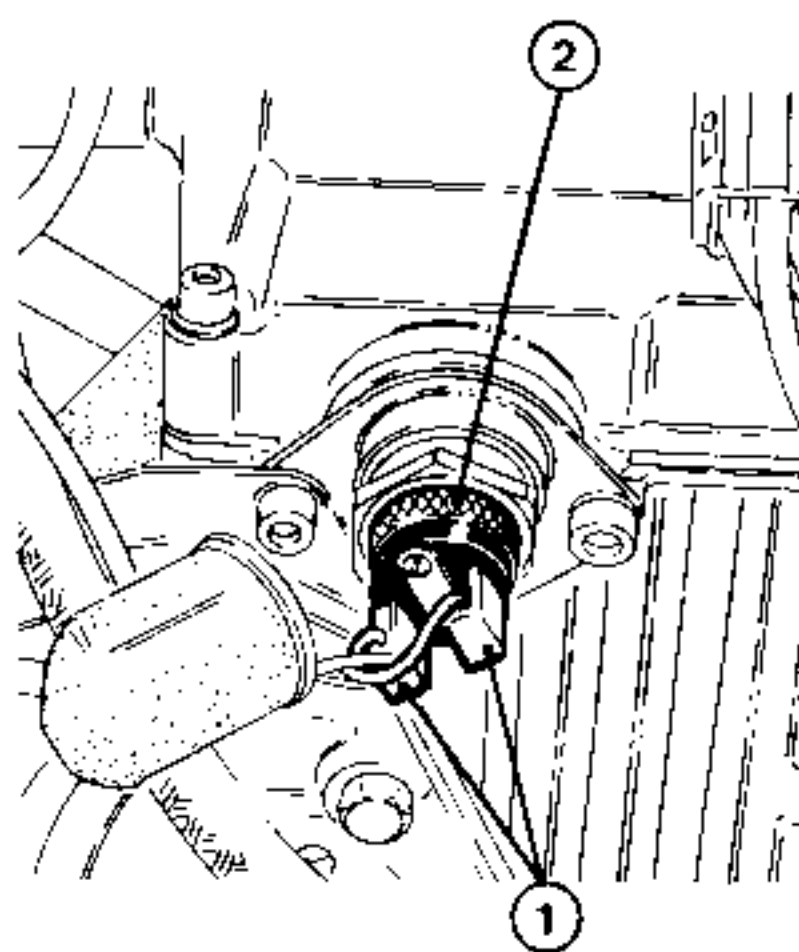
16. Still using the tool A.5.0103 to hold the gear, tighten the nut previously loosened.
17. Refit the bolt (7) in the aligned holes of the gear (8) and lock it.
18. Bend the locking edge of the nut back into position.
19. Make sure that the centre line of the

- distributor rotor arm is positioned as indicated in the previous point f. and then tighten the relative securing screws.
k. Position carefully the oil retaining half rings and the gaskets between the timing system cover and the cylinder head.
l. Refit the timing system cover by reversing the order of dismantling. Tighten the timing system cover securing screws to the recommended torque:

T : Tightening torque for the timing system cover securing screws
10 ÷ 14 N·m
(1.0 ÷ 1.4 kg·m)

CHECKING AND RESTORING OF GOOD WORKING ORDER OF THE TIMING VARIATOR

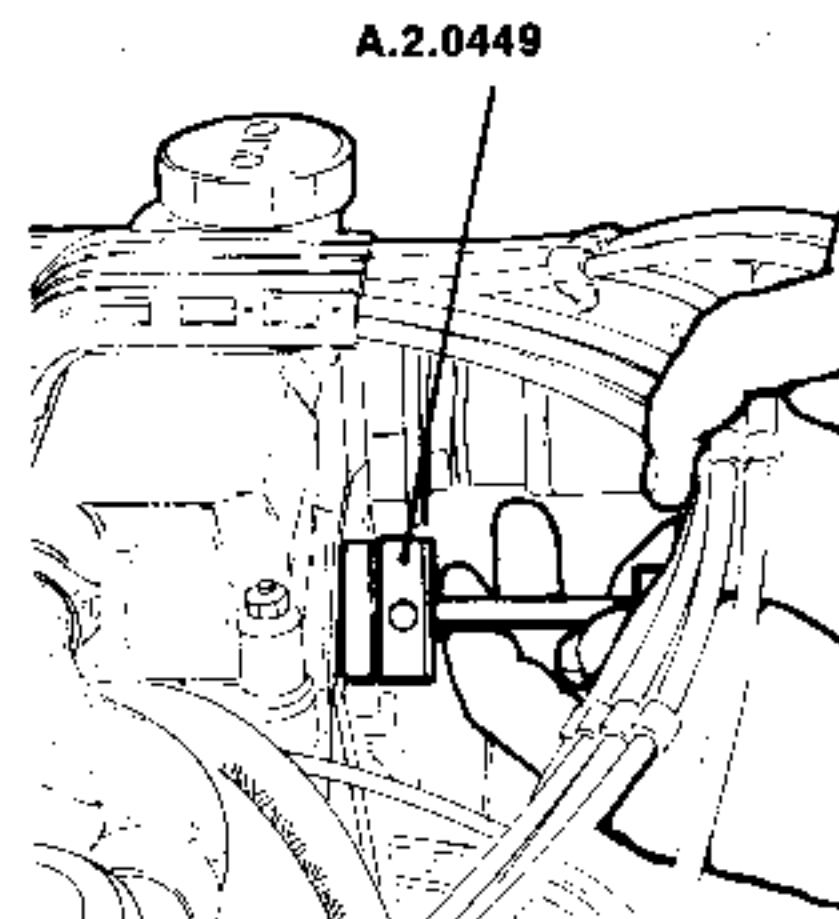
- a. Start the engine and leave it running on idle.
b. Disconnect the connector (1) of the electromagnet (2) and connect the 12 V supply (battery) to the pins of the electromagnet itself. Under these conditions the engine should stop or in any case run unevenly.



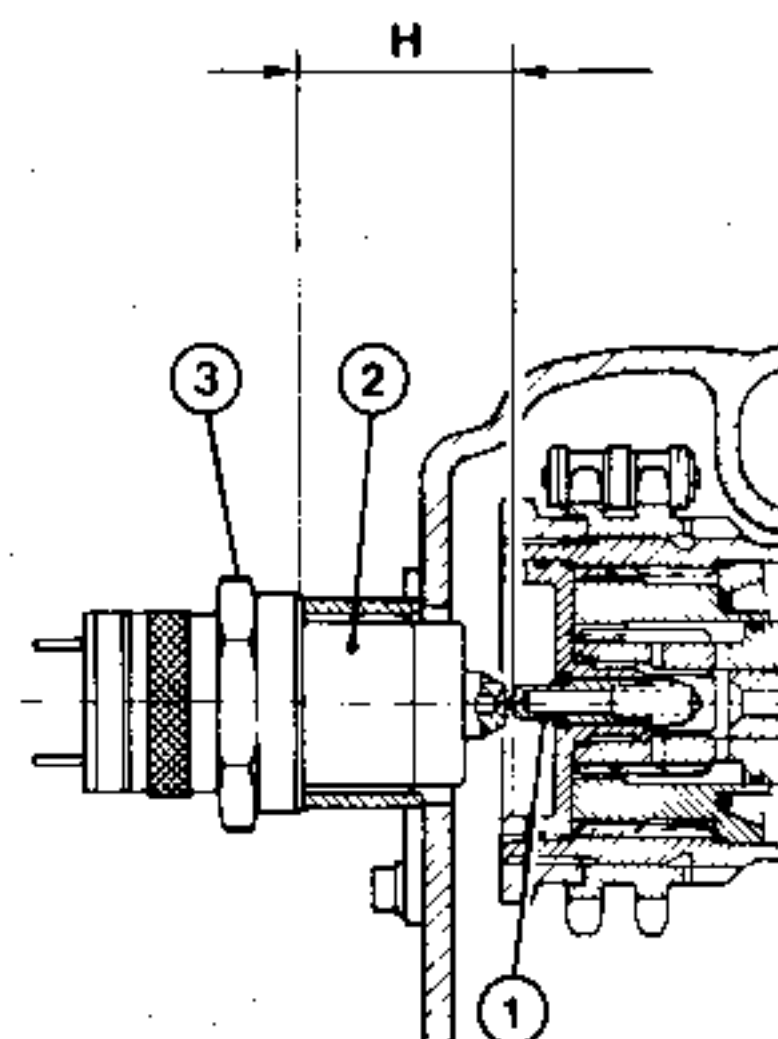
1. Electromagnet connectors
2. Timing variator electromagnet

- c. If this occurs, the timing variator is to be considered as being in good working order. If not proceed as follows.
d. **Adjustment of the positioning of the electromagnet**
1. Unscrew and remove the electromagnet.
2. Using the tool A.2.0449, measure the

distance «H» between the timing variator actuating valve (1) and the external edge of the electromagnet support flange. Transfer that measure, diminishing the value by 0.1 ÷ 0.4 mm onto the electromagnet itself in such a way that when it is fitted, the mobile core (2) of the electromagnet is at a distance of 0.4 mm from the timing variator actuating valve.



1. Timing variator actuating valve
2. Mobile core
3. Electromagnet securing nut



3. Fit the electromagnet, screwing it into the support flange (keeping the distance «H» unvaried) until the securing nut (3) meets the flange. Tighten the nut to the recommended torque.

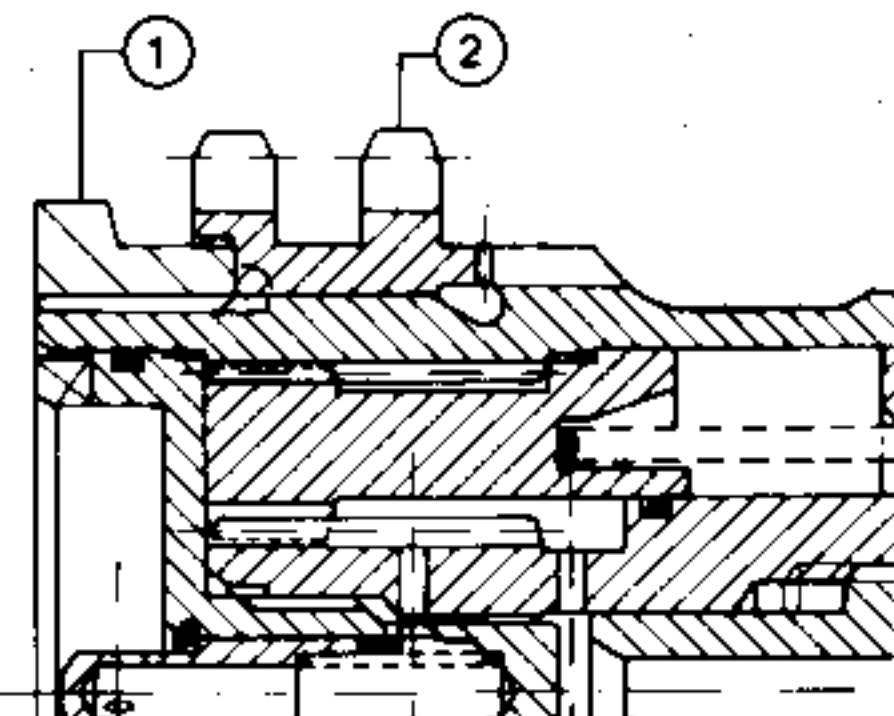
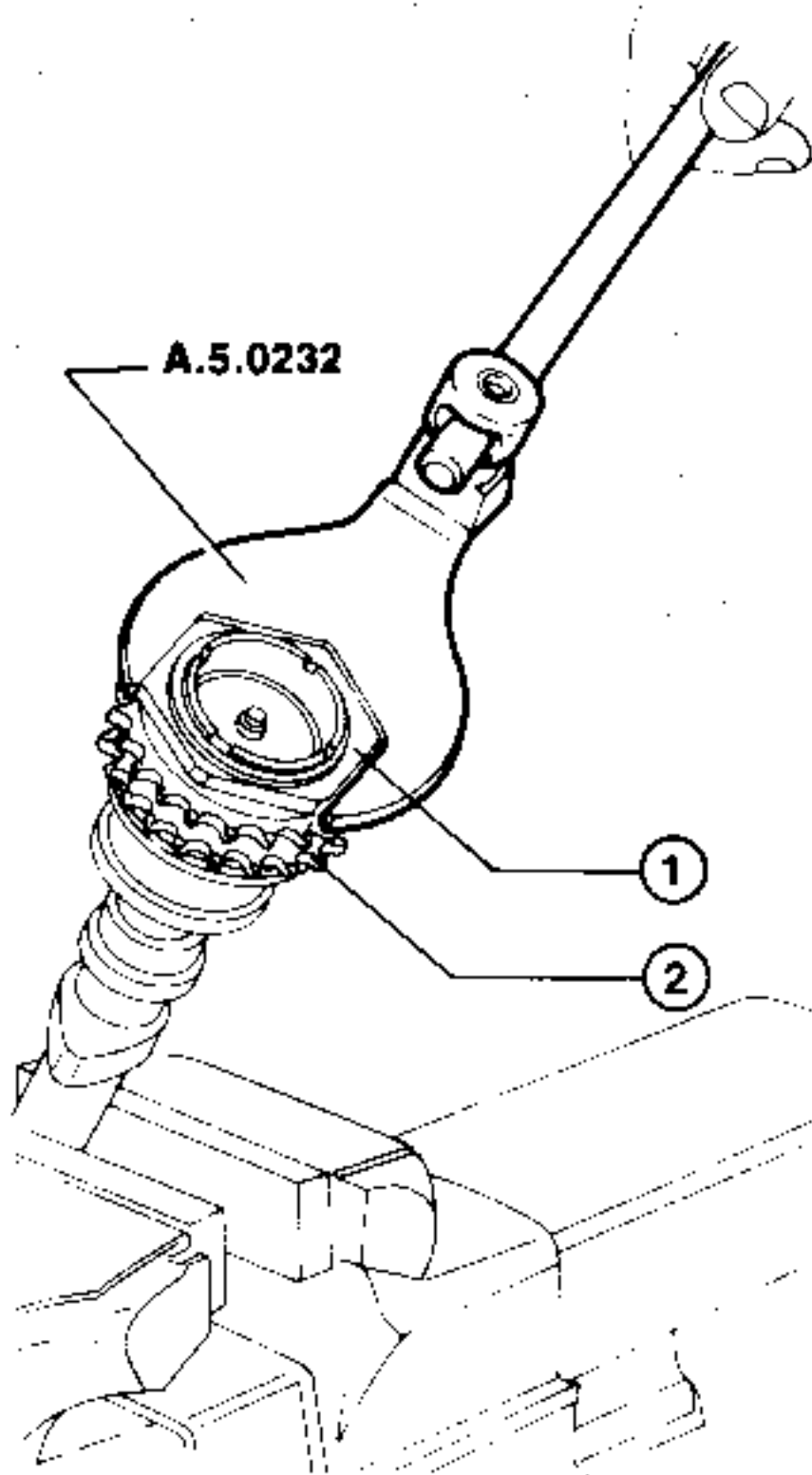
T : Tightening torque
Electromagnet securing nut
12.7 ÷ 14.7 N·m
(1.2 ÷ 1.4 kg·m)

e. Remove the cam shaft with timing variator from cylinder head

1. Remove the timing system cover as indicated in «Check and adjustment of valve clearances» step 1.
2. Dismantle the intake side cam shaft operating as described in «Check and adjustment of valve clearances» step 3.

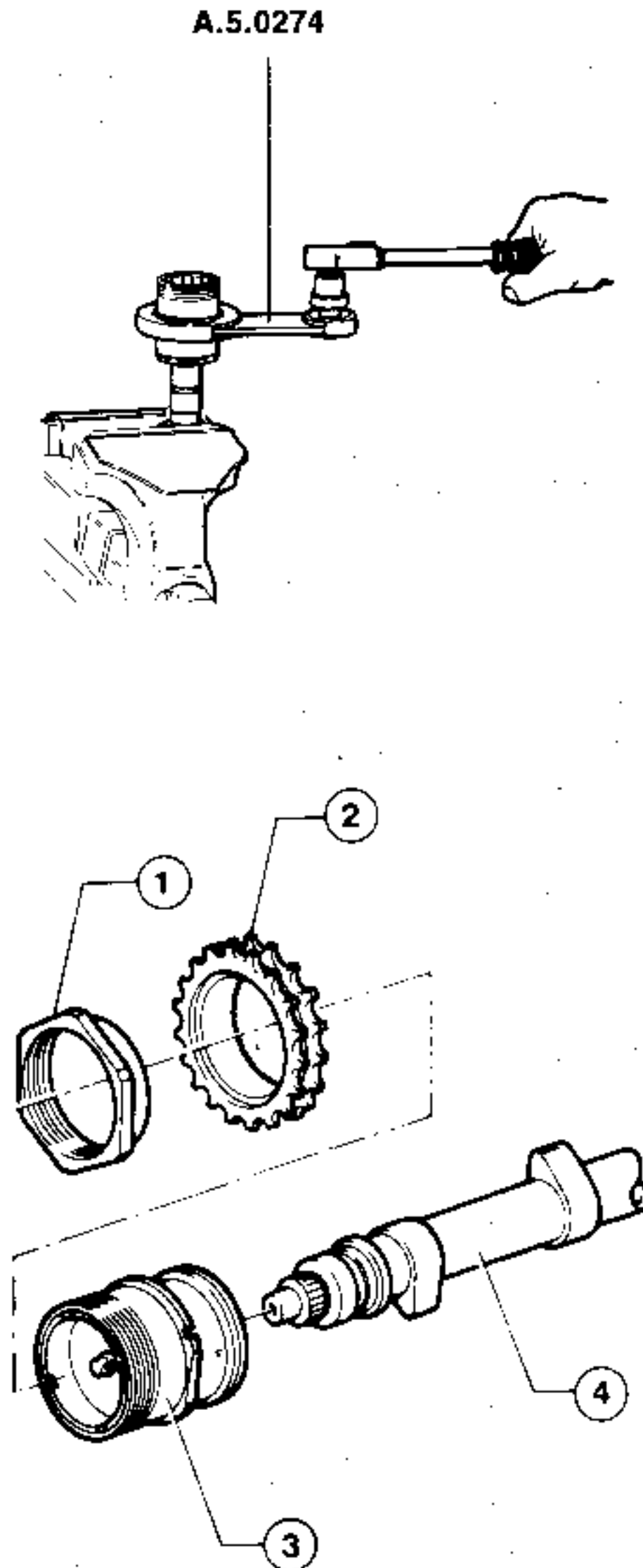
f. Remove the timing variator from the cam shaft

1. Lock the cam shaft in a vice fitted with protective jaws and using wrench **A.5.0232**, unscrew the nut (1) and then remove the gear (2).



1. Nut
2. Timing chain gear

2. With the cam shaft still in the vice, use the wrench **A.5.0274** and unscrew the complete timing variator from the cam shaft.



1. Nut
2. Timing chain gear
3. Timing variator
4. Cam shaft

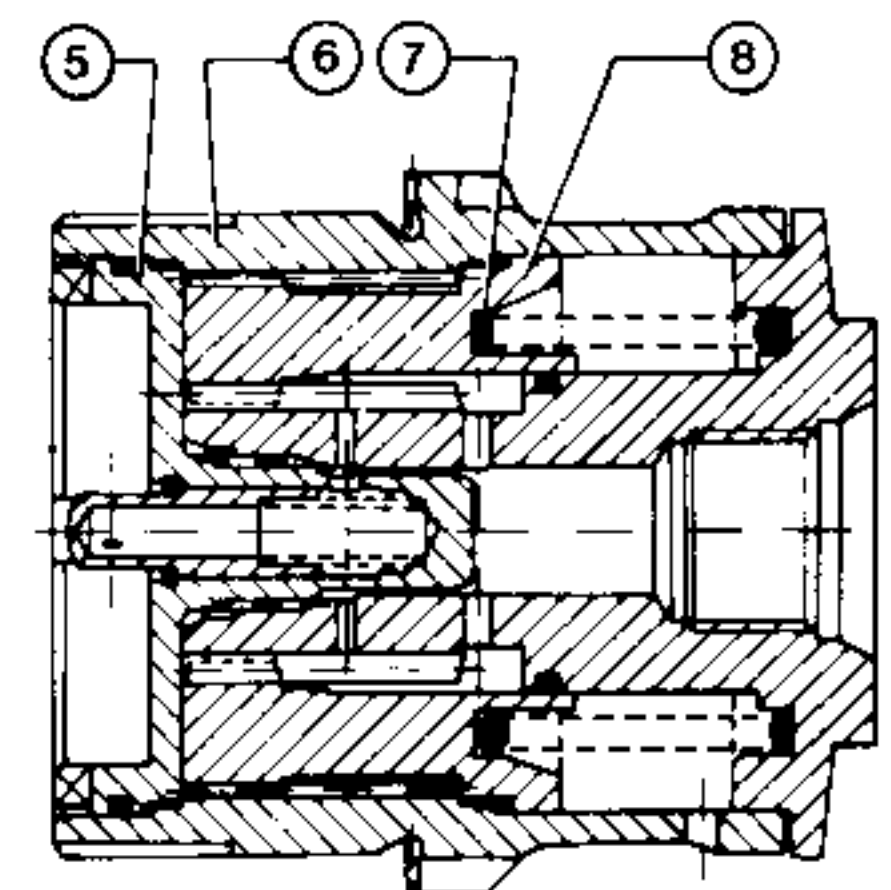
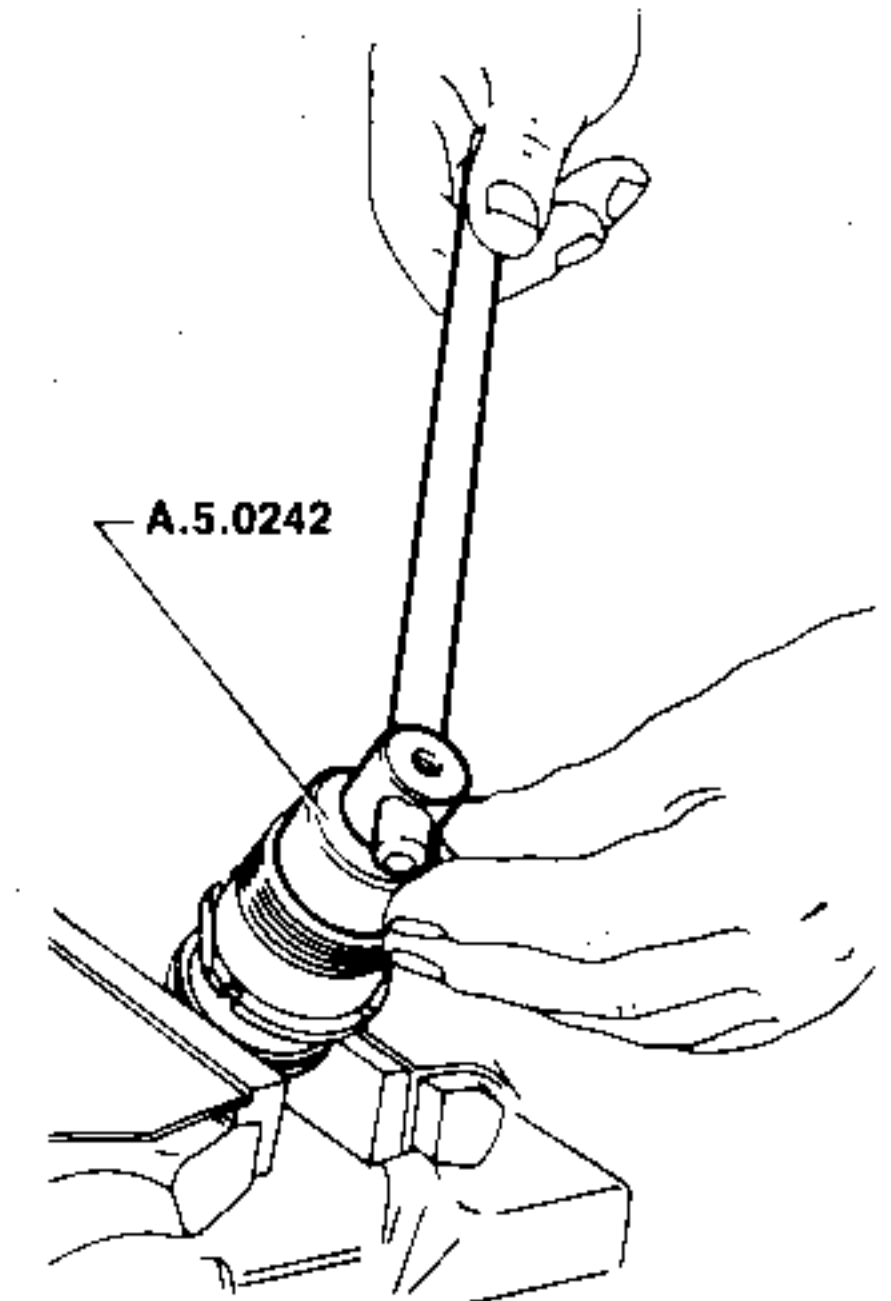
3. Move the actuating valve inwards, blow compressed air into the main duct and check that the timing variator rotates. If it is felt necessary proceed to the dismantling of the timing variator.

- g. **Dismantling of the timing variator**
 1. Using tool **A.5.0242**, unscrew the cover (5).

CAUTION:

The threading of the cover in question is «left-handed».

2. Withdraw the sleeve (6), the piston retaining spring (7) and the piston (8).



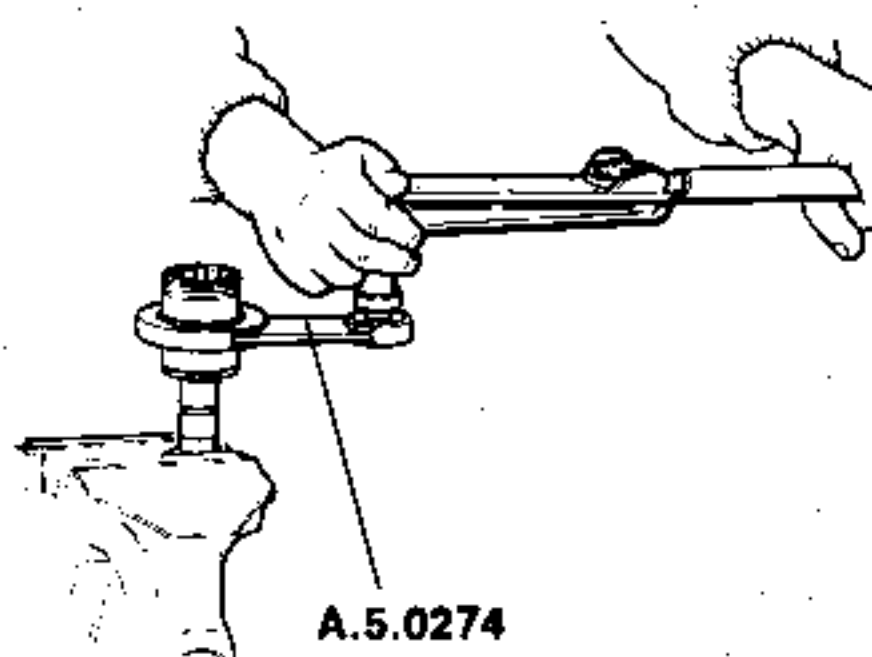
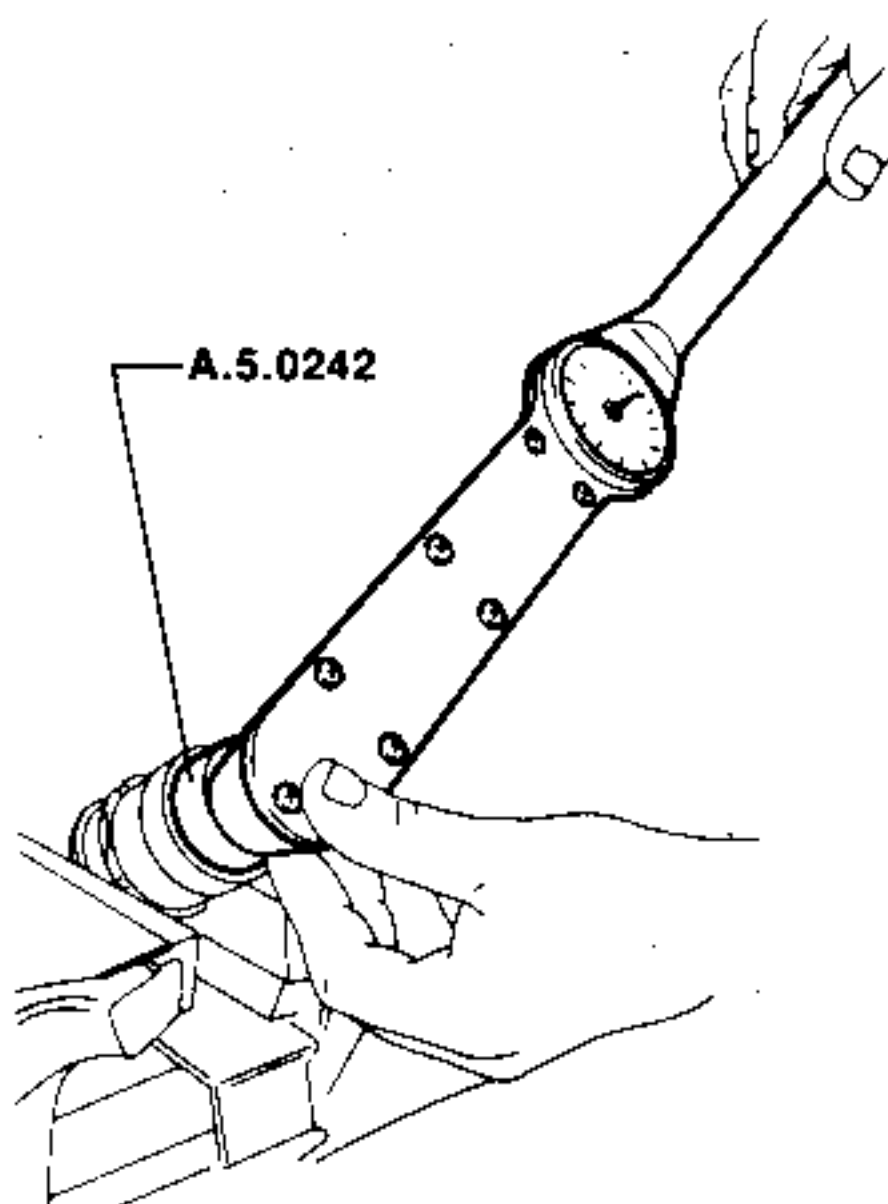
5. Cover
6. Sleeve
7. Spring
8. Piston

h. Checking of timing variator

1. Check all the oil passages for clogging.
2. Check the efficiency of the oil seal rings.

i. **Reassemble the timing variator**

1. Reassemble the timing variator by fitting the piston and the piston retaining spring.
2. Screw on the cover with the «left-handed» thread and with tool **A.5.0242** tighten it to the recommended torque **59 N·m (6 kg·m)**.



3. Fit the gear (2), and tighten the nut (1).

CAUTION:

The nut must be tightened so as to leave the gear (2) free.

j. **Fitting of timing variator on cam shaft**

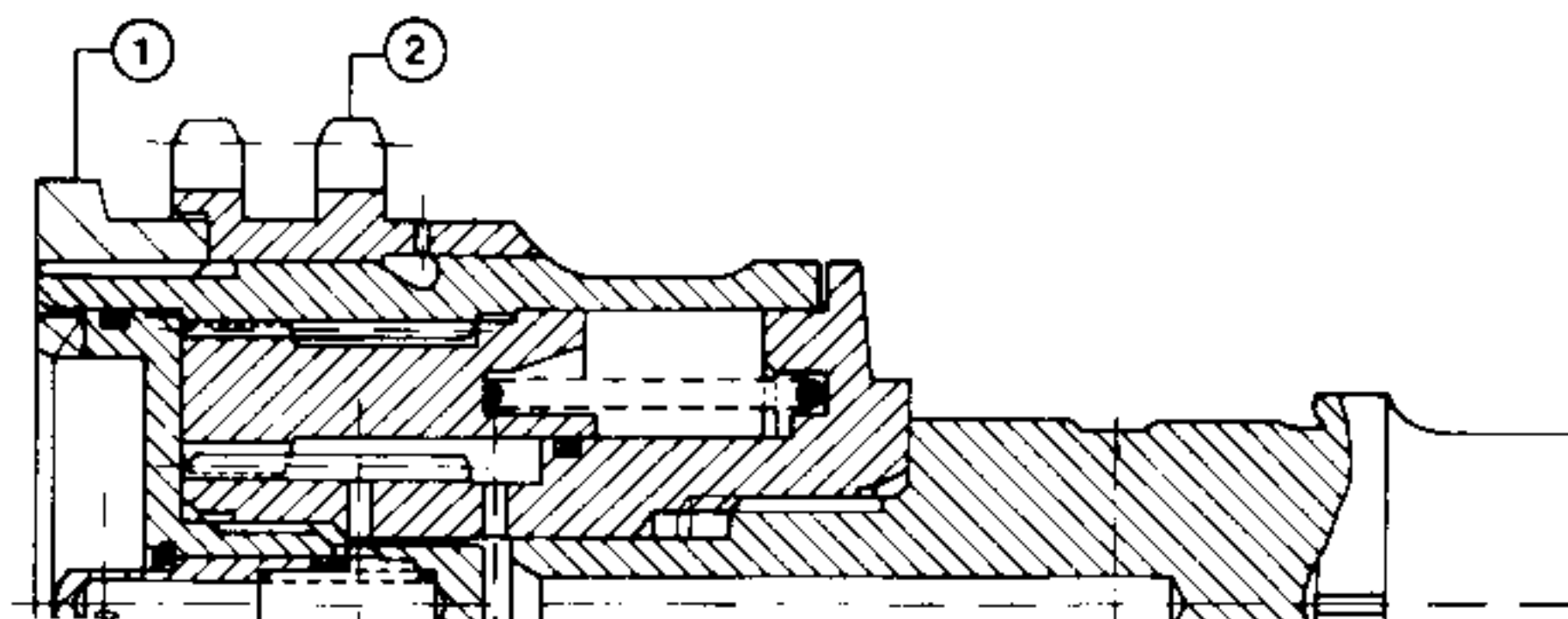
1. Smear a coat of Loctite sealing compound on the thread of the cam shaft.

CAUTION:

Take care to prevent the sealing compound from obstructing the oil passages.

2. Using the tool **A.5.0274**, screw the timing variator onto the cam shaft and tighten it to the recommended torque of **98 ÷ 117 N·m (10 ÷ 12 kg·m)**.

Wait for approximately six hours before mounting the cam shaft on the cylinder head.

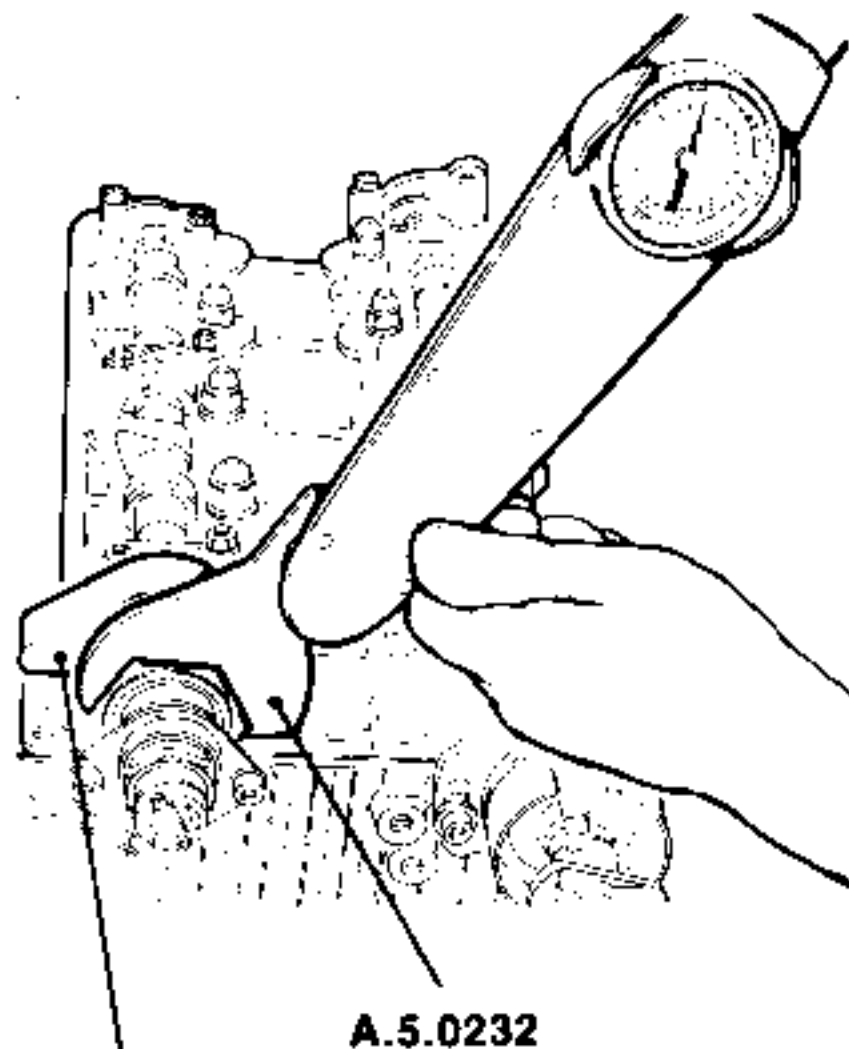


1. Nut
2. Timing chain gear

k. Fitting of cam shaft on cylinder head

1. Fit the cam shaft on the cylinder head following the procedure described in «Check and adjustment of valve clearances».
2. Tension the timing chain (see: «Check of timing and timing chain tension») and then tighten the gear until the coupling is tightly packed.
3. Block the timing variator, using tool **A.2.0423** tightening the nut to the recommended torque of $88 \div 96 \text{ N}\cdot\text{m}$ ($8.8 \div 9.6 \text{ kg}\cdot\text{m}$) using the wrench **A.5.0232** corresponding to $108 \div 117 \text{ N}\cdot\text{m}$ ($11 \div 12 \text{ kg}\cdot\text{m}$) on the axis of the nut.

With the valve closed, the piston, under the pressure of the oil, performs the stroke ($12.3 \div 12.7 \text{ mm}$) due to the effect of the helical coupling, thus causing the cam shaft to rotate clockwise by approximately $14^\circ 45' \div 15^\circ 15'$.



A.2.0423

l. Fitting of the timing system cover

1. Fit the timing distribution cover (see: «Check and adjustment of valve clearances»).

ADJUSTMENT OF TENSION AND REPLACEMENT OF ALTERNATOR DRIVE BELT

1. Adjustment of tension

The tension of the belt is correct if it deflects by $10 \div 15 \text{ mm}$, when a load of approxima-

tely 78 N (8 kg) is applied to the centre of the belt.

To adjust the tension unscrew the nuts (1) and (2) on the adjustment arm and then loosen the bolt (3).

Move the alternator so as to increase the belt tensioning and tighten the nut (2). Check the tension of the belt and then tighten the bolt (3) and the nut (1).

2. Replacement of belt

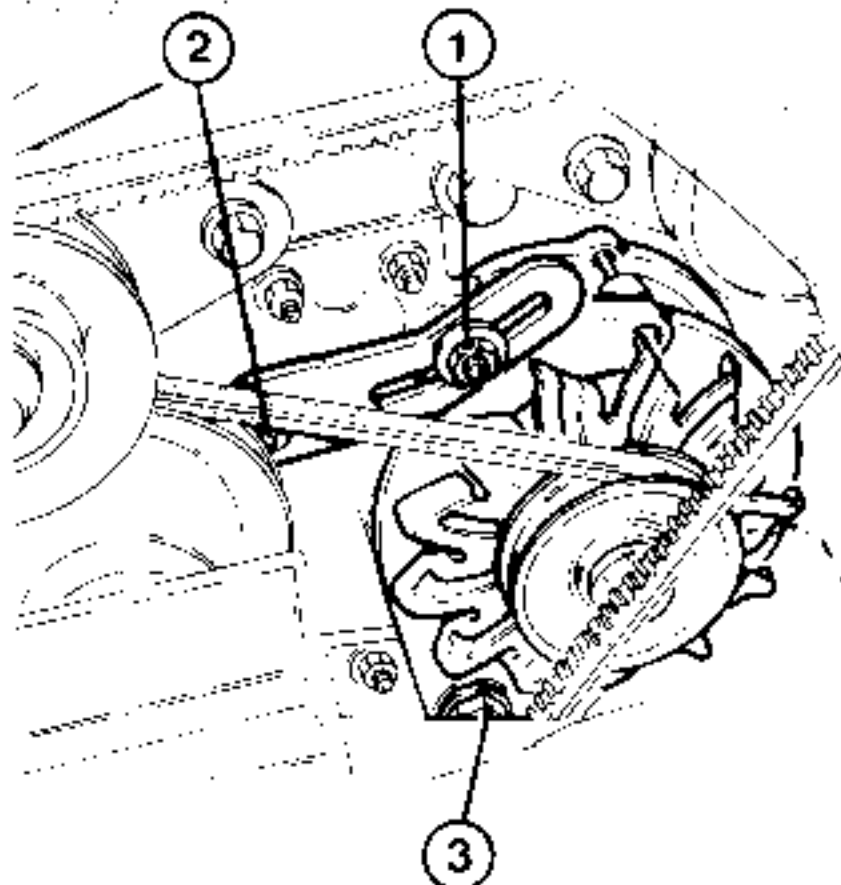
Remove the power steering pump drive belt and the air conditioner compressor drive belt as indicated in the following paragraphs.

Loosen the nuts (1) and (2) and the bolt (3). Move the alternator inwards and remove the worn belt.

Fit the new belt on the three pulleys and adjust the position of the alternator until the required belt tension is obtained.

Tighten fully the nut (2) and check the tension; tighten the bolt (3) and the nut (1).

Fit the power steering pump drive belt and the air conditioner compressor drive belt as indicated in the paragraphs below.



1. Nut
2. Nut
3. Bolt

ADJUSTMENT OF TENSION AND REPLACEMENT OF POWER STEERING PUMP DRIVE BELT

1. Adjustment of tension

The tension of the belt is correct if it deflects by 13 mm when a load of approximately

$147 \div 294 \text{ N}$ ($15 \div 30 \text{ kg}$) is applied to the centre of the belt.

To adjust the tension loosen the screws (1) and (3) on the front bracket (2) of the pulley tensioner.

Move the bracket upwards to increase the tension of the belt and then tighten the screw (1).

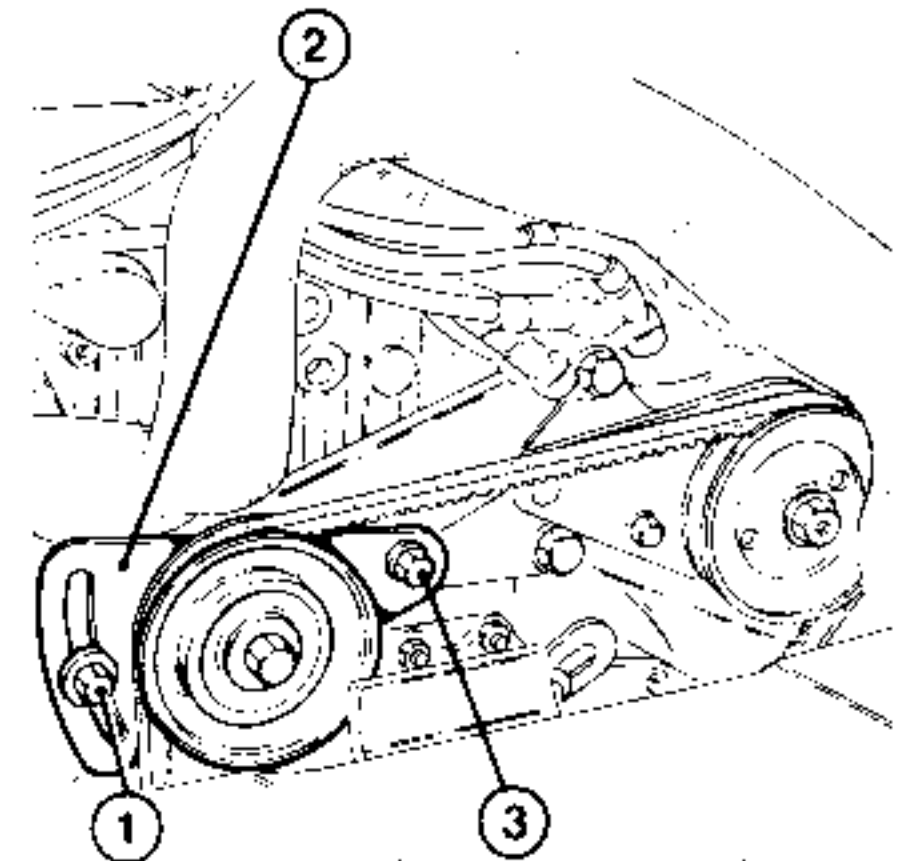
Check the tension of the belt again and then tighten the screws (1) and (3).

2. Replacement of the belt

Loosen the screw (1) and (3), move the belt tensioner bracket (2) downwards and remove the worn belt.

Fit the new belt on the three pulleys and adjust the position of the belt tensioner bracket until the required belt tension is obtained.

Tighten fully the screw (1), check the tension of the belt again and then tighten the screw (3).



1. Belt tensioner bracket securing screw
2. Belt tensioner bracket
3. Belt tensioner bracket securing screw

ADJUSTMENT OF TENSION AND REPLACEMENT OF AIR CONDITIONER COMPRESSOR DRIVE BELT

1. Adjustment of the tension

The tension is correct if the belt deflects by $10 \div 15 \text{ mm}$, when a load of approximately 78 N (8 kg) is applied to the centre of the belt.

To adjust the tension loosen the bolts (2) on the two slotted brackets (1) and then loosen the bolt (4).

Move the compressor outwards to increase the tension of the belt and re-tighten the bolts (2). Check the tension of the belt again and then tighten the bolt (4).

2. Replacement of the belt

Remove the power steering pump drive belt as indicated in the preceding paragraph. Disconnect the cooling system hose (3) and empty the system using a suitable container to collect the fluid.

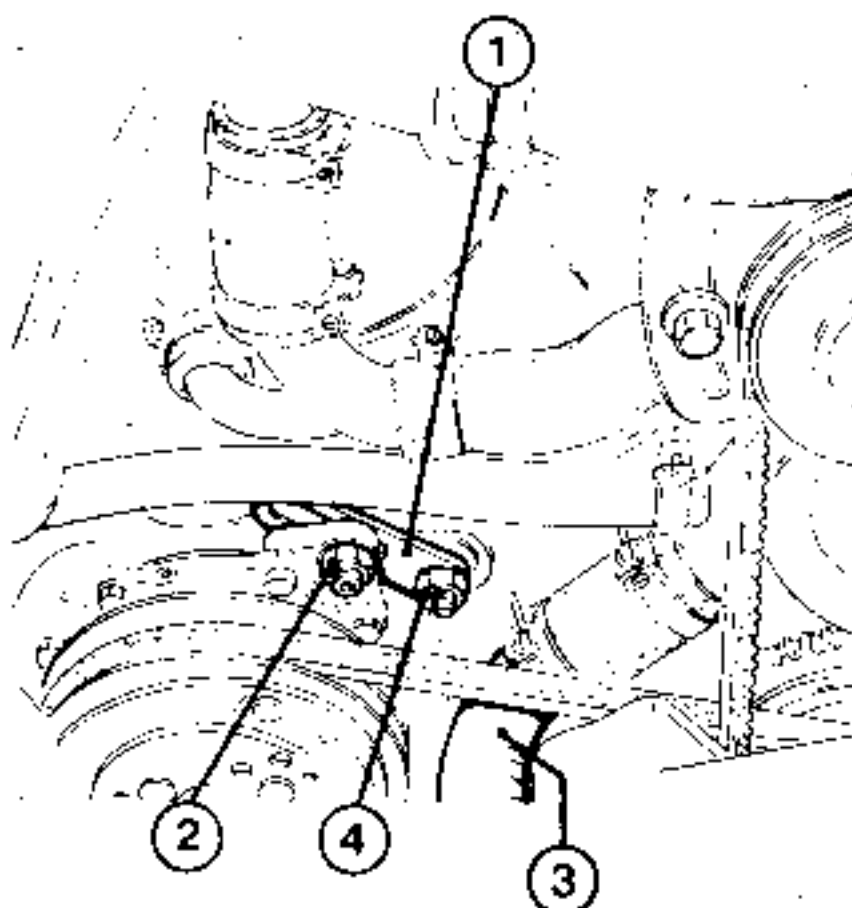
Loosen the bolts (2) on the two brackets (1) and the bolt (4) and then move the compressor inwards and remove the worn belt.

Fit the new belt on the two pulleys and adjust the position of the compressor until the belt tension required is obtained.

Tighten fully the bolts (2), check the tension of the belt and then tighten the bolt (4).

Re-fit the power steering pump drive belt and adjust the tension as indicated in the preceding paragraph.

Reconnect the cooling system hose (3), previously disconnected and fill the system with fluid of the recommended type and quantity as described in «Engine cooling» point 4.



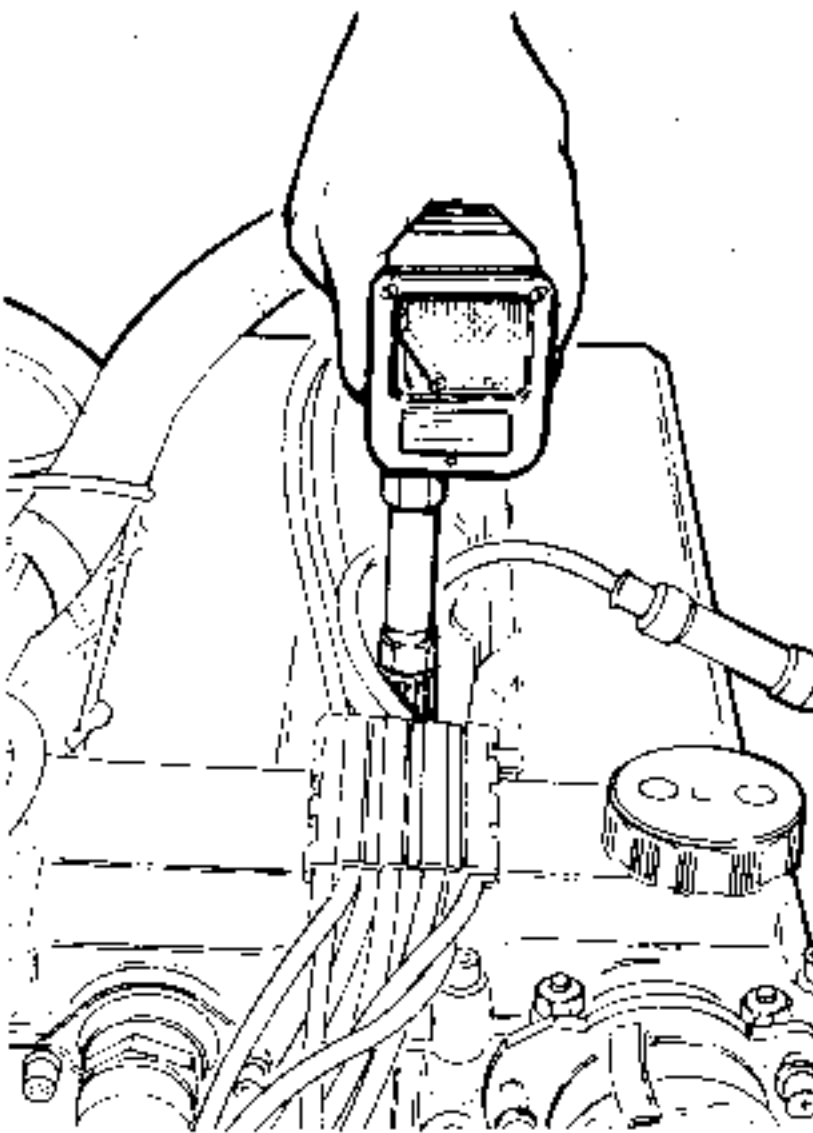
1. Bracket
2. Bracket securing bolt
3. Cooling system hose
4. Conditioner support cradle securing bolt

CYLINDER COMPRESSION TEST

When checking poor engine performance because power is not up to normal, it is advisable to test cylinder compression using the appropriate tester.

The test is carried out as follows:

- a. Start the engine and leave it running until it reaches normal running temperature.
- b. Remove the spark plugs.
- c. Disconnect the connectors from the power modules and the connectors on the electric fuel injectors.
- d. Insert the compression testing instrument in a spark plug seating.



- e. Turn the engine over a few times by means of the starter motor, keeping the accelerator pedal fully pressed. (Make sure there are no leaks from the pressure gauge union).
- f. Repeat the test to measure the compression values of the remaining cylinders taking care to reset the writing pointer of the tester each time; then compare the values measured.

NOTE:

If the difference between the pressure values measured in the cylinders is excessive, seek the cause starting with a check of the tightness of the valves and if necessary proceeding to a check of the compression rings and the pistons.

FUEL SYSTEM

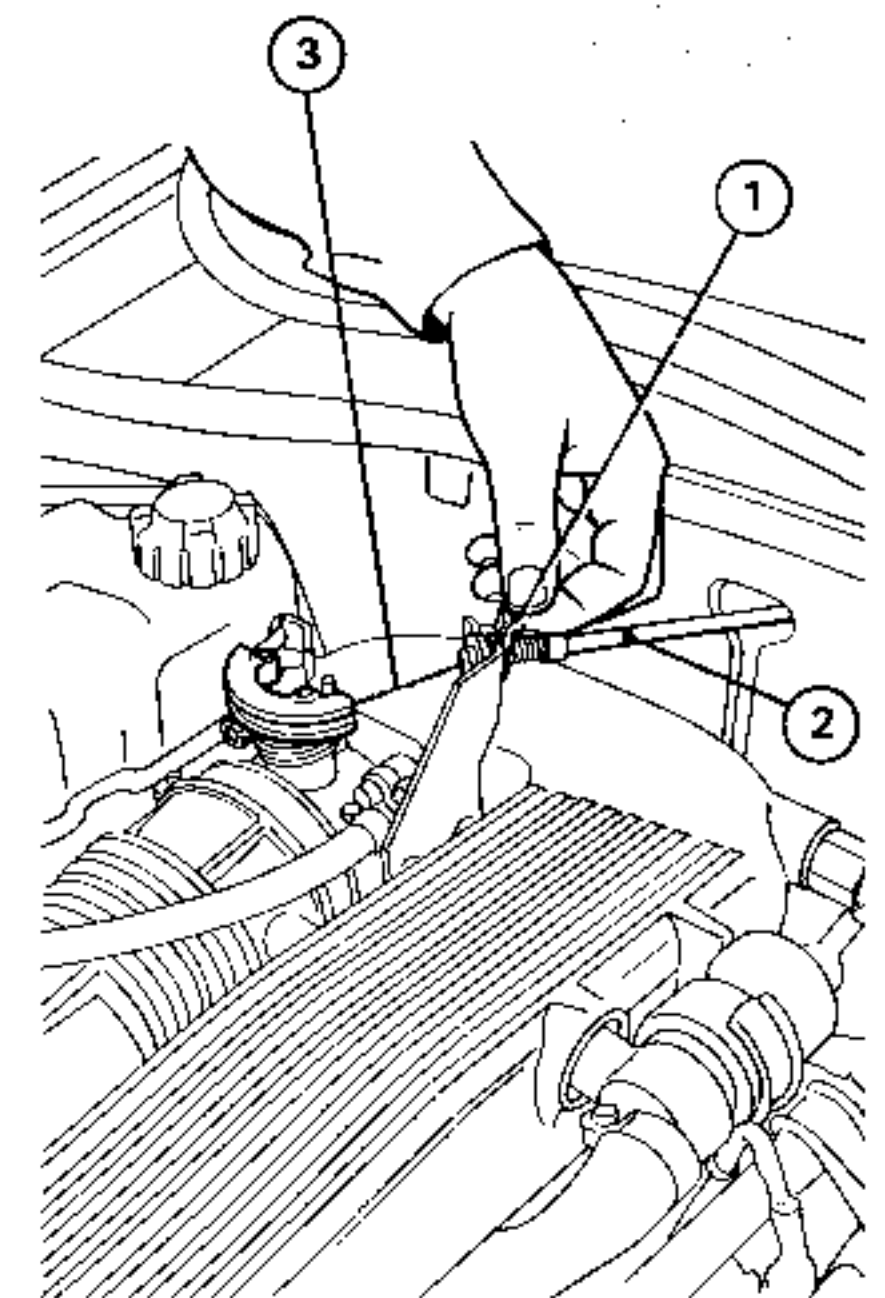
CHECK AND ADJUSTMENT OF THE ACCELERATOR

1. Checking of cable sliding

Check that the accelerator cable moves freely in its sheath.

2. Adjustment of play in cable

- a. With the accelerator pedal up, check that the accelerator end play on the control lever is 1 ÷ 2 mm.
- b. If necessary adjust the cable backlash by removing the adjusting spring (1) and moving the sheath (2) so as to produce the recommended backlash on the cable (3). Then reinsert the spring in the new position.

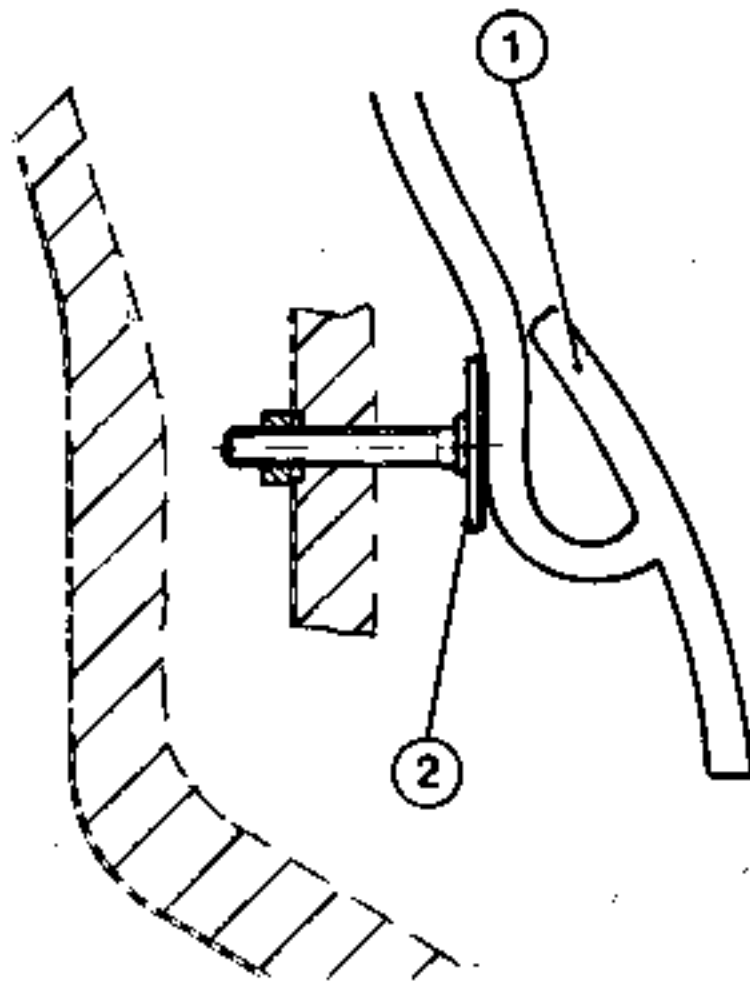


1. Adjusting spring
2. Accelerator cable sheath
3. Accelerator cable

3. Checking the maximum opening of the butterfly valve

- a. With the accelerator pedal pressed fully down, check that the accelerator control cam can still rotate by 1 ÷ 2 mm.

- b. If necessary proceed with the adjustment by means of the end of travel screw (2) under the accelerator pedal (1).



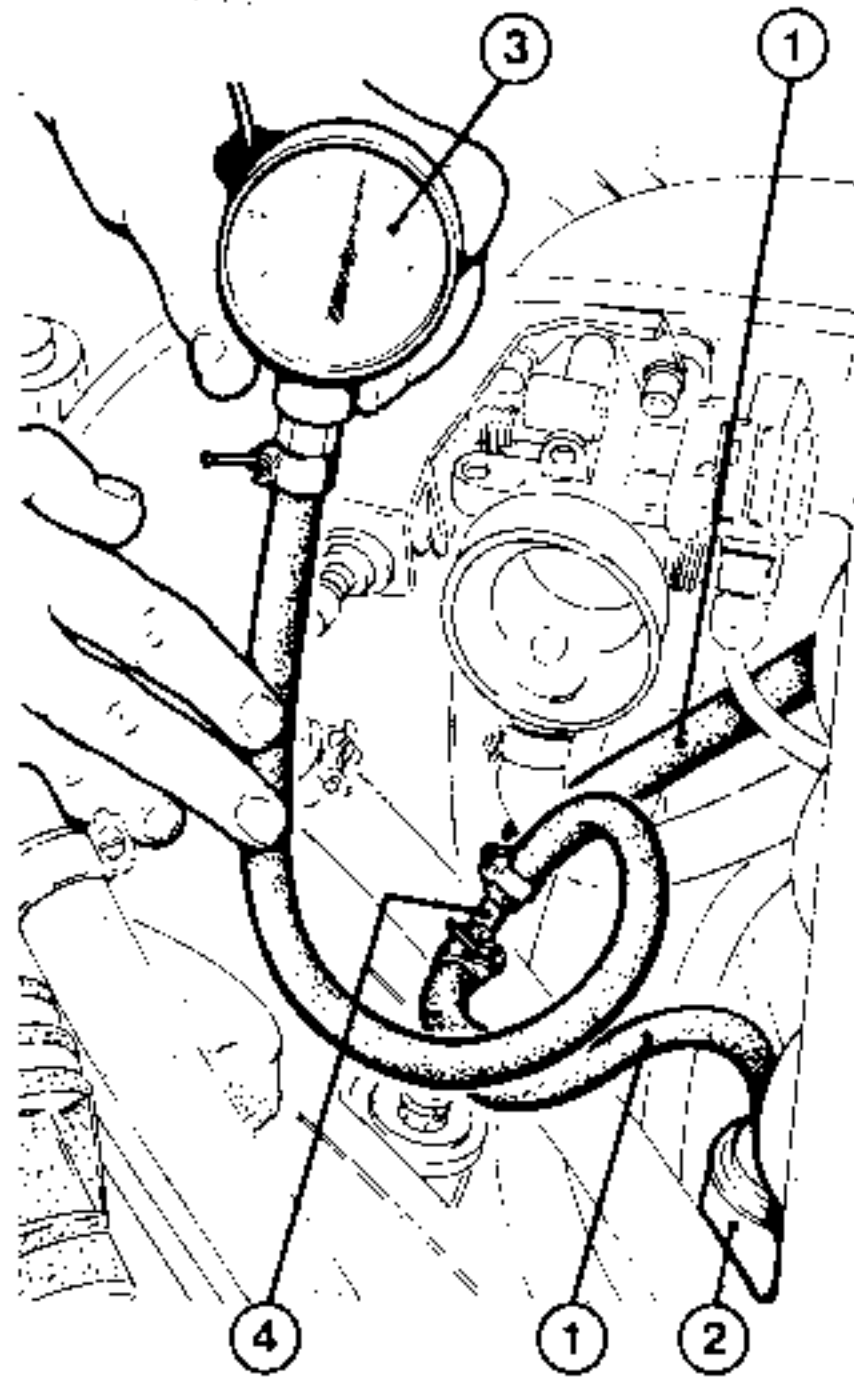
1. Accelerator pedal
2. End of travel screw

CHECK OF FUEL SYSTEM PRESSURE AND TIGHTNESS OF SYSTEM

1. Check of fuel system pressure

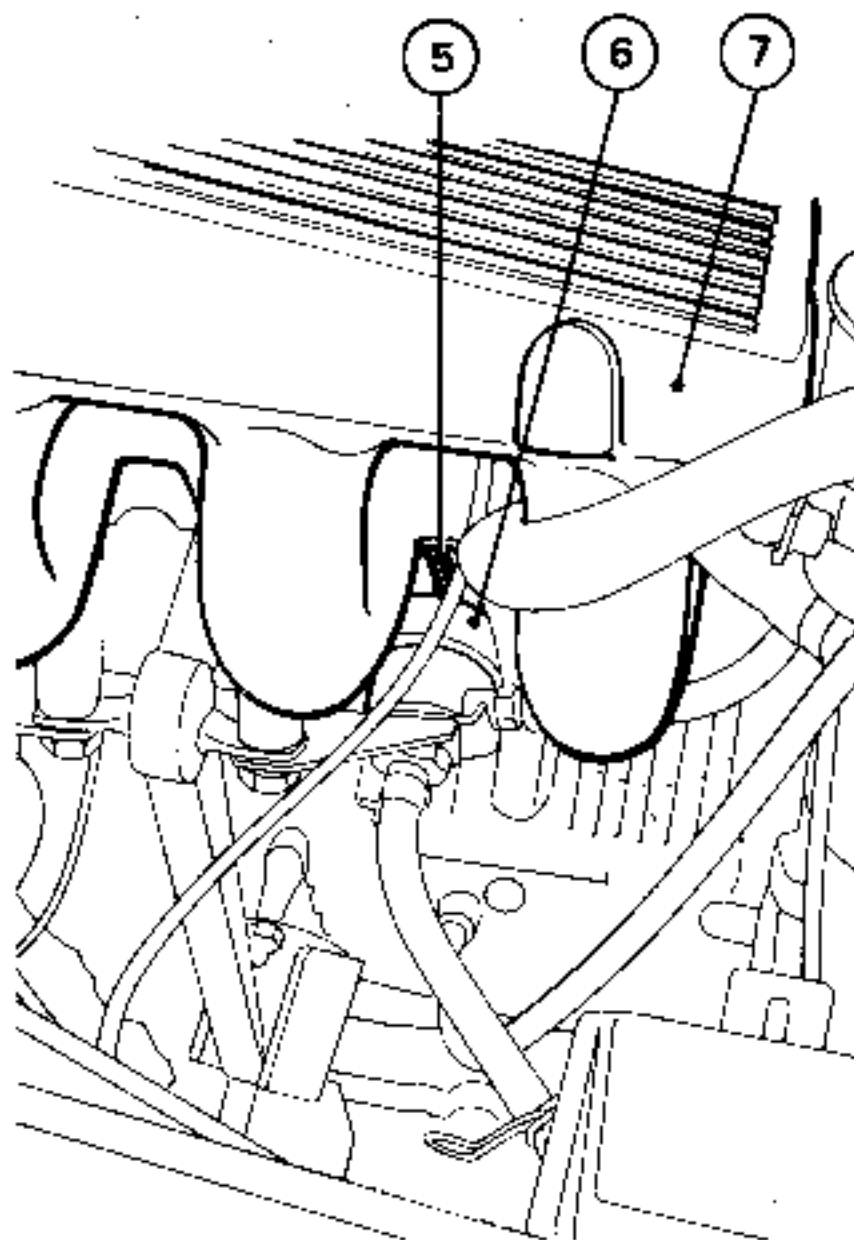
Carry out the check as follows:

- a. Connect a pressure gauge (3) between the fuel delivery tube (1) and hammering damper (2) by means of a «T» adaptor (4).



1. Fuel delivery tube
2. Hammering damper
3. Pressure gauge
4. «T» adaptor

- b. Disconnect the hose (5) that connects the pressure regulator (6) to the air intake box (7), in order to prevent any irregularities in the engine idling from causing irregular readings.



5. Vacuum hose
6. Pressure regulator
7. Air intake box

- c. Start the engine; with the engine on idle, using the pressure gauge, check that

the reading is equal to the recommended value:

Fuel pressure

284.3 ÷ 323.6 kPa

(2.8 ÷ 3.2 bar; 2.9 ÷ 3.3 kg/cm²)

- d. Re-connect the hose (5) to the air intake box (7). With the engine on idle the fuel pressure should fall to approximately 0.5 bar and then rise again when the accelerator butterfly valve is opened. If this does not occur, search for possible leaks from the vacuum hose (5).

2. Check tightness of system

- a. Keeping the pressure gauge connected, and with the engine on idle, choke the hose immediately downstream from the pressure regulator (6) until a pressure value of 4 bar is read (ensure that the pressure does not exceed this value).
b. With the pressure at 4 bar check that the fuel system tubes and unions do not present leaks.
c. If the pressure does not reach the value of 4 bar, and no leaks are encountered, check the filter and/or the functioning of the fuel pump.

TROUBLE DIAGNOSIS PROCEDURE FOR THE CHECKING OF THE TIGHTNESS OF THE FUEL INJECTION SYSTEM

The procedure is to be carried out at the intervals indicated in the «Vehicle maintenance schedule» and in the presence of the following symptoms:

- Smell of petrol
- Visible signs of leaks from the unions and connections of the system.

The possible causes are:

- Petrol leaks from the components, the unions and the connections of the system.

Carry out the procedure described in the preceding paragraph for the «Check of the fuel system pressure» and the «Check of the fuel system tightness» and in particular:

- a. Make sure of the presence of fire fighting equipment in the workshop so as to be able to work in conditions of maximum safety.
- b. Run the engine to normal running temperature.
- c. Switch the ignition off.
- d. Inspect visually the components and unions of the fuel system so as to locate the origin of the leak.
- e. Check the entire system (connecting tubes, unions, components) using an exhaust gas analyser (NDIR system).
- f. The pointer of the analyser will react in the vicinity of the zone of the leak.

The analyser test must be carried out slowly so as to allow for the slow response time of the instrument.

- g. Following the location of the leak by means of the procedure indicated in points d. and/or e. eliminate the leak by replacing the defective components of the system or by suitably tightening the loose clips.
- h. On completion of the preceding operation, start the engine, let the engine idle for a few minutes and then switch the ignition off.
- i. Repeat the test described in points c. and d. in order to check the exactness of the diagnosis and the effectiveness of the repair.
- l. On completion of the procedure described in points a. to h., carry out a road test of at least 30 minutes, followed by a final check to ensure the correct working order of the system.

CHECK OF THE TIGHTNESS OF THE FUEL VAPOUR EMISSION (EVAPORATION) SYSTEM

The procedure described below must be carried out when checking the fuel system pressure and in the presence of the smell of petrol.

The probable cause is a blow-by of vapour from the tubes, unions or parts of the system.

PROCEDURE «A»

- a. Disconnect the tube connecting the vapour cleaner and the fuel tank and connect it to a compressed air source, with a pressure gauge between the source of compressed air and the tube.
- b. Pressurise the system with compressed air until a pressure of:
0.025 bar (2.49 kPa;
0.0255 kg/cm²; 254 mm H₂O)
is obtained and close the system.
If this value cannot be reached, open the compressed air source and check the tightness of the system (with an HC analyser or a «Snoop» leak detector).
- c. Measure the fall in pressure in the system (this must not be more than:
0.00125 bar (0.125 kPa;
0.00127 kg/cm²; 12.7 mm H₂O)
after 10 minutes).
- d. If after 10 minutes the fall in pressure is greater than the specified value, locate the leaks by smearing the tubes and unions with soapy water or by using the «Snoop» detector.
- e. Bubbles will appear in the presence of leaks.
- f. In the case of leaks coming from the filler cap/pipe, replace the cap first of all. If after replacing the cap the tightness of the system is restored, this means that the cap was defective. If the tightness is not restored replace the filler pipe.
- g. Replace the parts that are thought to be defective and/or adequately tighten loose pipe clips etc.
- h. Repeat the operations b. and c. to check the correctness of the diagnosis.

ALTERNATIVE PROCEDURE «B»

To be carried out with the fuel tank at least 3/4 full.

- a. Disconnect the tube connecting the vapour cleaner and the fuel tank and connect it to a compressed air source, with a pressure gauge between the source of compressed air and the tube.

- b. Pressurise the system blowing propane into the vapour breather tubing until a pressure value is obtained equal to:

0.025 bar (2.49 kPa

0.0255 kg/cm²; 254 mm H₂O)

- c. Check for the existence of propane leaks from the tubing, unions or parts of the system, by using an HC (probe) sensor connected to an HC analyser.
- d. Repair the leak (or tighten the pipe clips, if this is sufficient).
- e. Repeat operations b. and c. to check the correctness of the diagnosis.

CHECK THE TIGHTNESS OF THE AIR INTAKE SYSTEMS DOWNSTREAM FROM THE AIRFLOW GAUGE

In order to detect the existence of air leaks throughout the entire air intake system, disconnect the flexible air intake hose that connects the constant idle actuator with the corrugated air intake sleeve and blow in air with a compressed air gun.

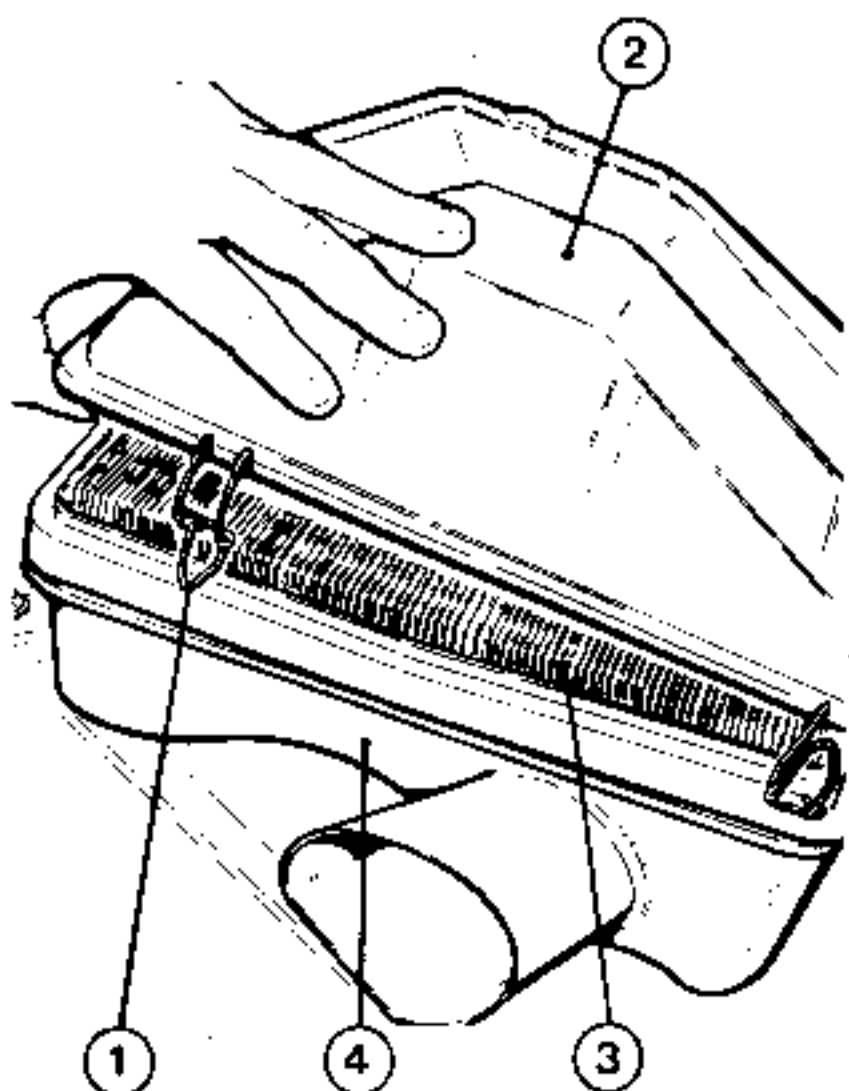
Completely open the accelerator butterfly valve and smear or spray soapy water on all the joints in the system; the formation of bubbles or foam indicates the existence of leaks.

CHECKING CLEANING AND REPLACEMENT OF THE AIR FILTER

- a. Release the clips ① which secure the filter cover ② to the filter container.

- b. Lift the cover enough to remove the cartridge (3) without damaging the surrounding components.
- c. Clean the cartridge container (4).
- d. Clean the cartridge thoroughly, by blowing low pressure compressed air into the cartridge from the filter lower side.
- e. Insert the filter cartridge in the container ensuring that the «top» label is facing upwards.
- f. Fit the cover (2) securing it with the clips (1).

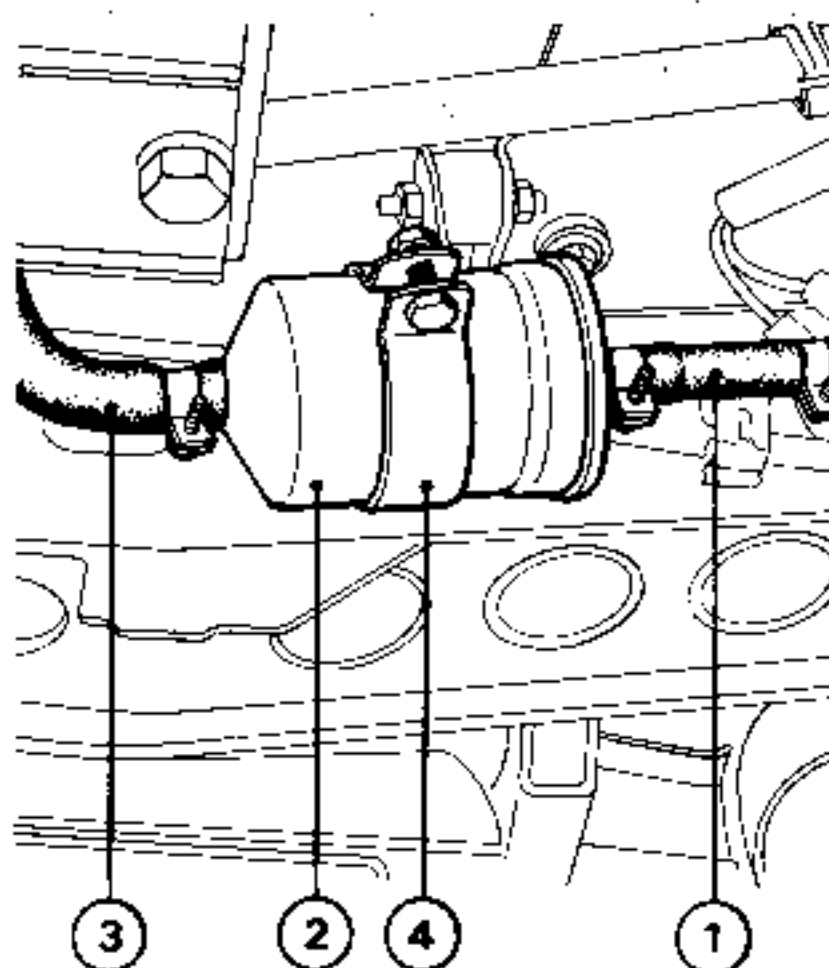
The air filter cartridge should be replaced periodically (see: «Vehicle maintenance schedule»).



1. Clips
2. Cover
3. Filter cartridge
4. Filter container

REPLACEMENT OF FUEL FILTER

- a. Working from underneath the vehicle, pinch the tubes (1) and (3).
- b. Loosen the pipe clips and disconnect the tubes (1) and (3) from the filter (2).
- c. Loosen the filter retaining clip (4) and remove the filter.
- d. Refit the new filter taking care to see that the arrow stamped on the filter is pointing in the direction of the fuel delivery.
- e. When the new filter is fitted, remove the clips from the fuel delivery tubes.



1. Fuel inlet tube
2. Fuel filter
3. Fuel outlet tube
4. Filter retaining clip

CHECK OF IDLE R.P.M.

The check of the idle r.p.m. is to be carried out with the engine at normal running temperature, the gear speed in neutral and all the ancillary devices excluded.

Idle r.p.m.
800 ± 50 r.p.m.

The regulation of the idle r.p.m. is automatically controlled in all engine functioning conditions by means of the constant idle actuator.

With the engine running on idle, the function of the actuator is to bring the actual r.p.m. to the nominal r.p.m. (800 ± 50 r.p.m.) by acting on the accelerator butterfly by-pass.

As well as controlling the idle r.p.m., it also acts as an additional air box and regulator for the operation of the air conditioning system.

When the compressor begins to operate, the electronic control unit automatically maintains the correct r.p.m. by means of the idle actuator.

NOTE:

With the Motronic system, periodic adjustment of the idle r.p.m. is not possible.

If the idle r.p.m. is above or below the recommended values and the vehicle presents no mechanical faults, then the fault probably lies in the electronic circuits. In this case it will be necessary to resort to the trouble diagnosis procedure using the appropriate tester.

If the specified idle r.p.m. is still not achieved, it will be necessary to replace the defective components.

CHECK OF EXHAUST EMISSIONS (CO) WITH ENGINE RUNNING ON IDLE

The check is to be carried out using NDIR type equipment. The gas to be analysed is taken from the end of the exhaust pipe upstream from the catalyser (catalytic silencer).

The check is carried out with the engine at normal running temperature, (after the electric fan has come on and then gone off) and after having carried out the idle r.p.m. check (see: «Check of the Idle r.p.m.»).

The following preliminary checks are also to be carried out:

- Check of engine oil level
- Cleaning of air filter cartridge
- Check of ignition system efficiency
- Ignition timing

The CO level should fall within the specified values:

% CO ≤ 0.2

NOTE:

With this configuration of the Motronic ML4.1 system, periodic adjustments of the CO emissions with the engine on idle are not possible. If the values are found to fall outside the specified limits and the vehicle does not present any mechanical fault, then it is probable that the fault lies in the electronic circuits.

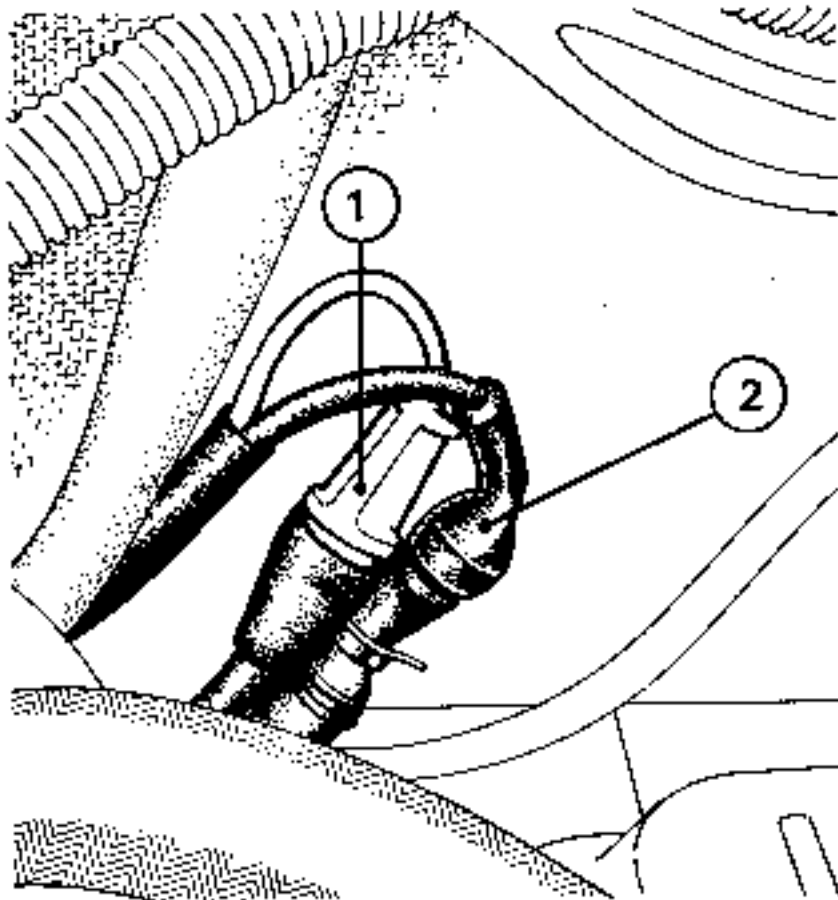
In this case it will be necessary to resort to the trouble diagnosis procedure using the appropriate tester.

If the CO level is still found to fall outside the specified limits, it will be necessary to replace the defective components.

EXHAUST SYSTEM

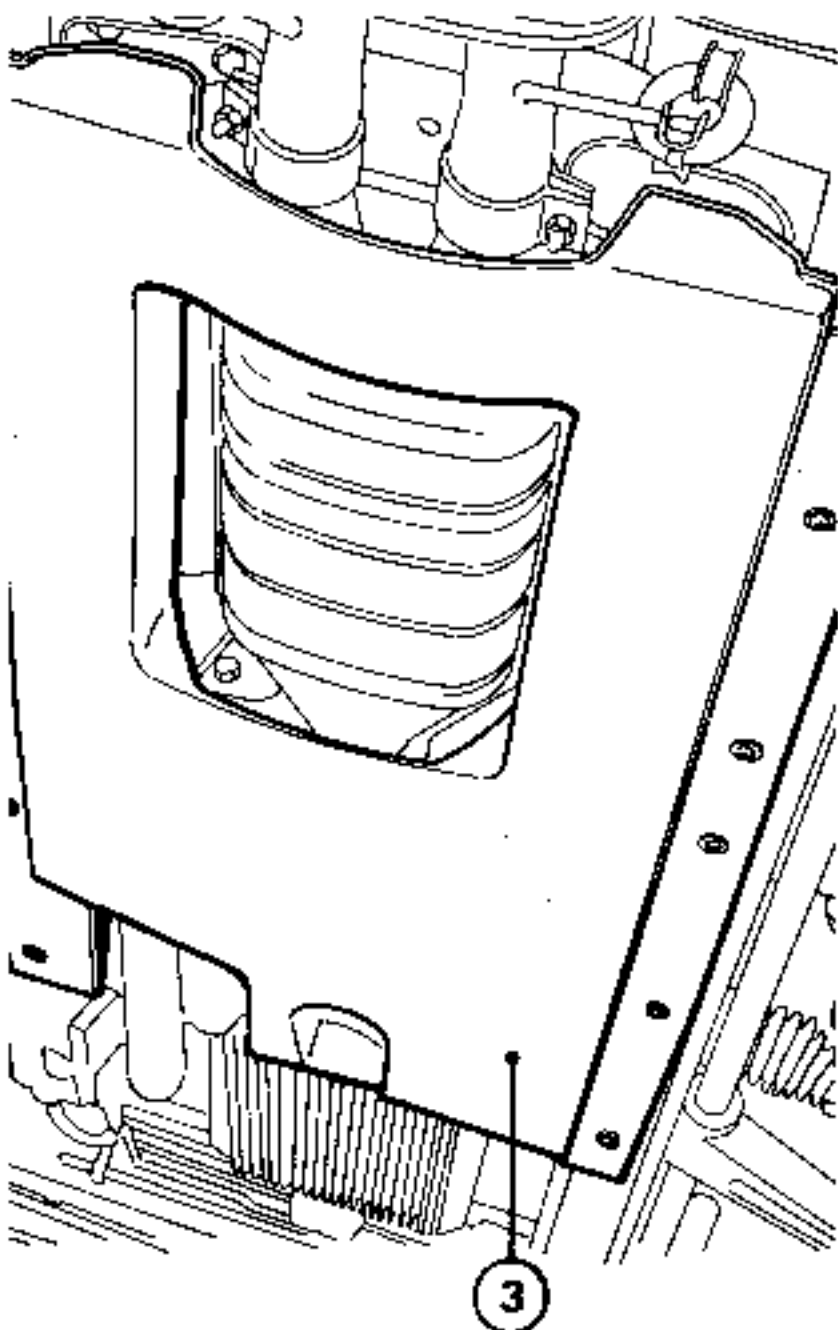
REPLACEMENT OF THE LAMBDA SENSOR AND THE CATALYSER

1. Set vehicle on lift.
2. Working from the engine compartment remove the rear cover and disconnect the connectors (1) and (2) of the Lambda sensor wiring.



1. Lambda sensor connector
2. Lambda sensor resistance connector

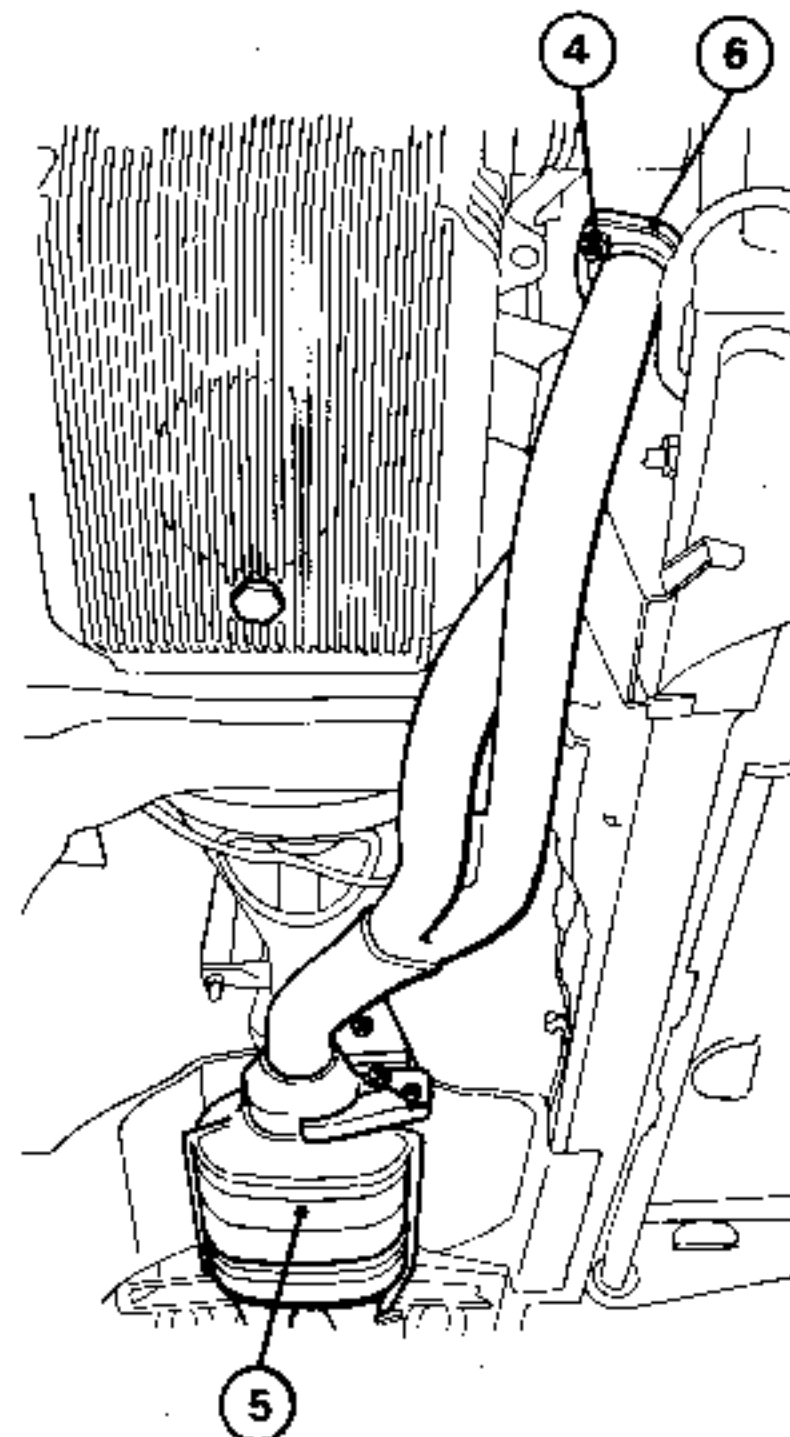
3. Working from beneath the vehicle unscrew the screws and remove the catalytic silencer heat shield (3).



3. Catalytic silencer heat shield

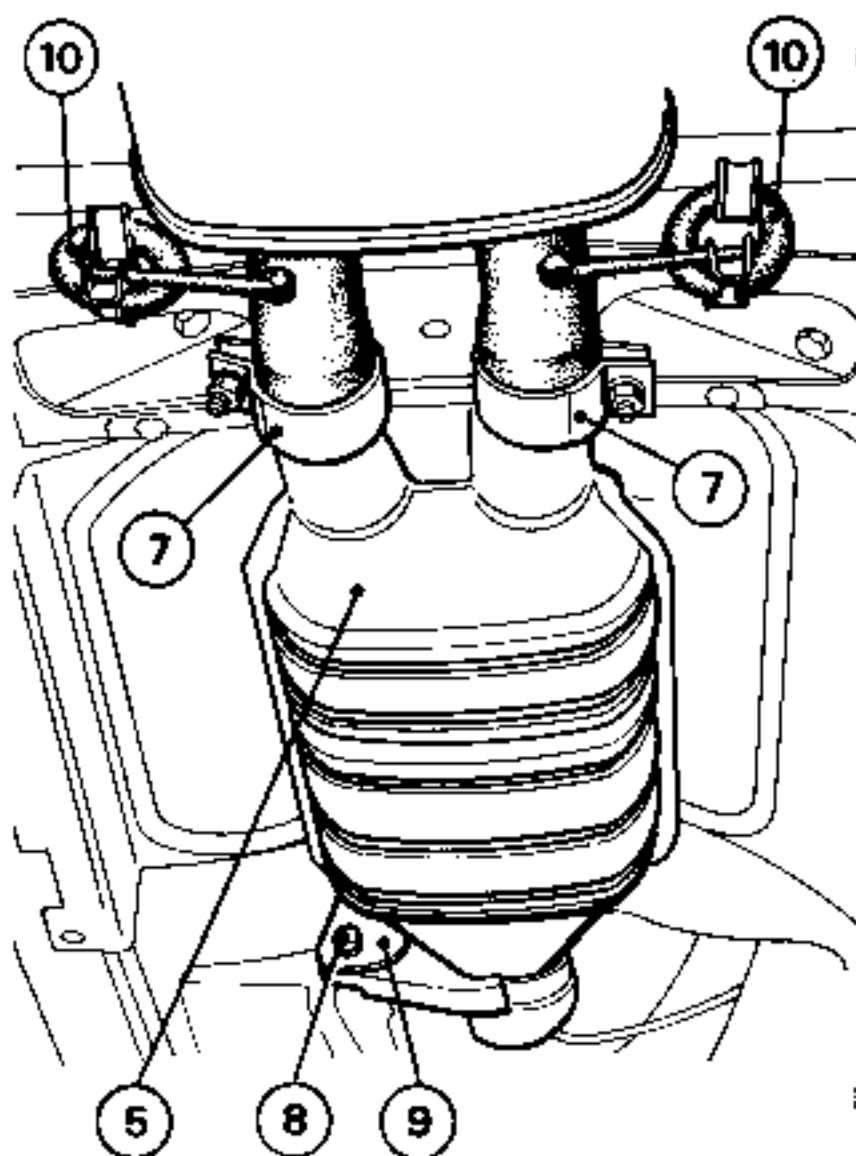
4. Unscrew the wire clip securing bolt and free the lead of the Lambda sensor.

5. Unscrew the nuts (4) securing the catalyser (5) to the two exhaust manifolds (6).



4. Securing nuts
5. Catalyser
6. Exhaust manifolds

6. Loosen the two clips (7) at the rear of the catalyser (5).
7. Unscrew and remove the two bolts (8) securing the catalyser to the support (9) and release the retaining rings (10).



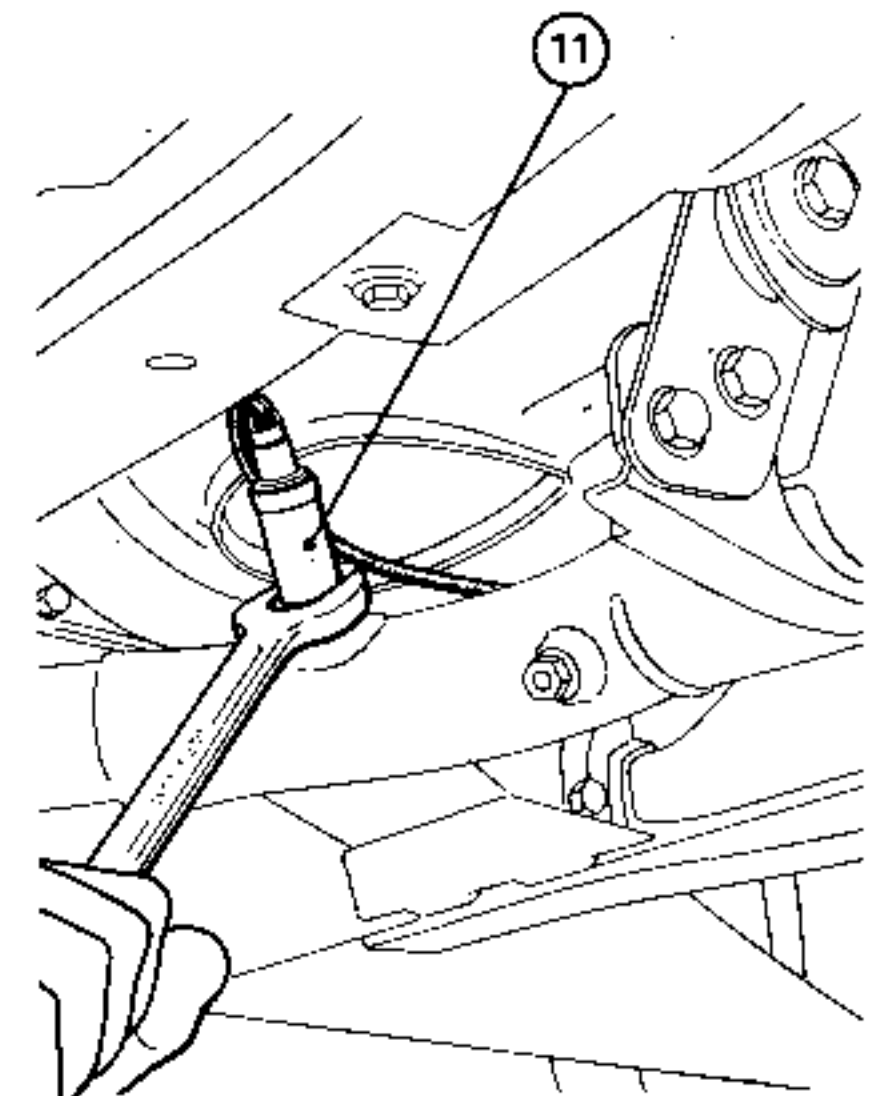
7. Clips
8. Securing bolts
9. Support
10. Elastic retaining rings

8. Disconnect the catalyser from the two exhaust manifolds and also remove the respective gaskets.

9. Remove the catalyser disconnecting it from the central length of the exhaust piping, knocking it lightly with a plastic hammer round the circumference of the connecting parts.

10. Fit a new Lambda sensor in a new catalyser proceeding as follows:

- a. Grease the thread of the body of the sensor with R. Gori Never Seez grease or alternatively BOSCH 5.964.00.105 grease.
- b. Using a suitable spanner, fit the Lambda sensor (11) in the catalyser.



11. Lambda sensor

11. Refit the catalyser by reversing the order of removal and being sure to carry out the following:

- a. Fit new gaskets between the catalyser and the exhaust manifolds.
- b. Shake the exhaust pipe a little so as to seat it properly and then tighten all the securing nuts and bolts.
- c. Position the Lambda sensor lead and fix it with the appropriate clip.
- d. Reconnect the two connectors of the Lambda sensor wiring located in the engine compartment.
- e. Start the engine and check that there are no leaks of exhaust gases from the pipe connections and that there is no excessive noise coming the system.

ENGINE IGNITION

CHECK OF IGNITION TIMING

- Connect the stroboscopic gun to the terminal of the No. 1 cylinder spark plug on the distributor. Connect the negative and positive leads of the stroboscopic gun to the respective battery terminals.
- Connect an electronic rev counter to the engine.
- Run the engine to normal running temperature and at idle r.p.m. (800 ± 50 r.p.m.), check that the notch on the engine pulley is aligned with the fixed reference index on the water pump.

Fixed advance
 $10^\circ \pm 1^\circ$ before T.D.C.

Take especial care to see that the engine is running at the idle r.p.m.: 800 ± 50 r.p.m.

CAUTION:

The system does not require and does not permit any adjustment of the spark advance. Do not rotate the ignition distributor. If it is rotated, the firing order could be modified, thus resulting in very serious consequences.

If the timing is not within the specified values and the vehicle does not present any mechanical fault, then there is probably a fault in the electronic circuits. In this case it will be necessary to resort to the trouble diagnosis procedure using the appropriate tester.

- The use of spark plugs with different features or dimensions can cause serious damage to the engine and can also alter the exhaust emission levels.
- Clean and replace the spark plugs periodically at the intervals indicated in the «Vehicle maintenance schedule».
- Replace the spark plugs if the ceramic insulator is cracked or the electrodes are excessively worn.

2. Replacement

- With the engine cold, roll back the rubber cap, blow compressed air into the spark plug seating in order to remove any foreign matter and then remove the spark plugs.
- Grease the threads with **ISECO Molikote A grease** and tighten the spark plugs to:

$25 \div 34$ N·m
($2.5 \div 3.5$ kg·m)

- Make sure that there is both a good mechanical and electrical connection between the spark plug leads and the connectors.
- If in doubt slide the rubber cap back along the spark plug lead, fully tighten the connector and slide the rubber cap back over the connector.

Connect the connector to the spark plug.

CAUTION:

The spark plug leads must be reconnected according to the correct firing order.

Firing order: 1-3-4-2.

ENGINE COOLING

CHECK OF ANTIFREEZE MIXTURE LEVEL AND COOLING SYSTEM TIGHTNESS CHECK

1. Check of system

- Check that the coolant level in the filler tank is within the MAX and MIN reference marks.
- Inspect the tubes and couplings checking that they are not worn and do not leak.
- Inspect the filler tank cap checking that the springs, the gasket and the valves are in good condition.
- Check that the electric fan is in correct working order.
 - Disconnect the two leads of the thermal switch on the radiator and short circuit them.
 - Turn the ignition key and check that the fan starts.
- Check the radiator referring to Group 07 - Cooling of the «WORKSHOP MANUAL - ENGINES».
- Should it be necessary to top up with considerable quantities of coolant liquid, check the system carefully for possible leaks and eliminate them.

2. Pressurised cap tightness test

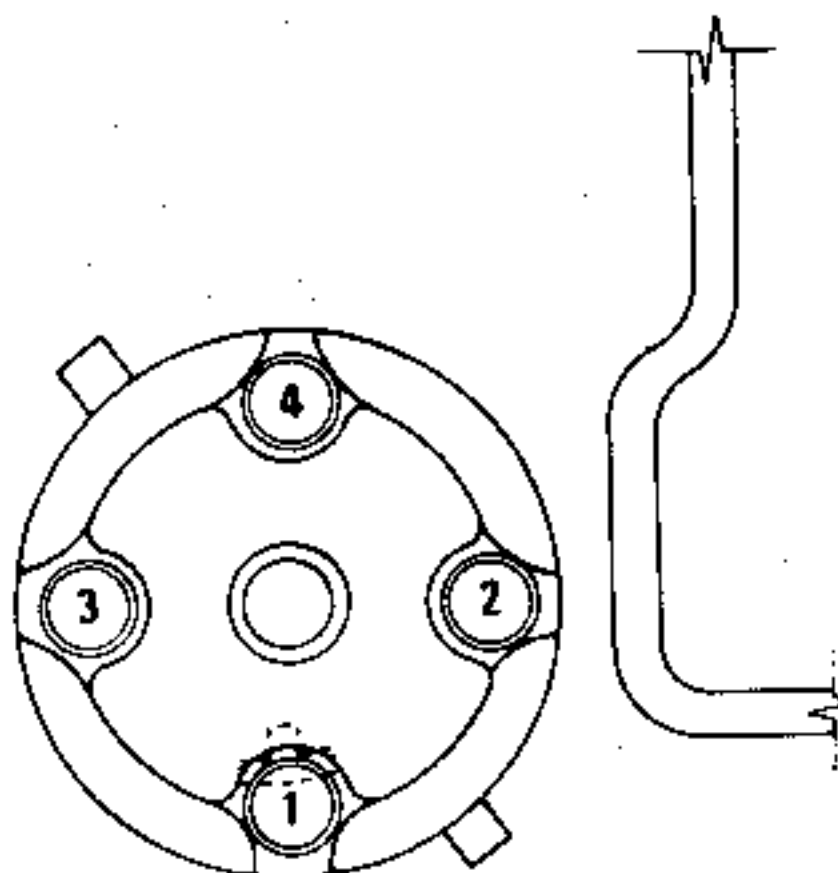
- Attach the appropriate coupling (2) to the testing instrument and insert it in the pressurised cap.
- Pressurise the cap and from the reading on the tester, check that the relief valve opens at the specified pressure.

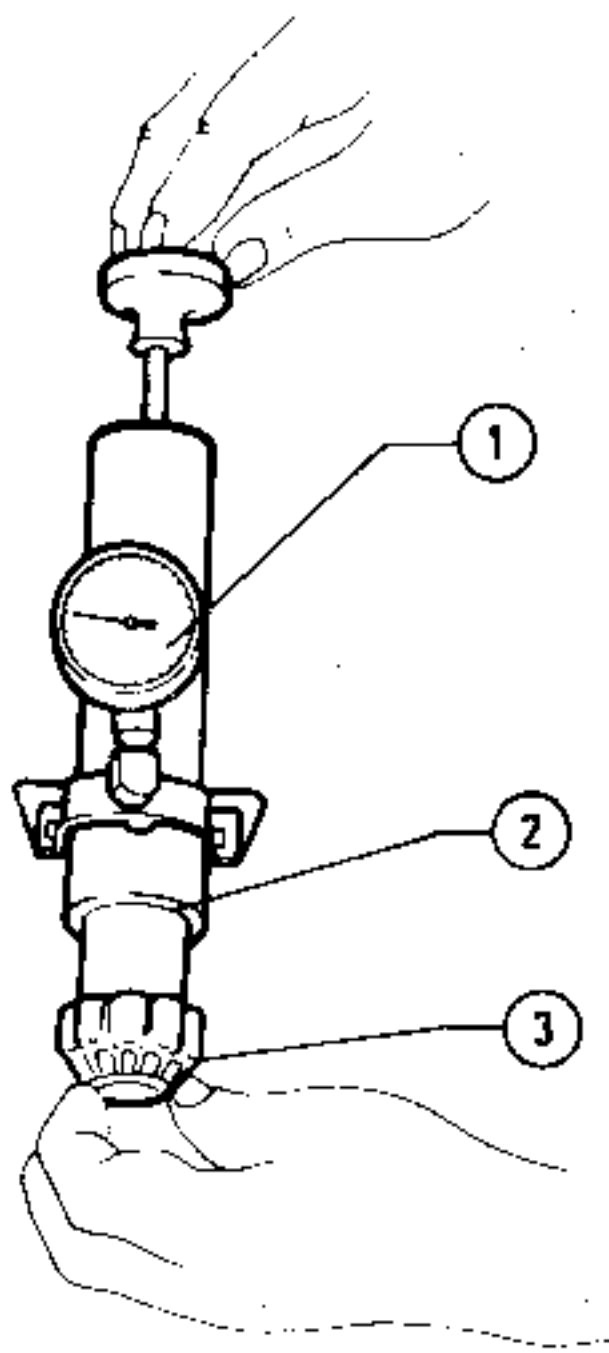
Specified cap pressure
68.6 kPa
(0.69 bar; 0.7 kg/cm²)

CHECK, CLEANING AND/OR REPLACEMENT OF THE SPARK PLUGS; FIRING ORDER

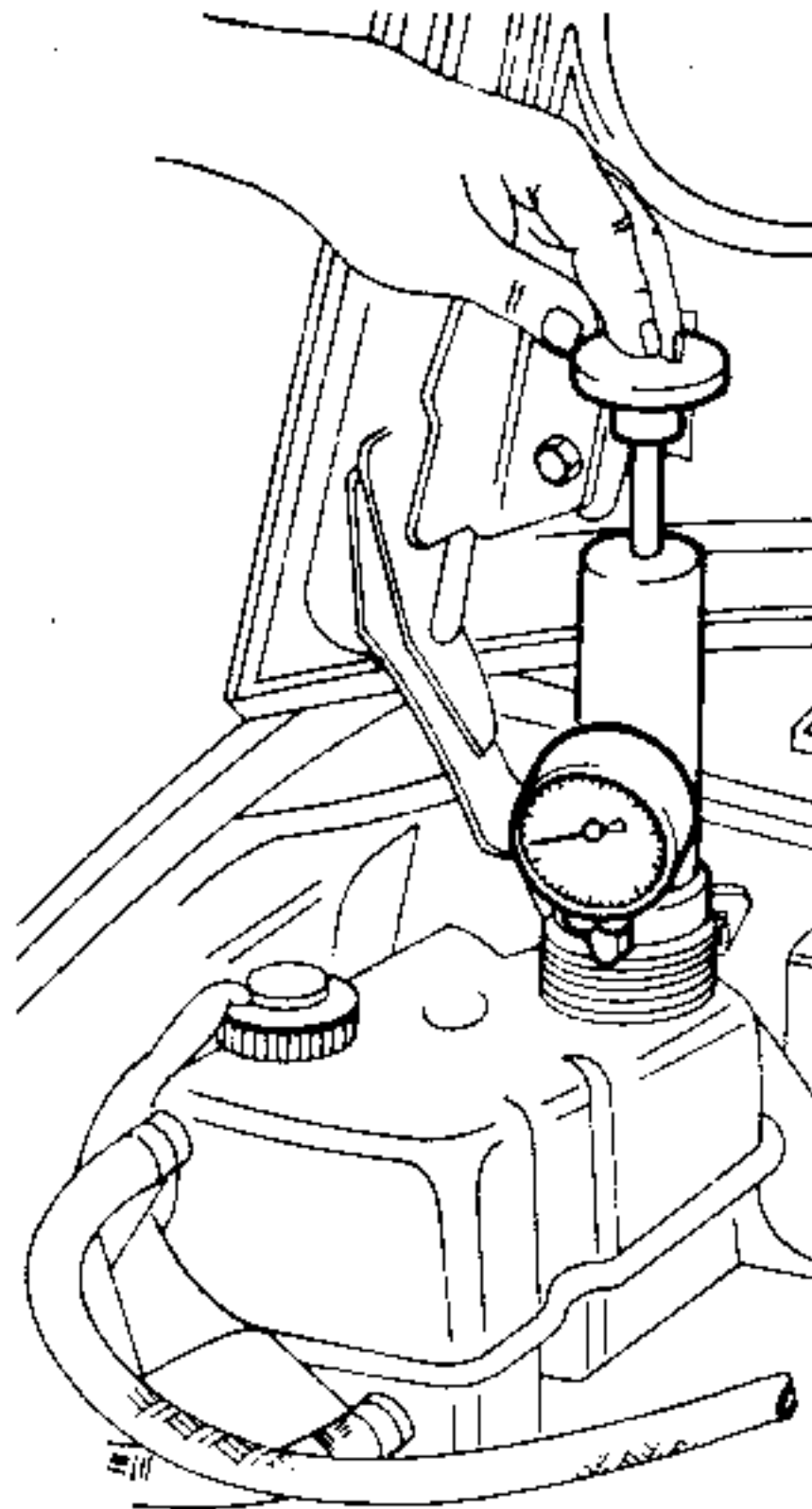
1. Checking

- The standard spark plugs fitted are of the surface discharge type with four points and a central electrode. No adjustment of the distance between the electrodes is required by this type of spark plug.





- 1. Testing instrument
- 2. Coupling
- 3. Cap



To increase the antifreeze protection from -30° to -45°C without draining the whole system, replace 2 litres of the mixture with as many litres of the specified concentrated antifreeze.

CAUTION:

Products harmful to paintwork.
Avoid contact with painted surfaces.

Refilling must be carried out through the filler tank inlet, being careful to observe the following:

- a. The heater control knob must be set to the "fully open position".
- b. Fill the system until the level reaches the maximum mark of the header tank.
- c. Start the engine and run it to normal running temperature so that the opening of the thermostat frees the residual air in the system.
- d. With the engine cold, top up the level to the maximum mark of the header tank.
- e. Refit the filler cap.

4. System refill

Having previously drained the system, refill it with the following type and quantity of coolant:

Min. External temperature	$^{\circ}\text{C}$	-30°	-45°
Concentrated antifreeze Std No. 3681-69956	l	1.2	2.65
Distilled water for dilution	l	6.8	5.35
Ready to use antifreeze Std No. 3681-69958	l	8	8

3. Tightness test of cooling system

- a. Unscrew the pressurised cap of the header tank.
- b. Attach the hydraulic system tester to the header tank filler inlet.
- c. Pressurise the system and from the reading on the instrument, check that the pressure is at the specified value.

Cooling system pressure check

107.9 kPa
(1.08 bar; 1.1 kg/cm²)

ELECTRICAL CHECKS USING THE TROUBLE DIAGNOSIS TESTING INSTRUMENT (MOTRONIC ML4.1 - DOUBLE IGNITION - 4 CYLINDERS)

CAUTION:

IF ONE OF THE FOLLOWING TESTS DOES NOT GIVE A POSITIVE RESULT, IDENTIFY THE CAUSE OF THIS BY CARRYING OUT THE FAULT FINDING PROCEDURE.

PRELIMINARY OPERATIONS

- Switch off the ignition.
- Disconnect the negative terminal of the battery.
- Disconnect the multiple connector from the Motronic electronic control unit.

NOTE:

With a voltmeter, check that there is no tension on pin 8 of the wiring side multiple connector (otherwise see test 13.7).

- Connect the wiring side multiple connector to the appropriate connector on the interface **C10136**.
DO NOT CONNECT THE ELECTRONIC CONTROL UNIT
- Select the ML4.1 motorization by pressing button No. 4 on the interface **C10136**.
- Connect the interface to the universal trouble diagnosis instrument **C10132** using the lead **C90032**.
- Reconnect the negative terminal of the battery.
- Disconnect the fuel pump relay.

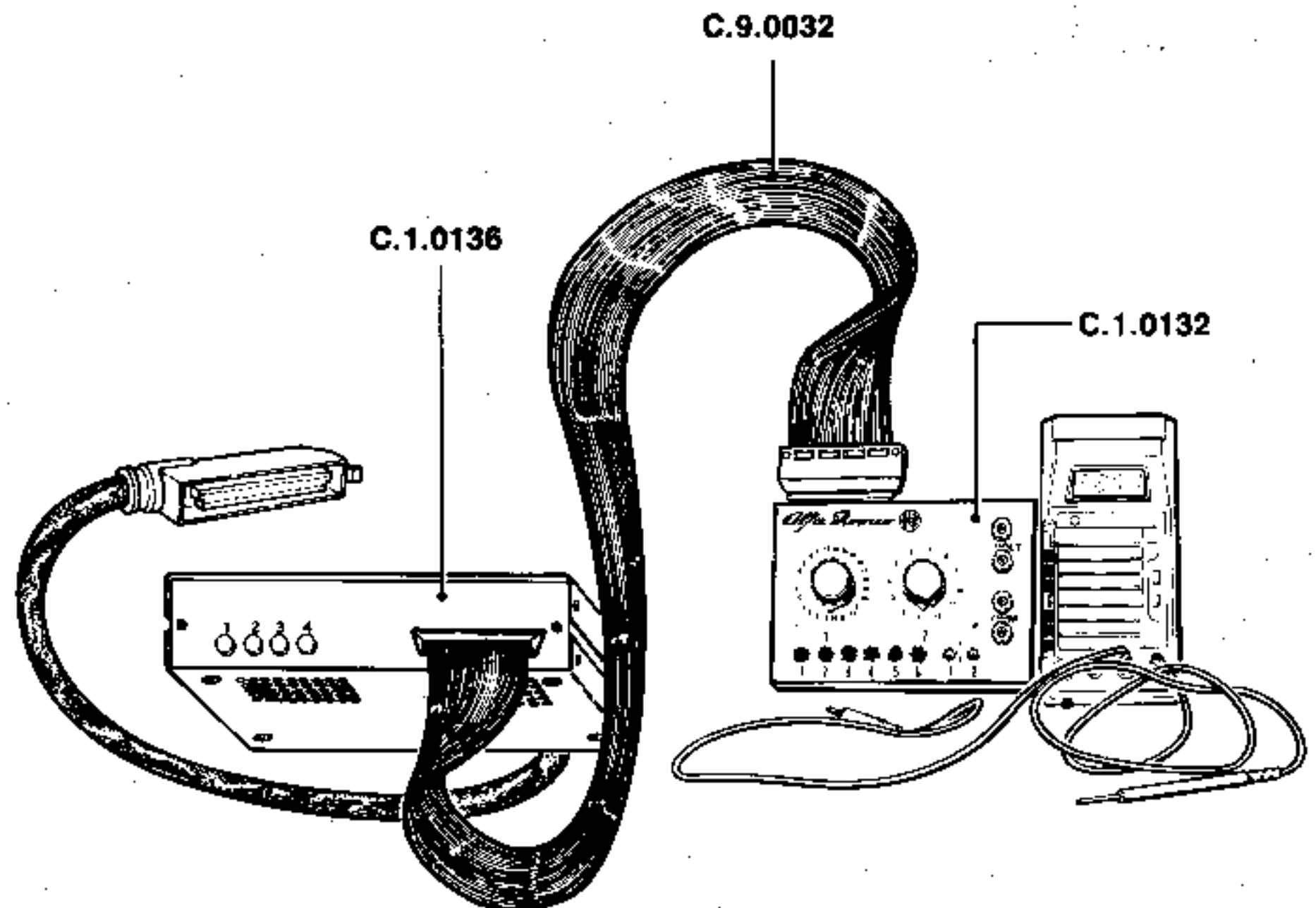
SETTING FOR OHM READINGS

- Set the selectors (1) and (2) to position 1.
- Set the switch (1) to position 2.
- Set the switch (2) to position 1.
- Place the test prods of a multimeter in the appropriate «OHM» sockets of the trouble diagnosis instrument.
- Ignition switched off.

TEST No. 1

CHECK ACCELERATOR BUTTERFLY MINIMUM OPENING MICRO-SWITCH - PIN 2 WIRING SIDE

- Ignition switched off.



- Selector (2) in position 1.
- Multimeter 200 Ohm F.S.
- Read a value of less than 10 Ohm on multimeter.
- Press the accelerator pedal lightly and read an infinite resistance on the multimeter.

TEST No. 2

CHECK ACCELERATOR BUTTERFLY OPENING MICRO-SWITCH -

PIN 3 WIRING SIDE

- Ignition switched off.
- Selector (2) in position 2.
- Multimeter 200 Ohm F.S.
- Read an infinite resistance on the multimeter.
- Press the accelerator pedal lightly and read a value of less than 10 Ohm on the multimeter.
(The change of state occurs when the butterfly is open at an angle of approximately 60°)

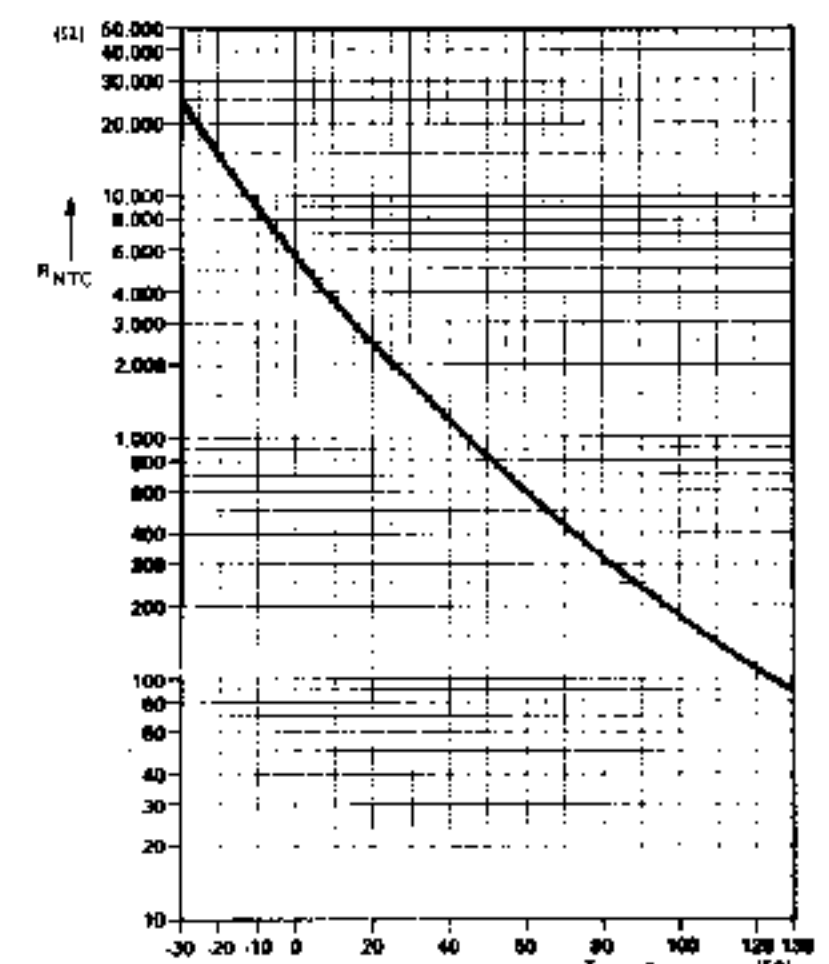
TEST No. 3

ENGINE TEMPERATURE SENSOR TEST - PIN 13 WIRING SIDE

- Ignition switched off.
- Selector (2) in position 3.
- Multimeter 20 kOhm F.S.

- Read a value on the multimeter as a function of the temperature.

- 10°C = 9 kOhm
- 0°C = 6 kOhm
- + 10°C = 3,8 kOhm
- + 15°C = 3 kOhm
- + 20°C = 2,5 kOhm
- + 25°C = 2,1 kOhm
- + 30°C = 1,7 kOhm
- + 40°C = 1,2 kOhm
- + 60°C = 600 Ohm
- + 80°C = 330 Ohm



TEST No. 4

AIR TEMPERATURE TEST - PIN 22 WIRING SIDE (PIN 6 TO GROUND BY MEANS OF C10136)

- Ignition switched off.
- Selector (2) in position 4.
- Multimeter 20 kOhm F.S.
- Read an infinite resistance on the multimeter.
- Press the button (3) and read a value on the multimeter as a function of the temperature (see graph test No. 3).

-
- Disconnect the terminal from the battery.
 - Insert the interface connector in the electronic control unit connector.
 - Reconnect the negative terminal of the battery.
-

TEST No. 5

GROUND CHECK FOR SCREENED CABLES - PIN 23 ELECTRONIC CONTROL UNIT

- Ignition switched off.
- Selector (2) in position 5.
- Multimeter 200 Ohm F.S.
- Read a value of less than 10 Ohm on the multimeter.

TEST No. 6

SETTING FOR DIFFERENT MOTORIZATIONS - PIN 11 WIRING SIDE (LONGITUDINAL ENGINE)

- Ignition key in MARCIA (running) position.
- Selector (2) in position 9.
- Multimeter 200 Ohm F.S.
- Read an infinite resistance value on the multimeter.

SETTING FOR VOLT READING

- Set selectors (1) and (2) to position 1.
- Set the switch (1) to position 2.
- Set the switch (2) to position 1.
- Measure the battery tension directly from the terminals of the battery itself with the ignition key in the MARCIA (running) position, note down the value.
- Switch the ignition off.
- Place the test prods of the multimeter in the appropriate «VOLT» socket of the trouble diagnosis instrument.

TEST No. 7

CHECK +12 V DIRECT - PIN 18 ELECTRONIC CONTROL UNIT MULTIPLE CONNECTOR

- Ignition switched off.

- Multimeter 20 V F.S.
- Selector (1) in position 1.
- Read a value equal to the battery tension previously noted down ± 50 mV.

TEST No. 8

CHECK +12 V FROM IGNITION SWITCH - PIN 35 ELECTRONIC CONTROL UNIT

- Multimeter 20 V F.S.
- Selector (1) in position 2.
- With ignition switched off read a value of 0 V. With the ignition key in the MARCIA (running) position read a value equal to the battery tension previously noted down ± 50 mV.

Turn ignition key to the MARCIA (running) position

TEST No. 9

CHECK GROUND - PIN 16 ELECTRONIC CONTROL UNIT

- Ignition key in MARCIA (running) position.
- Multimeter 200 mV F.S.
- Selector (1) in position 3.
- Read a tension of less than 30 mV on the multimeter.

TEST No. 10

CHECK POWER SUPPLY TO AIR FLOW GAUGE - PIN 9 ELECTRONIC CONTROL UNIT

- Ignition key in MARCIA (running) position.
- Multimeter 20 V F.S.
- Selector (1) in position 6.
- Read a tension value of between 4.5 V and 5.5 V on the multimeter.

TEST No. 11

CHECK AIR FLOW GAUGE POTENTIOMETER - PIN 7 ELECTRONIC CONTROL UNIT

- Ignition key in MARCIA (running) position.
- Multimeter 20 V F.S.
- Selector (1) in position 7.
- Read a tension value of between 100 mV and 300 mV on the multimeter.
- Operate the air flow gauge butterfly manually and check that the tension increases evenly, without gaps or jumps, to a value equal to or greater than 4.2 V.

TEST No. 12

CHECK POWER SUPPLY TO AND WIRING OF CONSTANT IDLE ACTUATOR

- Ignition key in MARCIA (running) position.
- Multimeter 20 V F.S.
- Selector (1) in position 5.
- Read a tension of between 4 V and 12 V on the multimeter.

- Disconnect the idle actuator connector for a moment and check that the tension falls to approximately 0 V (no tension).

-
- Disconnect the fuel relay (with the ignition key in the MARCIA (running) position the relay can be excited or start to tick).
-

TEST No. 13

TESTS TO BE CARRIED OUT ONLY WITH THE ENGINE NOT RUNNING

NOTE:

Make sure the check on pin 8 has been carried out, as described in the preliminary operation.

TEST No. 13.1

INDUCTIVE SENSOR TEST - PIN 25 ELECTRONIC CONTROL UNIT

- Multimeter 20 V F.S.

Set for alternating current readings

- Selector (1) in position 18.
- Attempt to start engine and read a tension greater than 1.5 V on the multimeter.

Reset multimeter for direct current readings

TEST No. 13.2

CHECK OF INJECTION TIME

- Multimeter 2 V F.S.
- Selector (1) in position 14.
- Switch (1) in position 1.
- Switch (2) in position 1.
- Attempt a prolonged engine starting and read a tension of between 200 mV and 1 V (2÷10 msec) on the multimeter.

TEST No. 13.3

CHECK OF ELECTRIC FUEL INJECTOR CURRENT

- Multimeter 2 V F.S.
- Selector (1) in position 13.
- Switch (2) in position 1.
- Attempt a prolonged engine starting and read a tension of between 200 mV and 300 mV on the multimeter.

TEST No. 13.4

CHECK ACTUATING COIL A - PIN 1 ELECTRONIC CONTROL UNIT

- Multimeter 2 V F.S.
- Selector (1) in position 16.
- Switch (1) in position 2.
- Attempt a prolonged engine starting and read a tension on the multimeter corresponding to the r.p.m. during starting
(e.g.: 20 mV = 200 r.p.m.
30 mV = 300 r.p.m.)

TEST No. 13.5

CHECK ACTUATING COIL B - PIN 19 ELECTRONIC CONTROL UNIT

- Multimeter 2 V F.S.
- Selector (1) in position 16.
- Switch (1) in position 1.
- Attempt a prolonged engine starting and read a tension on the multimeter corresponding to the r.p.m. during starting
(e.g.: 20 mV = 200 r.p.m.
30 mV = 300 r.p.m.)

TEST No. 13.6

CHECK FUEL SYSTEM

- Connect a pressure gauge to the fuel distribution pipe.
- Turn the ignition key to the MARCIA (running) position.
- Press button No. 4 of the trouble diagnosis instrument and check that the fuel pressure reaches a value equal to or greater than 2.8 bar.

NOTE:

It is possible that the pump is already turning.

TEST No. 13.7

CHECK CONNECTION - PIN 8 ELECTRONIC CONTROL UNIT

- Multimeter 20 V F.S.
- Switch the ignition off.
- Disconnect wiring side multiple connector.
- Place the test prods of the multimeter across pin 8 of the multiple connector and ground.
- Read a value of no tension on the multimeter.

TESTS TO BE CARRIED OUT WITH THE ENGINE RUNNING

TEST No. 14

CHECK THE POSITIVE HALF WAVE OF THE INDUCTIVE SENSOR

- Start engine.

- Multimeter 20 F.S.
- Selector (1) in position 11.
- Check that with the engine running on idle the reading on the multimeter is between 250 mV and 2 V.
- Speed up the engine and check that the value read increases.

TEST No. 15

CHECK NEGATIVE HALF WAVE OF THE INDUCTIVE SENSOR

- Start engine.
- Multimeter 20 V F.S.
- Selector (1) in position 12.
- Proceed as for test No. 14 checking that the value read is equal to or greater than the value previously read.

TEST No. 16

CHECK ELECTRIC FUEL INJECTOR CURRENT

- Start engine.
- Multimeter 2 V F.S.
- Selector (1) in position 13.
- Switch (1) in position 1.
- Switch (2) in position 1.
- Operate the accelerator with brief spurts of acceleration, checking that the maximum readings on the multimeter are 350 mV $\pm$ 40 mV (with the engine temperature greater than +50°C).

NOTE:

The reading in millivolts shows the current to the electric fuel injectors

- (e.g.: 200 mV = 2 A
300 mV = 3 A
400 mV = 4 A)

TEST No. 17

CHECK FUEL INJECTION TIME

- Start engine.
- Multimeter 2 V F.S.
- Selector (1) in position 14.
- Switch (1) in position 1.
- Switch (2) in position 1.
- With engine warmed up and running on idle, read a tension of between 150 mV and 250 mV on the multimeter, equivalent to an injection time of 1.5 $\pm$ 2.5 msec.

NOTE:

If the engine is cold or the external temperature is very low, the injection times are longer.

- Check the fuel enrichment during acceleration by effecting short sharp spurts of acceleration and checking

that the reading on the multimeter tends to increase.

- If the engine has reached or almost reached normal running temperature press button No. 5 (cold engine simulation) of the trouble diagnosis instrument and check the fuel enrichment with the engine cold by lengthening the injection times.
- If the external temperature is greater than 10°C, press the button No. 6 (cold air simulation) of the trouble diagnosis instrument and check that a small increase in the injection time occurs.

TEST No. 18

CHECK ACTUATING COIL A (PIN 1) AND COIL B (PIN 19)

- Start engine.
- Multimeter 2 V F.S.
- Selector (1) in position 16.
- Switch (1) in position 2.
- Read a tension corresponding to the engine r.p.m. (TEST COIL A) on the multimeter
(e.g.: 800 r.p.m. = 80 mV
1000 r.p.m. = 100 mV
3000 r.p.m. = 300 mV
4000 r.p.m. = 400 mV
5000 r.p.m. = 500 mV)
- Switch switch (1) in position 1 and check for the above tensions (TEST COIL B).

TEST No. 19

CHECK IGNITION ADVANCE

- Start the engine.
- Multimeter 2 V F.S.
- Selector (1) in position 17.
- Switch (1) in position 2.
- With the engine running at normal running temperature and on idle, read a tension of between 70 mV and 130 mV corresponding to an ignition advance of 7 $\div$ 13 degrees.
- Speed the engine up to 2000 r.p.m. and check that the ignition advance increase.

TEST No. 20

CHECK FUNCTIONING OF THE CONSTANT IDLE ACTUATOR

- With the engine running on idle, disconnect the actuator for a moment and check that the engine r.p.m. increases.
- Reconnect the connector and check the idle r.p.m. again.

TEST No. 21

CHECK THE FUNCTIONING OF THE ELECTRONIC CONTROL UNIT

- With the engine running at between 1000 and 1500 r.p.m. press button

No. 2 (full load) and check for the action of the timing variator (a momentary fall in the r.p.m. should be noticed).

- With the engine running at 3000 r.p.m. press the button No. 1 (accelerator butterfly closed) and check for a cut in the fuel delivery which will result in a fall in the r.p.m. followed by increases and reduction (hunting).

TEST No. 22

CHECK THE CONNECTIONS TO THE AIR CONDITIONER (IF FITTED) - PIN 29 AND 32 ELECTRONIC CONTROL UNIT

- Multimeter 20 V F.S.
- Selector (1) in position 9.
- Start engine.
- Make sure that the heating and ventilation systems are switched off.
- Read 0 V on the multimeter.
- Switch the heating and ventilation systems on but without activating the air conditioning compressor (fan in position 1 and temperature regulation on minimum).
- Read +12 V on the multimeter.

NOTE:

The engine r.p.m. may increase but NOT diminish.

- Selector (1) in position 10.
- With the compressor switched on read +12 V on the multimeter.
- With the compressor switched off read 0 V on the multimeter.
- Check that the engine r.p.m. does not fall below the minimum value.

TEST No. 23

CHECK THE SETTINGS FOR THE VARIOUS MARKETS

NOTE:

The setting is carried out by means of the connection, using the appropriate connector (S30), of a device in the form of a relay with a casing of a different colour.

- Place the test prods of the multimeter in the «OHM» sockets of the trouble diagnosis instrument.
- Multimeter 200 Ohm F.S.
- Disconnect the negative terminal of the battery.
- Disconnect the multiple connector of the interface C.1.0136 from the electronic control unit.

- Reconnect the terminal of the battery.
- Ignition switched off.
- With the selector (2) at the positions 7 and 8, read the values given below, on the multimeter, as a function of the setting for the market in question.

Selector position (2)	NON-POLLUTING VERSION WITH UNLEADED PETROL	
	95 OCTANE	91 OCTANE
7	Infinite resistance	Resistance less than 10 Ohm
8	Resistance less than 10 Ohm	Resistance less than 10 Ohm
	Bright yellow coloured device inserted in connector S30	Sky-blue coloured device inserted in connector S30

- Reconnect the multiple connector of the interface C.1.0136 to the electronic control unit.

- Start the engine.
- Place the test prods of the multimeter directly on the pins of the Lambda sensor preheating resistance.
- Read +12 V on the multimeter.
- With the resistance disconnected, check also for a resistance value (multimeter 200 Ohm F.S.) of between 3 Ohm and 20 Ohm on the pins of the resistance itself.

TEST No. 24

CHECK LAMBDA SENSOR

- Place the test prods of the multimeter in the «VOLT» sockets of the trouble diagnosis instrument.
- Multimeter 2 V F.S.
- Selector (1) in position 22.
- Start the engine and check that, with regard to the r.p.m. range, the reading on the multimeter falls between 100 mV and 1 V approximately.

TEST No. 25

CHECK FUEL VAPOUR CONTROL SOLENOID VALVE ACTUATOR

- Multimeter 20 V F.S.
- Place the test prods of the multimeter directly on the pins of the solenoid valve.
- Start the engine.
- Accelerate the engine with short sharp bursts and check the momentaneous reading of +12 V (with each acceleration).

TEST No. 26

CHECK THE POWER SUPPLY TO THE LAMBDA SENSOR PREHEATING RESISTANCE

- Multimeter 20 V F.S.

TROUBLE DIAGNOSIS

(MOTRONIC ML4.1 SYSTEM - DOUBLE IGNITION - 4 CYLINDERS)

NOTE:

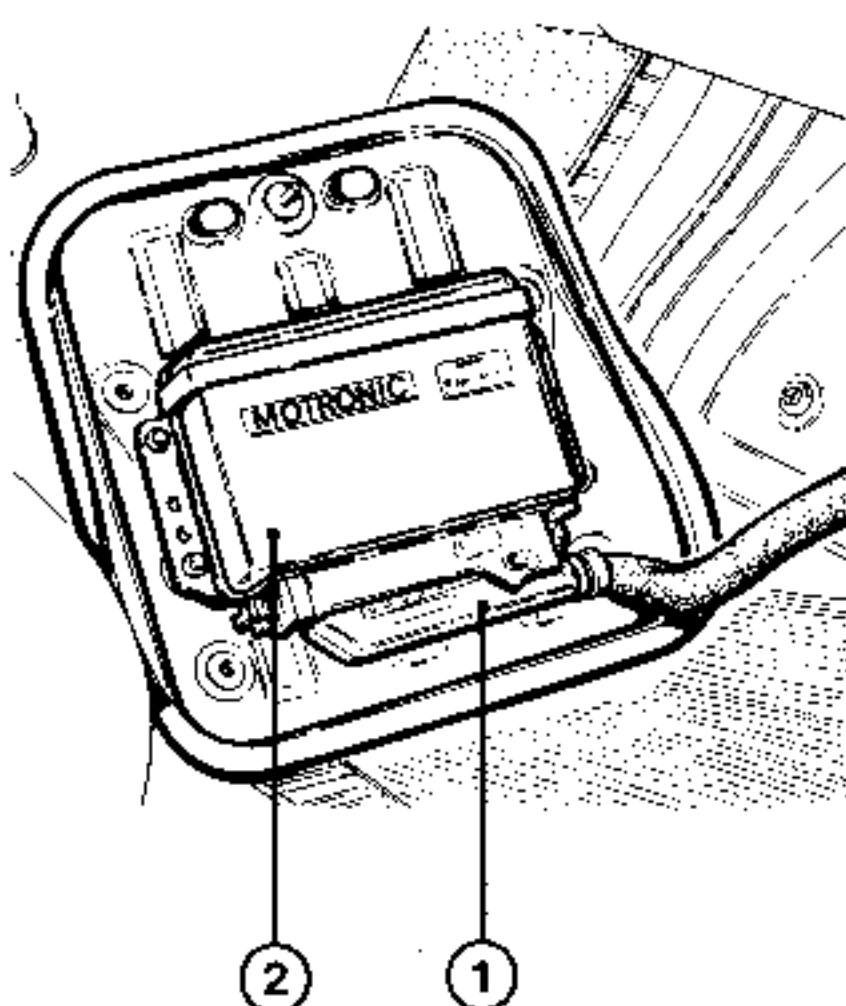
For the correct use of this trouble diagnosis procedure, it is assumed that the vehicle is in working order, that the engine is in good operating condition (valves, clearances, cylinders, etc.) and that the ignition is working efficiently (spark plugs, distributore, coils).

PRELIMINARY OPERATIONS

1. Switch the ignition off.
2. Disconnect the negative terminal of the battery.
3. Disconnect the multiple connector (1) from the Motronic electronic control unit (2) (located under the floor on the right side of the passenger compartment).

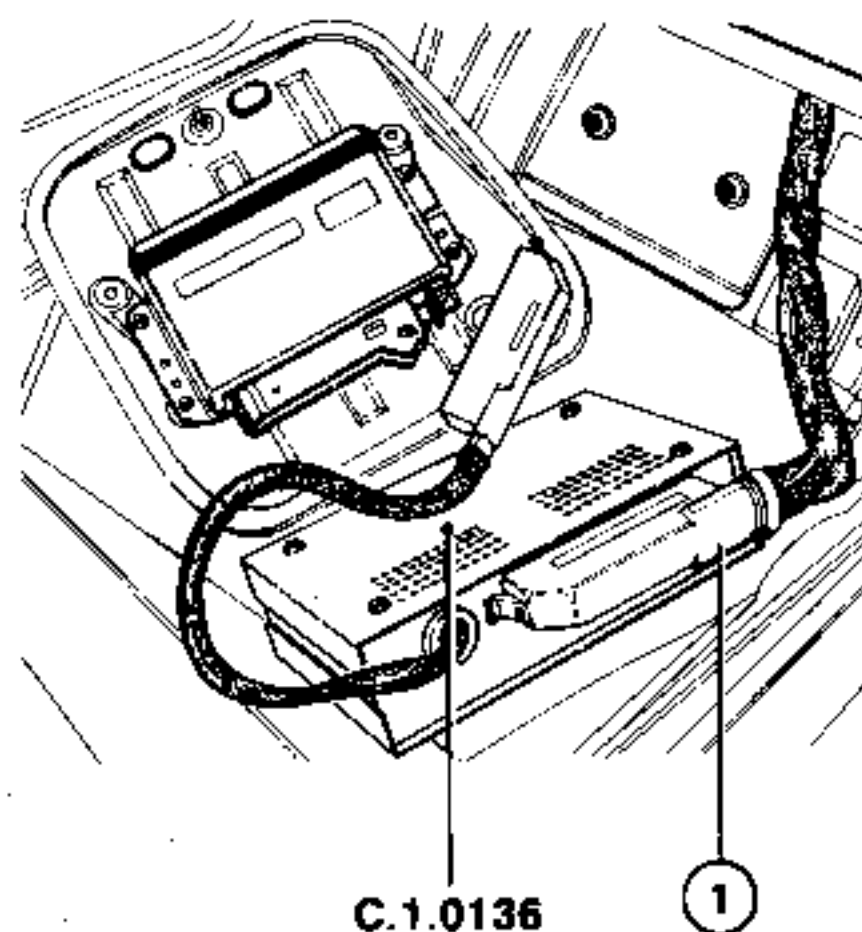
NOTE:

With a voltmeter, check that there is no tension on pin 8 of the wiring side multiple conductor (otherwise see test 13.7).



1. Electronic control unit multiple conductor
2. Motronic electronic control unit

4. Connect the multiple connector (1) (wiring side) to the relative connector on the interface C.1.0136. **DO NOT CONNECT THE ELECTRONIC CONTROL UNIT.**

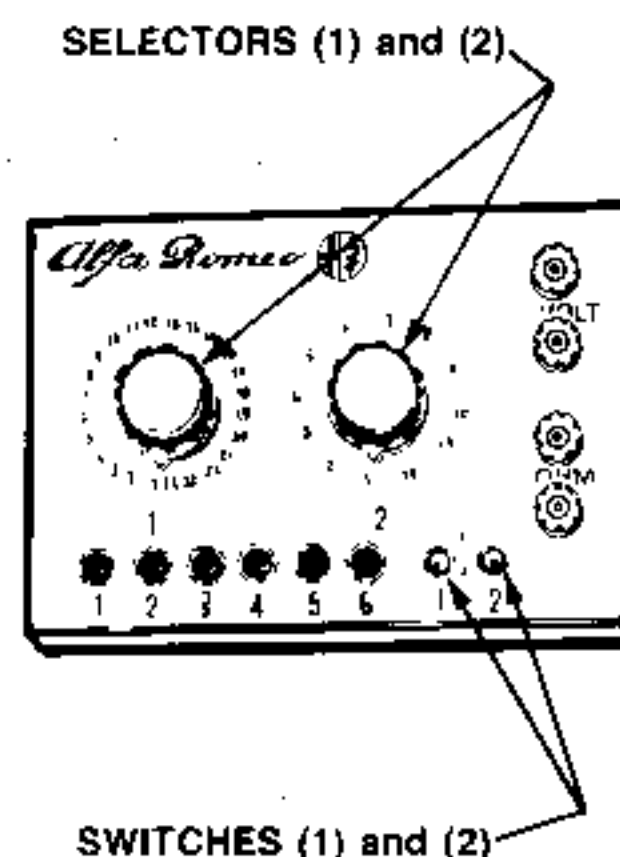


1. Motronic electronic control unit multiple connector

5. Select the ML4.1 motorization by pressing button No. 4 on the interface unit C.1.0136.
6. Connect the interface unit C.1.0136 to the trouble diagnosis instrument C.1.0132 using the lead C.9.0032.
7. Reconnect the negative terminal of the battery.
8. Disconnect the fuel pump relay.

SETTING FOR OHM READINGS

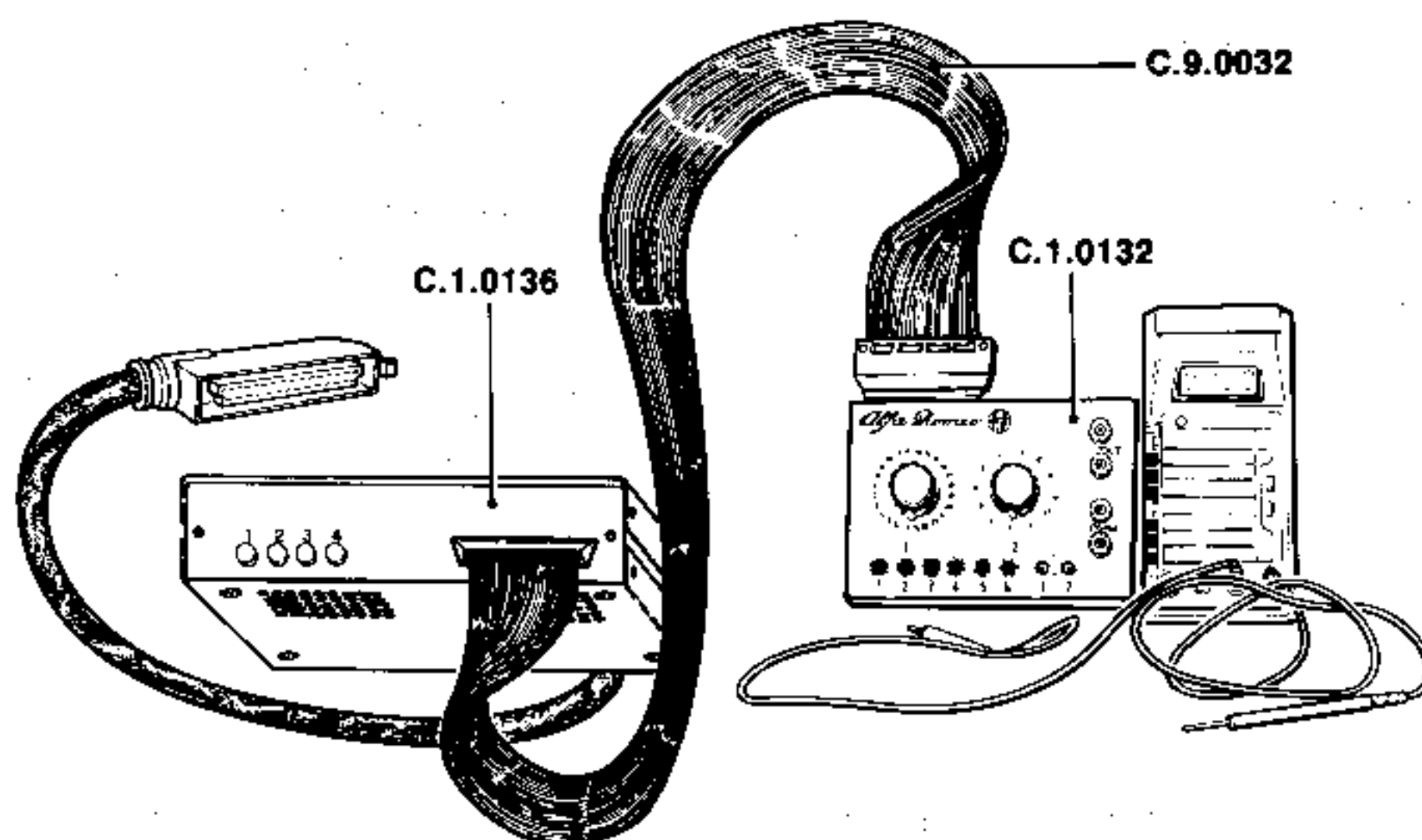
1. Set the selectors (1) and (2) to position 1.
2. Set the switch (1) to position 2.
3. Set the switch (2) to position 1.



4. Place the test prods of a multimeter in the appropriate «OHM» sockets of the trouble diagnosis instrument.

NOTE:

Should none of the tests give positive results, check that there is tension on the wiring side multiple conductor (pin 5 ground and pin 18 = +12 V) even with the ignition switched off.

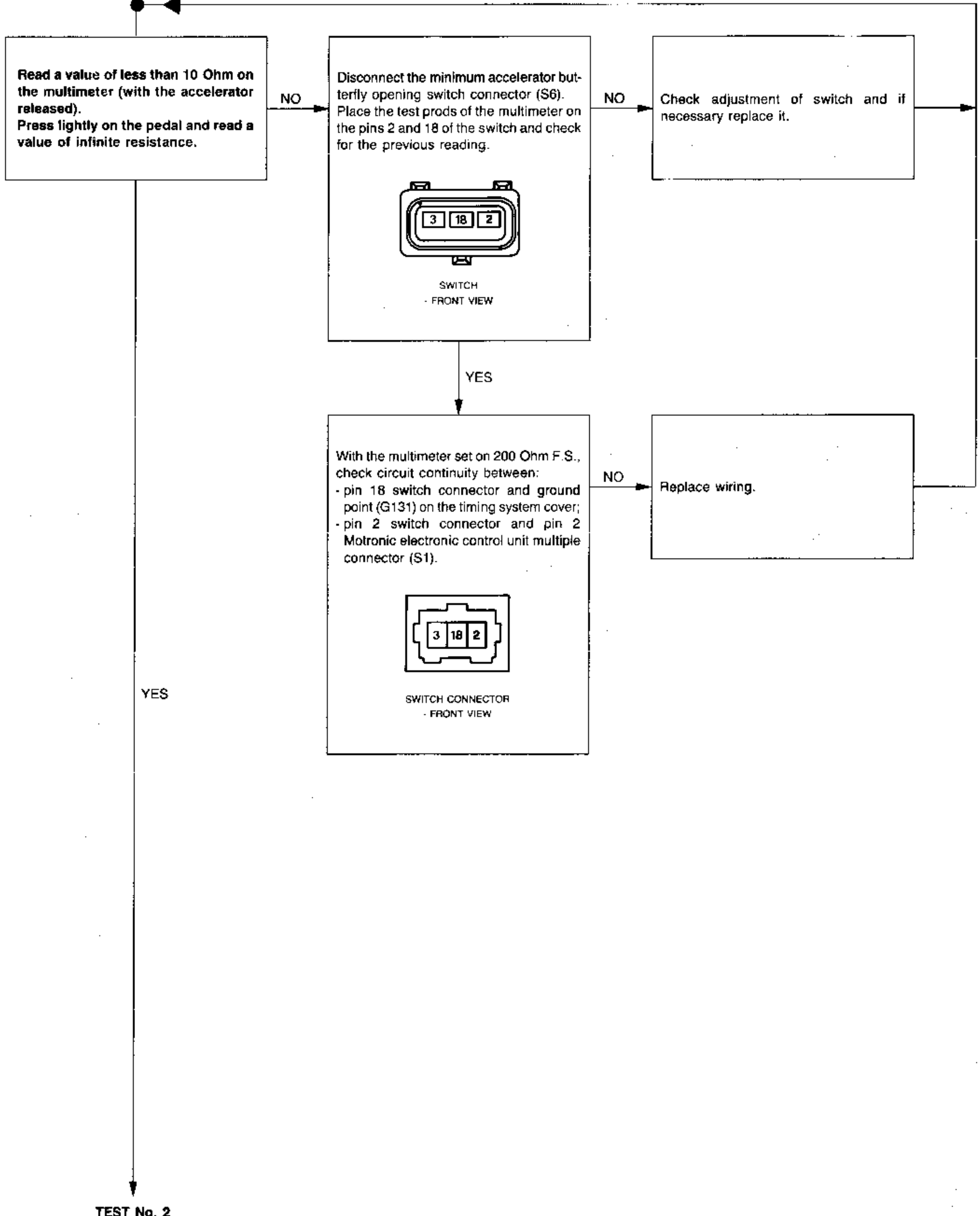


TEST No. 1 — ACCELERATOR BUTTERFLY MINIMUM OPENING MICRO-SWITCH

- Ignition switched off.
- Selector (2) in position 1.
- Set the multimeter for 200 Ohm F.S.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.

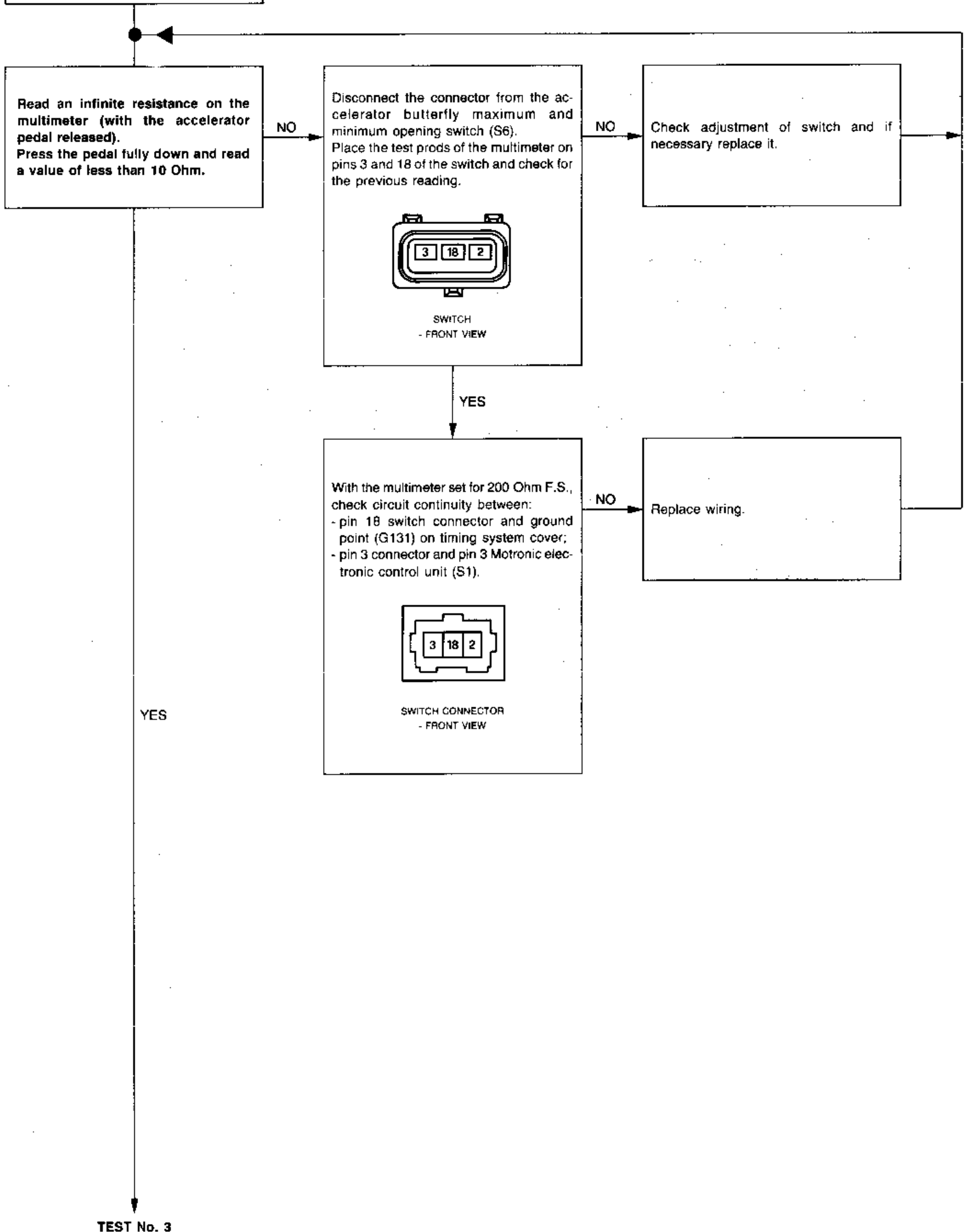


TEST No. 2 — CHECK ACCELERATOR BUTTERFLY MAXIMUM OPENING MICRO-SWITCH

- Ignition switched off.
- Selector (2) in position 2.
- Set the multimeter for 200 Ohm F.S.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.

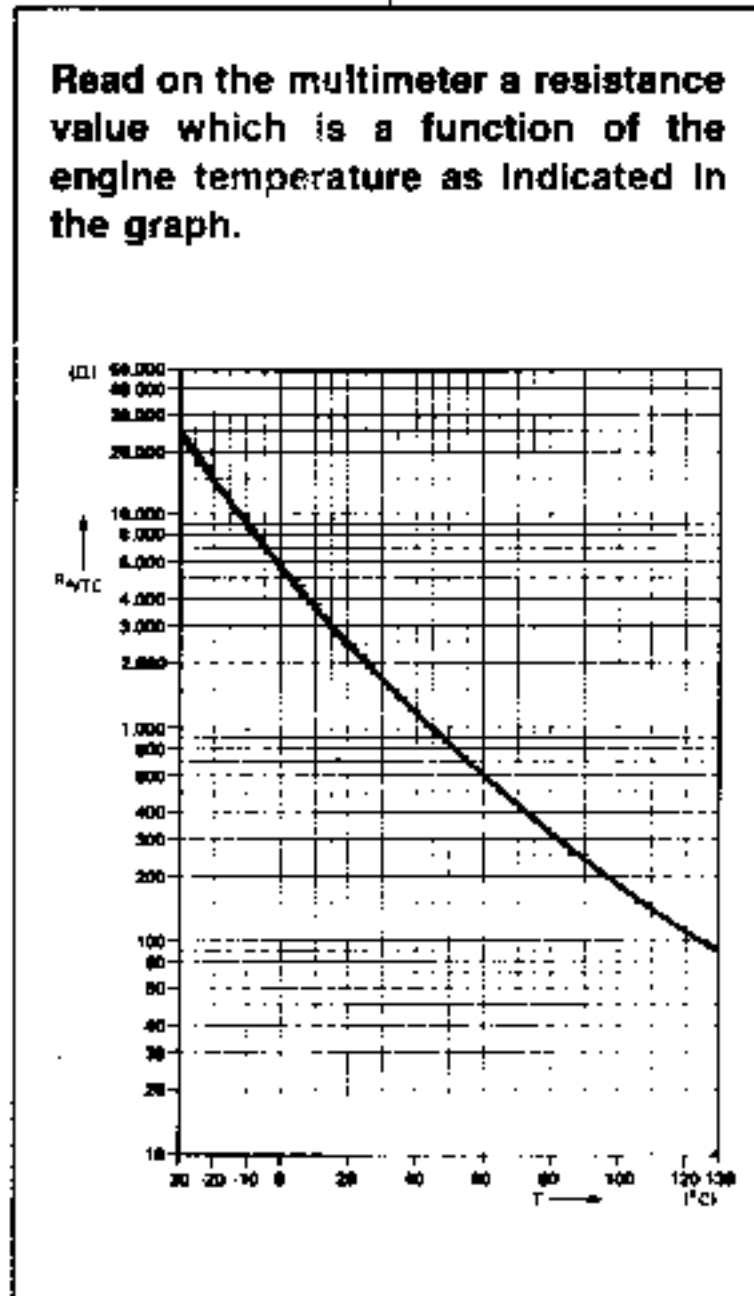


TEST No. 3 — TEST ENGINE TEMPERATURE SENSOR

- Ignition switched off.
- Selector (2) in position 3.
- Set multimeter for 20 kOhm F.S.

NOTE:

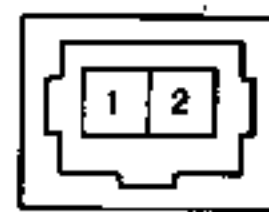
The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.



NO

Check the wiring continuity between:

- pin 13 Motronic electronic control unit multiple connector (S1) and pin 1 engine temperature sensor connector (S7);
- pin 2 sensor and grounds (G131) on timing system cover.



SENSOR CONNECTOR
- FRONT VIEW

NO

Replace wiring.

YES

Replace engine temperature sensor.

YES

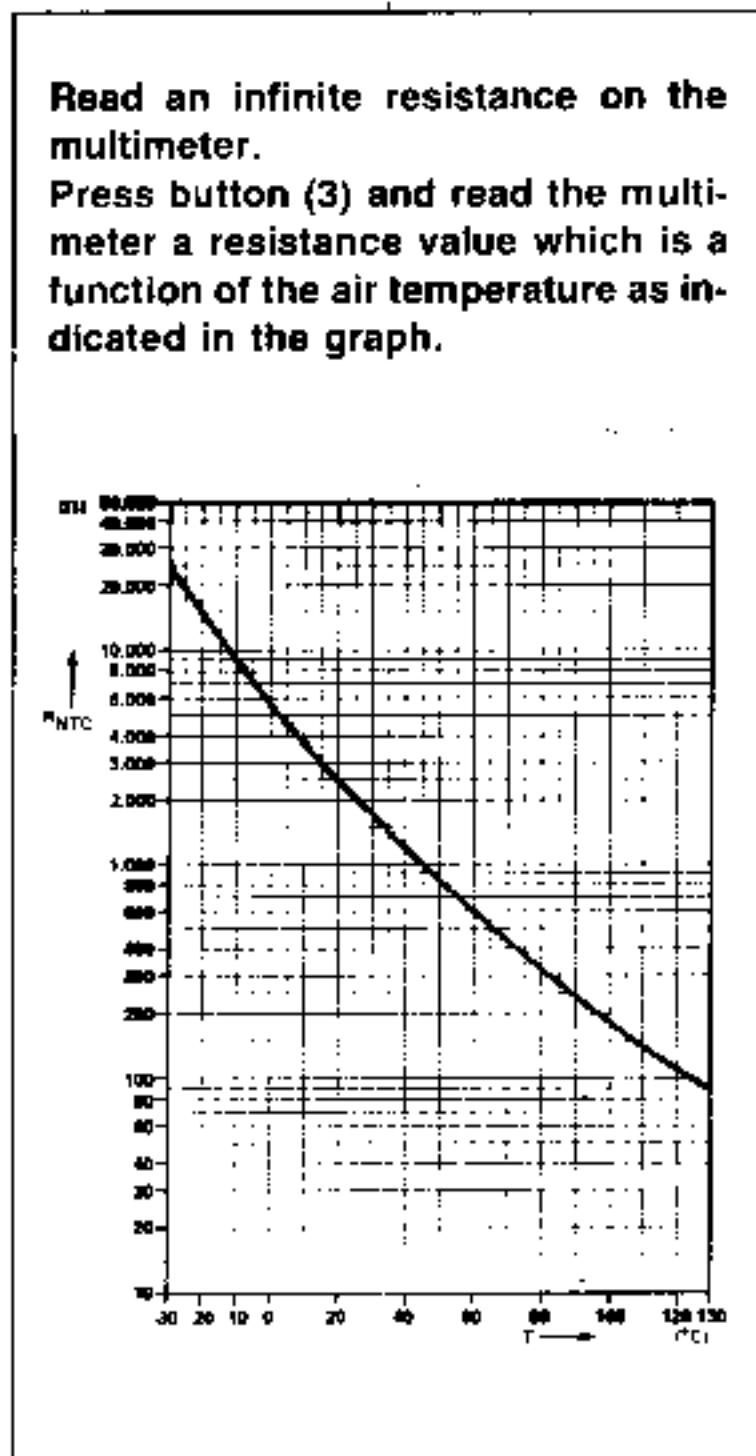
TEST No. 4

TEST No. 4 — TEST AIR TEMPERATURE SENSOR

- Ignition switched off.
- Selector (2) in position 4.
- Set multimeter for 20 kOhm F.S.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.



NO

Check the resistance of the air flow gauge (S5) between pin 5 and 4 (the value is a function of the air temperature as indicated in graph of the preceding point).

NO

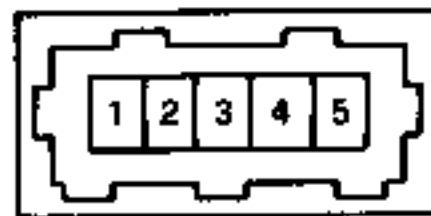
Replace air flow gauge.

YES

Check the wiring continuity between:
- pin 4 air flow gauge connector (S5) and pin 6 Motronic electronic control unit multiple connector (S1);
- pin 5 air flow gauge connector and pin 22 Motronic electronic control unit multiple connector.

NO

Replace wiring.



AIR FLOW GAUGE CONNECTOR
- FRONT VIEW

YES

Replace air flow gauge.

YES

- DISCONNECT NEGATIVE TERMINAL OF THE BATTERY.
- INSERT THE CONNECTOR OF THE INTERFACE UNIT IN THE CONNECTOR OF THE MOTRONIC ELECTRONIC CONTROL UNIT.
- RECONNECT THE NEGATIVE TERMINAL OF THE BATTERY.

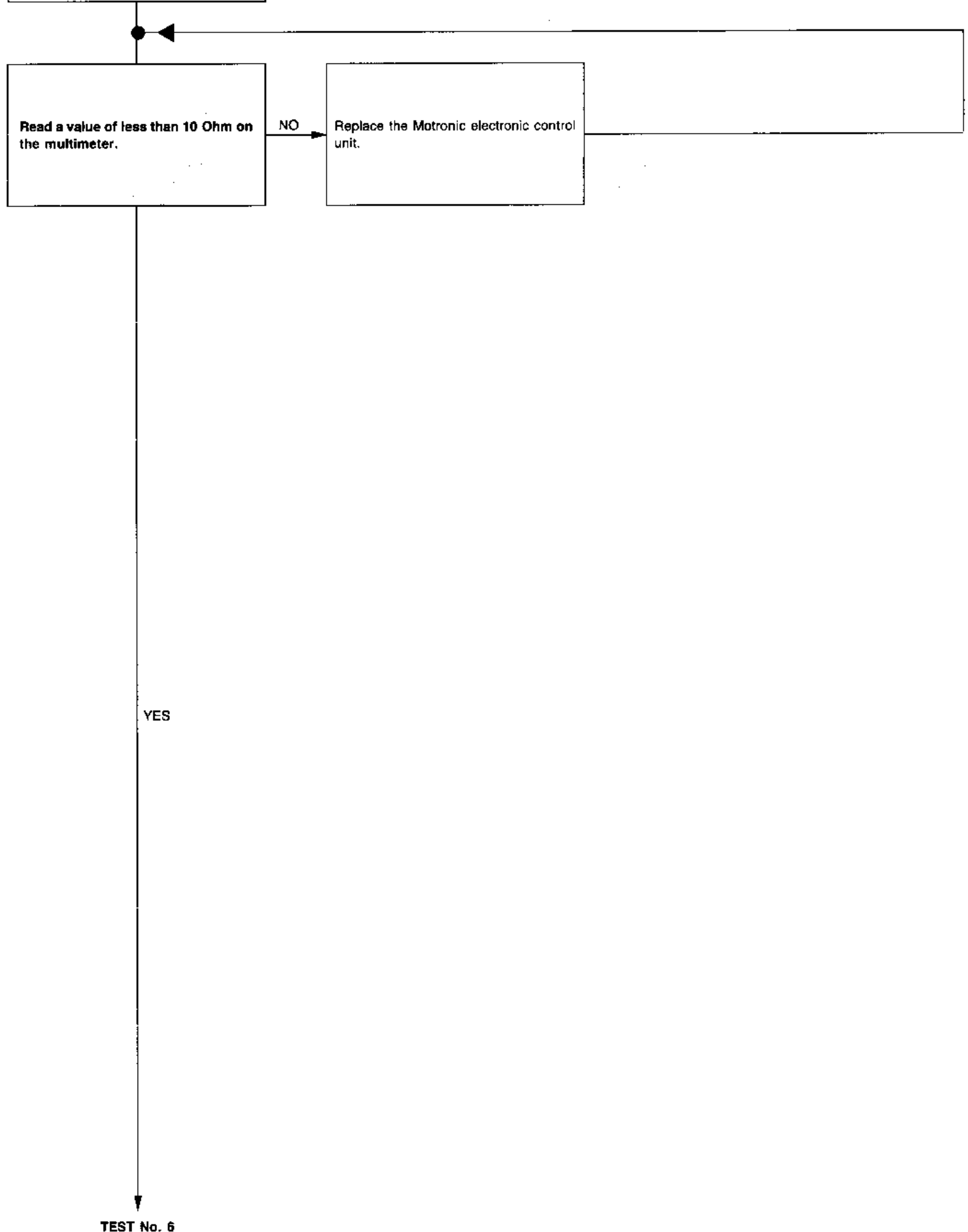
TEST No. 5

TEST No. 5 — CHECK GROUND FOR SCREENED CABLES

- Ignition switched off.
- Selector (2) in position 5.
- Set multimeter for 200 Ohm F.S.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.



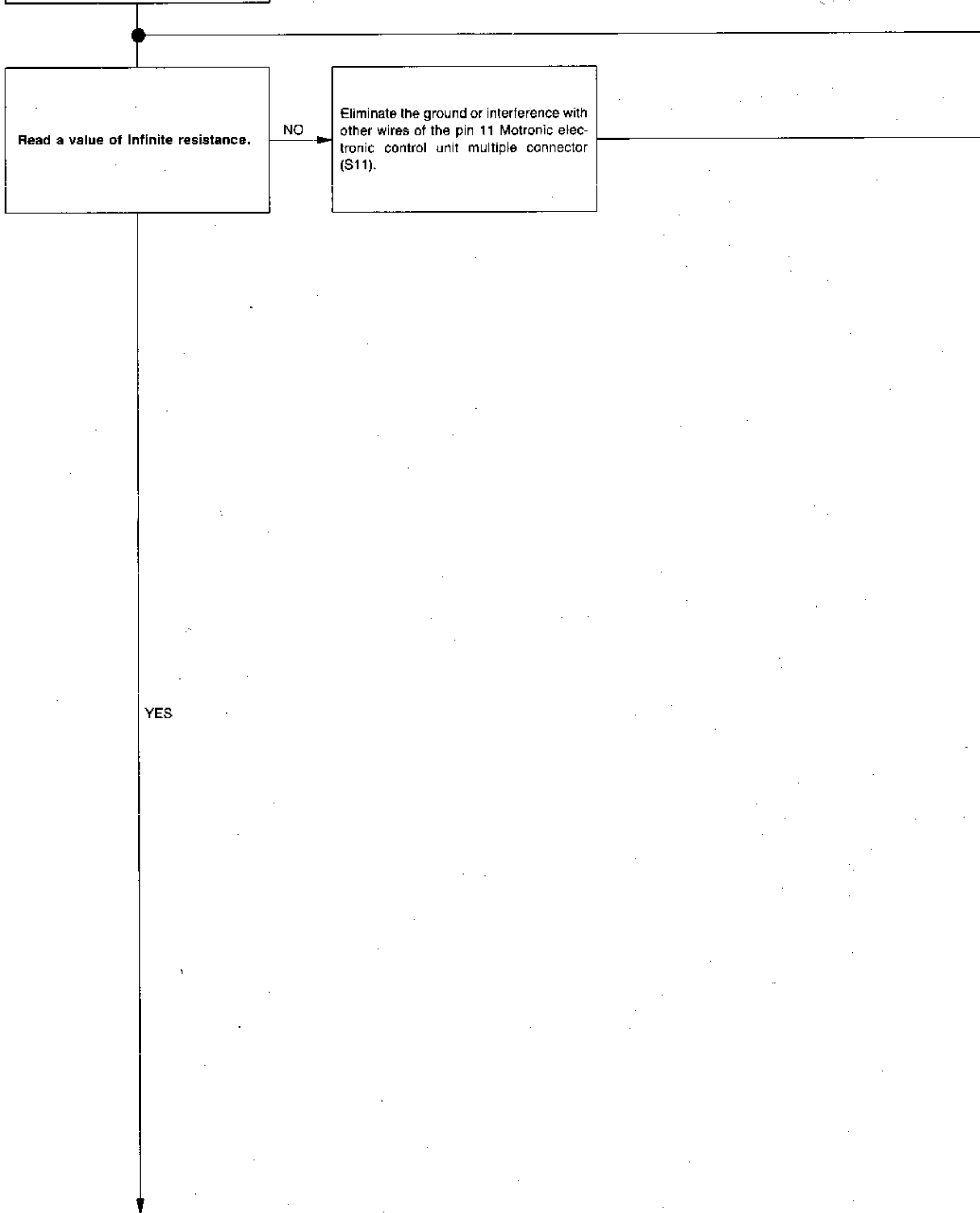
TEST No. 6

TEST No. 6 — SETTING FOR DIFFERENT MOTORIZATIONS (LONGITUDINAL ENGINE)

- Ignition key in MARCIA (running) position.
- Selector (2) in position 9.
- Set multimeter for 200 Ohm F.S.

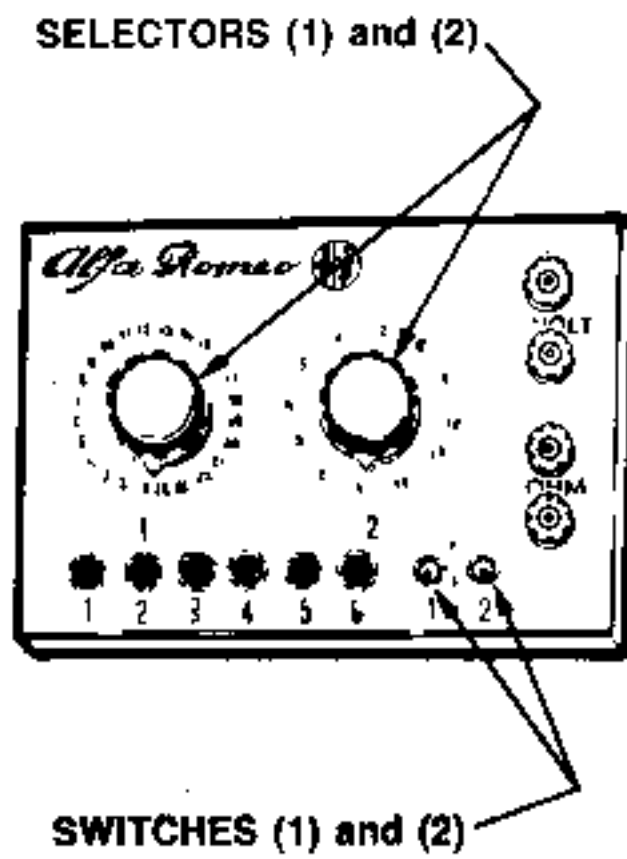
NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.



SETTING FOR VOLT READINGS

1. Set the selectors (1) and (2) in position 1.
2. Set the switch (1) in position 2.
3. Set the switch (2) in position 1.



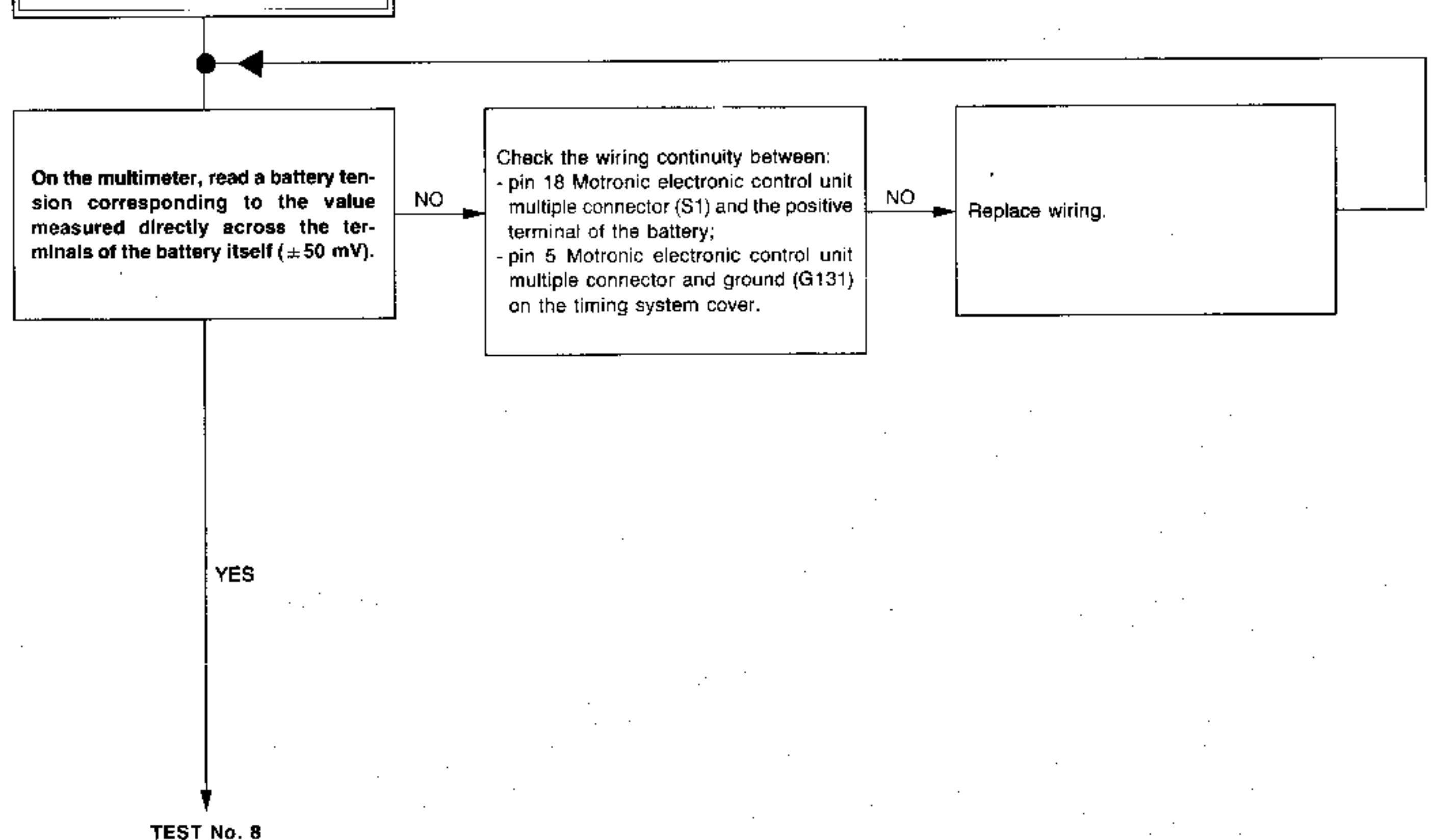
4. Measure the battery tension directly across the terminals of the battery itself with the ignition key in the MARCIA (running) position and note down the value.
5. Switch the ignition off.
6. Place the test prods of a multimeter in the «VOLT» sockets of the trouble diagnosis instrument.

TEST No. 7 — CHECK +12 V DIRECT TO THE MOTRONIC ELECTRONIC CONTROL UNIT

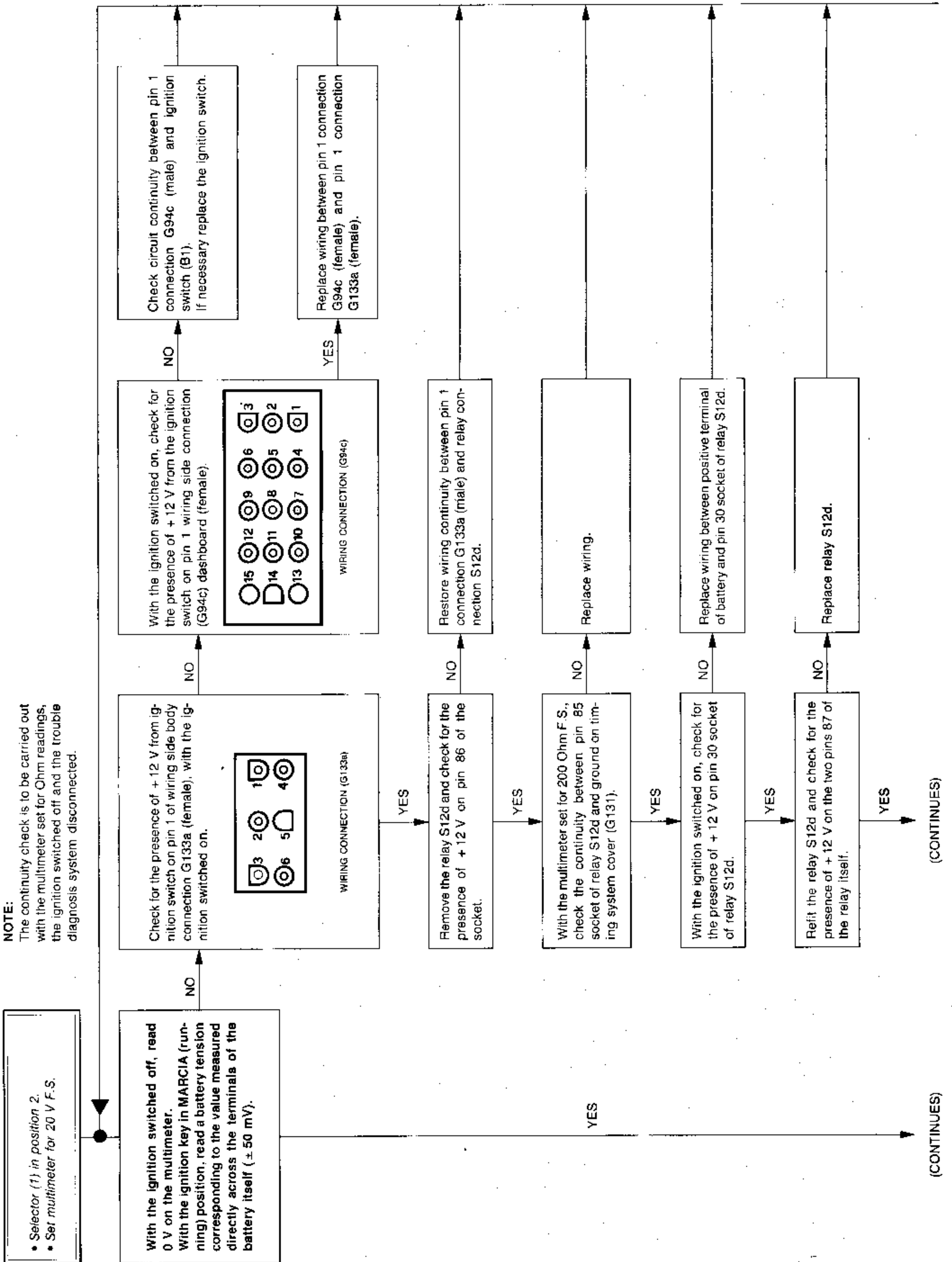
- Ignition switched off.
- Set multimeter for 20 V F.S.
- Selector (1) in position 1.

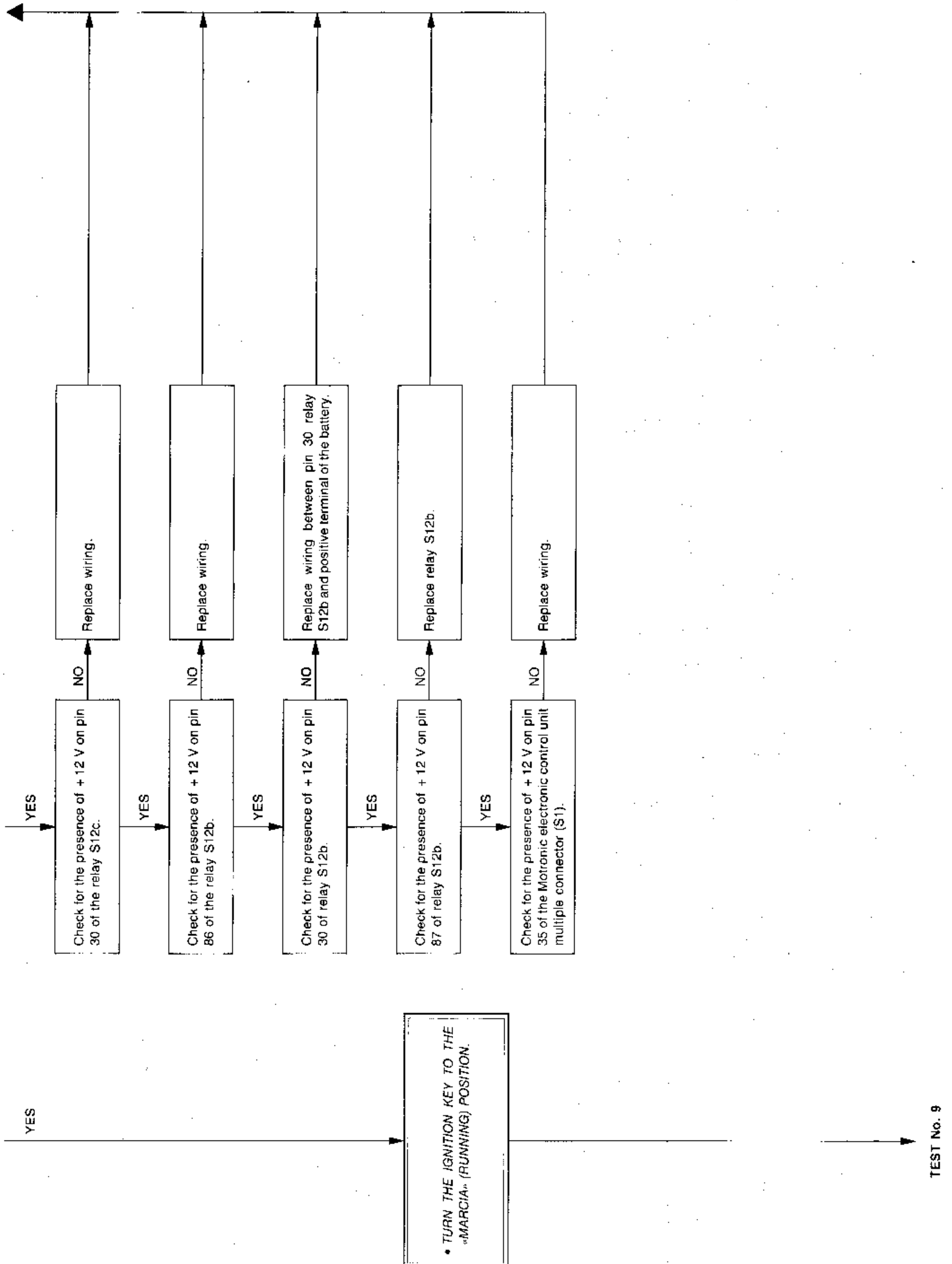
NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.

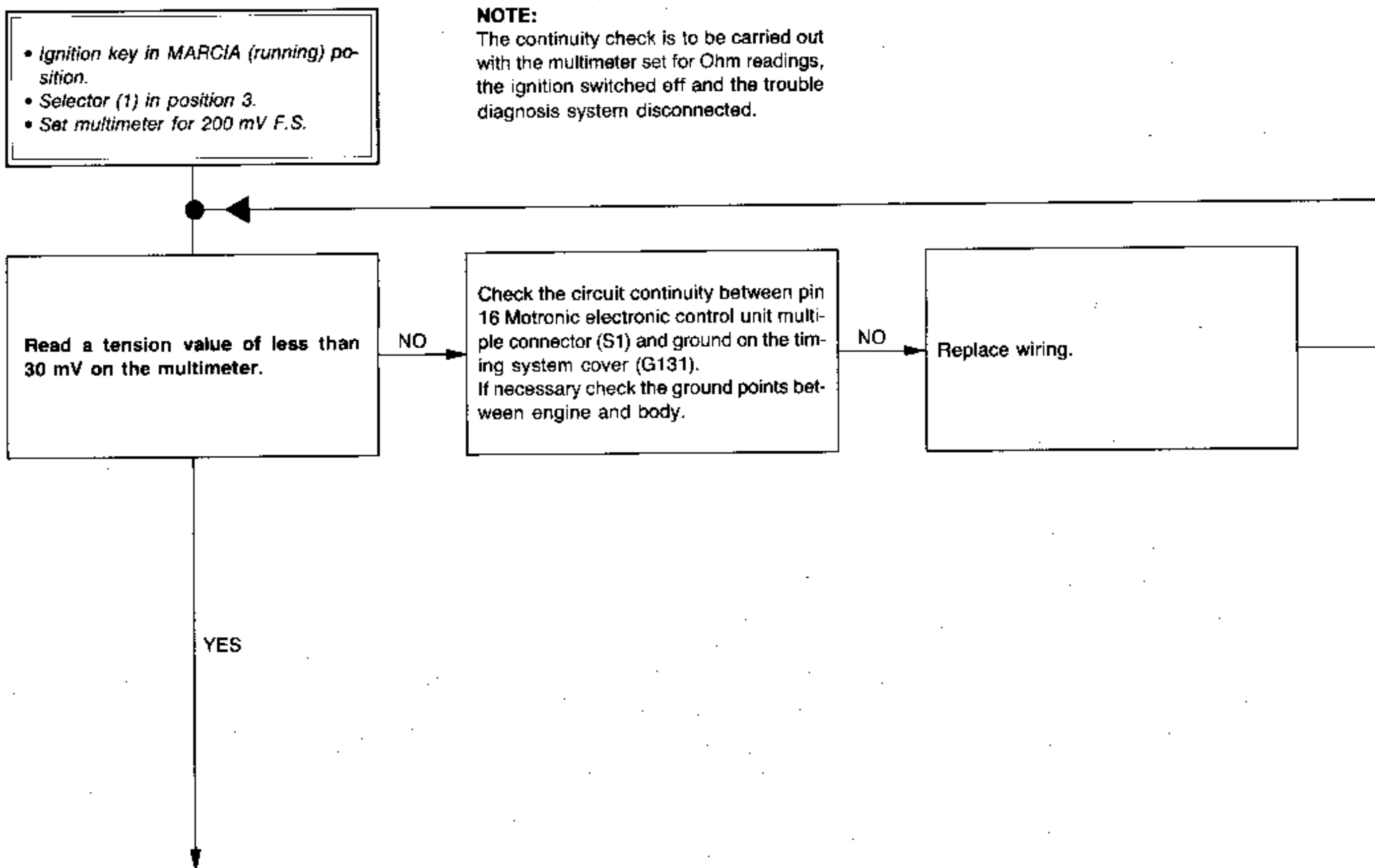


TEST No. 8 — CHECK +12 V FROM IGNITION SWITCH

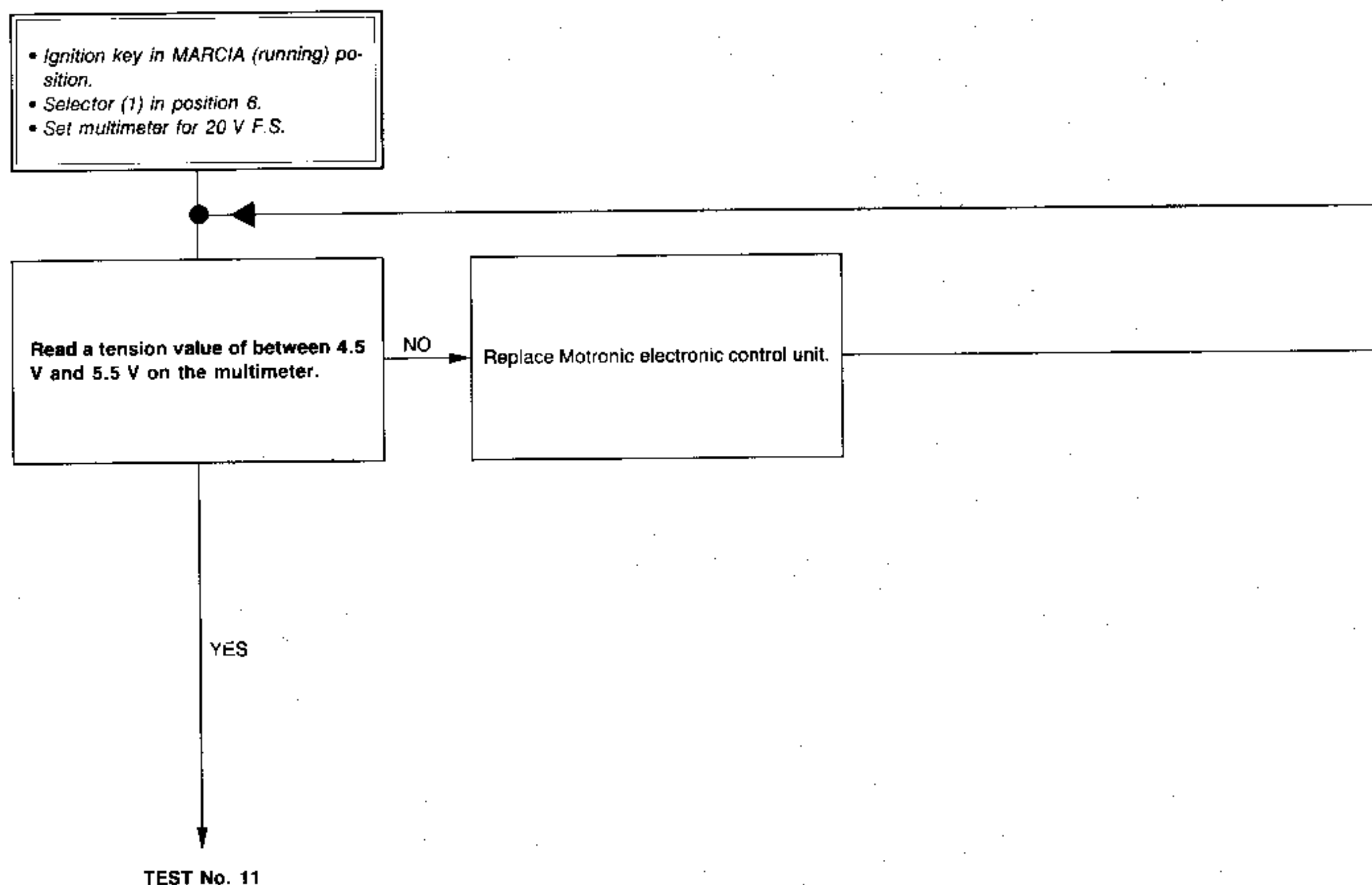




TEST No. 9 — CHECK GROUND PIN 16 MOTRONIC ELECTRONIC CONTROL UNIT MULTIPLE CONNECTOR



TEST No. 10 — CHECK POWER SUPPLY TO AIR FLOW GAUGE



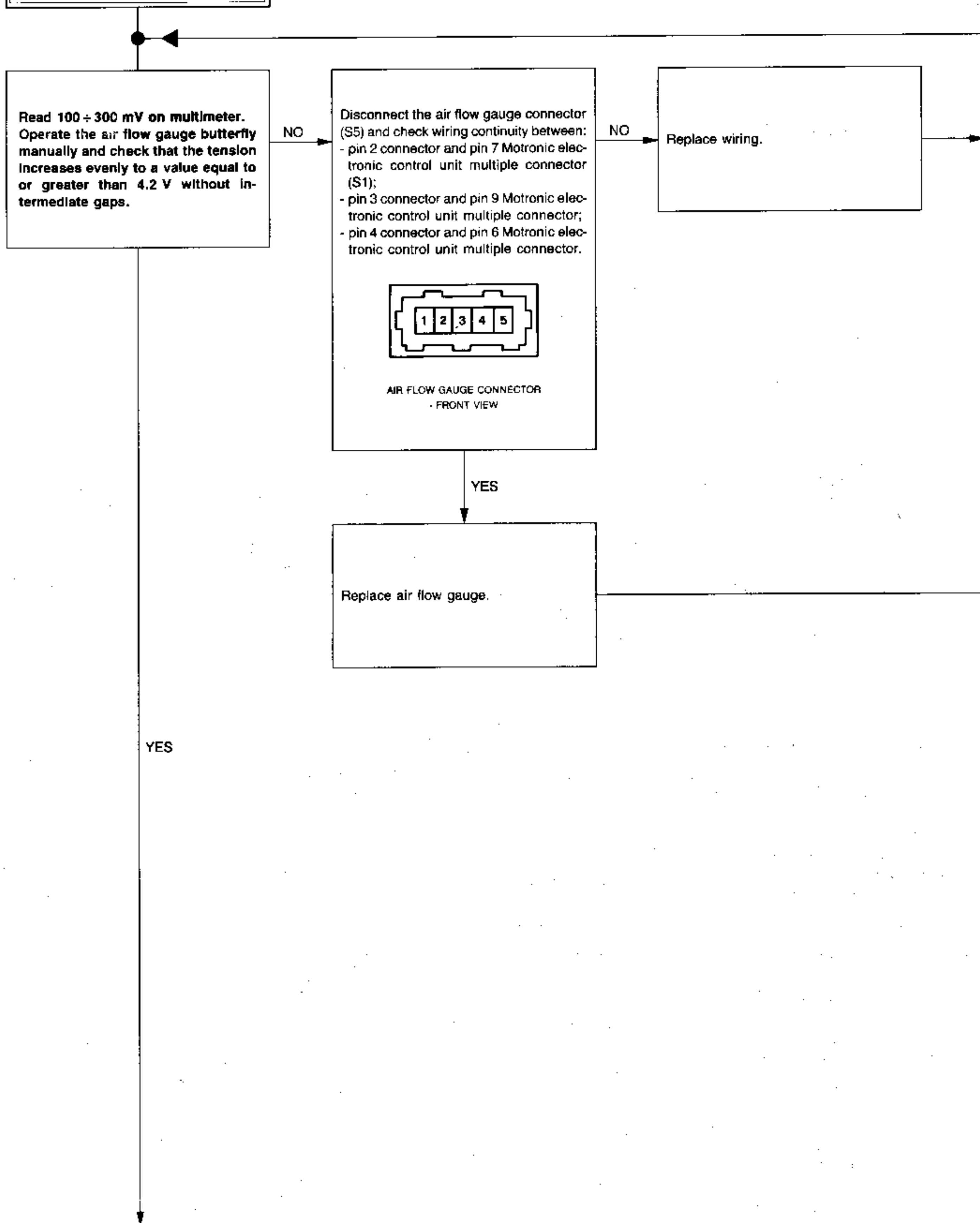
TEST No. 11

TEST No. 11 — CHECK AIR FLOW GAUGE POTENTIOMETER

- Ignition key in MARCIA (running) position.
- Selector (1) in position 7.
- Set multimeter for 20 V F.S.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.



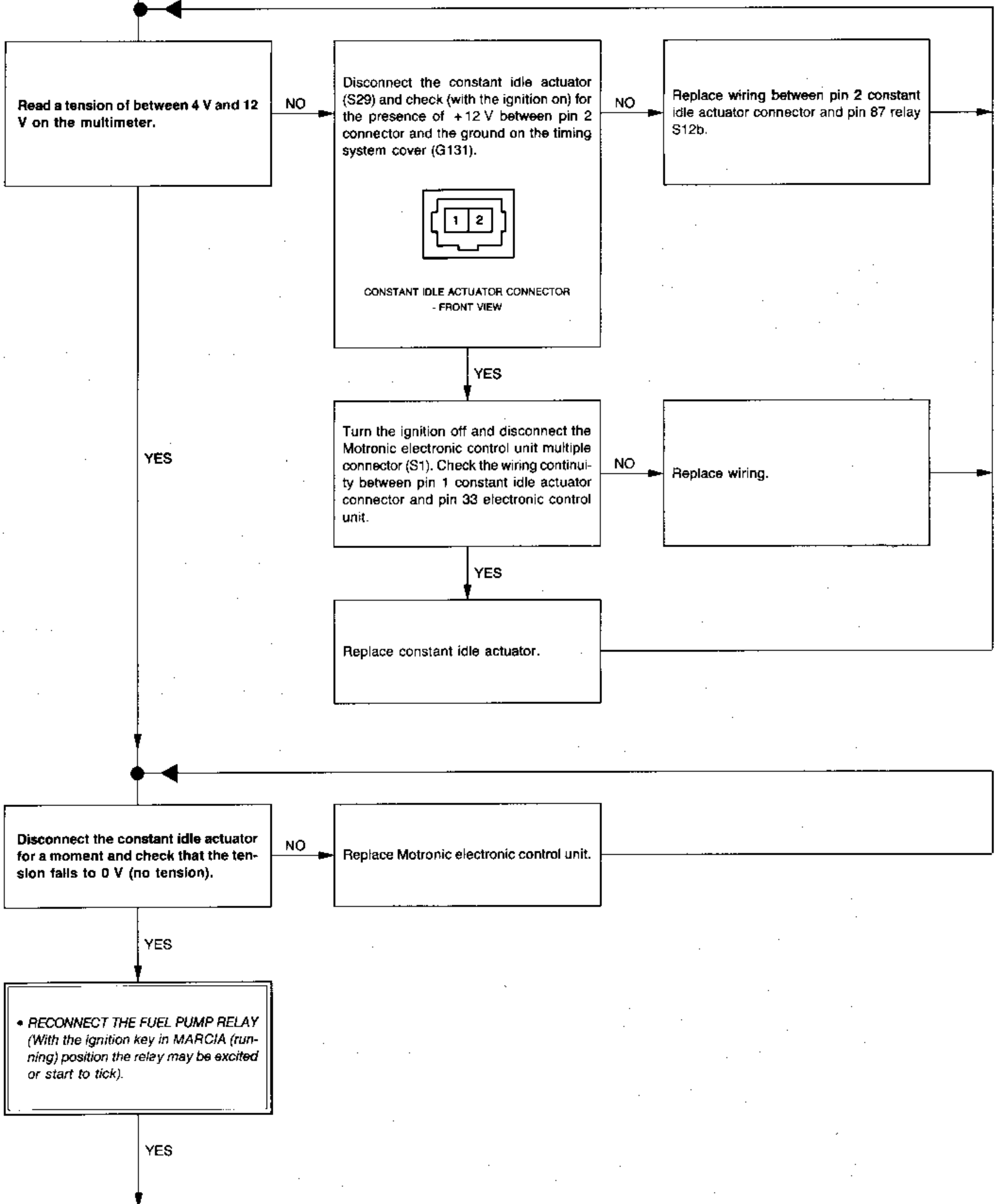
TEST No. 12

TEST No. 12 — CHECK WIRING AND POWER SUPPLY TO CONSTANT IDLE ACTUATOR

- Ignition key in MARCIA (running) position.
- Selector (1) in position 5.
- Set multimeter for 20 V F.S.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.



TEST No. 13 — TESTS TO BE CARRIED OUT WITH THE ENGINE NOT RUNNING

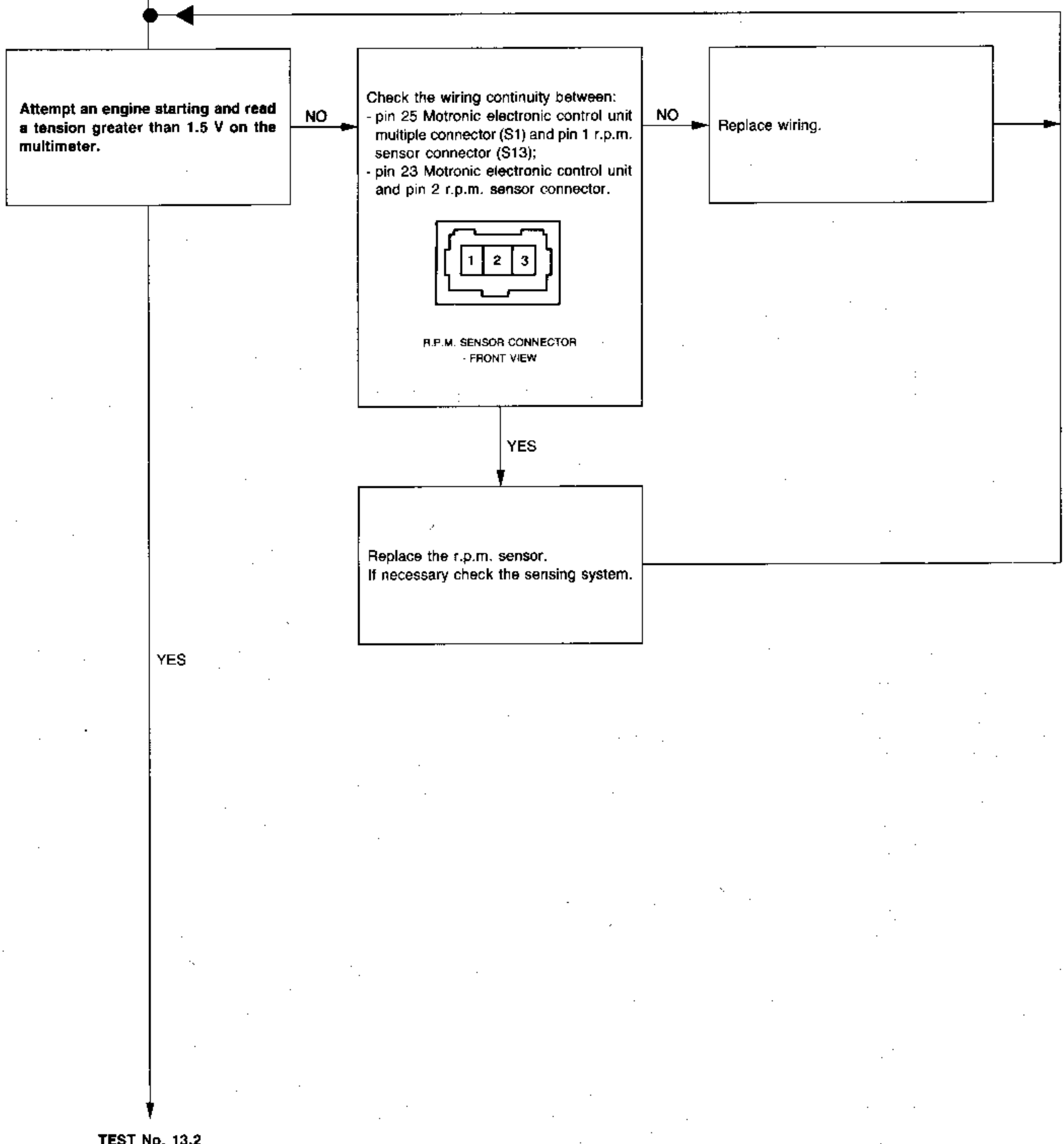
NOTE: Make sure that the check on pin 8, as described in the preliminary operations, is carried out.

TEST No. 13.1 — TEST INDUCTIVE SENSOR

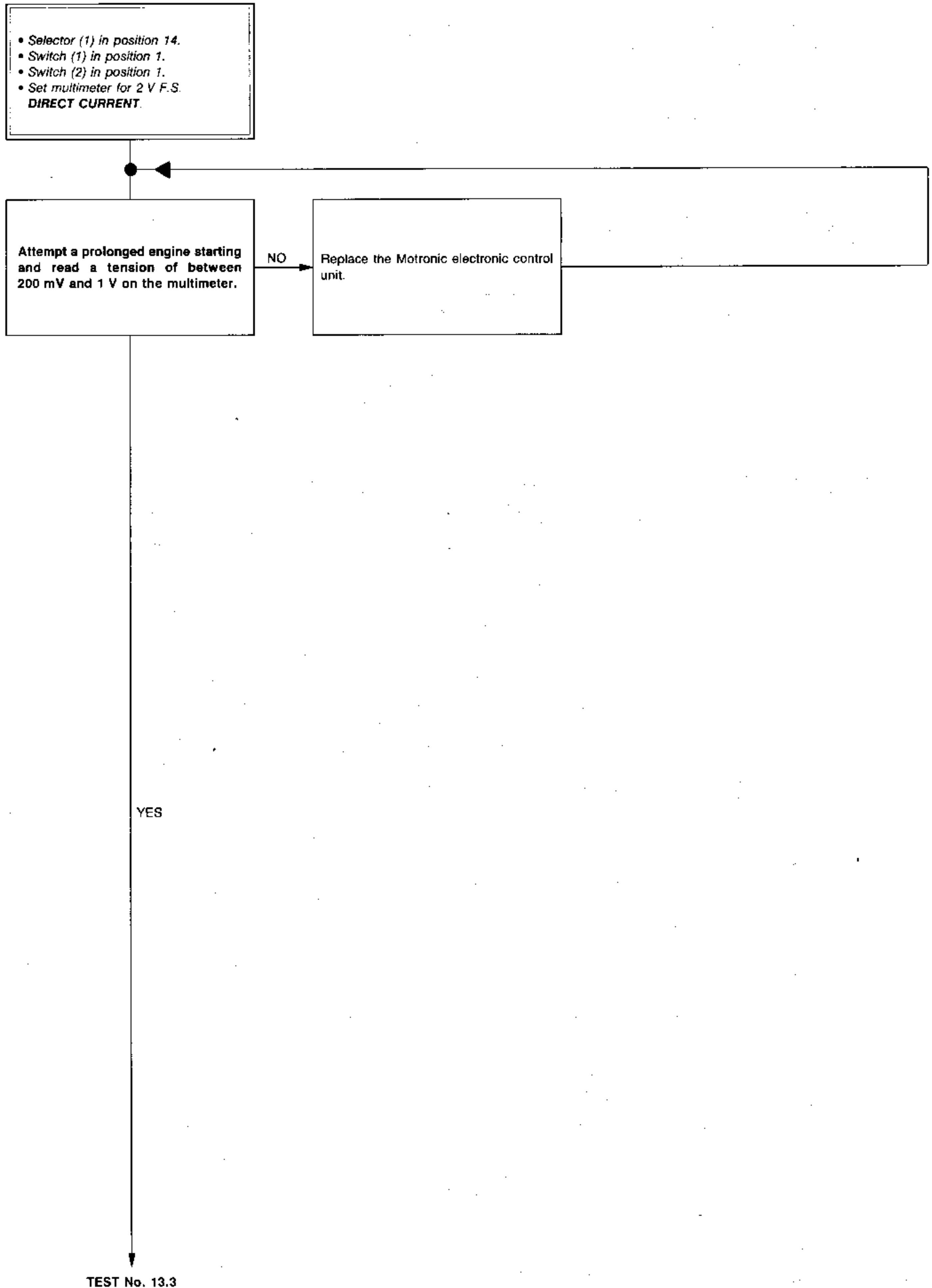
- Selector (1) in position 18.
- Set multimeter for 20 V F.S. ALTERNATING CURRENT.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.



TEST No. 13.2 — CHECK FUEL INJECTION TIME

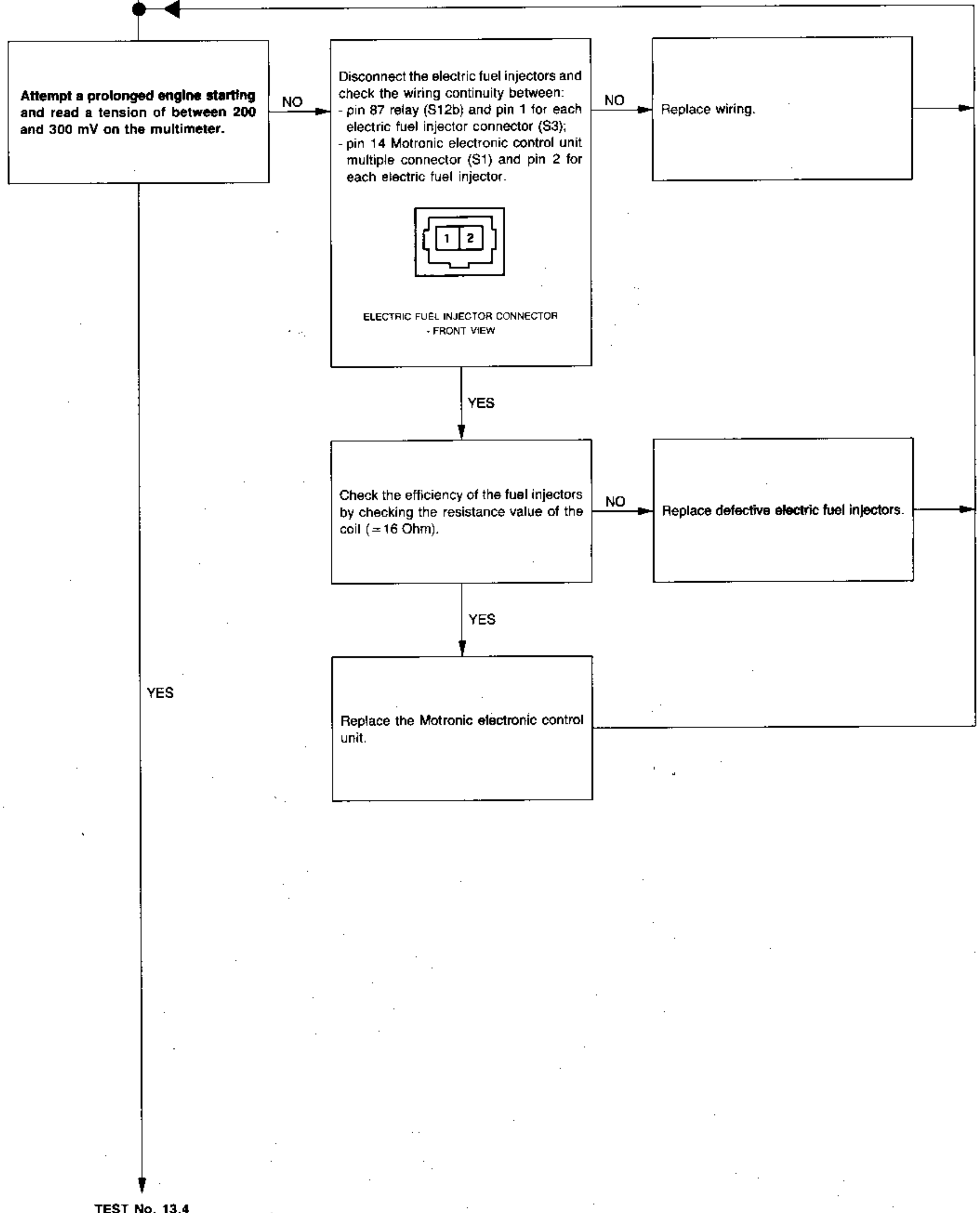


TEST No. 13.3 — CHECK CURRENT TO ELECTRIC FUEL INJECTORS

- Selector (1) in position 13.
- Switch (2) in position 1.
- Set multimeter for 2 V F.S.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.



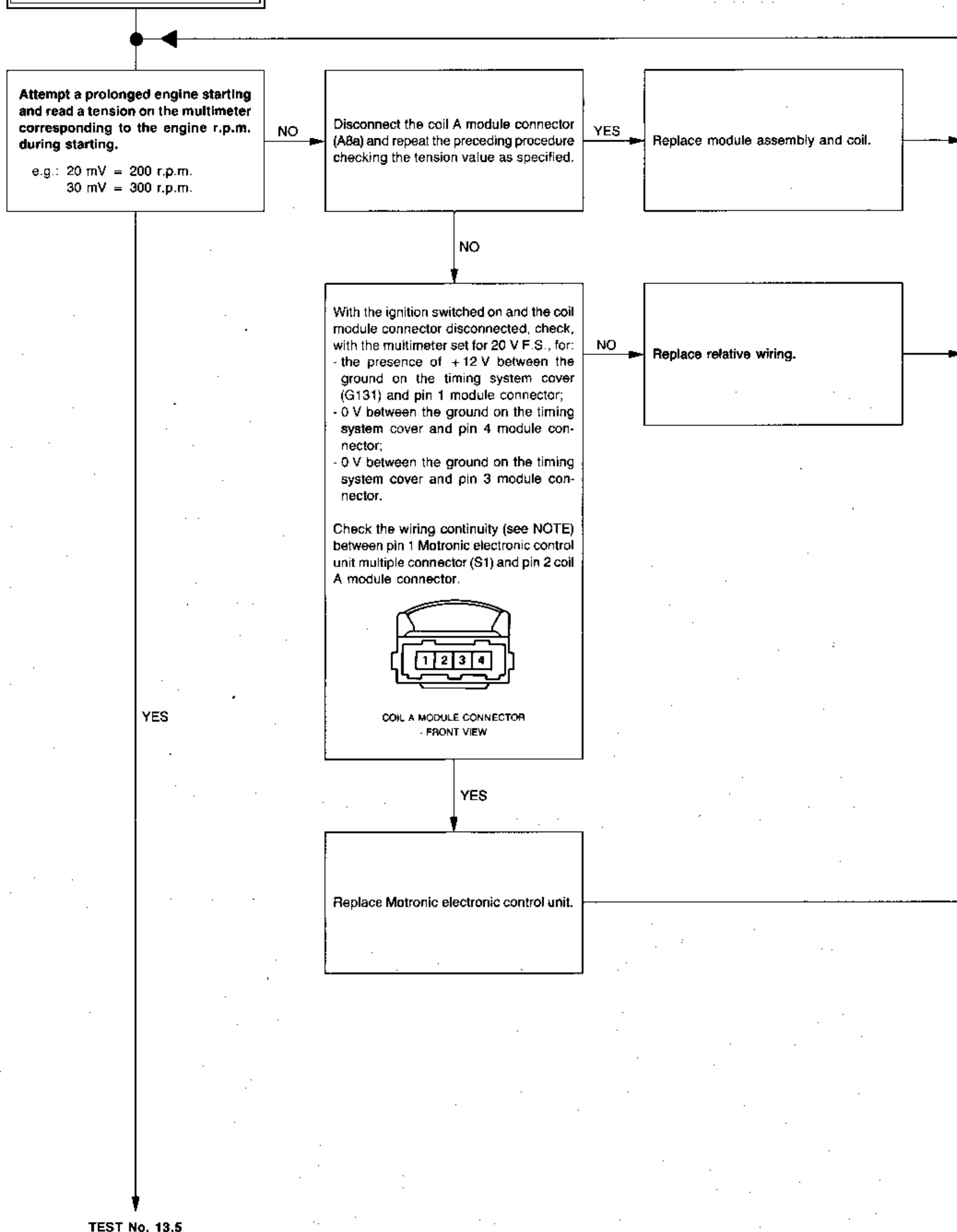
TEST No. 13.4

TEST No. 13.4 — CHECK COIL A ACTUATOR

- Selector (1) in position 16.
- Switch (1) in position 2.
- Set multimeter for 2 V F.S.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.

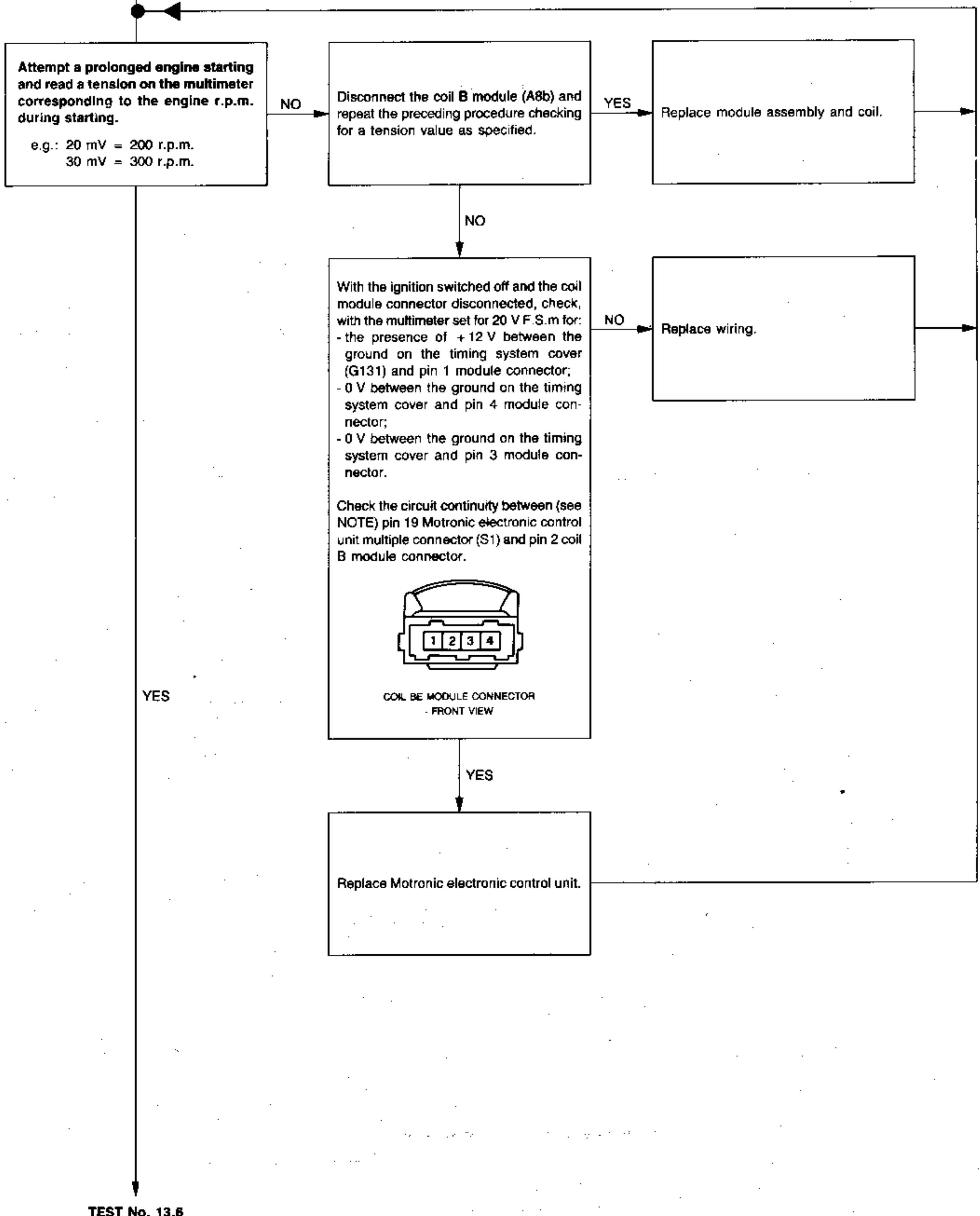


TEST No. 13.5 — CHECK COIL B ACTUATOR

- Selector (1) in position 16.
- Switch (1) in position 1.
- Set multimeter for 2 V F.S.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.

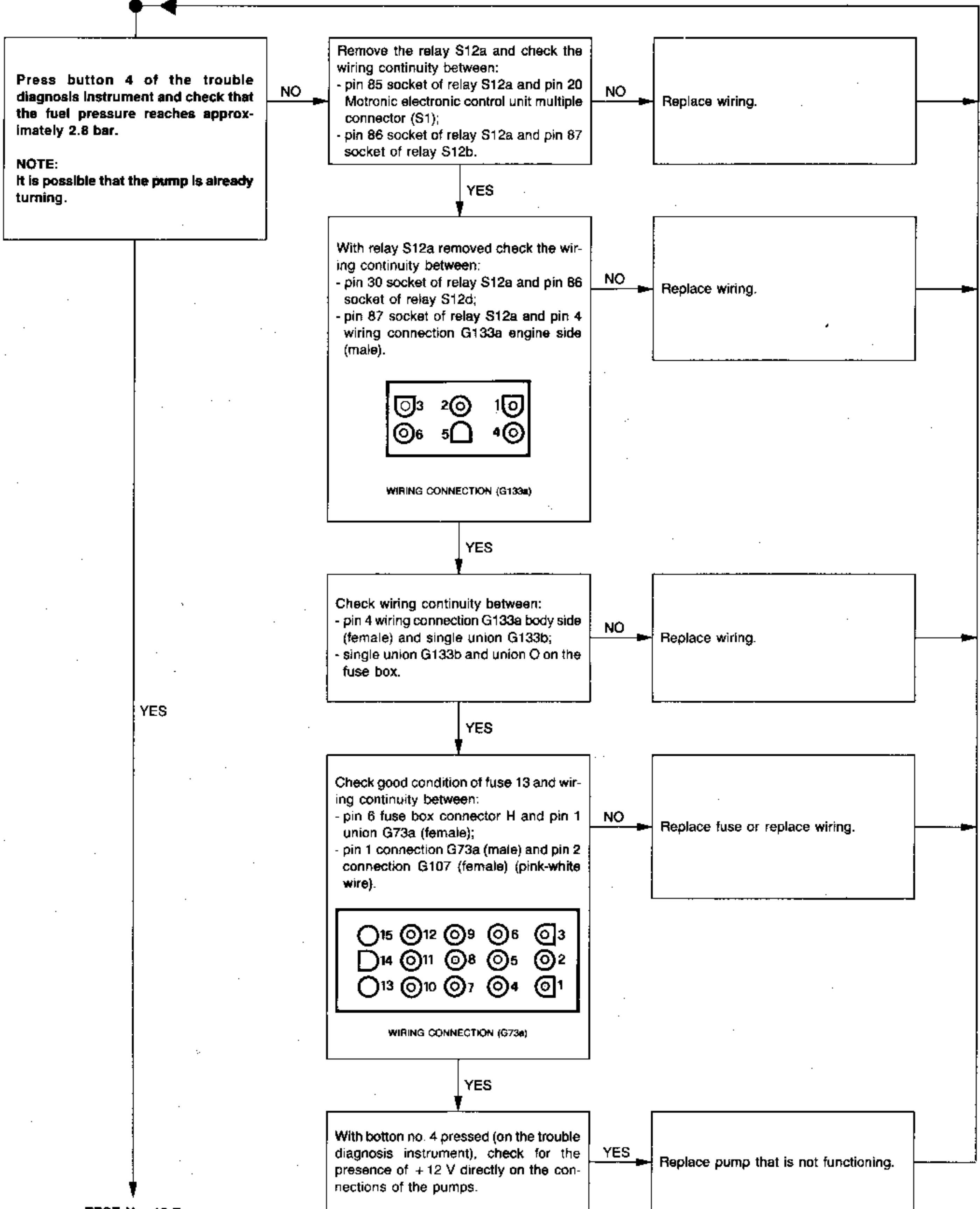


TEST No. 13.6 — FUEL SYSTEM CHECK

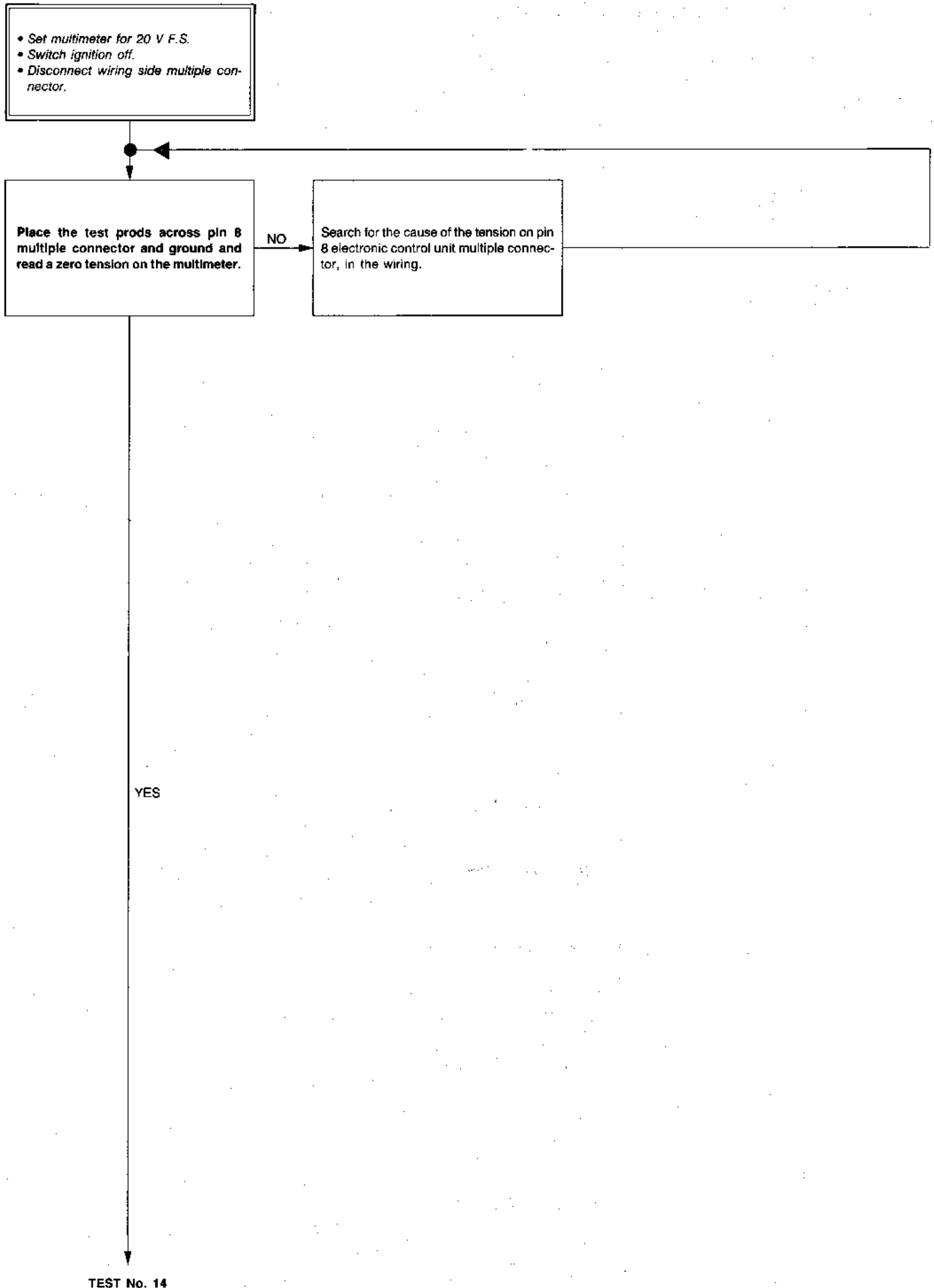
- Connect a pressure gauge to the fuel distribution pipe.
- Ignition key in MARCIA (running) position.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.



TEST No. 13.7 — CHECK CONNECTION PIN 8 ELECTRONIC CONTROL UNIT



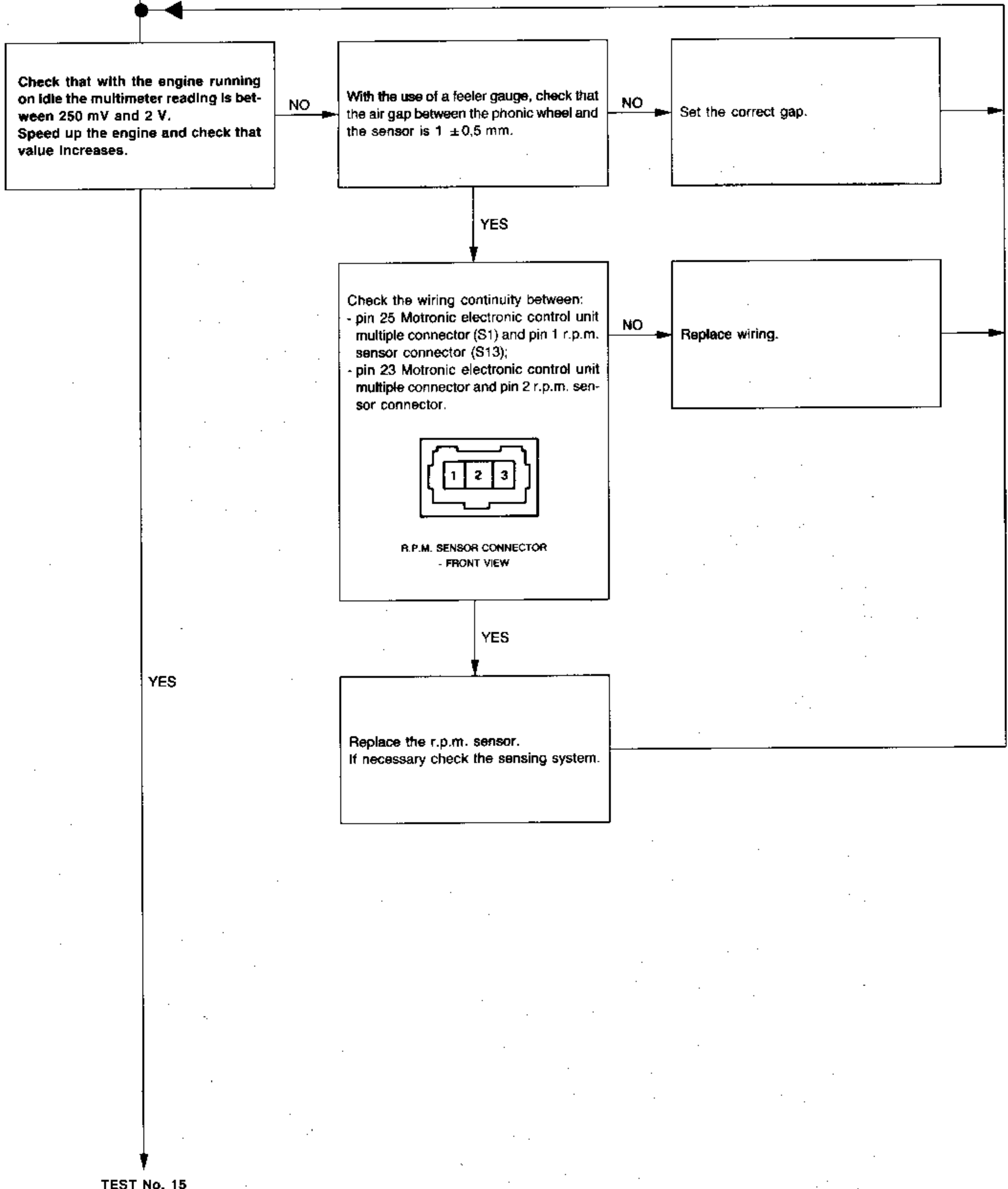
TESTS TO BE CARRIED OUT WITH THE ENGINE RUNNING

TEST No. 14 — CHECK POSITIVE HALF WAVE OF THE INDUCTIVE SENSOR

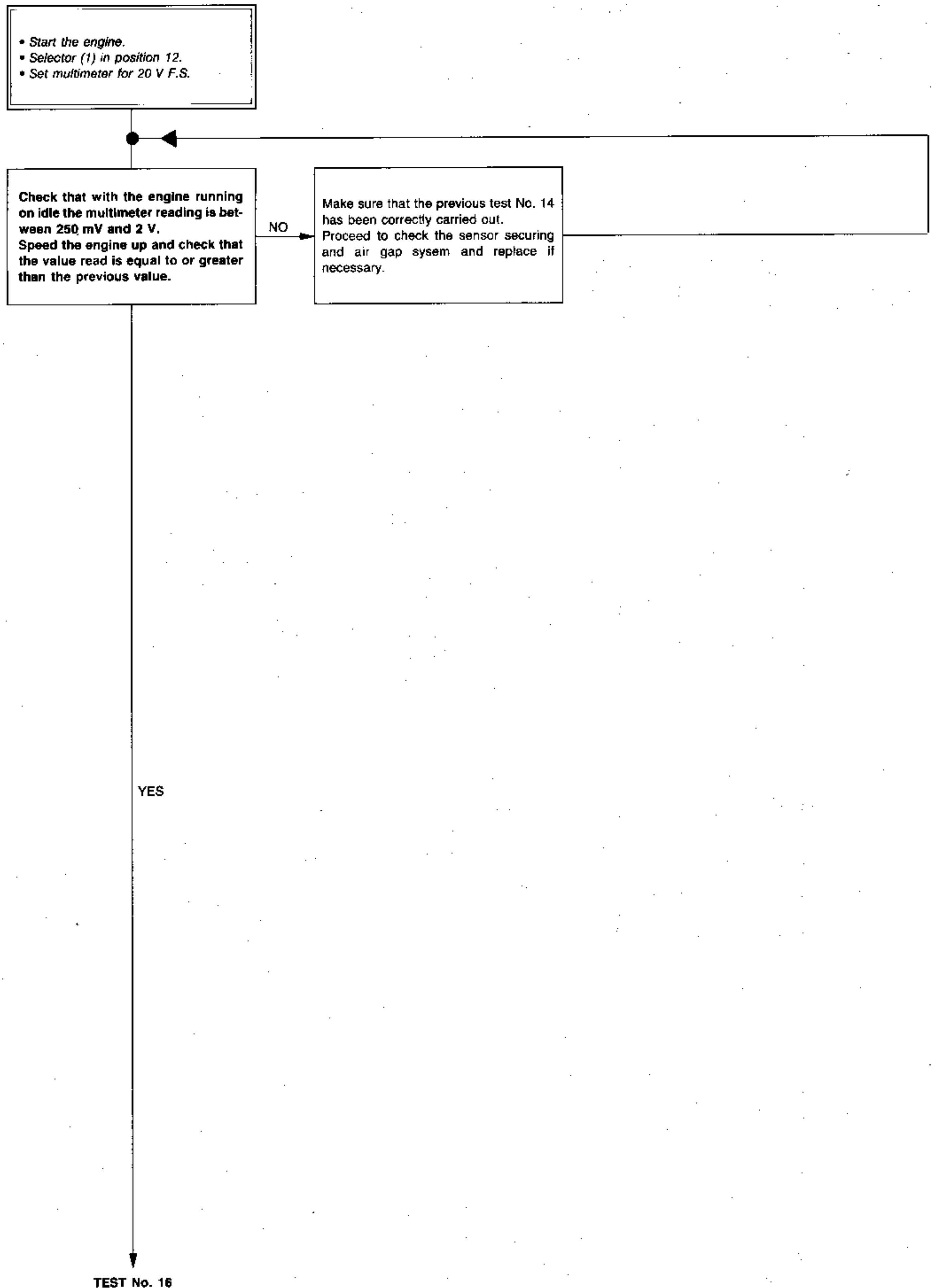
- Start engine.
- Selector (1) in position 11.
- Set multimeter for 20 V F.S.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.



TEST No. 15 — CHECK THE NEGATIVE HALF WAVE OF THE INDUCTIVE SENSOR

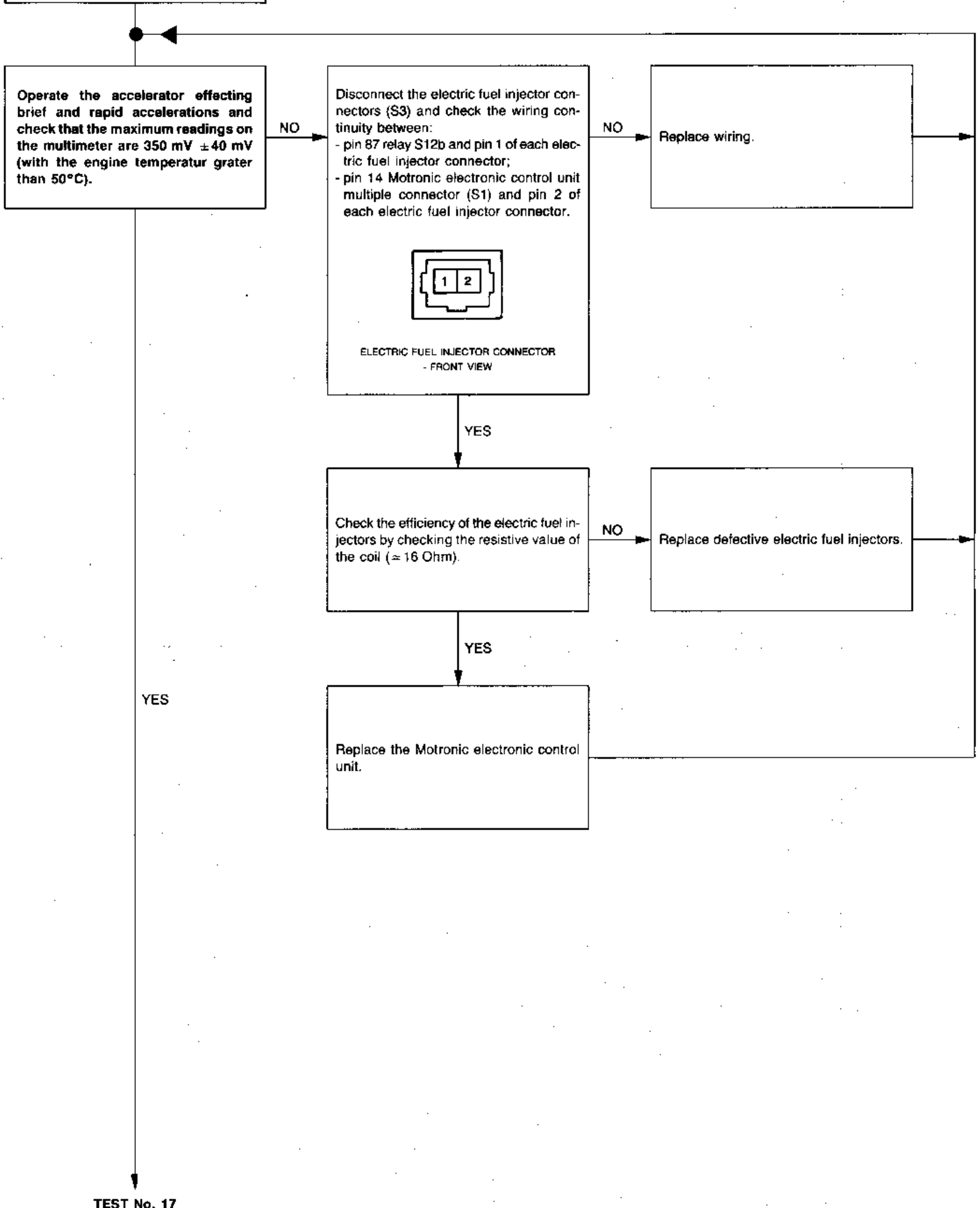


TEST No. 16 — CHECK OF CURRENT TO ELECTRIC FUEL INJECTORS

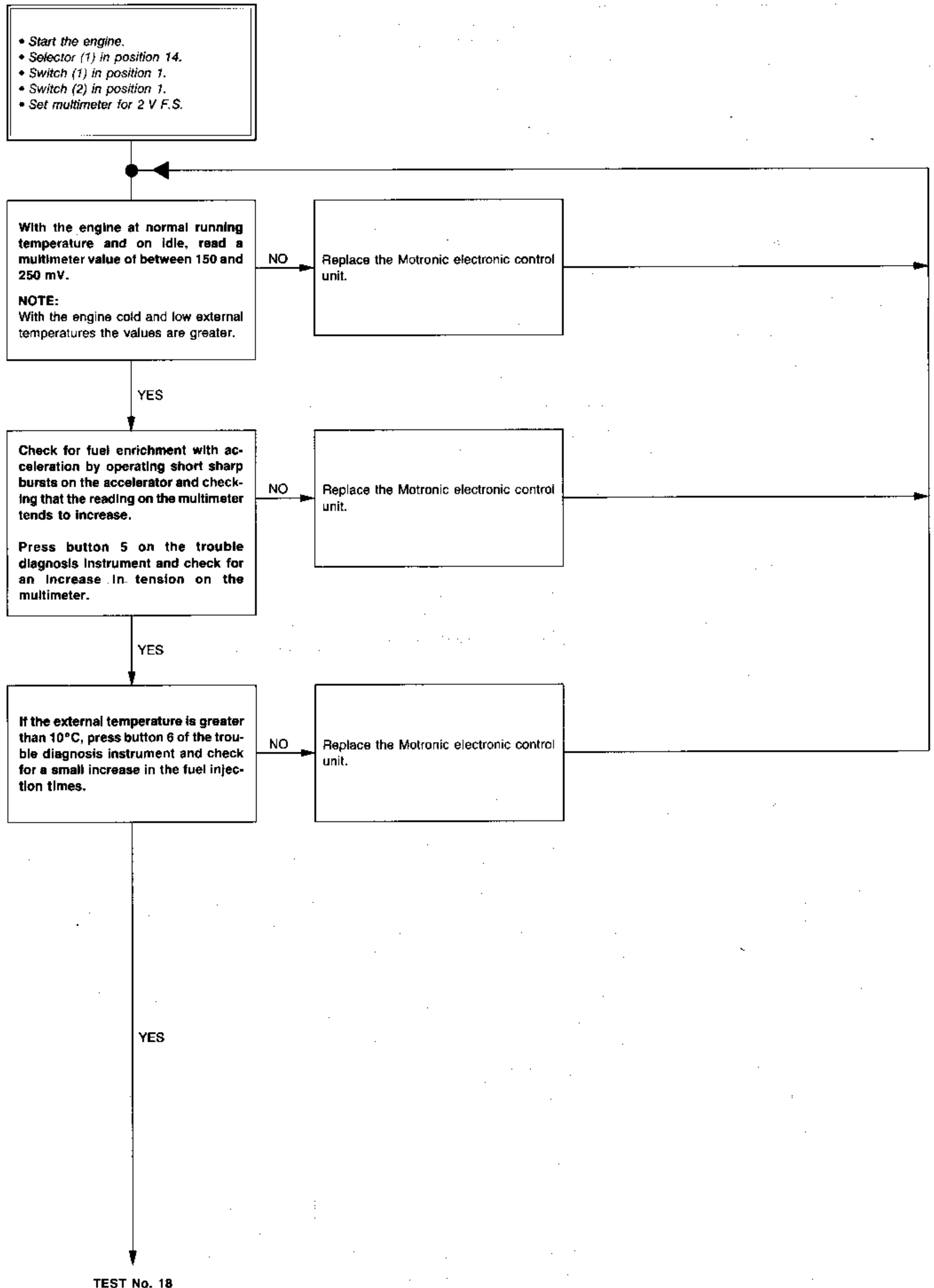
- Start engine.
- Selector (1) in position 13.
- Switch (1) in position 1.
- Switch (2) in position 1.
- Set multimeter for 2 V F.S.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.



TEST No. 17 — CHECK FUEL INJECTION TIME

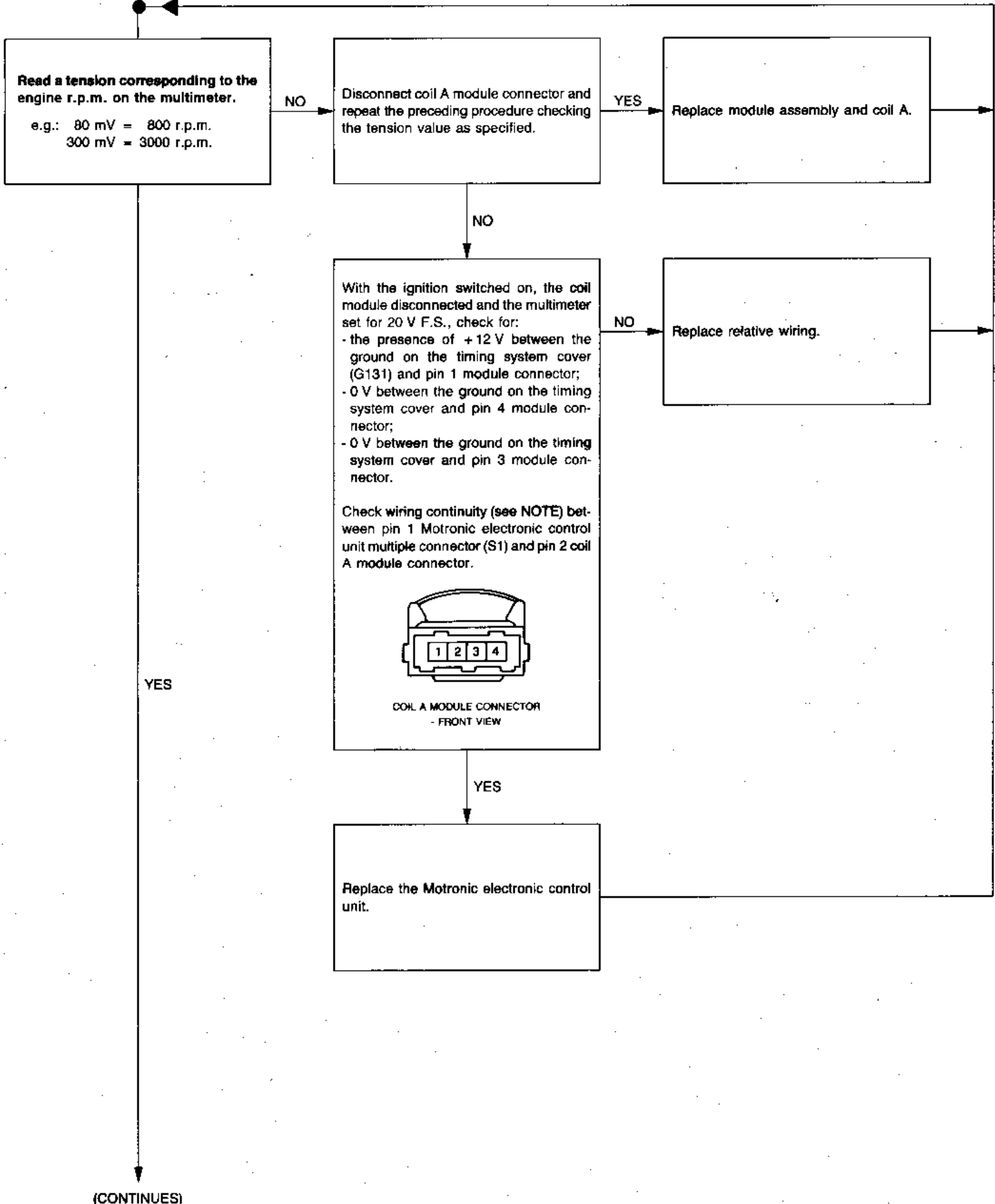


TEST No. 18 — CHECK ACTUATOR COIL A AND COIL B

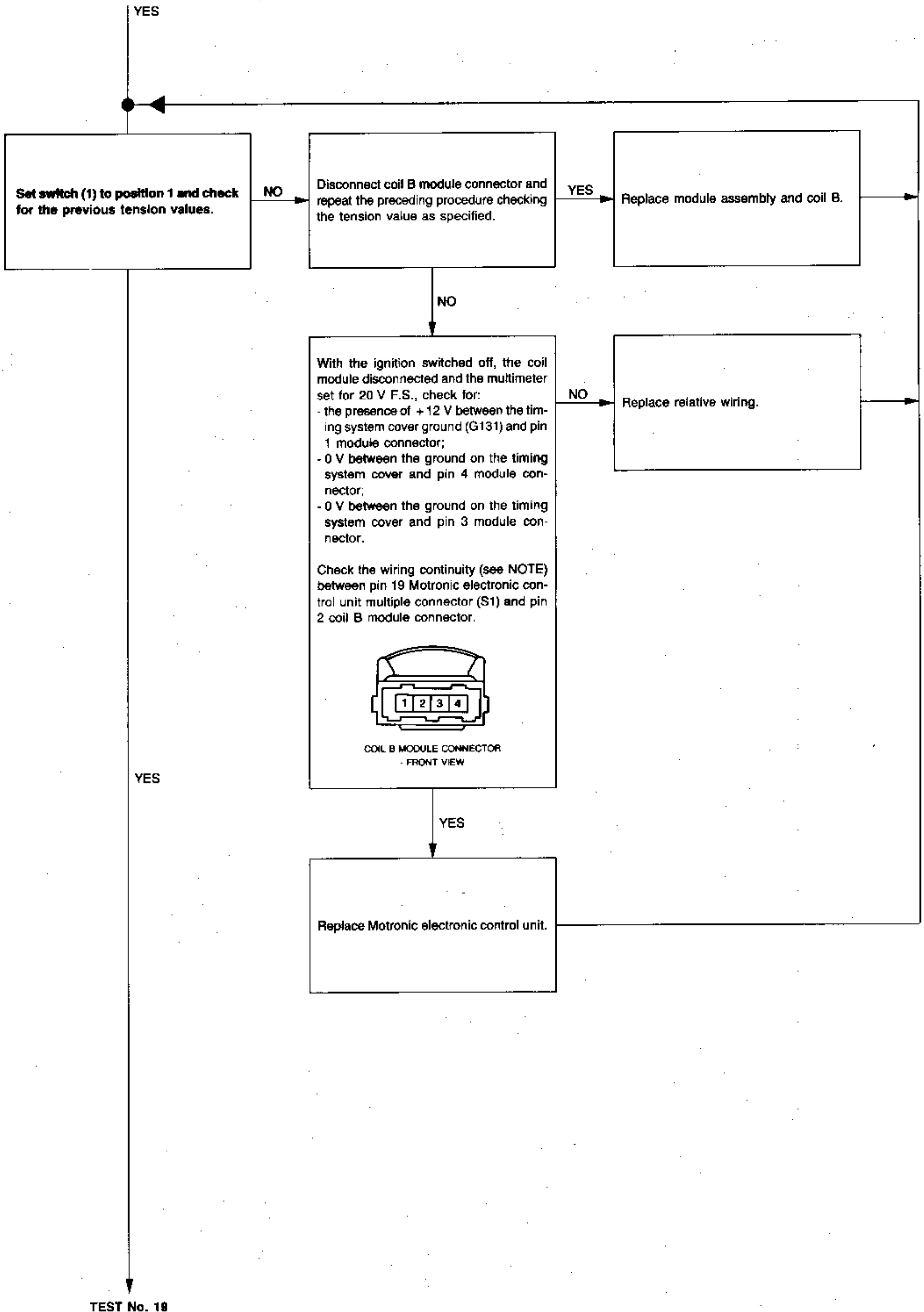
- Start the engine.
- Selector (1) in position 16.
- Switch (1) in position 2.
- Set multimeter for 2 V F.S.

NOTE:

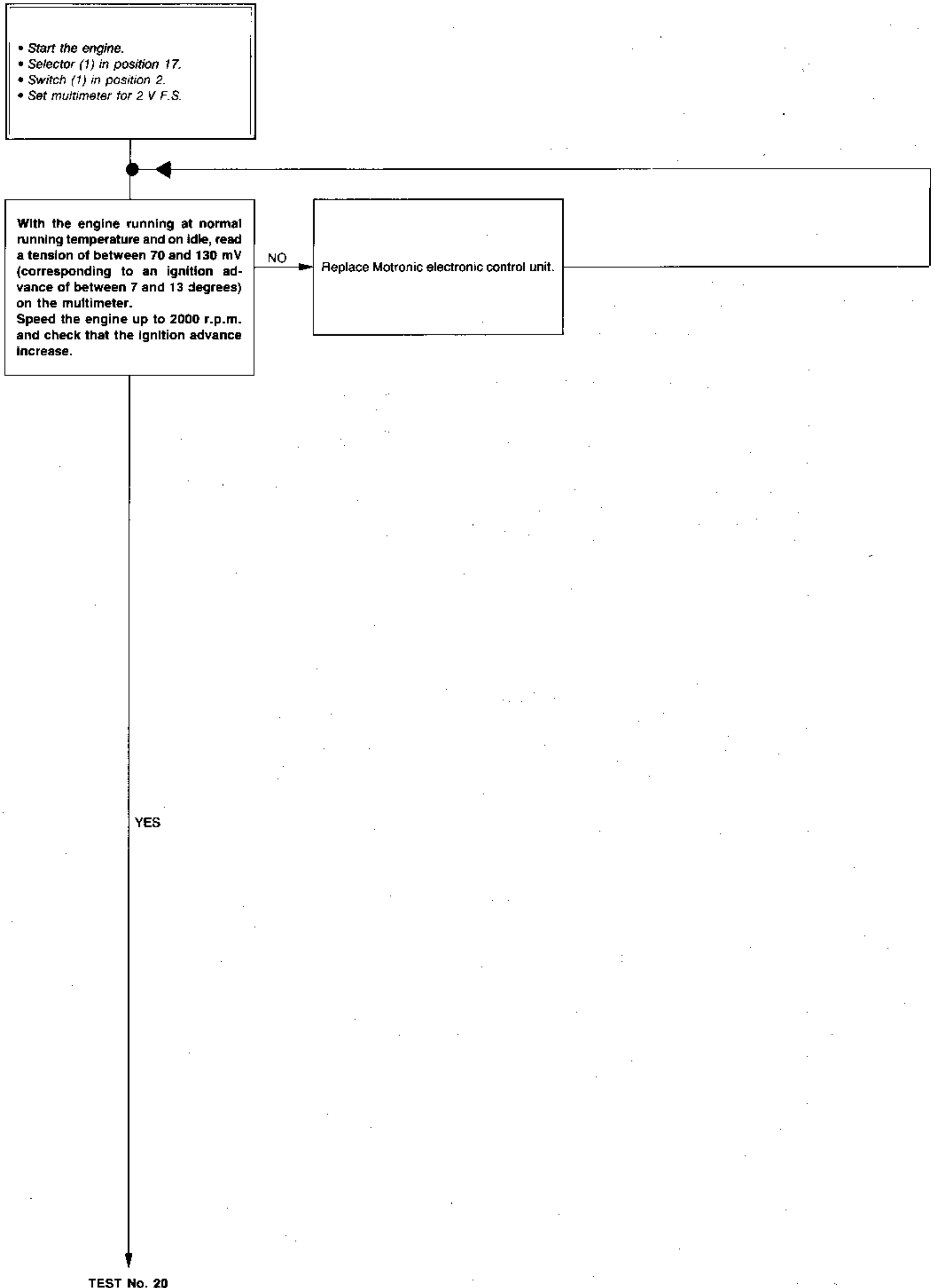
The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.



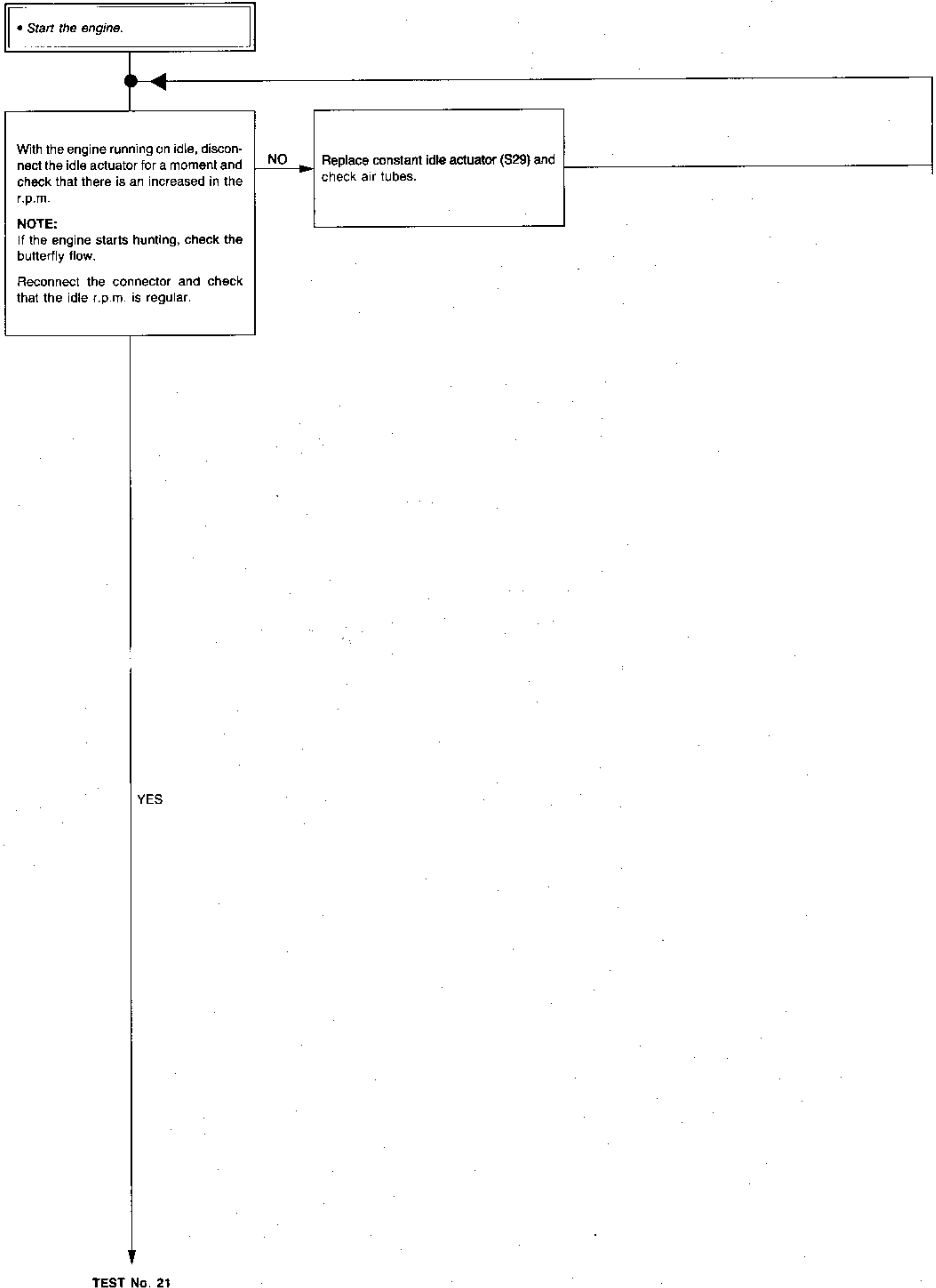
COMPLETE CAR



TEST No. 19 — CHECK IGNITION ADVANCE



TEST No. 20 — CHECK FUNCTIONING OF CONSTANT IDLE ACTUATOR

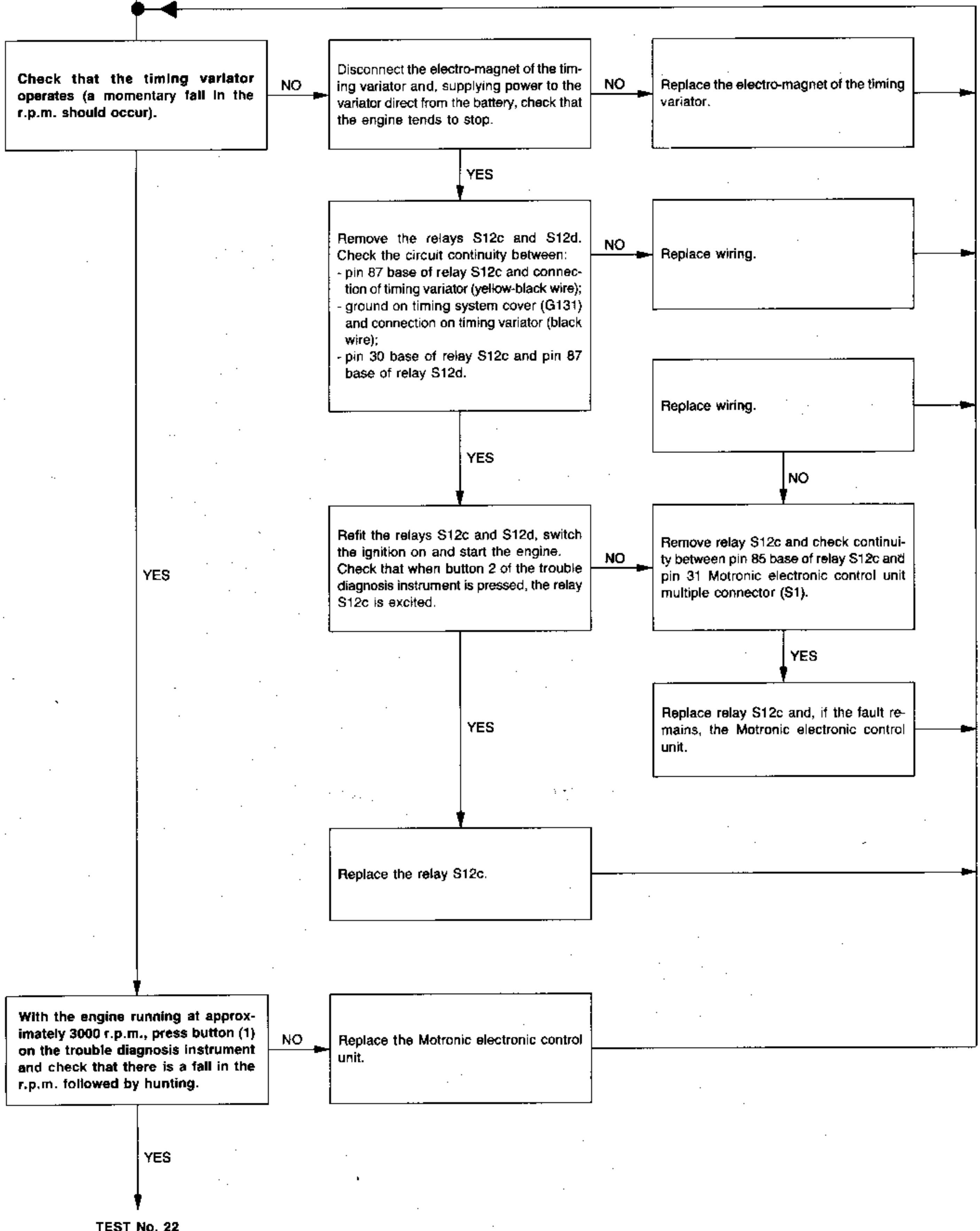


TEST No. 21 — CHECK FUNCTIONING OF ELECTRONIC CONTROL UNIT

• With the engine running at between 1000 and 1500 r.p.m., press button No. 2 of the trouble diagnosis instrument.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.

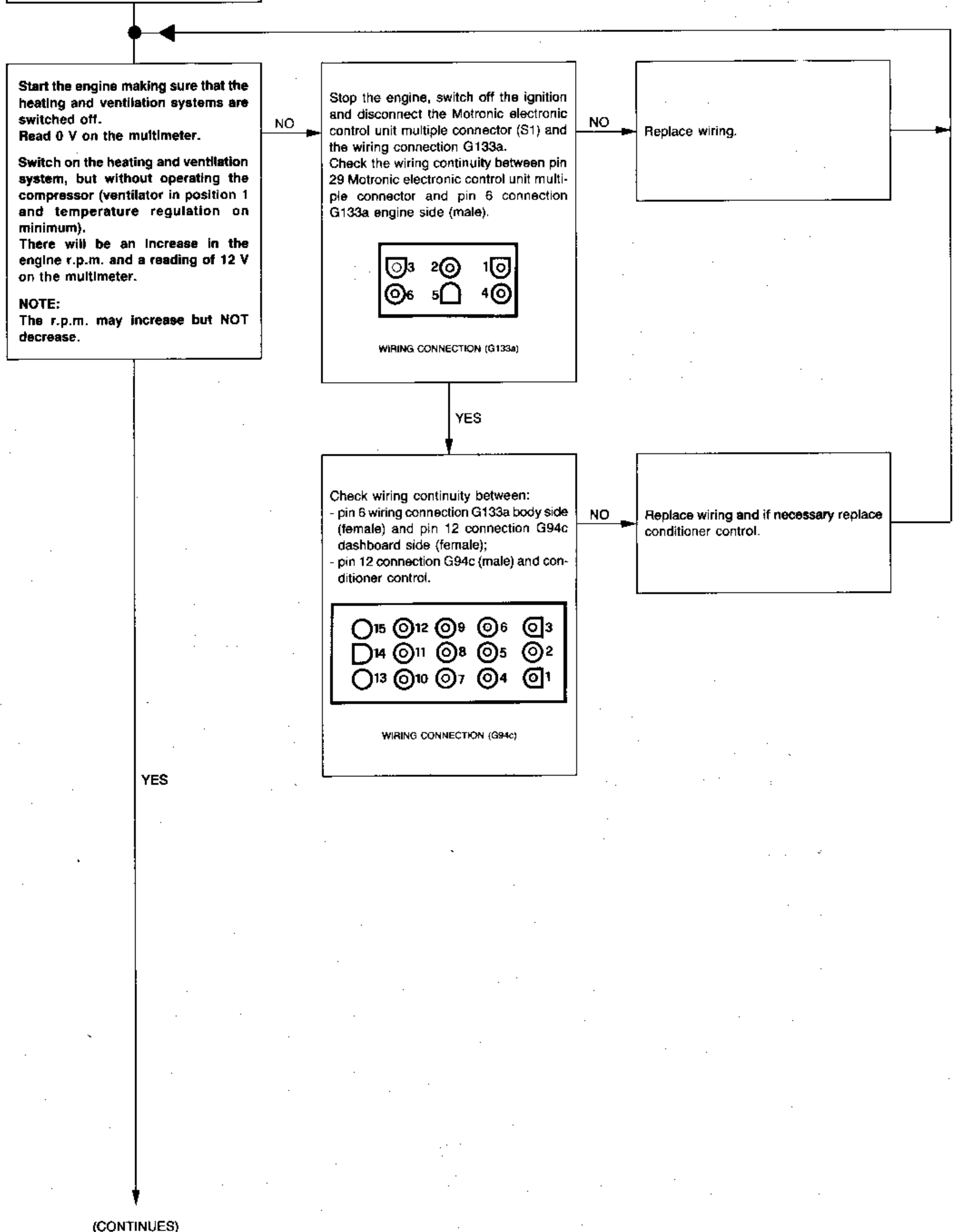


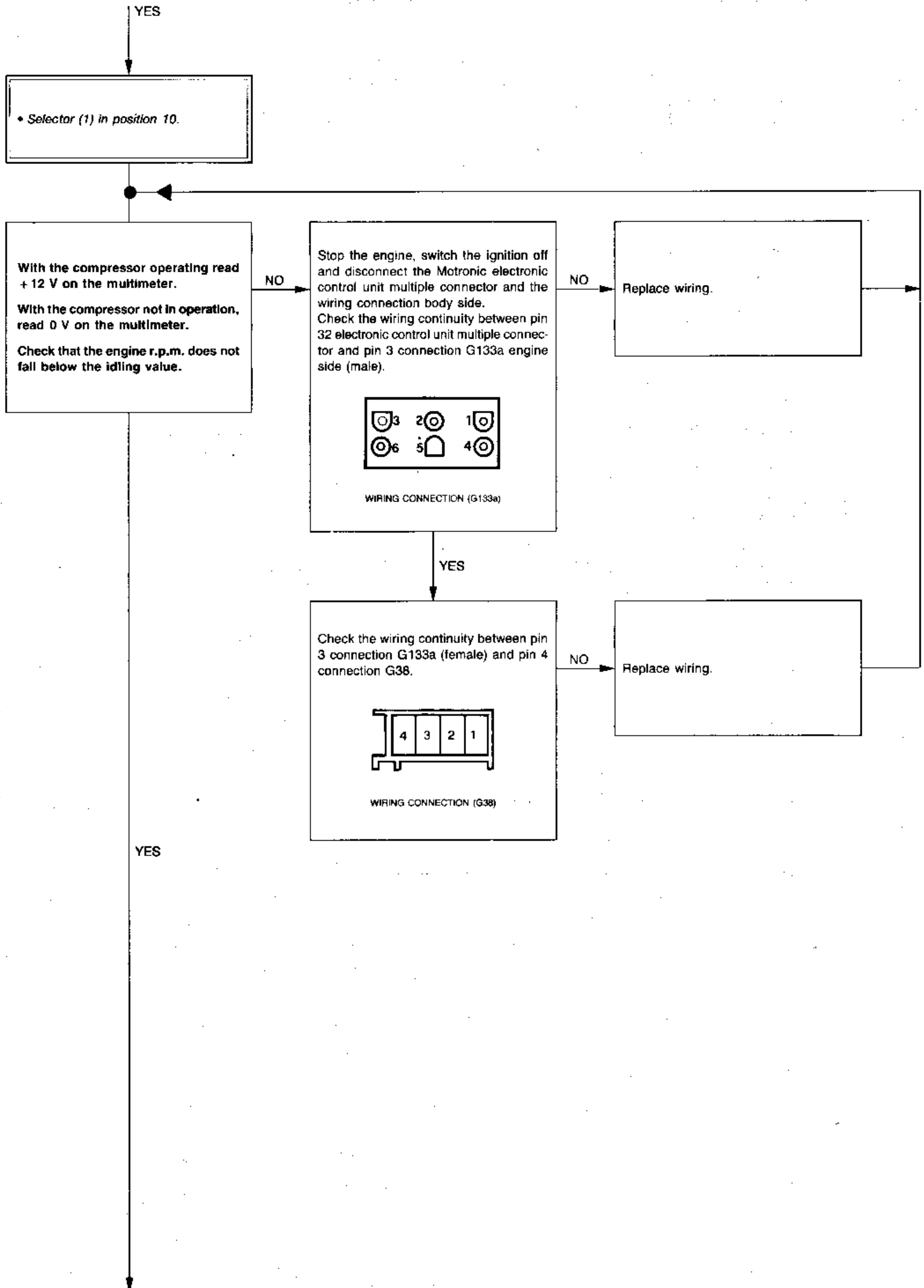
TEST No. 22 — CHECK OF CONNECTIONS TO CONDITIONER (IF FITTED)

- Selector (1) in position 9.
- Set multimeter for 20 V F.S.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.





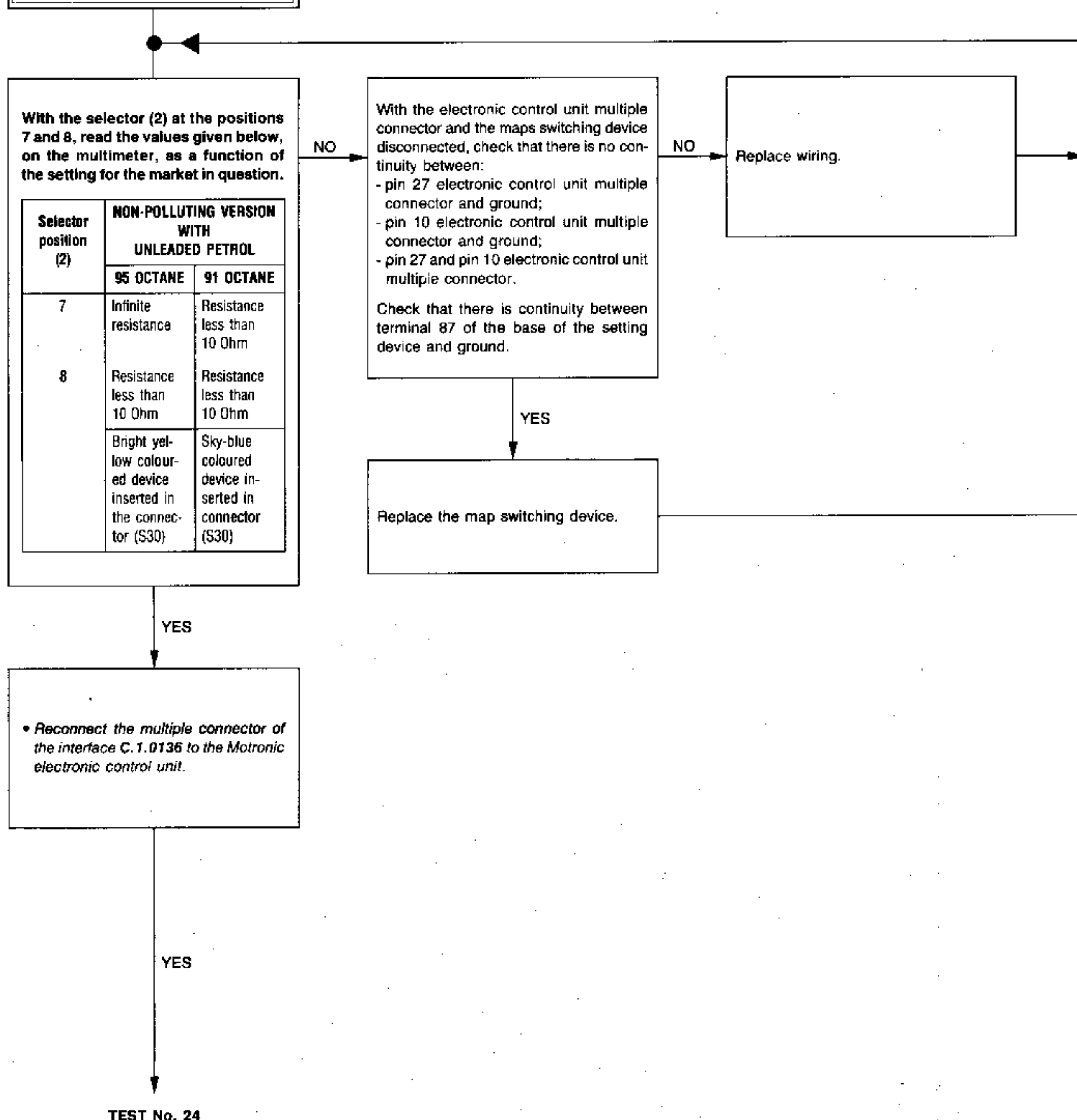
TEST No. 23 — CHECK THE SETTINGS FOR THE DIFFERENT MARKETS

NOTE: The setting is carried out by means of the connection, using the appropriate connector (S30), of a device in the form of a relay with a casing of a different colour.

- Multimeter 200 Ohm F.S.
- Disconnect the negative terminal of the battery.
- Disconnect the multiple connector of the interface C.1.0136 from the electronic control unit.
- Reconnect the negative terminal of the battery.
- Switch ignition off.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.

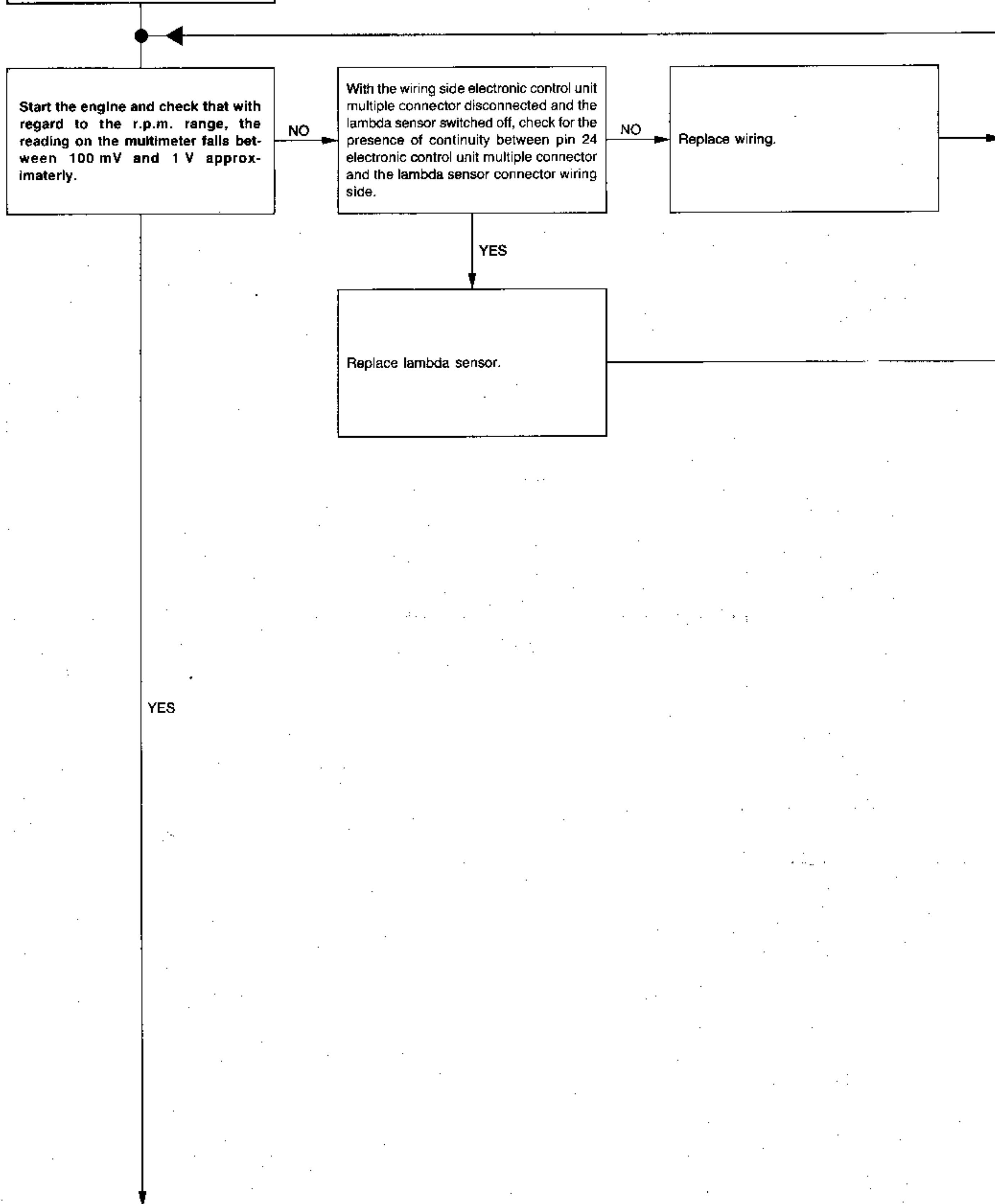


TEST No. 24 — CHECK LAMBDA SENSOR

- Place the test prods of a multimeter in the «VOLT» sockets of the trouble diagnosis instrument.
- Multimeter 2 V F.S.
- Selector (1) in position 22.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.



TEST No. 25

TEST No. 25 — CHECK FUEL VAPOUR CONTROL SOLENOID VALVE ACTUATOR

- Multimeter 20 V F.S.
- Start the engine.

NOTE:

The continuity check is to be carried out with the multimeter set for Ohm readings, the ignition switched off and the trouble diagnosis system disconnected.

Place the test prods of the multimeter on the pins of the solenoid valve.

Accelerate the engine with short sharp bursts and check for the momentaneous readings of +12 V on the multimeter (with each acceleration).

NO

Disconnect the blue/red wire from the solenoid valve.

With the ignition key in MARCIA (running) position check for the presence of +12 V between the blue/red wire and ground.

NO

Replace the wiring between the solenoid valve blue/red wire and pin 86 timing variator relay base S12c.

YES

Disconnect the brown wire from the solenoid valve and disconnect the electronic control unit multiple connector.

Check the circuit continuity between pin 34 electronic control unit multimeter connector and the brown wire solenoid valve.

NO

Replace wiring.

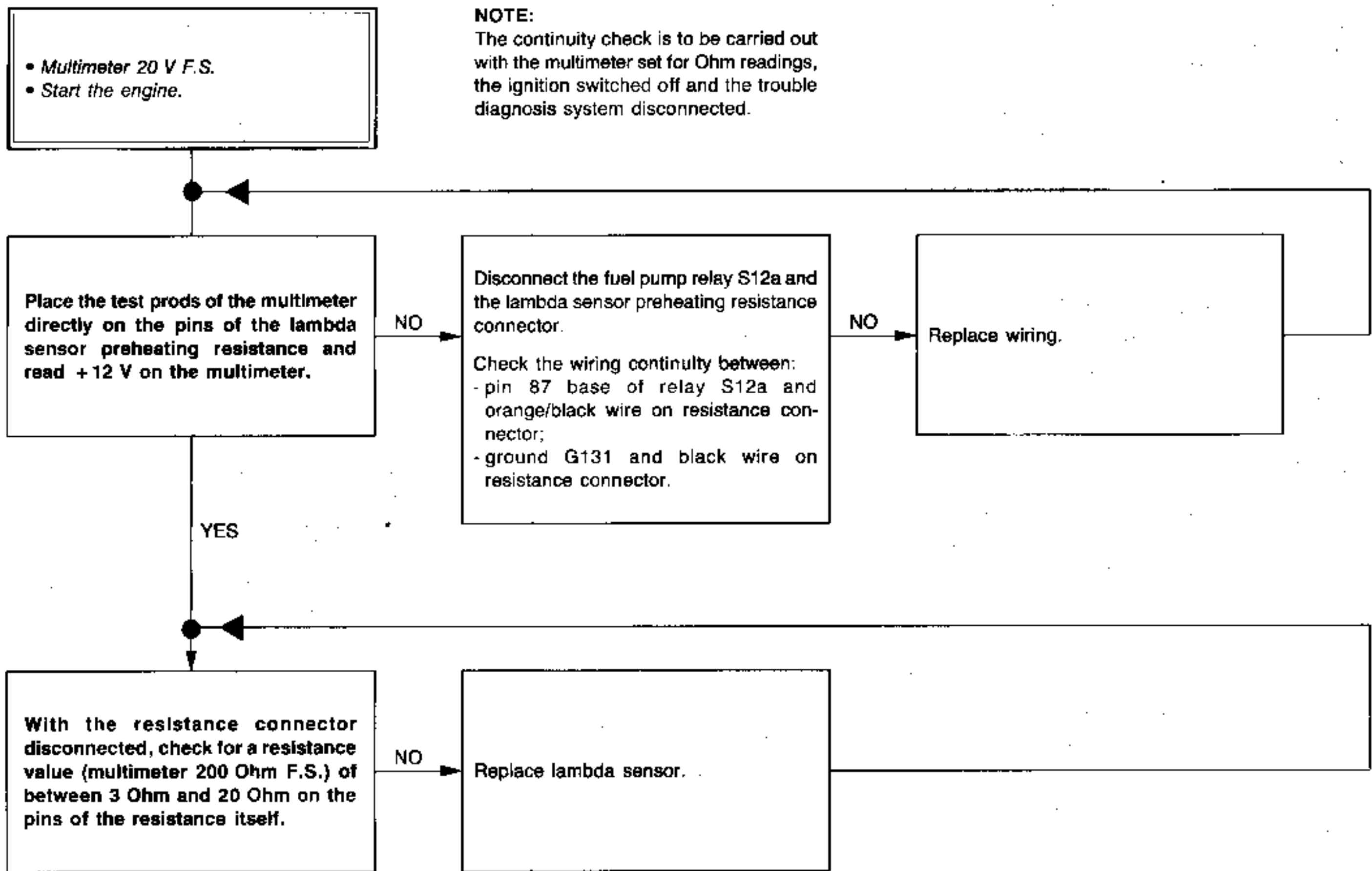
YES

Replace the Motronic electronic control unit.

YES

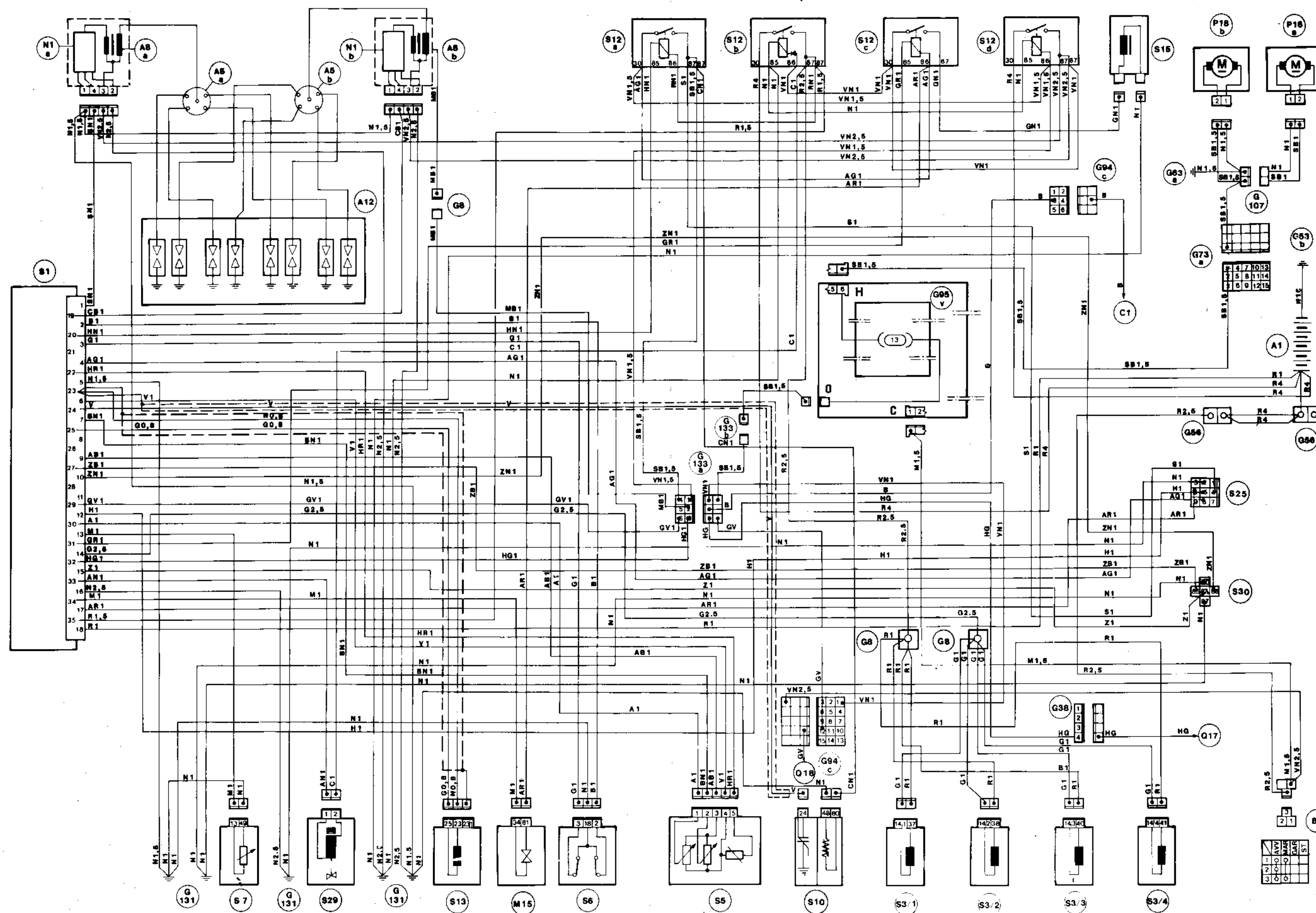
TEST No. 26

TEST No. 26 — CHECK POWER SUPPLY TO THE LAMBDA SENSOR PREHEATING RESISTANCE

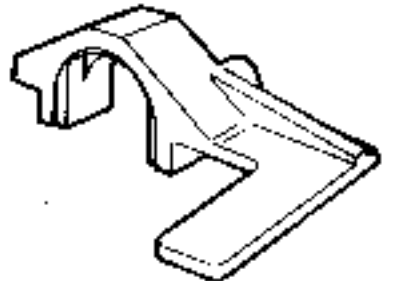
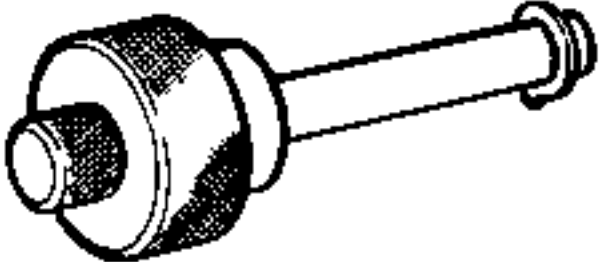
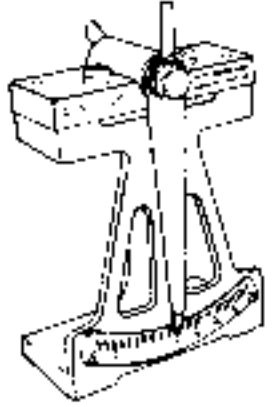
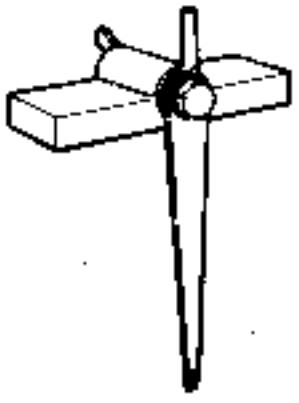
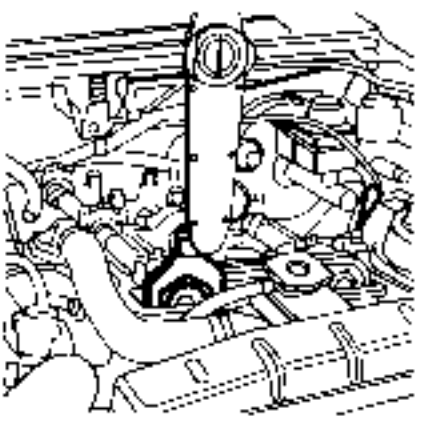
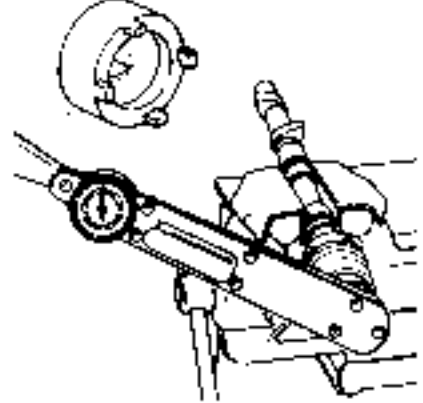


IGNITION AND INJECTION WIRING DIAGRAM (MOTRONIC ML4.1 SYSTEM - 4 CYLINDERS)

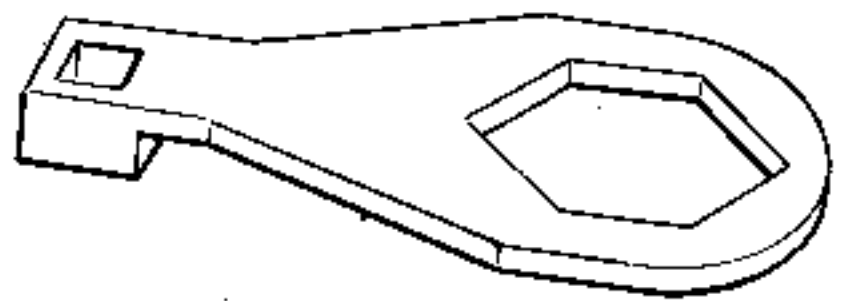
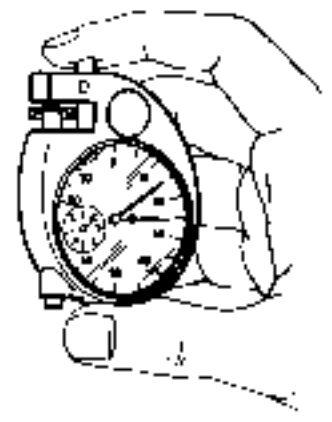
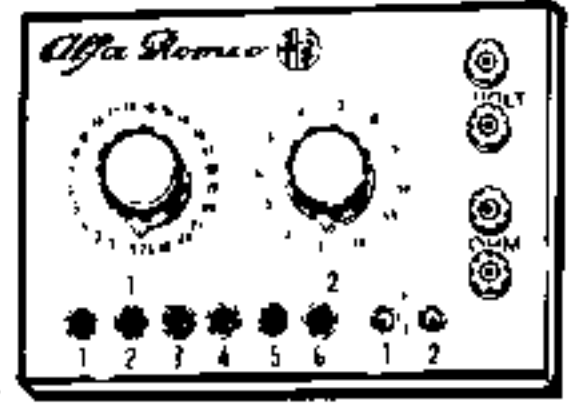
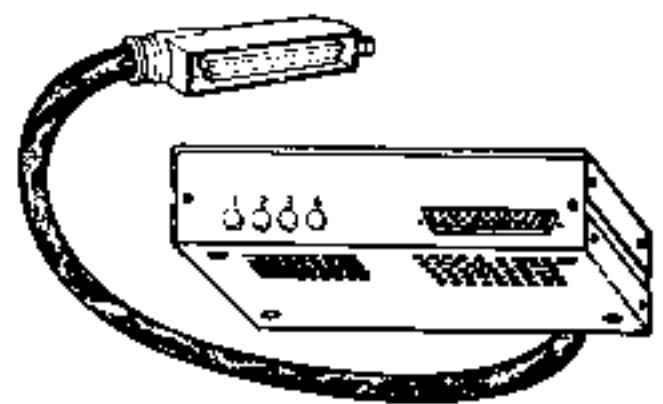
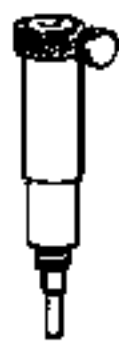
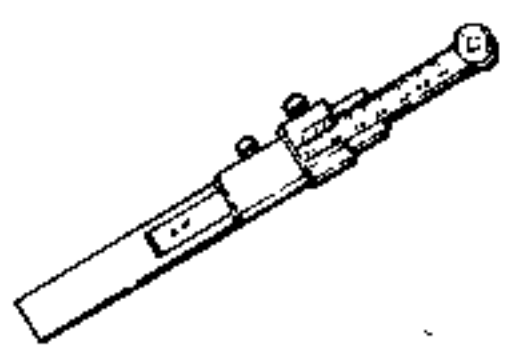
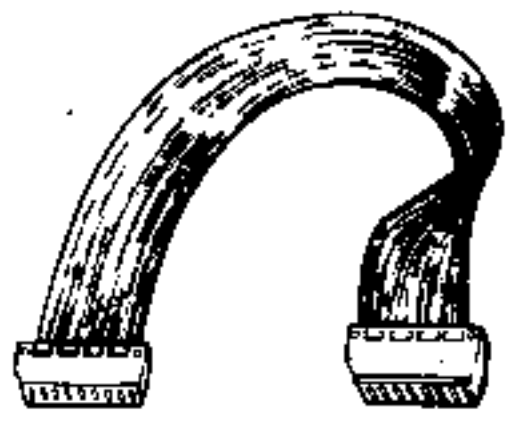
- A1** Battery
A5a Ignition distributor A
A5b Ignition distributor B
A8a Ignition coil A
A8b Ignition coil B
A12 Spark plugs
B1 Ignition switch
C1 Electronic rev-counter
G8 Single connector
G38 Connector for air-conditioner wiring
G53b Engine compartment ground left side
G56 Branch terminal board
G63a Rear right ground
G73a Connector for right rear services
G94c Engine compartment connector right side
G95v Fuse
G107 Connector for fuel pump
G131 Ground on upper cover
G133a Electronic injection-ignition wiring connector A
G133b Electronic injection-ignition wiring connector B
M15 Fuel vapour control solenoid valve
N1a Electronic ignition module A
N1b Electronic ignition module B
P18a Main electric fuel pump
P18b Auxiliary electric fuel pump
Q17 Relay for simultaneous control of engine cooling fan and supplementary fan
Q18 Heater
S1 Injection control unit
S3 Injectors
S5 Air flow gauge
S6 Accelerator butterfly switch
S7 Engine coolant temperature sensor
S10 Lambda sensor
S12a Motronic relay (fuel pump)
S12b Motronic relay (with diode)
S12c Motronic relay (timing variator)
S12d Main Motronic relay
S13 Timing and r.p.m. sensor
S25 Connector for self diagnosis
S29 Idle r.p.m. actuator
S30 Map switching device connector



SPECIAL SERVICE TOOLS

Identification number	Name	
A.2.0423	Tool for clamping valve timing variator (use with A.5.0231, A.5.0232 and A.5.0242)	
A.2.0449	Tool for positioning of timing variator electro-magnet	
A.4.0199	Tool for checking the reference notches on the cam-shaft caps	
A.4.0221	Upper plate for tool A.4.0199	
A.5.0103	Wrench for turning cam shaft	
A.5.0232	Spanner for cam shaft gear fixing ring nut	
A.5.0242	Spanner for timing variator cover	

COMPLETE CAR

Identification number	Name	
A.5.0274	Wrench for mounting of timing variator on cam shaft	
C.1.0108	Dial thickness meter for valve caps	
C.1.0132	Universal trouble diagnosis instrument	
C.1.0136	Interface	
C.6.0122	Instrument for checking Top Dead Centre point	
C.6.0168	Feeler gauge for valve clearance	
C.9.0032	Interface-universal trouble diagnosis instrument connection lead	

GROUP 01

CONTENTS

REMOVAL AND REFITTING OF ENGINE . 01-2	REASSEMBLY OF ENGINE (*)
Foreword 01-2	Reassembly of cylinder head on
Removal 01-3	workbench (*)
Refitting 01-6	Reassembly of engine block (*)
View of engine compartment 01-8	Refitting of cylinder head (*)
View of under part 01-11	Preparation of engine (*)
ENGINE OVERHAUL (*)	LUBRICATION SYSTEM (*)
DISMANTLING OF ENGINE (*)	TECHNICAL DATA AND
Preliminary operations (*)	SPECIFICATIONS 01-13
Removal of cylinder head (*)	Technical data - engine 01-13
Dismantling of cylinder head on	Checks and adjustments (*)
workbench (*)	General specifications (*)
Dismantling of exhaust side cam shaft .. (*)	Tightening torques (*)
Dismantling of intake side cam shaft	FAULT FINDING AND CORRECTIVE
and timing variator (*)	ACTION (*)
Dismantling of engine block (*)	SPECIAL SERVICE TOOLS (*)
CHECKS (*)	
Cylinder head and valves (*)	
Timing variator (*)	
Engine block (*)	

REMOVAL AND REFITTING OF ENGINE



FOREWORD

This section contains all the data and procedures concerning the operations necessary for the removal and the refitting of the engine fitted in the Alfa Romeo vehicle:

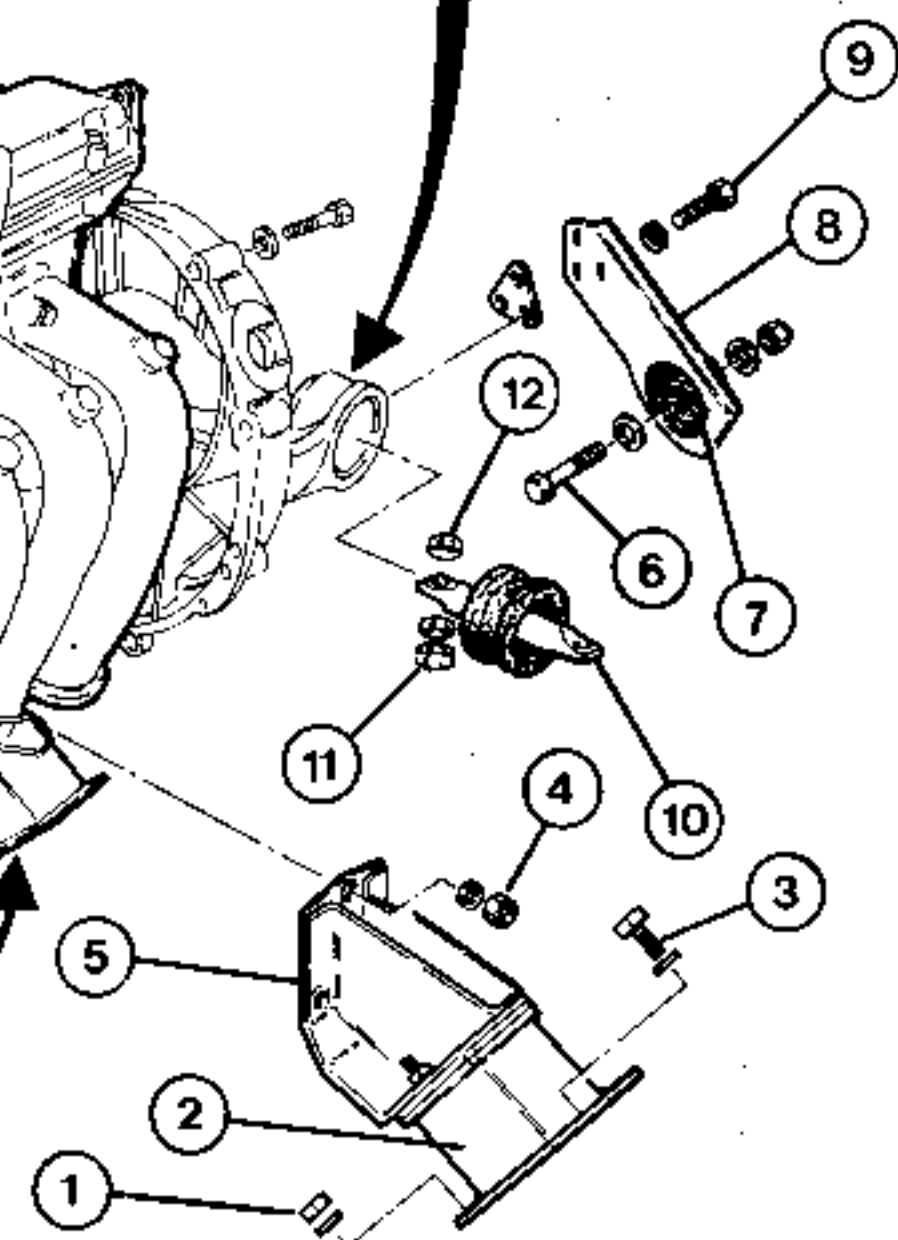
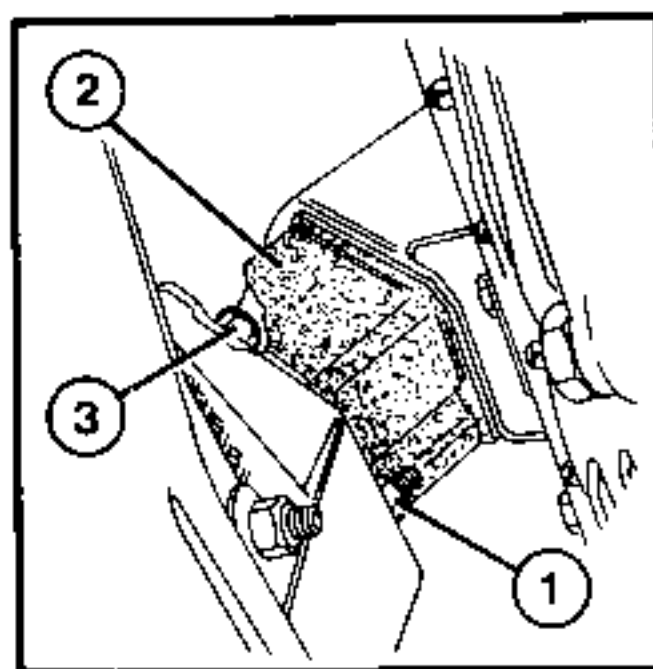
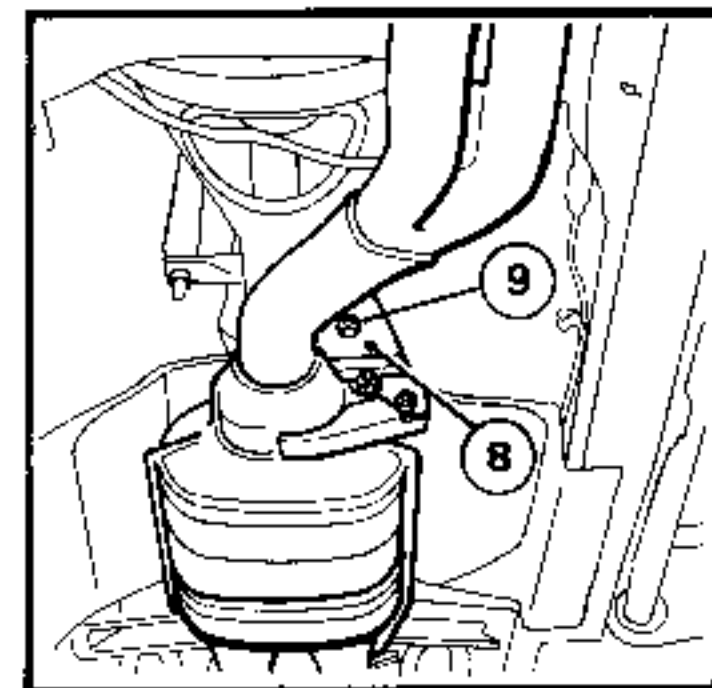
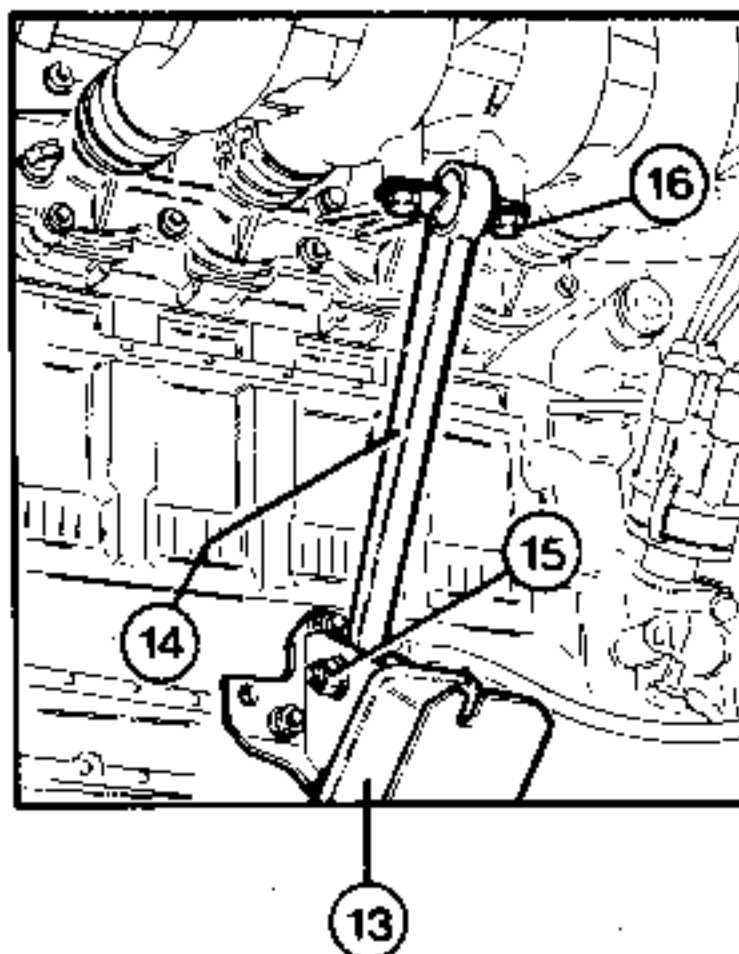


version with catalytic convertor

Given the large number and variety of the operations involved in the removal and refitting of the engine, it is recommended that the operator read the procedures carefully and examine the accompanying illustrations thoroughly in order to obtain a general overall understanding of the engine in question.

The knowledge thus obtained will enable the operator to acquire the correct operational techniques and prevent the oversight of technical data, cautions and warnings.

LOCATION OF ENGINE MOUNTINGS



1. Nut securing side mounting to the body
2. Elastic component of side mounting
3. Screw securing side mounting to the body
4. Nut securing mounting to engine block
5. Engine mounting - left side

6. Bolt securing exhaust tube bracket to rubber-type bushing
7. Rubber-type bushing for exhaust tube bracket
8. Exhaust tube support bracket

9. Screw securing bracket to flywheel housing cover
10. Rear engine mounting
11. Nut securing rear mounting to body
12. Spacer
13. Engine mounting - right side
14. Air intake support strut
15. Bolt securing strut
16. Screw securing strut to air intake

REMOVAL

1. Preliminary operations

- a. Place the vehicle on a hydraulic lift and stop the front wheels with appropriate wheel chocks.

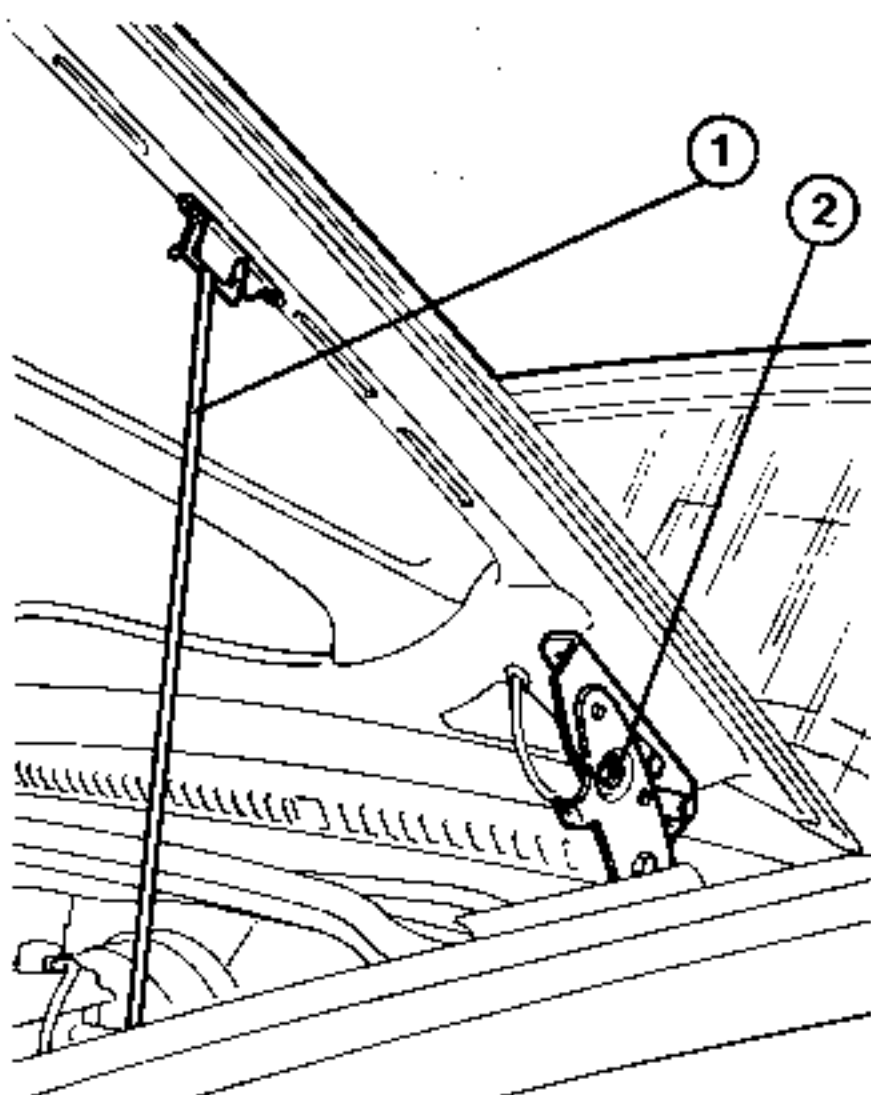
CAUTION:

If the engine is hot will be necessary to operate with care to avoid burns.

- b. Open the engine hood and support it with the rod (1).
Remove the bolts (2) that limit the movement of each hinge and open the hood as far as it will go.

WARNING:

Protect the resting surfaces of the hood with soft material.



1. Rod
2. Bolts

CAUTION:

For maximum safety, the operator is advised to secure the hood in the manner he feels best.
The non observance of this precaution may result in the sudden lowering of the hood.

For the following operations, refer to the figure «View of engine compartment» of the vehicle in question.

- c. Disconnect the positive terminal «+» and the negative terminal «-» of the battery (1).
- d. Unscrew the screw that secures the battery mounting bracket and if necessary remove the battery.
- e. Disconnect the servo-brake vacuum tube from the union on the servo-brake (2) by loosening the relative pipe clip (see detail A).

2. Removal of the air intake system

- a. Disconnect the connector (3) from the air flow gauge.
- b. Disconnect the following tubing from the air intake duct:
 - Peak r.p.m. oil vapour recycling tube (4).
 - By-pass tube for idle r.p.m. regulation (5).
- c. Loosen the clip (6) and disconnect the intake duct (7) from the accelerator housing.
- d. Loosen the clip (8) and remove the air intake duct (7) from the air flow gauge.
- e. Unhook the four spring clips securing the air filter cover (9) and remove it together with the air flow gauge.
Also remove the filter element.
- f. If it is felt to be necessary unscrew the three nuts (10) that secure the air filter container (11) to the body and remove it (see detail B).
- g. If it is felt to be necessary loosen the nut of the clip (62) and remove the air duct (63) of the air filter (see detail C).

CAUTION:

Suitably block the inlets of the air intake manifold so as to prevent the introduction of foreign matter.

3. Removal of radiator and tubing of cooling system

- a. Disconnect the following tubes and hoses, preferably removing them from the part indicated:
 - loosen the clip (12) and disconnect the coolant return hose (13) from the thermostat (see detail D);

- loosen the clip and disconnect the coolant delivery hose (14) from the water pump (see detail D);

NOTE:

Place a suitable container under the vehicle to collect the coolant liquid.

- loosen the clip and disconnect the coolant return tube (15) from the water pump (see detail D);
- loosen the clip and disconnect the radiator filler tube (16) from the three way joint (see detail D);
- loosen the clip and disconnect the breather tube (17) from the radiator;
- loosen the clip and disconnect the cooling system breather tube (18) from the single butterfly valve housing joint (see detail E).
- b. Disconnect the electric fan activating lead (20) from the thermoswitch fitted on the lower right part of the radiator (see detail F).
- c. Disconnect the electric fan power feed lead (21) from the flying connection (see detail F).
- d. Unscrew the securing screw (22) of the radiator (23) to the metal sheet of the body and remove the radiator together with the electric fan.

4. Removal of the fuel system

CAUTION:

- Operate with caution: the fuel supply system may be under pressure.
- Keep the tubing turned upwards in order to avoid spilling of fuel.
Also make sure that the workshop is adequately equipped, in order to be able to operate in safety.

- a. Disconnect the fuel return tube (24) from the pressure regulator (25) (see detail G).
- b. Disconnect the fuel delivery tube (26) from the hammering damper (27) (see detail H).

WARNING:

There may be residual pressure between the fuel pump and the hammering damper, which may give rise to a spray of petrol; suitably plug the disconnected tubing (26).

c. Disconnect the fuel vapour recycling tube (64), coming from the solenoid valve from the air intake manifold.

5. Disconnect the accelerator control cable

- Turn (forwards) the accelerator control cam right round and slide out the pawl of the accelerator cable (28) inserted in the end of the cam (see detail I).
- Remove the accelerator cable (28) from the support bracket (29) extracting it from below (see detail I).

6. Disconnection of electric leads

- Disconnect the following electric leads, removing them from the part indicated:
 - high tension lead (30) from the front spark plugs ignition coil;
 - high tension lead (31) from the rear spark plugs ignition coil;
 - minimum and maximum accelerator butterfly switch lead (33) from the respective switch (see detail E);
 - power supply lead (34) from the constant idle regulator actuator;
 - ground leads (35) of the injection system from the right side of the cylinder head cover;
 - engine oil pressure indicator lead (36) from the sensor fitted on the right side of the engine block (see detail M);
 - coolant temperature sensor lead (37) from the sensor fitted on the right part of the intake manifold (see detail M);
 - coolant temperature indicator lead (38) from sensor on rear part of cylinder (see detail M);
 - maximum coolant temperature warning lamp lead (39) from thermocontact on rear part of cylinder head (see detail M);

- r.p.m. and timing sensor lead (40) from connection fitted on right side of engine compartment (see detail N);
- engine ground lead (41), loosen screw on front right side of engine block near hydraulic steering pump (see detail O);
- minimum engine oil pressure warning lamp lead from the flying connection (42) near the alternator (see detail O);
- minimum engine oil level warning lamp lead (43), from the sensor contact fitted on the right side of engine block under the ignition distributor (see detail P);
- timing variator leads (44) from the respective connector on front right side of cylinder head;
- electric fuel injectors power supply leads (45) from the respective connectors;
- alternator power supply lead (46) and warning light lead (47) from the terminal board (48) fitted on the left side of the engine compartment (see detail Q);
- power supply leads (49) and exciting lead (50) from the starter motor (51) fitted on the right side of the rear cover (see detail R);
- lambda sensor connectors (65) and (66) situated on the rear part of the air intake manifold, remove the engine compartment protection (see detail T).

WARNING:

Detach the electric leads from any wire clips and separate them from the engine so as not to obstruct its removal.

7. Removal of compressor and air-conditioner

- Working from beneath the vehicle, remove the two bolts that secure the air conditioner compressor support bracket (52) to the engine block.
- Remove the compressor drive belt (53).
- Move the compressor (52) to the right side of the vehicle and secure it suitably.

d. If it is felt necessary, drain off the Freon and disconnect the compressor from the tube joints.

8. Removal of servo steering pump

- Loosen the securing screws of the belt tensioning pulley (54) and remove the servo steering pump drive belt (55).
- Loosen the three screws (56) securing the servo steering pump to the support.
- Move the servo steering pump (57) to the left side of the vehicle and secure it suitably.
- If it is felt necessary drain off or suck out using a syringe, the fluid from the tank (58) and disconnect the tubes from the servo steering pump.

9. Final operations

- Loosen, on both sides, but do not remove, the screws (59) that secure the upper part of the engine mountings to the metal sheet of the body (see detail S).
- Unscrew the two screws (60) that secure the upper part of the heat shield (61) from left engine mounting (see detail S).

For the following steps of the procedure, refer to the figure «View of the under part» of the vehicle in question.

10. Draining off oil

(if required, according to the operations to be carried out)

- Raise vehicle on hydraulic lift.
- Unscrew the plug (1) and drain off the engine oil. Screw plug back on when the operation is finished.

11. Removal of exhaust tube

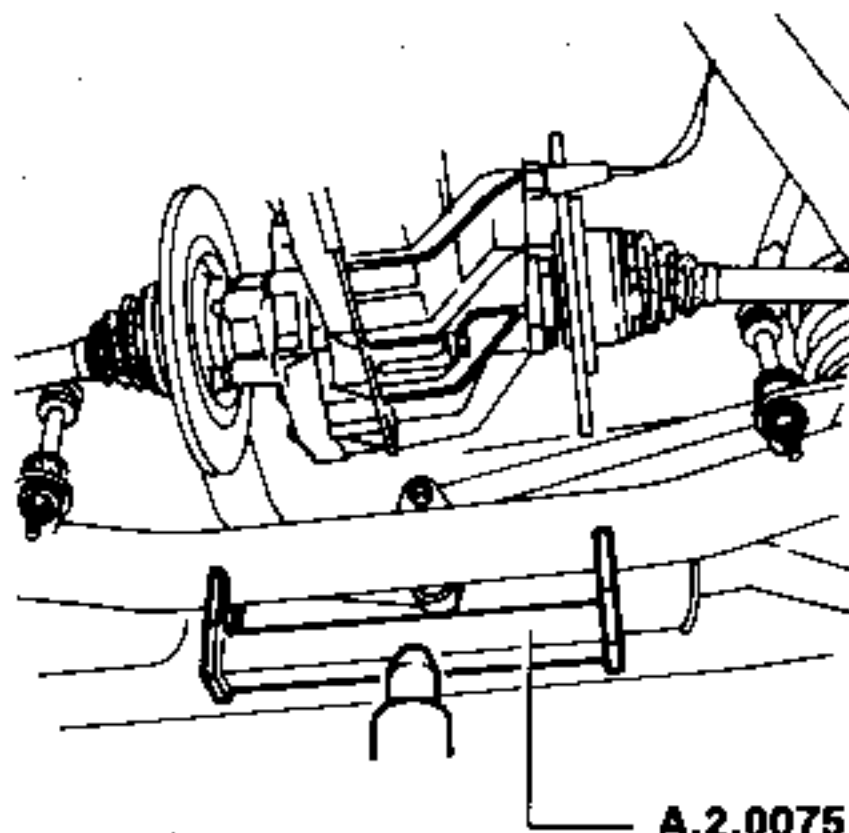
- Unscrew the screws and remove the heat shield from the catalytic silencer box (33).
- Remove the four nuts which washers (2) connecting the catalytic silencer box (3) of the exhaust tube to the exhaust manifold of the engine.
- Loosen the nut (4) that locks the pipe clip (5) connecting the central length of the exhaust tubing to the rear length (6) (see detail A).
- Remove the bolts (7) securing the catalytic silencer box to the bracket (8) at the end of the flywheel housing bell.

- e. Unhook the catalytic silencer box (3) from the elastic support rings (9) (see detail B).
- f. Unhook the central length from the elastic support rings and remove the complete exhaust tube from the rear length.
- g. Remove the two screws (10) that secure the lower part of the heat shield, fitted on the left engine mounting, and remove the shield (11).

12. Removal of the propeller shaft

- a. Remove the four screws and remove the upper heat shield (34) of the silencer box.
- b. Remove the central cross piece (13) unscrewing the screws (12) securing it to the body.
- c. Slip off the protective boot (14) and unscrew and remove the bolt (15) connecting the gear selector rod (16) (see detail C). If it is felt to be necessary, unscrew the screws (17) securing the gear lever support (18) and move it so as to facilitate the removal of the propeller shaft (see detail C).
- d. Unscrew the bolts (19) and remove the panel (20) protecting the flywheel (see detail E).
- e. With the gear lever in neutral and turning the propeller shaft (21) appropriately, unscrew alternately the nuts (22) and the bolts (23) that connect the shaft to the flywheel and the clutch fork respectively (see details D and F).
- f. Unscrew the two screws (24) and disconnect the stud (25) of the rear engine mounting from the body (see detail G).
- g. Unscrew the two nuts (26) and disconnect the central support (27) of the propeller shaft from the body (see detail C).
- h. Unscrew the six screws (28) securing the rear cross piece (29) to the body and remove it (see detail B).
- i. Raise the rear axle with a column-type jack equipped with cradle A.2.0075 and slip the propeller shaft off from the clutch fork.

- j. Lower the jack and remove the propeller shaft.

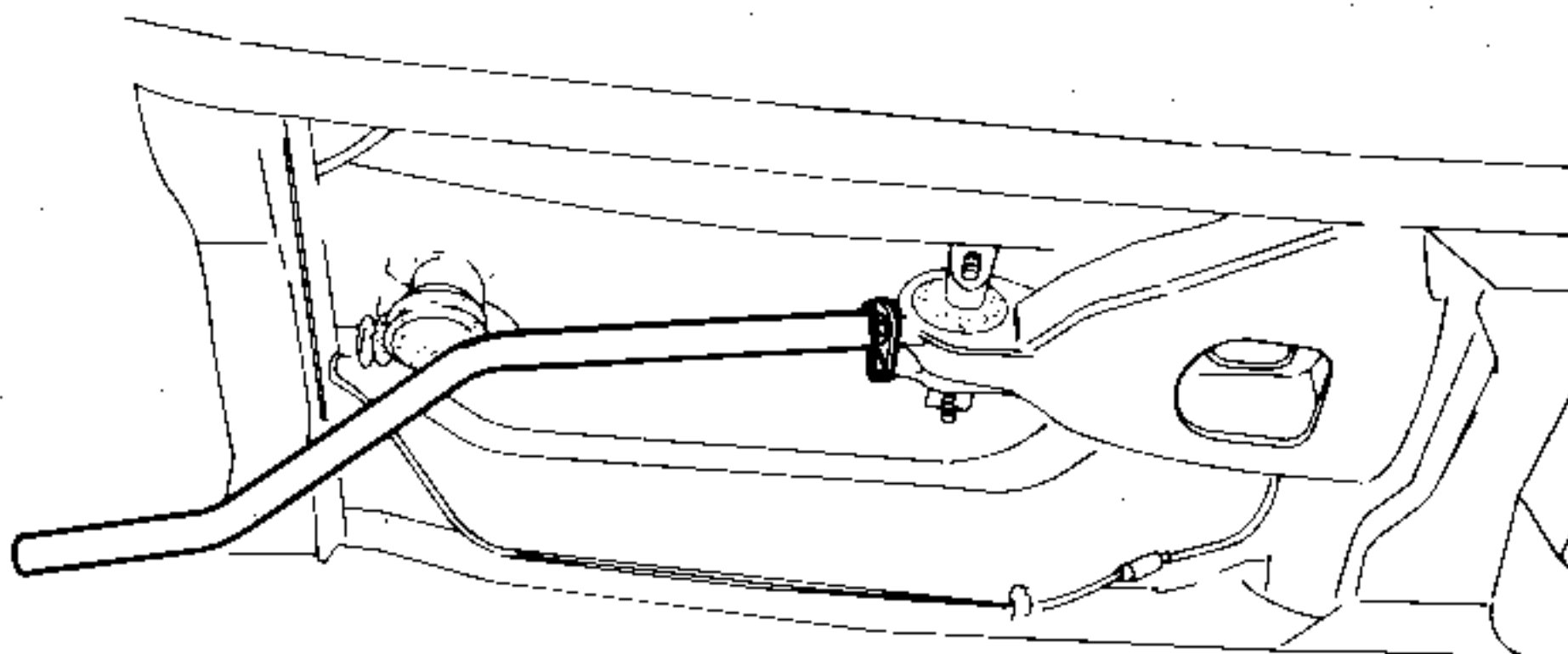


13. Final operations

- a. Fit a suitable lever on the rear engine mounting so as to facilitate the operation of the removal of the engine.
- b. Unscrew and remove the lower securing nuts (30) of the side engine mountings (31) (see detail H).
- c. Lower the hydraulic lift and unscrew and remove the upper securing screws (32) of the side engine mountings (31) (see detail H).
Raise the hydraulic lift again.
- d. Attach the engine to the lifting gear, raise it with an adequate hoist and remove it from the engine compartment manoeuvring it with the lever attached to the rear engine mounting.

CAUTION:

If necessary disconnect the central spark plug leads and remove the spark plugs themselves.



REFITTING

For the following steps of the procedure refer to the figure «View of the under part» of the vehicle in question.

1. Preliminary operations

- Fit the manoeuvring lever on the rear engine mounting.
- Attach the engine to suitable lifting gear and using a hoist, let it fall gently into the engine compartment, manoeuvring it by the manoeuvring lever.
- Centre the engine in the engine compartment resting it on the two side mountings and making sure that the holes for screws and bolts are aligned for both the mountings.
- Insert and fully tighten the screws (32) securing the elastic mountings (31) to the body (see detail H) on both sides.
- Raise the vehicle and screw and fully tighten the nuts (30) securing the lower part of the elastic mountings to the body (see detail H) on both sides.
- Remove the manoeuvring lever from the rear engine mounting.

2. Refitting of the propeller shaft

- Carry out the refitting of the complete propeller shaft by reversing the procedure described at step 12. «Removal» taking into account the following:
 - Lubricate the front bushing of the propeller shaft and the spherical seating of the rear joint with 5 cm³ of ISECO MOLYKOTE BR2 grease.
 - If necessary use the same grease to grease the flywheel of the engine.
- From time to time lock the propeller shaft, preventing it from rotating using the method which is felt to be most suitable and then fully tighten the nuts (22) and the bolts (23) of the elastic joints to the specified tightening torque:

T : Tightening torque
Nuts and bolts securing the propeller shaft elastic joints to the flywheel and the clutch fork
 55 ÷ 57 N·m
 (5.6 ÷ 5.8 kg·m)

WARNING:
 When refitting use new self-locking nuts.

- Tighten the nuts (26) securing the central support (27) of the propeller shaft

to the floor of the vehicle to the specified torque.

T : Tightening torque
Nuts securing the central support of the propeller shaft
 93 ÷ 103 N·m
 (9.5 ÷ 10.5 kg·m)

- Fix the stud (25) of the rear engine mounting to the body by means of the two screws (24).
- Refit the flywheel protection panel (20) tightening the bolts (19).
- Refit the gear selector rod (16) by means of the bolt (15) tightening it to the specified torque and then fit on the protective boot (14).

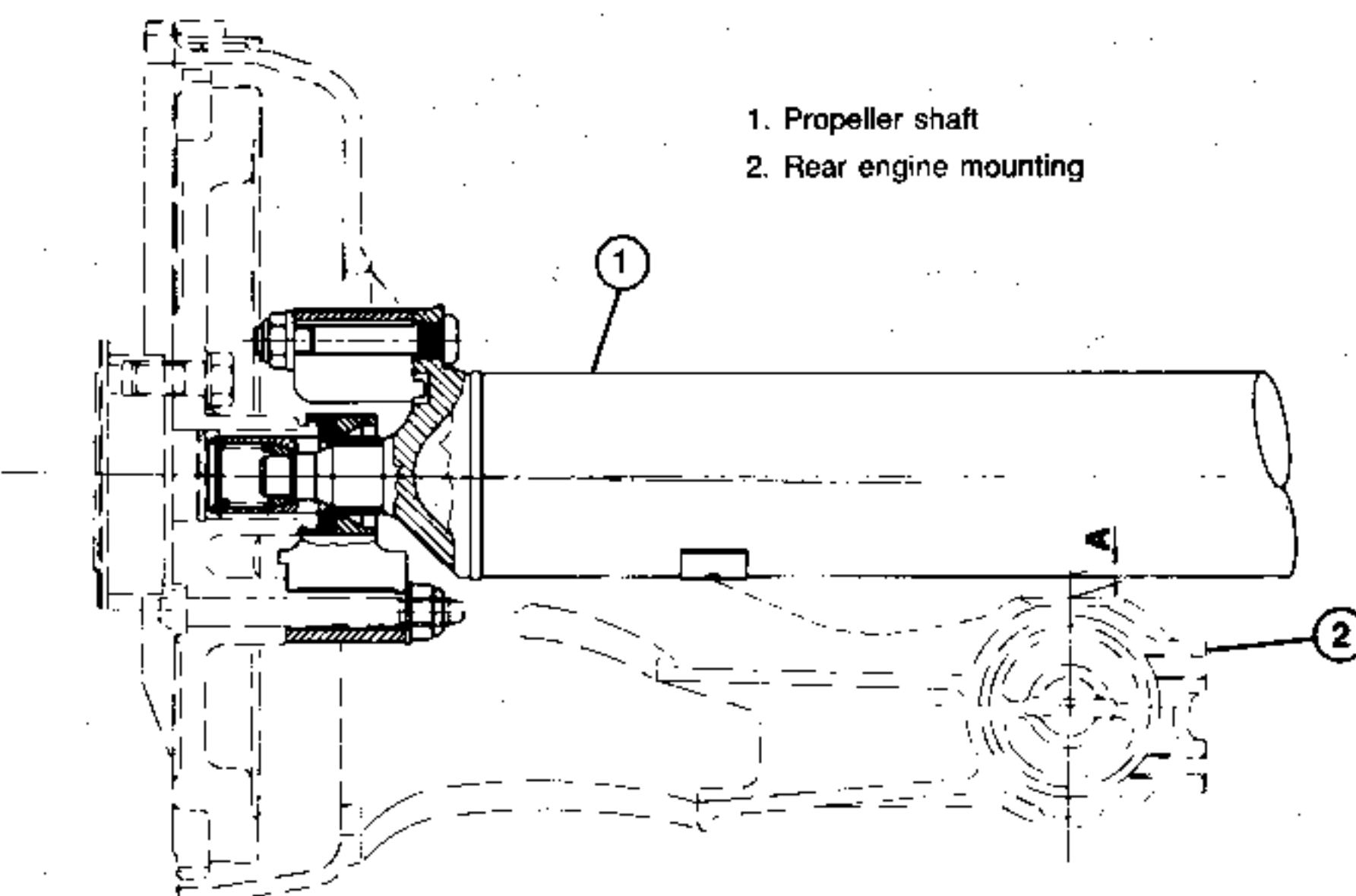
T : Tightening torque
Nut securing the gear selector rod to the rear lever
 13 ÷ 16 N·m
 (1.3 ÷ 1.6 kg·m)

- Fit the central cross piece (13) to the body, tightening the screws (12).
- Tighten, to the specified torque, the screws (28) securing the gear box assembly support cross piece (29) to the body.

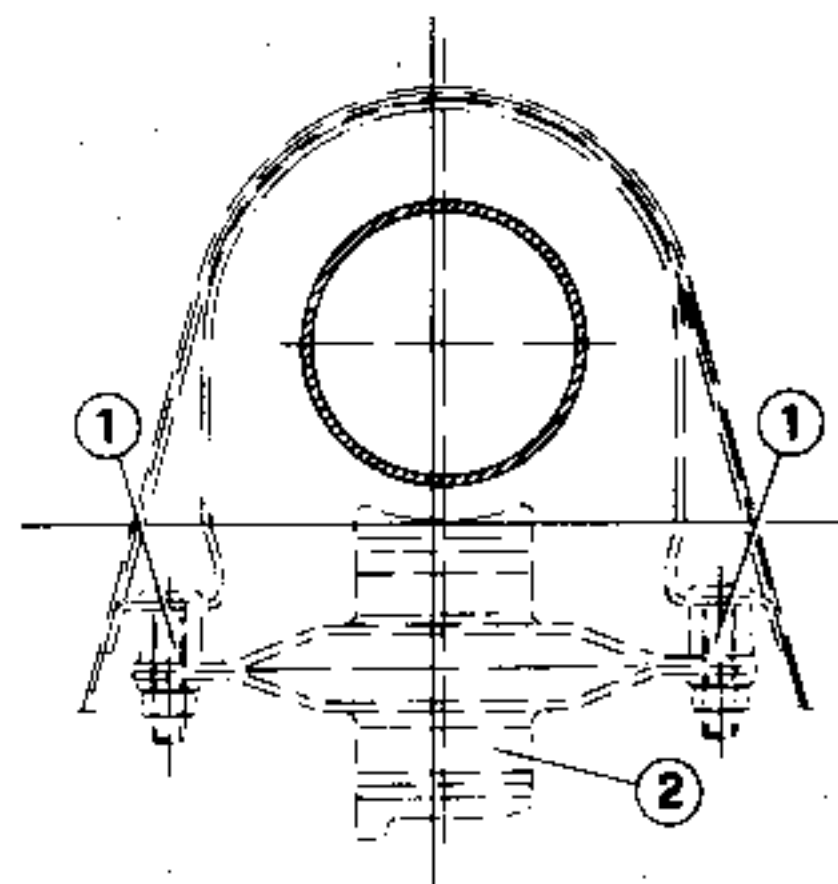
T : Tightening torque
Screw securing the gear box assembly support cross piece to the body
 39 ÷ 44 N·m
 (4.0 ÷ 4.5 kg·m)

- Check that the distance «A» between

Distance «A» between the propeller shaft and the rear engine mounting
 A = 7 mm



the propeller shaft and the rear engine mounting is equal to the specified distance.
 h. If the distance is not equal to that specified, vary accordingly the length of the spacers (1) between the engine mounting (2) and the body.



3. Refitting of the exhaust tube

- Position the catalytic silencer (3) on the elastic support rings (9).
- Position the central length of the exhaust tube on the elastic support rings and connect it to the rear length (6) without tightening the nut (4) of the pipe clip (5).
- Tighten the bolt (7) that secures the catalytic silencer box (3) to the bracket (8) at the end of the flywheel housing bell.

- d. Shake the exhaust tube a little so as to seat it properly.
- e. Fully tighten the nuts with washers (2) that secure the catalytic silencer box to the exhaust manifold of the engine and lock the pipe clip (5) tightening the nut (4).
- f. Fit the catalytic silencer heat shield (33) tightening the respective screws.

For the following steps in the procedure refer to the figure «View of the engine compartment» of the vehicle in question.

4. Refitting of servo steering pump

- a. Position the servo steering pump (57), fix it to the support and tighten the screws (56).
- b. Fit the drive belt (55) on the pulley, move the belt tensioner pulley (54) upwards until the specified tension is reached and then tighten the screws securing the belt tensioner pulley.

Load to be applied to the middle part of the belt:
 $P = 147 \div 294 \text{ N (15} \div 30 \text{ kg)}$

Camber:
 $F = 13 \text{ mm}$

- c. If operations have been carried out on the servo steering system restore the system to proper working order operating as follows:

- Reconnect the tubes to the servo steering pump observing the following tightening torques:

T : Tightening torques
Oil return tube fitting on servo steering pump fitting
 $45 \div 50 \text{ N} \cdot \text{m}$
 $(4.3 \div 5.1 \text{ kg} \cdot \text{m})$

Oil delivery tube fitting on servo steering pump fitting
 $28 \div 31 \text{ N} \cdot \text{m}$
 $(2.9 \div 3.2 \text{ kg} \cdot \text{m})$

- Refill the reservoir (58) with the specified fluid (AGIP ATF DEXRON B 11297; IP DEXRON FLUID B 11297) filling it completely full.
- On the pump fitting, loosen the fitting securing the oil return tube from the pump reservoir until the fluid comes out and until all the air is expelled.

- Tighten the fitting to the specified torque.
- With the engine refitting completed, start the engine and top up the reservoir until the level is stabilised.
- With the engine running turn the steering wheel putting on a few full locks, both left and right, and then top up the reservoir to the «MAX» reference mark.
- Refit the reservoir filler cap.

5. Refitting of the air-conditioner compressor

- a. Refit the lower bracket of the air-conditioner compressor (52) to the engine block securing it to the vehicle with the relative bolts.
- b. Refit the compressor drive belt (53).
- c. Restore the correct tension to the compressor drive belt and tighten the nut.

Load to be applied to the middle part of the belt:
 $P = 78 \text{ N (8 kg)}$

Camber:
 $F = 10 \div 15 \text{ mm}$

- d. If disconnected fit the tube fittings to the compressor (52) and refill with Freon.

6. Refitting of radiator

Refit the radiator together with the electric fan and then reconnect the tubes of the cooling system, proceeding in the reverse order to that described in «Removal» at step 3.

7. Refitting of the air filter

Refit the air filter and then reconnect the air feed tubes, proceeding in the reverse order to that described in «Removal» at step 2.

8. Fuel supply system

Restore the fuel supply system proceeding in the reverse order to that described in «Removal» at step 4.

9. Refitting of the accelerator control cable

Reconnect the accelerator cable proceeding in the reverse order to that described in «Removal» step 5.

10. Electrical connections

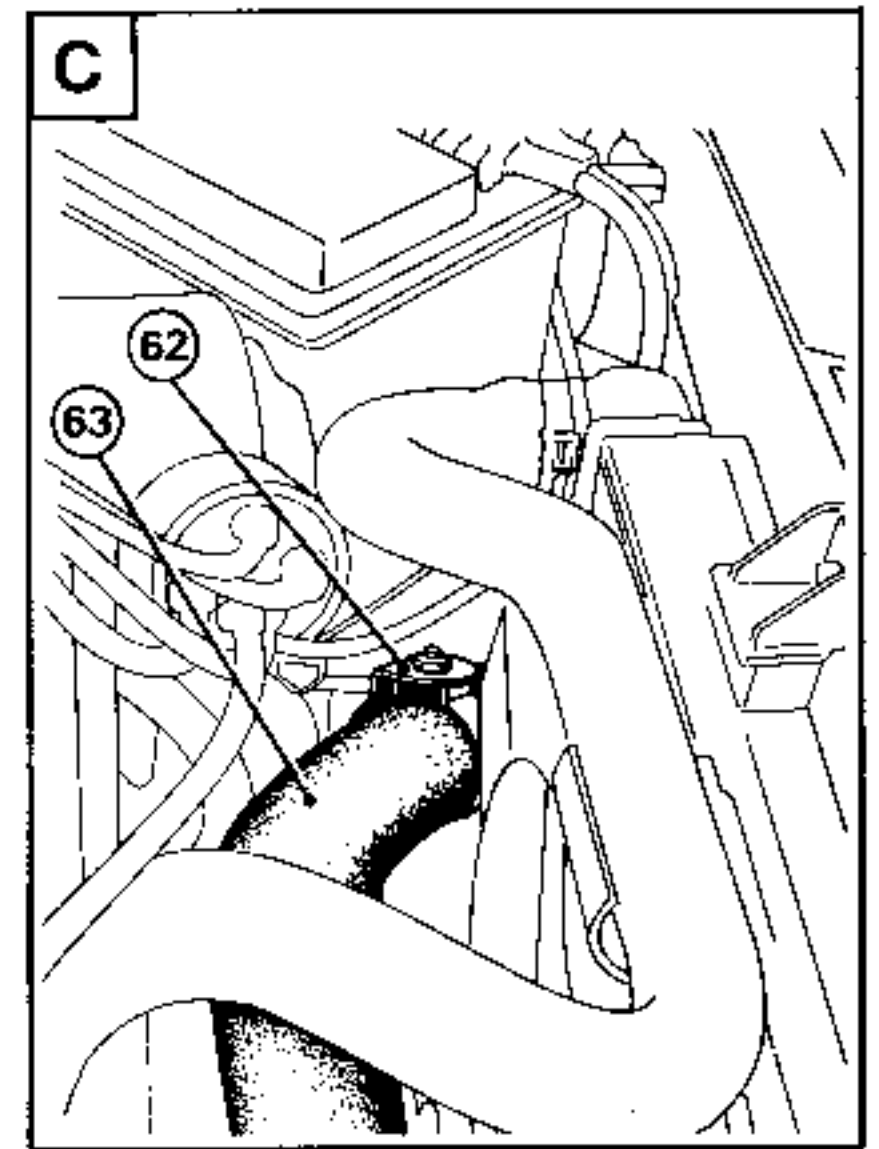
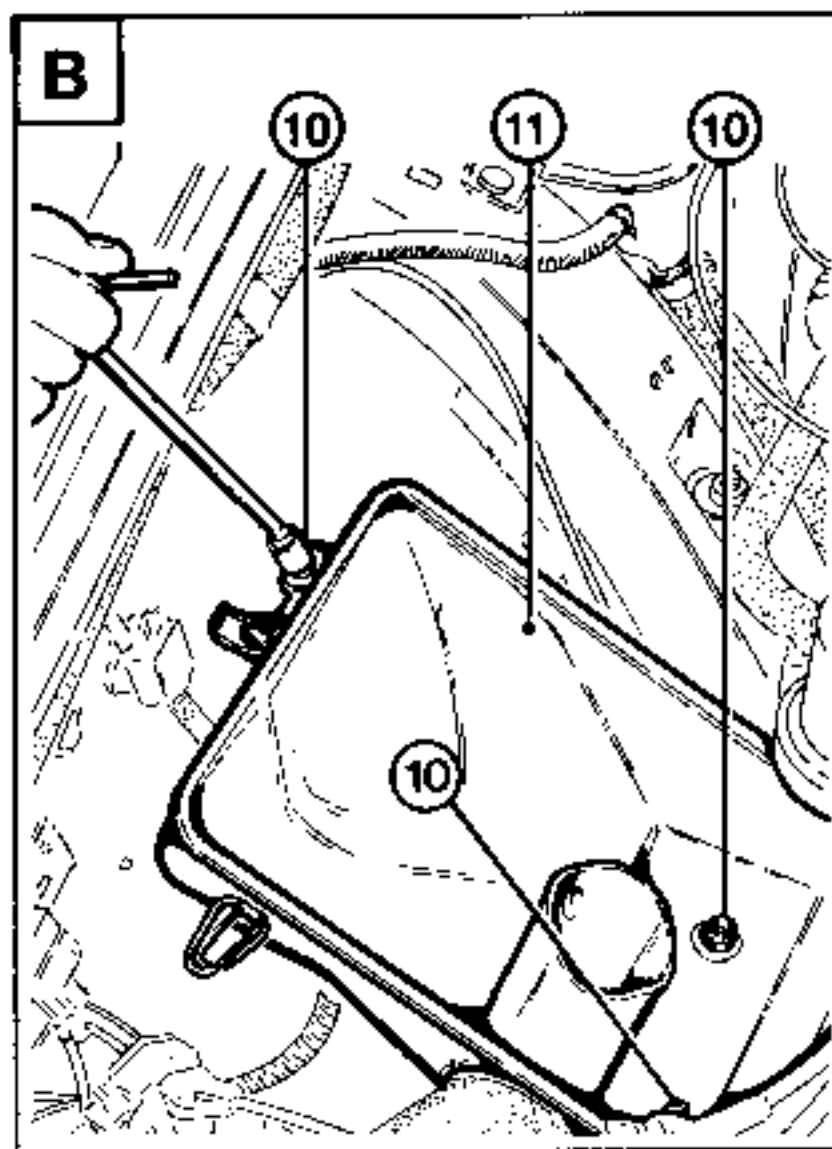
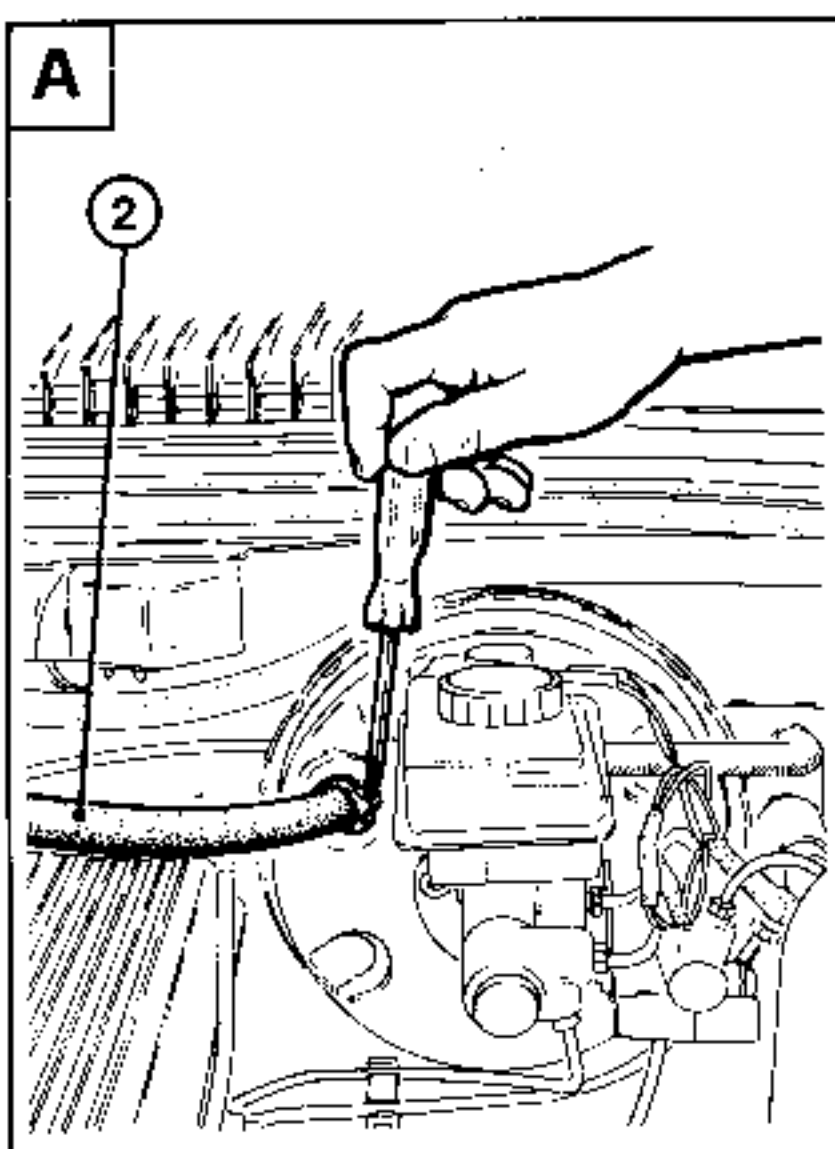
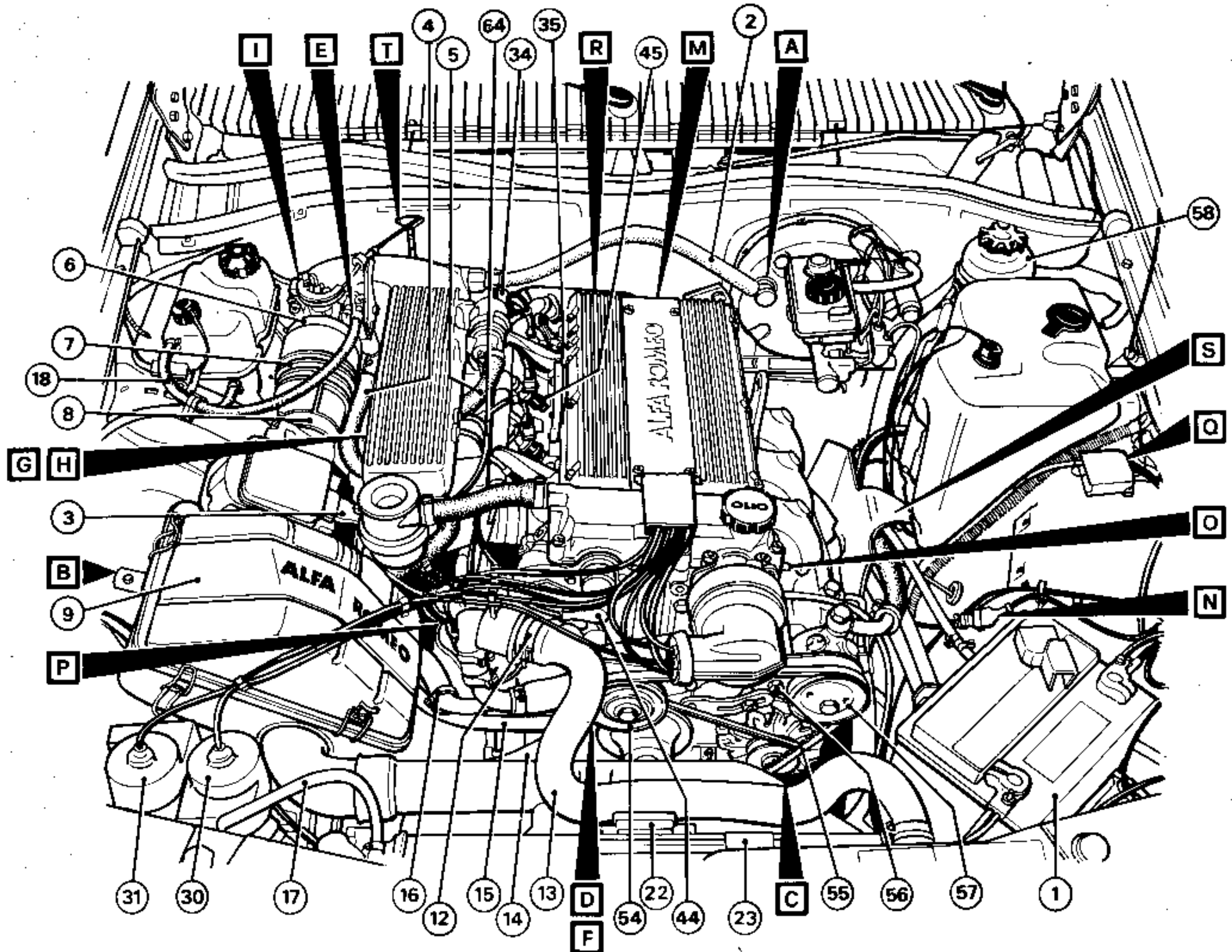
Restore the electrical connections proceeding in the reverse order to that described in «Removal» at step 6.

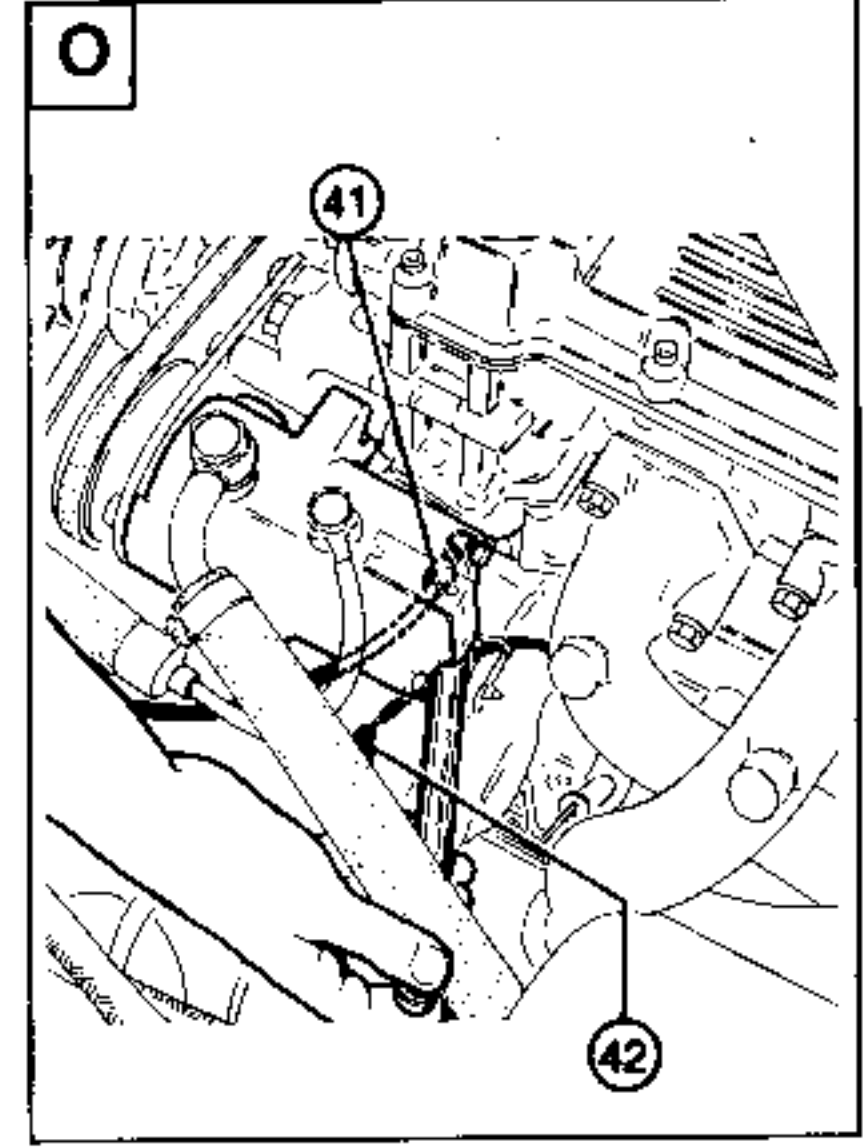
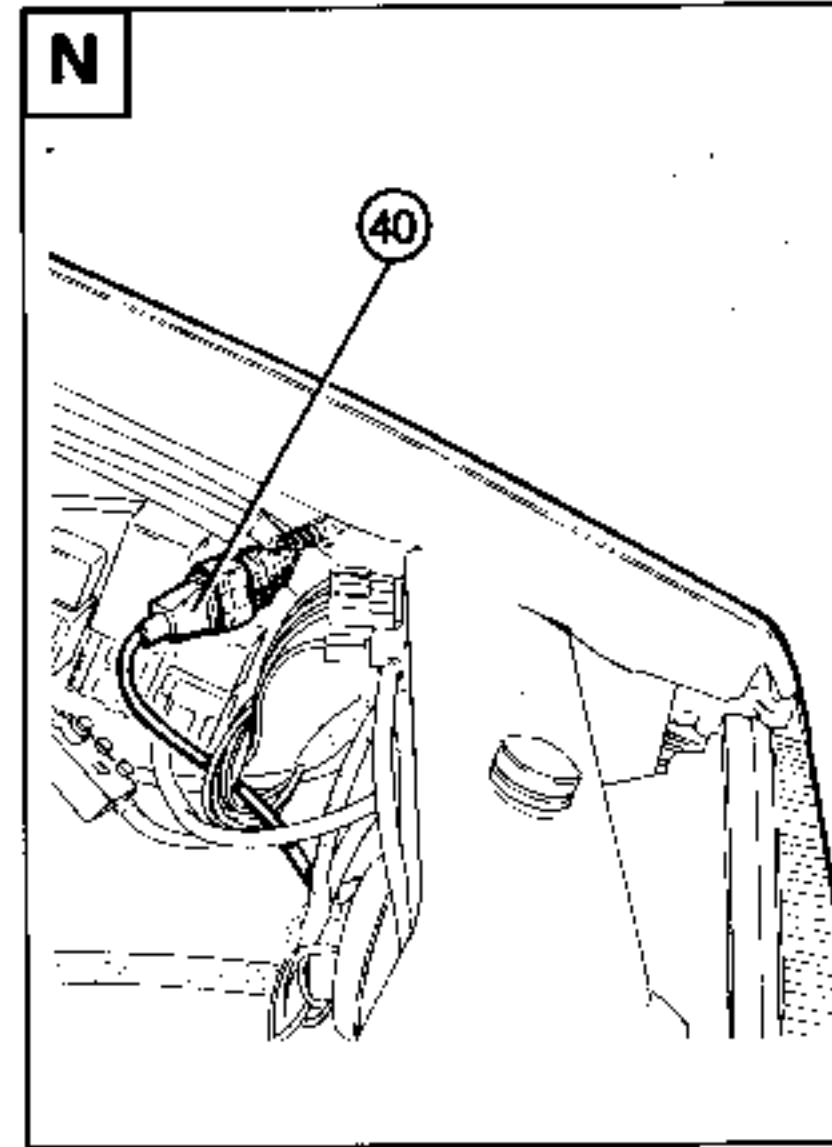
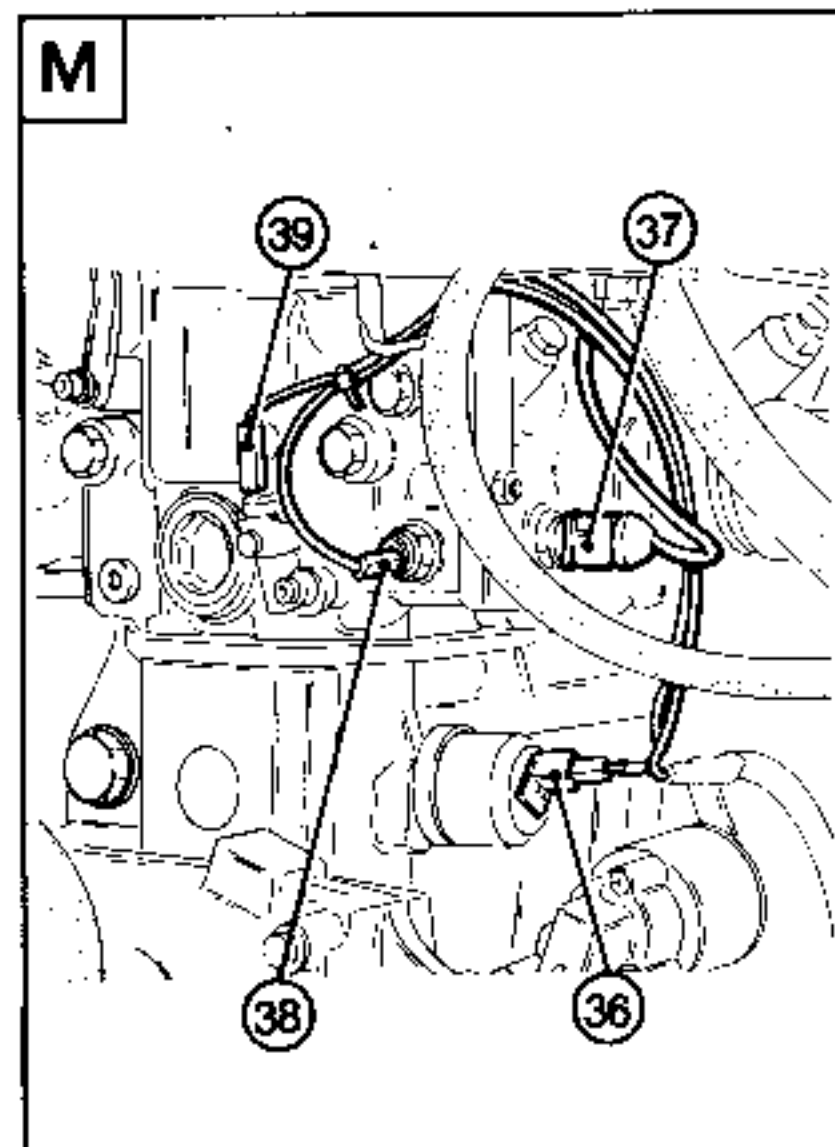
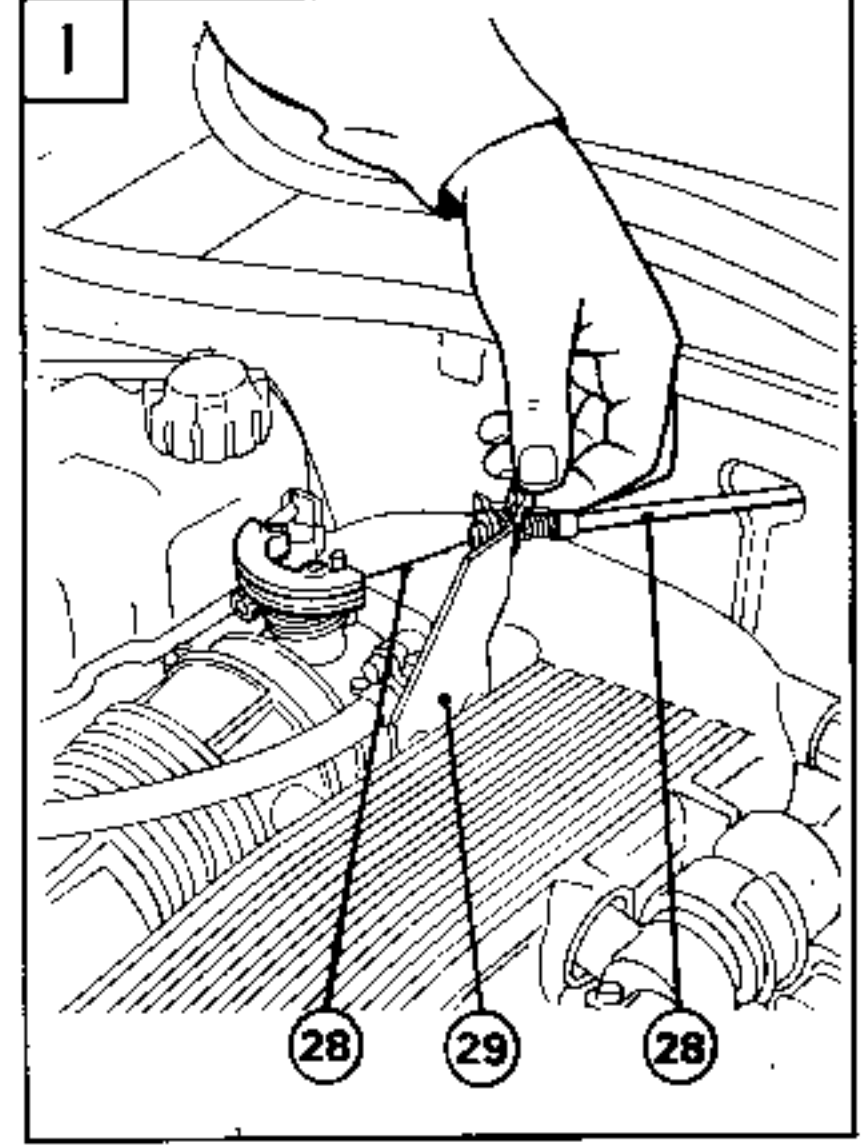
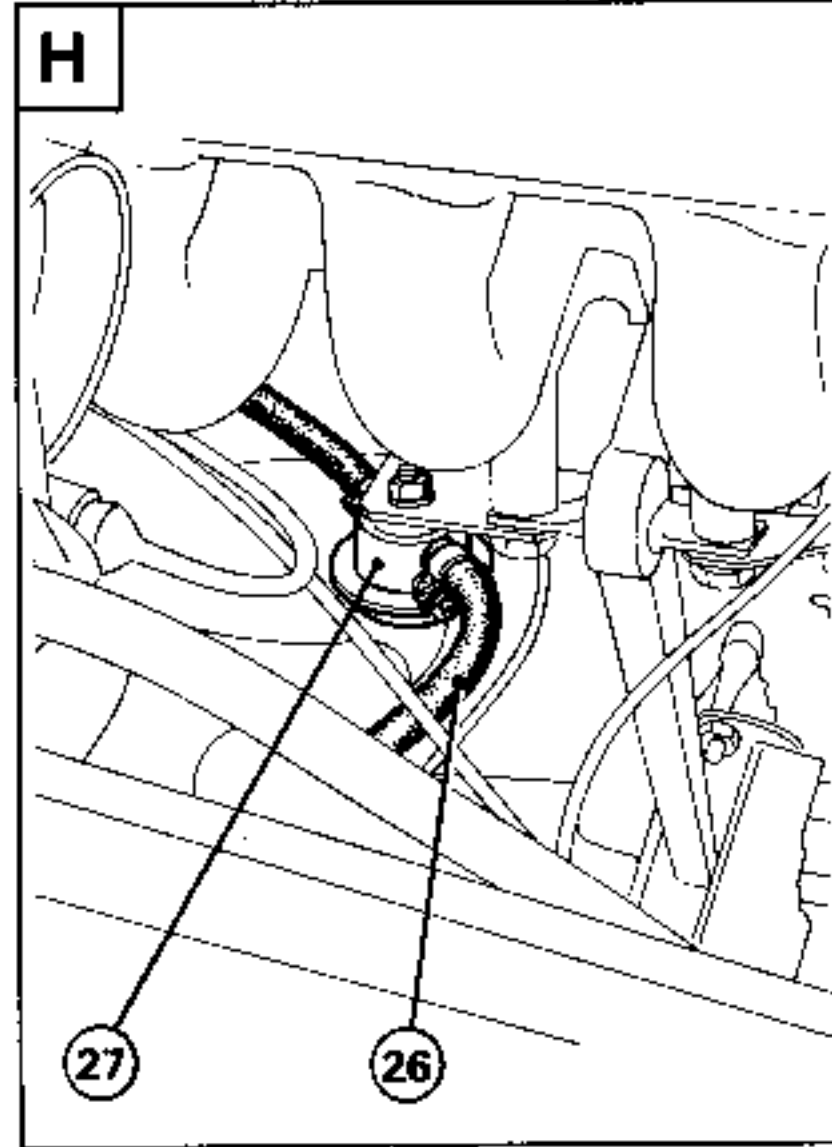
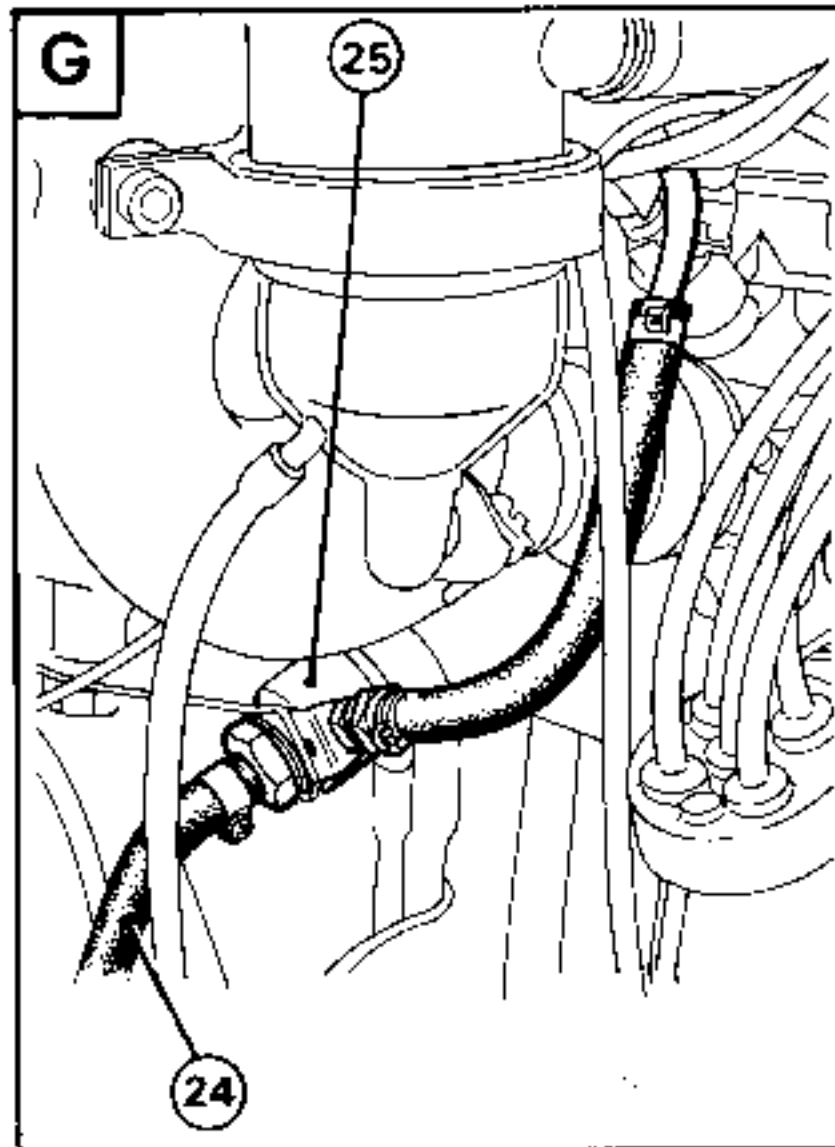
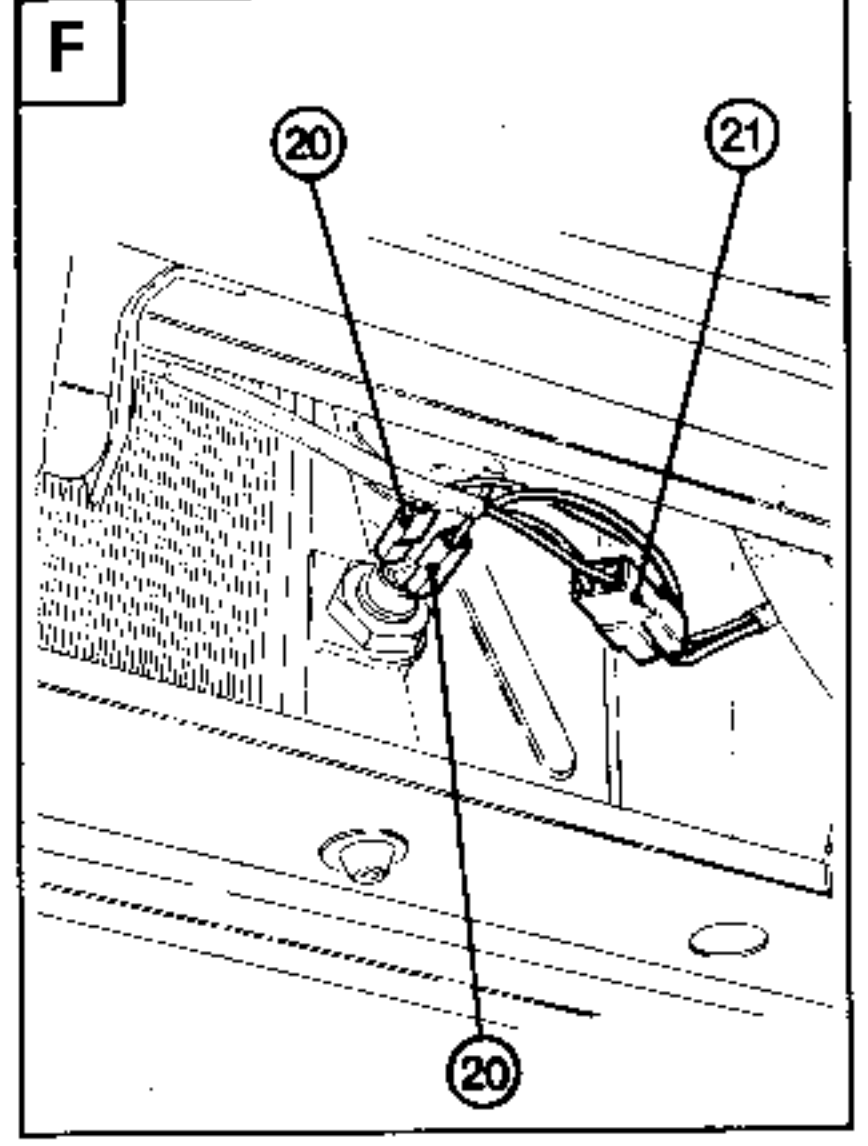
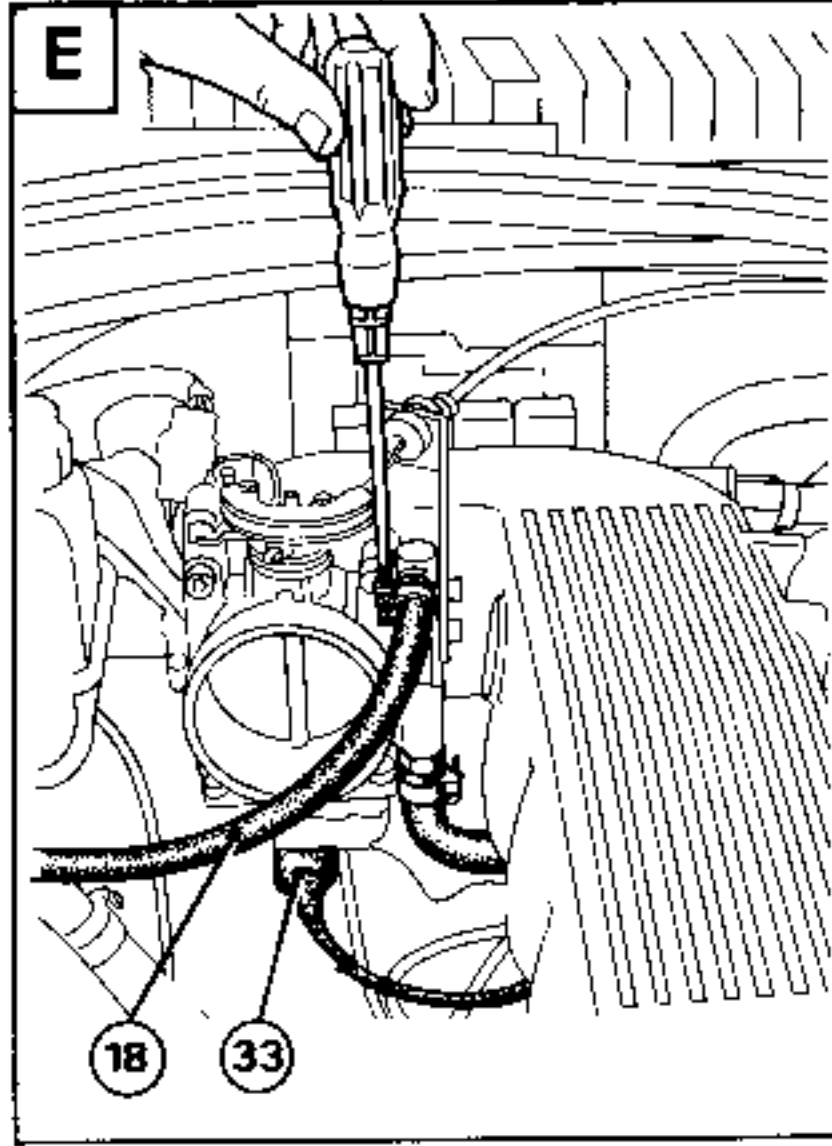
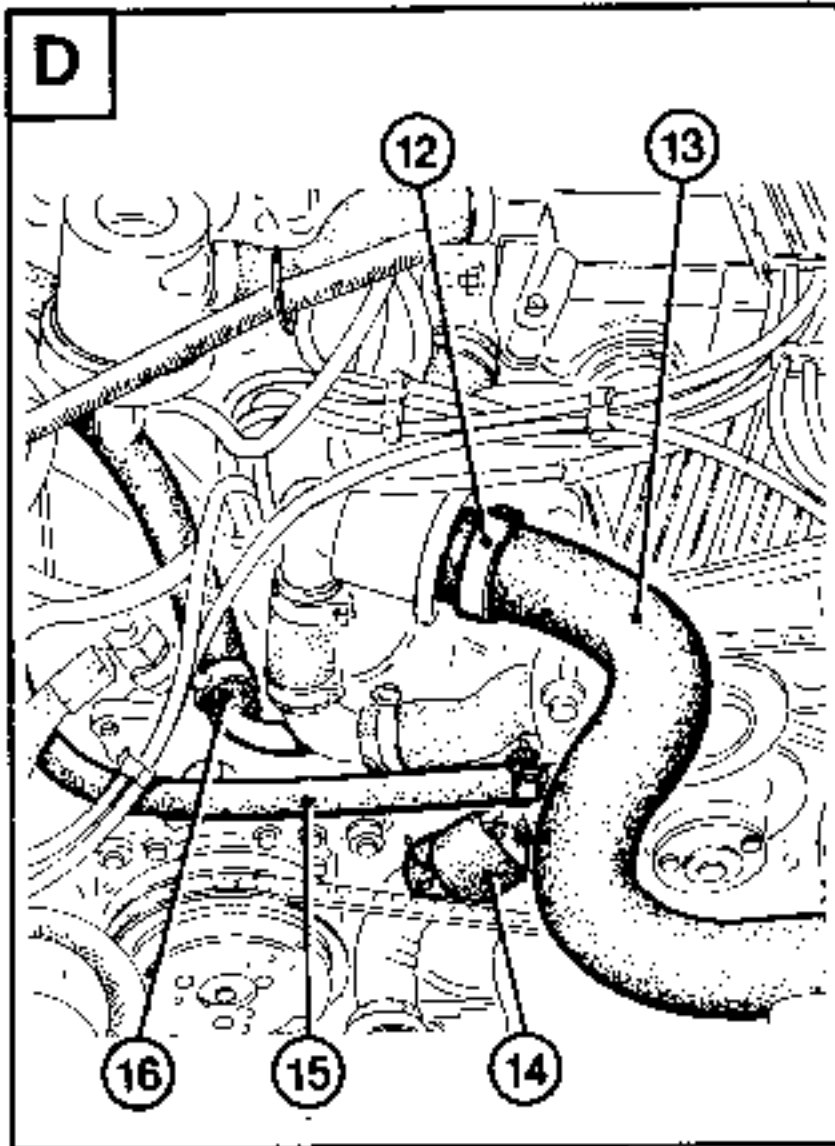
11. Final operations

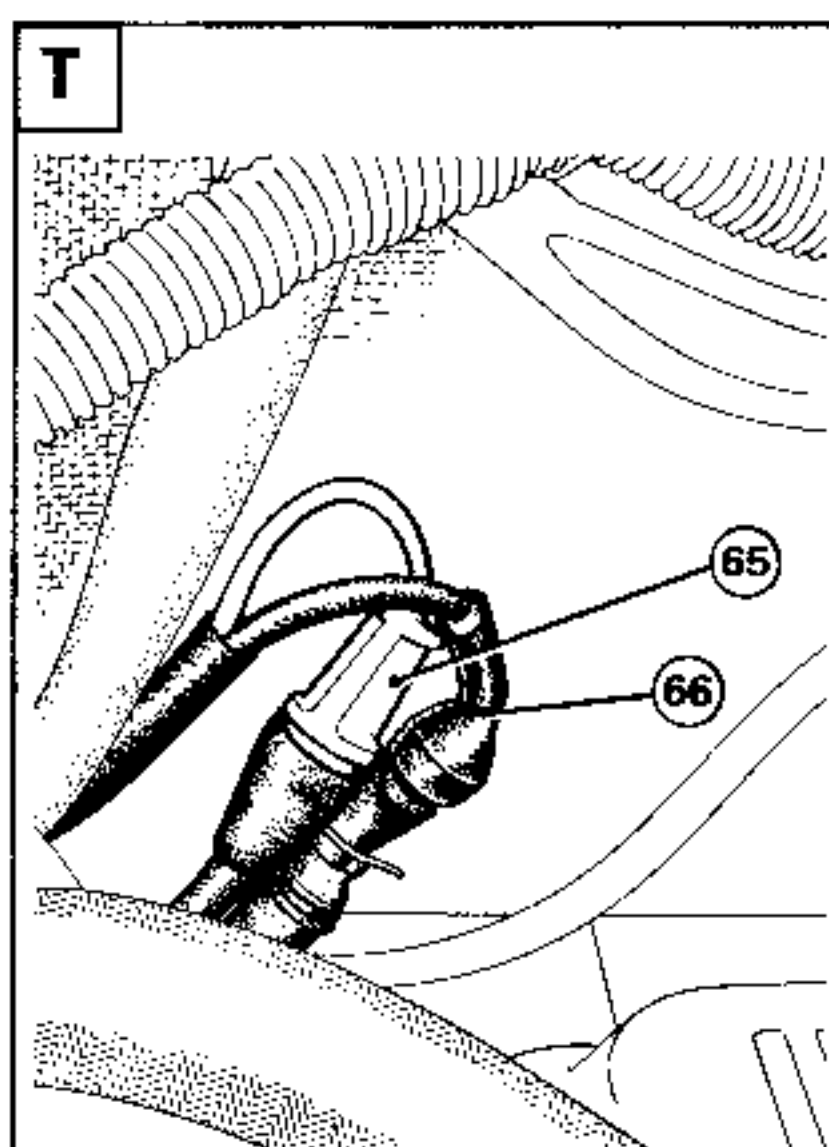
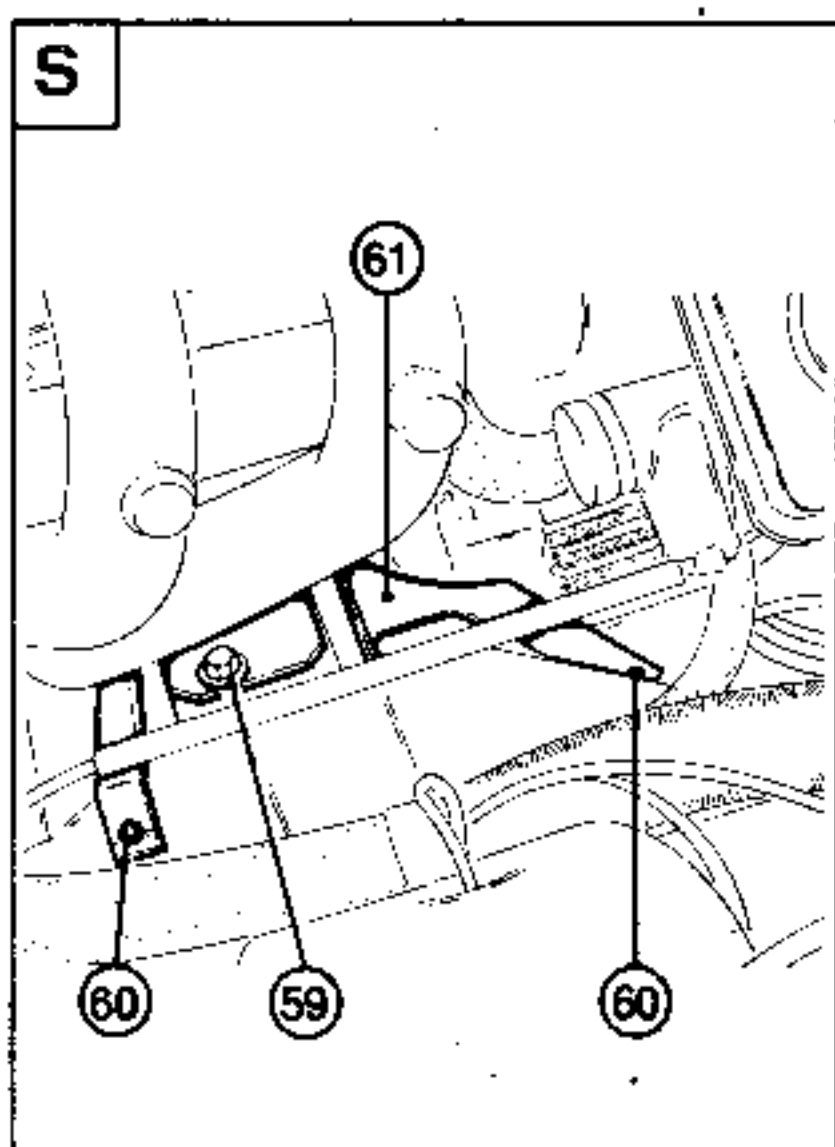
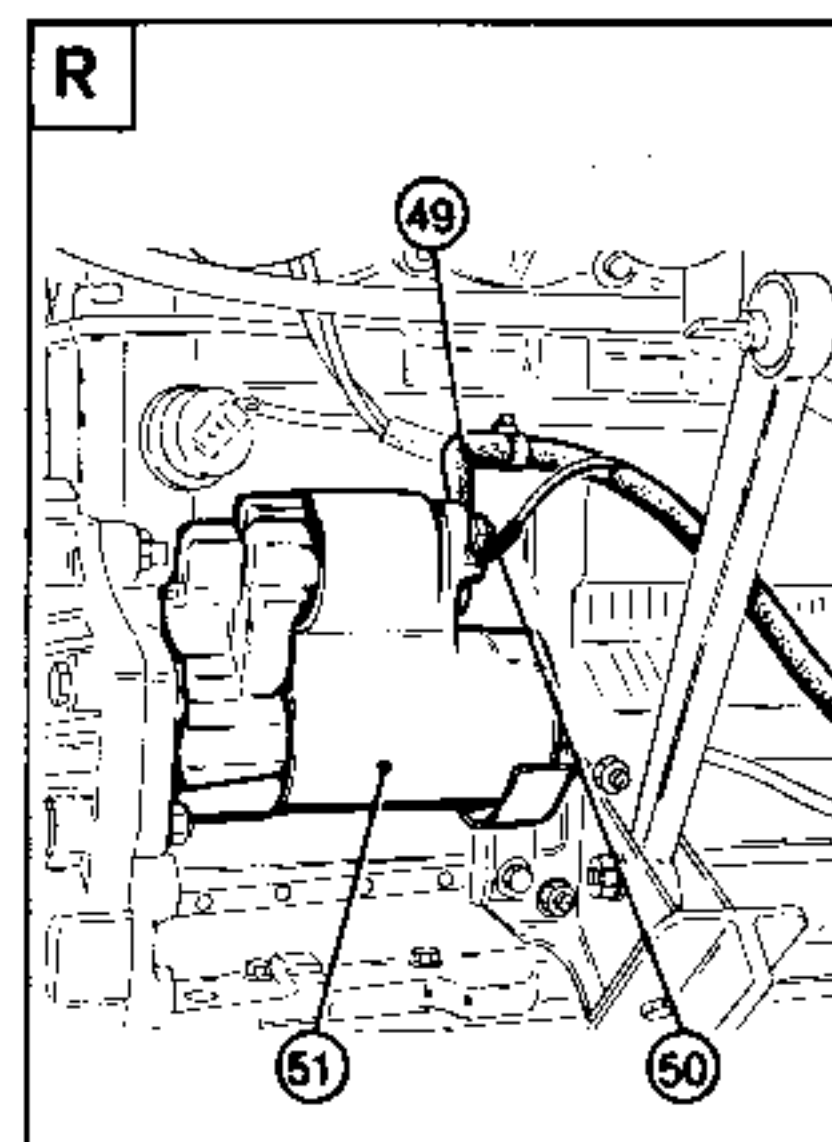
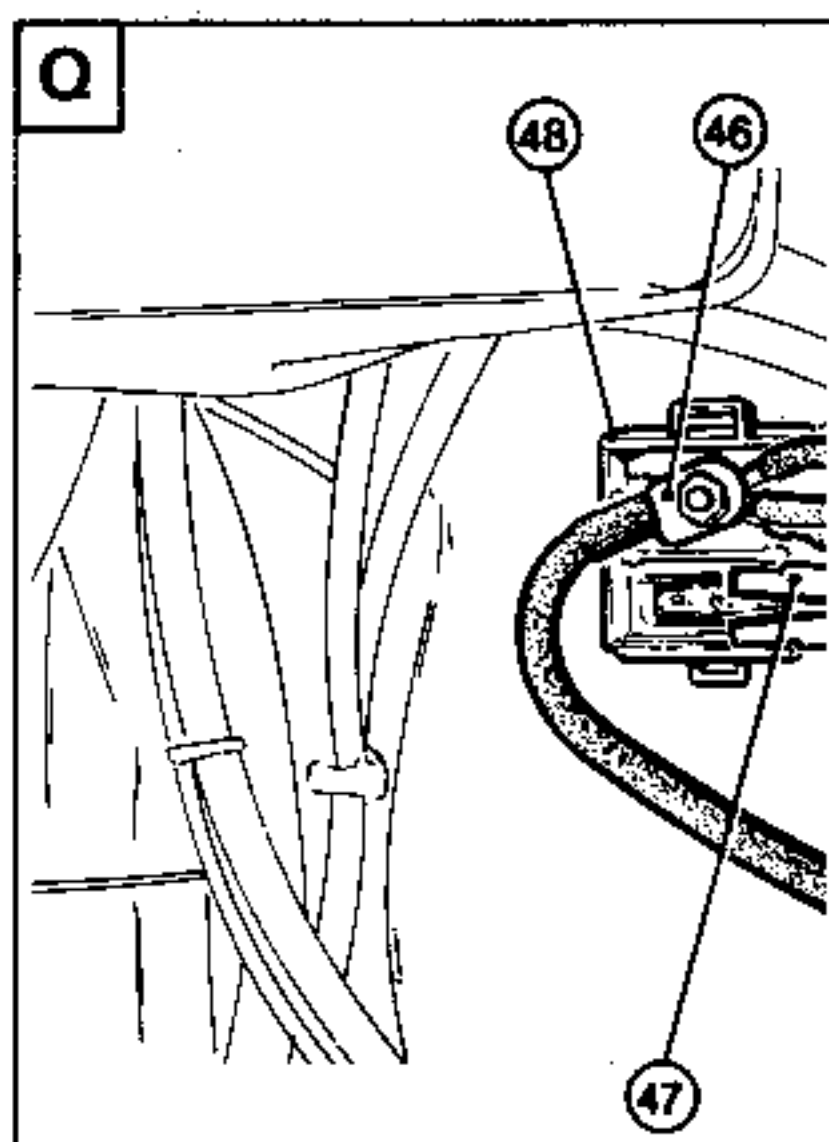
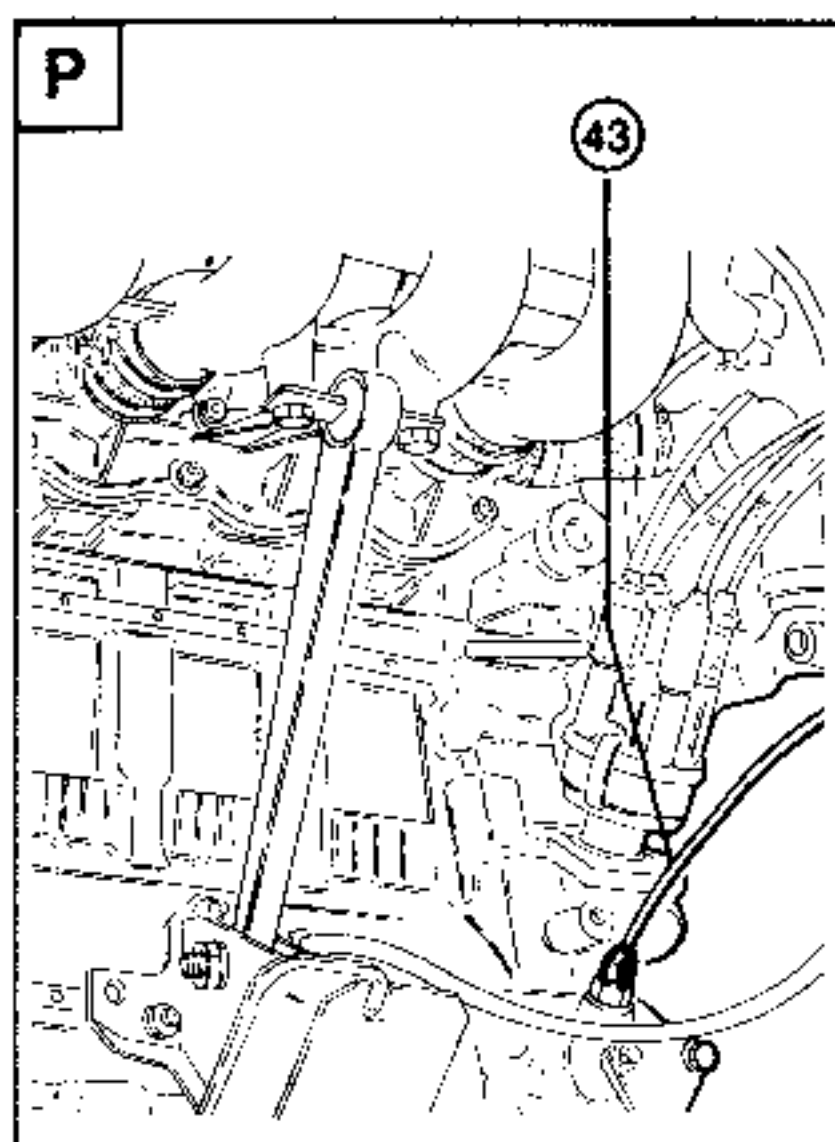
- a. Reconnect the servo brake vacuum tube (2) to the fitting on the servo brake.
- b. Position the battery (1) in its compartment and secure it with the relative mounting bracket. Reconnect the battery terminals.
- c. For filling and checks refer to the paragraph «Engine maintenance» — Group 00.
- d. Release the engine hood, support it and re-attach the hinge securing bolts on both sides of the vehicle.

ENGINE MAIN MECHANICAL UNIT

VIEW OF ENGINE COMPARTMENT







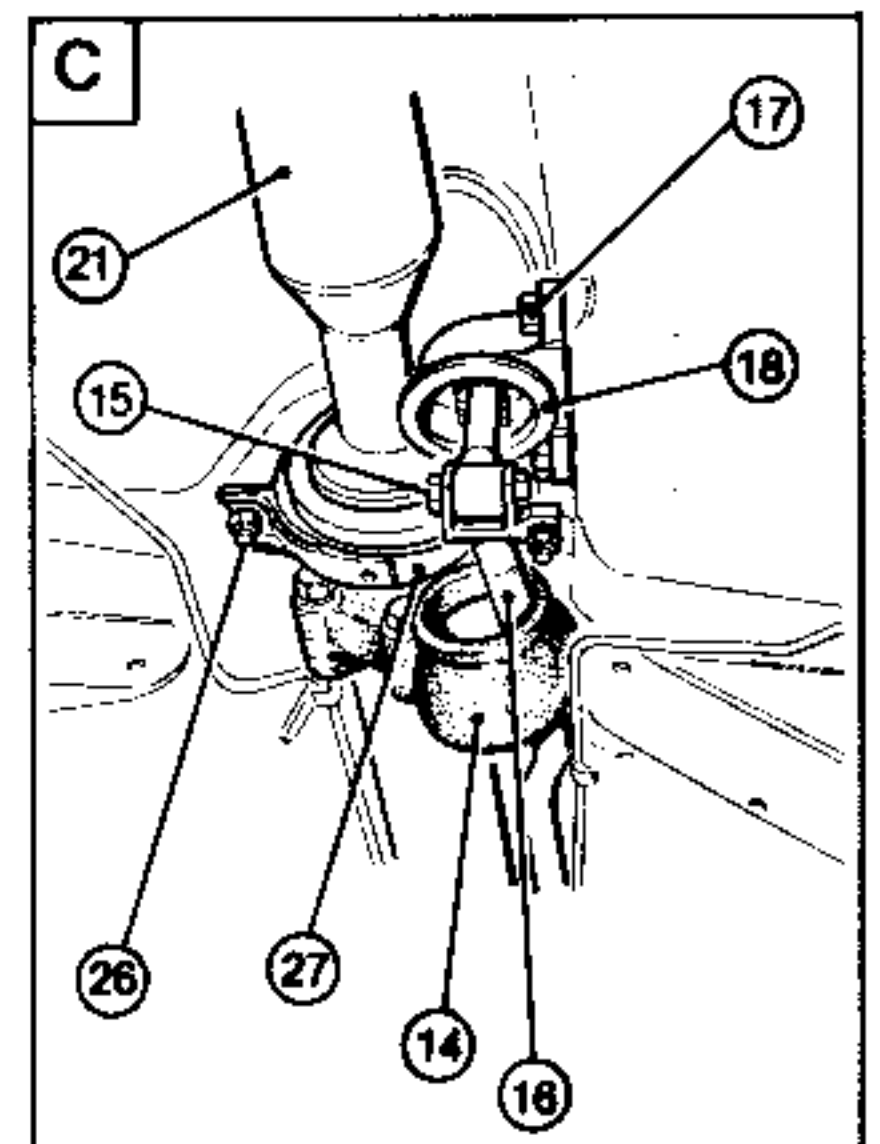
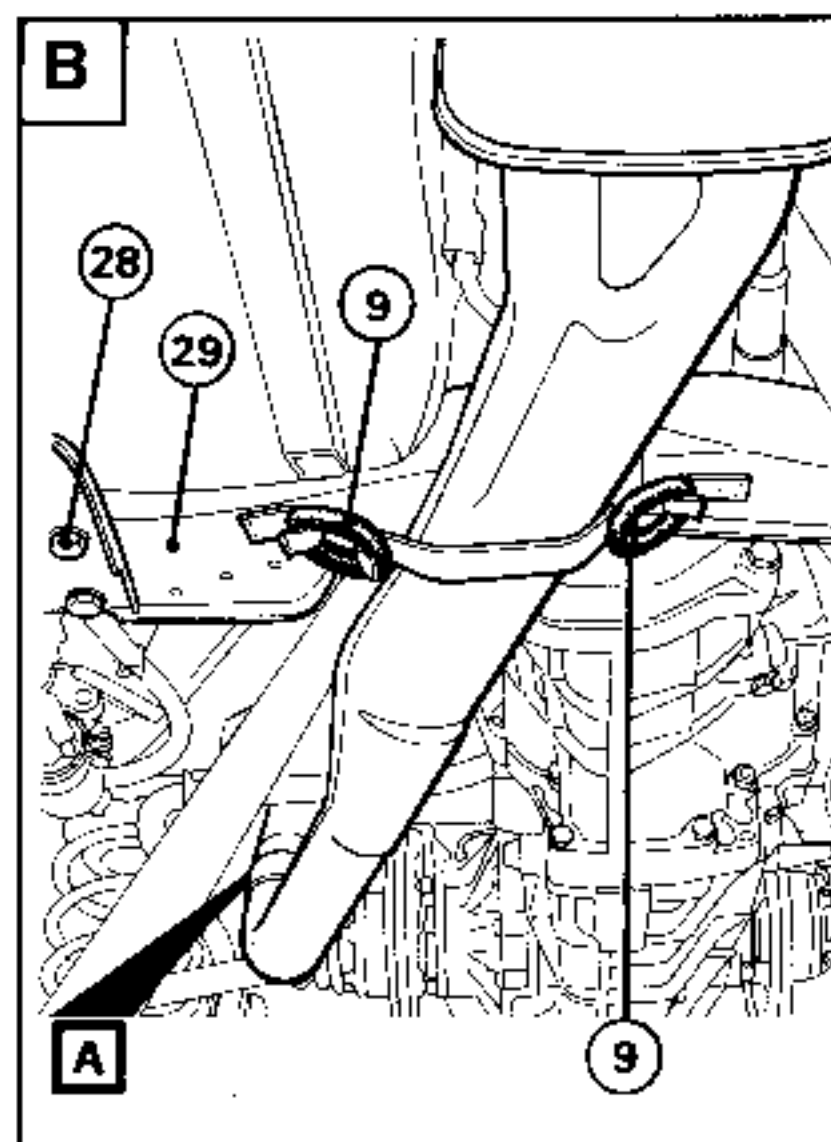
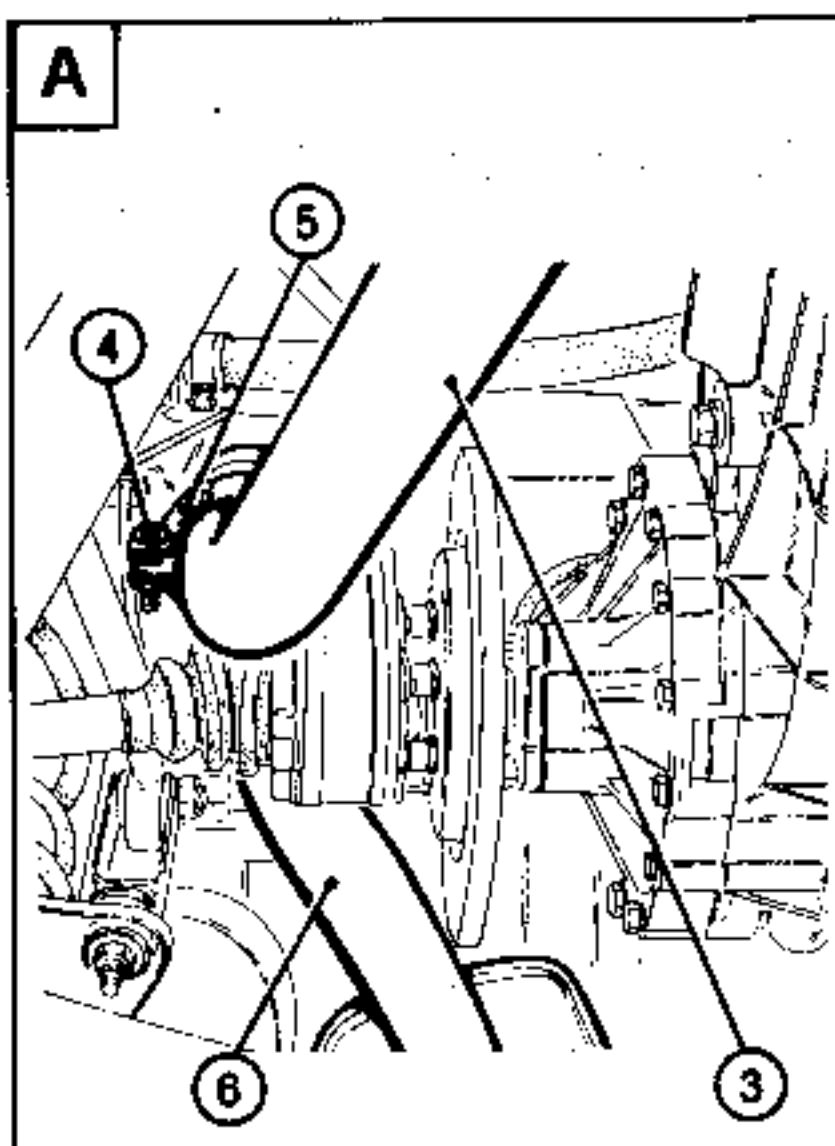
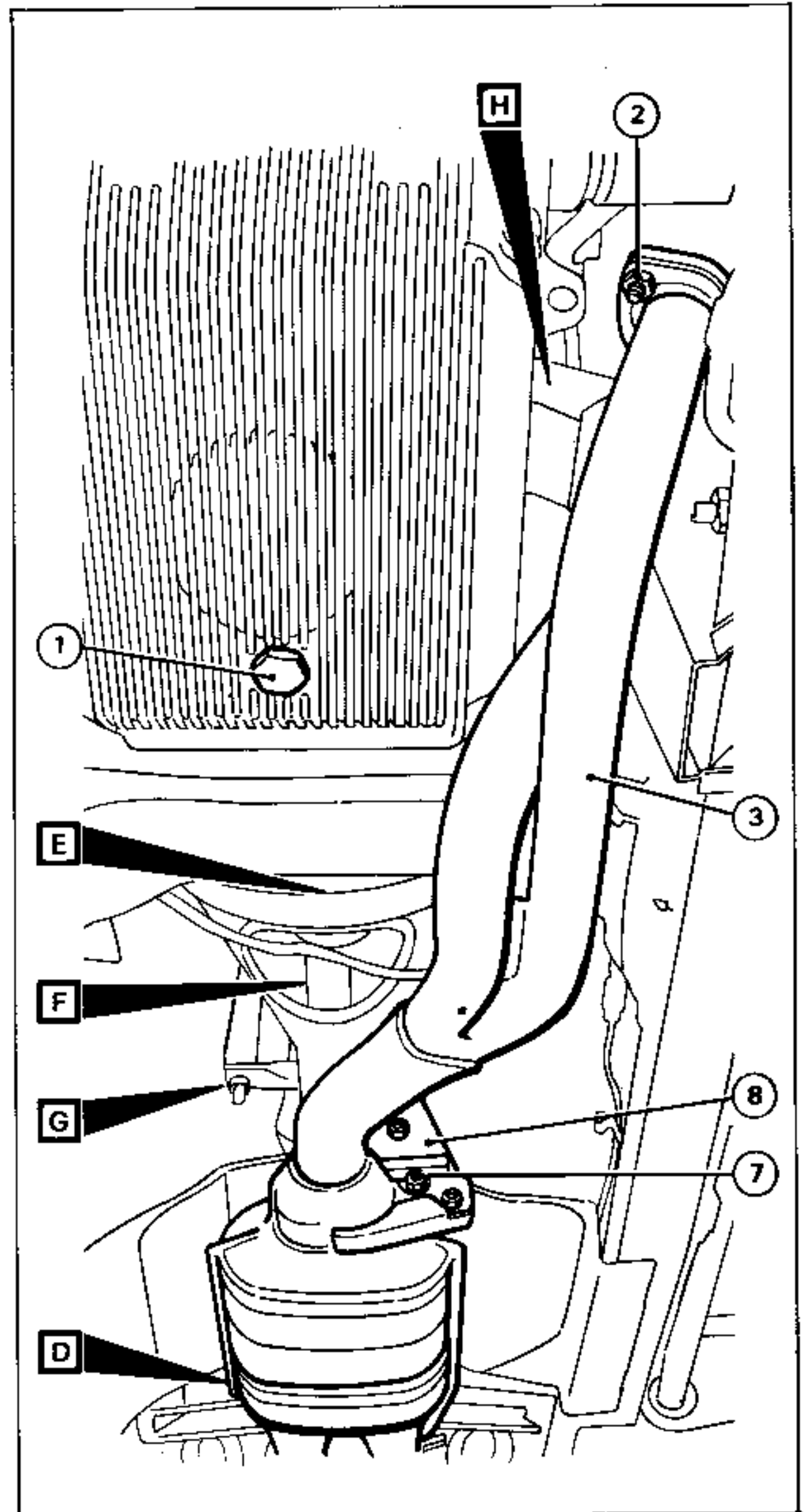
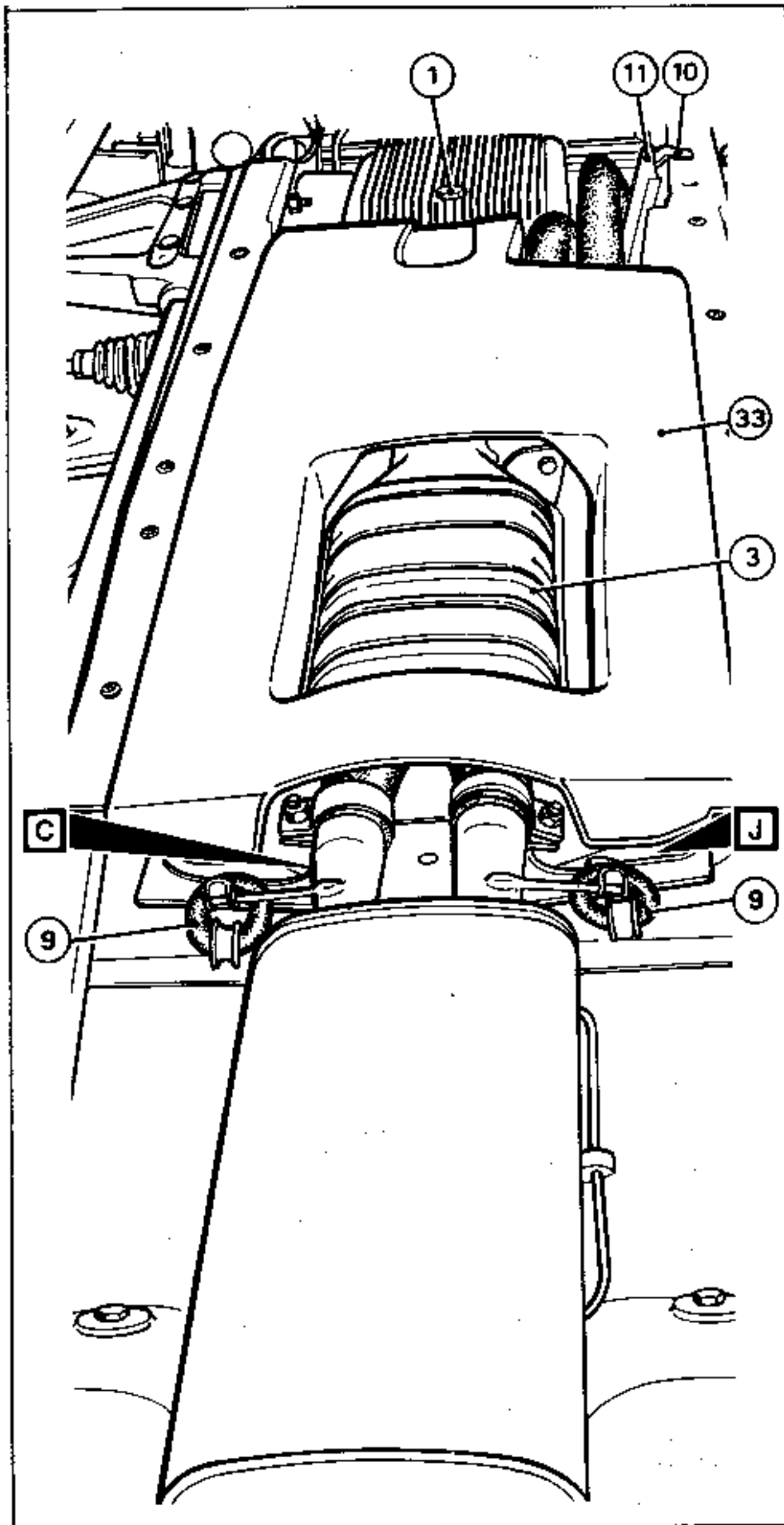
1. Battery
2. Servo brake vacuum tube
3. Air flow gauge lead
4. Maximum r.p.m. oil vapour tube
5. Idle r.p.m. by-pass tube
6. Air intake duct securing clip
7. Air intake duct
8. Air intake duct securing clip
9. Air filter cover
10. Air filter container securing nuts
11. Air filter container
12. Hose securing clip
13. Coolant return hose
14. Coolant delivery hose
15. Coolant return tube
16. Radiator filler tube
17. Radiator breather tube

18. Cooling system breather tube
19. Deleted
20. Electric fan activating lead
21. Electric fan power supply lead
22. Radiator securing screw
23. Radiator
24. Fuel return tube
25. Fuel pressure regulator
26. Fuel delivery tube
27. Pulse damper
28. Accelerator control cable
29. Support bracket
30. Front spark plug ignition coil lead
31. Rear spark plug ignition coil lead
32. Deleted
33. Accelerator butterfly switch
34. Idle regulation actuator lead

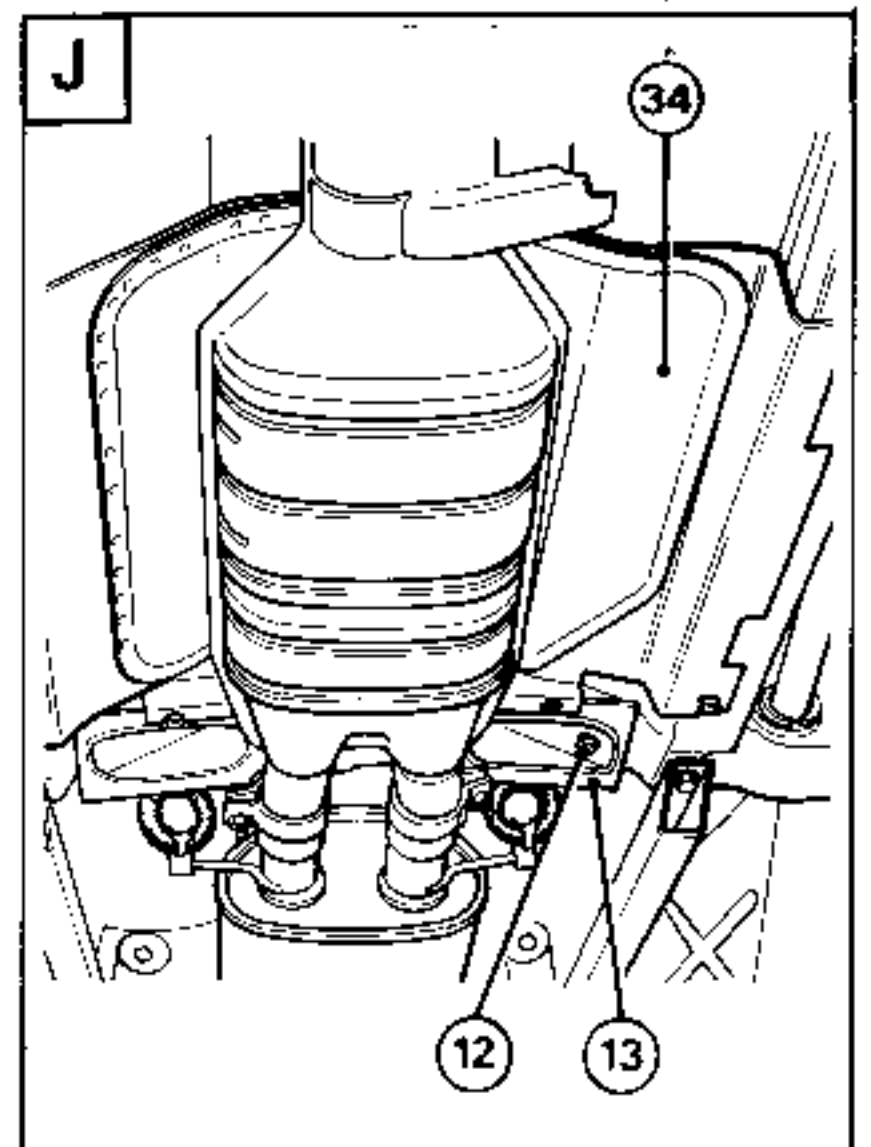
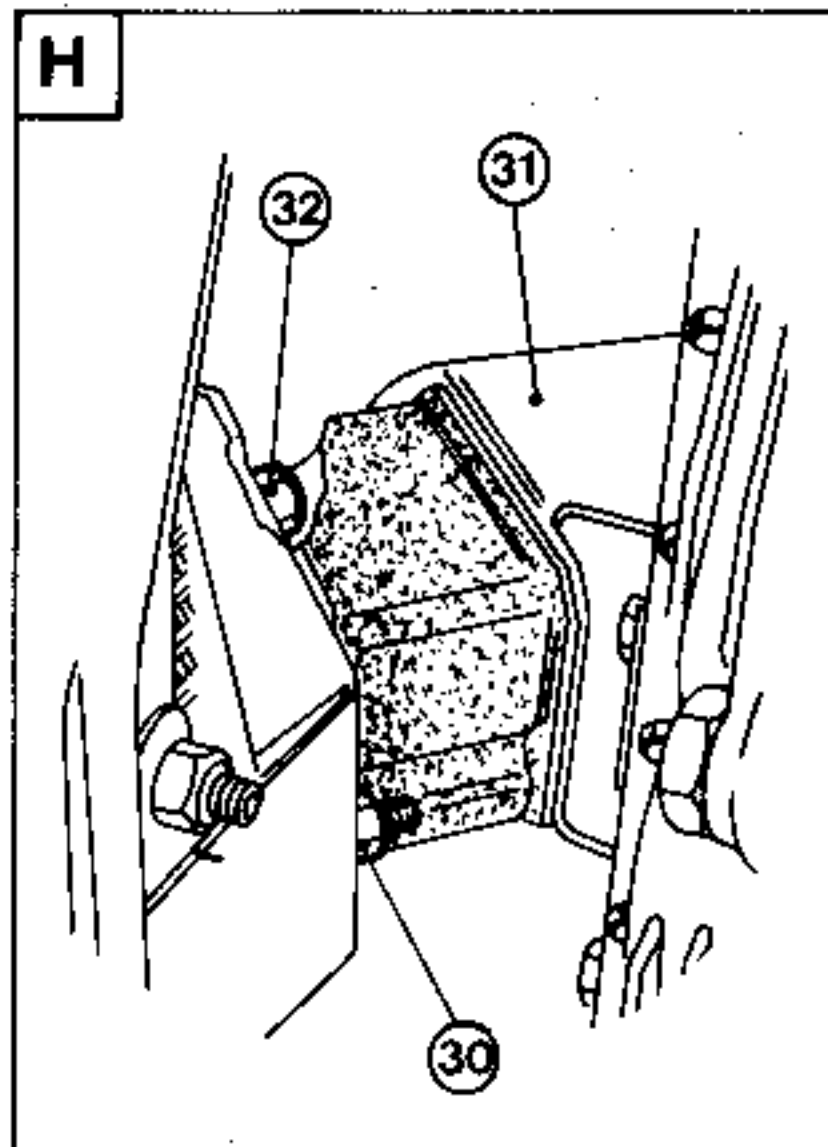
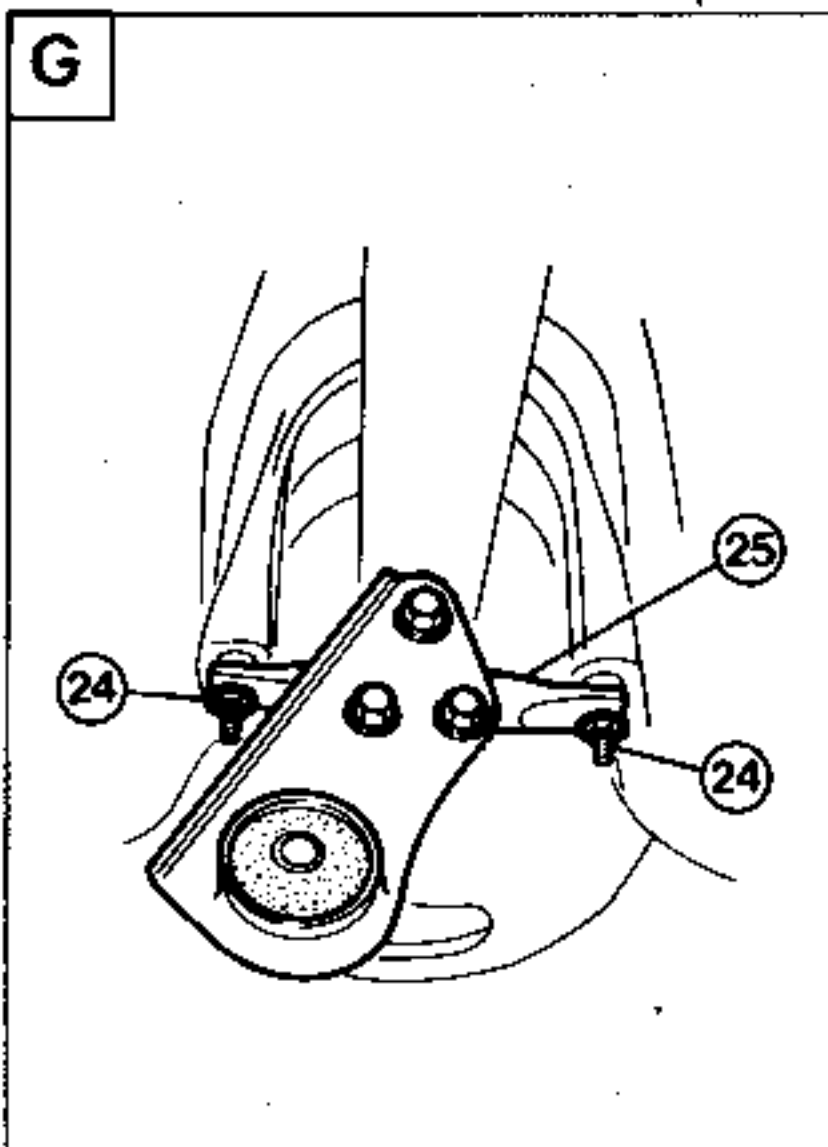
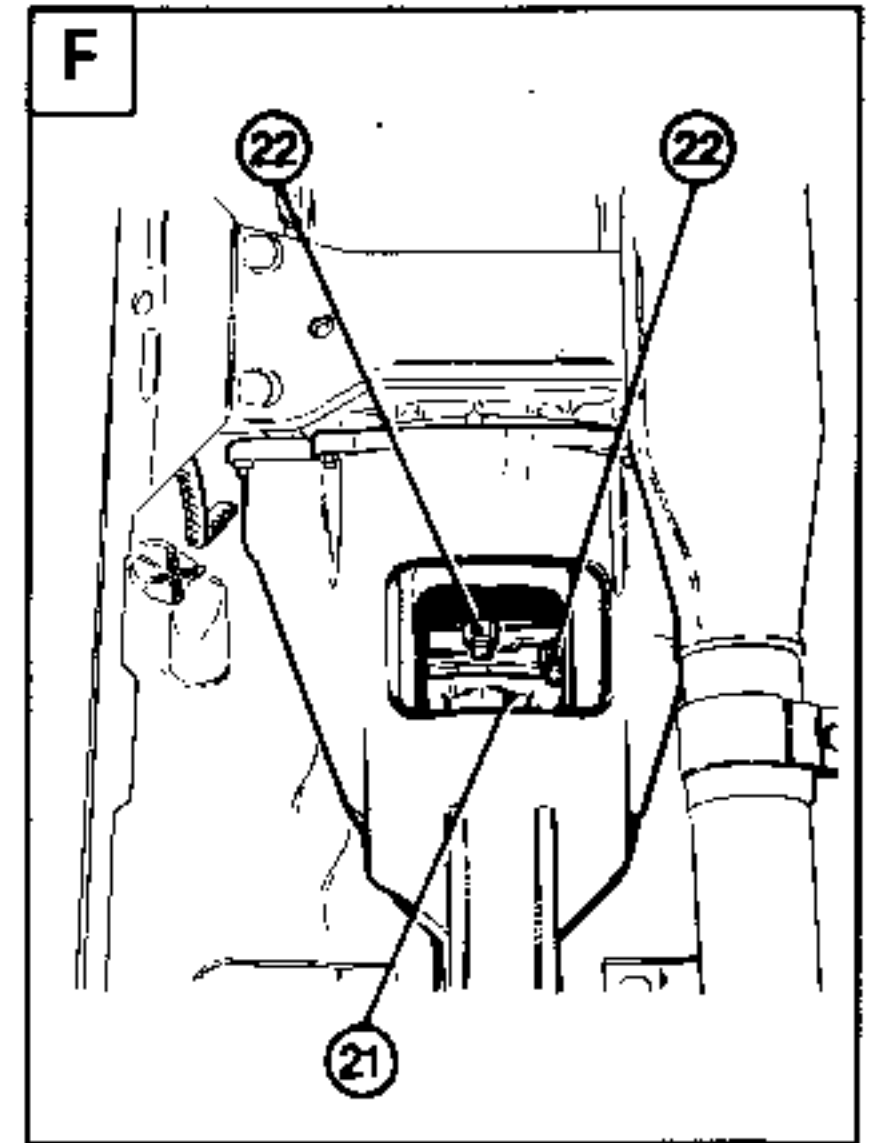
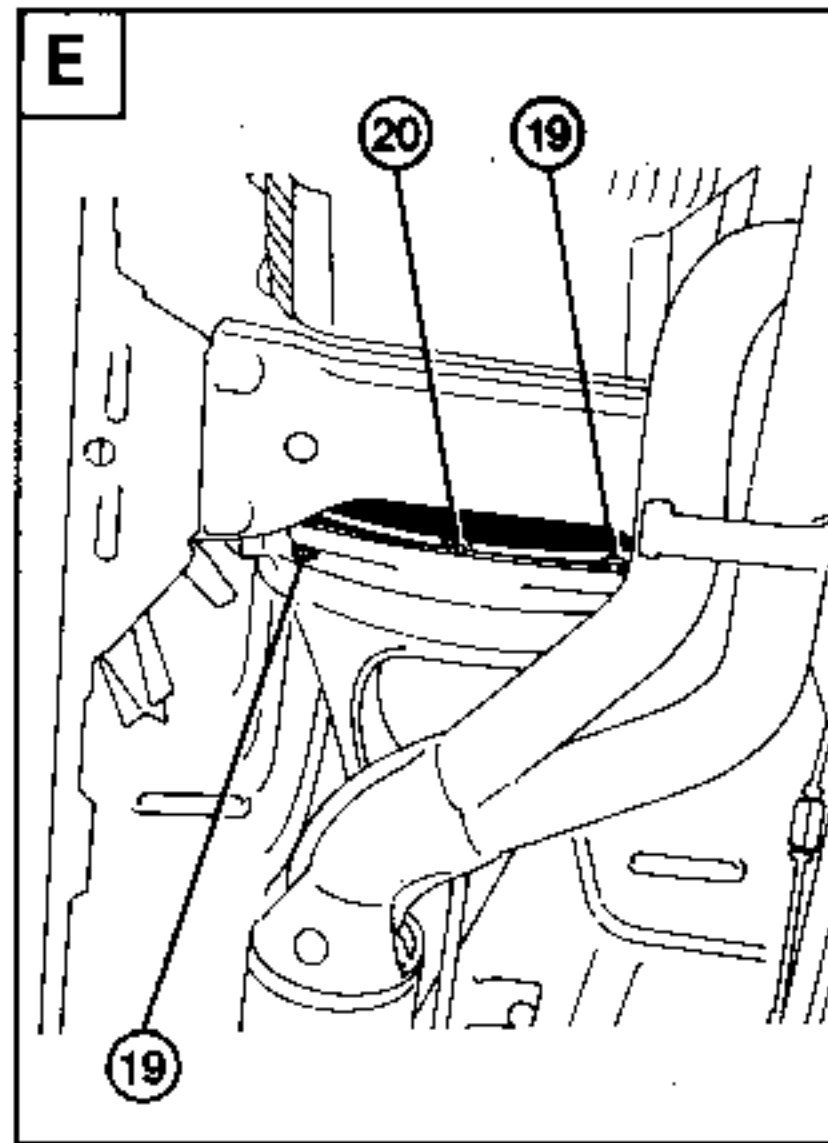
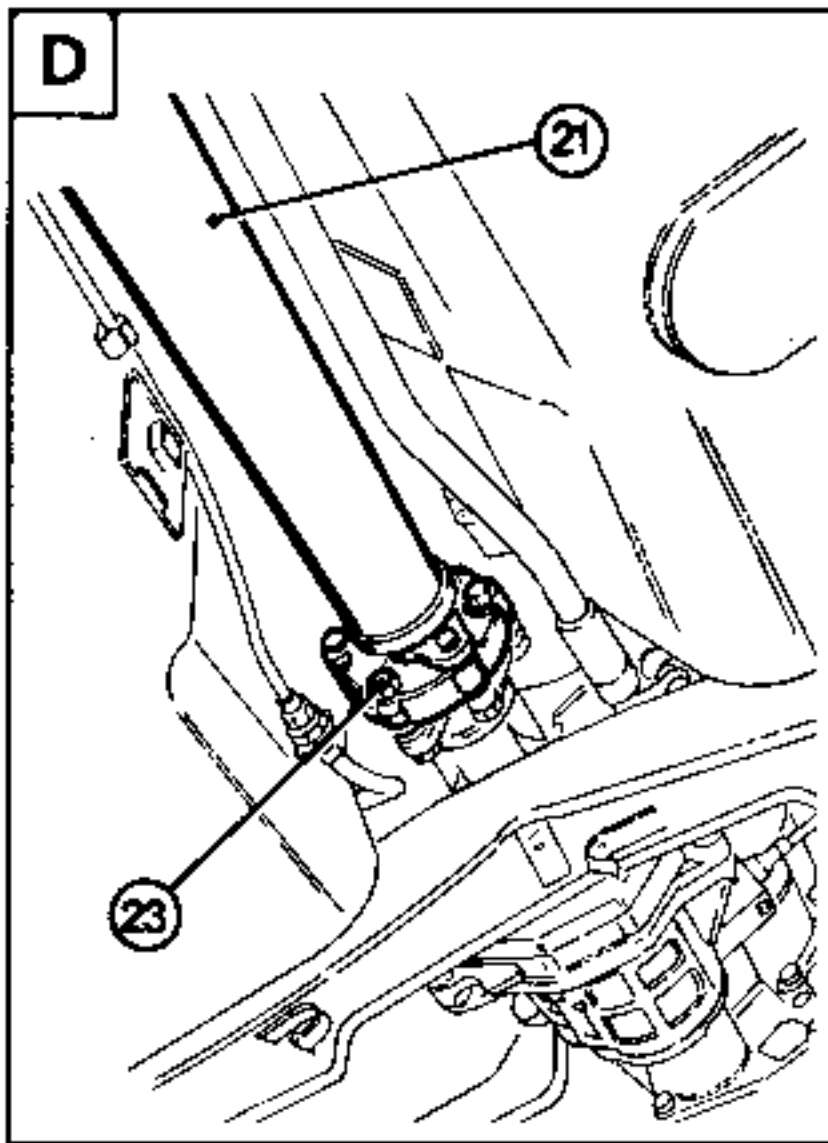
35. Fuel delivery system, ground leads
36. Engine oil pressure indicator lead
37. Coolant temperature sensor lead
38. Coolant temperature indicator lead
39. Maximum coolant temperature warning lamp lead
40. Timing and r.p.m. sensor lead
41. Engine ground lead
42. Connection for minimum oil pressure warning lamp lead
43. Minimum oil level warning lamp lead
44. Timing variator leads
45. Electric fuel injector power supply leads
46. Alternator power supply leads
47. Alternator warning lamp lead
48. Terminal board
49. Starter motor power supply leads
50. Starter motor electromagnet excitation lead
51. Starter motor
52. Air-conditioner compressor
53. Compressor drive belt
54. Belt tensioner pulley
55. Servo steering pump drive belt
56. Servo steering pump securing screws
57. Servo steering pump
58. Servo steering system fluid reservoir
59. Side engine mounting upper securing screws
60. Heat shield securing screws
61. Heat shield (left mounting)
62. Pipe clip
63. Air duct
64. Fuel vapour recycling tube
65. Lambda sensor resistance connector
66. Lambda sensor connector

ENGINE MAIN MECHANICAL UNIT

VIEW OF THE UNDER PART



ENGINE MAIN MECHANICAL UNIT



1. Oil drainage plug
2. Nuts with washers for securing of the catalytic silencer box to the exhaust manifold
3. Catalytic silencer box exhaust tube
4. Pipe clip nut
5. Pipe clip
6. Rear length of exhaust tube
7. Bolt for securing catalytic silencer box to the bracket
8. Support bracket for catalytic box exhaust tube
9. Elastic rings
10. Heat shield securing screws
11. Heat shield on left mounting
12. Central cross-piece securing screws
13. Central cross-piece
14. Protective boot
15. Securing bolt

16. Gear selector rod
17. Support securing screws
18. Gear lever support
19. Flywheel protective panel securing bolts
20. Flywheel protective panel
21. Propeller shaft
22. Nuts securing front elastic joint
23. Bolts securing rear elastic joint
24. Screws securing stud
25. Rear engine mounting stud
26. Nuts securing propeller shaft central support
27. Propeller shaft central support
28. Screws securing rear cross-piece
29. Rear cross piece
30. Side engine mounting lower securing screws
31. Side engine mountings

32. Side engine mounting upper securing screws
33. Catalytic silencer box heat shield (lower)
34. Catalytic silencer box heat shield (upper)

TECHNICAL DATA

TECHNICAL FEATURES OF ENGINE

		Engine	
		2000	
		(062.24)	
Cycle		Otto 4 stroke cycles	
Number of cylinders		4 in line	
Numbering of cylinders			
Bore — Stroke	mm	84 x 88,5	
Cylinder capacity	cm ³	1962	
Combustion chamber	cm ³	54,5	
Compression ratio		10	
Power DIN			
Maximum	kW (CV)	107 (148) at 5700 ÷ 5900 r.p.m.	
Torque DIN	Nm (kgm)	156,9 (16) at 2000 r.p.m.	
		176,5 (18) at 3000 r.p.m.	
		186,3 (19) at 4000 r.p.m.	
Effective average piston velocity (1)	m/1"	17,7	
Octane requirement	R.O.N.	95	
	Sensitivity (2)	10	
Engine oil pressure (3)			
Minimum at idle r.p.m.		49,03 (0,49; 0,5)	
Minimum at maximum r.p.m.	kPa (bar; kg/cm ²)	343,19 (3,43; 3,5)	
Maximum at minimum r.p.m.		441,24 ÷ 490,27 (4,41 ÷ 4,90; 4,5 ÷ 5,0)	

(1) At minimum r.p.m.

(2) Difference between the Octane Research Method Number and the Octane Method Number

(3) Values to be measured with engine at normal running temperature (oil at 90°C)

GROUP 04

CONTENTS

DESCRIPTION	04-2	R.P.M. AND TIMING SENSOR	04-23
Functional description	04-2	IGNITION AND FUEL INJECTION	
Diagram of Motronic ML4.1		ELECTRONIC CONTROL UNIT	
fuel system	04-3	(MOTRONIC)	04-24
Wiring and main components of		MAP SWITCHING DEVICE	04-24
Motronic ML4.1 system	04-6	EXHAUST SYSTEM	04-25
Important information of a		Manifolds, catalyser and silencers	04-26
general nature	04-7	Rubber supports	04-27
AIR INTAKE SYSTEM	04-8	Lambda sensor	04-27
COMPONENTS OF THE AIR INTAKE		SETTING AND ADJUSTMENTS	04-28
SYSTEM	04-9	Setting of accelerator butterfly	
Air filter	04-11	(flow rate)	04-28
Air flow gauge and temperature		Setting of the accelerator butterfly	
sensor	04-11	switch	04-28
Complete accelerator butterfly		Adjustment of the accelerator	
housing	04-12	control	04-29
Minimum and maximum accelerator		Check of fuel delivery pressure and	
butterfly opening switch	04-13	tightness of system	04-29
Constant idle regulation actuator	04-13	Trouble diagnosis procedure for	
Air intake box	04-14	checking the tightness of the fuel	
FUEL DELIVERY AND GAS VAPOUR		injection fuel feed system	04-30
SYSTEM	04-16	Check of tightness of fuel vapour	
Fuel tank	04-17	emission (evaporative) system	04-30
Fuel level gauge	04-17	Check of tightness of the air intake	
Auxiliary fuel pump and gauze-type		system downstream from the air	
filter	04-18	flow gauge	04-31
Fuel supply tubing	04-18	Check of the idle running	04-31
Compensation valve	04-19	Check of exhaust emission (CO)	
Fuel filter	04-19	on idle	04-31
Main fuel pump	04-19	TECHNICAL DATA AND	
Fuel pressure regulator	04-19	SPECIFICATIONS	04-32
Hammering damper	04-20	Technical data	04-32
Electric fuel injectors	04-20	Checks and adjustments	04-33
Fuel vapour trap	04-21	General specifications	04-35
Air inlet valve	04-22	SPECIAL SERVICE TOOLS	04-36
Carbon cleaner	04-22		
Fuel vapour flow control			
solenoid valve	04-22		

DESCRIPTION



FUNCTIONAL DESCRIPTION

The fuel is pumped to the fuel injectors (17) passing through the pulse damper (14) and the filter (13), coming from the fuel tank (10), by means of two electric pumps (11) and (12).

The pressure regulator (16) regulates the pressure of the fuel in the fuel distributor tube (15) as a function of the pressure measured in the air intake box (8), in such a way as to maintain the difference between the fuel pressure and the pressure in the air intake box constant.

When the fuel pressure exceeds the maximum specified value (3 bar), the pressure regulator causes the return of the excess fuel to the fuel tank.

In this way the quantity of fuel injected depends exclusively on the injection time, which is decided by the electronic control unit (30) by means of the help of sensors designed to measure the data which characterise the functioning of the engine. These data are: r.p.m., engine load, battery tension, engine temperature etc.

The quantity of air taken in is measured by the air flow gauge (2), which has the function of quantifying the air flow rate and consequently sending a signal to the electronic control unit. The exact dosaging of the fuel injected is determined on the basis of this signal.

Inside the air flow gauge, there is a sensor (3) which measures the temperature of the air taken in. This sensor furnishes a signal to the electronic control unit and the unit is thus able to compensate the injection time according to the variation in the air weight - fuel weight ratio.

The engine temperature is measured by the special sensor (18), fitted with the sensing part immersed in the coolant liquid. From the air flow gauge (2) the air enters the air intake duct (4) and then reaches the accelerator butterfly housing (5).

A switch (6) is fitted on the accelerator butterfly housing and it consists of two microswitches. One of these is the minimum opening switch, which furnishes a signal when the angle of the butterfly is from 0° to 1° (completely closed) and the other is the maximum opening switch,

which furnishes a signal when the opening angle of the butterfly is greater than 60°. The signals sent to the electronic control unit by these two microswitches permit respectively a command to cut the fuel supply during engine deceleration whenever the conditions of butterfly closed and r.p.m. greater than 1080 are recognised, and the control of the fuel enrichment during acceleration when, on a specific request for engine power, the air flow gauge signal exceeds a predetermined increment and commands, not only the fuel injection to meet the new requirement, but an additional increase to reach the required r.p.m. rapidly.

The constant idle actuator (7) is fitted in a tube which by-passes the accelerator butterfly housing. With the butterfly closed or slightly open the section of the passage of the actuator determines a flow of air which is not controlled by the accelerator but by a command from the electronic control unit. The air passes from the accelerator butterfly housing into the air intake box (8) and then through the air intake manifold (9) into the cylinders.

During cold starting, the electronic control unit controls the ignition advance and the injection time.

The ignition advance depends exclusively on the r.p.m. and the engine temperature. The injection time is determined by a value programmed into the electronic control unit and corrected according to the temperature of the air taken in, the engine temperature, the battery tension and the r.p.m.

The sensor designed to measure the engine r.p.m. and the engine timing (20) is of the inductive type and functions by means of the variation in the magnetic field generated by the passage of the teeth of the cog wheel (phonic wheel) fitted on the drive shaft of the engine.

The ignition advance is determined by a map programmed into the electronic control unit functioning on the basis of the r.p.m. and the engine load.

The value thus obtained is optimised as a function of the air intake temperature and the engine temperature.

If the value thus optimised differs greatly from the value obtained from the programmed map, the injection time is in-

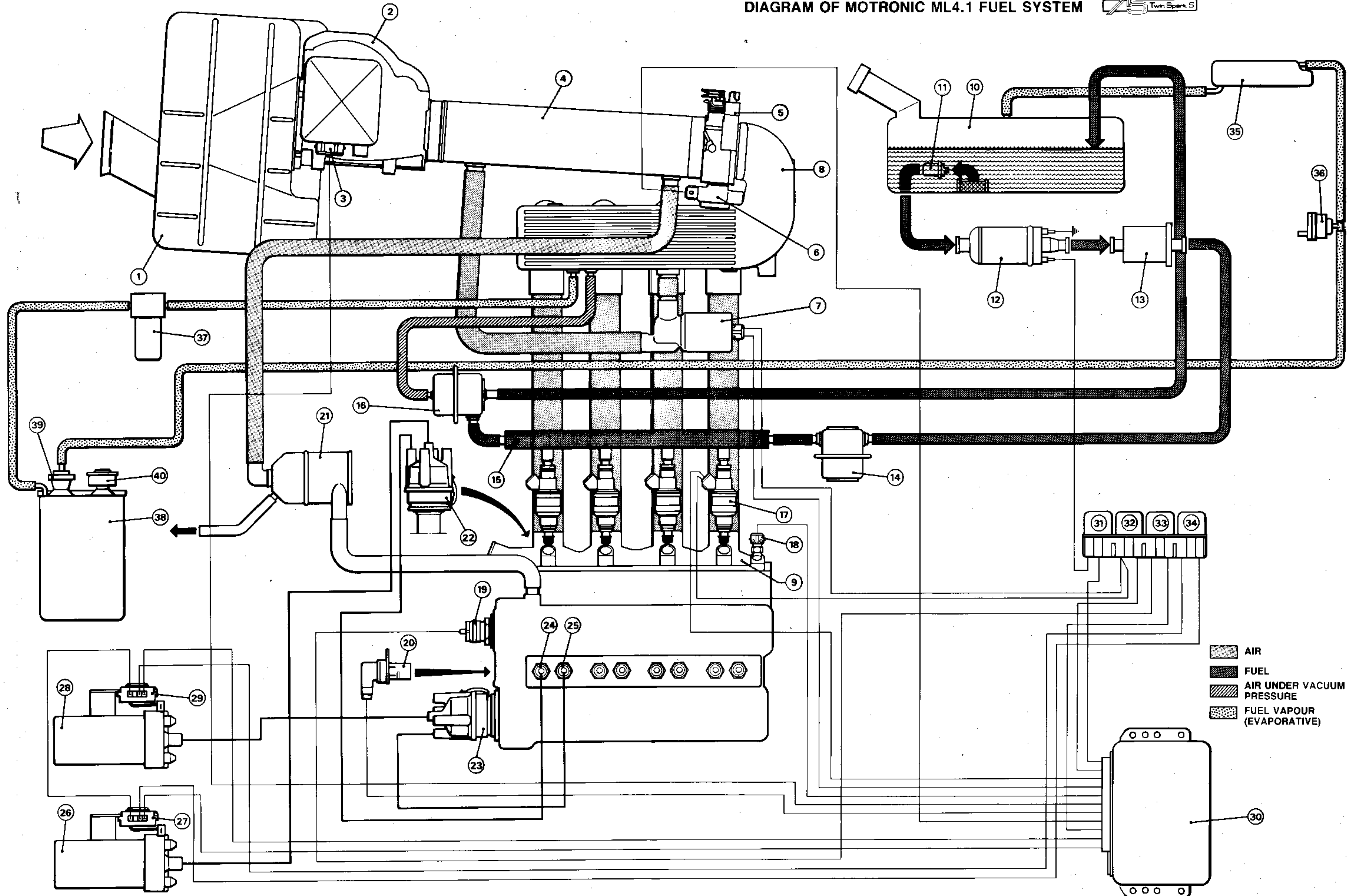
creased to guarantee a sufficient margin from the spark knock limit.

The cam shaft (air intake side) is equipped with an electromechanical-hydraulic type timing variator (19), which is able to modify the air intake timing (advance) so that a greater quantity of air is taken in.

The regulation of the idle running is controlled during all stages of functioning by means of the constant idle actuator (7). When the engine is running on idle the function of the actuator is to bring the real r.p.m. to the nominal r.p.m. by acting on the accelerator butterfly by-pass.

As well as controlling the idle running of the engine, the actuator (7) also acts as an additional air box and regulator for the air conditioning system.

DIAGRAM OF MOTRONIC ML4.1 FUEL SYSTEM



- | | | |
|---|--|--|
| <ol style="list-style-type: none"> 1. Air filter 2. Air flow gauge 3. Air intake temperature sensor 4. Air intake duct 5. Accelerator butterfly housing 6. Minimum and maximum accelerator butterfly opening switch 7. Constant idle regulation actuator 8. Air intake box 9. Air intake manifold 10. Fuel tank 11. Auxiliary fuel pump 12. Main fuel pump 13. Fuel filter 14. Hammering damper 15. Fuel distributor tube 16. Fuel pressure regulator | <ol style="list-style-type: none"> 17. Electric fuel injectors 18. Engine coolant temperature sensor 19. Timing variator 20. R.p.m. and timing sensor 21. Oil vapour trap 22. Front spark plugs ignition distributor 23. Rear spark plugs ignition distributor 24. Front spark plugs 25. Rear spark plugs 26. Front spark plugs ignition (coil B) 27. Coil B power module 28. Rear spark plugs ignition coil (coil A) 29. Coil A power module 30. Ignition and fuel injection electronic control unit (Motronic) | <ol style="list-style-type: none"> 31. Fuel pump relay 32. Relay with diode 33. Timing variator relay 34. Main relay 35. Fuel vapour trap reservoir 36. Air inlet valve (compensation valve) 37. Solenoid valve 38. Carbon canister 39. One-way valve 40. Fuel vapour flow control valve (washing) |
|---|--|--|

FUEL VAPOUR EMISSION CONTROL SYSTEM

The fuel vapours emanating from the tank are collected, through special tubing, into a trap (35) which thanks to its special design permits the return of the petrol condensate to the petrol tank.

To prevent the vapours from escaping into the atmosphere the tank is fitted with a sealed cap.

The fuel vapours which do not condense in the trap pass out of the upper fitting of the trap and, passing through the vapour breather tubing and the one-way valve (39), reach the active carbon filter (carbon canister) (38).

The vapour flow is controlled by a solenoid valve (37) which opens (or closes) on the basis of signals received from the electronic control unit (Motronic) (30).

If the vacuum pressure is less than a preset value (e.g.: with the engine not running or on idle) the solenoid valve remains closed and does not permit the vapour flow to enter the vapour cleaner.

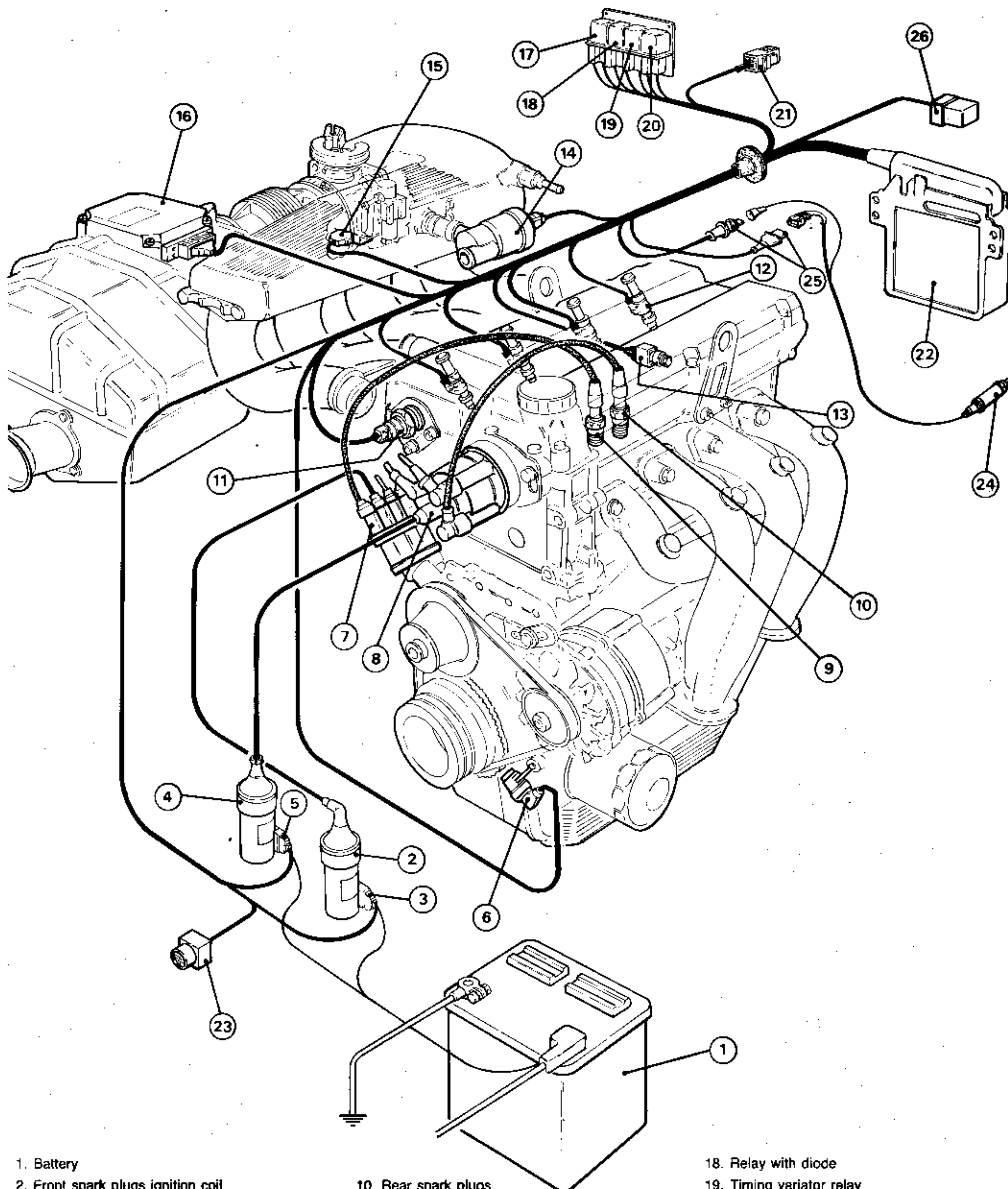
Under normal engine functioning conditions, the vapour flow gains access to the vapour cleaner and is absorbed by the activated carbon. Here, due to the effect of the pressure difference existing in the filter, the carbon is «washed» by the current of air which flows through the filter itself by means of the valve (40).

In the «washing» action, the petrol vapours and the atmospheric air mixed together, are conducted due to the effect of the vacuum pressure, to the air intake box where they are added to the mixture.

There are two constrictions in the system: the first is located at the exit of the fuel vapour trap (diameter 3 mm); the second lies between the vapour cleaner and the air intake manifold (diameter 1 mm).

If, after the stopping of the engine, the pressure in the liquid-vapour trap tends to fall, due to a drop in temperature, a compensation valve (36), positioned in the vapour breather tubing, between the trap and the filter, permits the entrance of atmospheric air and maintains the pressure in the trap equal to the external atmospheric pressure.

WIRING AND MAIN COMPONENTS OF THE MOTRONIC ML4.1 SYSTEM



1. Battery

2. Front spark plugs ignition coil (coil B)

3. Power module (coil B)

4. Rear spark plugs ignition coil (coil A)

5. Power module (coil A)

6. R.p.m. and timing sensor

7. Front spark plugs ignition distributor

8. Rear spark plugs ignition distributor

9. Front spark plugs

10. Rear spark plugs

11. Timing variator

12. Electric fuel injectors

13. Engine coolant temperature sensor

14. Coolant idle regulation actuator

15. Minimum and maximum accelerator opening switch

16. Air flow gauge and air intake temperature sensor

17. Fuel pump relay

18. Relay with diode

19. Timing variator relay

20. Main relay

21. Body wiring connection

22. Ignition and fuel injection electronic control unit (Motronic)

23. Connector for self trouble diagnosis

24. Lambda sensor

25. Lambda sensor connectors

26. Motronic electronic control unit map switching device

IMPORTANT INFORMATION OF A GENERAL NATURE

- Never disconnect the battery with the engine running or in any case with the ignition switched on (starting key in the position «Mar» (second click)). Failure to observe this precaution will result in serious and permanent damage to the electrical components and the electronics of the electronic control system.
 - Before starting the engine, make sure that the terminals of the battery are fully tightened.
 - Do not use a «rapid charger» to start the engine.
 - Completely disconnect the battery from the system before recharging it.
 - Do not start the engine if the electrical connections are interrupted or components have been removed.
 - Do not connect any low or high tension point to ground or interrupt any connections while the engine is running.
 - Remove the electronic control unit when executing paintwork in furnace at temperatures of more than 80°.
 - When fitting accessories on the vehicle, it is always advisable to disconnect the electronic control unit and proceed to check the functioning of the accessories with the control unit disconnected.
- The connection of leads to the connections of the electronic control system for accessories is very strongly not recommended.
- Before carrying out any operation on the various components of the system, make sure that there are no connectors disconnected, clips loosened or tubes torn or visibly obstructed.
 - Never connect or disconnect the electrical plugs from the conductors of the electronic control unit with the ignition switched on.
 - Do not connect the high or low tension cables to earth in order to test them under any circumstances.
 - Make sure that the connectors of the screened leads are correctly connected.
 - Make sure that the ignition system is functioning efficiently by checking the spark plugs and checking that the distributor cap is not damp or cracked, that the leads between the coil and the distributors and between the distributors and the spark plugs are cor-

rectly connected and that the insulation does not present traces of burning or abrasions.

- When replacing fuses, remove the power supply first (disconnect the contact). If a fuse burns repeatedly, seek the cause of the short circuit. Never replace a fuse with a piece of wire.
- It is imperative that burnt fuses be replaced with fuses of the same amperage.

TEMPERATURE OF THE CATALYTIC SILENCER BOX

A too high temperature of the catalytic silencer box during driving can cause damage to the alumina monolith thus reducing its transformation capacity and damage the container or the vehicle resulting in a risk of fire.

The engine phenomena that can cause overheating of the catalytic silencer box are:

- Carbon deposits on the spark plugs of one or more cylinders.
- Fuel pump defective or fuel filter clogged (fuel pressure too low).
- Fuel injectors defective.
- Air filter cartridge very dirty.
- Accelerator control system not set and adjusted correctly.
- Engine and related components not set and adjusted to the manufacturers specified standards.
- Leaks in the exhaust tubing upstream from the exhaust gas sensor.
- Pressure regulator not functioning.
- Battery tension too low (or recharging circuit defective).

The driving conditions that can cause overheating of the silencer box are:

- Too little fuel in the tank.
- Overloading of the engine for long periods, for example, when travelling at maximum speed, when towing a trailer or climbing of ten.
- Travelling downhill with the engine switched off.

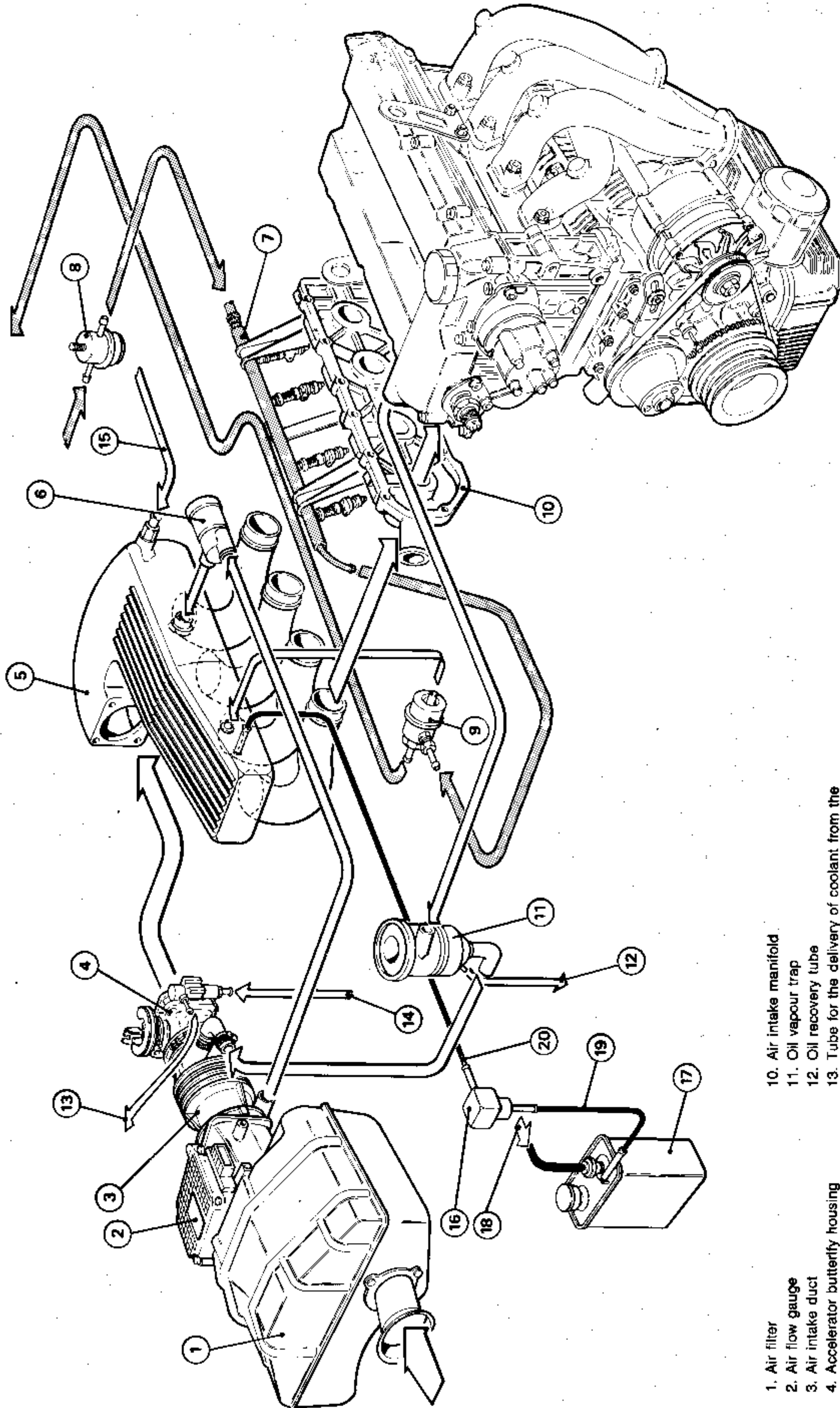
PRECAUTIONS TO BE TAKEN WITH VEHICLES FITTED WITH CATALYTIC SILENCER BOX

- Use only unleaded petrol.

- Avoid allowing the petrol tank to become empty.
- Do not run the engine with one of the spark plugs disconnected and never connect the spark plugs to ground.
- Do not overload the engine for prolonged periods. Pay particular attention when towing or climbing for long periods.
- Do not turn the engine off when driving down hill. First stop the vehicle and then stop the engine.
- Do not park on or near inflammable material such as dry grass, petrol soaked ground, dry leaves, rubbish etc.
- Never tamper with the exhaust emission control system: it is forbidden by law.
- Carry out the maintenance operations as described in the instruction booklet. Perfect engine maintenance is fundamental to the conservation of the catalytic silencer box.

AIR INTAKE SYSTEM

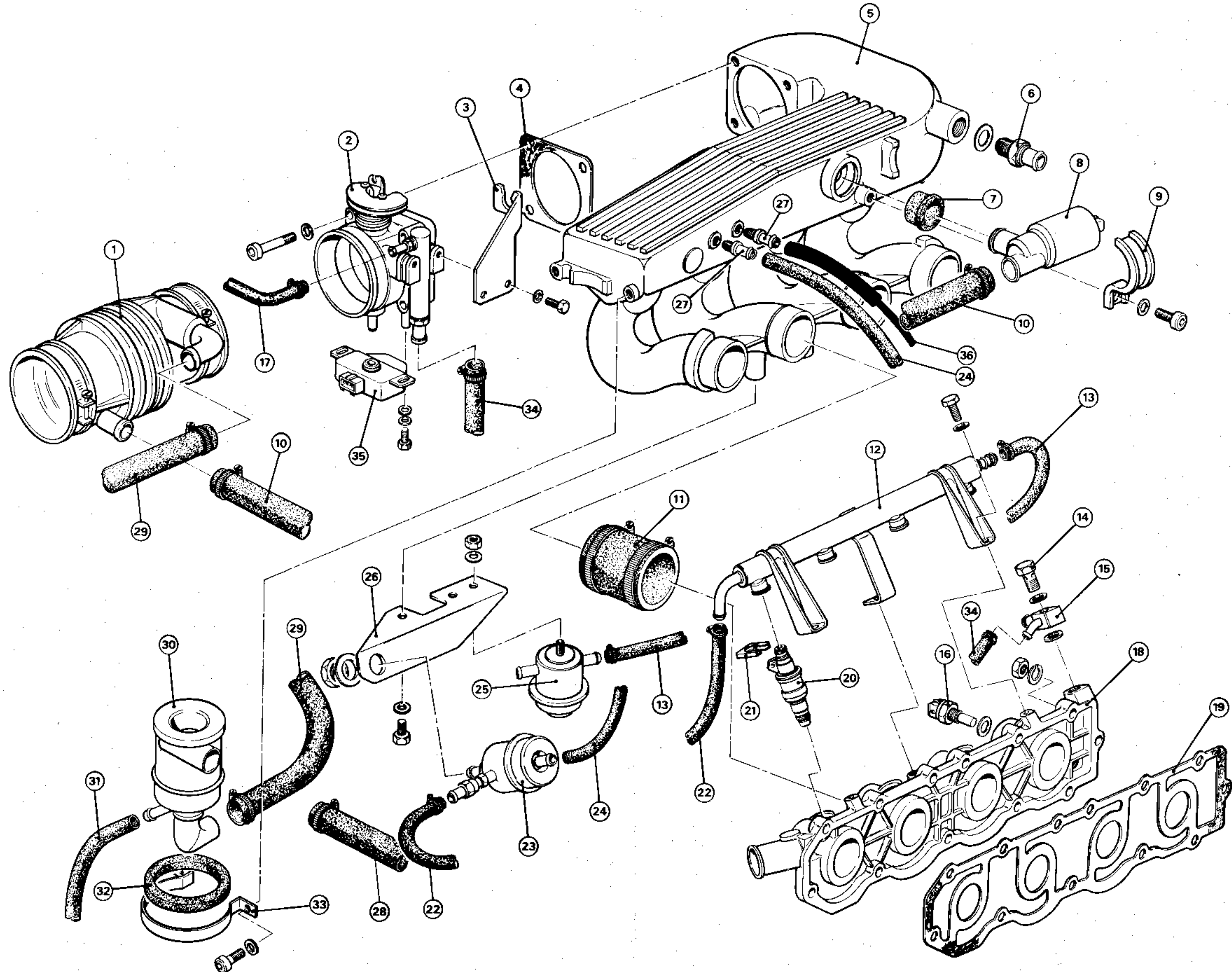
AIR
 FUEL
 FUEL VAPOURS (EVAPORATIVE)



- | | | |
|---|--|---|
| <p> 1. Air filter
 2. Air flow gauge
 3. Air intake duct
 4. Accelerator butterfly housing
 5. Air intake box
 6. Constant idle regulation actuator
 7. Fuel distributor tube
 8. Hammering damper
 9. Fuel pressure regulator </p> | <p> 10. Air intake manifold
 11. Oil vapour trap
 12. Oil recovery tube
 13. Tube for the delivery of coolant from the accelerator butterfly housing to the heater
 14. Tube for the delivery of coolant from the cylinder head to the accelerator butterfly housing
 15. Servo-brake vacuum tube </p> | <p> 16. Solenoid valve
 17. Carbon canister
 18. Tube for recycling of fuel vapours (from the petrol tank)
 19. Tube for the recycling of fuel vapours (from the solenoid valve)
 20. Tube for the recycling of fuel vapours (from the air intake box) </p> |
|---|--|---|

AIR INTAKE SYSTEM COMPONENTS

1. Air intake duct
2. Accelerator butterfly housing
3. Accelerator cable support bracket
4. Gasket
5. Air intake box
6. Pipe fitting for servo-brake vacuum tube
7. Actuator idle regulation actuator
8. Constant idle regulation actuator
9. Actuator securing bracket
10. Constant idle regulation tube
11. Coupling connecting the air intake box with the inlet manifold
12. Fuel distributor tube
13. Fuel delivery tube
14. Securing union for run-off fitting
15. Two way run-off fitting
16. Engine coolant temperature sensor
17. Tube for the delivery of coolant from the header tank to the accelerator butterfly housing
18. Inlet manifold
19. Gasket
20. Electric fuel injector
21. Electric fuel injector securing spring clip
22. Fuel return tube
23. Fuel pressure regulator
24. Vacuum tube for fuel pressure regulator
25. Hammering damper
26. Support bracket for hammering damper and fuel pressure regulator
27. Pipe fitting for vacuum tube
28. Oil vapour breather tube (from cylinder head)
29. Oil vapour recycling tube
30. Oil vapour trap
31. Oil recovery tube
32. Rubber ring
33. Oil vapour trap securing bracket
34. Tube for the delivery of coolant from the accelerator butterfly housing to the cylinder head
35. Minimum and maximum accelerator butterfly opening switch
36. Tube for the recycling of fuel-vapours from the solenoid valve to the air intake box

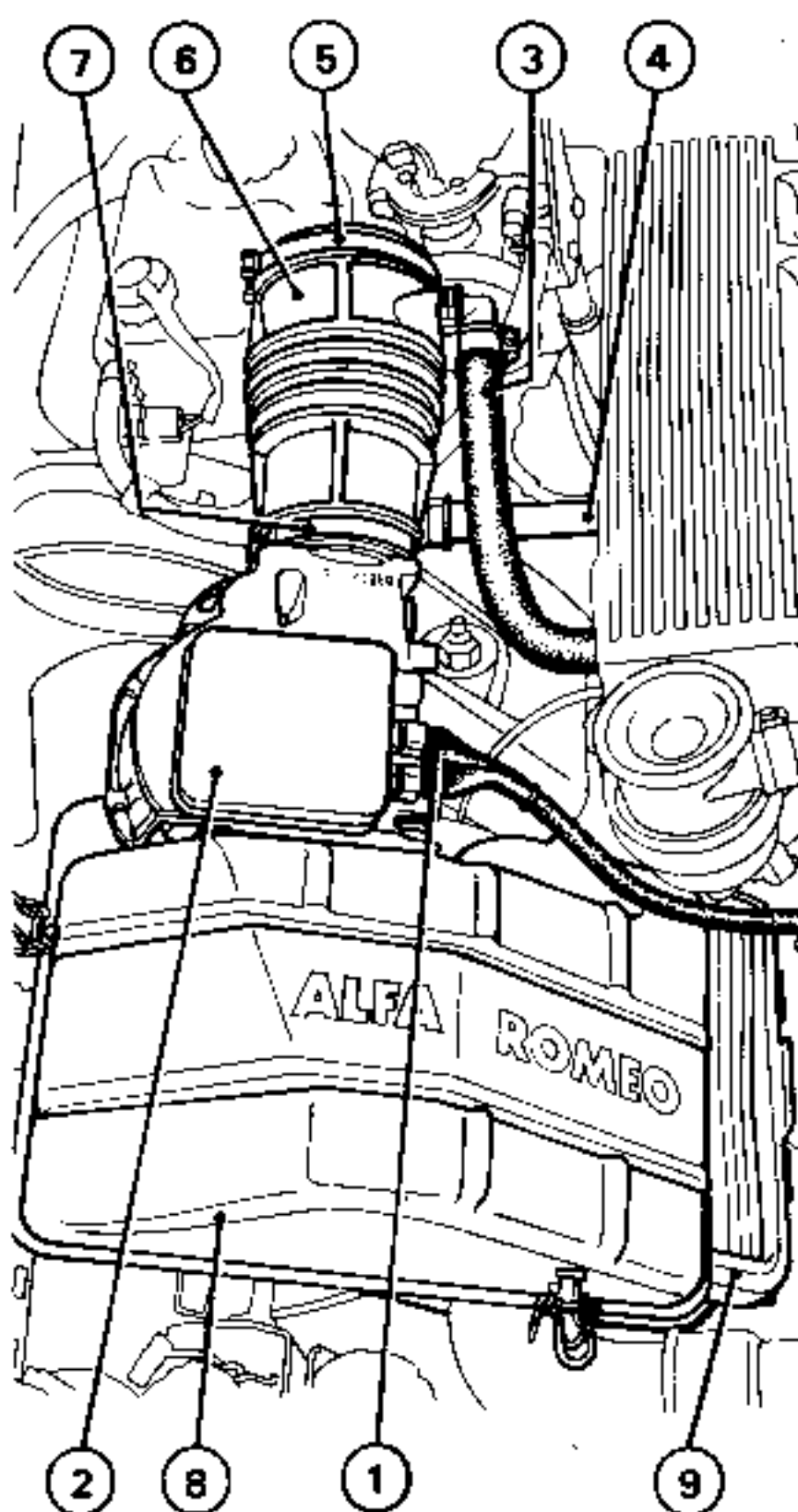


AIR FILTER

REMOVAL

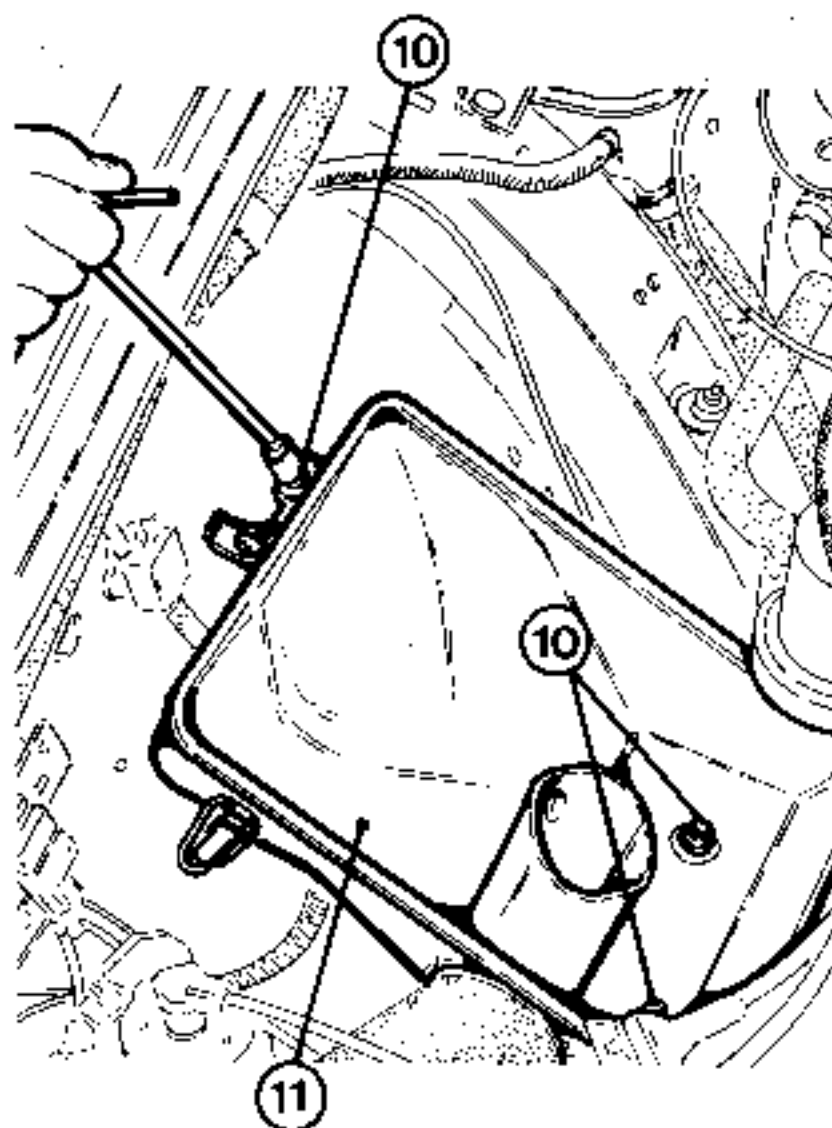
Proceed to the removal of the air filter operating as follows:

1. Disconnect the connector (1) from the air flow gauge (2).
2. Disconnect the following tubes from the air intake duct:
 - Tube for the recycling of oil vapours at peak r.p.m. (3).
 - By-pass tube for constant idle regulation (4).
3. Loosen the securing clip (5) and disconnect the air intake duct from the accelerator butterfly housing (6).
4. Loosen the securing clip (7) and remove the air intake duct (6) from the air flow gauge (2).
5. Unhook the four spring clips from the air filter cover (8) and remove it together with the air flow gauge. Also remove the filter element (9).



1. Connector
2. Air flow gauge
3. Peak r.p.m. oil vapour recycling tube
4. Constant idle regulation by-pass tube
5. Securing clip
6. Air intake duct
7. Securing clip
8. Air filter cover
9. Filter element

6. If necessary unscrew the three nuts (10) that secure the air filter container (11) to the body and remove it.



10. Securing nuts
11. Air filter container

INSPECTION AND ADJUSTMENT

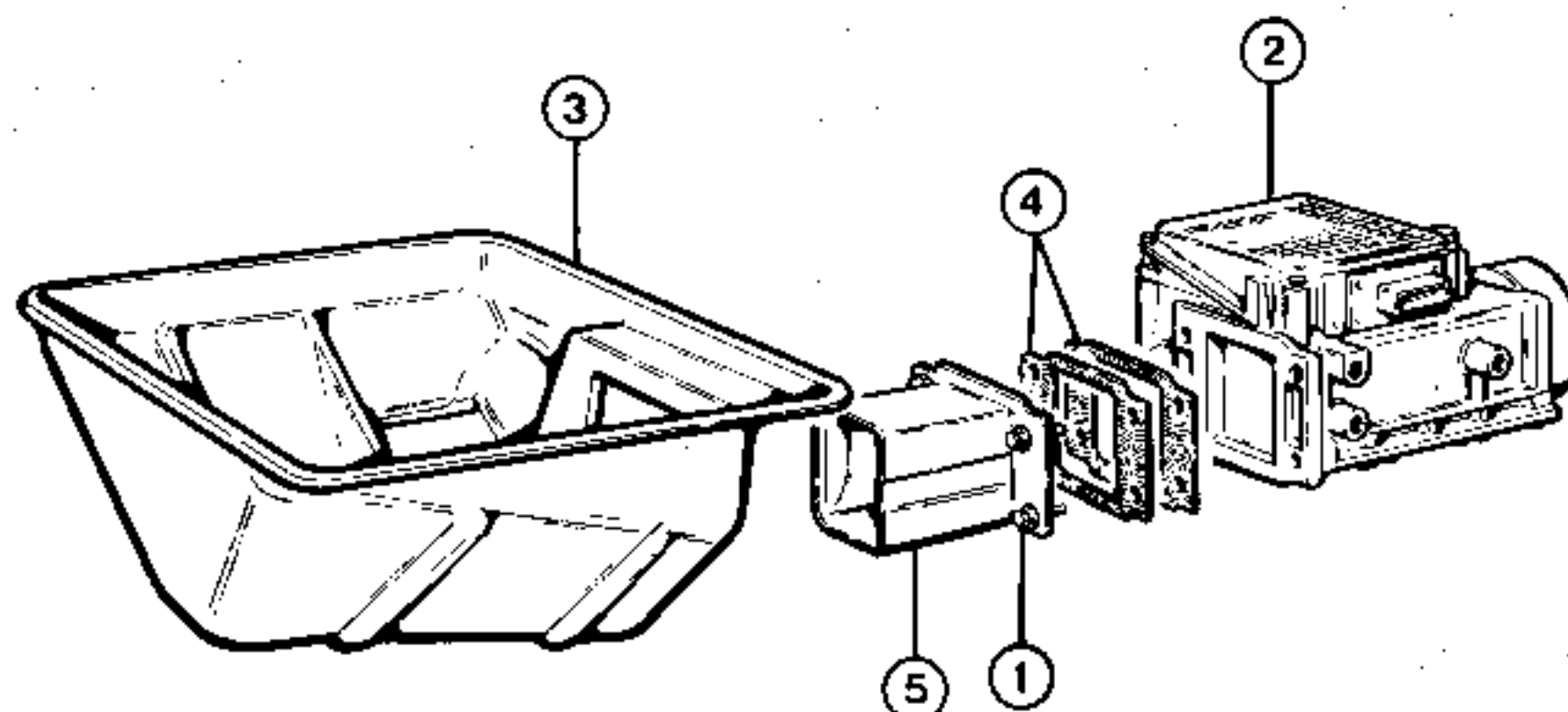
1. Clean the filter element thoroughly blowing compressed air through it at low pressure. If necessary replace the filter element.

REFITTING

Proceed to the refitting of the air filter by reversing the order of removal.

NOTE:

When positioning the filter element in the container, be sure that the arrow, indicating the upper part, is facing upwards.



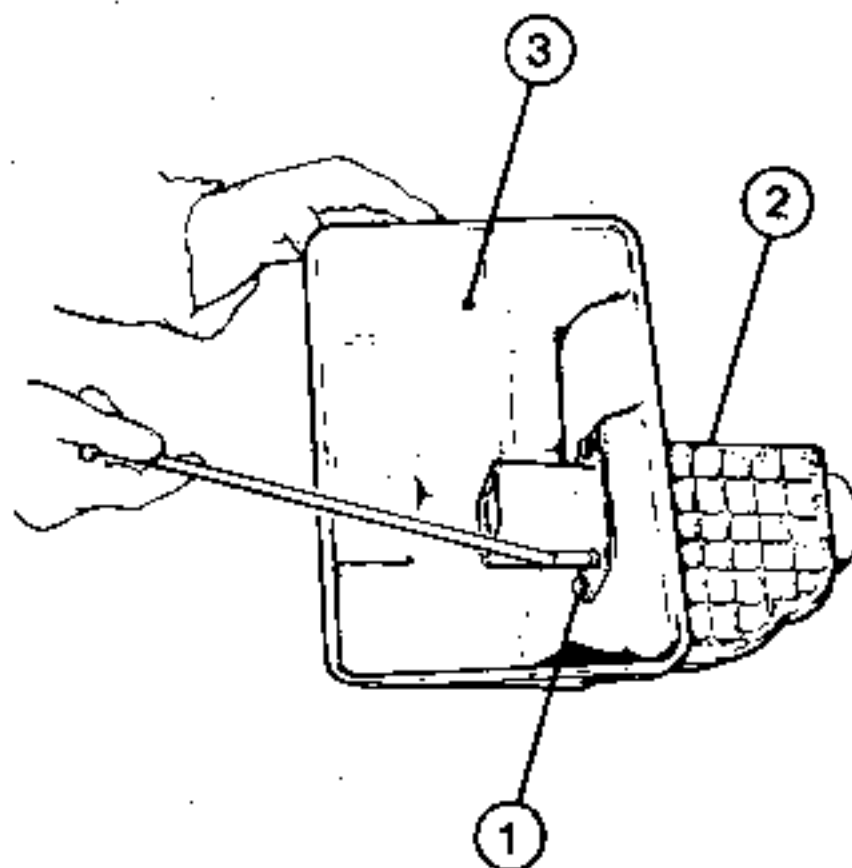
AIR FLOW GAUGE AND TEMPERATURE SENSOR

ELECTRICAL CHECKS

Refer to the paragraph «Electrical checks» of the Group 00.

REMOVAL

1. Remove the air filter assembly (see paragraph «Air filter - Removal»).
2. Unscrew the four screws (1) that secure the air flow gauge (2) to the filter cover (3).
3. Remove the air flow gauge (2) with the relative gaskets (4) and remove the inlet flange (5) from the filter cover (3).



1. Air flow gauge securing screws
2. Air flow gauge
3. Air filter cover

4. Gaskets
5. Inlet flange

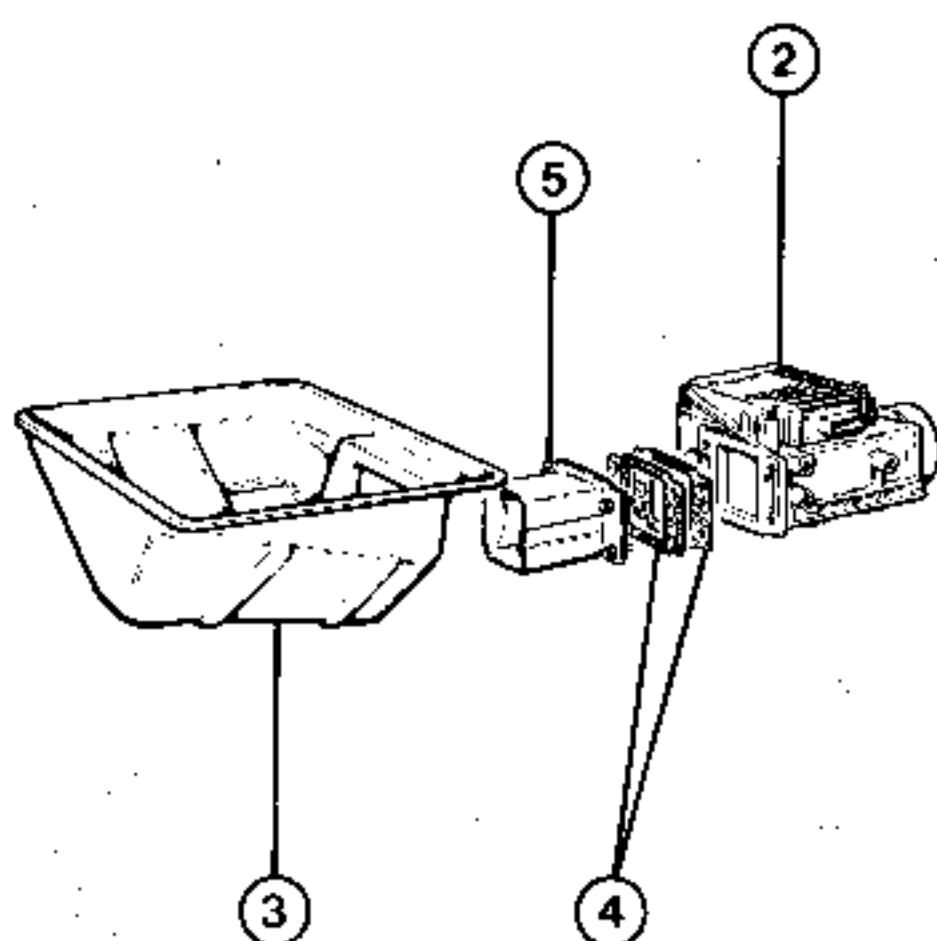
INSPECTION AND ADJUSTMENT

Press on the butterfly of the air flow gauge and check that it turns freely without sticking or catching and that it is not scored or dirty.

If necessary, clean the internal surfaces of the air flow gauge with a dry cloth.

REFITTING

1. Refit the air flow gauge (2), by reversing the order of removal.
- Replace the gaskets (4).



2. Air flow gauge
3. Filter cover
4. Gaskets
5. Inlet flange

WARNING:

Pay particular attention to the tightening of the fittings so as to prevent air from being taken in other than through the filter.

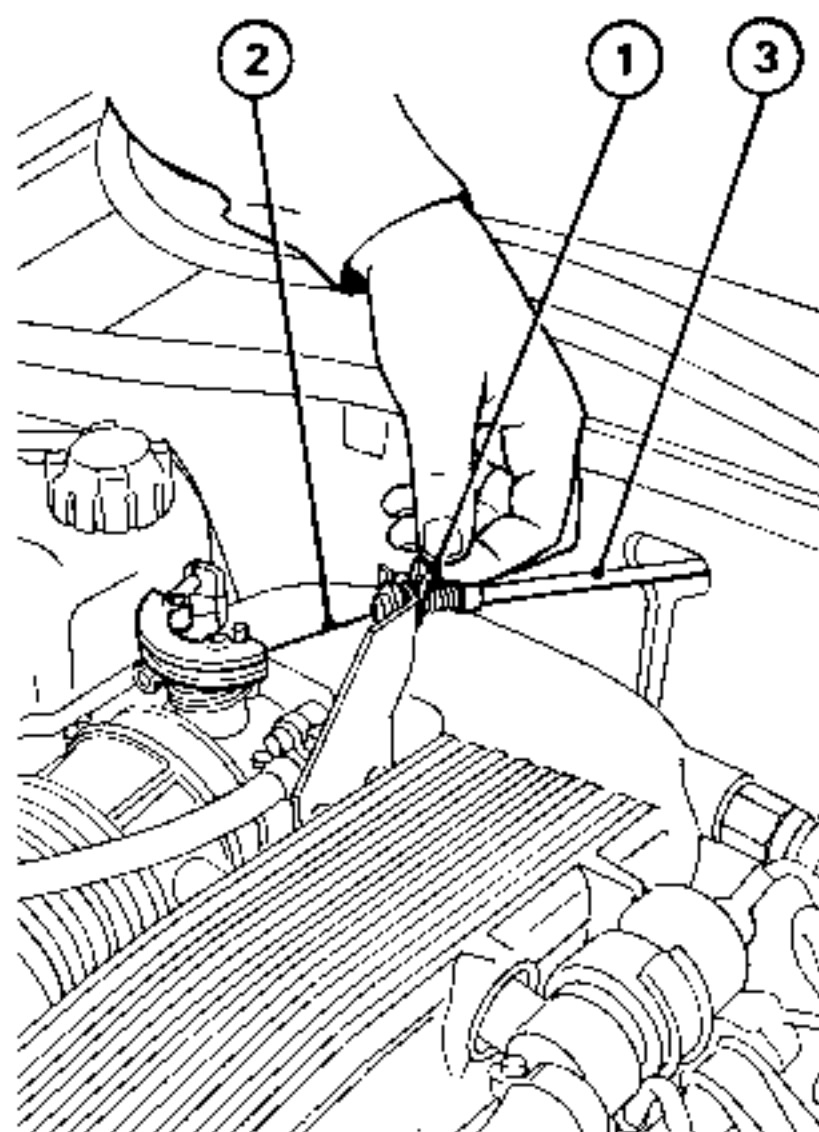
2. When the air flow gauge has been refitted, carry out the check and adjustment, if necessary, of the exhaust CO percentage (see paragraph «Settings and adjustment»).

COMPLETE ACCELERATOR BUTTERFLY ASSEMBLY AND HOUSING

REMOVAL

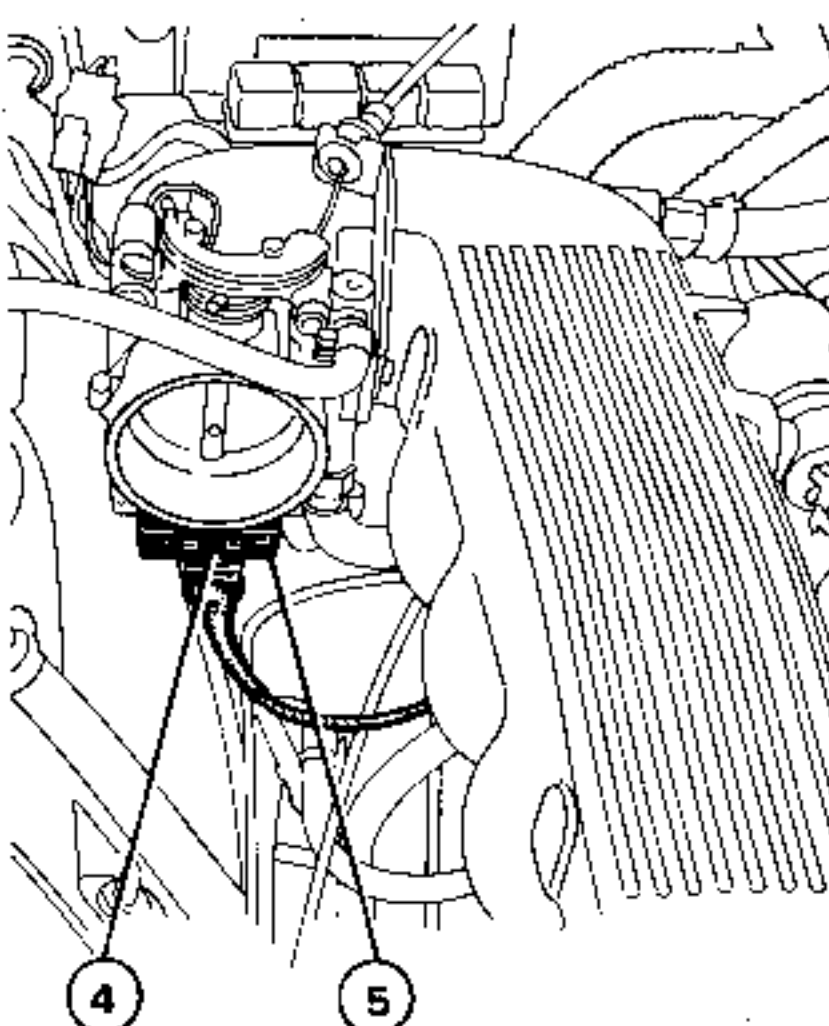
Remove the complete accelerator butterfly housing and assembly proceeding as follows:

1. Disconnect the negative terminal of the battery.
2. Remove the air filter together with the air flow gauge and the relative air intake duct (see paragraph «Air filter - Removal»).
3. Remove the stop ring (1), disconnect the accelerator control cable (2) and slide back the sheathing (3) from the relative support.



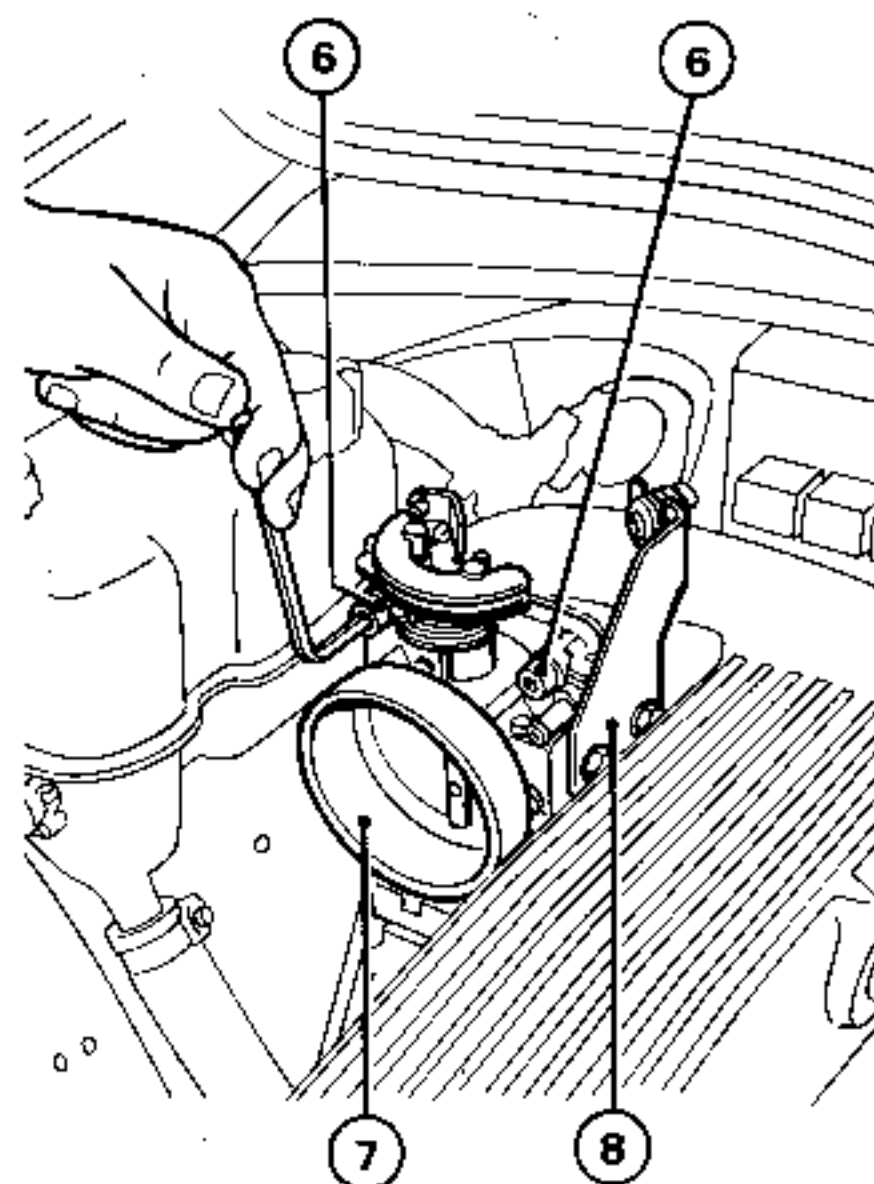
1. Stop ring
2. Accelerator control cable
3. Sheathing

4. Disconnect the connector (4) from the accelerator butterfly minimum and maximum opening switch (5).



4. Switch connector
5. Accelerator butterfly minimum and maximum opening switch

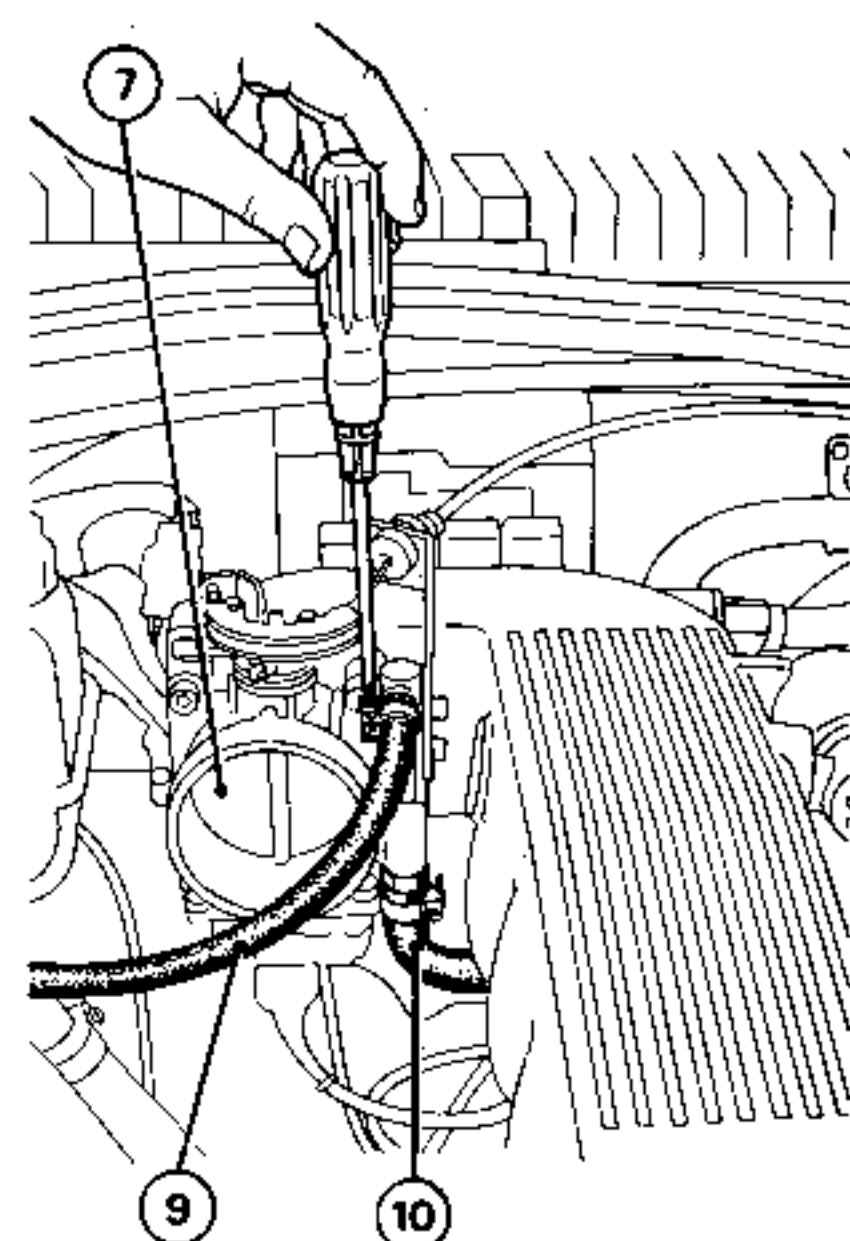
5. Unscrew the four securing screws (6), remove the accelerator housing (7) and recover the gasket and the accelerator cable support (8).



6. Accelerator butterfly housing securing screws
7. Accelerator butterfly housing
8. Accelerator cable support

6. Loosen the pipe clips and disconnect the following tubes from the accelerator butterfly housing (7):

- tube (9) for the delivery of coolant from the accelerator butterfly housing to the header tank.
- tube (10) for the delivery of coolant from the accelerator butterfly housing to the cylinder head.



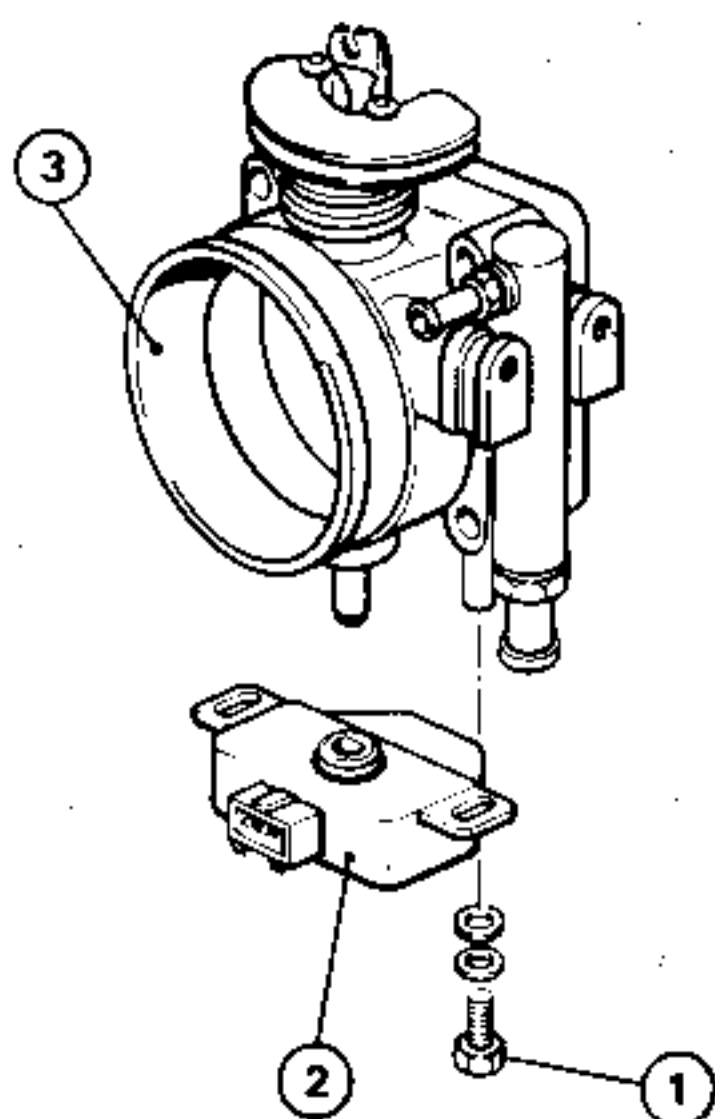
7. Accelerator butterfly housing
9. Tube for the delivery of coolant from the accelerator butterfly housing to the header tank
10. Tube for the delivery of coolant from the accelerator butterfly housing to the cylinder head

WARNING:

- Maintain the tubes ⑨ and ⑩ above the level of the header tank and plug them appropriately so as to avoid the loss of coolant.
- Do not tamper with the accelerator butterfly assembly adjustments.
- Plug the inlet to the air intake box so as to prevent any foreign matter from entering.

Removal of the accelerator butterfly assembly switch

1. Unscrew the two screws ① and remove the accelerator butterfly minimum and maximum opening switch ②.



1. Switch securing screws
2. Accelerator butterfly minimum and maximum opening switch
3. Accelerator butterfly housing

Refitting of accelerator butterfly assembly switch

Proceed to the refitting of the accelerator butterfly assembly switch by reversing the order of removal and then adjust it as described in the paragraph «Settings and adjustment».

REFITTING

Proceed to the refitting of the complete accelerator butterfly housing and assembly by reversing the order of removal, taking

care to restore all the electrical connections correctly, to fit a new gasket between the accelerator butterfly housing and the air intake box and to tighten the clips on the air intake box well.

If necessary, carry out the setting of the accelerator butterfly assembly (see paragraph «Setting and adjustment»).

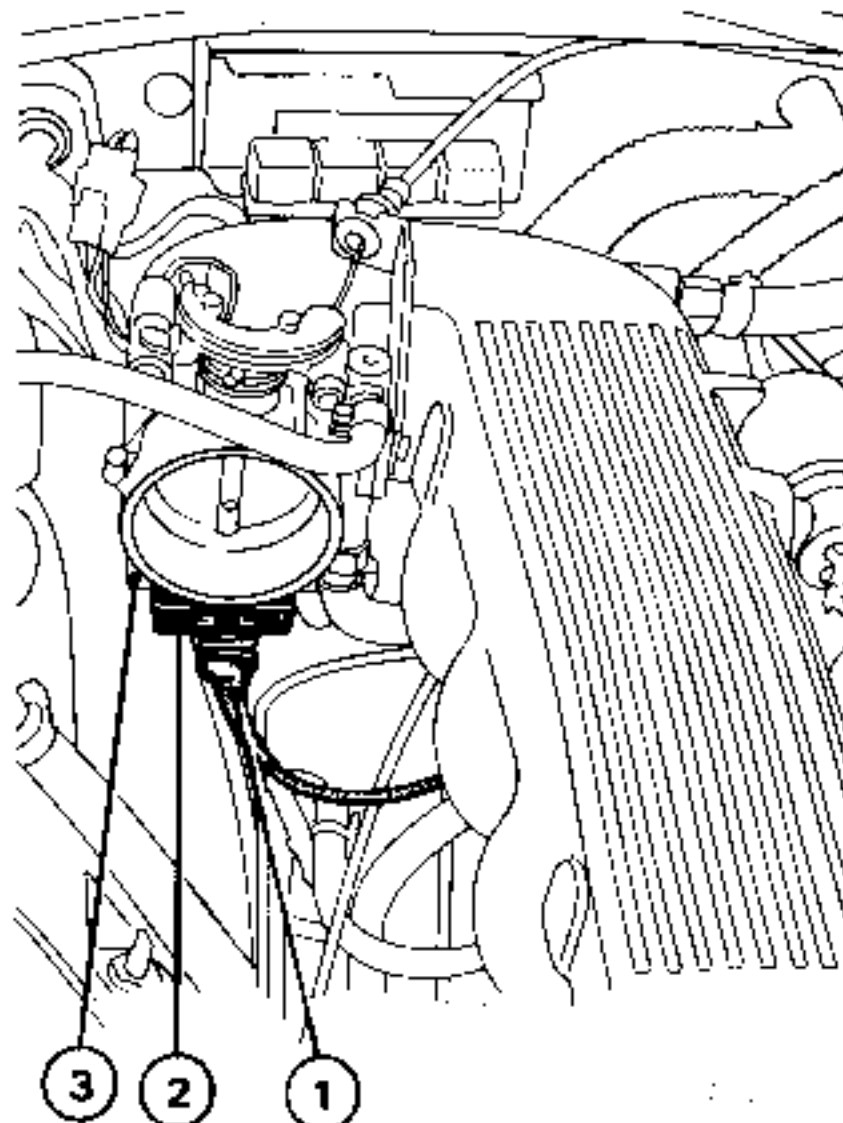
ACCELERATOR BUTTERFLY MAXIMUM AND MINIMUM OPENING SWITCH

ELECTRICAL CHECKS

Refer to the paragraph «Electrical checks» of Group 00.

REPLACEMENT

1. Disconnect the connector ① of the switch ②.
2. Unscrew the two screws ③ and remove the switch.



1. Switch connector
2. Accelerator butterfly minimum and maximum opening switch
3. Switch securing screws

3. Fit a new switch and proceed to the setting of it (see paragraph «Setting and adjustment»).

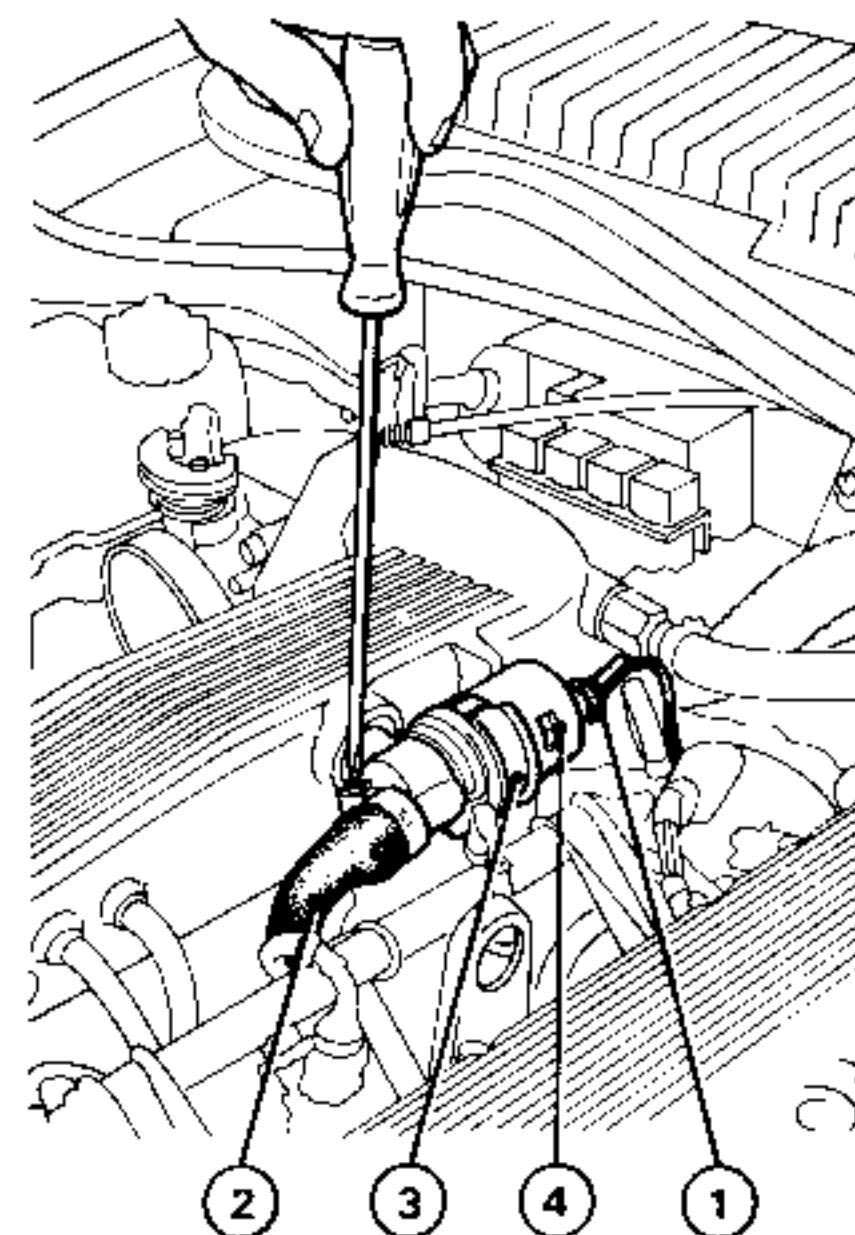
CONSTANT IDLE REGULATION ACTUATOR

ELECTRICAL CHECKS

Refer to the paragraph «Electrical checks» of Group 00.

REMOVAL

1. Disconnect the connector ①.
2. Loosen the pipe clip and disconnect the constant idle regulation by-pass tube ②.
3. Unscrew the securing screw of the clip ③ that holds the actuator to the air intake box.
4. Remove the actuator ④ complete with clip.



1. Connector
2. By-pass tube
3. Clip
4. Constant idle regulation actuator

REFITTING

Proceed to the refitting of the constant idle regulation actuator by reversing the order of removal and paying particular attention to the following:

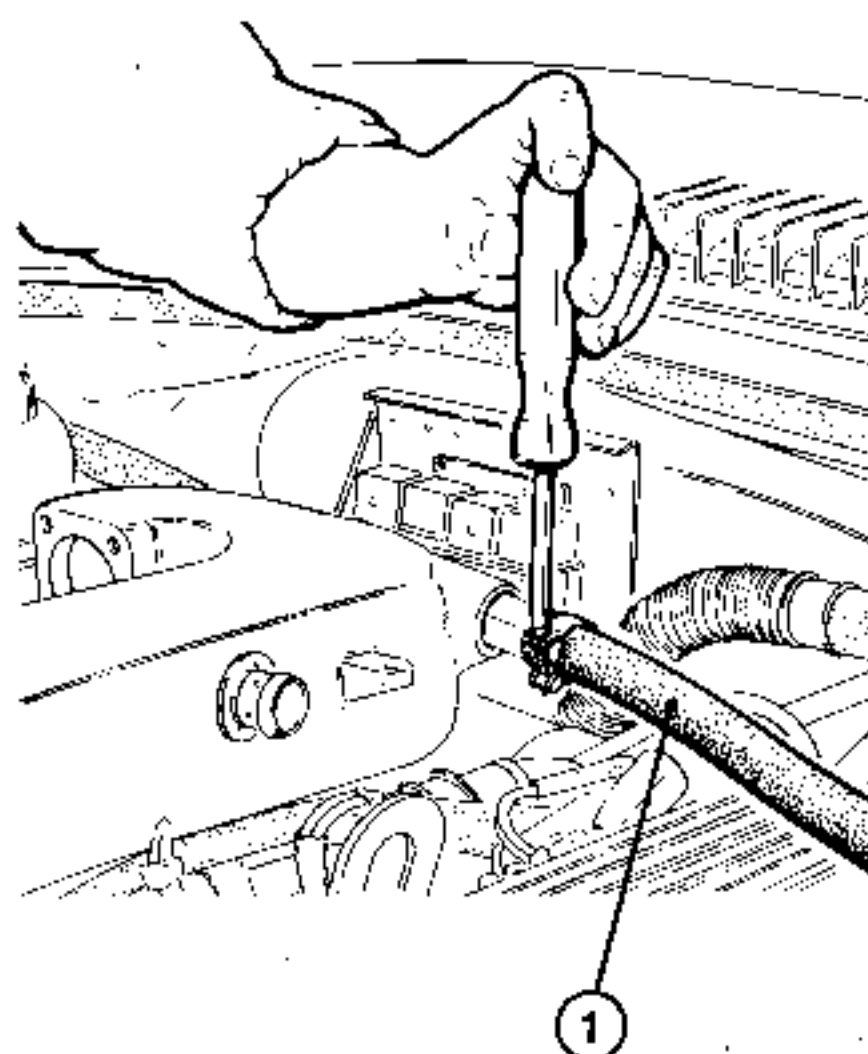
- The pipe clip ② must be well tightened to prevent the leakage of air.
- The connector ① must be pushed completely onto its seating on the actuator.

AIR INTAKE BOX

REMOVAL

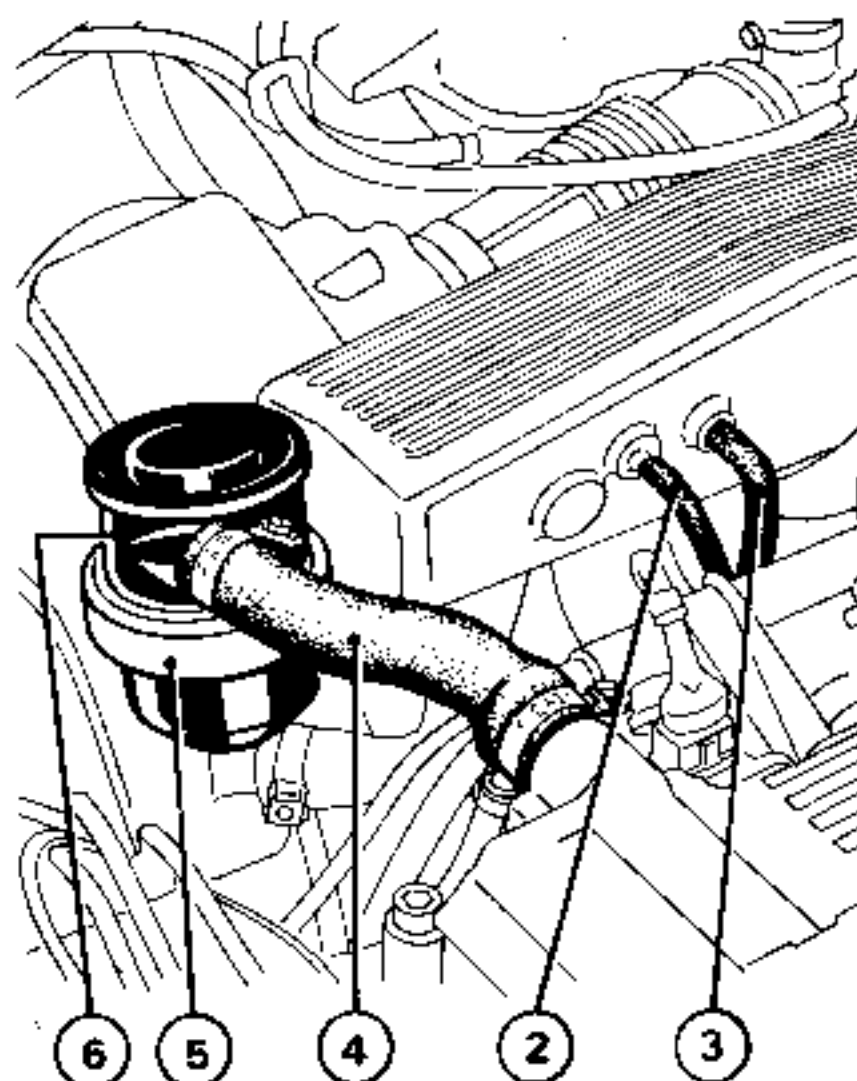
Proceed to the removal of the air intake box operating as follows:

1. Disconnect the battery terminals.
2. Remove the air filter together with the airflow gauge and the relative air intake duct (see paragraph «Air filter - Removal»).
3. Remove the accelerator butterfly housing (see paragraph «Complete accelerator butterfly housing and assembly - Removal»).
4. Loosen the pipe clip and disconnect the servo-brake vacuum tube (1) from the air intake box.



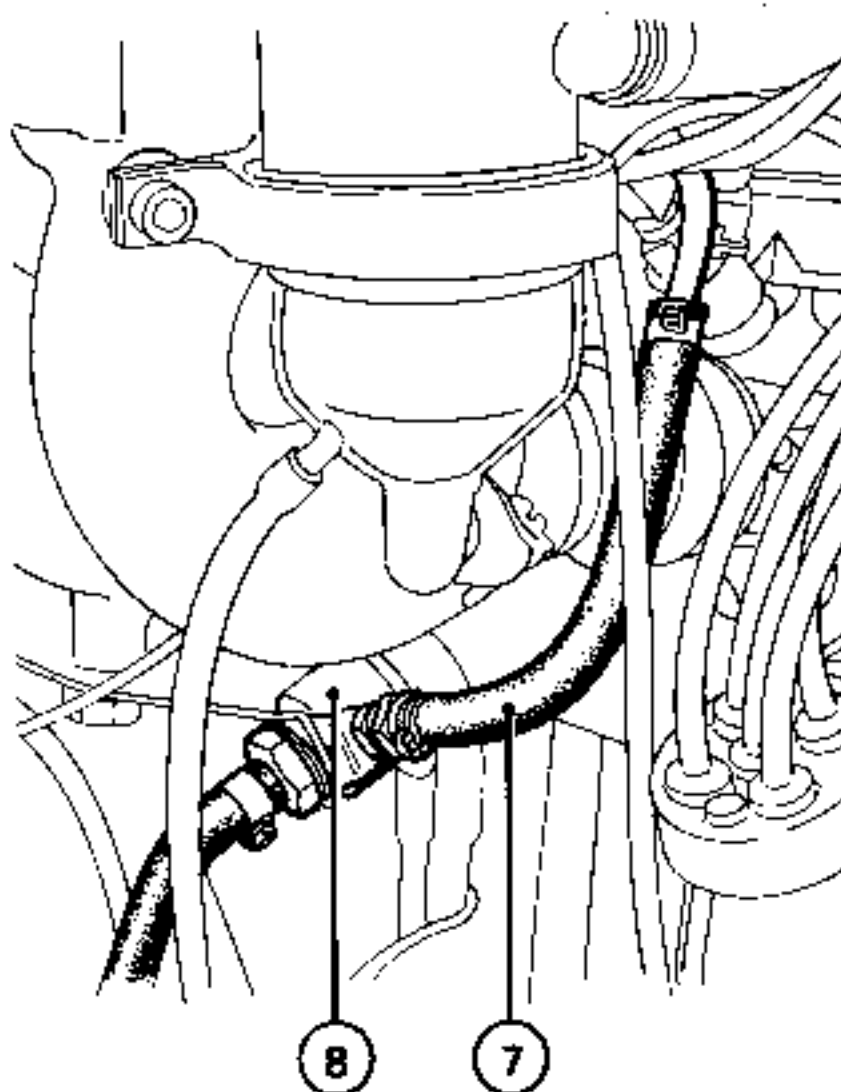
1. Servo-brake vacuum tube

5. Disconnect the vacuum tube for the pressure regulator (2) and the fuel vapour recycling tube (3) from the air intake box.
6. Loosen the pipe clip and disconnect the peak r.p.m. oil vapour recycling tube (4) from the oil vapour trap.
7. Unscrew the screw securing the clip (5) and remove the oil vapour trap (6) from the air intake box.



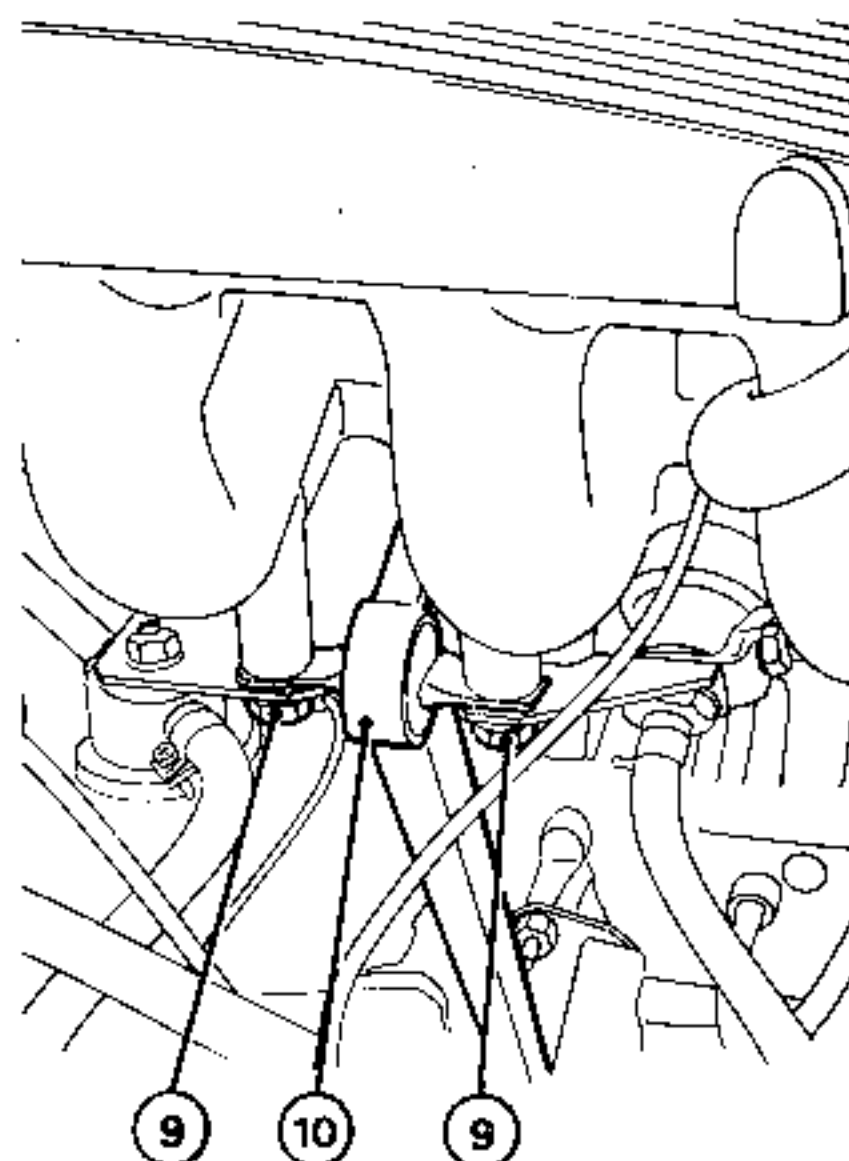
2. Vacuum tube for the fuel pressure regulator
3. Fuel vapour recycling tube
4. Peak r.p.m. oil vapour recycling tube
5. Clip
6. Oil vapour trap

8. Loosen the pipe clip and disconnect the petrol return tube (7) from the fuel pressure regulator (8).



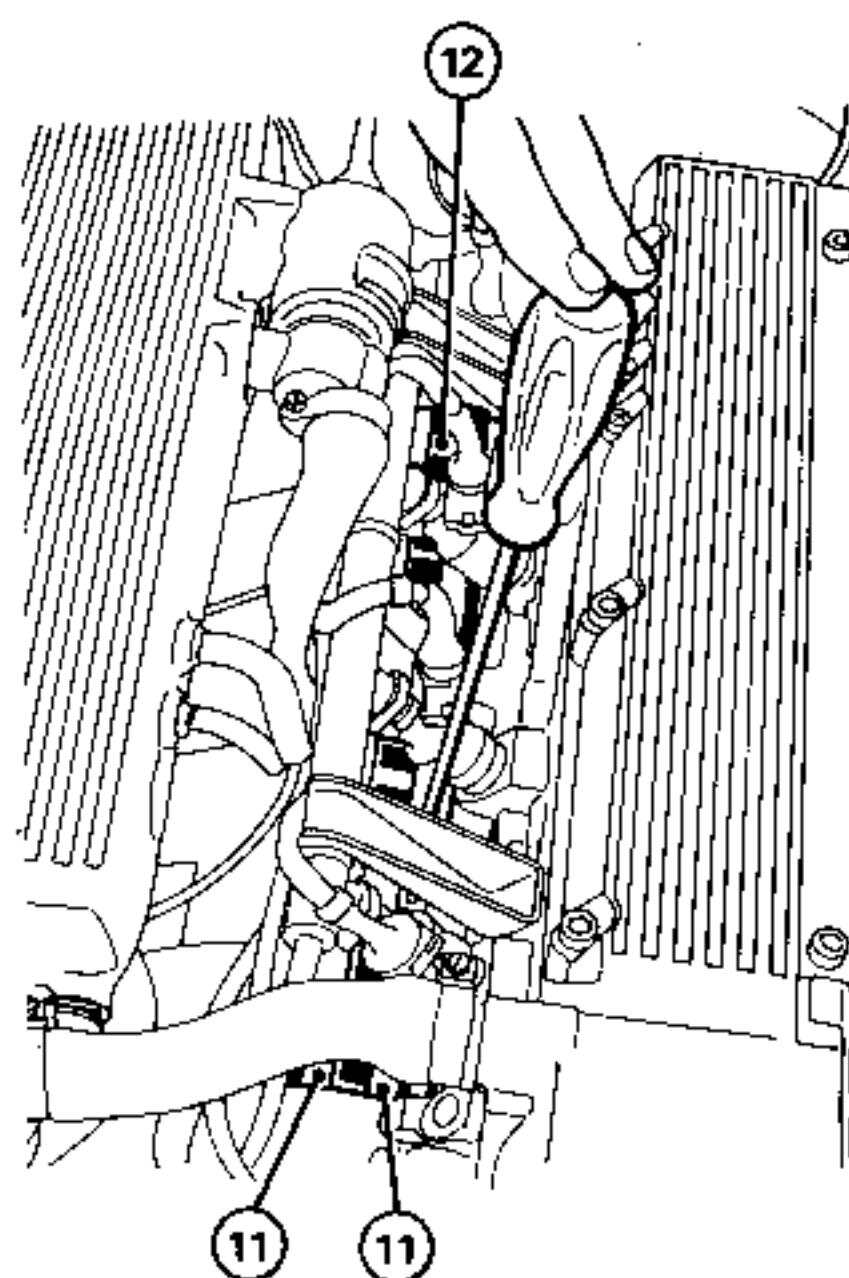
7. Petrol return tube
8. Fuel pressure regulator

9. Unscrew the screws (9) that secure the air intake box to the support (10).



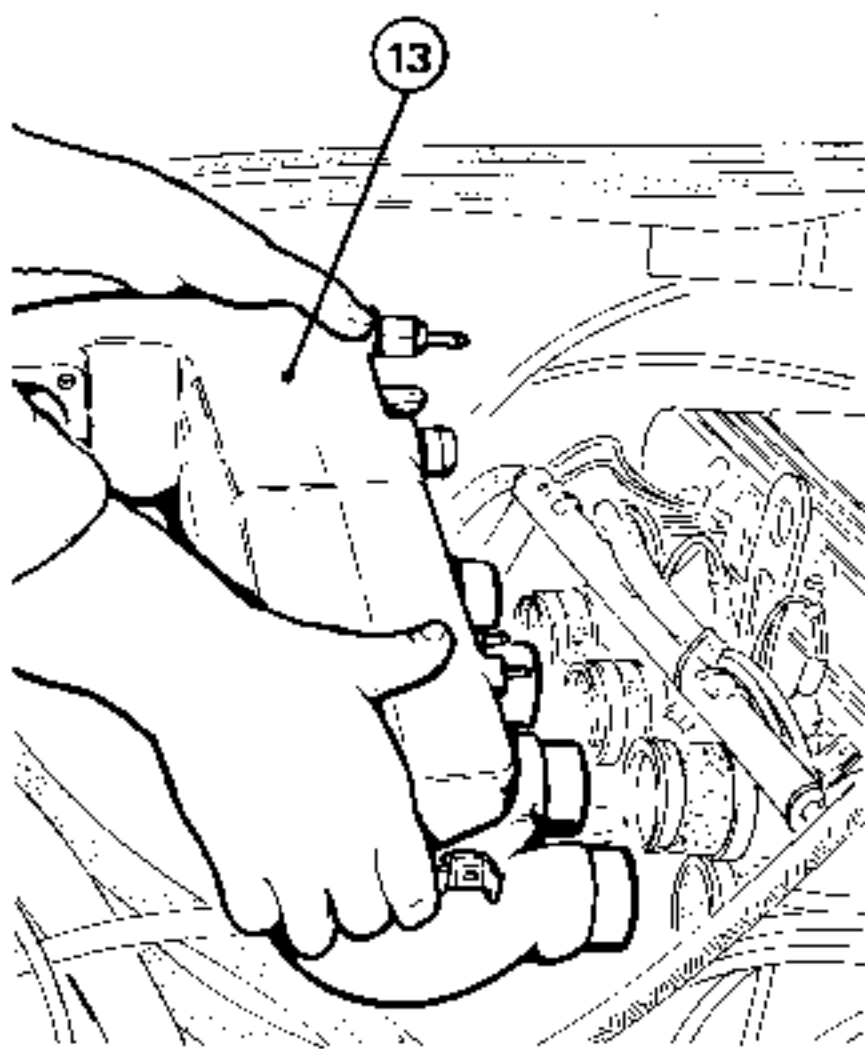
9. Securing screw
10. Support

10. Loosen the pipe clips (11) securing the rubber connectors (12) of the air inlet manifold to the air intake box.



11. Pipe clips
12. Rubber connectors

11. Remove the air intake box (13) withdrawing it from the rubber connectors of the air inlet manifold.



13. Air inlet manifold

INSPECTION AND ADJUSTMENT

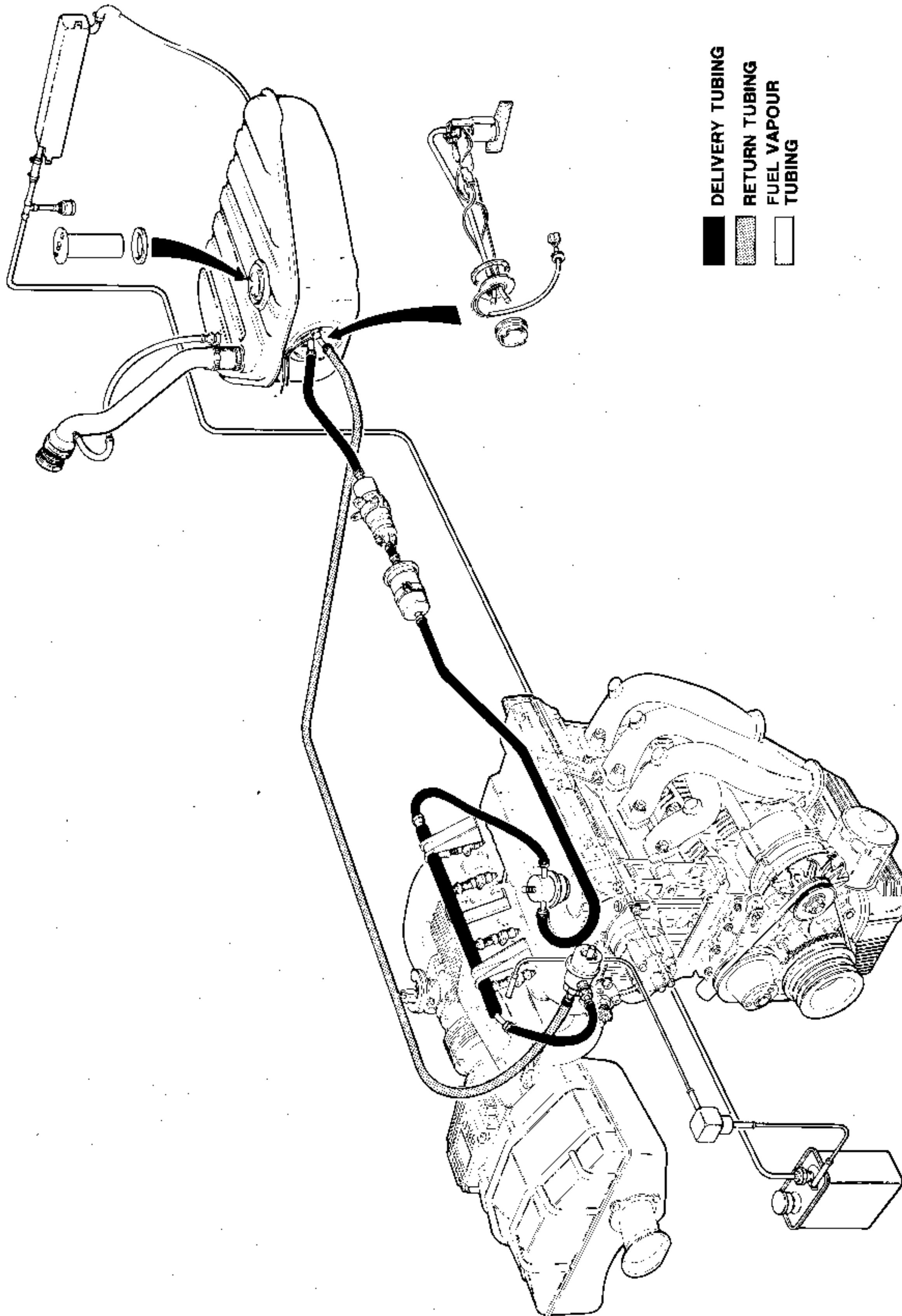
1. Clean the inside of the air intake box thoroughly, by blowing compressed air into it.

REFITTING

Proceed to the refitting of the air intake box by reversing the order of removal and paying particular attention to the following:

- The pipe clips (11) securing the rubber connectors (12) to the air intake box must be tightened well so as to avoid any leakage of air.
- If necessary replace the rubber connectors (12) between the air intake box and the air inlet manifold.
- Fit a new gasket between the accelerator butterfly housing and the air intake box.

FUEL AND FUEL VAPOUR SYSTEM



DELIVERY TUBING
RETURN TUBING
FUEL VAPOUR TUBING

1. Fuel tank
2. Filler inlet
3. Breather tubes for filling
4. Fuel level gauge
5. Compensation valve
6. Immersed pump
7. Filter
8. Main pump
9. Fuel return tubing
10. Fuel delivery tubing
11. Hammering damper
12. Fuel distributor tube
13. Fuel pressure regulator
14. Electric fuel injector
15. Fuel vapour trap
16. Air inlet valve
17. Solenoid valve
18. Carbon canister
19. Fuel vapour return tube
20. Inlet tube for fuel vapours into the air intake box

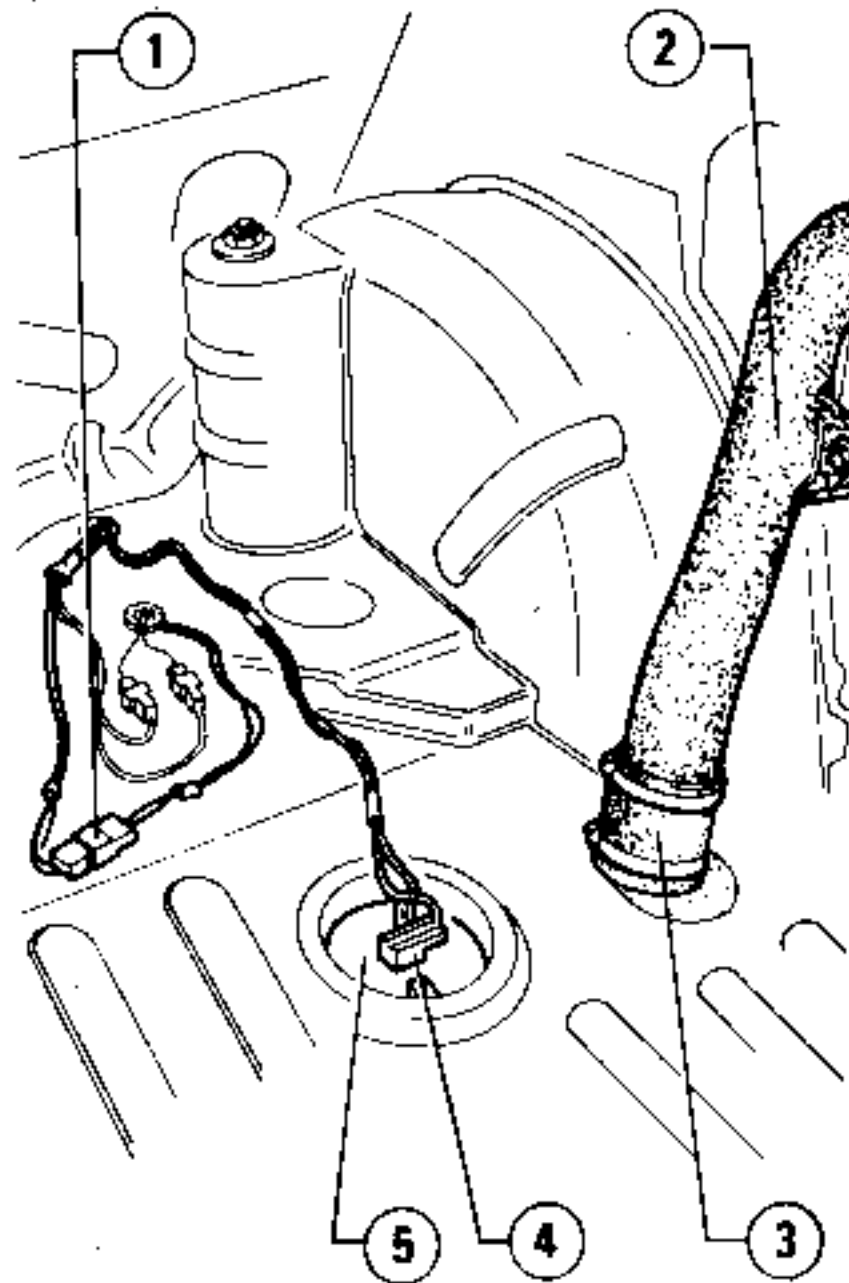
CAUTION:

Before replacing the components of the fuel system the following must be scrupulously observed:

- Make sure that suitable safety equipment (fire extinguishers etc.) is available in the workshop.
- Disconnect the ground terminal of the battery.
- Place the fuel taken from the fuel tank in a suitable container with a safety lid.

WARNING:

After having refitted the components of the fuel system, check the tightness of the system to a pressure of 4 bar.



- Immersed fuel pump connector
- Filler inlet
- Coupling connecting the inlet to the tank
- Fuel level gauge connector
- Fuel level gauge

INSPECTION AND ADJUSTMENT

Check that the tank is not cracked or deformed, replace if necessary.

REFITTING

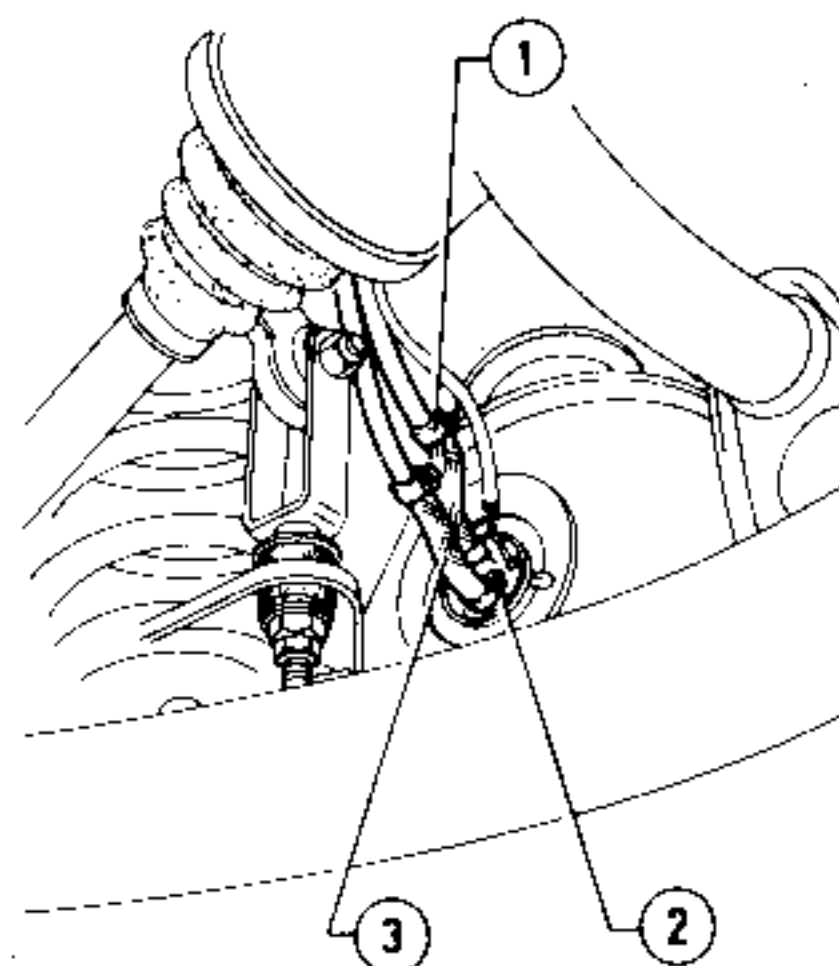
- Fit the tank on the vehicle proceeding in the reverse order to that followed for the removal and paying particular attention to the correct positioning of the rubber gasket between the tank and the floor of the luggage compartment where the inlet filler pipe meets the tank.

FUEL TANK

REMOVAL

- Set the vehicle on a hydraulic lift, remove the filler cap and suck the fuel from the tank using a suitable pump.
- Remove the lining of the floor of the luggage compartment, move aside the lining of the wall of the compartment (right side) and remove the cover of the fuel level gauge.
- Disconnect the connectors (1) and (4) and then withdraw the connector (1) from its lead passage extracting it from beneath the vehicle.
- Loosen the clip and detach the coupling (3) from the tank without damaging the rubber gasket under the coupling.

- Raise the vehicle on the lift and disconnect the tubes (1) and (3) from the flange (2).



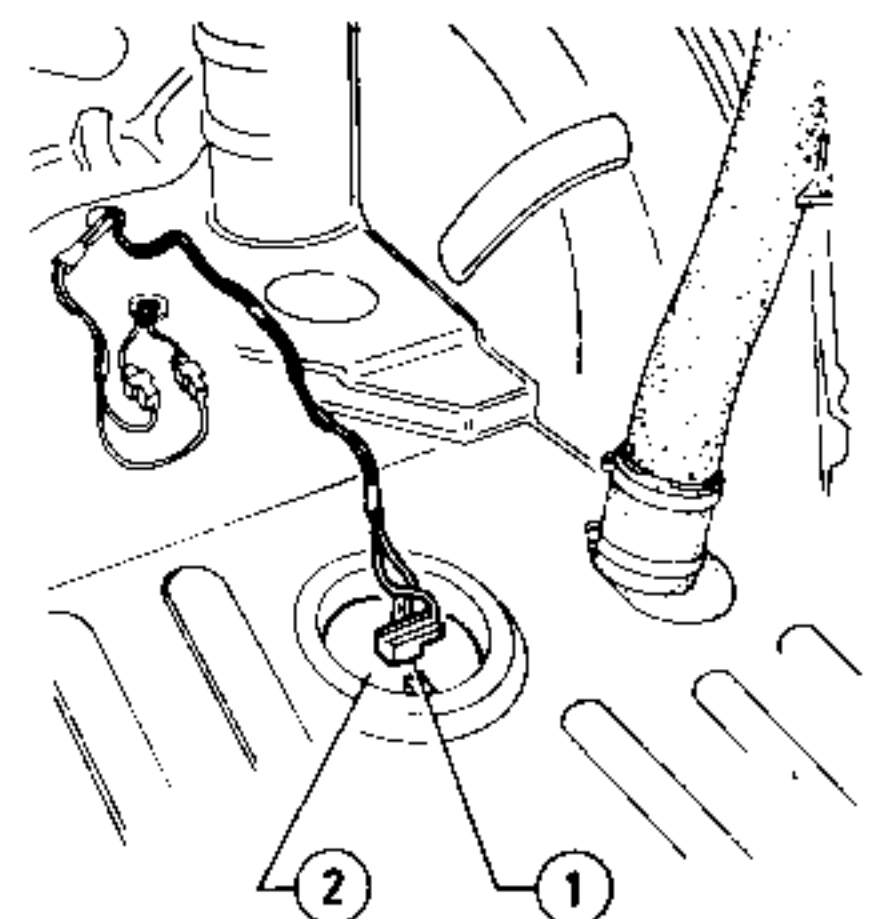
- Fuel return tube
- Immersed fuel pump flange
- Fuel delivery tube

- Support the tank on a column type jack, unscrew the three screws securing the tank to the body and remove it.
- If necessary, divide the tank into its various component parts.

FUEL LEVEL GAUGE

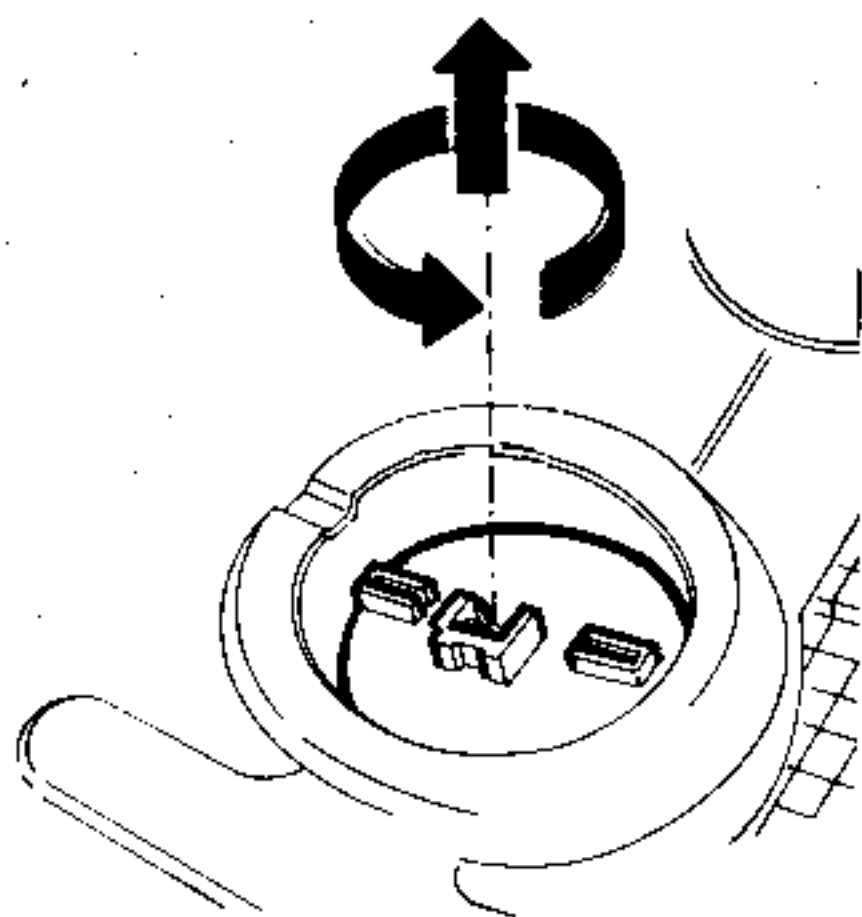
REPLACEMENT

- Remove the lining of the floor of the luggage compartment.
- Remove the fuel level gauge cover (2) and disconnect the connector (1).

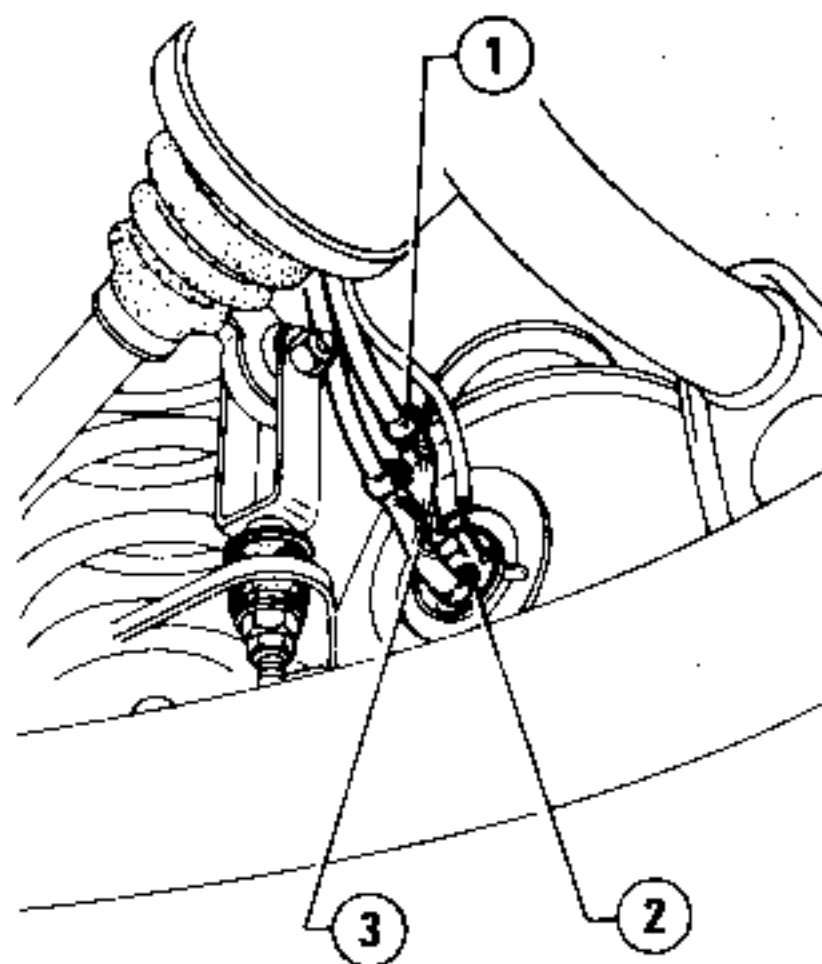


- Fuel level gauge connector
- Fuel level gauge

- Using a suitable tool, turn the fuel level gauge anti-clockwise and extract it from the fuel tank with the relative gasket.

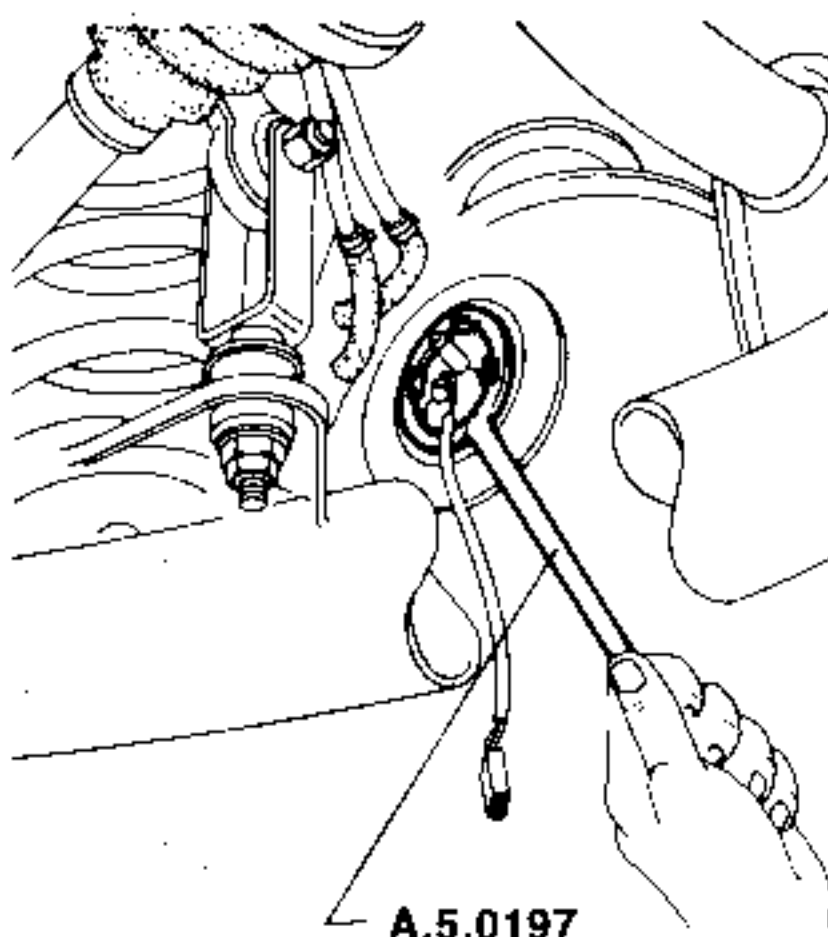


- Replace the gasket before fitting the fuel level gauge on the tank.



- Fuel return tube
- Immersed fuel pump flange
- Fuel delivery tube

- Using special service tool A.5.0197, turn the immersed fuel pump flange anti-clockwise and extract the assembly from the tank with the relative gasket.



- Replace the gasket before fitting the immersed fuel pump assembly. Proceed to refit it using the special service tool A.5.0197.

FUEL SYSTEM TUBING

REMOVAL

WARNING:

The tubing of the fuel system should only be removed if absolutely necessary.

- Set the vehicle on a hydraulic lift.
- Remove the fuel filler cap and using a suitable pump suck the fuel from the tank.
- Loosen the pipe clips of the tubes to be removed.

WARNING:

Plug the ends of the tubes to prevent the entrance of foreign matter during disassembly (both rigid and flexible tubing).

- In order to remove the tubing located on the floor inside the passenger compartment, first remove the lining of the floor on the right side.

INSPECTION AND ADJUSTMENT

- Check that the flexible tubes are not porous or defective in any way. Replace any defective tubing.
- Check that the rigid tubes are neither clogged nor dented and that they do not show signs of oxidation.

REFITTING

Refit the tubing with care by operating in the reverse order to that followed for the removal paying attention to the following warning.

WARNING:

- Refit the pipe clips on the junctions of the system with care. Do not over tighten the pipe clips so as to avoid damaging the tubing.
- Neither bend nor twist the rigid tubing while refitting these on the vehicle.
- The tubing located inside the vehicle must be inserted in the relative tube passages as far as the red reference bands marked on each tube.
- Start the engine and check that there are no leaks from the junctions.

AUXILIARY FUEL PUMP AND GAUZE-TYPE FILTER

REPLACEMENT

- Set the vehicle on a hydraulic lift, remove the filler cap and suck the fuel from the tank using a suitable pump.
- Lift the lining of the floor of the luggage compartment, disconnect the immersed fuel pump connector, slide it through the relative lead passage and extract it from beneath the vehicle.
- Raise the vehicle on the hydraulic lift and disconnect the tubes ① and ③ from the flange ②.

COMPENSATOR VALVE

REPLACEMENT

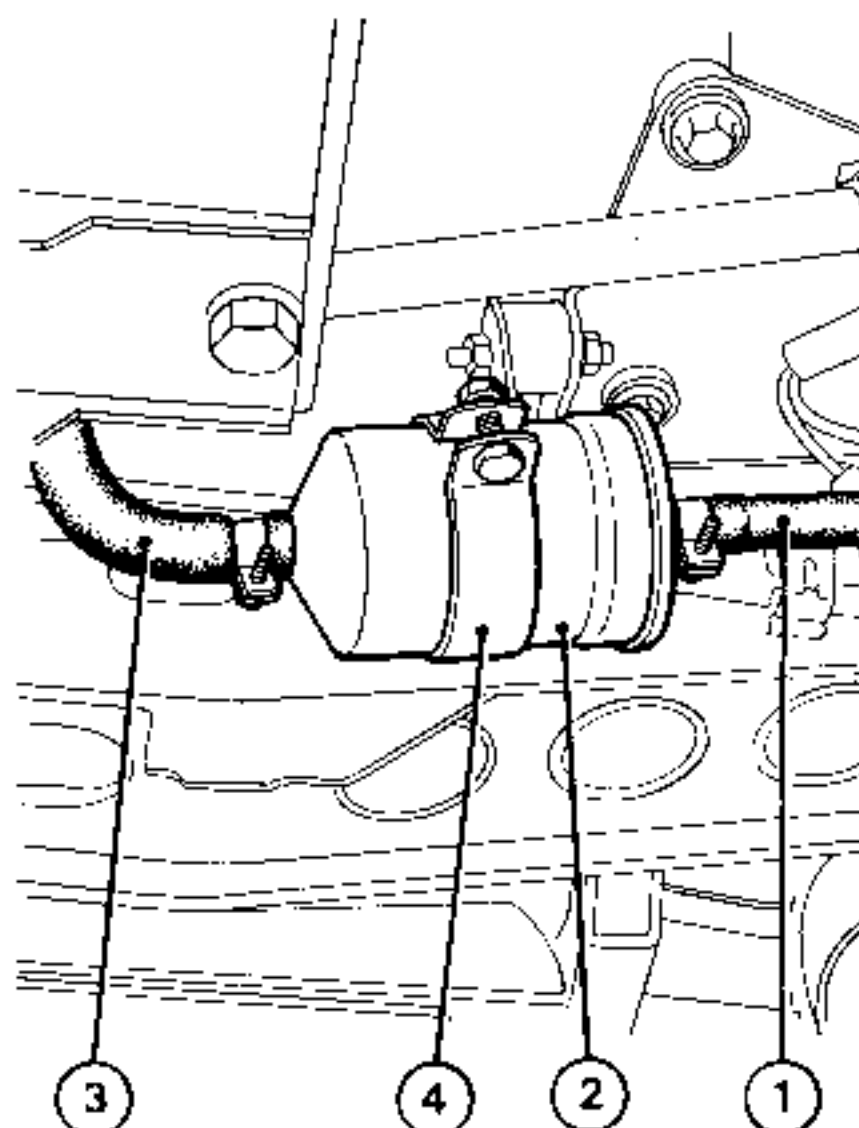
1. Remove the lining of the floor of the luggage compartment.
2. Disconnect the filling breather tube with the attached compensation valve.

INSPECTION AND ADJUSTMENT

1. Blow a jet of air into the valve from the fitting on the petrol inlet side. Considerable resistance should be felt and a certain quantity of air should come out of the fitting on the atmosphere side.
2. Blow a jet of air into the valve from the fitting on the atmosphere side. The jet of air should come straight out of the fitting on the petrol inlet side without any resistance being felt.
3. If the compensation valve does not present the above described characteristics, then it must be replaced.

REFITTING

When refitting the compensation valve, take care to fit it the right way round, in the direction of its functioning.



1. Fuel inlet tube
2. Fuel filter
3. Fuel outlet tube
4. Filter support clip

5. Fit the new pump by reversing the order of removal and paying particular attention to the following:

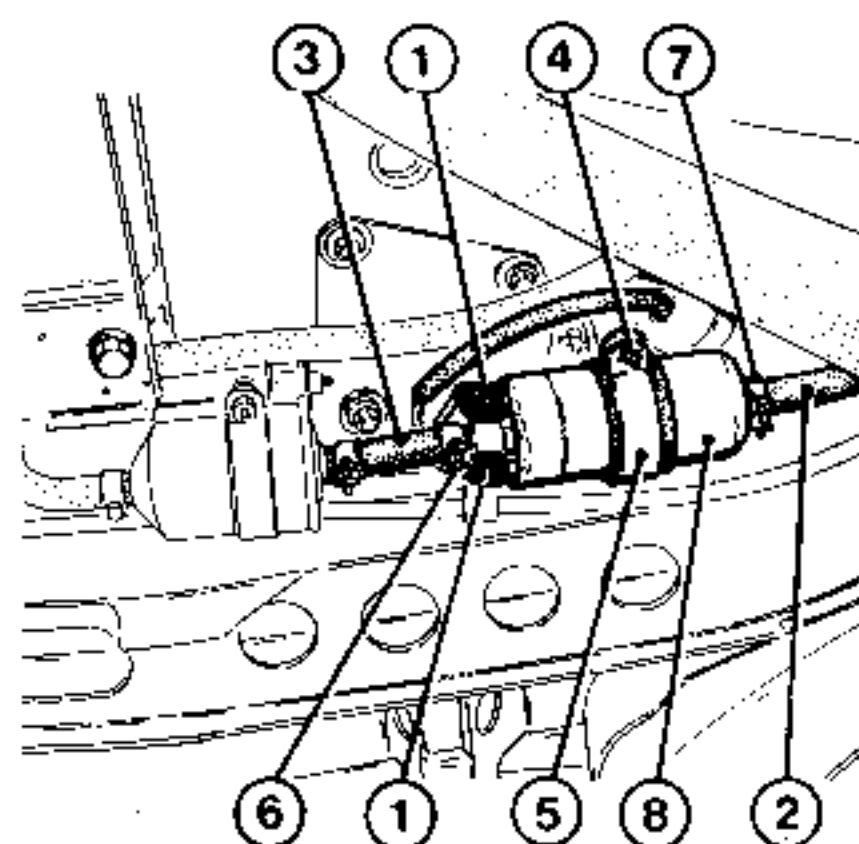
- The replacement pump is supplied in a sealed packaging, filled with protective oil and with the pipe fittings closed with special plugs. When fitting it is not necessary to empty it.
- Take care not reverse the connections of the power supply leads (1).
- Tighten the following securing component to the specified torque:
 - Nut (4) for locking of pump securing clip (5).

T : Tightening torque
 1.9 ÷ 2.4 N·m
 (0.19 ÷ 0.24 kg·m)

MAIN FUEL PUMP

REPLACEMENT

1. Set the vehicle on a hydraulic lift and disconnect the negative terminal of the battery.
2. Working from beneath the vehicle disconnect the pump power supply leads (1).
3. Pinch the tubes (2) and (3), unscrew the nut (4) that locks the pump clip (5), loosen the pipe clips (6) and (7) and then disconnect the tubes (2) and (3) from the pump (8).
4. Loosen the clip (5) and remove the pump (8).

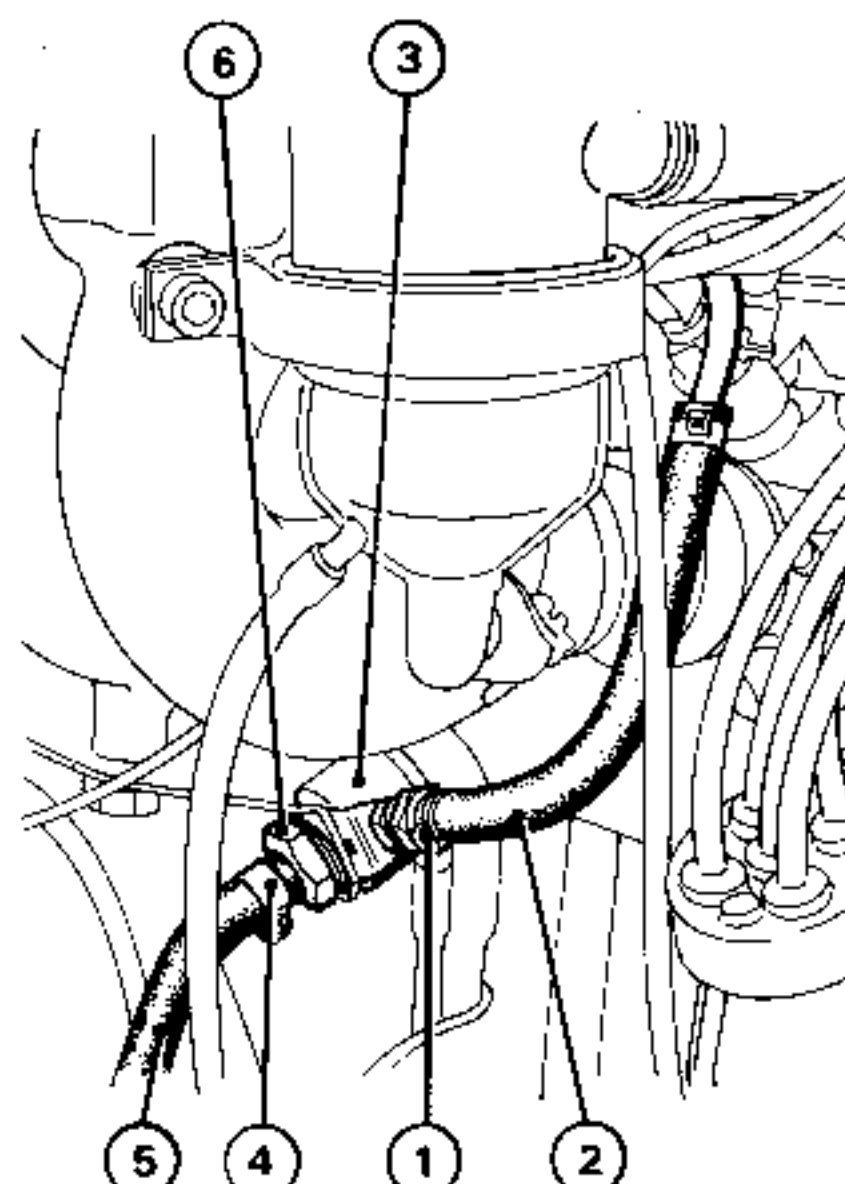


1. Fuel pump power supply leads
2. Fuel pump inlet tube
3. Fuel pump outlet tube
4. Securing nut
5. Pump support clip
6. Pipe clip
7. Pipe clip
8. Fuel pump

FUEL PRESSURE REGULATOR

REPLACEMENT

1. Remove the air filter (see paragraph «Air filter - Removal»).
2. Paying attention for possible sprays of fuel, loosen the pipe clip (1) and disconnect the tube (2) from the fuel pressure regulator (3) plugging it appropriately.



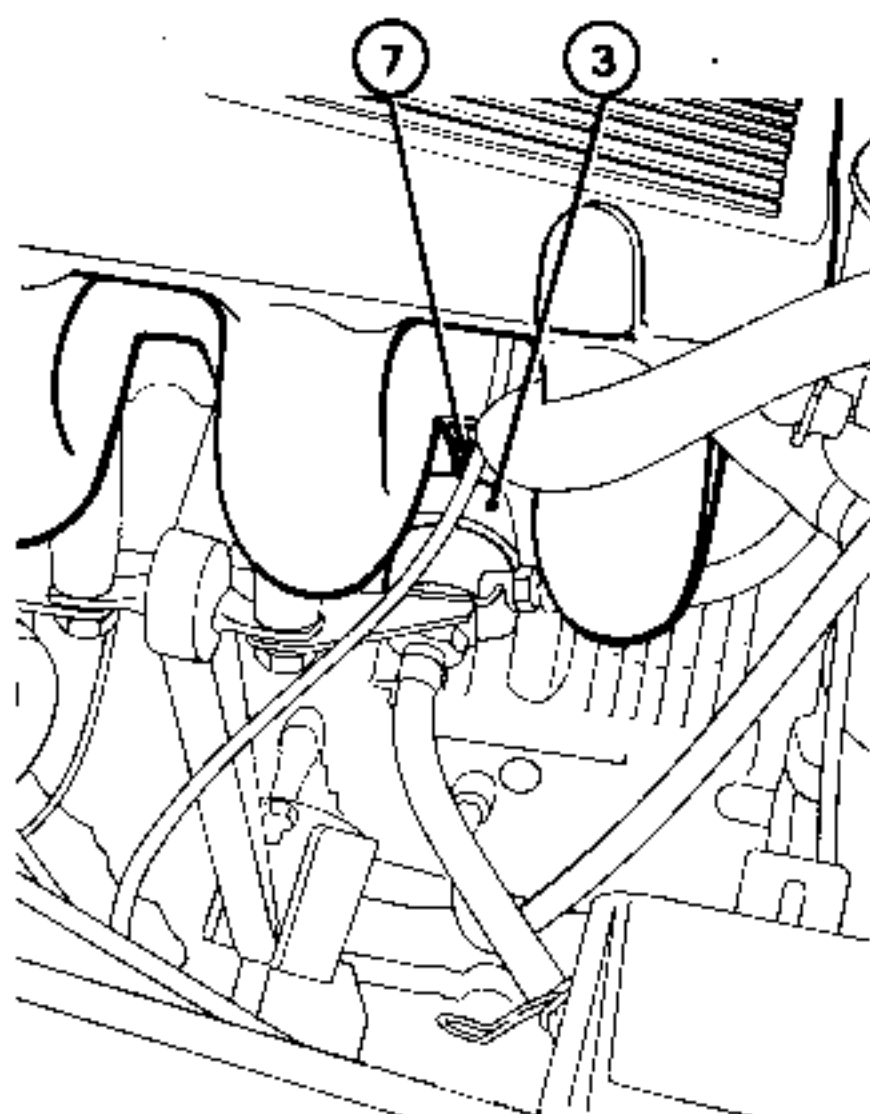
1. Pipe clip
2. Tube for fuel return from the fuel distributor tube
3. Fuel pressure regulator
4. Pipe clip
5. Tube for fuel return to the tank
6. Securing nut

FUEL FILTER

REPLACEMENT

- a. Operating from beneath the vehicle pinch the tubes (1) and (3).
- b. Loosen the pipe clips and detach the tubes (1) and (3) from the filter (2).
- c. Loosen the support clip (4) and remove the filter.
- d. Refit the new filter taking care to see that the arrow stamped on the casing of the filter is facing in the direction of the fuel delivery.
- e. When the fitting is complete, remove the tube pinchers from the fuel delivery tubing.

3. Loosen the pipe clip (4) and disconnect the fuel return tube (5) from the pressure regulator.
4. Unscrew the nut (6) that secures the pressure regulator to the bracket.
5. Withdraw the pressure regulator (3) from the bracket and disconnect the vacuum tube.



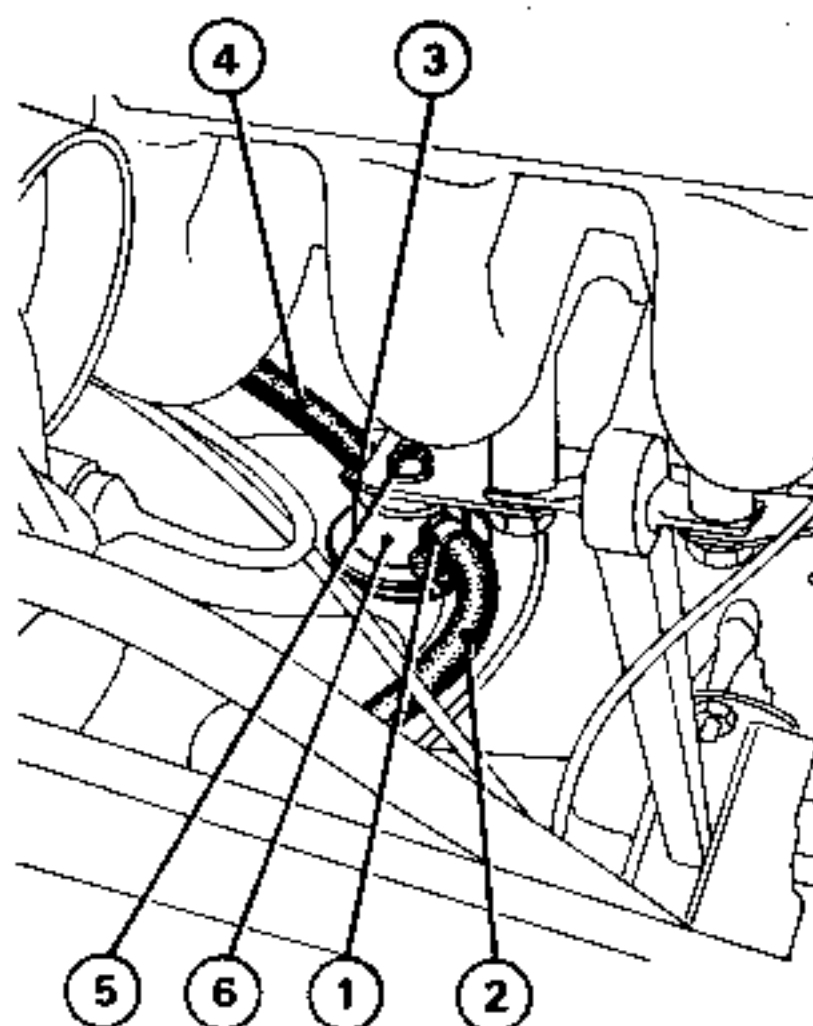
3. Pressure regulator
7. Pressure regulator vacuum tube

6. Refit the new pressure regulator by reversing the order of removal.
7. Refit the air filter (see paragraph «Air filter - Refitting»).

HAMMERING DAMPER

REPLACEMENT

1. Remove the air filter (see paragraph «Air filter - Removal»).
2. Paying attention for possible sprays of petrol, loosen the pipe clip (1) and disconnect the fuel delivery tube (2).
3. Loosen the pipe clip (3) and disconnect the fuel delivery tube (4) from the fuel distributor tube.
4. Unscrew the nut (5) that secures the hammering damper (6) to the bracket, recover the washer beneath, and remove the hammering damper.



1. Pipe clip
2. Fuel delivery tube
3. Pipe clip
4. Tube for delivery of fuel to the fuel injectors
5. Hammering damper securing nut
6. Hammering damper

5. Refit a new hammering damper by reversing the order of the removal.
6. Refit the air filter (see paragraph «Air filter - Refitting»).

ELECTRIC FUEL INJECTORS

INSPECTION AND ADJUSTMENT

1. Check electrical circuit continuity
Refer to the paragraph «Electrical checks» of Group 00.
2. Check the correct opening of the fuel injectors
 - a. Measure the exhaust CO percentage (see paragraph «Setting and adjustment»).
 - b. Disconnect the fuel injector connectors one at a time; check the exhaust CO percentage each time and check that the value remains constant for each check.
 - c. If it does not remain constant, identify the faulty injector and replace it (see «Replacement»).
 - d. In any case a visual indication of the functioning of the fuel injectors is furnished by a comparison with the electrodes of the spark plugs:

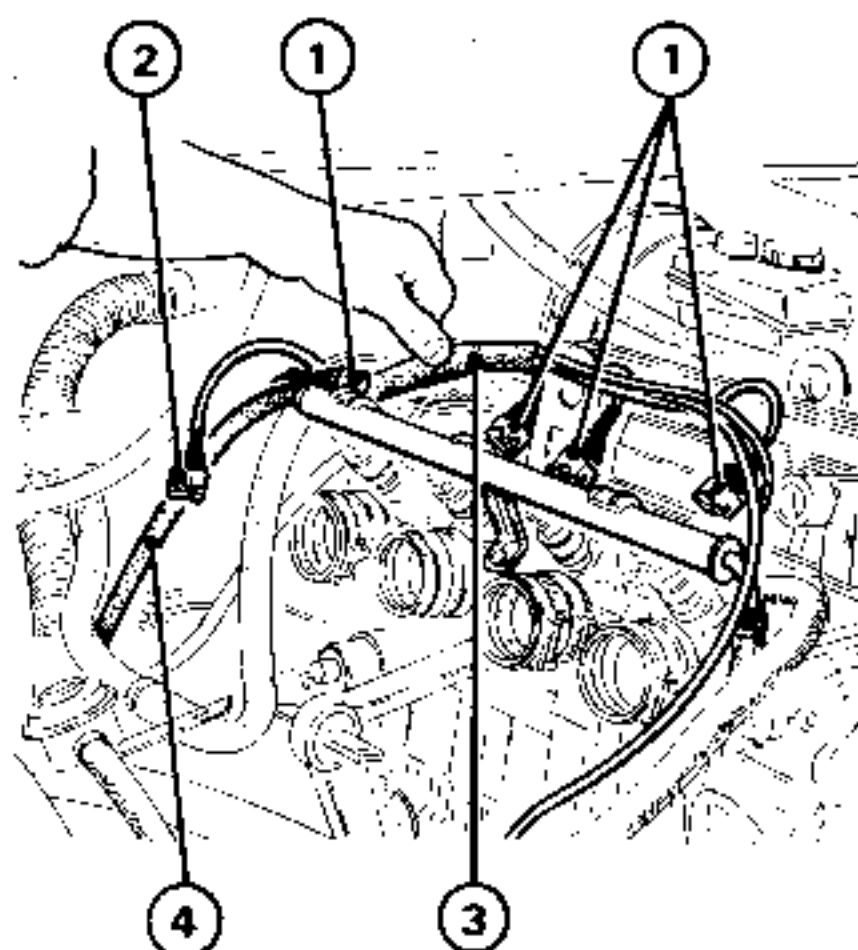
- If the mixture is too rich the spark plugs will be black in colour.
- If the mixture is too lean the spark plugs will be light in colour.

3. Check fuel injectors for leaks

- a. Remove the fuel injector assembly, complete with fuel distributor tube, from the inlet manifold, operating as indicated in «Removal». Keep the assembly connected to the fuel delivery system.
- b. Disconnect the fuel injector connectors.
- c. Operate the starter motor and check that there are no leaks of petrol from the fuel injectors. In the case of leaks, replace the defective injectors.

REMOVAL

1. Remove the air intake box (see paragraph «Air intake box - Removal»).
2. Disconnect the power supply connectors (1) to the fuel injectors and the connector (2) of the engine temperature sensor.
3. Remove the clip (3) securing the electric wiring to the fuel distributor tube.
4. Loosen the clip and remove the tube (4) for the delivery of fuel from the hammering damper.

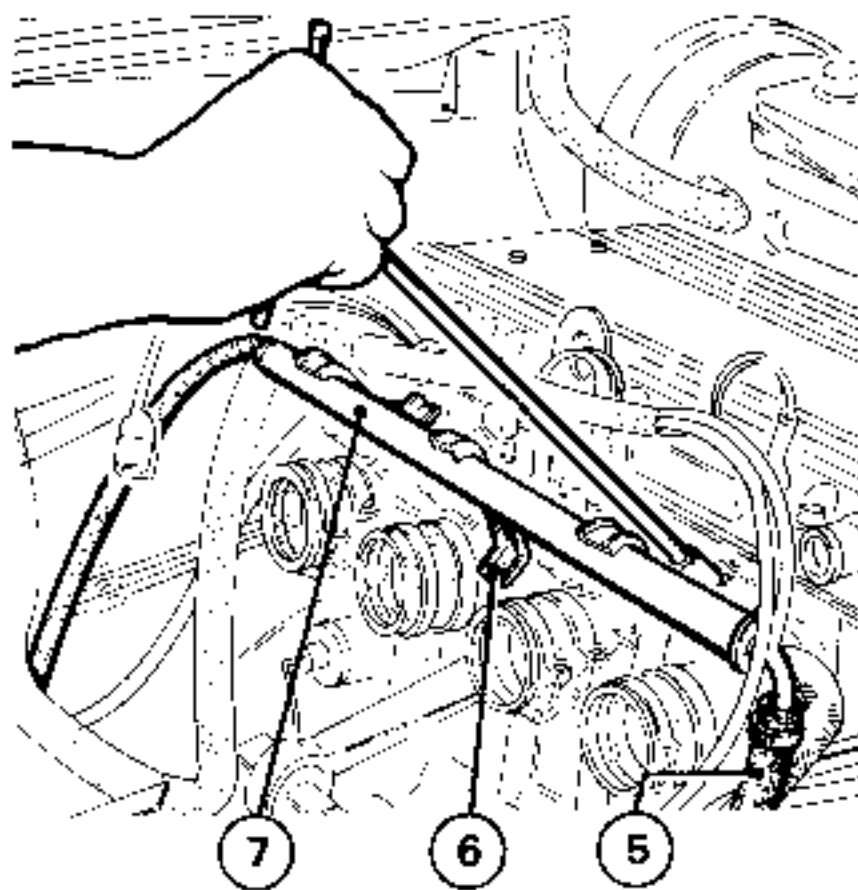


1. Electric fuel injectors
2. Engine temperature sensor connector
3. Electric wiring
4. Fuel delivery tube

WARNING:

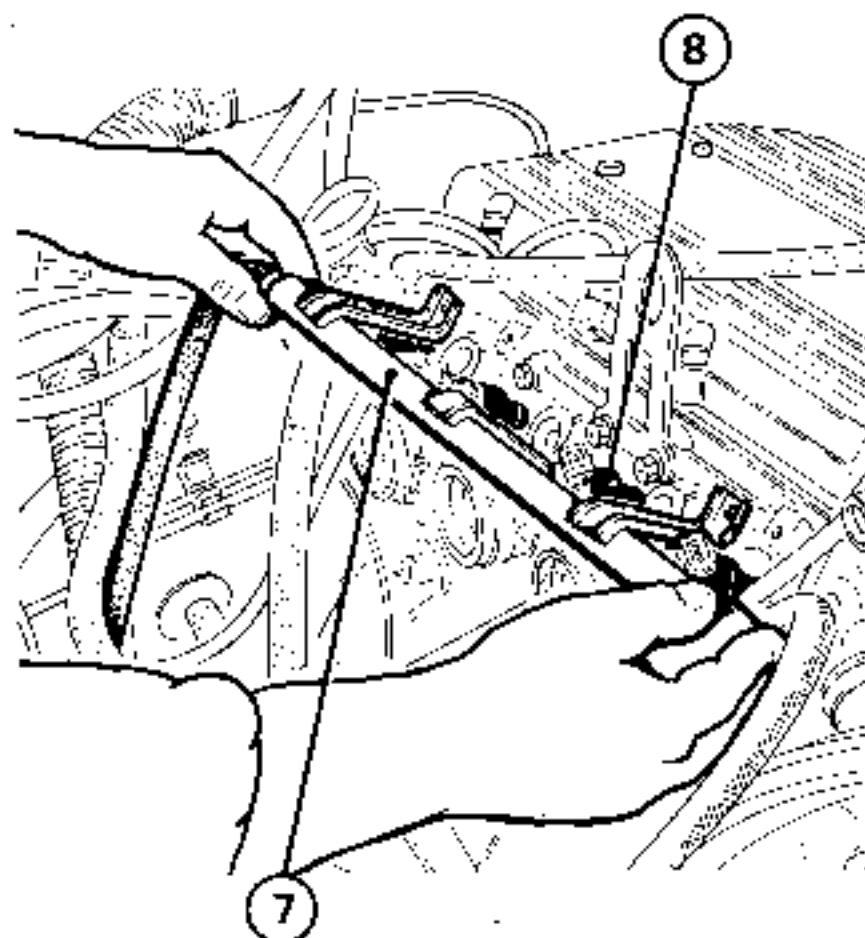
When disconnecting tube (4), be careful that the residual pressure in the tube does not cause sprays of petrol.

5. Loosen the pipe clip and disconnect the fuel return tube (5) from the fuel distributor tube.
6. Unscrew the three screws (6) that secure the fuel distributor tube (7) to the air inlet manifold.



5. Fuel return tube
6. Fuel distributor securing screws
7. Fuel distributor tube

7. Remove the fuel distributor tube (7) complete with the fuel injectors (8).



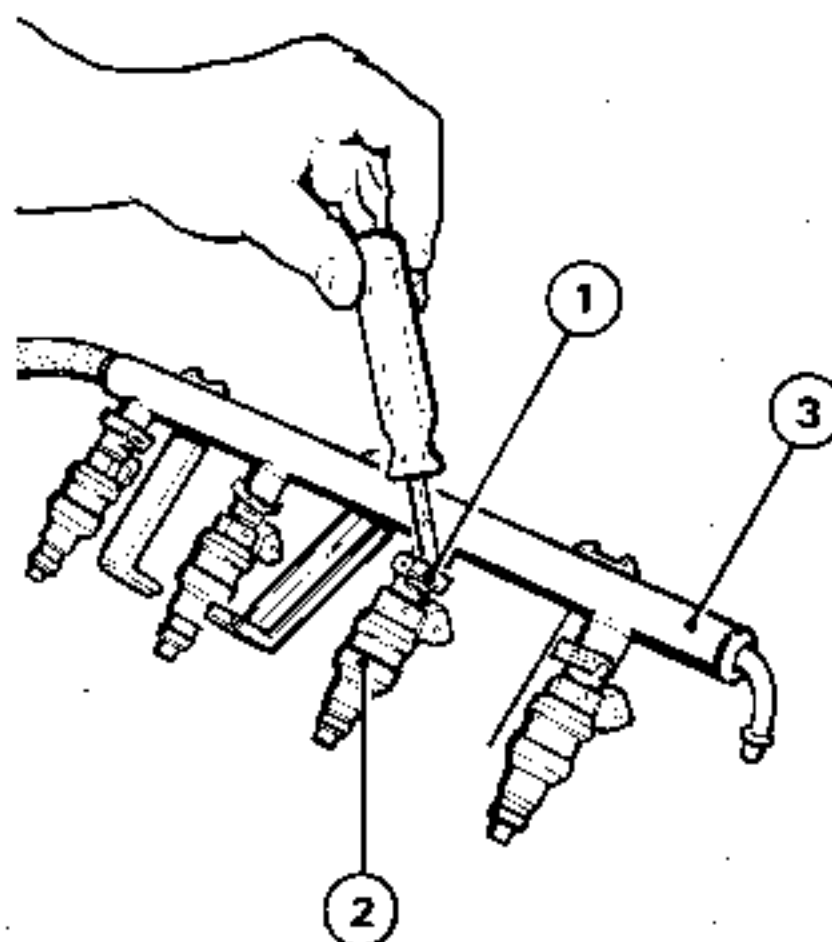
7. Fuel distributor tube
8. Electric fuel injectors

REPLACEMENT

WARNING:

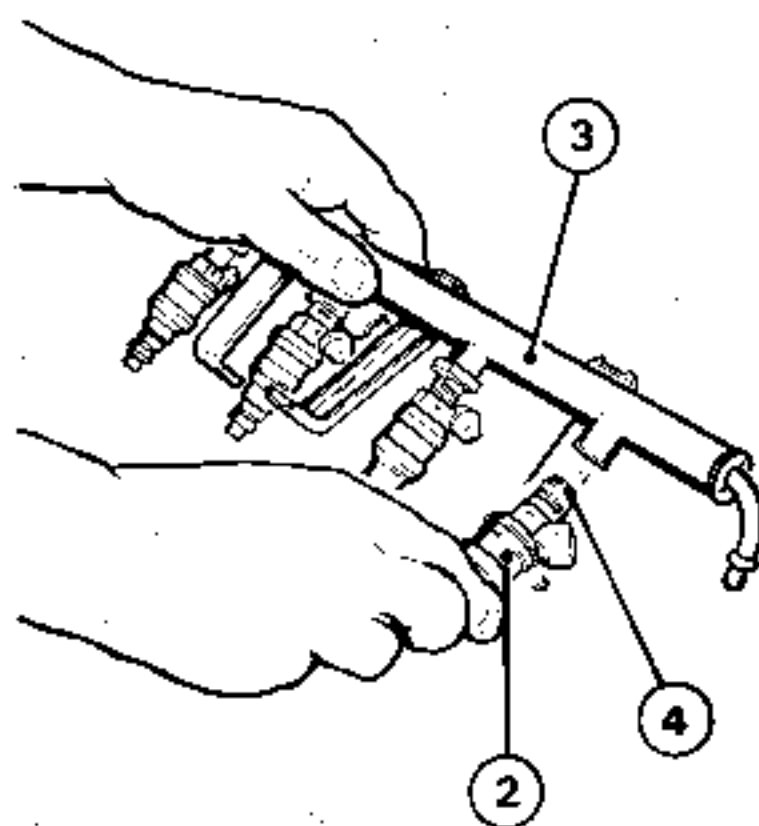
Before proceeding to the replacement of a fuel injector, check the positioning of the connector on the injector so as to be able to maintain the same positioning when fitting the new injector.

1. Withdraw the spring clip (1) that secures the fuel injector (2) to the fuel distributor tube (3).



1. Spring clip
2. Electric fuel injector
3. Fuel distributor tube

2. Withdraw the fuel injector (2) from the fuel distributor tube (3).



2. Electric fuel injector
3. Fuel distributor tube
4. O-Ring

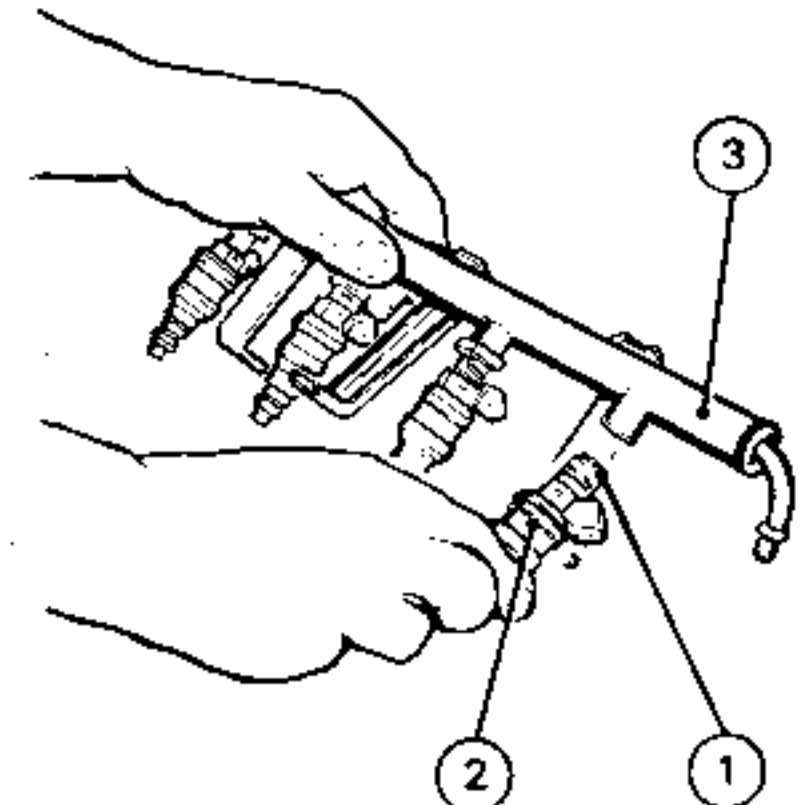
3. Fit a new electric fuel injector slipping it onto the fuel distributor tube and securing it with the relative spring clip.

WARNING:

- Before fitting the fuel injector onto the fuel distributor tube, replace the O-Ring (4).
- The fuel injector should be fitted onto the fuel distributor tube with the relative connector pointing upwards as marked on removal.

REFITTING

1. Replace the O-ring (1).
2. Fit the fuel injectors in their respective seatings, taking care that the O-rings (1) are correctly positioned.

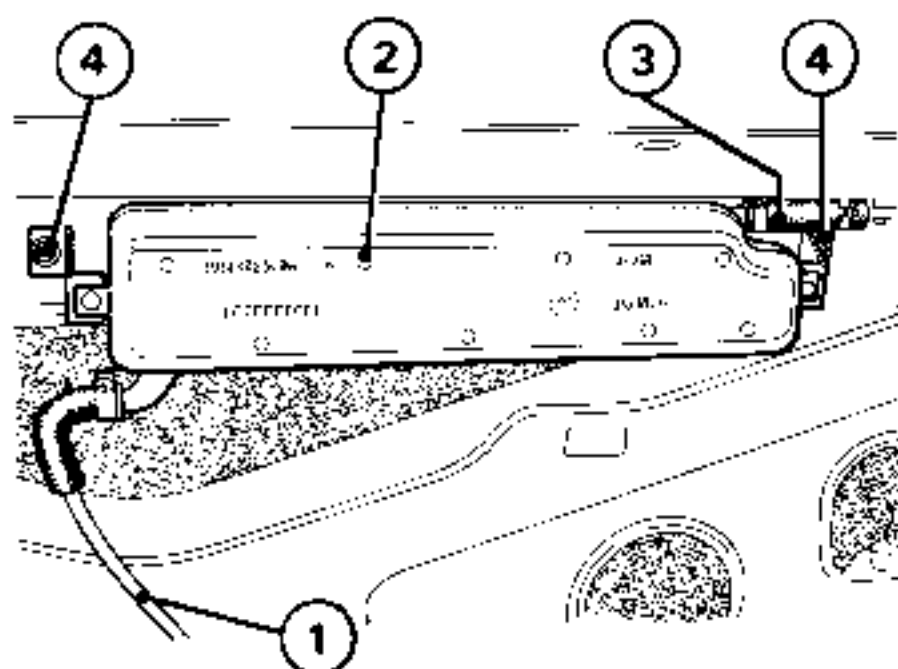


1. O-ring
2. Fuel injector
3. Fuel distributor tube

3. Refit the other components by reversing the order of removal.
4. Carry out the check of the exhaust CO percentage, if necessary proceeding to the adjustment (see paragraph «Setting and adjustment»).

FUEL VAPOUR TRAP

1. Remove the rear lining of the luggage compartment.
2. Loosen the pipe clips and disconnect the tubes (1) and (3) from the trap (2).
3. Unscrew the two nuts (4) that secure the trap (2) to the body and remove the trap itself.



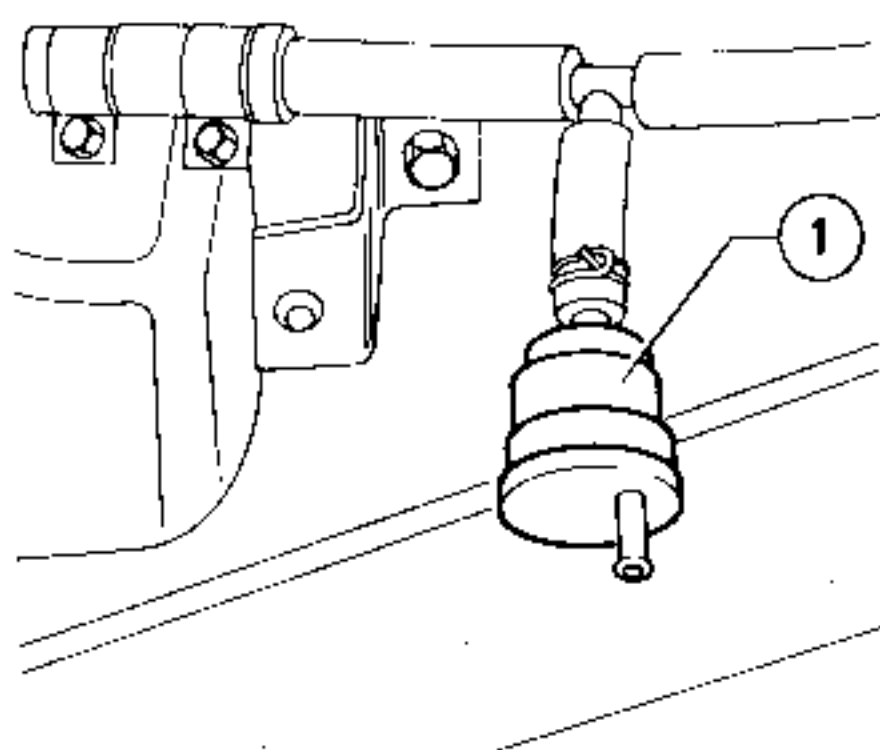
1. Fuel breather tube
2. Fuel vapour trap
3. Fuel vapour recycling tube
4. Securing nut

4. If necessary clean the trap by blowing in compressed air.
5. Fit the fuel vapour trap by reversing the order of removal.

AIR INLET VALVE

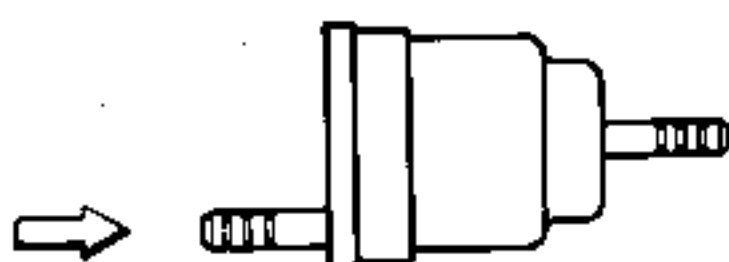
REMOVAL, INSPECTION AND ADJUSTMENT, REFITTING

1. Partially remove the rear lining of the luggage compartment in order to gain access to the air inlet valve (1).
2. Unfasten the securing spring clip and remove the valve (1).



1. Air inlet valve

3. Check that the valve is in correct working order by blowing compressed air into it. The air should be able to pass only in the direction indicated by the arrow. If the valve is not functioning correctly replace it.



4. Carry out the refitting by reversing the order of removal, referring to the preceding figure for the correct positioning of the valve.

CARBON CANISTER

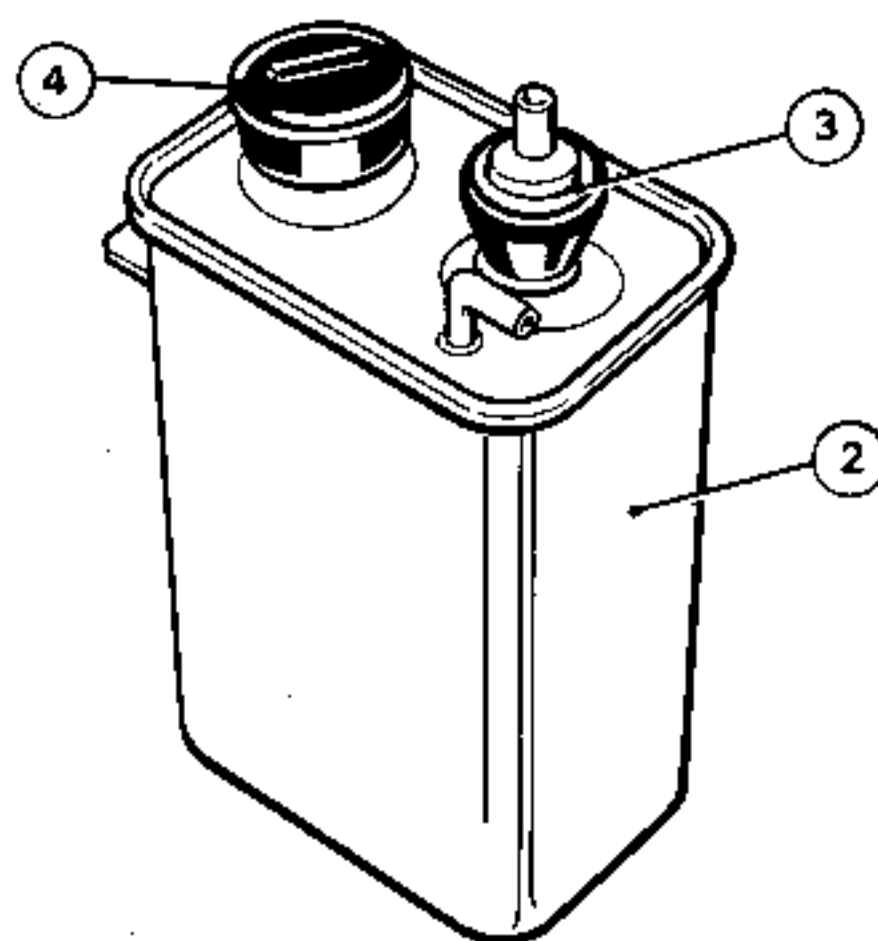
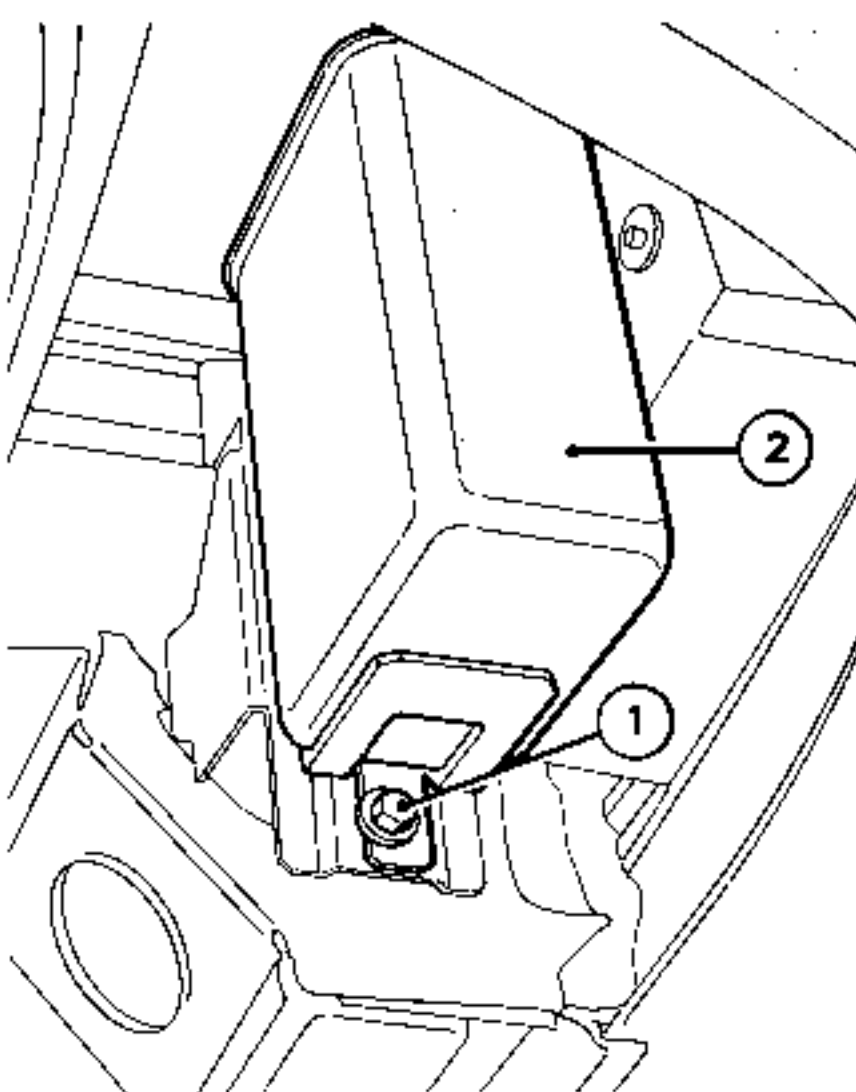
REMOVAL AND REFITTING

Working from beneath the vehicle, remove the screw (1) and dislodge the carbon canister (2) from its housing.

2. Lower the canister in order to be able to gain access to the vapour inlet and outlet tubes. Disconnect the tubing and remove the canister.

3. Check that the one-way valve (3) and the washing valve (4) are in correct working order.

4. Carry out the refitting by reversing the order of the removal.



1. Securing screw
2. Carbon canister
3. One-way valve
4. Washing valve

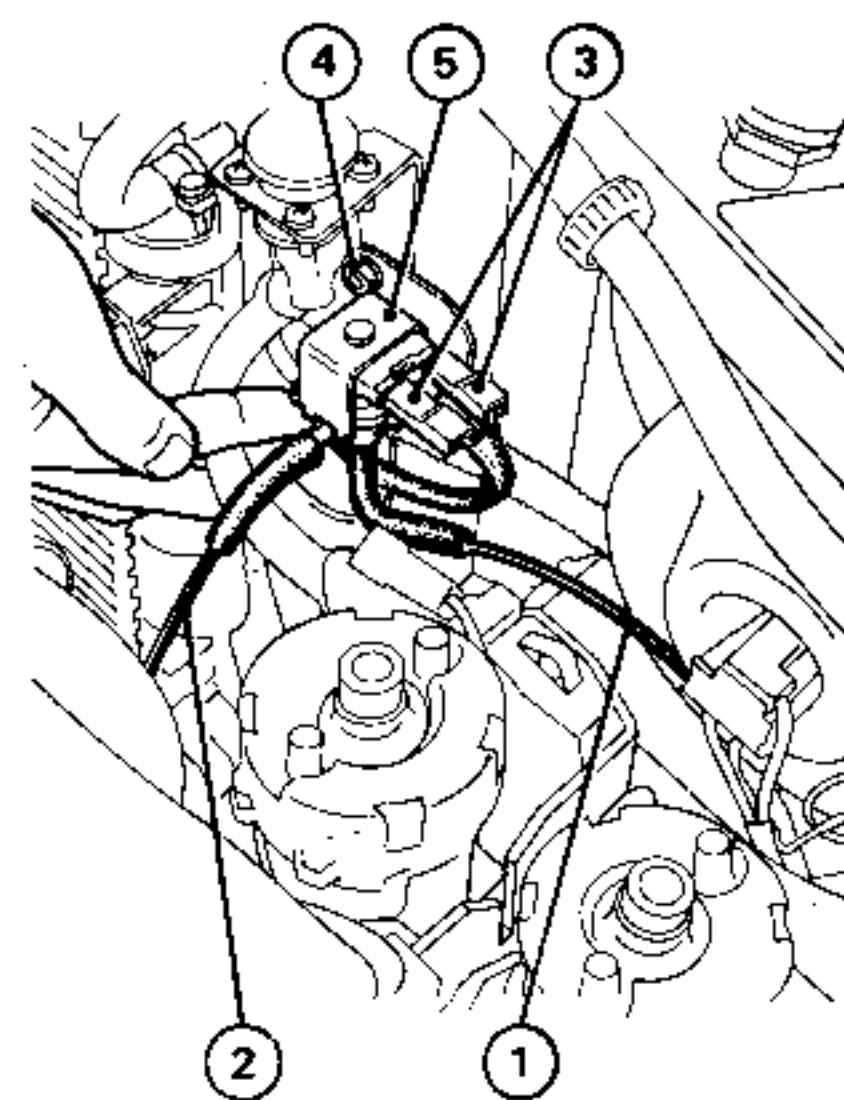
FUEL VAPOUR FLOW CONTROL SOLENOID VALVE

ELECTRICAL CHECK

Check the circuit continuity of the solenoid valve as described in the paragraph «Electrical checks with the use of the trouble diagnosis instrument» of the Group 00.

REMOVAL AND REFITTING

1. Disconnect the fuel vapour recycling tube (1) coming from the carbon cleaner.
2. Disconnect the fuel vapour recycling tube (2) that provides the inlet to the air intake box.
3. Disconnect the power supply connectors (3) to the solenoid valve.
4. Unscrew the screws (4) that secure the solenoid valve to the body.
5. Remove the solenoid valve (5).



1. Fuel vapour recycling tube (from the carbon cleaner)
2. Fuel vapour recycling tube (to the air intake box)
3. Power supply connectors
4. Securing screw
5. Solenoid valve

6. Carry out the refitting of the solenoid valve by reversing the order of the removal.

TIMING AND R.P.M. SENSOR

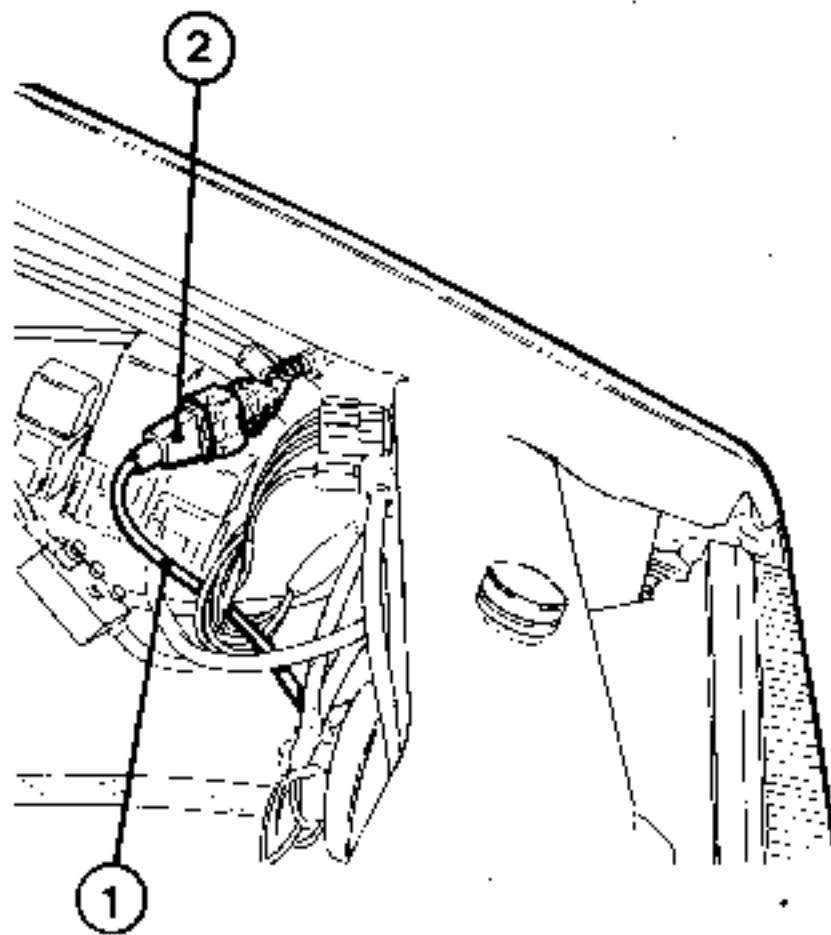
INSPECTION AND ADJUSTMENT

Refer to paragraph «Electrical checks» of the Group 00.

REPLACEMENT

For the replacement of the timing and r.p.m. sensor proceed as follows:

1. Disconnect the timing and r.p.m. sensor lead (1) from the flying connection (2) situated on the left side valance panel of the engine compartment.

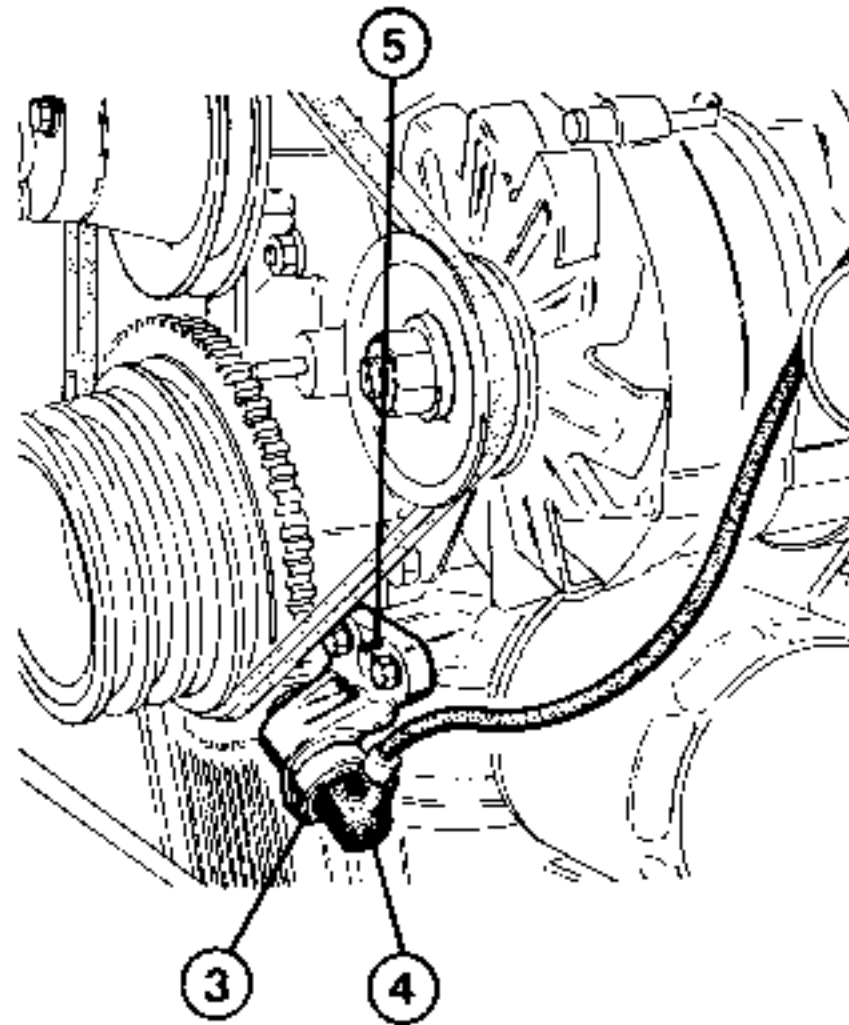


1. Timing and r.p.m. sensor lead
2. Connection

2. Remove the screw (3) and extract the timing r.p.m. sensor (4) from its support (5).

NOTE:

It is advisable not to remove the support (5) of the timing and r.p.m. sensor.



3. Sensor securing screw
4. Timing and r.p.m. sensor
5. Sensor support

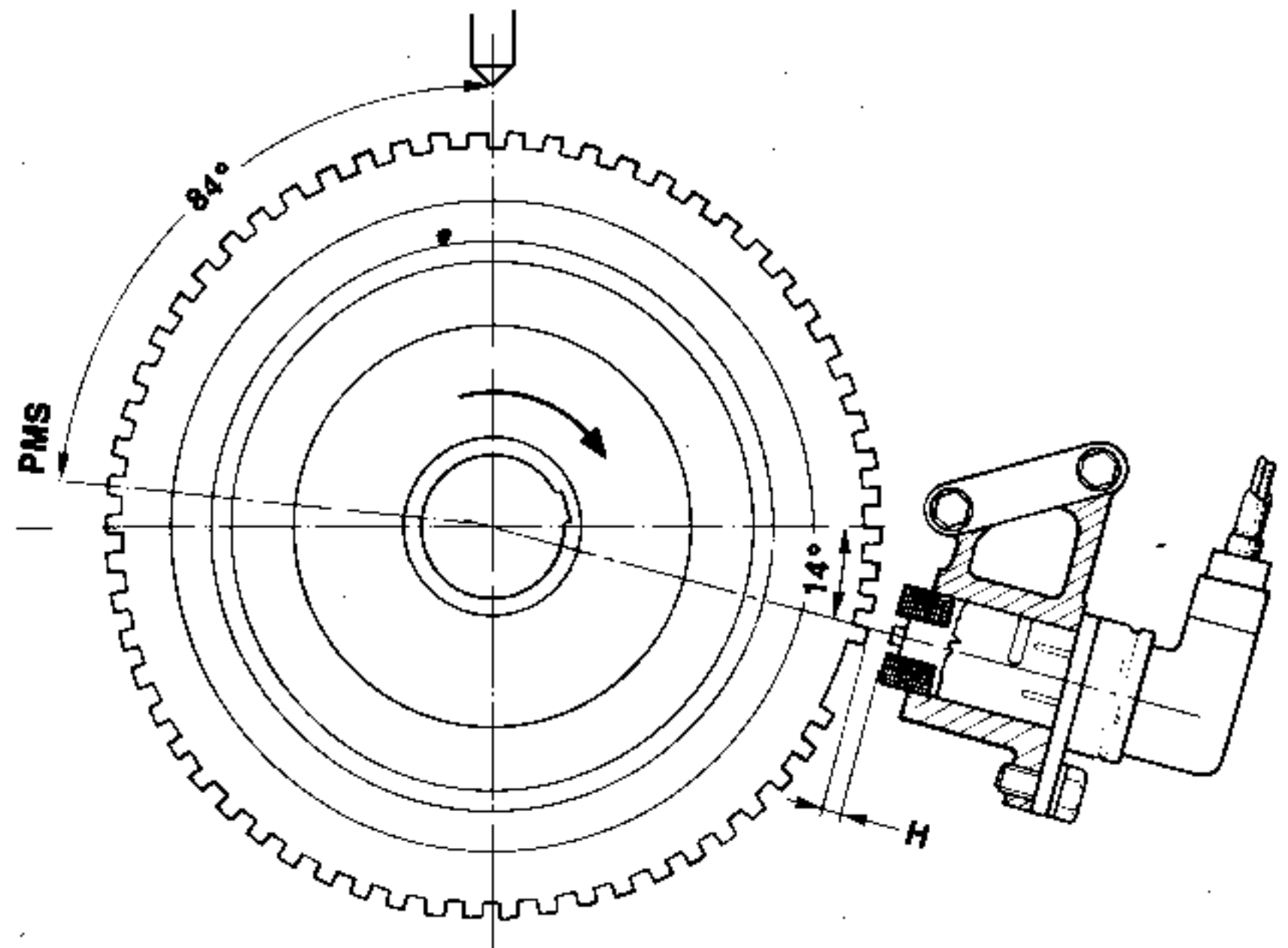
3. Refit a new timing and r.p.m. sensor by reversing the order of removal and taking care to observe the following fitting specifications:

- Remove the protection from the new sensor before fitting.
- Fit the new timing and r.p.m. sensor using hand pressure only. Do not use a mallet and do not strike the sensor.
- Tighten the sensor securing screw to the following tightening torque (the screw must be partially microencapsulated).

T : Tightening torque
8 N·m
(0.8 kg·m)

- Position the magnetic pole of the timing and r.p.m. sensor in such a way that its distance from the phonic wheel (cogged wheel) falls within the specified value.

H = distance of timing and r.p.m. sensor from the phonic wheel:
0.5 ÷ 1.5 mm



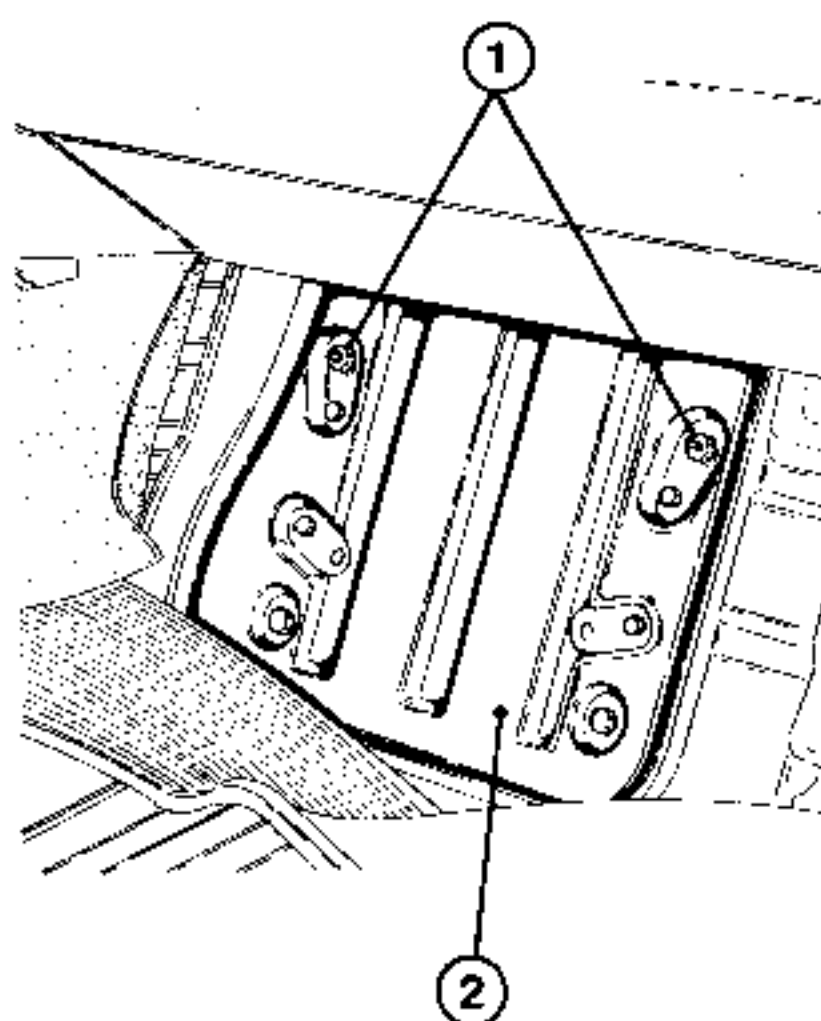
IGNITION AND FUEL INJECTION ELECTRONIC CONTROL UNIT (MOTRONIC)

INSPECTION AND ADJUSTMENT

Refer to the paragraph «Electrical checks» of the Group 00.

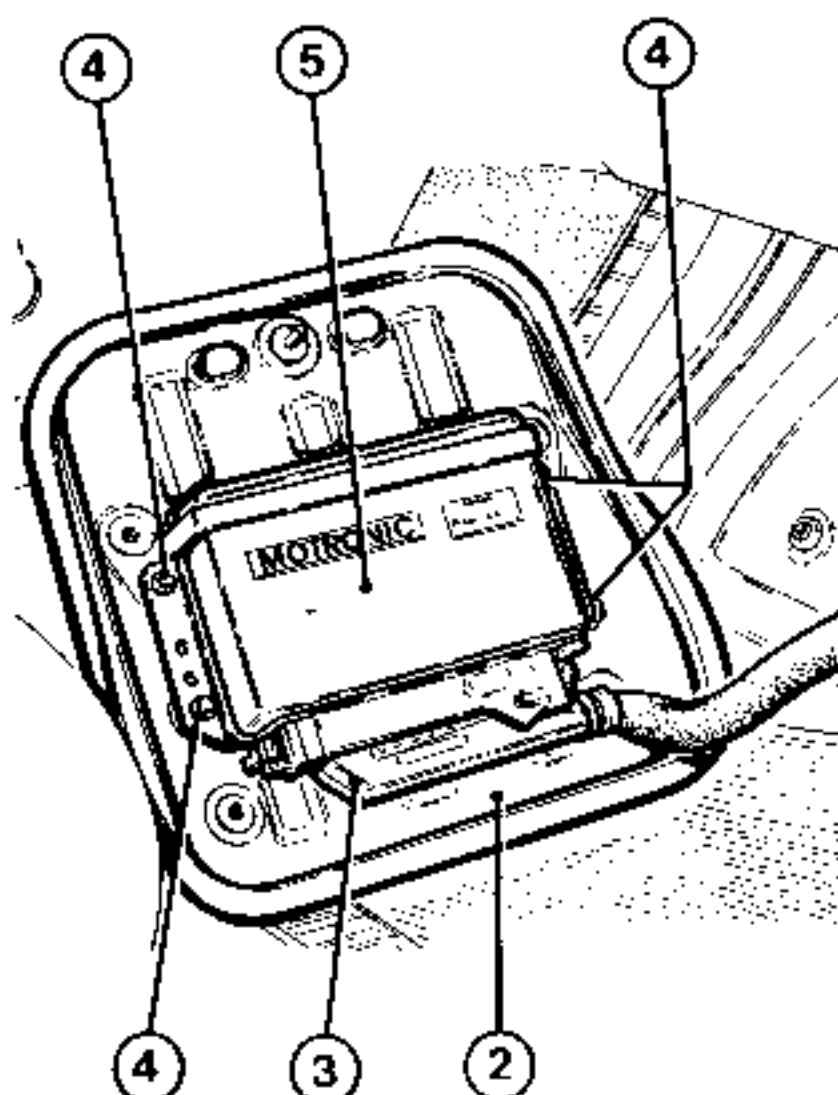
REMOVAL

1. Switch the ignition off.
2. Disconnect the negative terminal (—) of the battery.
3. Remove the lining of the front right floor of the passenger compartment (passenger side) in order to gain access to the sheet panel that supports the Motronic electronic control unit.
4. Unscrew the two nuts (1) that secure the support panel (2) of the Motronic electronic control unit to the passenger compartment floor.



1. Securing nuts
2. Motronic electronic control unit support panel

5. Disconnect the multiple connector (3) from the Motronic electronic control unit.
6. Remove the four screws (4) and separate the ignition and injection control unit (5) from the support panel (2).



2. Motronic electronic control unit support panel
3. Motronic electronic control unit multiple connector
4. Motronic electronic control unit securing screws
5. Ignition and injection control unit

REFITTING

1. Fit the ignition and injection control unit by reversing the order of removal and paying attention to the following warning.

WARNING:

- a. The multiple connector (3) must be attached and then pressed as far as it will go, taking care not to damage the contact pins.
- b. Check the correct positioning of the rubber gasket situated on the external profile of the Motronic electronic control unit support panel.

MAP SWITCHING DEVICE

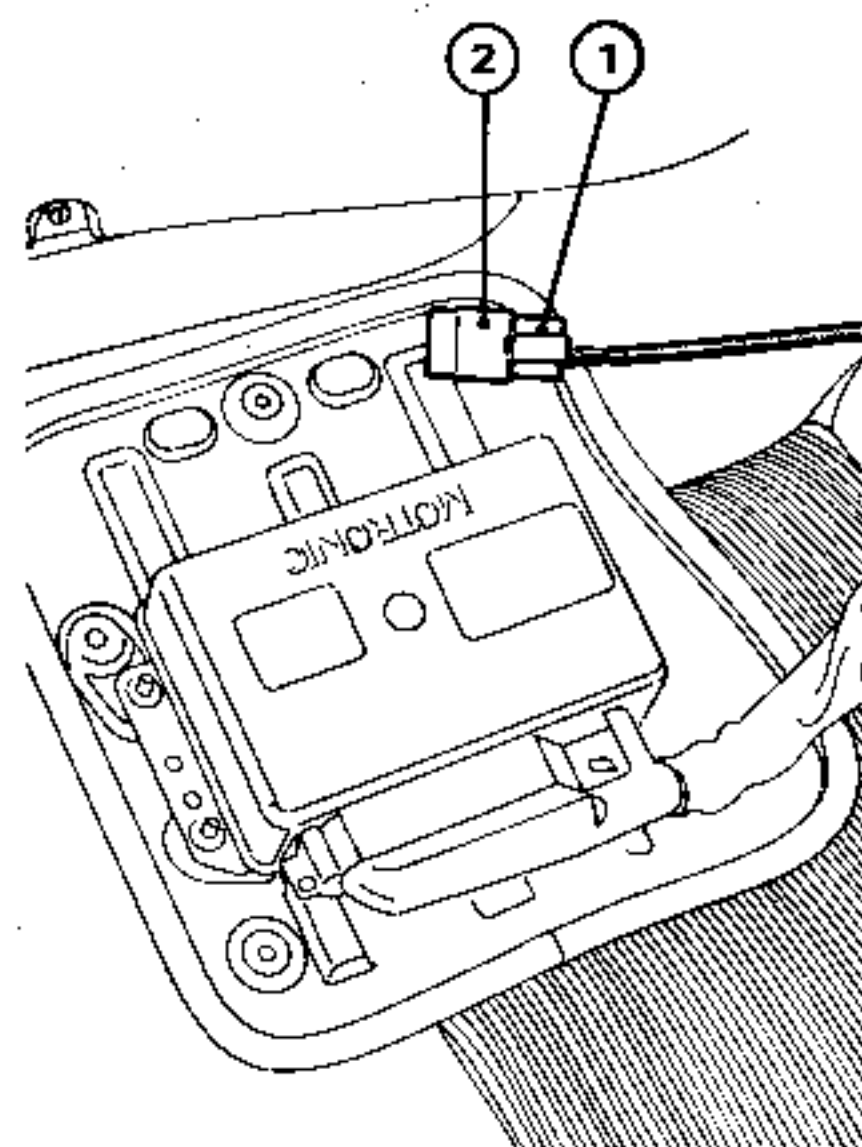
INSPECTION AND ADJUSTMENT

Refer to the paragraph «Electrical checks» of the Group 00.

REPLACEMENT

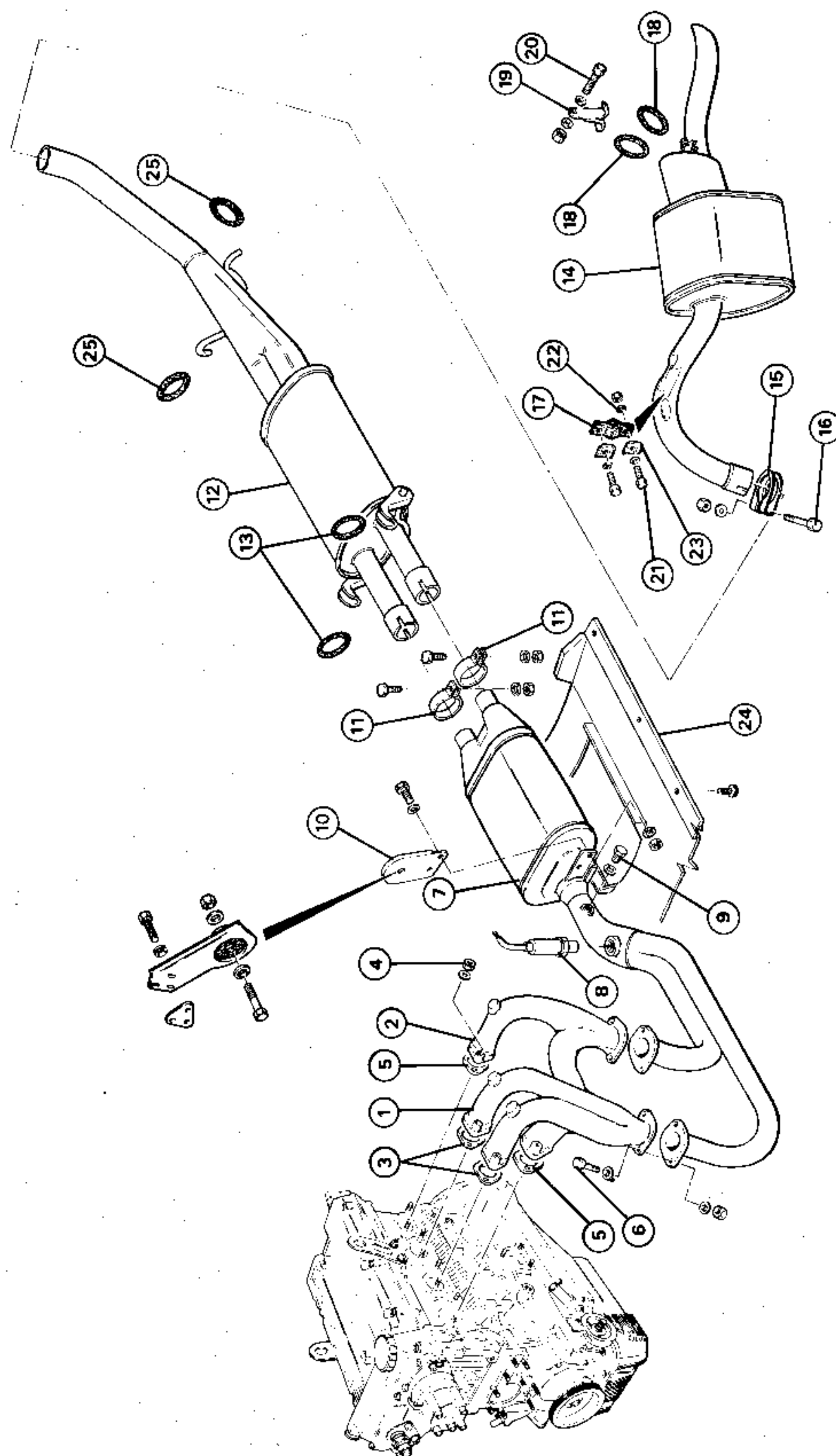
The device consists of a connector (1) and a relay (2) with a different coloured casing.

1. BRIGHT YELLOW coloured relay for lead free 95 OCTANE petrol.
2. SKY BLUE coloured relay for unleaded free 91 OCTANE petrol.



1. Connector (S30)
2. Map switching relay

EXHAUST SYSTEM



- | | | |
|--|---|--|
| 1. Exhaust manifold 2nd and 3rd cylinder | 10. Support | 18. Rear elastic support ring |
| 2. Exhaust manifold 1st and 4th cylinder | 11. Clips | 19. Support for elastic ring |
| 3. Gaskets | 12. Silencer - Central element | 20. Support securing bolt |
| 4. Manifold securing nuts | 13. Elastic support ring | 21. Bolt for securing rear silencer with elastic tag |
| 5. Gaskets | 14. Silencer - Rear element | 22. Spacer |
| 6. Bolt | 15. Clamp for the union of the central silencer and the rear silencer | 23. Small plate |
| 7. Catalyser | 16. Bolt | 24. Catalytic silencer lower protection |
| 8. Lambda sensor | 17. Front elastic support tag | 25. Elastic ring |
| 9. Plug for measuring exhaust CO | | |

NOTE:

- With the following procedures it is possible to remove single elements separately.
- The method of removal can be modified as a function of the purpose of the operation.
- In the case of the removal of the complete system, if necessary, resort to the assistance of a second operator.

The reference numbers of the following procedure refer to the figure «Exhaust System» of the vehicle in question.

MANIFOLDS, SILENCERS AND CATALYSER

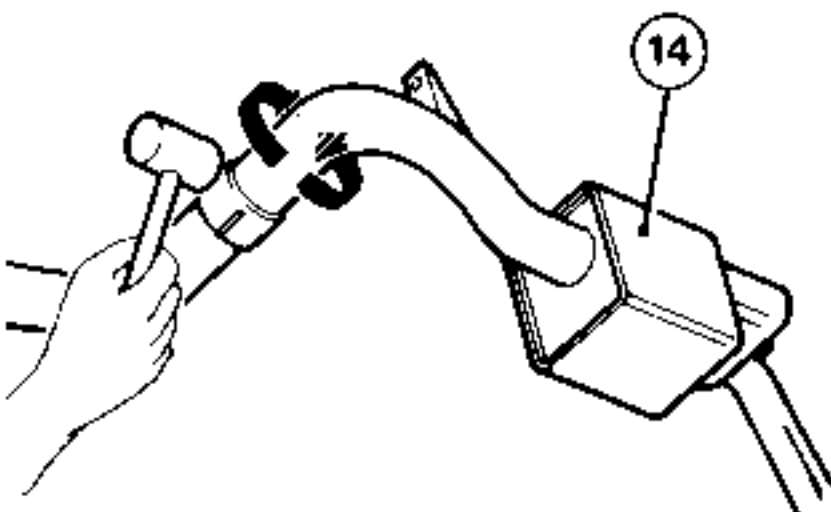
PRELIMINARY OPERATIONS

- Set the vehicle on a hydraulic lift and raise it.
- Remove the lower protection (24) of the catalytic silencer box.

REMOVAL OF THE REAR SILENCER

Remove the rear silencer of the exhaust system by operating as follows:

- Loosen the bolt (16) that secures the clamp (15).
- Unscrew and withdrawn the bolt (21) that secures the silencer with the elastic tag (17).
- Unhook the rear silencer (14) from the rear elastic rings (18).
- Tap lightly and repeatedly with a plastic mallet round the circumference of the tubing where the two sections join and then rotate the rear section backwards and forwards to facilitate the separation of the two sections.



14. Silencer - Rear element

REMOVAL OF CENTRAL SILENCER

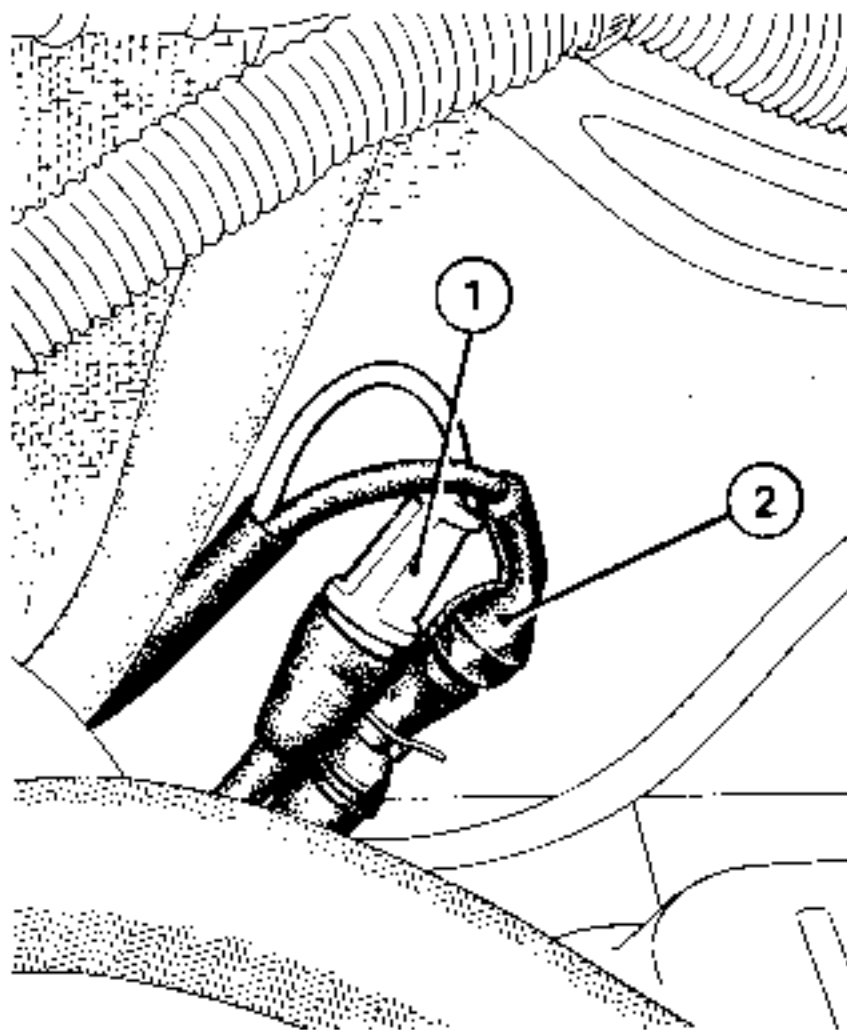
Remove the central silencer of the exhaust system operating as follows:

- Loosen the bolts that secure the clips (11).
- Loosen the bolt (16) that secures the clamp (15).
- Unhook the central silencer from the elastic rings (13).
- Detach the central silencer (12) from the catalytic silencer (7) by tapping lightly with a plastic mallet round the circumference of the joints.
- Unhook the central silencer from the rear elastic rings (25).
- Tap lightly and repeatedly with a plastic mallet round the circumference of the tubing where the two sections join and then rotate the central silencer backwards and forwards to facilitate the separation.

REMOVAL OF CATALYTIC SILENCER

Remove the catalytic silencer (catalyser) by operating as follows:

- Working from the engine compartment, disconnect the connectors (1) and (2) illustrated in the figure below and detach the leads from any cable clips.



- Lambda sensor resistance connector
- Lambda sensor connector

- Referring to the exploded view, unscrew the nuts of the bolts (6) and disconnect the manifolds of the catalytic silencer (7) from the exhaust manifolds (1) and (2).
- Loosen the clip securing bolts (11).

- Unscrew the bolts that secure the catalytic silencer to the support (10).
- Remove the catalytic silencer (7) from the central silencer (12) by tapping lightly with a plastic mallet round the circumference of the joints.
- If necessary, remove the Lambda sensor (8) from the catalytic silencer by unscrewing it using a suitable spanner.

REMOVAL OF THE EXHAUST MANIFOLDS

Remove the two exhaust manifolds by operating as follows:

- Unscrew the nuts of the bolts (6) and disconnect the exhaust manifolds (1) and (2) from the catalytic silencer (7), recovering the gaskets (5).
- Lower the hydraulic lift and working in the engine compartment, unscrew the nuts (4) that secure the manifolds to the cylinder head.
- Remove the exhaust manifolds (1) and (2) together with the gaskets (3).

INSPECTION AND ADJUSTMENT

The catalytic silencer must be replaced after 100,000 km

- Inspect the silencer and exhaust tubing and check that they are not damaged and that they neither present cracks nor traces of corrosion.
- Inspect the rubber rings and supports and replace them if they present signs of cracks, porosity or aging.

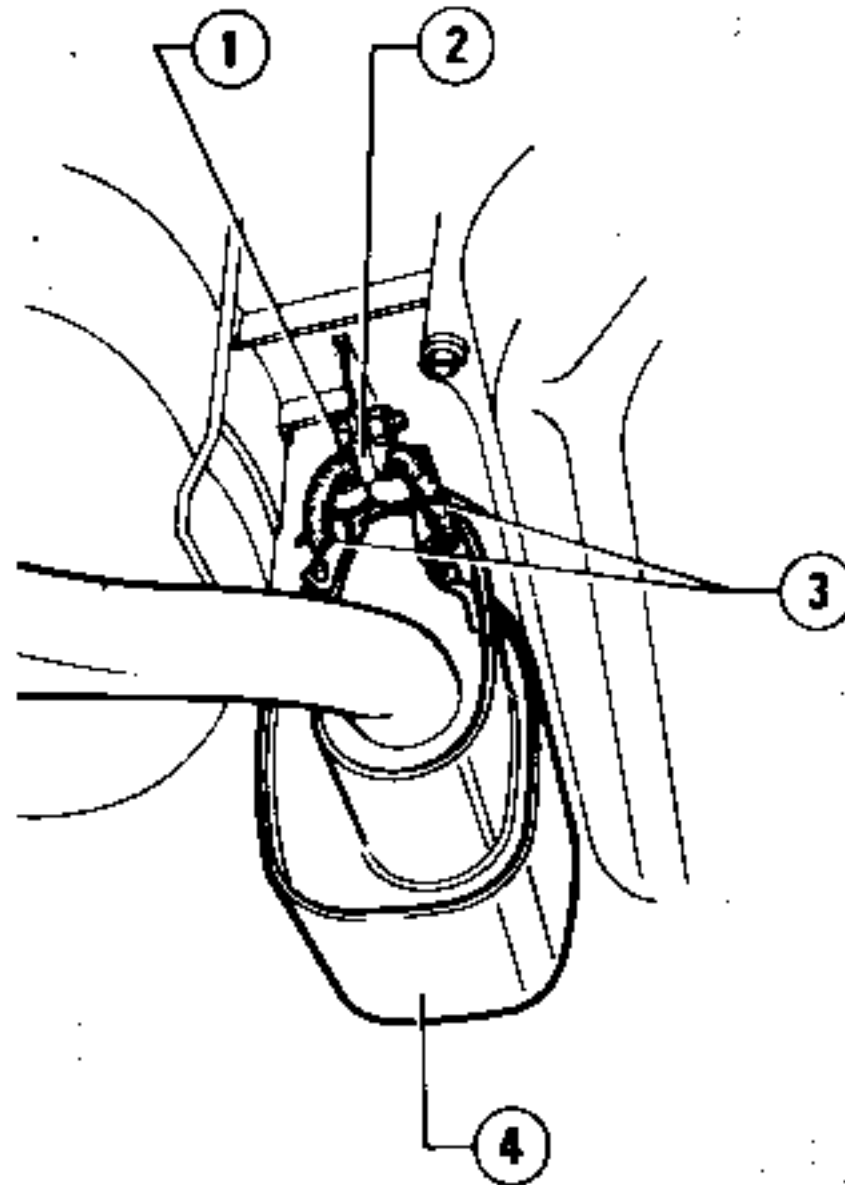
REFITTING

Carry out the refitting of the individual elements by reversing the order of the removal and taking into account the following:

- Apply R. GORI Never Seez or BOSCH 5.964.080.105 grease to the thread of the Lambda sensor and secure it to the catalytic silencer using a suitable spanner.
- Fit new gaskets (3) between the flange of the exhaust manifolds and the cylinder head.
- Use new self-locking nuts (4) to secure the exhaust manifolds to the cylinder head.

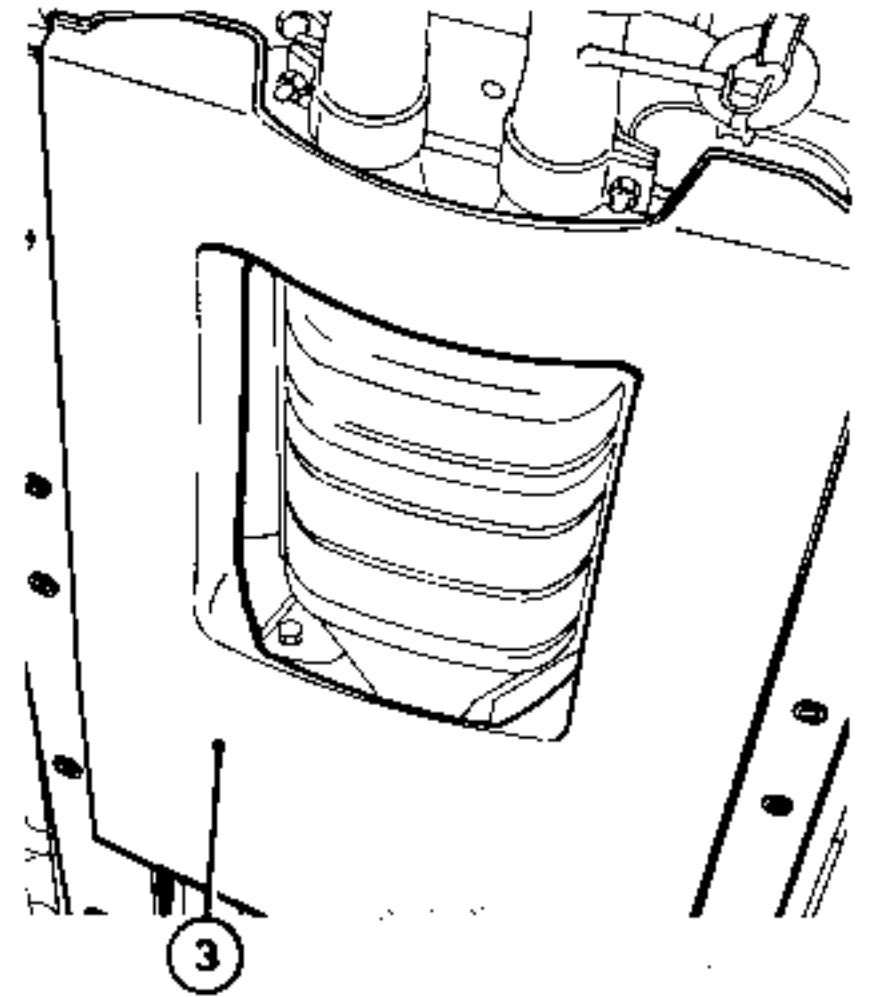
- d. Position the exhaust tube on the elastic supports (13) and (25) and then secure it to the central support (10).
- e. Connect the central silencer of the exhaust tube to the rear silencer.
- f. Fix the front ends of the catalytic silencer to the exhaust manifolds fitting new gaskets (5).
- g. Shake the exhaust tubing a little so as to seat it properly.
- h. Tighten all the securing bolts and screws.
- i. Connect the Lambda sensor connectors in the engine compartment.
- j. On completion of the fitting, check that the rubber support rings are able to swing freely and are not under tension.
- k. With the engine running, check that there are no leaks of exhaust gases from the joints of the tubing and that the whole system is not excessively noisy.

5. If necessary, unscrew the bolt (1) and remove the rear hook (2).
6. Carry out the refitting by reversing the order of the removal making sure that on completion of the fitting the supports are able to swing freely and are not under tension.



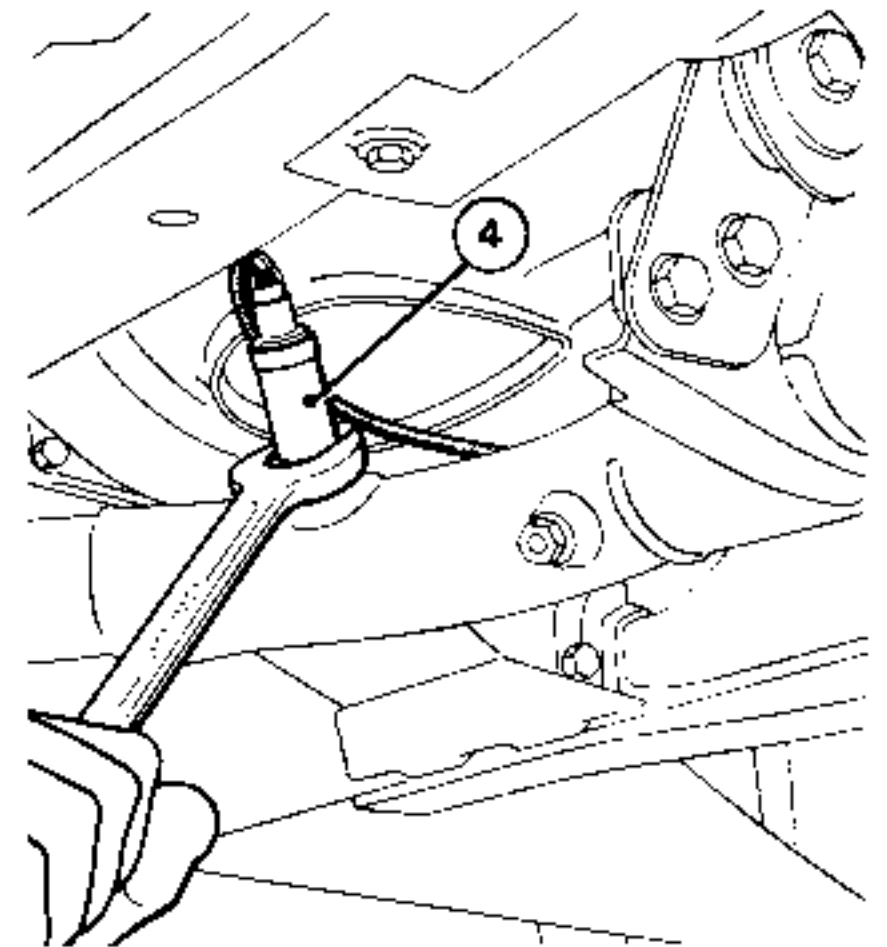
1. Bolt
2. Rear hook
3. Elastic rings
4. Silencer - Rear element

3. Working from beneath the vehicle, remove the lower protection of the catalytic silencer (3).



3. Catalytic silencer protection

4. Remove the Lambda sensor (4) and the relative wiring using a suitable spanner.

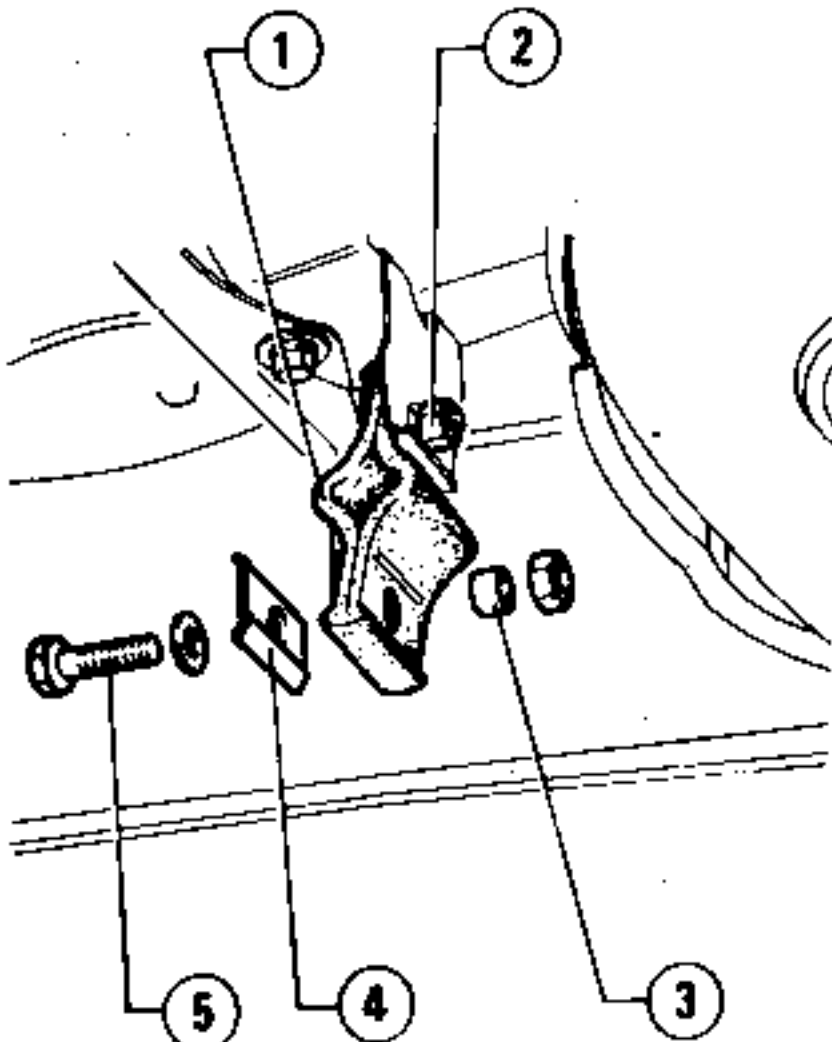


4. Lambda sensor

RUBBER SUPPORTS

REPLACEMENT

1. Raise the vehicle on a hydraulic lift.
2. Unscrew the lower bolt (5), recovering the small plate (4) and the spacer (3).
3. Unscrew the bolt (2) and remove the support (1) with the relative small plate (4) and the spacer.



1. Rubber support
2. Bolt securing support to the body
3. Spacer
4. Small plate
5. Bolt securing exhaust tube to the support

4. For the ring supports, proceed by simply releasing the support from the hooks.

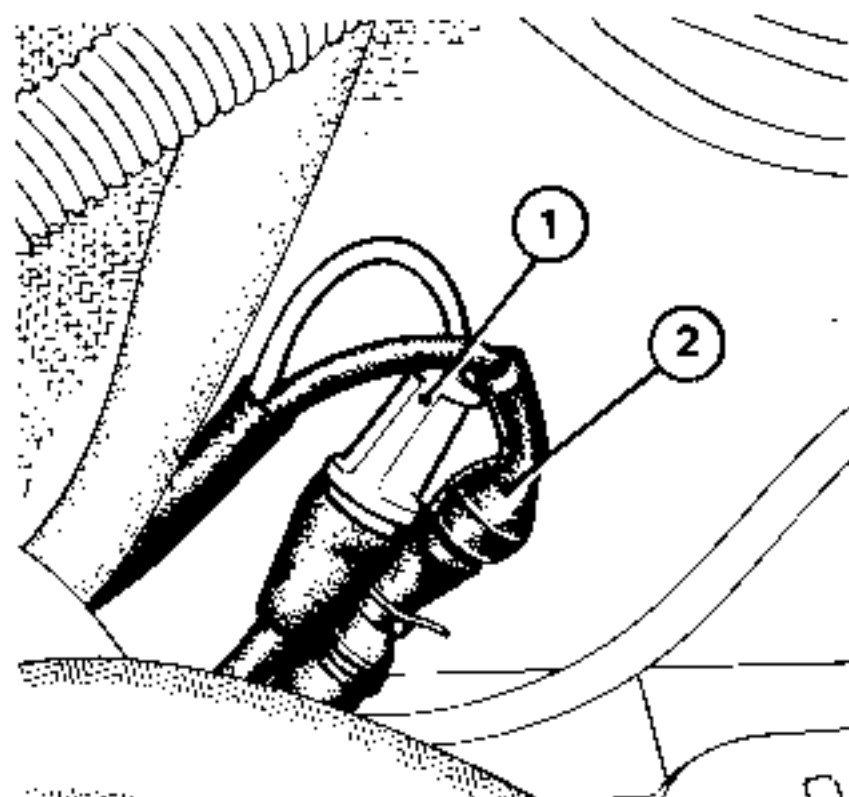
LAMBDA SENSOR

INSPECTION AND ADJUSTMENT

Refer to the paragraph «Electrical checks» of the Group 00.

REMOVAL AND REFITTING

1. Set the vehicle on a hydraulic lift.
2. Working from the engine compartment, remove the rear protection and disconnect the connectors (1) and (2) of the Lambda sensor wiring.



1. Lambda sensor resistance connector
2. Lambda sensor connector

5. On refitting apply R. GORI Never Seez or BOSCH 5.964.080.105 grease to the thread of the Lambda sensor.
6. Using a suitable spanner fit the Lambda sensor in the catalyser tightening it to a torque of:

0.5 ÷ 0.6 N-m (5 ÷ 6 kg-m)

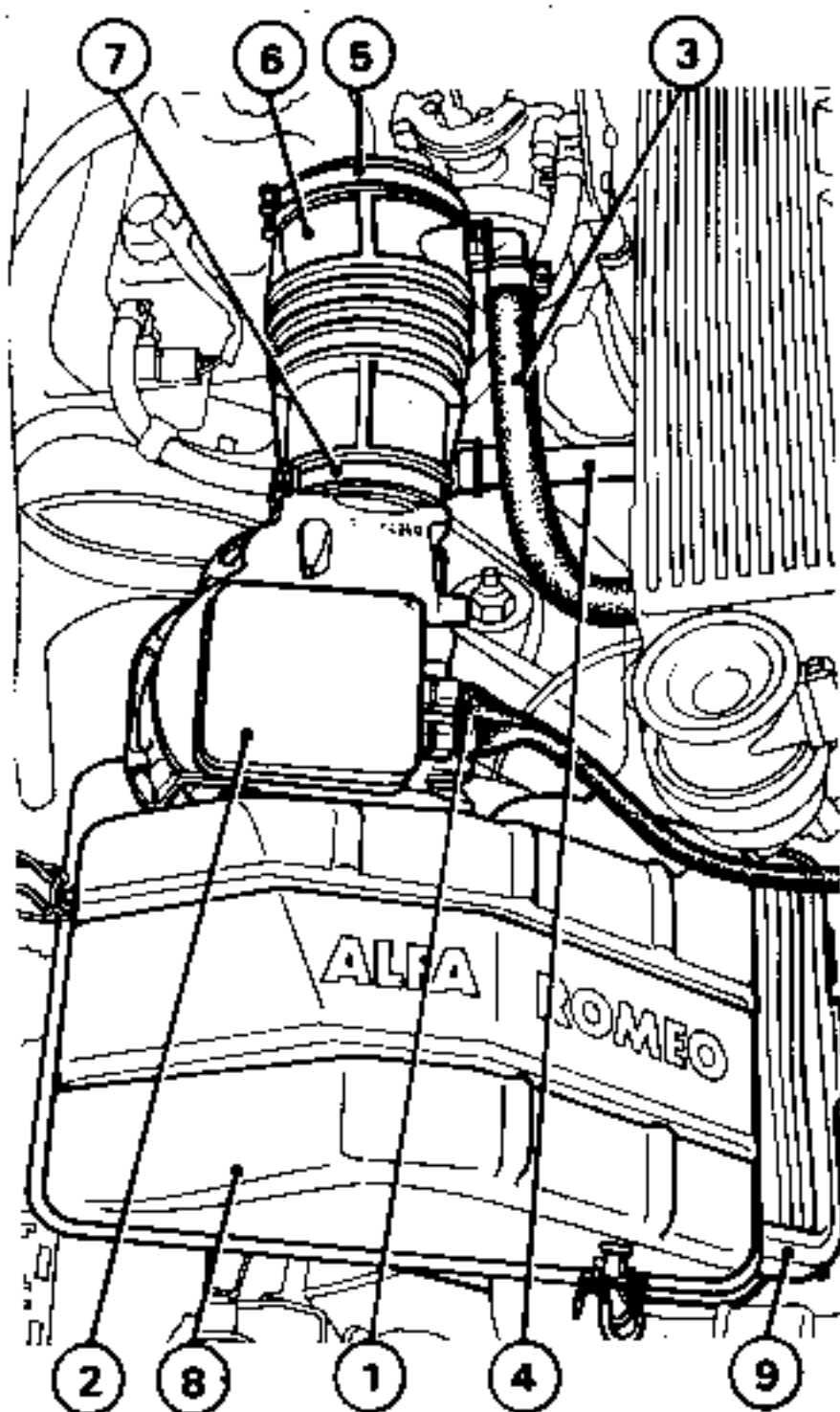
7. Reposition the wiring fixing it with the relative clips and connecting the connectors (1) and (2).
8. Refit the lower protection of the catalytic silencer (3).

SETTINGS AND ADJUSTMENTS

SETTING OF ACCELERATOR BUTTERFLY (Flow rate)

Check the tightness of the accelerator butterfly disk with the flow meter operating as follows:

1. Disconnect the connector (1) from the air flow gauge (2).
 2. Disconnect the following tubing from the air intake duct:
 - Peak r.p.m. oil vapour recycling tube (3).
 - Constant idle regulation by-pass tube (4).
 3. Loosen the clip (5) and disconnect the air intake duct (6) from the accelerator butterfly housing.
 4. Loosen the clip (7) and remove the air intake duct (6) from the air flow gauge (2).
 5. Unfasten the four spring clips securing the air filter cover (8) and remove it together with the air flow gauge.
- Also remove the filter element (9).

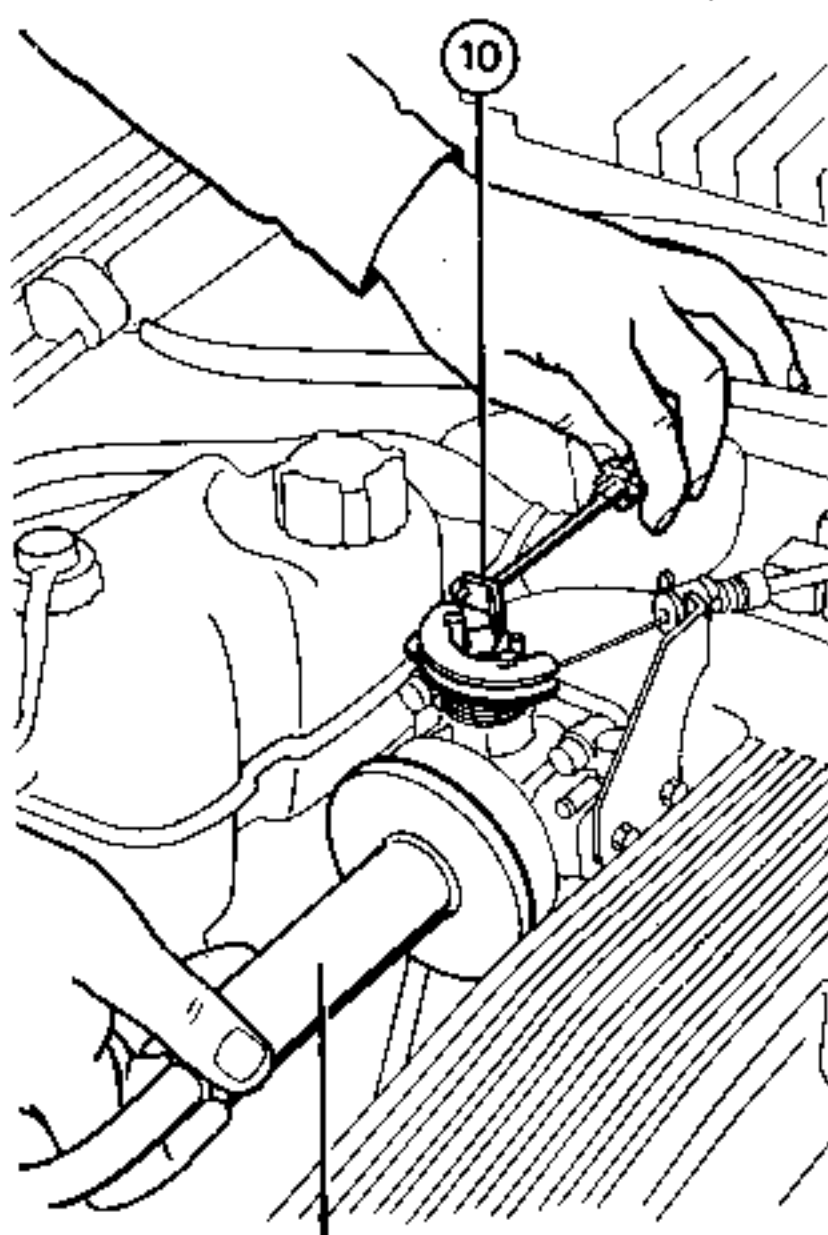


1. Connector
2. Air flow gauge
3. Peak r.p.m. oil vapour recycling tube
4. Constant idle regulation by-pass tube
5. Clip
6. Air intake duct
7. Clip
8. Air filter cover
9. Filter element

6. Place the buffer C.2.0055 of the flow meter against the opening of the accelerator butterfly housing.
7. Measure the flow of air through the accelerator butterfly housing and check that the value falls within the specified values.

Accelerator butterfly blow-by with butterfly in the closed position (Solex flow meter):
 $240 \div 260$ on N scale

8. If the air flow rate does not fall within the specified limits, adjust the screw (10) until the correct value is obtained.



C.2.0055

10. Accelerator butterfly position adjusting screw

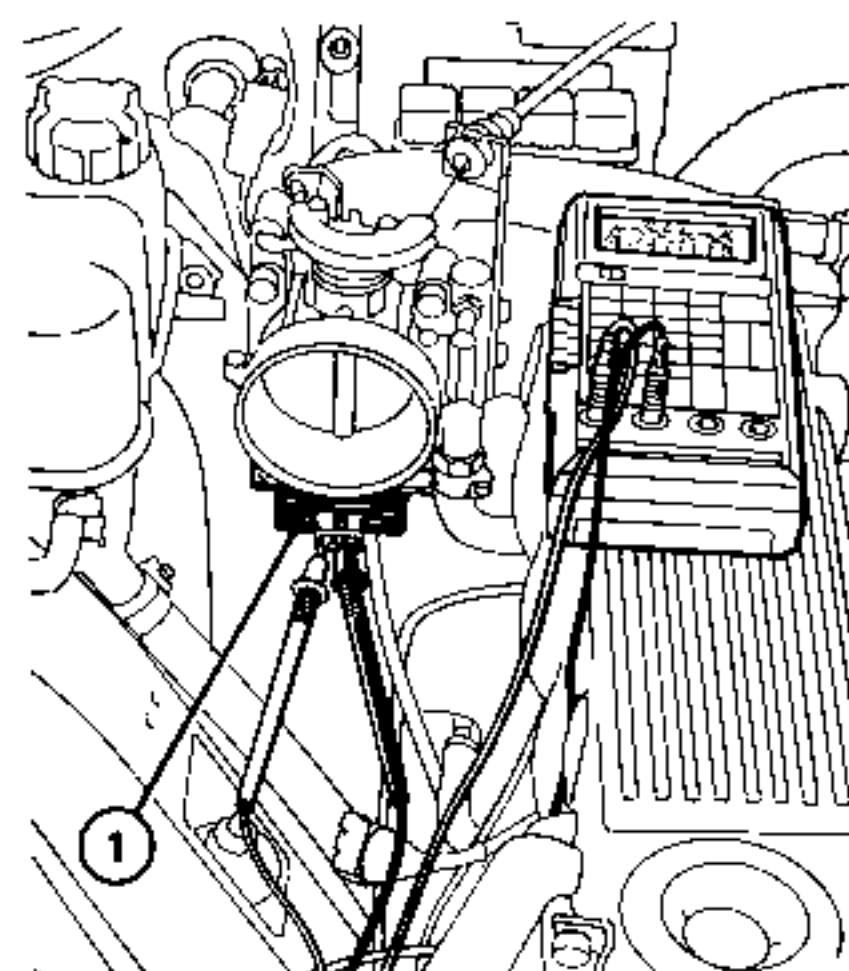
9. Refit the disconnected components by reversing the order of their removal.
10. Carry out the check of the idle running and the exhaust emissions (see paragraph «Check of idle running and exhaust emissions (CO)').

SETTING OF ACCELERATOR BUTTERFLY SWITCH

NOTE:

Before proceeding to the adjustment of the accelerator butterfly minimum and maximum opening switch, make sure that the accelerator butterfly setting is correct (see «Setting of the accelerator butterfly assembly').

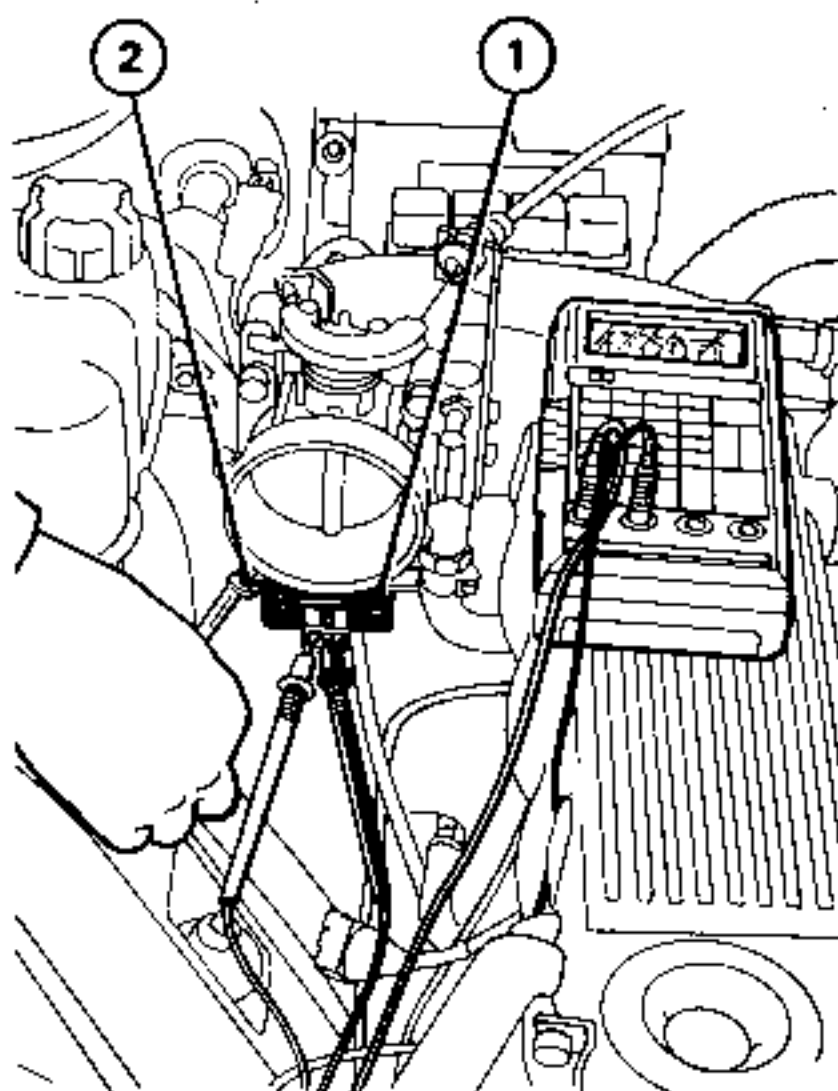
1. Disconnect the power supply connector from the accelerator butterfly switch.
2. Place the test prods of a multimeter across the terminals 2 and 18 of the accelerator butterfly switch (1).
3. In this position electrical continuity (0 Ω) should be read on the multimeter with the accelerator butterfly completely closed and accelerator pedal released (circuit closed).



1. Accelerator butterfly minimum and maximum opening switch

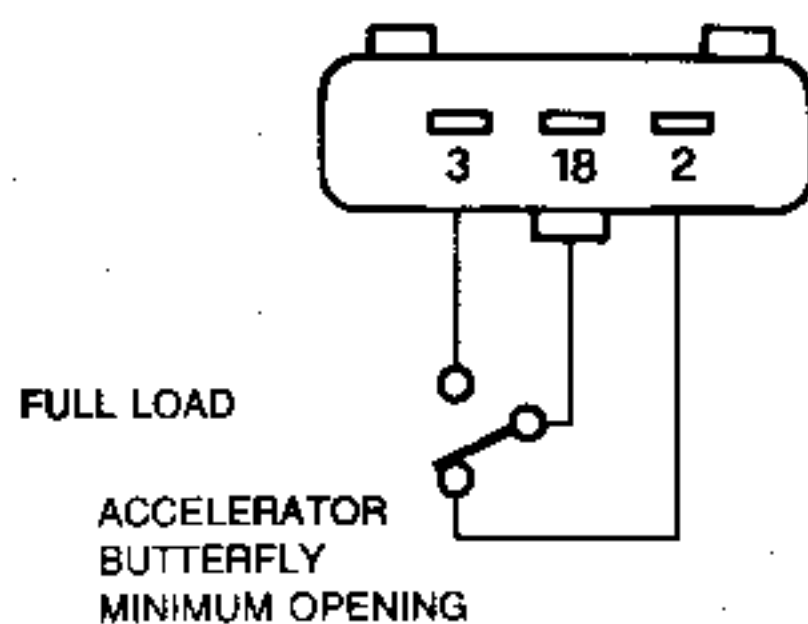
4. Turning the accelerator butterfly slowly and keeping the test prods of the multimeter on the terminals 2 and 18 of the accelerator butterfly switch (1), an infinite resistance should be read on the multimeter before the butterfly has turned through 1° from the completely closed position.

5. If the correct value is not found, carry out the adjustment of the accelerator butterfly switch (1) by loosening the securing screws (2) and turning the switch until the value 0 Ω is read on the multimeter as indicated at step 3.
6. Retighten the screws (2).



1. Accelerator butterfly switch
2. Securing screws

7. Turn the accelerator butterfly as far as it will go (accelerator pedal pressed down) and check that the power enrichment contact closes; read a value of 0 Ω on the multimeter with the test prods of the multimeter on the terminals 3 and 18 of the accelerator butterfly switch.
8. If the specified values are not found, check the accelerator control or replace the switch.



2. Idle running terminal (corresponding to the accelerator butterfly closed position)
3. Peak r.p.m. running (corresponding to the accelerator butterfly open position)

9. Reconnect the power supply connector to the accelerator butterfly switch.

SETTING OF THE ACCELERATOR CONTROL

1. Check sliding of the cable

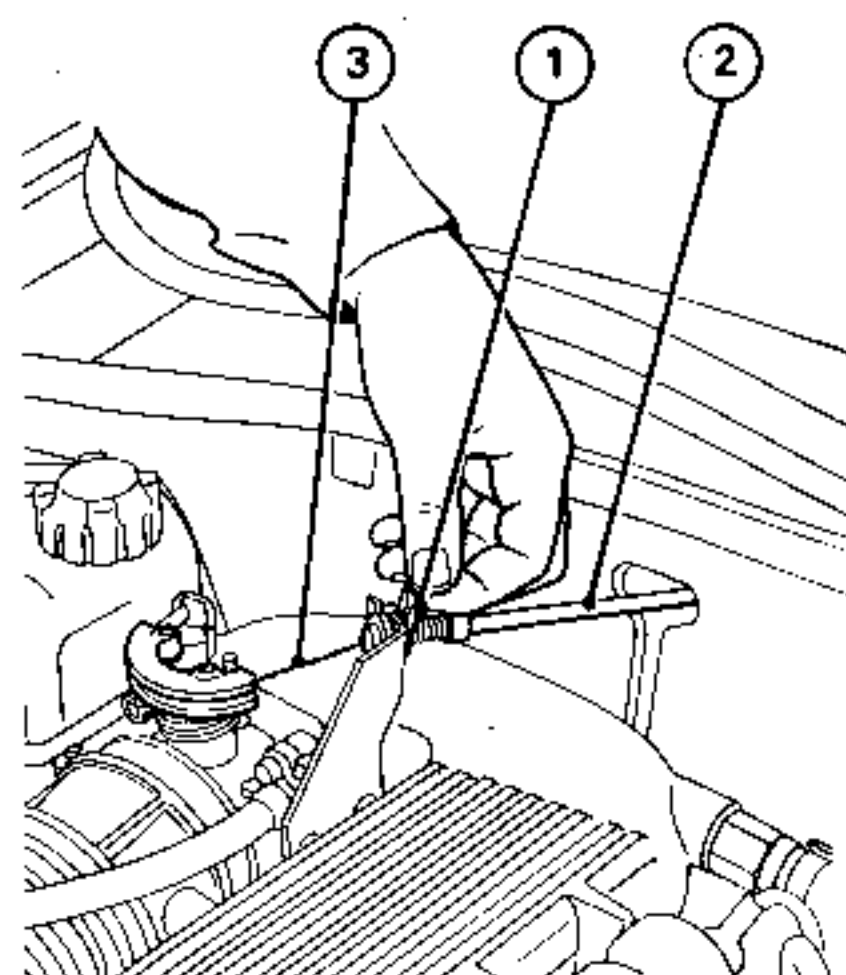
Check that the accelerator cable slides easily in its sheathing.

2. Setting of cable backlash

- a. With the accelerator pedal up check that there is an axial play of the accelerator cable on the control lever of:

$$1 \div 2 \text{ mm}$$

- b. If necessary proceed to the adjustment of the cable backlash by withdrawing the adjusting spring (1) and moving the sheathing (2) so as to furnish the cable (3) with the specified backlash and then reinsert the adjusting spring in the new position.



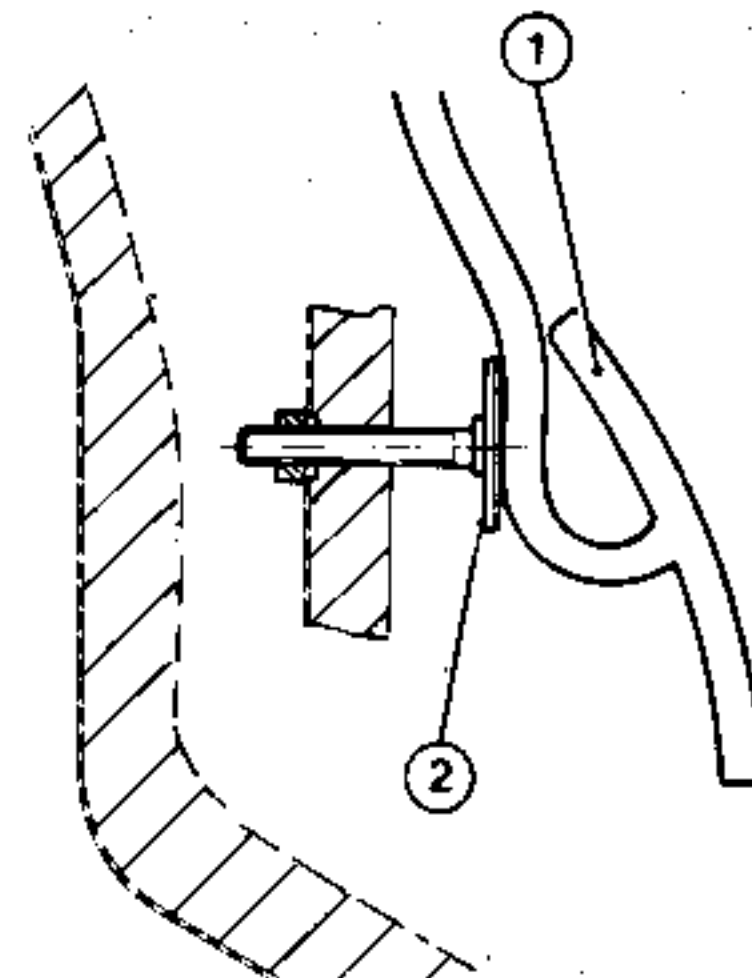
1. Adjusting spring
2. Accelerator cable sheathing
3. Accelerator cable

3. Check the maximum opening of the butterfly valve

- a. With the accelerator control pedal in the end of travel position, check that the accelerator control cam can turn by:

$$1 \div 2 \text{ mm}$$

- b. If necessary proceed to the adjustment by acting on the end of travel screw (2) under the accelerator pedal (1).



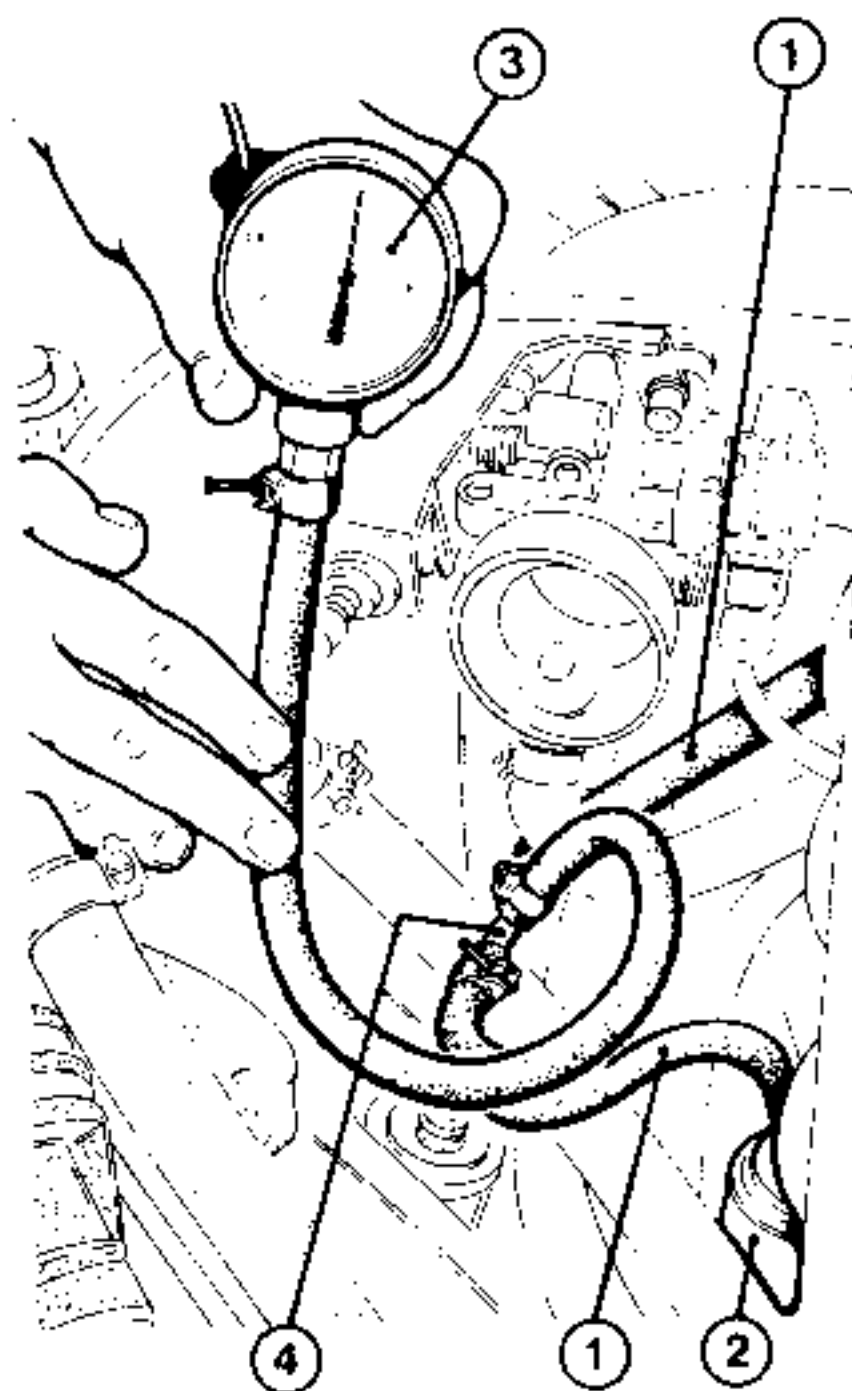
1. Accelerator pedal
2. End of travel screw

CHECK OF FUEL DELIVERY PRESSURE AND TIGHTNESS OF SYSTEM

1. Check fuel delivery pressure

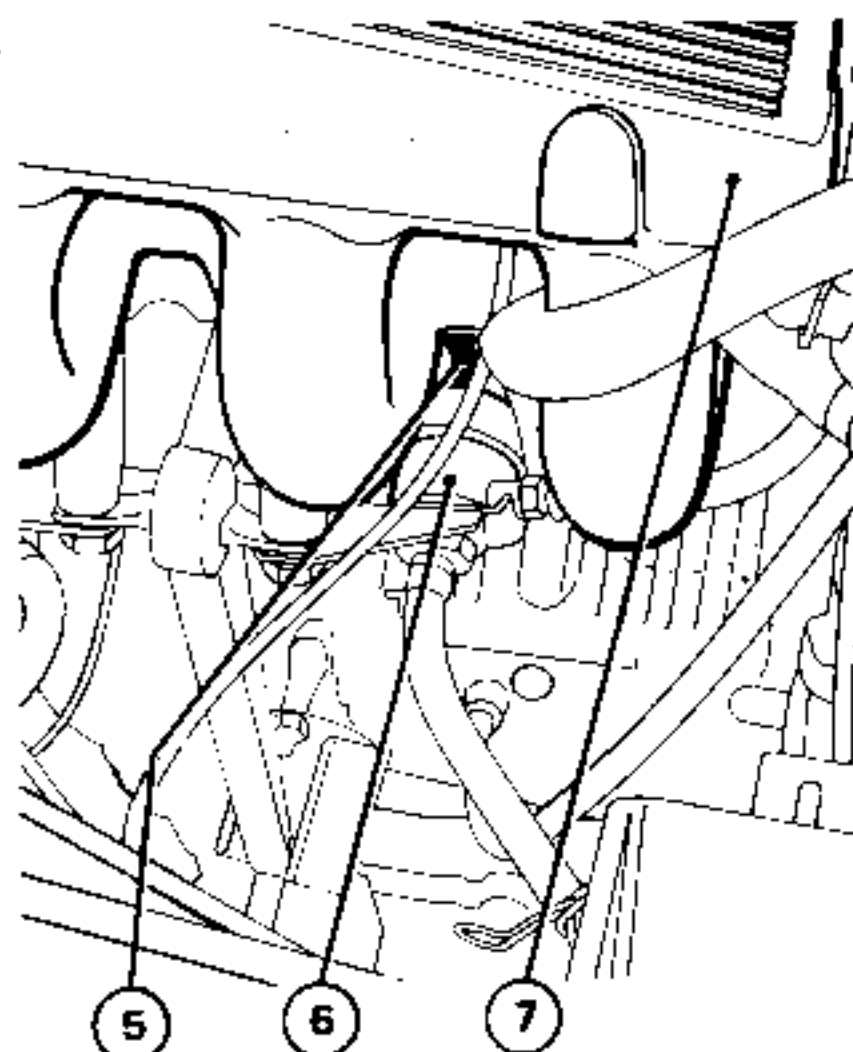
Carry out the check operating as follows:

- a. Connect the fuel delivery tube (1) and the hammering damper (2) to a pressure gauge (3) by means of a «T» adaptor (4).



1. Fuel delivery tube
2. Hammering damper
3. Pressure gauge
4. «T» adaptor

- b. Disconnect the tube (5) that connects the pressure regulator (6) with the air intake box (7) so as to prevent any irregularities in the idle running from causing irregular readings.



5. Vacuum tube
6. Pressure regulator
7. Air intake box

- c. Start the engine and with the engine running on idle check that the value read on the pressure gauge is equal to the specified value:

Fuel pressure
284.3 ÷ 323.6 kPa
(2.6 ÷ 3.2 bar; 2.9 ÷ 3.3 kg/cm²)

- d. Reconnect the tube (5) to the air intake box (7). With the engine on idle the pressure should fall to approximately 0.5 bar and then rise again when the accelerator butterfly valve is opened. If this does not occur search for possible leaks from the vacuum tube (5).

2. Checking the tightness of the system

- a. Keeping the pressure gauge connected and with the engine running on idle, throttle the tube immediately downstream from the pressure regulator (6) and read an increase in the pressure on the pressure gauge up to 4 bar (do not allow the pressure to exceed that value).
b. With the pressure at 4 bar, check that the tubing and joints of the fuel delivery system do not present leaks.
c. If the pressure does not reach the value of 4 bar and no leaks are found, check the filter and/or the functioning of the fuel pump.

TROUBLE DIAGNOSIS PROCEDURE FOR CHECKING THE TIGHTNESS OF THE FUEL DELIVERY SYSTEM

The procedure should be carried out at the intervals indicated in the «Vehicle maintenance schedule» and in the presence of the following symptoms:

- Smell of petrol
- Visible signs of leaks on the fittings and joints of the system.

The possible causes may be:

- Leakages of petrol from the fittings and the joints of the system.

Carry out the procedure described in the preceding paragraph for the «Check of the fuel pressure» and the «Check of tightness of the system» and in particular:

- In order to be able to operate in safety, check that fire fighting equipment is available in the workshop.
- Run the engine to normal running temperature.
- Switch the ignition off.
- Carry out a visual inspection of the components and fittings of the fuel system in order to locate the origin of the leak.
- Check the entire system (connecting tubes, fittings, components) using an exhaust gas analyser (NDIR system).
- A reaction of the pointer of the analyser with noticed in the vicinity of the leak.

The search with the analyser must be carried out slowly in order to compensate for the delay in the response of the instrument.

- When the leak has been located, by following the procedure indicated in steps d. and/or e., eliminate the leak by replacing the defective components of the system or tightening appropriately the loose pipe clips.
- On the completion of the preceding step, start the engine, letting it run on idle for a few minutes and then switch the ignition off.

- Repeat the search described in steps c. and d. to check the exactness of the diagnosis and the effectiveness of the repair.

- On completion of the procedure described in the steps a. to h. carry out a road test of at least 30 minutes to be sure of the good working order of the system.

CHECK OF THE TIGHTNESS OF THE VAPOUR EMISSION SYSTEM (EVAPORATIVE)

The procedure described below must be carried out when checking the fuel pressure and in the presence of the smell of petrol.

The probable cause will be a blow-by of vapour from the tubing fittings or parts of the system.

PROCEDURE «A»

- Disconnect the tube between the vapour cleaner and the fuel tank and connect it to a source of compressed air, connecting a pressure gauge between the source and the tube.
- Pressurise the system with compressed air until a pressure of:
0.025 bar (2.49 kPa;
0.0255 kg/cm²; 254 mm H₂O) is obtained and close the system. If it is not possible to reach this value, open the compressed air system and check the tightness of the system (with an HC analyser or a «Snoop» leak detector).
- Measure the fall in pressure in the system (it must not exceed:
0.00125 bar (0.125 kPa;
0.00127 kg/cm²; 12.7 mm H₂O) after 10 minutes).
- If after 10 minutes the fall in pressure exceeds the specified value, locate the leaks by smearing the tubing and fittings with soapy water or by using the «Snoop» leak detector.
- Bubbles appear in the presence of blow-bys.
- If the leak comes from the vicinity of the filler inlet/cap, replace the cap first of all. If after the replacement of the cap the

tightness of the system is restored, it means that the cap was defective, otherwise replace the filler inlet.

g. Replace the parts that are thought to be defective and/or tighten the loose pipe clips etc.

h. Repeat the steps b. and c. to check the exactness of the diagnosis.

ALTERNATIVE PROCEDURE «B»

To be carried out with the fuel tank at least 3/4 full.

a. Disconnect the tube connecting the vapour cleaner and the fuel tank and connect it to a source of compressed air with a pressure gauge between the source and the tube.

b. Pressurise the system blowing propane into the vapour breather tubing until a pressure of:

0.025 bar (2.49 kPa

0.0255 kg/cm²; 254 mm H₂O)

is obtained.

c. Check for leaks of propane from the system using an HC sensor (probe) connected to an HC analyser.

d. Repair the leak (or if necessary tighten the pipe clips).

e. Repeat steps b. and c. to check the correctness of the diagnosis.

CHECK OF THE TIGHTNESS OF THE AIR INTAKE SYSTEM DOWNSTREAM FROM THE AIR FLOW GAUGE

In order to identify any air leakage from the entire air intake system, disconnect the flexible hose that connects the constant idle actuator and the corrugated air intake duct and blow in compressed air with a compressed air gun.

Open the accelerator butterfly valve completely and spray or smear soapy water on all the joins of the system; the appearance of bubbles or foam will indicate the presence of a leak.

CHECKING OF THE IDLE RUNNING R.P.M.

Carry out the check of the idle running with the engine at normal running temperature, the gear lever in neutral and all the auxiliary devices excluded.

Idle r.p.m.

800 ± 50 r.p.m.

The regulation of the idle r.p.m. is automatically piloted in all states of functioning by means of the constant idle actuator.

With the engine running on idle the function of the actuator is to bring the real r.p.m. to the nominal r.p.m. (800 ± 50 r.p.m.) by acting on the accelerator butterfly by-pass. As well as controlling the idle r.p.m. the actuator also functions as an additional air box and regulator for the operation of the air conditioning system.

When the compressor is activated, the electronic control unit acts, through the actuator, to maintain automatically the specified r.p.m.

NOTE:

With the Motronic system periodic adjustments of the idle r.p.m. are not possible. If this check furnishes values outside the specified values and the vehicle does not present any mechanical type faults, it is probable that there is a fault in the electronic circuits. In this case it will be necessary to resort to the trouble diagnosis procedure using the special tester. If the check does not furnish the specified values in this case also, it will be necessary to replace the defective components.

The following preliminary checks should also be carried out:

- Check the level of the engine oil.
- Clean the air filter cartridge.
- Check the efficiency of the ignition system.
- Check the ignition timing.

The CO value should fall within the following values:

% CO ≤ 0.2

NOTE:

With the Motronic ML4.1 system in this configuration, period adjustments of the CO emissions with idle r.p.m. are not possible.

If this check furnishes values which fall outside the specified limits and the vehicle does not present faults of a mechanical type, it is probable that there is a fault in the electronic circuits. In this case it will be necessary to resort to the trouble diagnosis procedure using the special tester. If the check does not furnish the specified values in this case also, it will be necessary to replace the defective components.

CHECK OF THE EXHAUST EMISSIONS (CO) WITH ENGINE ON IDLE R.P.M.

The check is carried out with NDIR type equipment, analysing the exhaust gases taken from the exhaust tubing upstream from the catalyser.

The check is carried out with the engine at normal running temperature (after the fan has come on and then gone off) and after having carried out the check of the idle r.p.m. (see: «Check of the idle running r.p.m.»).

TECHNICAL DATA AND SPECIFICATIONS

TECHNICAL DATA

FUEL DELIVERY AND INJECTION SYSTEM COMPONENTS

Component	Part number ALFA ROMEO	Type
Main fuel pump — Rated voltage: 12 V — Operating tension: 7 ÷ 15 V — Operating pressure: ≤3.0 bar — Maximum admitted fuel temperature: ≤60°C — Maximum admitted difference in temperature between pump and tank: ≤2°C — Operating temperature: —30° ÷ +60°C — Rated delivery (temperature 20°C, tension 12 V, pressure 3.0 bar): 100 l/h (minimum) — Current input (temperature 20°C, tension 12 V, pressure 3.0 bar): ≤6.5 A	116.46.04.021.00	BOSCH 0.580.464.020
Auxiliary fuel pump — Rated voltage: 13.5 ±0.05 V — Rated delivery: ≥115 l/h at 160 mbar (*) ≥67 l/h at 230 mbar (*) 0 at 298 ÷ 436 mbar (*) (*) Pressure measured at pump level	115.41.32.009.00	GENERAL MOTORS 6441336
Fuel pressure regulator	195.00.32.045.00	BOSCH 0.280.160.213
Hammering damper — Operating pressure: 1.7 ÷ 3.0 bar — Temperature range on mounting: —30° ÷ +100°C	161.10.04.550.00	BOSCH 0.280.161.030
Electric fuel injectors	195.36.11.030.00	BOSCH 0.280.150.702
Air flow gauge	195.36.11.013.02	BOSCH 0.280.202.202
Constant idle regulation actuator — Rated voltage: 12 V — Operating tension: 7 ÷ 15 V — Temperature range on mounting: —30° ÷ +120°C — Rated ampere: 0,7 A — Air flow capacity with Δp = 50 mbar: ≥33 m³/h — Control frequency: 100 Hz	195.32.11.017.01	BOSCH 0.280.140.516
Ignition and injection electronic control unit (Motronic)	162.24.11.042.02	BOSCH 0.261.200.108
Engine coolant temperature sensor — Rated resistance at 20°C: 2.28 ÷ 2.72 kΩ — Rated voltage: supply from control unit — Temperature range on mounting: —30° ÷ +130°C	195.32.11.010.00	BOSCH 0.280.130.026
Inductive impulse generator (timing and r.p.m. sensor)	195.32.11.019.00	BOSCH 0.261.210.036
Accelerator butterfly switch	195.36.11.022.01	BOSCH 0.280.120.315
Lambda sensor	161.24.11.016.11 162.28.11.016.00 (1)	BOSCH 0.258.003.061 BOSCH 0.258.003.006 (1)

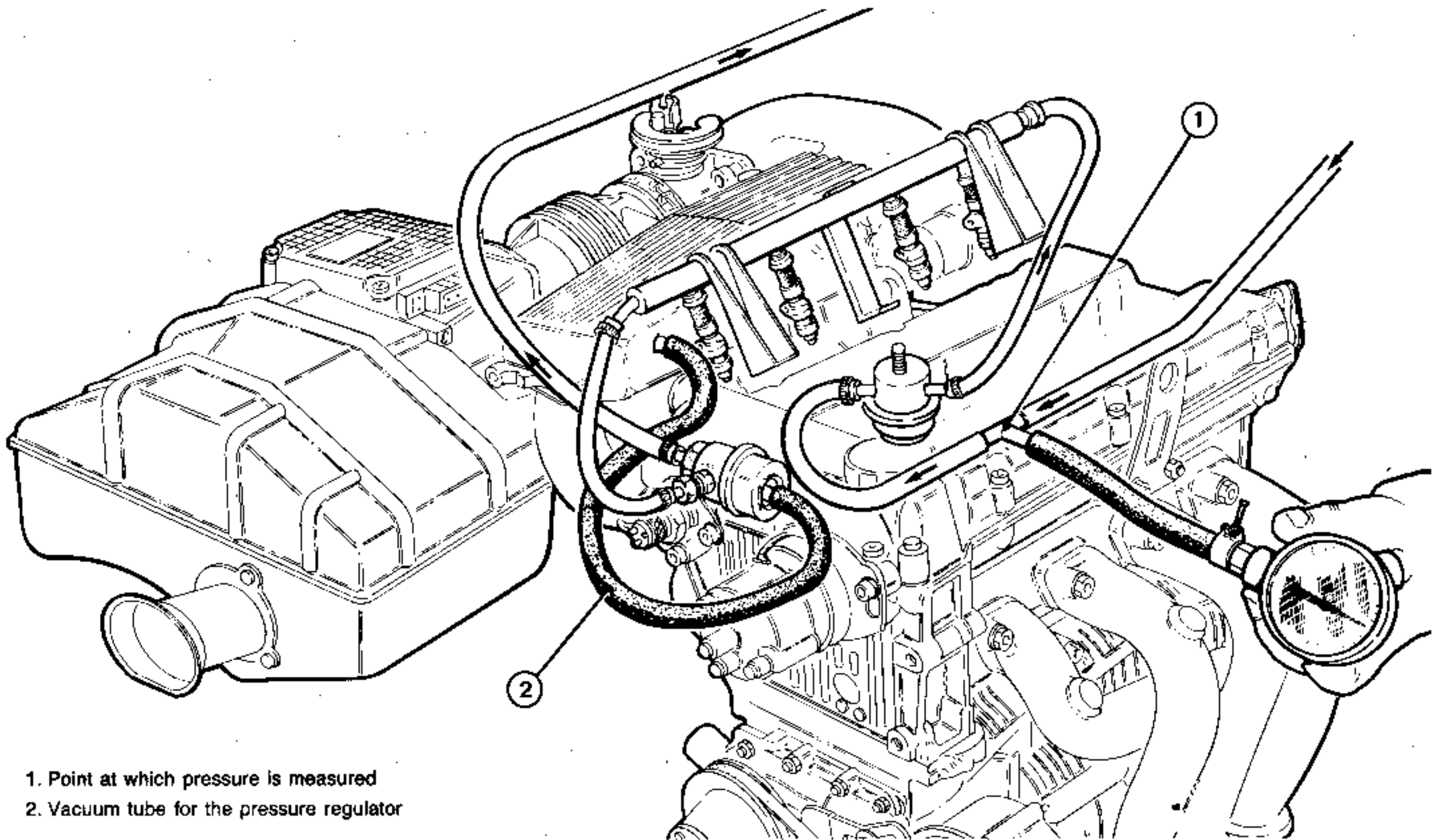
(1) Alternative

FUEL TANK

Features	Unit of measurement
	litres
Total capacity	49
Reserve	8

CHECKS AND ADJUSTMENTS

FUEL PRESSURE CHECK



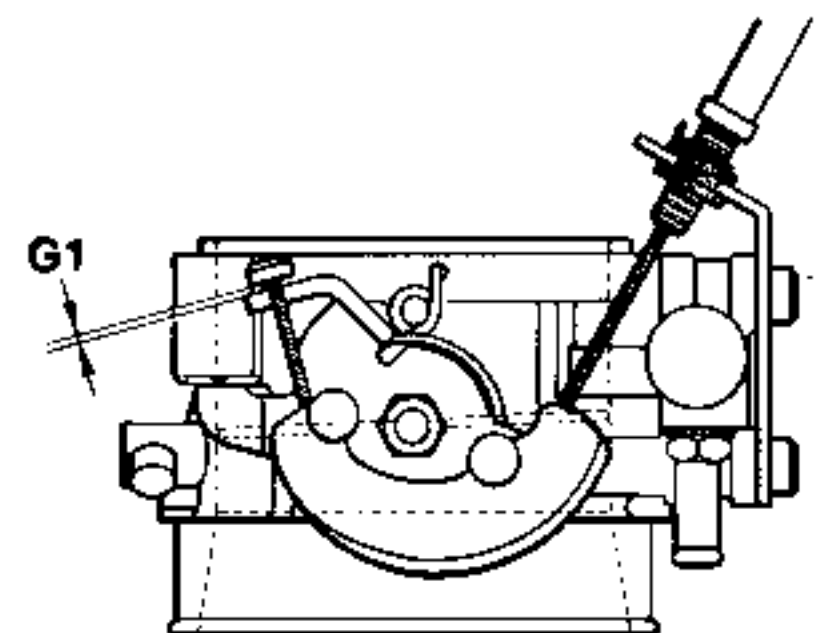
1. Point at which pressure is measured
2. Vacuum tube for the pressure regulator

Check	Values
Operating pressure to be measured at the point ① with the tube ② disconnected and with the engine running at idle r.p.m.	kPa 284.3 ÷ 323.6
	bar 2.8 ÷ 3.2
	kg/cm ² 2.9 ÷ 3.3

ACCELERATOR CONTROL CHECK

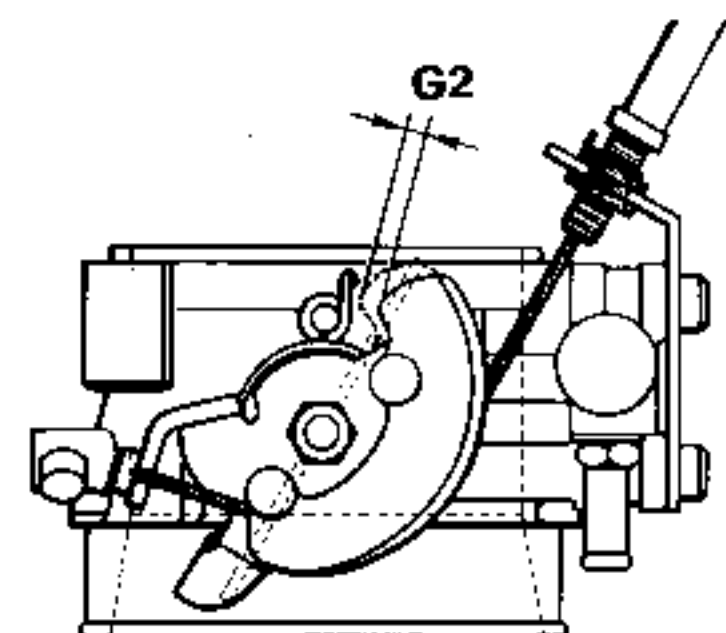
Accelerator cable backlash (with accelerator pedal released)

$$G_1 = 1 \div 2 \text{ mm}$$



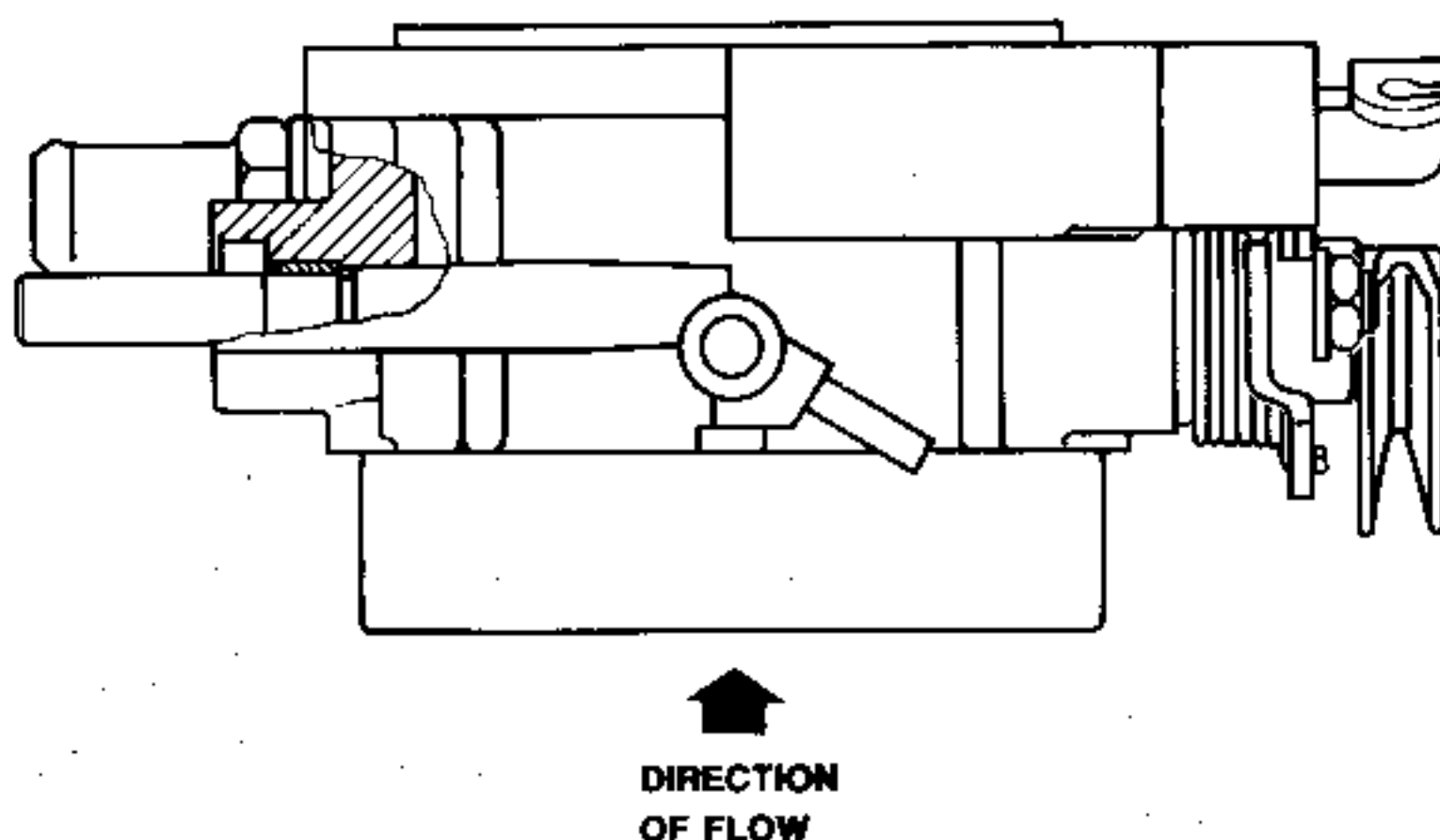
Play in accelerator control cam (with accelerator pedal pressed right down)

$$G_2 = 1 \div 2 \text{ mm}$$



ENGINE FUEL SYSTEM

SETTING OF ACCELERATOR BUTTERFLY ASSEMBLY (Flow rate)

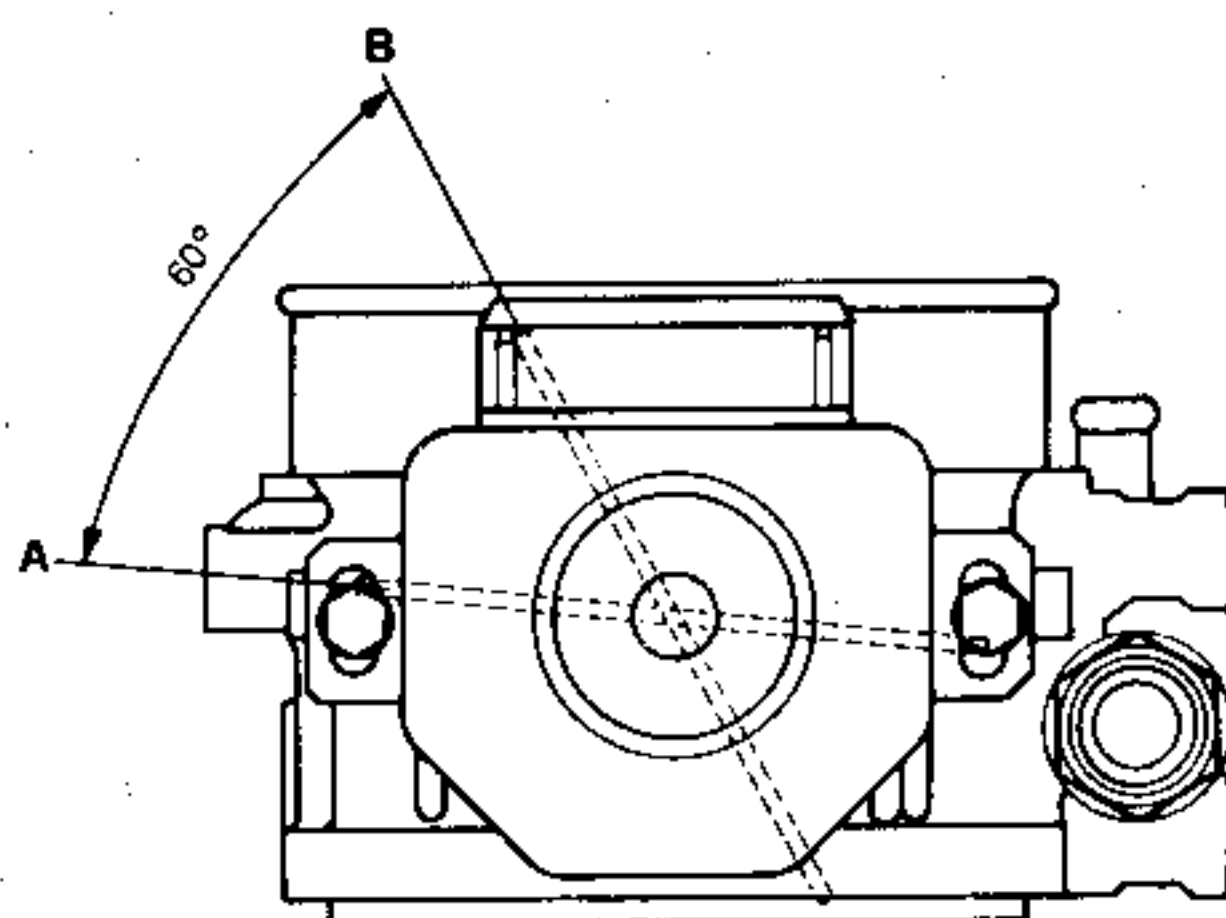


Check	Values
Blow by of air with accelerator in the closed position The reading of the values on the Solex flow meter must be carried out applying the buffer to the opening of the accelerator butterfly housing	(Solex Flow meter) Scale N 240 ÷ 260

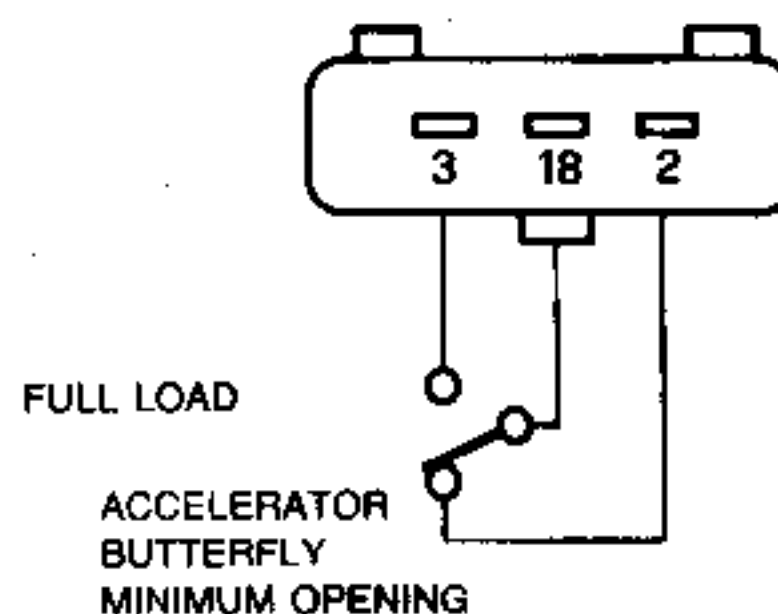
ENGINE IDLE R.P.M. AND EXHAUST CO %

Check	Values
Engine idle r.p.m. (engine warm, gear lever in neutral auxiliary devices excluded)	800 ± 50 r.p.m.
CO % of exhaust emission at idle r.p.m.	≤ 0.2

SETTING OF ACCELERATOR BUTTERFLY SWITCH



2. Terminal for the idle r.p.m. check (corresponding to the position «A» accelerator butterfly closed)
3. Terminal for the check of the peak r.p.m. (corresponding to the position «B» accelerator butterfly completely open)



Check	Terminals 2 — 18	Terminals 3 — 18
Resistance between the terminals with the accelerator pedal released (accelerator butterfly completely closed)	0 Ω	∞
Resistance between the terminals with the accelerator pedal pressed (accelerator completely open equal to an angle $\alpha \approx 60^\circ$)	∞	0 Ω

ENGINE FUEL SYSTEM

GENERAL SPECIFICATIONS

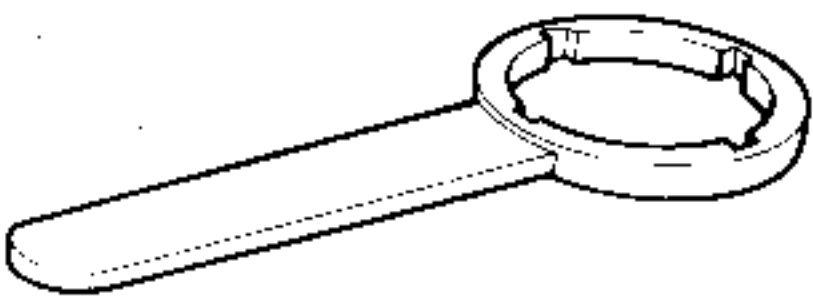
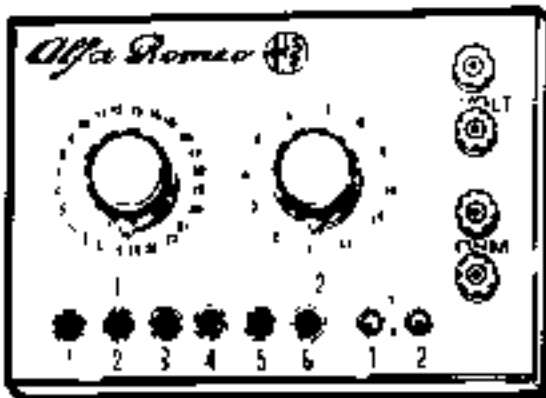
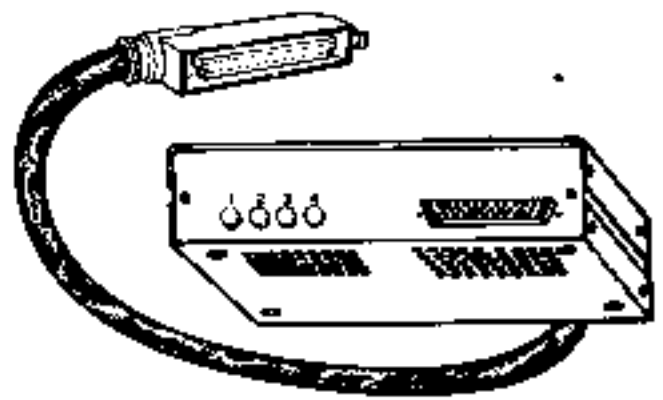
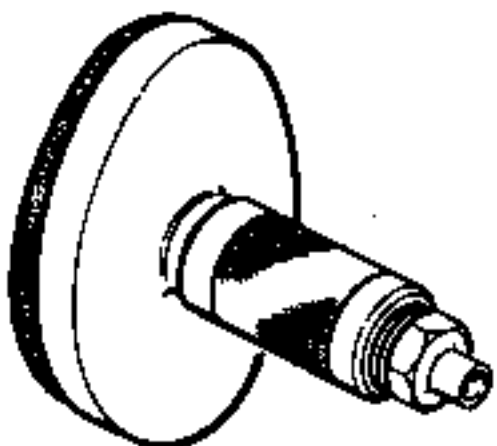
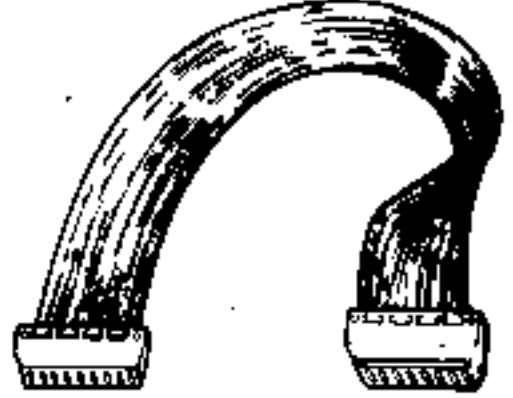
FLUIDS AND LUBRICANTS

Application	Type	Name	Q.ty
Accelerator pedal spindle (on rubber supports)	GREASE	ISECO Molykote Longterm n. 2 Std No. 3671-69831	—
Lambda sensor thread	GREASE	BOSCH 5.964.080.105 R. GORI Never Seez	—
Engine temperature sensor		Std No. 3671-69850	

FUEL

Unleaded petrol with Octane Number (R.M.): ≥ 95 R.O.N.

SPECIAL SERVICE TOOLS

Identification number	Name	
A.5.0197	Spanner for the auxiliary fuel pump securing ring nut	
C.1.0132	Universal trouble diagnosis instrument	
C.1.0136	Interface	
C.2.0055	Buffer for measuring accelerator butterfly housing flow rate	
C.9.0032	Interface - universal trouble diagnosis instrument connecting lead	

GROUP 05

CONTENTS

BATTERY	05-2	CHARGING	(•)
ELECTRICAL SYSTEM	(•)	Dismantling	(•)
Ignition and injection diagram	(*)	Checks and adjustments	(•)
Starting diagram	(•)	Reassembly	(•)
Charging diagram	(•)	Bench testing	(•)
Technical data and specifications	05-3	Technical data and specifications	(•)
STARTING	(•)	Fault finding and corrective	
Dismantling	(•)	operations	(•)
Checks and adjustments	(•)	IGNITION	(•)
Reassembly	(•)	Dismantling	(•)
Bench testing	(•)	Checks and adjustments	(•)
Technical data and specifications	(•)	Reassembly	(•)
Fault finding and corrective		Bench testing	(•)
operations	(•)	Fitting of ignition distributor or vehicle ...	(•)

(*) SEE GROUP 00

(•) SEE WORKSHOP MANUAL FOR PETROL ENGINE — GROUP 05

BATTERY

ATTENTION:

- Do not touch the negative and positive poles of the battery simultaneously with bare hands.
- When starting the engine from an auxiliary battery using jump leads, the input must not exceed 12 V.

CHECKS AND ADJUSTMENTS

- Check that there are no signs of leakage of acid and/or cracks on the external casing of the battery.
- Check that the top of the battery is clean and that the terminals are free from oxidation.
- Make sure that the terminals are well tightened so as to guarantee a good contact.

CLEANING

- Clean the upper part of the battery, the poles and the terminals with a solution of water and bicarbonate of sodium.
- Before fitting the terminals, apply the specified type of grease (REINACH E10 TAC).

TENSION TEST

- Check the tension across the terminals of the battery periodically, to see that it coincides with the exact rating of the tension regulator.
- The value of the tension across the terminals of the battery should be $13.7 \div 14.7$ V with the engine running at 3,000 r.p.m..
- Check that either the minimum value, with the engine warmed up and the auxiliary devices (at least the headlamps) on, or the maximum value with the engine cold and the auxiliary devices off, is equal to the specified values.
- If the values obtained do not fall within the specified limits, it will be necessary to check the components of the electrical system.

BATTERY CHARGE CHECK

- Do not use the battery for at least 2 hours and then measure the tension with

the circuit open and the negative terminal disconnected to prevent the dispersion of current into the electrical system.

- If the battery is not properly charged (flat), the value will be less than 12.30 V.
- The condition of charge of the battery can be estimated approximately from the following table:

Tension across the terminals	Charge
12.30	50
12.36	
12.42	
12.48	75
12.54	
12.60	
12.66	100
12.70	

WARNING:

The use of a digital voltmeter is advised in so far as this permits readings down to 1/100 of a V (on the scale from 0 to 20 V) and is characterised by lower absorption.

CHARGING

- Recharging must be effected with the input of a current (in A) of approximately 1/20 of the capacity of the battery (in Ah) corresponding to approximately 1/100 of the value indicated on the rating plate.
 - The recharging is complete when the variation in the value of the battery tension is less than 0.05 V for two consecutive readings taken with an interval of 1 hour between them.
- The duration of the recharging is directly proportional to the condition of charge of the battery.

WARNING:

Check that the temperature of the electrolyte during recharging does not exceed 50°C and that the tension does not exceed 16.5 V.

- After recharging, check the battery tension again after an interval of 2 hours.

WARNING:

Sealed batteries are not fitted with topping up caps. Some of these are fitted with a lid which should only be removed in case of emergency to restore the level of the electrolyte by topping up with distilled water when the wrong setting of the tension regulator (excessive tension) has resulted in an excessive consumption of water.

GENERAL SAFETY MEASURES

- Lead batteries generate (especially during recharging) an explosive mixture of hydrogen and oxygen.

It is therefore indispensable to take safety measures in order to guard against damage to persons and to the vehicle.

- The recharging zone must be adequately ventilated so as to facilitate the dispersion of the gas which is released during recharging.

If the recharging is carried out in an enclosed environment, artificial ventilation must be provided.

- The transfer of the acid must be carried out with the greatest care wearing protective clothing (rubber gloves and acid resistant apron) for the protection of clothes and person.

Protective goggles must also be worn.

- When mixing acid with water (for example for the dilution of an excessively concentrated acid), the acid must be poured slowly into the water and not vice versa.

- The use of metallic funnels and containers is not recommended.

Perfectly clean glass or plastic funnels and containers are recommended.

- The use of a naked flame (matches or cigarette lighters) is absolutely forbidden for the checking of batteries.

TECHNICAL DATA AND SPECIFICATIONS

TECHNICAL DATA

Components

Engine	Starter engine	Alternator (4)	Ignition distributor	Coil with electronic module	Spark plugs
2000 (062.24)	116.55.05.030.03 BOSCH 0.001.108.011 12V-1,4 kW	116.10.05.060.08 BOSCH 0.120.489.549 K1 → 14V55A20	195.36.05.011.00 (2) BOSCH 0.237.501.005	195.36.06.079.02 BOSCH 0.221.600.054	195.10.05.106.00 SPICA LODGE 25 HLD
		116.10.05.060.12 PARIS-RHONE A13R192	195.36.05.011.01 (3) BOSCH 0.237.501.006		195.10.05.106.01 (1) CHAMPION RC6YC
		116.55.05.060.00 MAGNETI MARELLI			

(1) Alternative

(2) Distributor mounted on the cylinder head

(3) Distributor mounted on the timing system cover

(4) With electronic tension regulator incorporated

Battery

Tension (V)	12
Capacity (Ah)	55
Discharge current (A)	255
Electrolyte density (kg/dm ³)	1.28 ± 0.01

ENGINE IGNITION, STARTER, CHARGING

GENERAL PRESCRIPTIONS

Fluids and lubricants

Application	Type	Name		Q.ty
Spark plug thread	OIL	ISECO Molykote A	Norm. 4500-18304	—

TIGHTENING TORQUES

Item	Unit of measurement	
	N·m	kg·m
Spark plugs	25 ÷ 34	2.5 ÷ 3.5

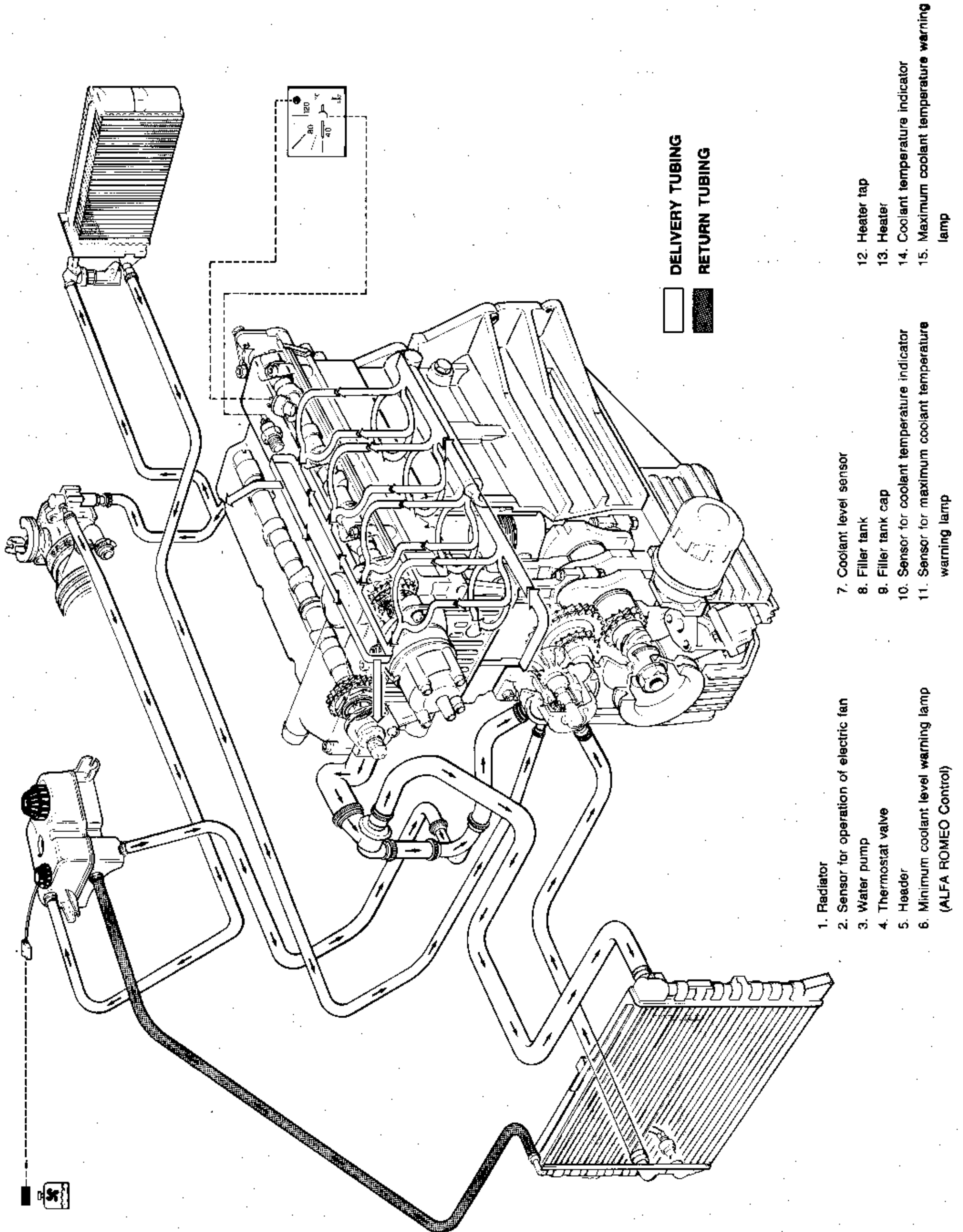
GROUP 07

CONTENTS

COOLING SYSTEM	07-2	THERMOSTAT	(•)
General description	07-3	Removal	(•)
Test tightness of cooling system	07-4	Inspection and adjustment	(•)
RADIATOR	07-5	Refitting	(•)
Removal	07-5	TECHNICAL DATA AND	
Refitting	07-5	SPECIFICATIONS	(•)
Tightness test	07-5	Checks and adjustments	(•)
ELECTRIC FAN THERMAL CONTACT		General specifications	(•)
CONTROL	(•)	Tightening torques	(•)
Check	(•)	FAULT FINDING AND CORRECTIVE	
PRESSURISED FILLER CAP	(•)	OPERATIONS	(•)
Tightness test	(•)		
WATER PUMP	(•)		
Removal	(•)		
Inspection and adjustment	(•)		
Refitting	(•)		

(•) SEE WORKSHOP MANUAL FOR PETROL ENGINES — GR. 07

COOLING SYSTEM



ENGINE COOLING SYSTEM

GENERAL DESCRIPTION

The cooling system is of the sealed type with circulation effected by means of a centrifugal pump driven from the drive shaft by means of a «V» belt.

The rotation of the water pump (3) creates a suction pressure in the return circuit which draws in the coolant, coming from the cylinders through the header tube (5) or from the heater-radiator (13) when the re-

lative control tap (12) is open (circulation of coolant in the heater-radiator).

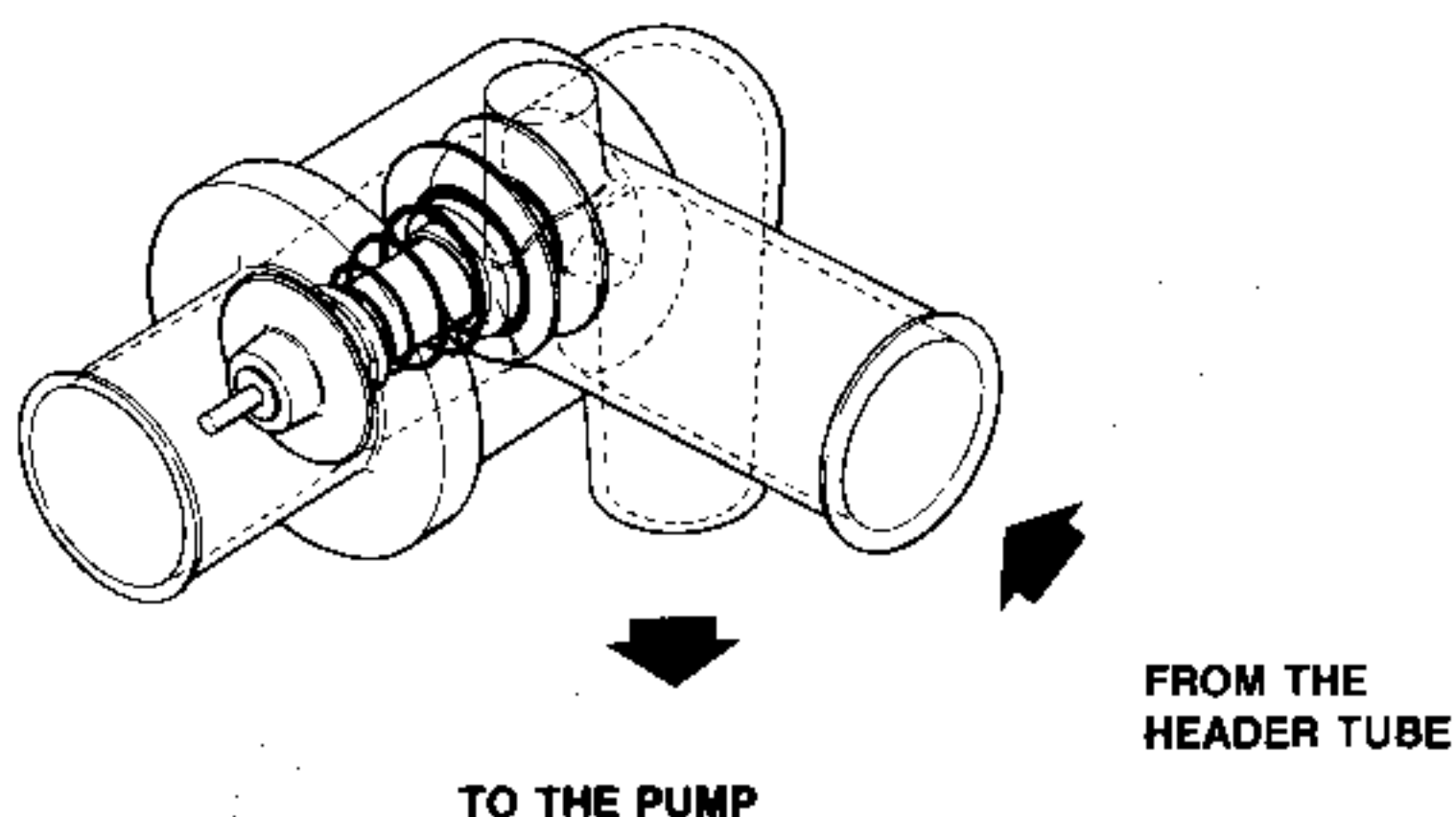
A thermostat (4) is mounted at the exit of the header tube (5). The function of this is to ensure that the engine reaches normal running temperature in the shortest possible time and subsequently to maintain the engine temperature within the optimum values for engine functioning.

The thermostat valve remains closed, deviating the coolant directly towards the

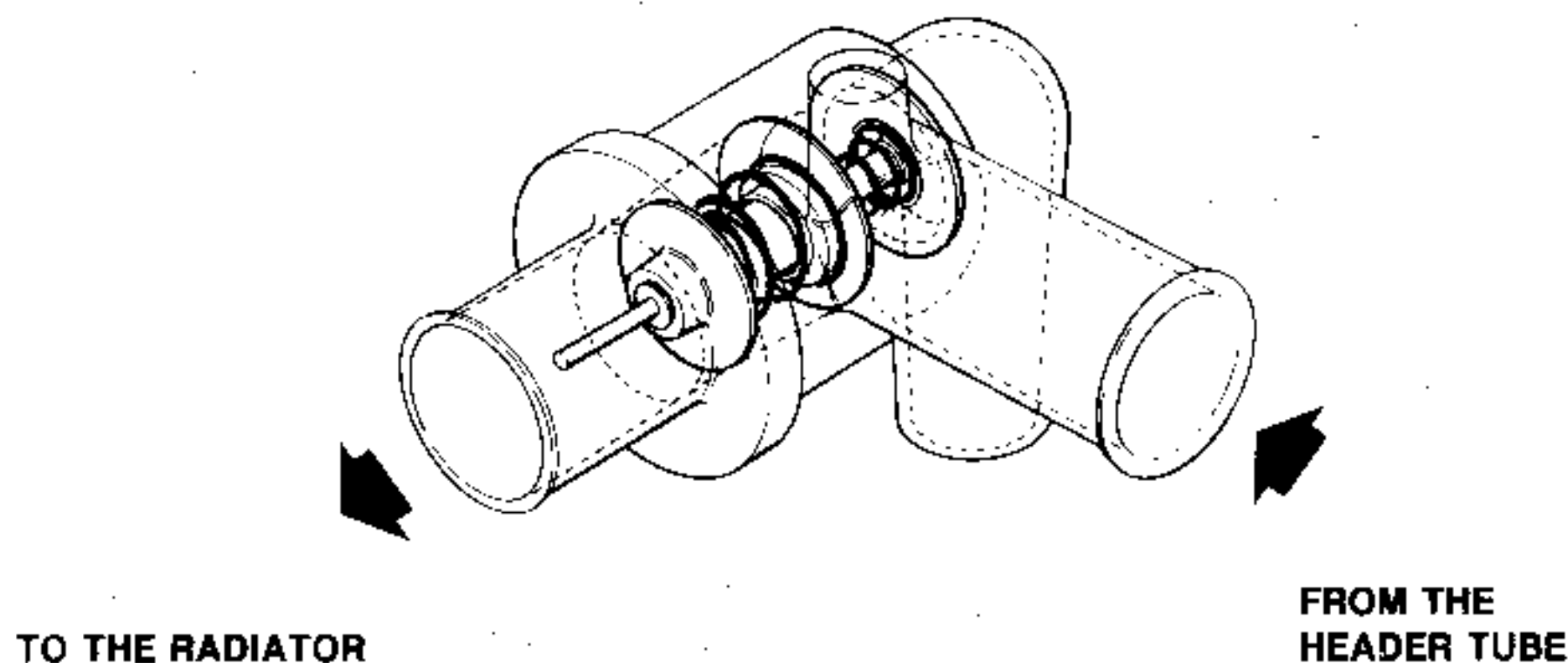
pump (3), until the engine reaches a temperature of $81 \div 95^{\circ}\text{C}$.

At higher temperatures the opening of the valve permits the passage of the coolant to the radiator (1).

THERMOSTAT VALVE CLOSED



THERMOSTAT VALVE OPEN



Apart from the natural air cooling during driving, the radiator is cooled by the electric fan, which is switched on by the thermal contact (2) whenever the coolant in the lower part of the radiator itself reaches $\sim 88^{\circ}\text{C}$.

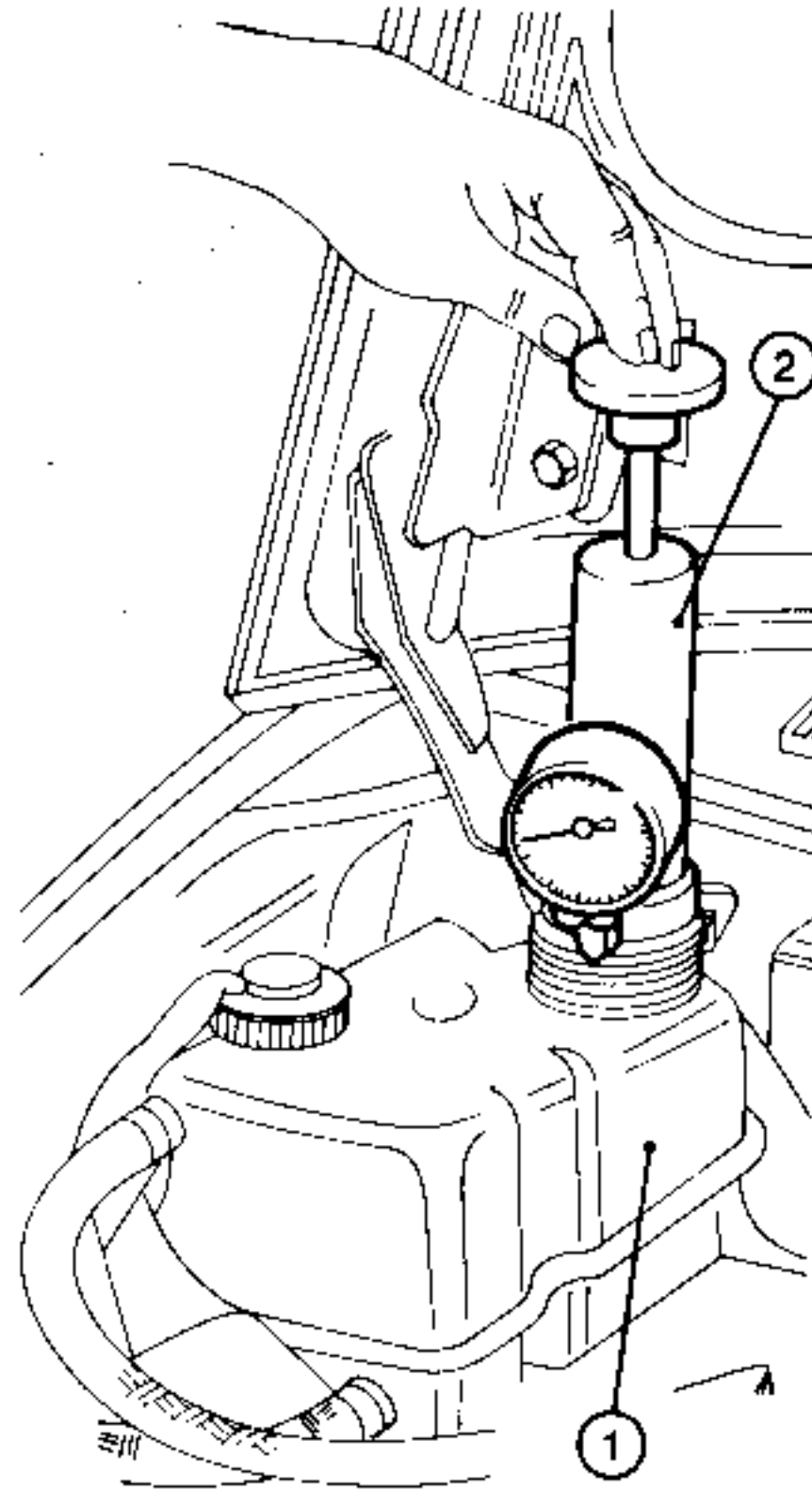
The circulation of coolant in the heater-radiator (13) is regulated by the tap (12) controlled by the heater control knob.

COOLING SYSTEM TIGHTNESS TEST

- a. Unscrew the pressurised cap of the filler tank (1).
- b. Screw the instrument (2) onto the inlet of the filler tank to test the tightness of the coolant system.
- c. Pressurise the system and check that the value indicated on the testing instrument remains at the specified value.
- d. If the pressure does not remain constant at the specified value, check the system for leaks from the hoses or from the radiator.

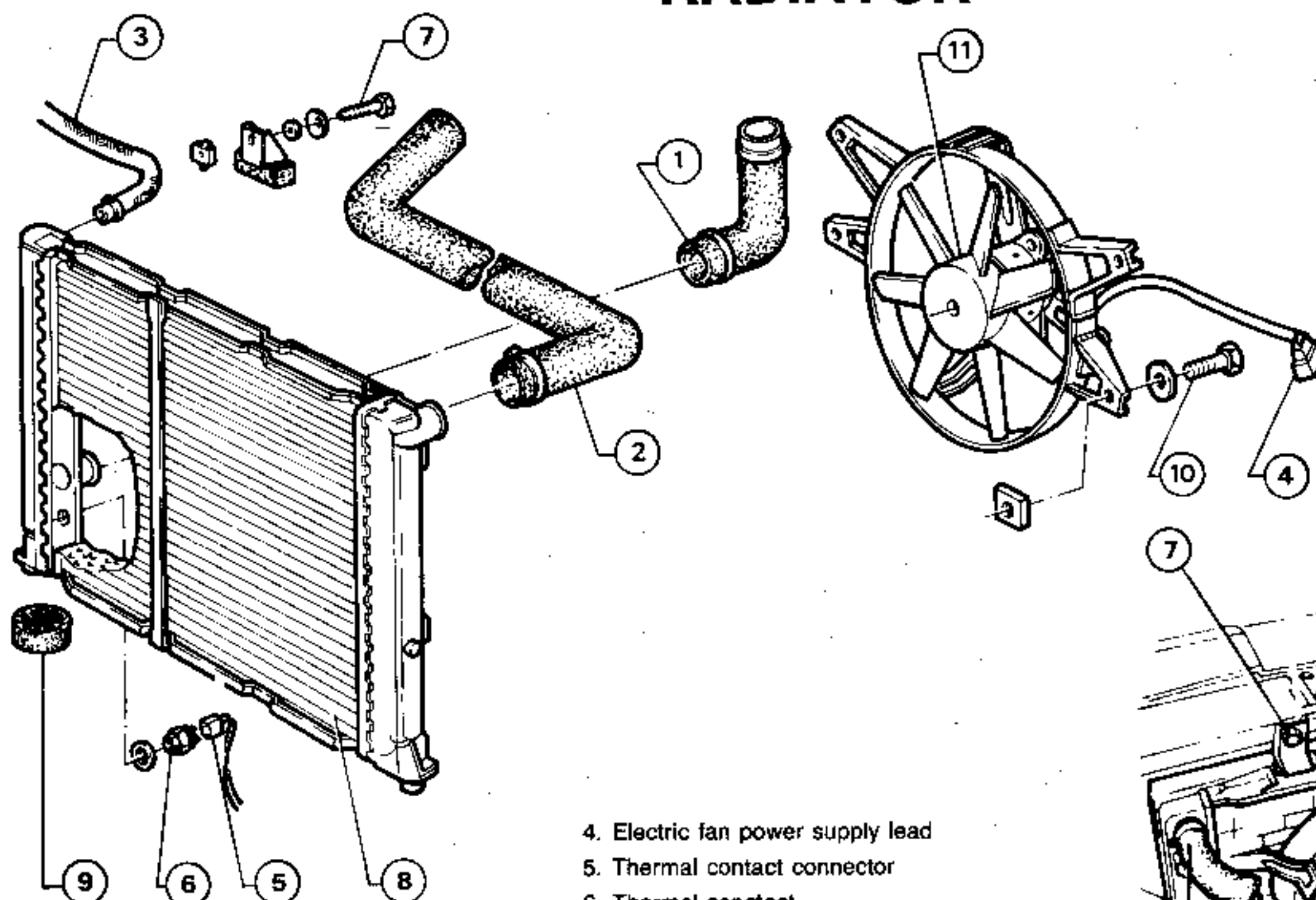
If necessary proceed to the removal and inspection as described in the paragraph «Radiator».

Pressure for cooling system test
107.9 kPa (1.08 bar; 1.1 kg/cm²)



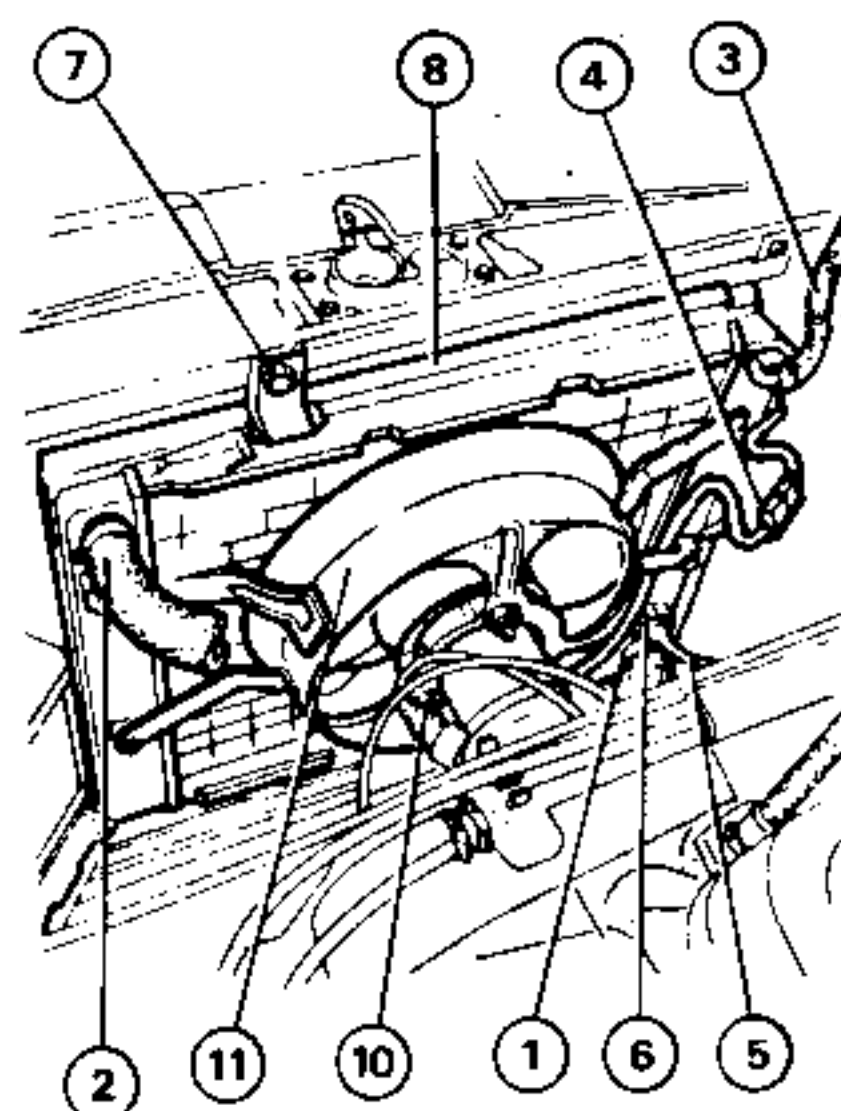
1. Filler tank
2. Testing instrument

RADIATOR



1. Hose for the delivery of coolant to the pump
2. Hose for the delivery of coolant to the radiator
3. Radiator breather tube

4. Electric fan power supply lead
5. Thermal contact connector
6. Thermal contact
7. Radiator securing screws
8. Radiator
9. Elastic pad
10. Screw for securing of electric fan to radiator
11. Radiator



REMOVAL

1. Disconnect the battery.
2. Detach the hose (1) from the radiator, drain off the coolant and collect it in a container.

WARNING:

To avoid scolds, take care not to drain off the coolant when the engine is hot.

3. Detach the hose (2) and the tube (3) from the radiator.
4. Disconnect the electric fan power supply leads connector (4) and the connector (5) from the thermal contact (6).
5. Unscrew the screw (7) securing the radiator to the body, remove the radiator (8) from the engine compartment and extract support pads (9).
6. If necessary unscrew the screw (10) and remove fan (11).

REFITTING

1. Proceed to the refitting of the radiator by reversing the order of removal and then carry out the refilling with coolant liquid by operating as follows:
 - Remove the cap of the filler tank and carry out the refilling of the system with the specified coolant.

Refilling of the cooling system

Minimum external temperature	°C	-30	-45
Concentrated antifreeze Std No. 3681-69956	l	1.2	2.65
Distilled water for dilution	l	6.8	5.35
Ready to use antifreeze Std No. 3681-69958	l	8	8

WARNING:

Products are damaging to paintwork. Avoid contact with painted parts.

2. Start the engine, run it to normal running temperature so as to allow the coolant to circulate through the system and switch the heater on in order to open the heater-radiator tap.
3. With the engine cold, carry out the topping up of the system up to the level of the maximum reference mark in the filler tank.

TIGHTNESS TEST

1. Remove the radiator from the vehicle (see: «Removal and Refitting»).
2. Seal the coolant inlet and outlet apertures of the radiator.
3. Immerse the radiator in tank filled with water and locate any leaks by blowing compressed air in through the breather tube until a pressure of:

107.9 kPa

(1.08 bar; 1.1 kg/cm²)

is reached.

4. In the presence of leaks, replace the radiator by operating as described in «Removal and refitting».