Chapter 12
Chassis electrical system

Contents

	Section
Aerial - removal and refitting	14
Bulb renewal	19
Circuit breakers - general information	5
Combination switch - removal and refitting	8
Cruise control system - description and check	21
Electric side view mirrors - description and check	20
Electrical troubleshooting - general information	2
Fuses - general information	3
Fusible links - general information	4
General information	1
Headlights - adjustment	17
Headlights - removal and refitting	16
Horn - check and renewal	18
Ignition switch and lock cylinder - removal and refitting	9
Instrument cluster - removal and refitting	11
Instrument panel gauges - check	10
Power door lock system - description and check	23
Power window system - description and check	22
Radio and speakers - removal and refitting	13
Rear window defogger - check and repair	15
Relays - general information and testing	6
Turn signal and hazard flasher - check and renewal	7
Wiper motor - removal and refitting	12
Wiring diagrams - general information	24

1 General information

The electrical system is a 12-volt, negative earth type. Power for the lights and all electrical accessories is supplied by a lead/acid-type battery which is charged by the alternator.

This Chapter covers repair and service procedures for the various electrical components not associated with the engine. Information on the battery, alternator, distributor and starter motor can be found in Chapter 5.

It should be noted that when any portion of the electrical system is serviced, the cable should be disconnected from the negative battery terminal to prevent electrical shorts and/or fires.

2 Electrical troubleshooting - general information

A typical electrical circuit consists of an electrical component, any switches, relays, motors, fuses, fusible links or circuit breakers related to that component and the wiring and electrical connectors that link the component to both the battery and the chassis. To help you pinpoint an electrical circuit problem, wiring diagrams are included at the end of this Chapter.

Before tackling any troublesome electrical circuit, first study the appropriate wiring diagrams to get a complete understanding of what makes up that individual circuit. Trouble spots, for instance, can often be narrowed down by noting if other components related to the circuit are operating properly. If several components or circuits fail at one time, chances are the problem is in a fuse or earth connection, because several circuits are often routed through the same fuse and earth connections.

Electrical problems usually stem from simple causes, such as loose or corroded connections, a blown fuse, a melted fusible link or a bad relay. Visually inspect the condition of all fuses, wires and connections in a problem circuit before troubleshooting it.

If testing instruments are going to be utilised, use the diagrams to plan ahead of time where you will make the necessary connections in order to accurately pinpoint the trouble spot.

The basic tools needed for electrical troubleshooting include a circuit tester or voltmeter (a 12-volt bulb with a set of test leads can also be used), a continuity tester, which includes a bulb, battery and set of test leads, and a jumper wire, preferably with a circuit breaker incorporated, which can be used to bypass electrical components. Before attempting to locate a problem with test instruments, use the wiring diagram(s) to decide where to make the connections.

Voltage checks

Voltage checks should be performed if a circuit is not functioning properly. Connect one lead of a circuit tester to either the negative battery terminal or a known good earth. Connect the other lead to a electrical connector in the circuit being tested, preferably nearest to the battery or fuse. If the bulb of the tester lights, voltage is present, which means that the part of the circuit between the electrical connector and the battery is problem free. Continue checking the rest of the circuit in the same fashion. When you reach a point at which no voltage is present, the problem lies between that point and the last test point with voltage. Most of the time the problem can be traced to a loose connection.
Note: *Keep in mind that some circuits receive voltage only when the ignition key is in the Accessory or Run position.*

Finding a short

One method of finding shorts in a circuit is to remove the fuse and connect a test light or voltmeter in its place. There should be no voltage present in the circuit. Move the wiring harness from side to side while watching the test light. If the bulb goes on, there is a short to earth somewhere in that area, probably where the insulation has rubbed through. The same test can be performed on each component in the circuit, even a switch.

Earth check

Perform an earth test to check whether a component is properly earthed. Disconnect the battery and connect one lead of a self-powered test light, known as a continuity tester, to a known good earth. Connect the other lead to the wire or earth connection being tested. If the bulb goes on, the earth is good. If the bulb does not go on, the earth is not good.

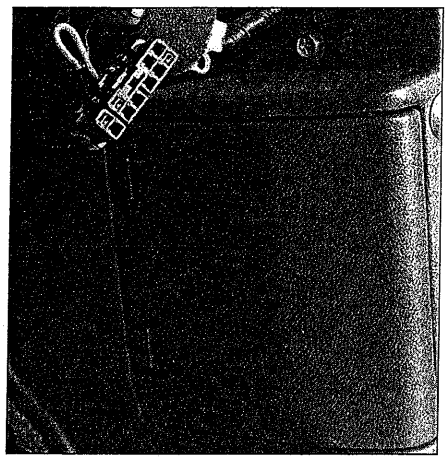
Continuity check

A continuity check is done to determine if there are any breaks in a circuit - if it is passing electricity properly. With the circuit off (no power in the circuit), a self-powered continuity tester can be used to check the circuit. Connect the test leads to both ends of the circuit (or to the "power" end and a good earth), and if the test light comes on the circuit is passing current properly. If the light doesn't come on, there is a break somewhere in the circuit. The same procedure can be used to test a switch, by connecting the continuity tester to the power in and power out sides of the switch. With the switch turned On, the test light should come on.

Finding an open circuit

When diagnosing for possible open circuits, it is often difficult to locate them by sight because oxidation or terminal misalignment are hidden by the electrical connectors. Merely wiggling an electrical connector on a sensor or in the wiring harness may correct the open circuit condition. Remember this when an open circuit is indicated when troubleshooting a circuit. Intermittent problems may also be caused by oxidised or loose connections.

Electrical troubleshooting is simple if you keep in mind that all electrical circuits are basically electricity running from the battery, through the wires, switches, relays, fuses and fusible links to each electrical component (light bulb, motor, etc.) and to earth, from which it is passed back to the battery. Any electrical problem is an interruption in the flow of electricity to and from the battery.



3.1a Remove this cover panel . . .

3 Fuses - general information

Refer to illustrations 3.1a, 3.1b and 3.3

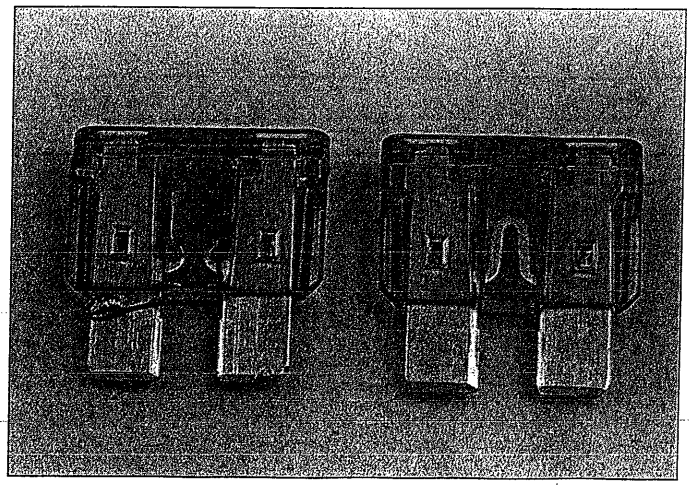
The electrical circuits of the vehicle are protected by a combination of fuses, circuit breakers and fusible links. Fuse blocks are located in the right kick panel and in the engine compartment **(see illustrations)**.

Each of the fuses is designed to protect a specific circuit, and the various circuits are identified on the fuse panel cover.

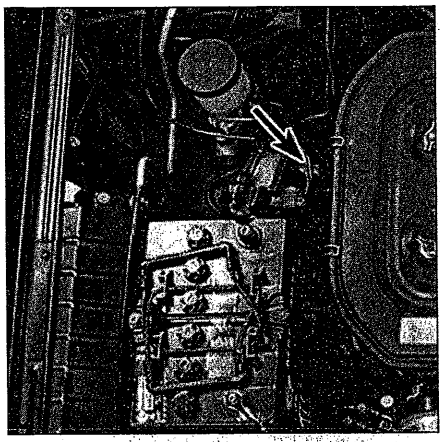
Miniaturised fuses are employed in the fuse blocks. These compact fuses, with blade terminal design, allow fingertip removal and renewal. If an electrical component fails, always check the fuse first. A blown fuse is easily identified through the clear plastic body. Visually inspect the element for evidence of damage **(see illustration)**.

Be sure to renew blown fuses with the correct amperage rating. Fuses of different ratings are physically interchangeable, but only fuses of the proper rating should be used. Renewing a fuse with one of a higher or lower value than specified is not recommended. Each electrical circuit needs a specific amount

3.1b . . . to access the fuses and relays behind it. There is a spare fuse and a fuse puller on the cover



3.3 When a fuse blows, the element between the terminals burns - the fuse on the left is blown; the fuse on the right is good



4.2 The fusible links are connected to the positive terminal of the battery. Be sure to disconnect the negative terminal before working on them

of protection. The amperage value of each fuse is moulded into the fuse body.

If the replacement fuse immediately fails, don't renew it again until the cause of the problem is isolated and corrected. Fuses do not wear out. There is always another component in the system which caused the fuse to blow. In most cases, this will be a short circuit in the wiring caused by a broken or deteriorated wire.

4 Fusible links - general information

Refer to illustration 4.2

Some circuits are protected by fusible links. The links are used in circuits which are not ordinarily fused, such as the ignition circuit.

There are several fusible links located adjacent to the battery in the engine compartment. They can be easily inspected for melting **(see illustration)**.

Conventional type fusible links cannot be repaired, a new link of the same gauge should be refitted in its place. The procedure is as follows:

a) Disconnect the cable from the negative battery terminal.
b) Disconnect the fusible link from the wiring harness.
c) Cut the damaged fusible link out of the wiring just behind the connector.
d) Strip the insulation back approximately 10 mm.
e) Position the connector on the new fusible link and crimp it into place.
f) Use rosin core solder at each end of the new link to obtain a good solder joint.
g) Use plenty of electrical tape around the soldered joint. No wires should be exposed.
h) Connect the battery earth (negative) cable. Test the circuit for proper operation.

5 Circuit breakers - general information

Circuit breakers can protect components such as, power windows, power door locks and headlights. Not all models utilise circuit breakers.

On some models, the circuit breaker resets itself automatically, so an electrical overload in a circuit breaker protected system will cause the circuit to fail momentarily, then come back on. If the circuit doesn't come back on, check it immediately. Once the condition is corrected, the circuit breaker will resume its normal function. Some circuit breakers must be reset manually.

6 Relays - general information and testing

General information

Refer to illustrations 6.1a and 6.1b

1 Several electrical accessories in the vehicle, such as the fuel injection system, horns, starter, and fog lamps use relays to transmit the electrical signal to the component. Relays use a low-current circuit (the control circuit) to open and close a high-current circuit (the power circuit). If the relay is defective, that component will not operate properly. The various relays are mounted in the engine compartment, at the fuse box and in other locations throughout the vehicle **(see illustrations)**. If a faulty relay is suspected, it can be removed and tested using the procedure below or by a dealer service department or a repair shop. Defective relays must be renewed as a unit.

Testing

2 It's best to refer to the wiring diagram for the circuit to determine the proper hook-ups for the relay you're testing. However, if you're not able to determine the correct hook-up from the wiring diagrams, you may be able to determine the test hook-ups from the information that follows.

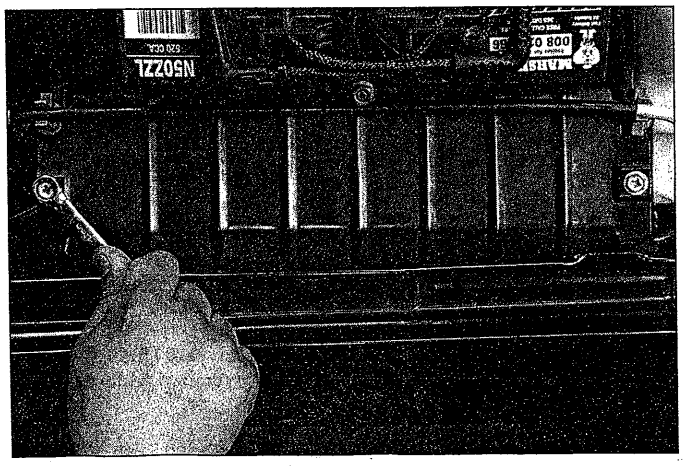
3 On most relays, two of the terminals are the relay's control circuit (they connect to the relay coil which, when energised, closes the large contacts to complete the circuit). The other terminals are the power circuit (they are connected together within the relay when the control-circuit coil is energised).

4 The relays are usually marked as an aid to help you determine which terminals are the control circuit and which are the power circuit.

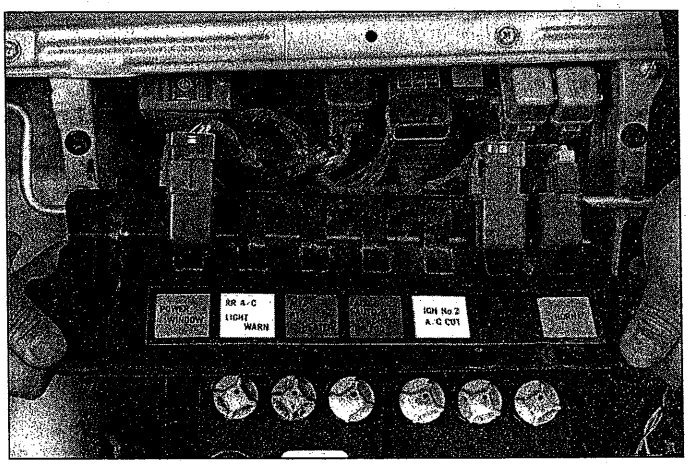
5 Connect a fused jumper wire between one of the two control circuit terminals and the positive battery terminal. Connect another jumper wire between the other control circuit terminal and earth. When the connections are made, the relay should click. On some relays, polarity may be critical, so, if the relay doesn't click, try swapping the jumper wires on the control circuit terminals.

6 With the jumper wires connected, check for continuity between the power circuit terminals as indicated by the markings on the relay.

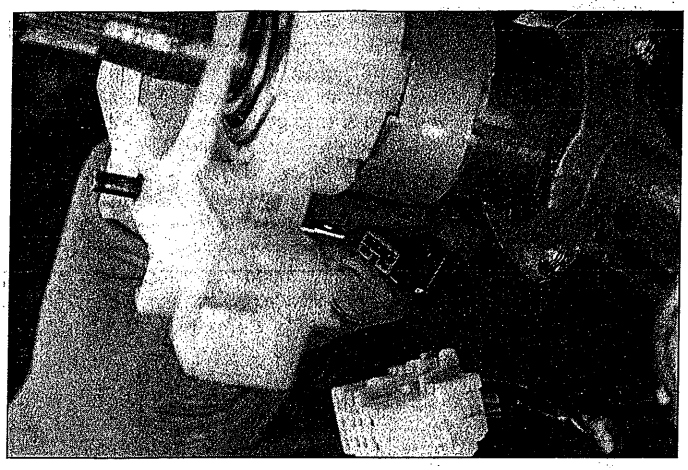
7 If the relay fails any of the above tests, renew it.



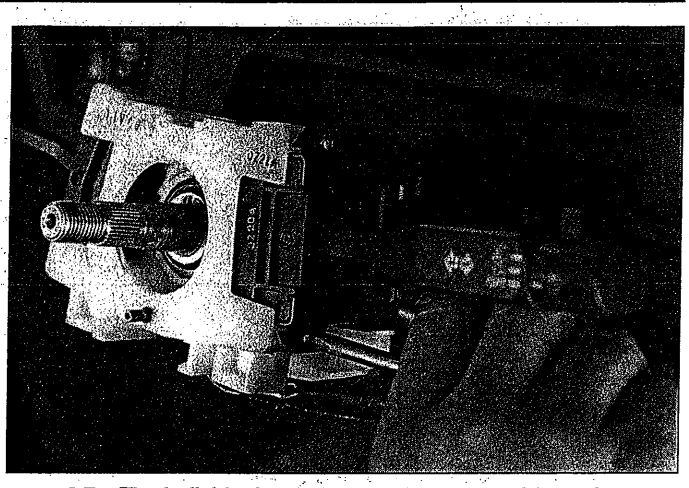
6.1a Two screws secure the cover over the relay box



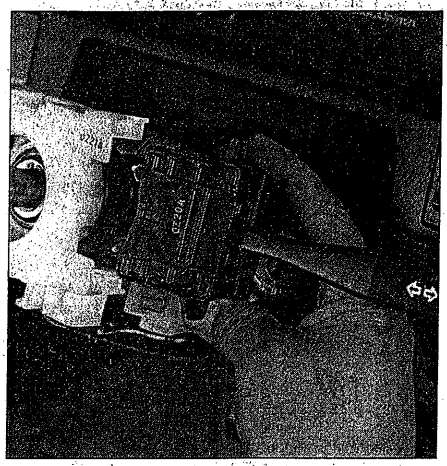
6.1b The relays are clearly labeled. As they operate, they emit a clicking which can be heard and felt



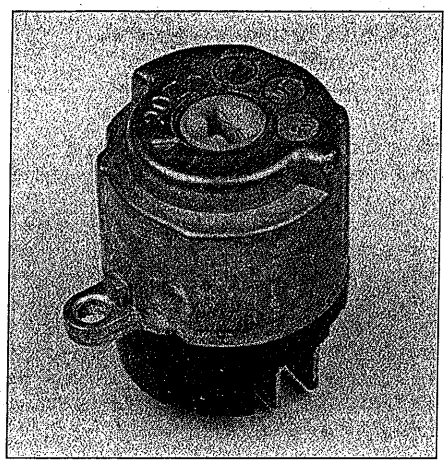
8.4 Disconnect the wiring from the rear of the combination switch before loosening the retaining screw



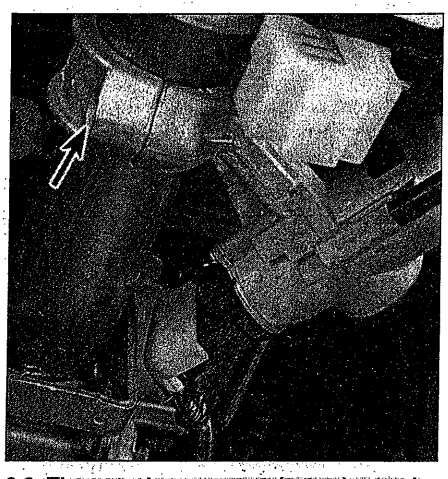
8.7a The individual switches can be removed from the combination switch by removing the mounting screws . . .



8.7b . . . then simply lift the switch off



9.5 The ignition switch is secured by a single screw



9.9 The two shear screws (arrow) must be drilled out in order to remove the entire housing

7 Turn signal and hazard flasher - check and renewal

1 The turn signal/hazard flasher is contained (in most models) in a single small unit located in the wiring harness under the dash to the left of the steering column.

2 When the flasher unit is functioning properly, an audible click can be heard during its operation. If the turn signals fail on one side or the other and the flasher unit does not make its characteristic clicking sound, a faulty turn signal bulb is indicated.

3 If both turn signals fail to blink, the problem may be due to a blown fuse, a faulty flasher unit, a broken switch or a loose or open connection. If a quick check of the fuse box indicates that the turn signal fuse has blown, check the wiring for a short before refitting a new fuse.

4 To renew the flasher, simply pull it out of the socket.

5 Make sure that the new unit is identical to the original. Compare the old one to the new one before refitting it.

6 Refitting is the reverse of removal.

8 Combination switch - removal and refitting

Refer to illustrations 8.4, 8.7a and 8.7b

1 Disconnect the cable from the negative terminal of the battery.

2 Remove the steering wheel (see Chapter 10).

3 Remove the steering column covers (see Chapter 11).

4 Unplug the electrical connectors from the combination switch **(see illustration)**.

5 Remove the retaining screw.

6 Push in on the switch and turn it clockwise. Pull the combination switch from the shaft.

7 Refitting is the reverse of removal. The combination switch must seat correctly with its tab in the hole in the steering column.

Note: *The wiper/washer switch and the light switch can both be removed from the switch base and renewed independently* **(see illustrations)**.

9 Ignition switch and lock cylinder - removal and refitting

Ignition switch

Refer to illustration 9.5

1 Disconnect the cable from the negative terminal of the battery.

2 Remove the lower steering column cover (see Chapter 11).

3 Remove the switch retaining screw.

4 Disconnect the wiring harness from the switch.

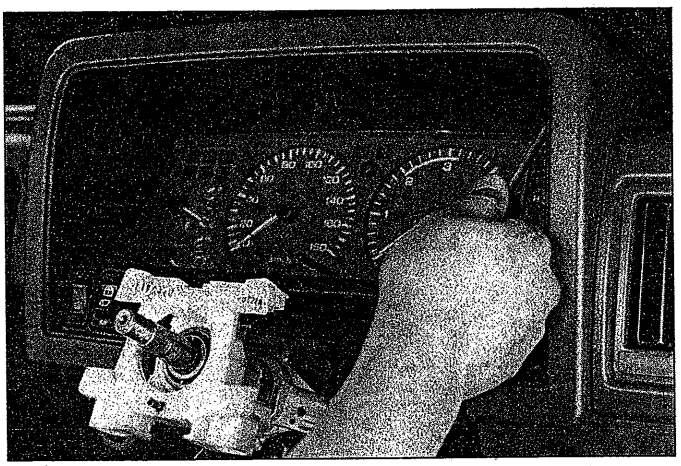
5 Remove the switch **(see illustration)**.

6 Refitting is the reverse of removal.

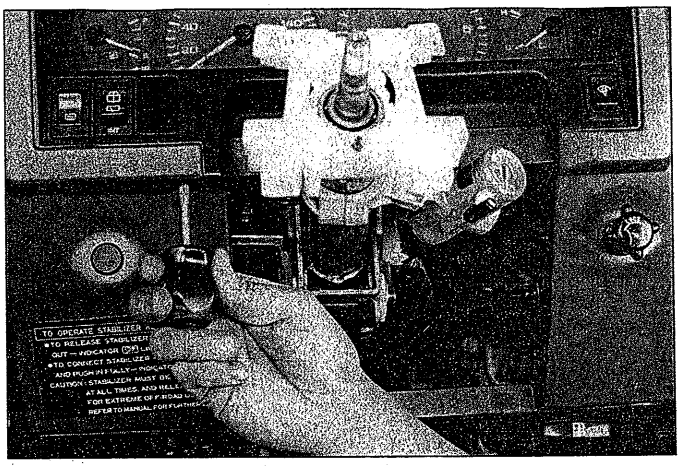
Lock cylinder

Refer to illustration 9.9

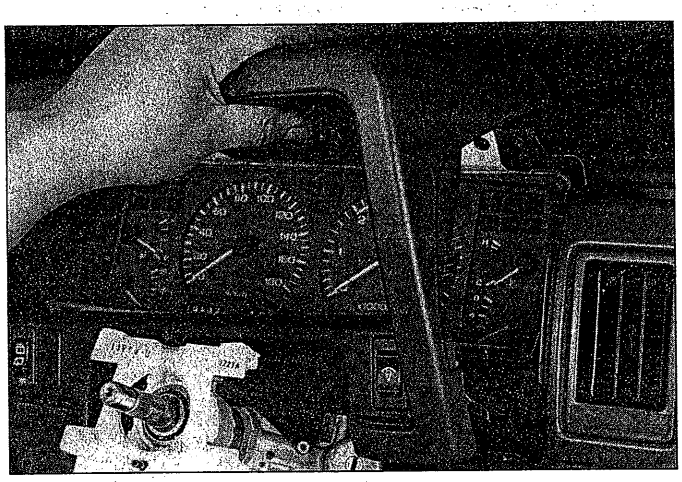
7 Remove the steering column covers (refer to Chapter 11).



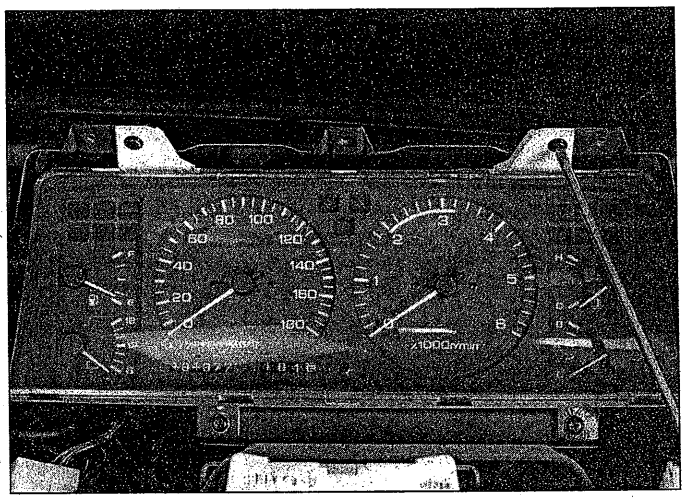
11.2a Remove the instrument cluster bezel upper screws



11.2b The bezel lower screws are removed next



11.3 Pull the bezel off. Some components are removed here for clarity - be careful to avoid scratching the upper steering column cover when it is in place



11.4a There are four cluster screws

8 Using a small nail or punch to depress the lock cylinder retaining pin, pull straight out on the lock cylinder assembly to remove it from the vehicle.

9 To refit the lock cylinder, depress the retaining pin and guide the lock cylinder into the steering column housing until the retaining pin extends back into the locating hole in the steering column housing. **Note:** *The lock cylinder housing is secured to the steering shaft with two shear bolts* **(see illustration).** *These will have to be drilled out if the entire assembly is to be renewed.*

10 The remainder of the refitting is the reverse of removal.

10 Instrument panel gauges - check

Fuel, oil and temperature gauges

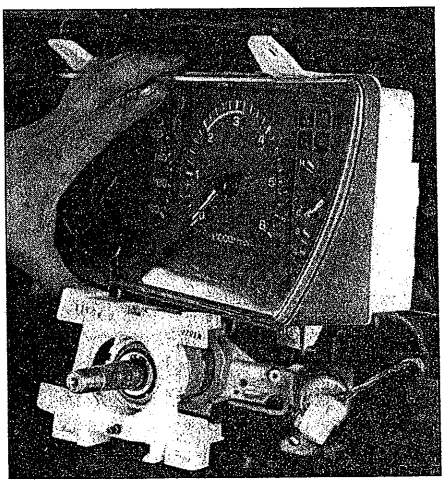
1 All tests below require the ignition switch to be turned to ON position when testing.

2 If the gauge pointer does not move from the empty, low or cold positions, check the fuse. If the fuse is good, locate the particular sending unit for the circuit you're working on (see Chapter 4 for fuel sending unit location, Chapter 2 for the oil sending unit location or Chapter 3 for the temperature sending unit location). Connect the sending unit connector to earth. If the pointer goes to the full, high or hot position renew the sending unit. If the pointer stays in same position, use a jumper wire to earth the sending unit terminal on the back of the gauge, if necessary, refer to the wiring diagrams at the end of this Chapter. If the pointer moves, the problem lies in the wire between the gauge and the sending unit. If the pointer does not move with the sending unit terminal on the back of the gauge earthed, check for voltage at the other terminal of the gauge. If voltage is present, renew the gauge.

11 Instrument cluster - removal and refitting

Refer to illustrations 11.2a, 11.2b, 11.3, 11.4a, 11.4b and 11.5

1 Disconnect the negative battery cable.

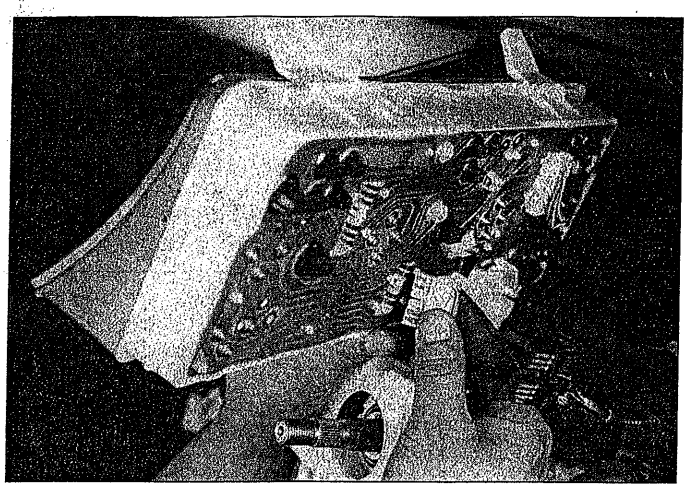


11.4b Lift the cluster out only slightly . . .

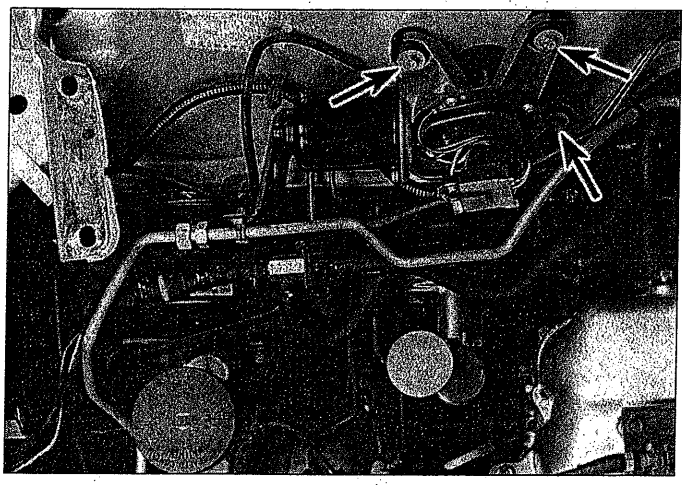
2 Remove the cluster bezel screws **(see illustrations).**

3 Remove the instrument cluster bezel **(see illustration).**

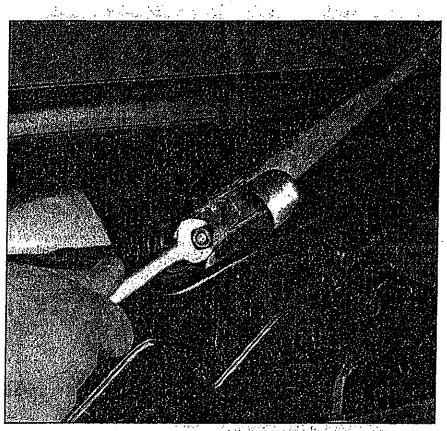
4 Remove the cluster mounting screws **(see illustrations)** and pull the instrument



11.5 . . . and then disconnect the wiring

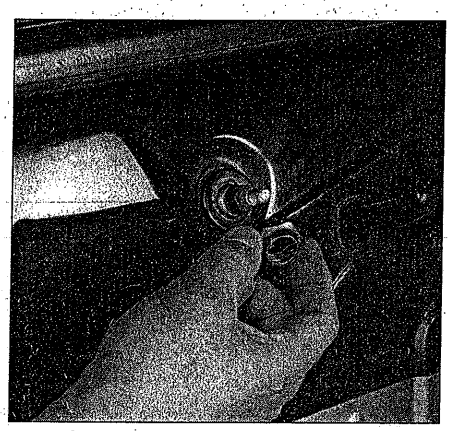


12.10 Remove the mounting bolts (arrows)



12.14a Prise up the cover from the rear wiper arm nut and then remove it

12.14b Unscrew the retaining nut . . .



12.14c . . . remove the nut . . .

cluster towards the steering wheel.

5 Disconnect any electrical connectors that would interfere with removal **(see illustration)**.

6 Cover the steering column with a cloth to protect the trim covers then remove the instrument cluster from the vehicle.

7 Refitting is the reverse of removal.

12 Wiper motor - removal and refitting

Wiper motor circuit check

Note: *Refer to the wiring diagrams for wire colours and locations in the following checks. Keep in mind that power wires are generally larger in diameter and brighter colours, where earth wires are usually smaller in diameter and darker colours. When checking for voltage, probe an earthed 12-volt test light to each terminal at a connector until it lights; this verifies voltage (power) at the terminal.*

1 If the wipers work slowly, make sure the battery is in good condition and has a strong charge (see Chapter 1). If the battery is in good condition, remove the wiper motor (see below) and operate the wiper arms by hand. Check for binding linkage and pivots. Lubricate or repair the linkage or pivots as necessary. Refit the wiper motor. If the wipers still operate slowly, check for loose or corroded connections, especially the earth connection. If all connections look correct, renew the motor.

2 If the wipers fail to operate when activated, check the fuse. If the fuse is good, connect a jumper wire between the wiper motor and earth, then retest. If the motor works now, repair the earth connection. If the motor still doesn't work, turn on the wipers and check for voltage at the motor. If there's no voltage at the motor, remove the motor and check it off the vehicle with fused jumper wires from the battery. If the motor now works, check for binding linkage (see Step 1 above). If the motor still doesn't work, renew it. If there's no voltage at the motor, check for voltage at the switch. If there's no voltage at the switch, check the wiring between the switch and fuse panel for continuity. If the wiring is good, the switch is probably bad.

3 **If the wipers only work on one speed,** check the continuity of the wires between the switch and motor. If the wires are good, renew the switch.

4 **If the interval (delay) function is inoperative,** check the continuity of all the wiring between the switch and motor. If the wiring is good, renew the interval module.

5 **If the wipers stop at the position they're in when the switch is turned off (fail to park),** check for voltage at the wiper motor when the wiper switch is OFF but the ignition is ON. If voltage is present, the limit switch in the motor is malfunctioning. Renew the wiper motor. If no voltage is present, trace and repair the limit switch wiring between the fuse panel and wiper motor.

6 **If the wipers won't shut off unless the ignition is OFF,** disconnect the wiring from the wiper control switch. If the wipers stop, renew the switch. If the wipers keep running, there's a defective limit switch in the motor; renew the motor.

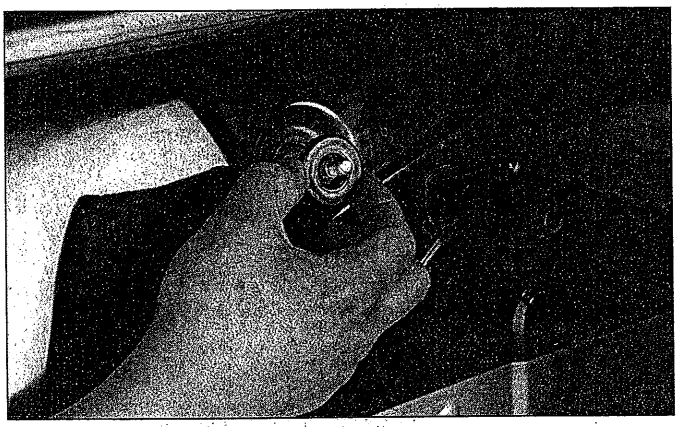
7 **If the wipers won't retract below the bonnet line,** check for mechanical obstructions in the wiper linkage or on the vehicle's body which would prevent the wipers from parking. If there are no obstructions, check the wiring between the switch and motor for continuity. If the wiring is good, renew the wiper motor.

Wiper motor renewal

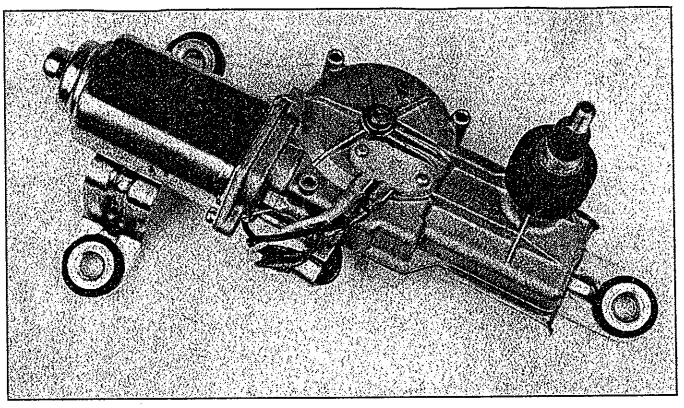
Front

Refer to illustration 12.10

8 Disconnect the negative battery cable.



12.14d . . . and lift off the washer



12.17 The rear wiper motor with the harness disconnected. Do not disconnect the wires shown

9 Disconnect the wiring from the motor.
10 Remove the mounting bolts and pull the motor out slightly **(see illustration)**.
11 Disconnect the wiper transmission from the motor. Remove the motor.
12 Refitting is the reverse of removal.

Rear

Refer to illustrations 12.14a, 12.14b, 12.14c, 12.14d and 12.17

13 Disconnect the negative battery cable.
14 Remove the wiper arm (refer to Chapter 1). It may be necessary to first remove the spare tyre. Remove the nut and bezel from the wiper shaft **(see illustrations)**.
15 Remove the inner door panel (refer to Chapter 11).
16 Disconnect the wiring from the motor.
17 Unbolt the motor and remove it **(see illustration)**.
18 Refitting is the reverse of removal.

13 Radio and speakers - removal and refitting

1 Disconnect the negative battery cable.

Radio

2 Remove the centre dash bezel (refer to Chapter 11).
3 Remove the screws and pull the radio out far enough to access the rear of it.
4 Disconnect the aerial and the wiring harness from the rear of the radio, then remove the radio.
5 Refitting is the reverse of removal.

Speakers

Refer to illustration 13.7

6 Remove the door trim panel (see Chapter 11).
7 Remove the speaker retaining screws. Disconnect the electrical connector and remove the speaker from the vehicle **(see illustration)**.
8 Refitting is the reverse of removal.

14 Aerial - removal and refitting

1 Detach the radio and disconnect the aerial lead from the rear side of the radio (see Section 13). Attach a piece of stiff wire to the end of the aerial lead, then remove any retaining clips under the instrument panel securing the aerial lead.
2 On vehicles equipped with fixed type antennas, use a small spanner and remove the aerial mast retaining nut.
3 Using a pair of snap ring pliers or similar tool, remove the aerial base retaining nut.
4 On vehicles equipped with a power aerial, remove the aerial motor mounting screws from the inner fender well.
5 Pull the aerial up and out to remove it until you can see the wire. then remove the old aerial lead from the wire and renew it with the new aerial lead.
6 Working in the passenger compartment, pull the wire and the aerial lead rearward into the passenger compartment.
7 The remainder of refitting is the reverse of removal.

15 Rear window defogger - check and repair

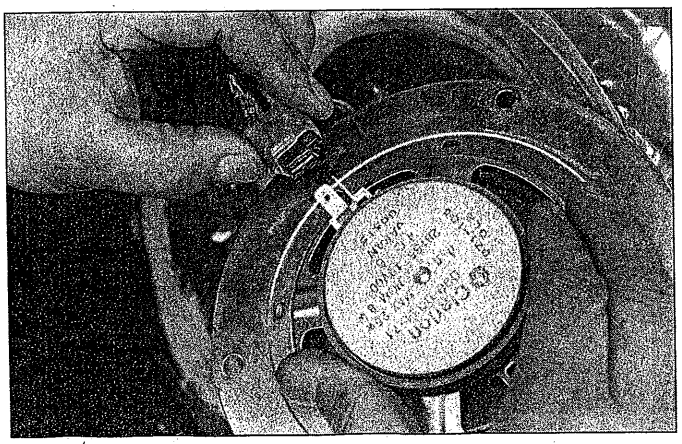
Refer to illustration 15.1

1 The rear window defogger consists of a number of horizontal elements laminated onto the glass surface **(see illustration)**.
2 Small breaks in the element can be repaired without removing the rear window.

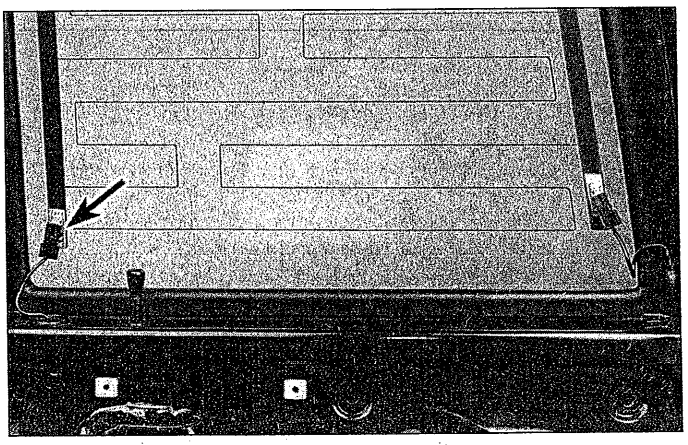
Check

Refer to illustrations 15.4, 15.5 and 15.7

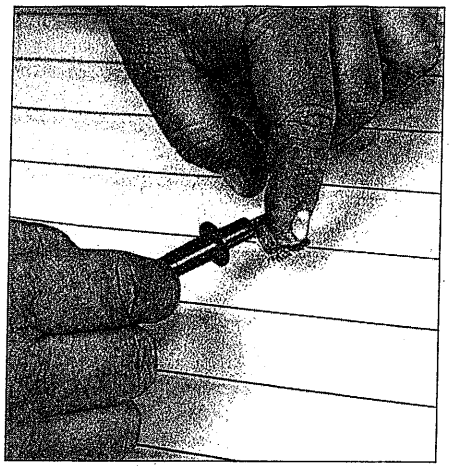
3 Turn the ignition switch and defogger system switches to the ON position.



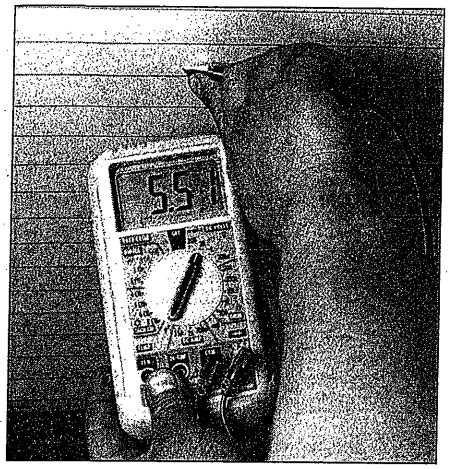
13.7 Disconnect the speaker wiring after removing it from the door frame



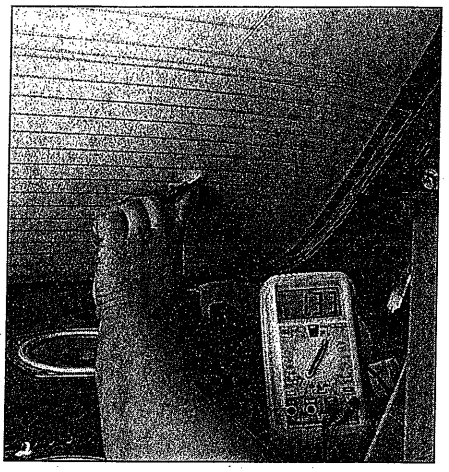
15.1 The defogger circuit consists of a 12 volt input (arrow) and an earth at the other end of the grid



15.4 When measuring the voltage at the rear window defroster grid, wrap a piece of aluminium foil around he negative probe and press the foil against the wire with your finger



15.5 To determine if a heating element has broken, check the voltage at the centre of each element - if the voltage is 6-volts, the element is unbroken - if the voltage is 12-volts, the element is broken between the centre and the positive end - if there is no voltage, the element is broken between the centre and the earth



15.7 To find the break, place the voltmeter positive probe against the defogger positive terminal, place the voltmeter negative probe with the foil strip against the heating element at the positive terminal and slide it toward the negative terminal - the point at which the voltmeter reading changes abruptly is the point at which the element is broken

4 When measuring voltage during the next two tests, wrap a piece of aluminium foil around the tip of the voltmeter negative probe and press the foil against the heating element with your finger **(see illustration)**.

5 Check the voltage at the centre of each heating element **(see illustration)**. If the voltage is 6-volts, the element is okay (there is no break). If the voltage is 12-volts, the element is broken between the centre of the element and the positive end. If the voltage is 0-volts the element is broken between the centre of the element and earth.

6 Connect the negative lead to a good earthing point. The reading should stay the same.

7 To find the break, place the voltmeter positive lead against the defogger positive terminal. Place the voltmeter negative lead with the foil strip against the heating element at the positive terminal end and slide it toward the negative terminal end. The point at which the voltmeter deflects from zero to several volts is the point at which the heating element is broken **(see illustration)**.

Repair

Refer to illustration 15.13

8 Repair the break in the element using a repair kit specifically recommended for this purpose, such as Dupont paste No. 4817 (or equivalent). Included in this kit is plastic conductive epoxy.

9 Prior to repairing a break, turn off the system and allow it to cool off for a few minutes.

10 Lightly buff the element area with fine steel wool, then clean it thoroughly with isopropyl alcohol.

11 Use masking tape to mask off the area being repaired.

12 Thoroughly mix the epoxy, following the instructions provided with the repair kit.

13 Apply the epoxy material to the slit in the masking tape, overlapping the undamaged area about 20 mm on each end **(see illustration)**.

14 Allow the repair to cure for 24 hours before removing the tape and using the system.

16 Headlights - removal and refitting

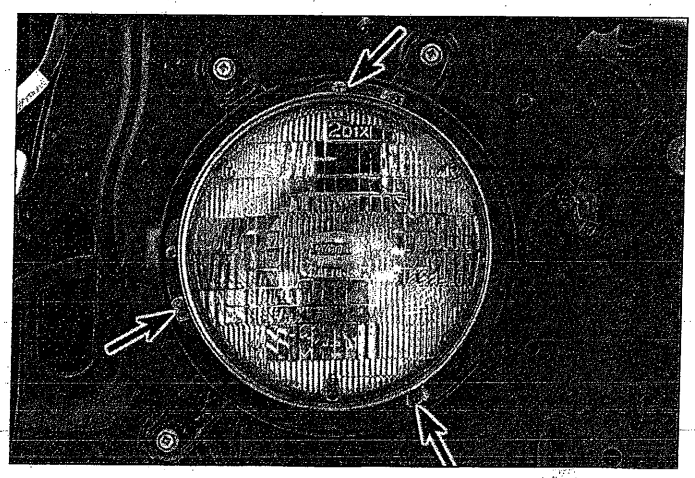
1 Disconnect the negative cable from the battery.

Sealed beam type

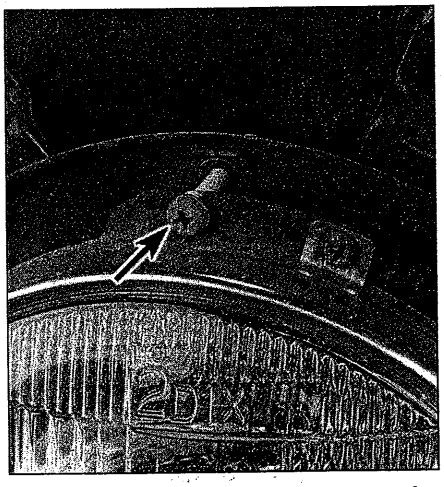
Refer to illustration 16.4

2 Remove the grille/headlight trim bezel on utility and cab chassis models (refer to Chapter 11).

15.13 To use a defogger repair kit, apply masking tape to the inside of the window at the damaged area, then brush on the special conductive coating



16.4 These are the three screws which retain the headlight. The other screws should not be touched



17.1 There are two adjustment screws for each headlight. This (arrow) is an upper one for the vertical adjustment

3 Whenever renewing a headlight, be careful not to turn the spring-loaded adjusting screws of the headlight, as this will alter the aim.

4 Remove the screws which secure the retaining ring and withdraw the ring. Support the light as this is done **(see illustration)**.

5 Pull the headlight out slightly and disconnect the electrical connector from the rear of the light. Remove the light from the vehicle.

6 Position the new unit close enough to connect the electrical connector. Make sure that the numbers moulded into the lens are at the top.

7 Refit the retaining ring with its mounting screws and spring.

8 Check the headlights for proper operation and adjustment. If the adjusting screws were not altered, the new headlight will not need to have its aim adjusted.

9 Refit the radiator grille if necessary.

Halogen bulb-type

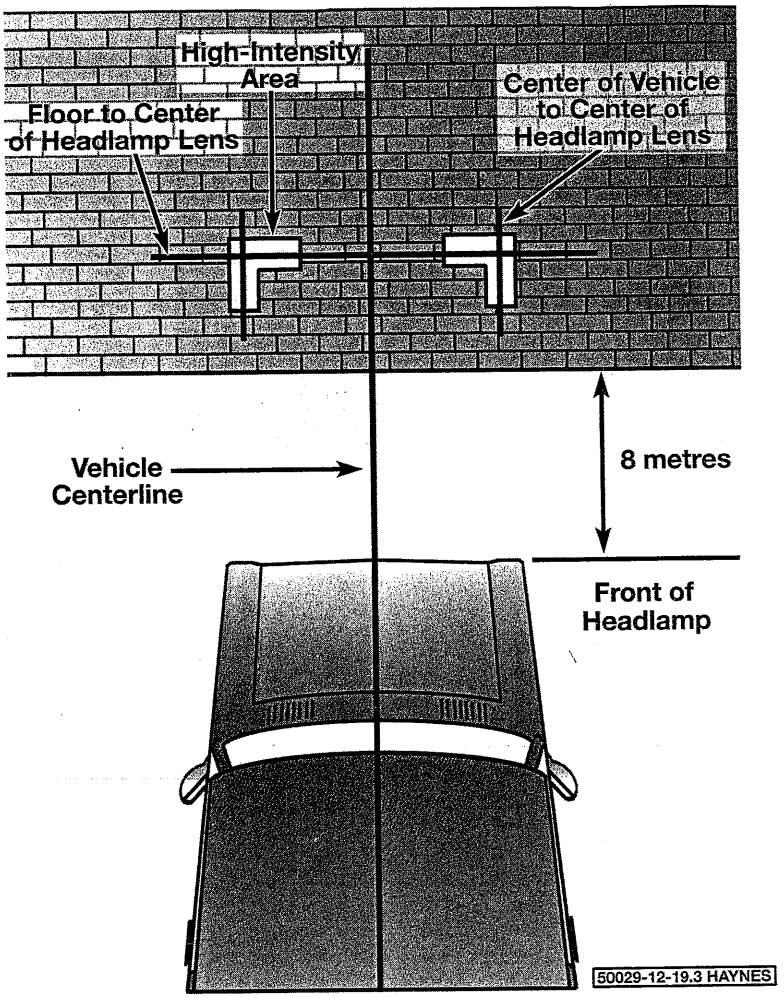
Warning: *Halogen gas filled bulbs are under pressure and may shatter if the surface is scratched or the bulb is dropped. Wear eye protection and handle the bulbs carefully, grasping only the base whenever possible. Do not touch the surface of the bulb with your fingers because the oil from your skin could cause it to overheat and fail prematurely. If you do touch the bulb surface, clean it with isopropyl alcohol.*

10 Reach behind the headlight assembly and unplug the electrical connector.

11 Grasp the bulb holder securely and rotate it counterclockwise to remove it from the housing.

12 Remove the rubber cover from the rear of the headlight.

13 Turn the bulb counter-clockwise to remove it from the bulb holder. Without touching the glass with your bare fingers, insert the new bulb assembly into the headlight housing.



17.3 Headlight adjustment details

14 Plug in the electrical connector. Test headlight operation, then close the bonnet.

17 Headlights - adjustment

Refer to illustrations 17.1 and 17.3

Note: *The headlights must be aimed correctly. If adjusted incorrectly they could blind the driver of an oncoming vehicle and cause a serious accident or seriously reduce your ability to see the road. The headlights should be checked for proper aim every 12 months and any time a new headlight is refitted or front end body work is performed. It should be emphasised that the following procedure is only an interim step which will provide temporary adjustment until the headlights can be adjusted by a properly equipped shop.*

1 All headlights have two spring loaded adjusting screws, one on the top or bottom controlling up-and-down movement and one on the side controlling left-and-right movement **(see illustration)**.

2 There are several methods of adjusting the headlights. The simplest method requires a blank wall 8 meters in front of the vehicle and a level floor.

3 Position masking tape vertically on the wall in reference to the vehicle centre line and the centre lines of both headlights **(see illustration)**.

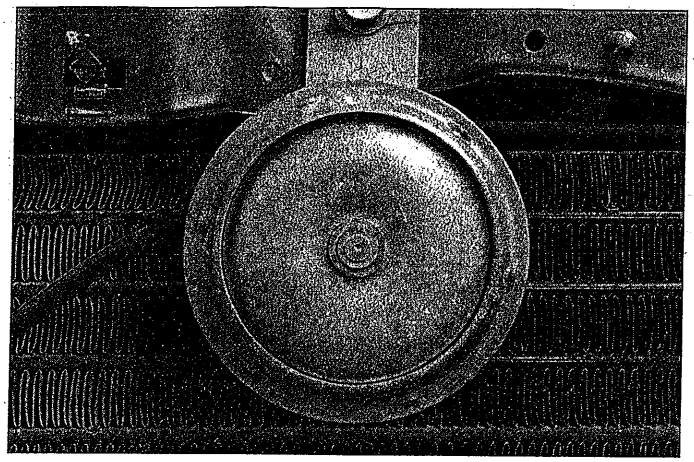
4 Position a horizontal tape line in reference to the centre line of all the headlights.

Note: *It may be easier to position the tape on the wall with the vehicle parked close to the wall.*

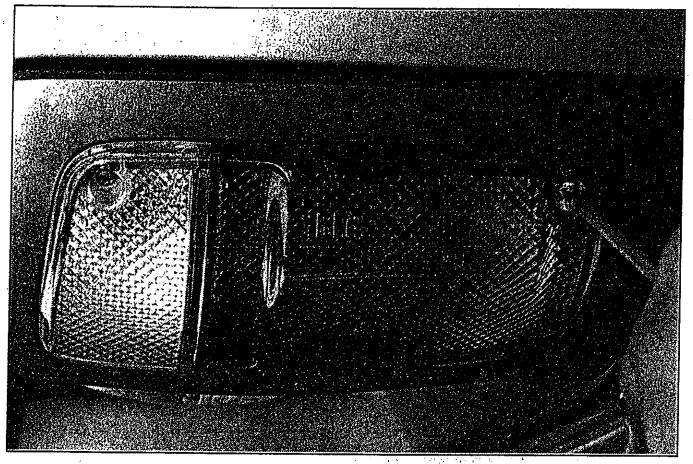
5 Adjustment should be made with the vehicle sitting level, the fuel tank half-full and no unusually heavy load in the vehicle.

6 Starting with the low beam adjustment, position the high intensity zone so it is 5 centimetres below the horizontal line and 5 centimetres to the side of the headlight vertical line away from oncoming traffic. Adjustment is made by turning the top or bottom adjusting screw to raise or lower the beam. The adjusting screw on the side should be used in the same manner to move the beam left or right.

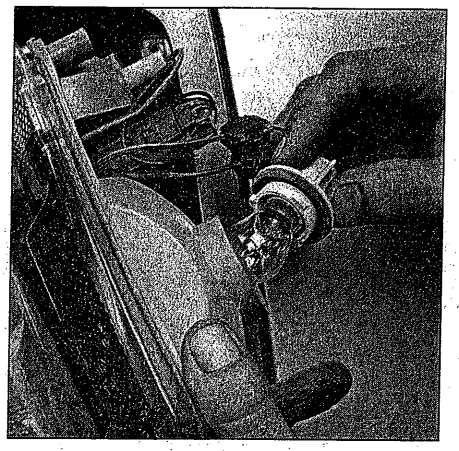
7 With the high beams on, the high intensity zone should be vertically centred with the



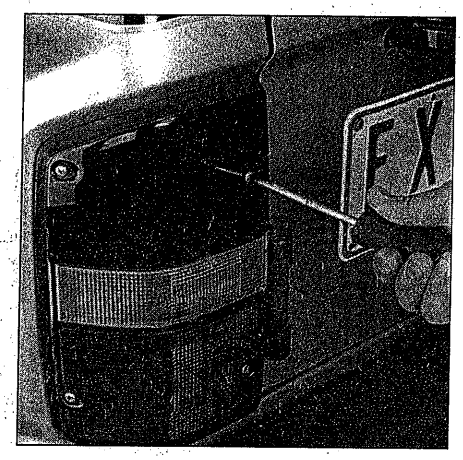
18.9 The horn is secured by a single bolt. It is easiest to remove the horn if the grille is removed completely



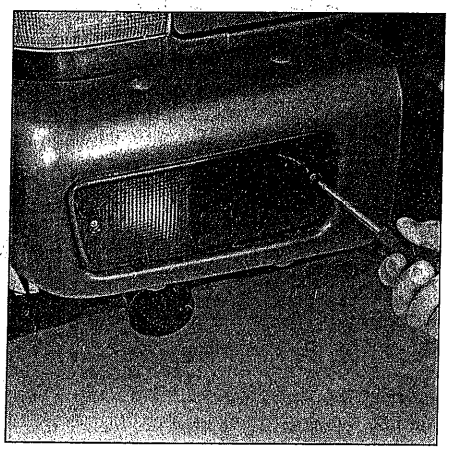
19.1 Most exterior lights are serviced like this turn signal assembly - remove the Phillips head screws and pull it out



19.2 The bulb holder can be removed by turning it counter-clockwise



19.8a Both styles of rear lights are removed with a Phillips screwdriver . . .



19.8b . . . some units are located in the bumper

exact centre just below the horizontal line.
Note: *It may not be possible to position the headlight aim exactly for both high and low beams. If a compromise must be made, keep in mind that the low beams are the most used and have the greatest effect on driver safety.*
8 Have the headlights adjusted by a dealer service department or service station at the earliest opportunity.

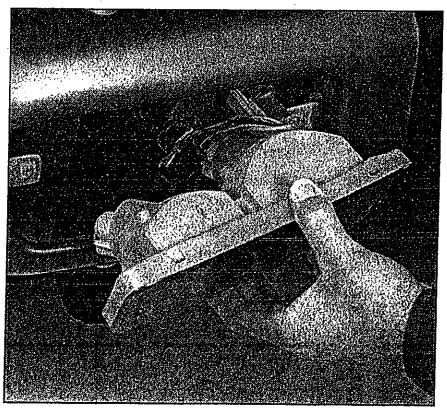
18 Horn - check and renewal

Check

Note: *Check the fuses before beginning electrical diagnosis.*
1 Remove the grille, if necessary and disconnect the electrical connector from the horn.
2 To test the horn, connect battery voltage to the two terminals (or to the terminal and earth) with a pair of jumper wires. If the horn doesn't sound, renew it.
3 If the horn does sound, check for voltage at the terminal when the horn button is depressed. If there's voltage at the terminal, check for a bad earthing point at the horn.
4 If there's no voltage at the horn, check the relay (see Section 6). Note that most horn relays are either the four-terminal or externally earthed three-terminal type.
5 If the relay is good, check for voltage to the relay power and control circuits. If either of the circuits is not receiving voltage, inspect the wiring between the relay and the fuse panel.
6 If both relay circuits are receiving voltage, depress the horn button and check the circuit from the relay to the horn button for continuity to earth. If there's no continuity, check the circuit for an open. If there's no open circuit, renew the horn button.
7 If there's continuity to earth through the horn button, check for an open or short in the circuit from the relay to the horn.

Renewal

Refer to illustration 18.9
8 Remove the radiator grille (see Chapter 11).
9 To renew the horn(s), disconnect the electrical connector and remove the bracket bolt **(see illustration)**.
10 Refitting is the reverse of removal.



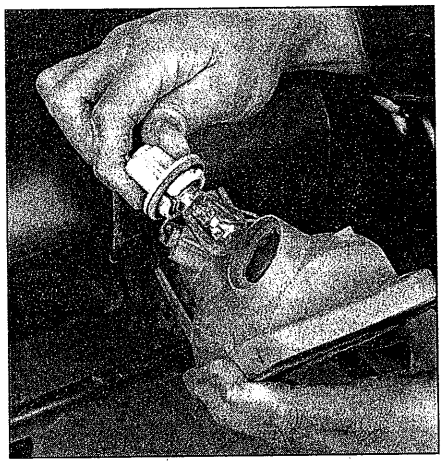
19.8c Pull the assembly out . . .

19 Bulb renewal

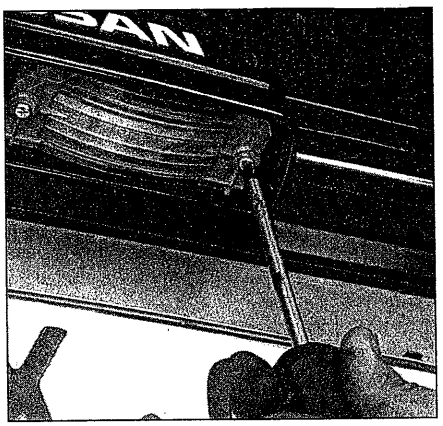
Front combination or turn signal light

Hardtop and wagon models

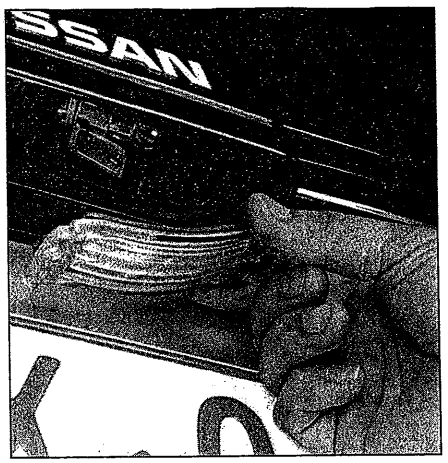
Refer to illustrations 19.1 and 19.2
1 Remove the light assembly **(see illustration)**.



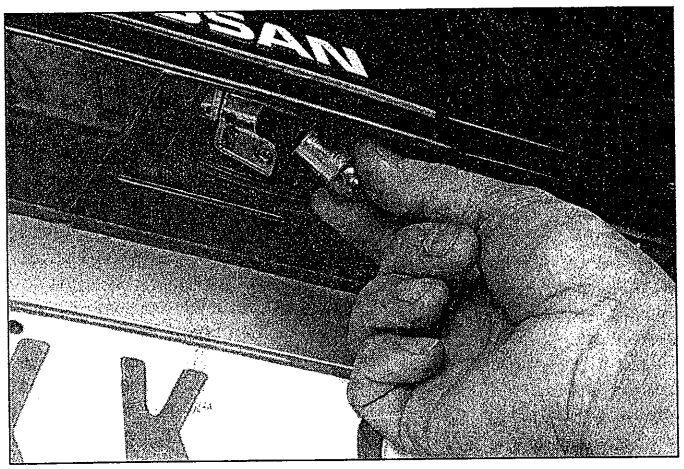
19.9 . . . then remove the bulb holder



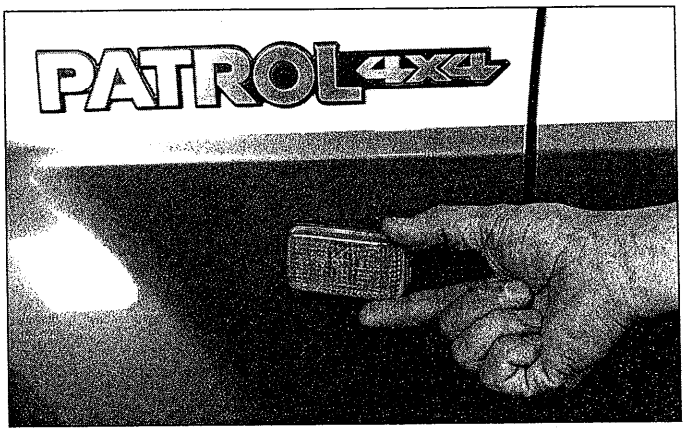
19.15a The number plate light should be checked periodically to avoid a citation. If it is defective, remove the screws . . .



19.15b . . . then prise off the lens



19.16 The bulb is then accessible



19.18 A typical side marker light can be pried off with a screwdriver. A card slipped between the blade and the paint is a good idea

2 Turn the bulb holder one quarter turn counter-clockwise and remove it from the rear of the light **(see illustration)**.
3 For parking light bulbs pull the bulb from the socket. For turn signal bulbs, push the bulb inward and turn it counter-clockwise to remove it.
4 Refitting is the reverse of removal.

Early utility and cab chassis models

5 Remove the lens and gasket from the light.
6 Push the bulb inward and turn it counter-clockwise to remove it from the socket.
7 Clean the socket if necessary. Refitting is the reverse of removal.

Rear combination or turn signal light

Hardtop and wagon models

Refer to illustrations 19.8a, 19.8b, 19.8c and 19.9

8 Remove the light from the rear of the vehicle **(see illustrations)**.
9 Turn the bulb holder one quarter turn counter-clockwise and remove it from the rear of the light. **(see illustration)**.
10 Push the bulb inward and turn it counter-clockwise to remove it.
11 Refitting is the reverse of removal.

Utility and cab chassis models

12 Remove the lens and gasket from the light.
13 Push the bulb inward and turn it counter-clockwise to remove it from the socket.
14 Clean the socket if necessary. Refitting is the reverse of removal.

Number plate light

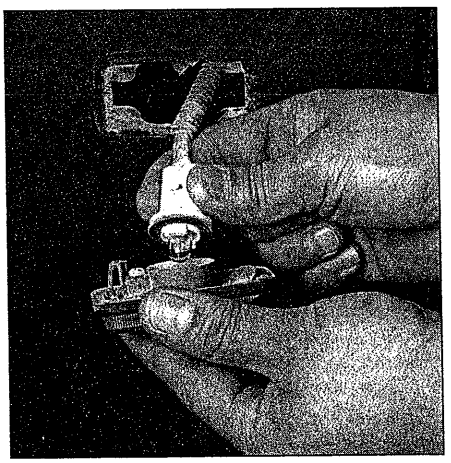
Refer to illustrations 19.15A, 19.15b and 19.16

15 Remove the screws and detach the lens and gasket **(see illustrations)**.
16 Remove the bulb from the socket by pushing inwards and turning it counter-clockwise **(see illustration)**.
17 Refitting is the reverse of removal.

Side marker light

Refer to illustrations 19.18 and 19.19

18 Remove the side marker light from the vehicle **(see illustration)**.
19 Turn the bulb holder one quarter turn counter-clockwise and remove it from the light **(see illustration)**.
20 Push the bulb inward and turn it counter-clockwise to remove it.
21 Refitting is the reverse of removal.

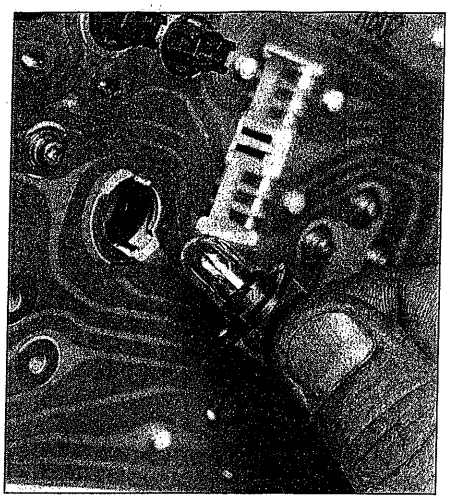


19.19 Twist the bulb holder to get at the bulb inside

Instrument cluster lights

Refer to illustration 19.23

22 To gain access to the instrument cluster



19.23 Each bulb holder in the rear of the instrument panel can be twisted and then removed

illumination bulbs, the instrument cluster will have to be removed (see Section 11). The bulbs can then be renewed from the rear of the cluster.

23 Rotate the holders counterclockwise to remove them **(see illustration)**. Pull the bulbs out.

24 Refitting is the reverse of removal.

Interior light

Hardtop and wagon models

25 Prise the interior lens off the interior light housing.

26 Pull the bulb directly out of the socket.

27 Refitting is the reverse of removal.

Utility and cab chassis models

28 Rotate the round lens (if used) counterclockwise to remove it.

29 Use a screwdriver to carefully prise off the square lens (if used).

30 Pull the bulb directly out. If it is difficult to remove, prise downward on one end with a small screwdriver. Do not prise on the glass.

31 Refitting is the reverse of removal.

Map light

32 Use a small screwdriver to carefully prise the lens from the lamp.

33 Remove the bulb by pushing it inward while turning it counter-clockwise.

34 Refitting is the reverse of removal.

20 Electric side view mirrors - description and check

1 Most electric rear view mirrors use two motors to move the glass; one for up and down adjustments and one for left-right adjustments.

2 The control switch has a selector portion which sends voltage to the left or right side mirror. With the ignition ON but the engine OFF, roll down the windows and operate the mirror control switch through all functions (left-right and up-down) for both the left and right side mirrors.

3 Listen carefully for the sound of the electric motors running in the mirrors.

4 If the motors can be heard but the mirror glass doesn't move, there's probably a problem with the drive mechanism inside the mirror. Remove and disassemble the mirror to locate the problem.

5 If the mirrors don't operate and no sound comes from the mirrors, check the fuse (see Chapter 1).

6 If the fuse is good, remove the mirror control switch from its mounting without disconnecting the wires attached to it. Turn the ignition ON and check for voltage at the switch. There should be voltage at one terminal. If there's no voltage at the switch, check for an open or short in the circuit between the fuse panel and the switch.

7 If there's voltage at the switch, disconnect it. Check the switch for continuity in all its operating positions. If the switch does not have continuity, renew it.

8 Re-connect the switch. Locate the wire going from the switch to earth. Leaving the switch connected, connect a jumper wire between this wire and earth. If the mirror works normally with this wire in place, repair the faulty earth connection.

9 If the mirror still doesn't work, remove the mirror and check the wires at the mirror for voltage. Check with ignition ON and the mirror selector switch on the appropriate side. Operate the mirror switch in all its positions. There should be voltage at one of the switch-to-mirror wires in each switch position (except the neutral "off" position).

10 If there's not voltage in each switch position, check the circuit between the mirror and control switch for opens and shorts.

11 If there's voltage, remove the mirror and test it off the vehicle with jumper wires. Renew the mirror if it fails this test.

21 Cruise control system - description and check

1 The cruise control system maintains vehicle speed with an electrically operated motor located in the engine compartment, which is connected to the accelerator pedal by a cable. The system consists of the cruise control unit, brake switch, control switches and vehicle speed sensor. Some features of the system require special testers and diagnostic procedures which are beyond the scope of this manual. Listed below are some general procedures that may be used to locate common problems.

2 Locate and check the fuse (Section 3).

3 Have an assistant operate the brake lights while you check their operation (voltage from the brake light switch deactivates the cruise control).

4 If the brake lights don't come on or don't shut off, correct the problem and retest the cruise control.

5 Visually inspect the control cable between cruise control motor and the throttle linkage for free movement, renew if necessary.

6 The cruise control system uses a speed sensing device. The speed sensor is located in the speedometer. To test the speed sensor see Chapter 6.

7 Test drive the vehicle to determine if the cruise control is now working. If it isn't, take it to a dealer service department or an automotive electrical specialist for further diagnosis.

22 Power window system - description and check

1 The power window system operates electric motors, mounted in the doors, which lower and raise the windows. The system consists of the control switches, relays, the motors, regulators, glass mechanisms and associated wiring.

2 The power windows can be lowered and raised from the master control switch by the driver or by remote switches located at the individual windows. Each window has a separate motor which is reversible. The position of the control switch determines the polarity and therefore the direction of operation.

3 The circuit is protected by a fuse and a circuit breaker. Each motor is also equipped with an internal circuit breaker, this prevents one stuck window from disabling the whole system.

4 The power window system will only operate when the ignition switch is ON. In addition, many models have a window lockout switch at the master control switch which, when activated, disables the switches at the rear windows and, sometimes, the switch at the passenger's window also. Always check these items before troubleshooting a window problem.

5 These procedures are general in nature, so if you can't find the problem using them, take the vehicle to a dealer service department or other properly equipped repair facility.

6 If the power windows won't operate, always check the fuse first.

7 If only the rear windows are inoperative, or if the windows only operate from the master control switch, check the rear window lockout switch for continuity in the unlocked position. Renew it if it doesn't have continuity.

8 Check the wiring between the switches and fuse panel for continuity. Repair the wiring, if necessary.

9 If only one window is inoperative from the master control switch, try the other control switch at the window. **Note:** *This doesn't apply to the driver's door window.*

10 If the same window works from one switch, but not the other, check the switch

for continuity. If the continuity is not as specified renew the switch.

11 If the switch tests valid, check for a short or open in the circuit between the affected switch and the window motor.

12 If one window is inoperative from both switches, remove the trim panel from the affected door and check for voltage at the switch and at the motor while the switch is operated.

13 If voltage is reaching the motor, disconnect the glass from the regulator (see Chapter 11). Move the window up and down by hand while checking for binding and damage. Also check for binding and damage to the regulator. If the regulator is not damaged and the window moves up and down smoothly, renew the motor. If there's binding or damage, lubricate, repair or renew parts, as necessary.

14 If voltage isn't reaching the motor, check the wiring in the circuit for continuity between the switches and motors. You'll need to consult the wiring diagram for the vehicle. If the circuit is equipped with a relay, check that the relay is earthed properly and receiving voltage.

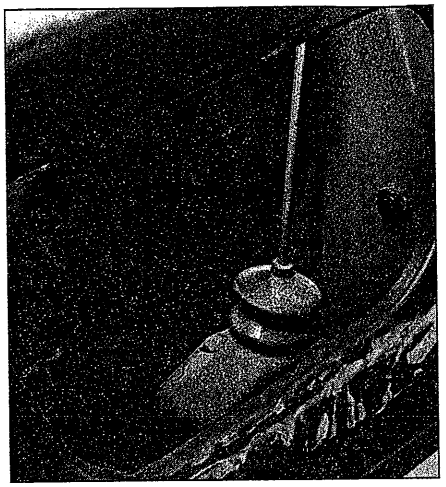
15 Test the windows after you are done to confirm proper repairs.

23 Power door lock system - description and check

Refer to illustration 23.2

The power door lock system operates the door lock actuators mounted in each door. The system consists of the switches, actuators, a control unit and associated wiring. Diagnosis can usually be limited to simple checks of the wiring connections and actuators for minor faults which can be easily repaired. In-depth diagnosis should be left to a dealership service department.

Power door lock systems are operated



23.2 The door lock solenoid is at the base of the door

by bi-directional solenoids located in the doors **(see illustration)**. The lock switches have two operating positions: Lock and Unlock. When activated, the switch sends an earth signal to the door lock control unit to lock or unlock the doors. Depending on which way the switch is activated, the control unit reverses polarity to the solenoids, allowing the two sides of the circuit to be used alternately as the feed (positive) and earth side.

Some vehicles may have an anti-theft systems incorporated into the power locks. If you are unable to locate the trouble using the following general Steps, consult your a dealer service department.

1 Always check the circuit protection first. Some vehicles use a combination of circuit breakers and fuses.

2 Operate the door lock switches in both directions (Lock and Unlock) with the engine off. Listen for the click of the solenoids operating.

3 Test the switches for continuity. Renew the switch if there's not continuity in both switch positions.

4 Check the wiring between the switches, control unit and solenoids for continuity. Repair the wiring if there's no continuity.

5 Check for a bad earth at the switches or the control unit.

6 If all but one lock solenoids operate, remove the trim panel from the affected door (see Chapter 11) and check for voltage at the solenoid while the lock switch is operated One of the wires should have voltage in the Lock position; the other should have voltage in the Unlock position.

7 If the inoperative solenoid is receiving voltage, renew the solenoid.

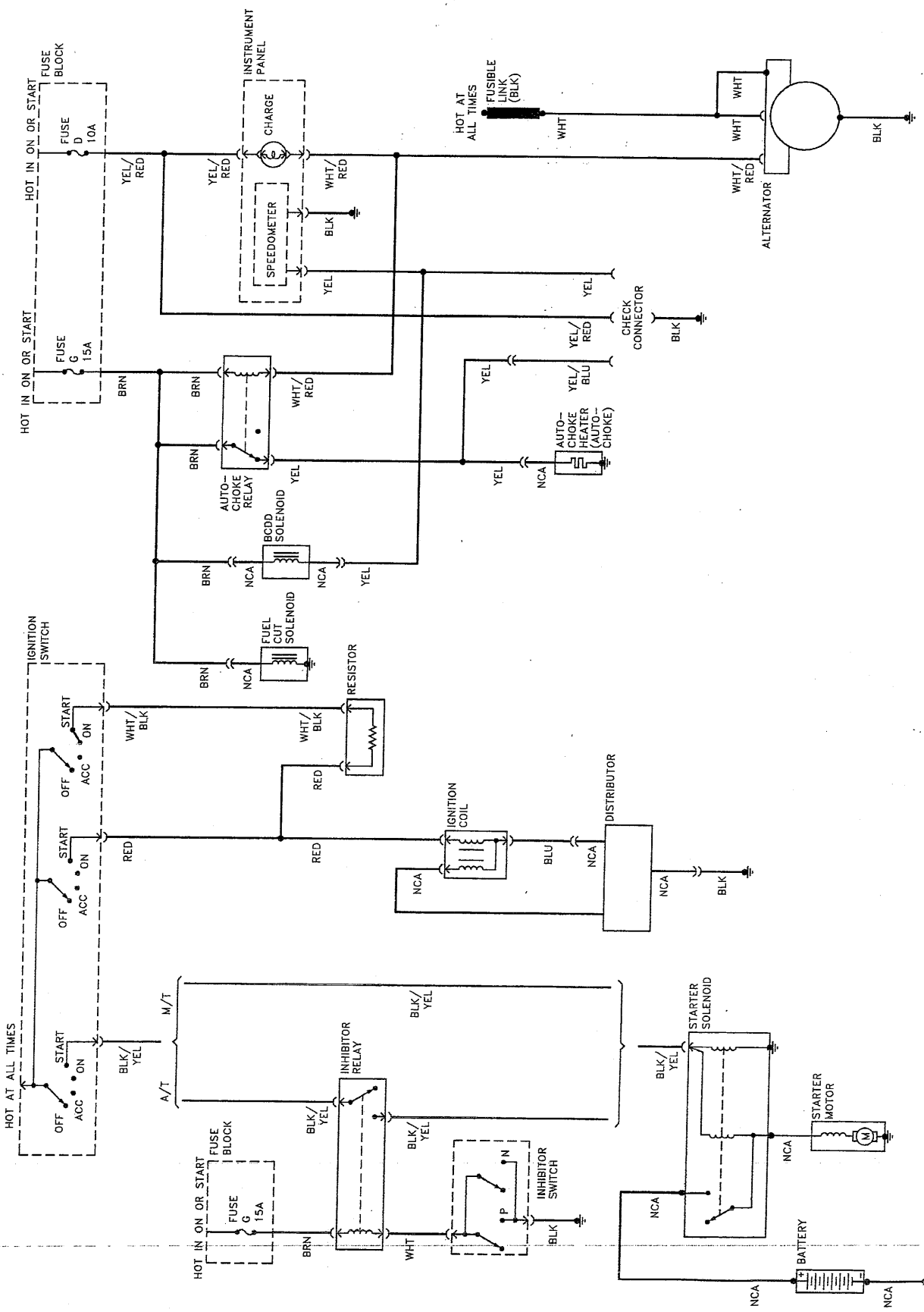
8 If the inoperative solenoid isn't receiving voltage, check the relay or for an open or short in the wire between the lock solenoid and the control unit. **Note:** *It's common for wires to break in the portion of the harness between the body and door (opening and closing the door fatigues and eventually breaks the wires).*

24 Wiring diagrams - general information

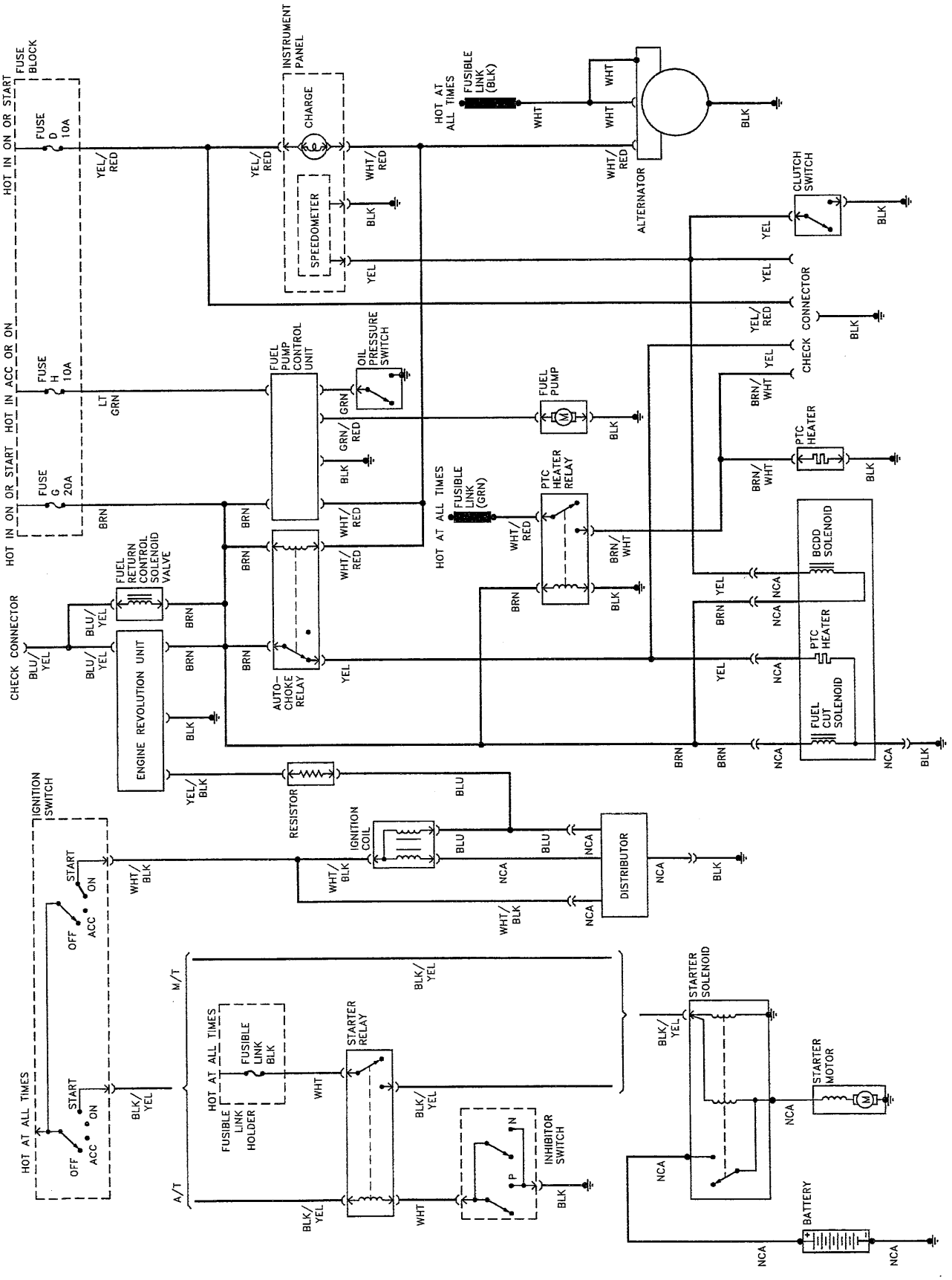
Since it isn't possible to include all wiring diagrams for every year covered by this manual, the following diagrams are those that are typical and most commonly needed.

Prior to troubleshooting any circuits, check the fuse and circuit breakers (if equipped) to make sure they're in good condition. Make sure the battery is properly charged and check the cable connections (see Chapter 1).

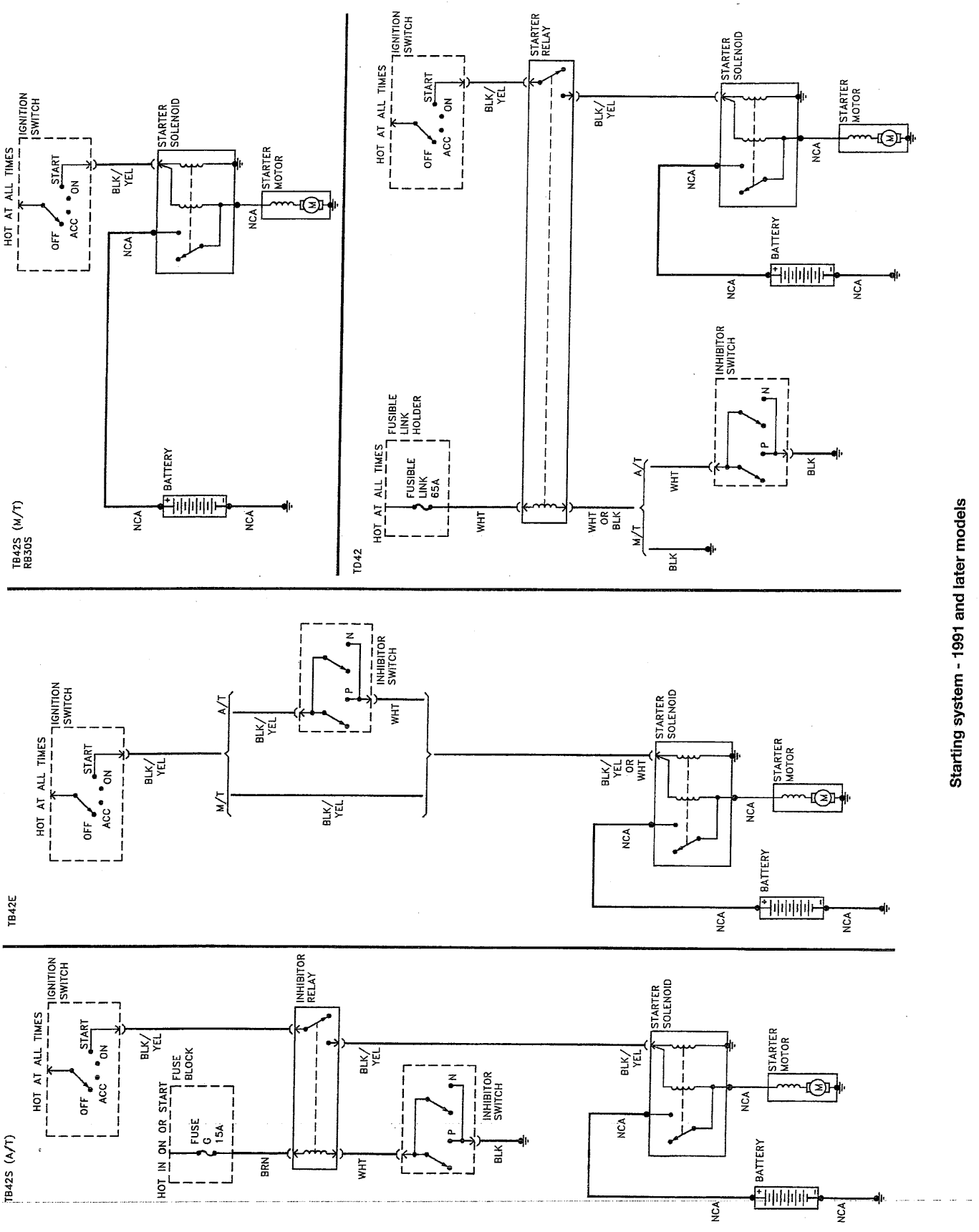
When checking a circuit, make sure that all connectors are clean, with no broken or loose terminals. When unplugging a connector, do not pull on the wires. Pull only on the connector housings themselves.



Starting, charging and ignition system - 1988 models

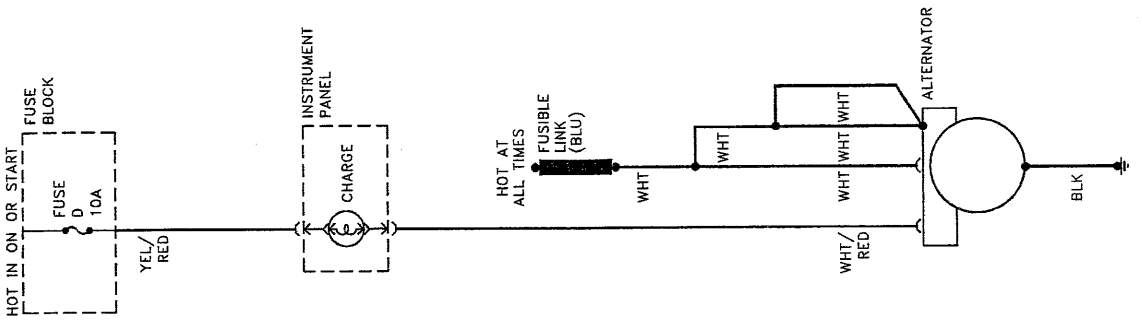


Starting, charging and ignition systems - 1990 and earlier models

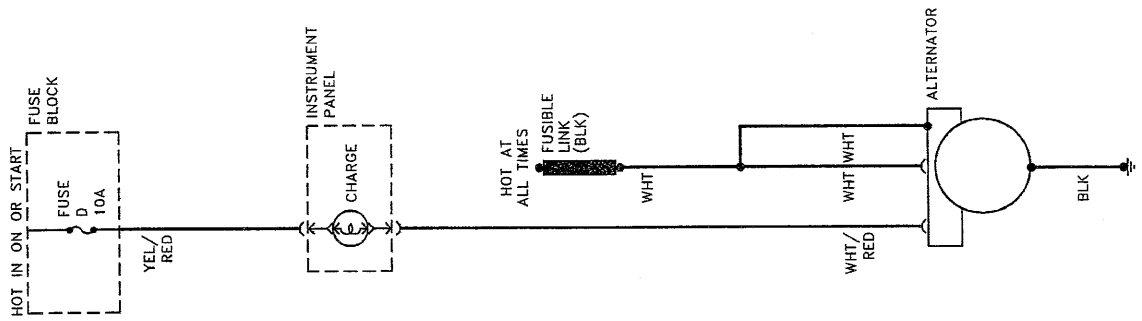

TB42S (M/T)
RB30S
HOT AT ALL TIMES
IGNITION SWITCH
START
ON
OFF
ACC
BLK/YEL
STARTER SOLENOID
STARTER MOTOR
NCA
BATTERY
TD42
FUSIBLE LINK HOLDER
FUSIBLE LINK 65A
WHT
STARTER RELAY
WHT OR BLK
A/T
M/T
INHIBITOR SWITCH
N
P
BLK
TB42E
BLK/YEL OR WHT
TB42S (A/T)
FUSE BLOCK
HOT IN ON OR START
FUSE G 15A
BRN
INHIBITOR RELAY

Charging system - 1991 and later models

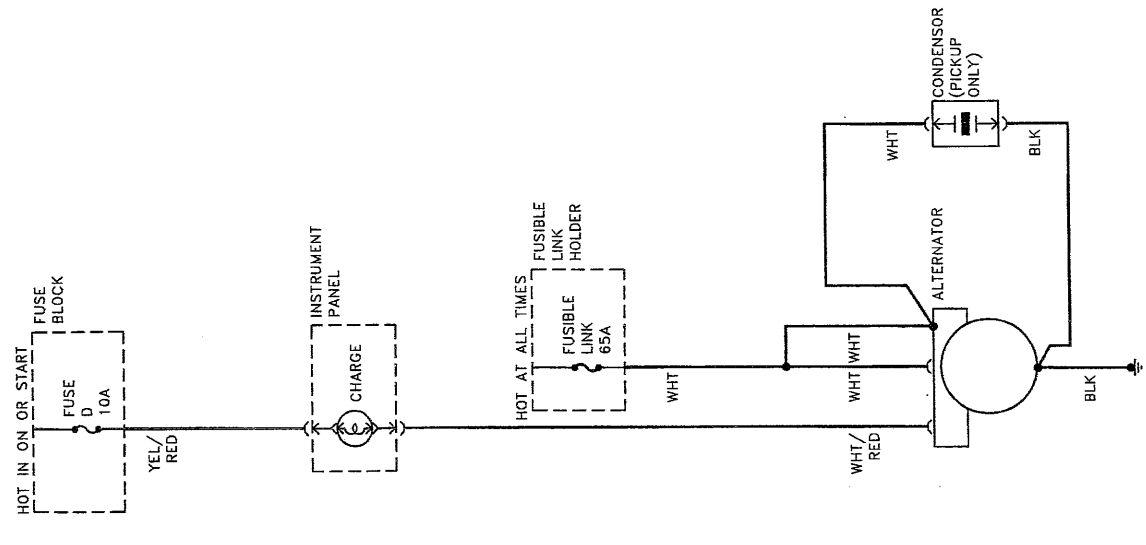
TB42E

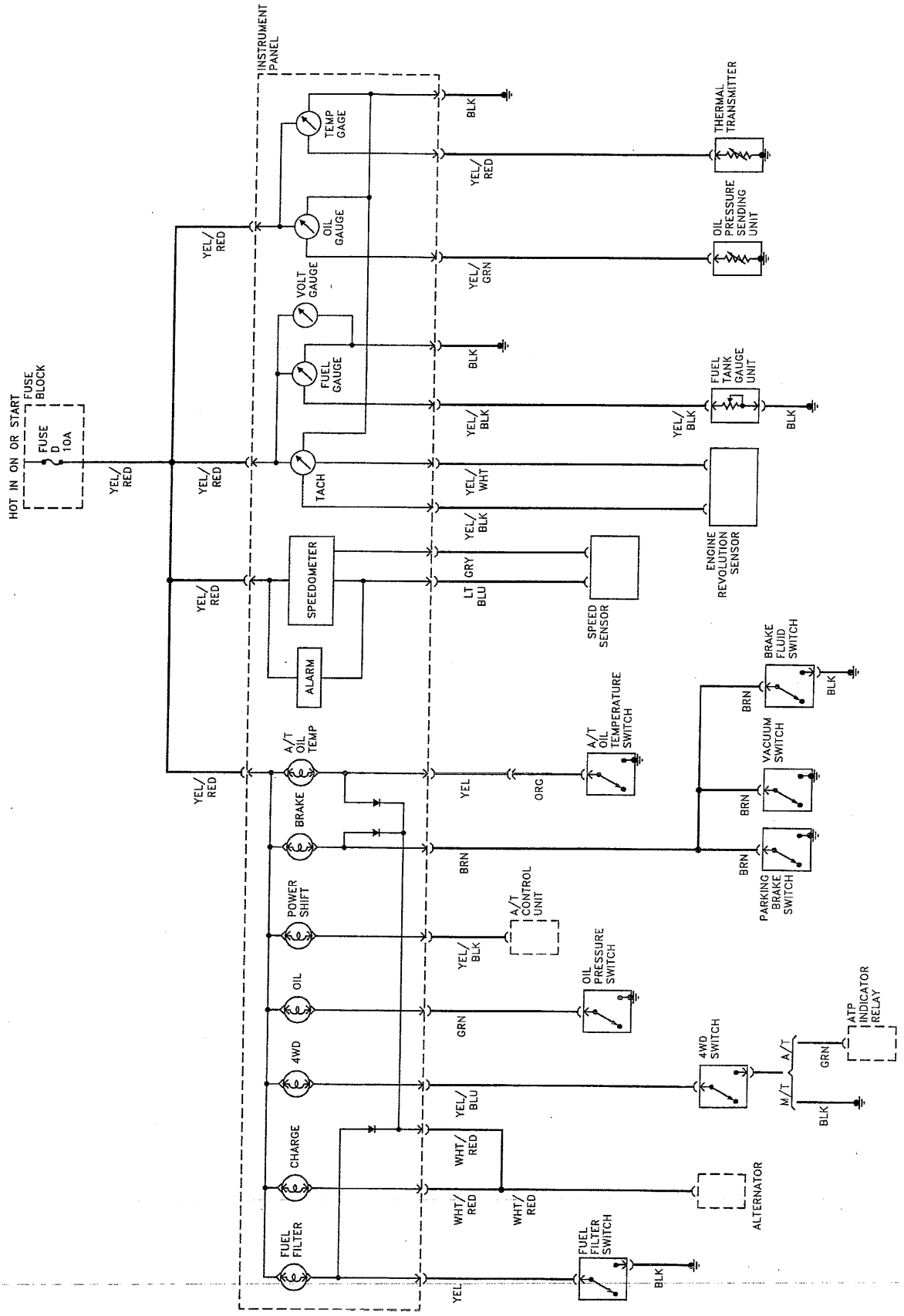


TB42S
RB30S

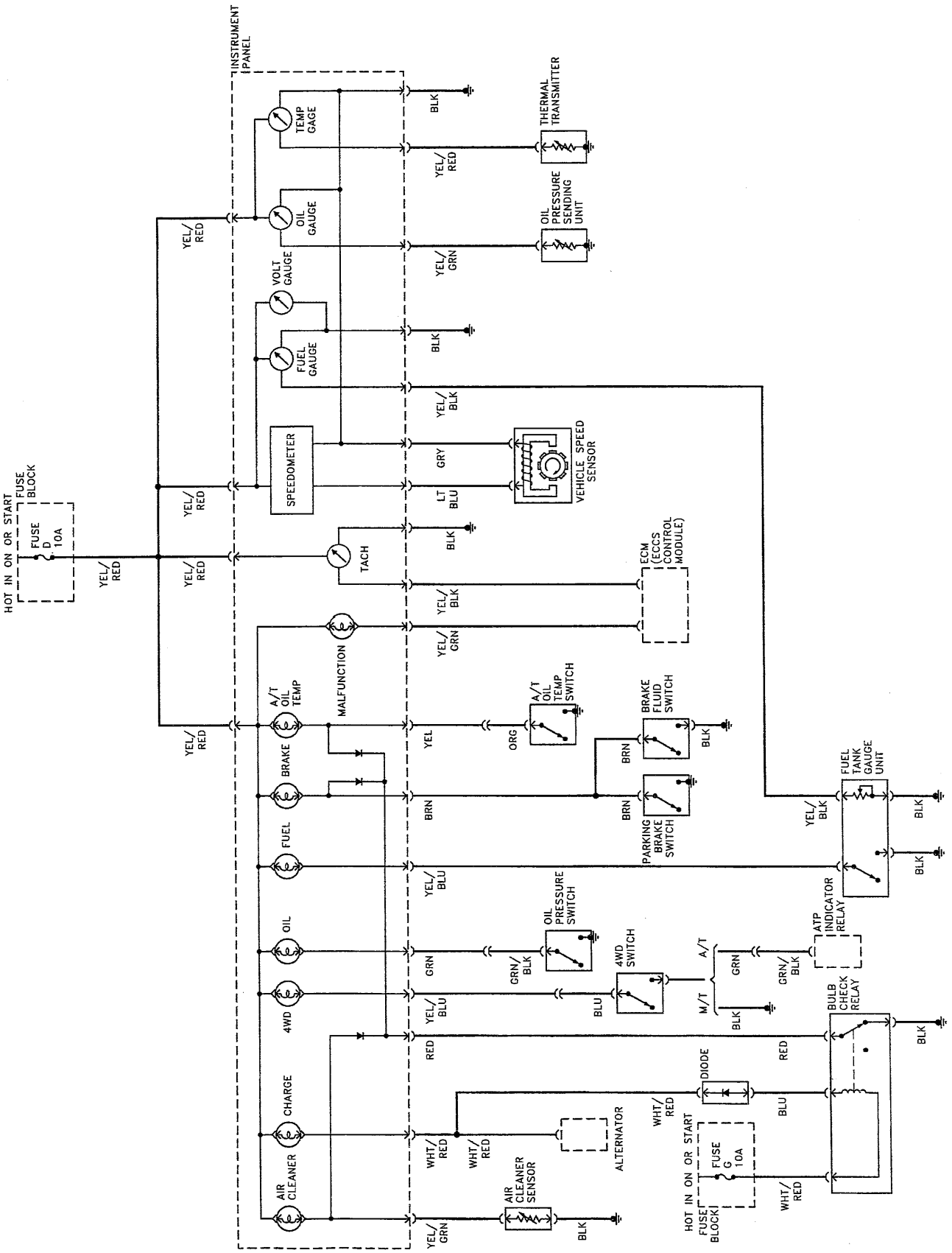


TD42

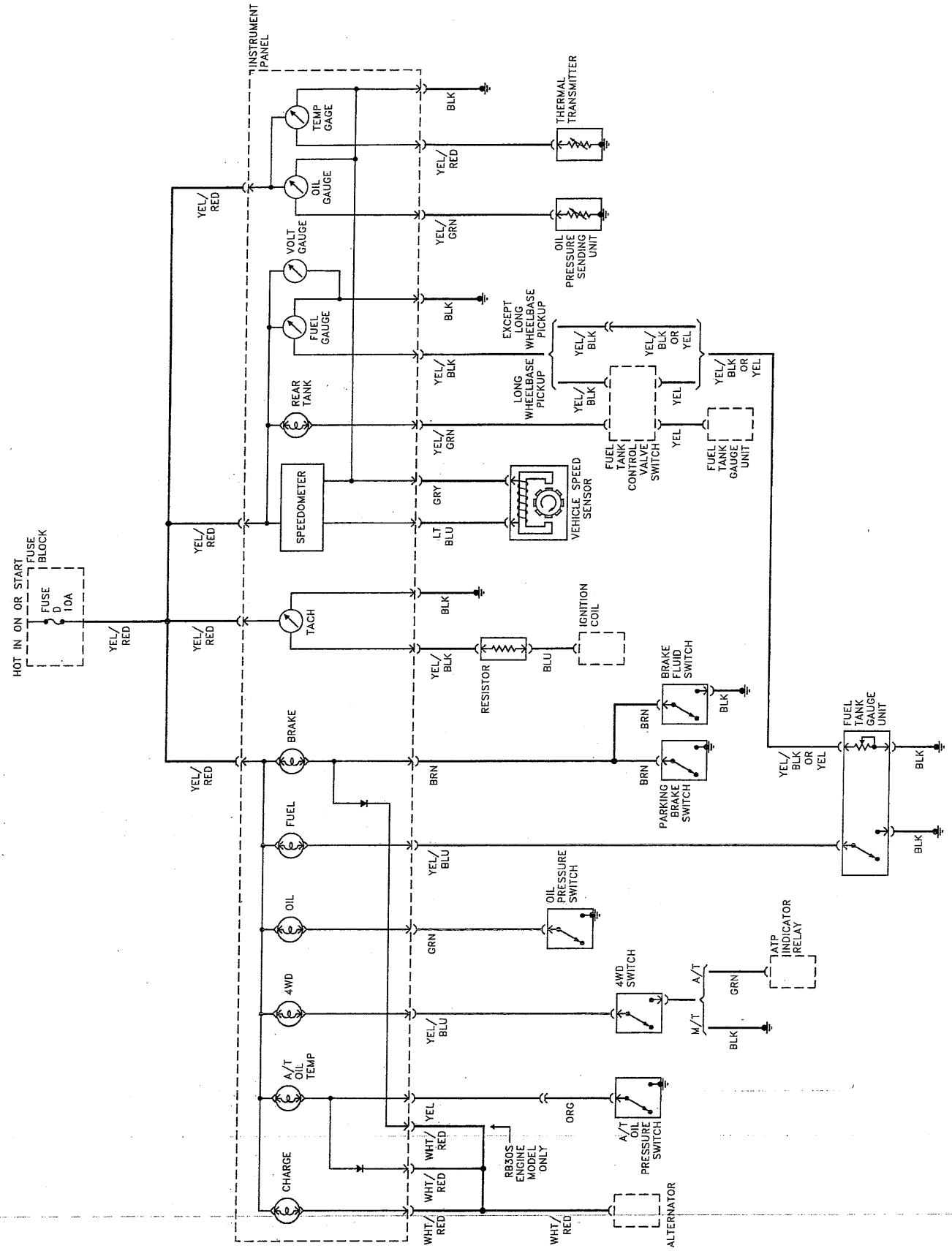




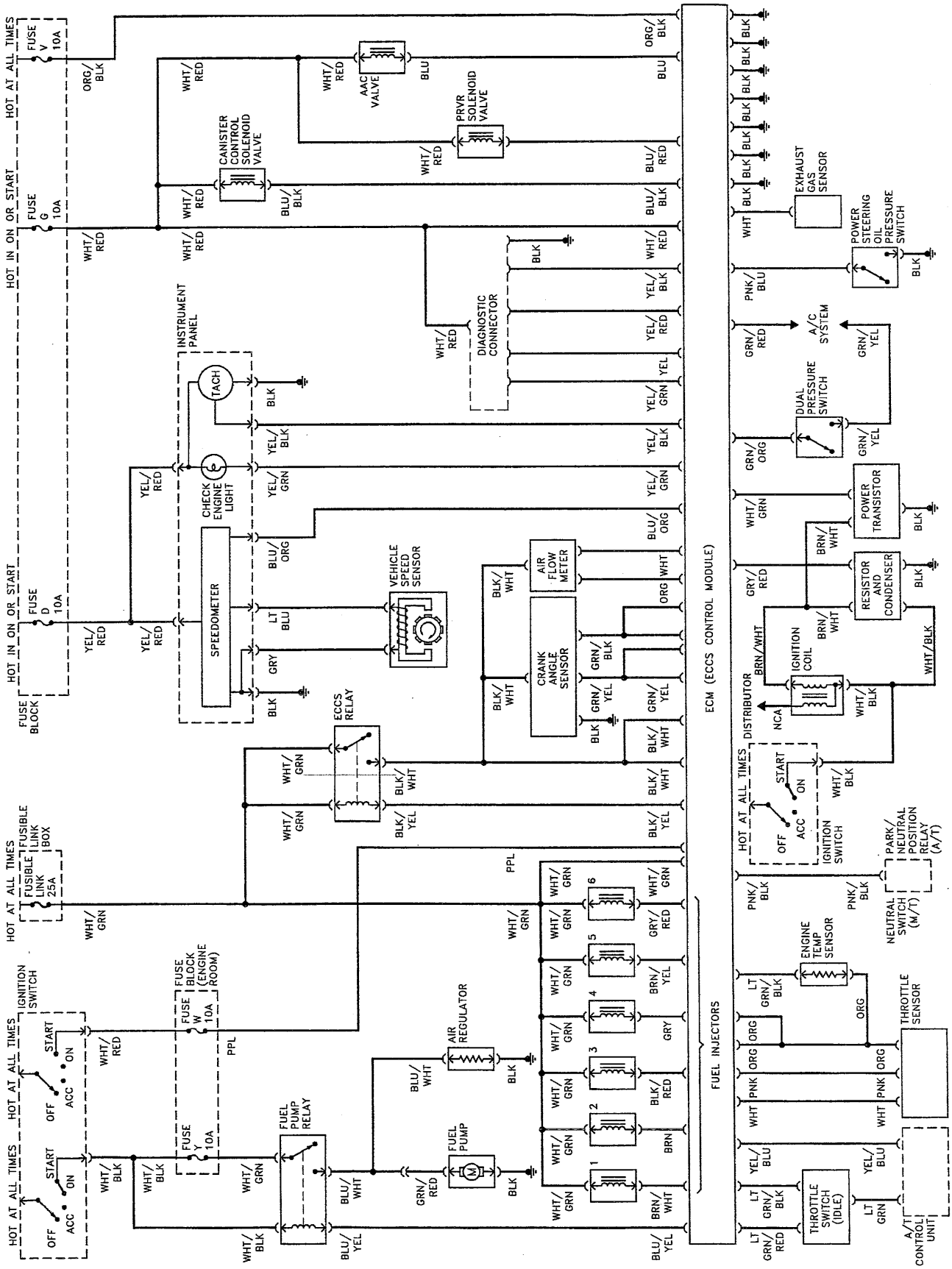
Gauges and warning light system - 1990 and earlier models



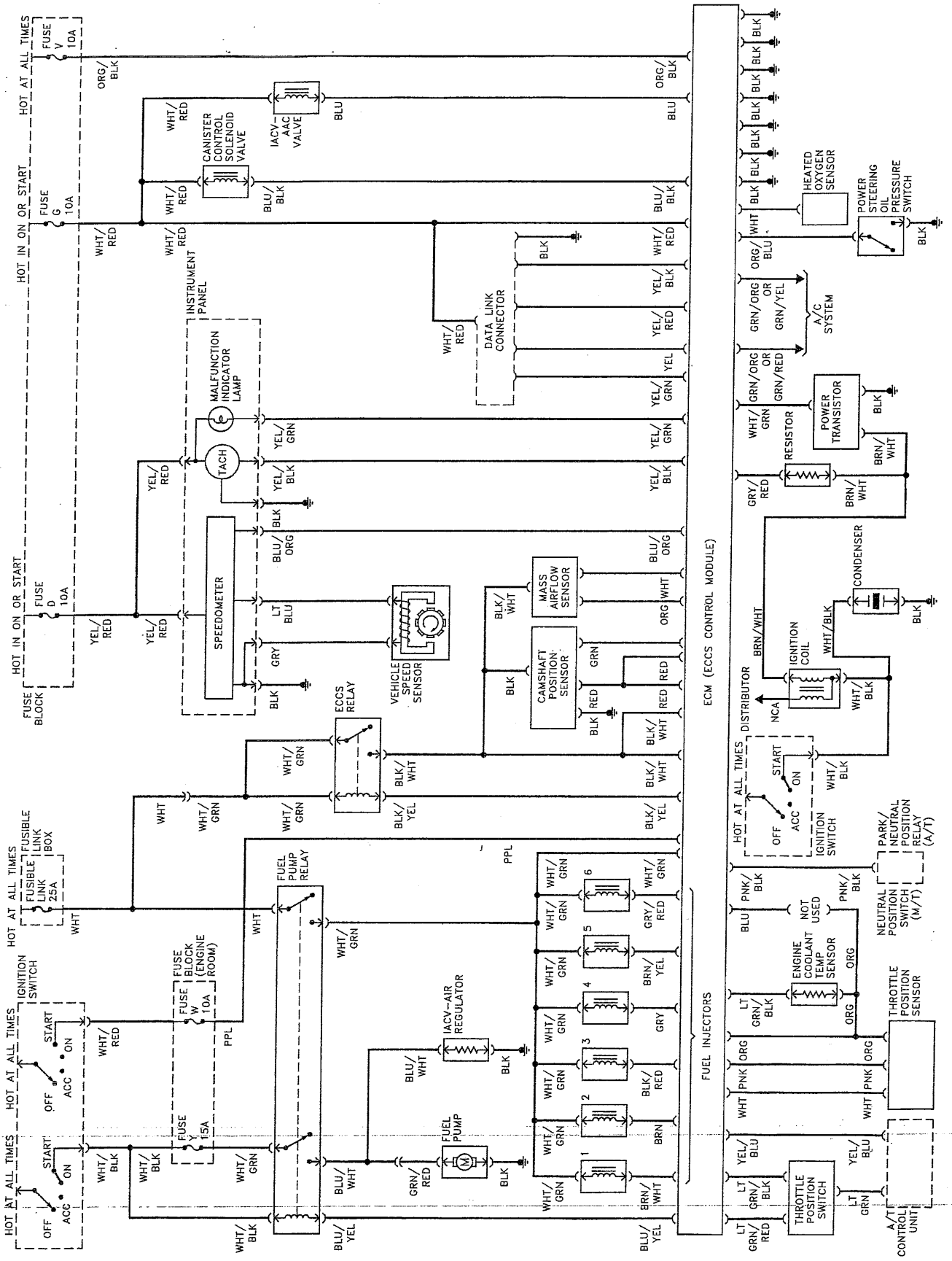
Gauges and warning light system - 1991 and later models with TB42E engine



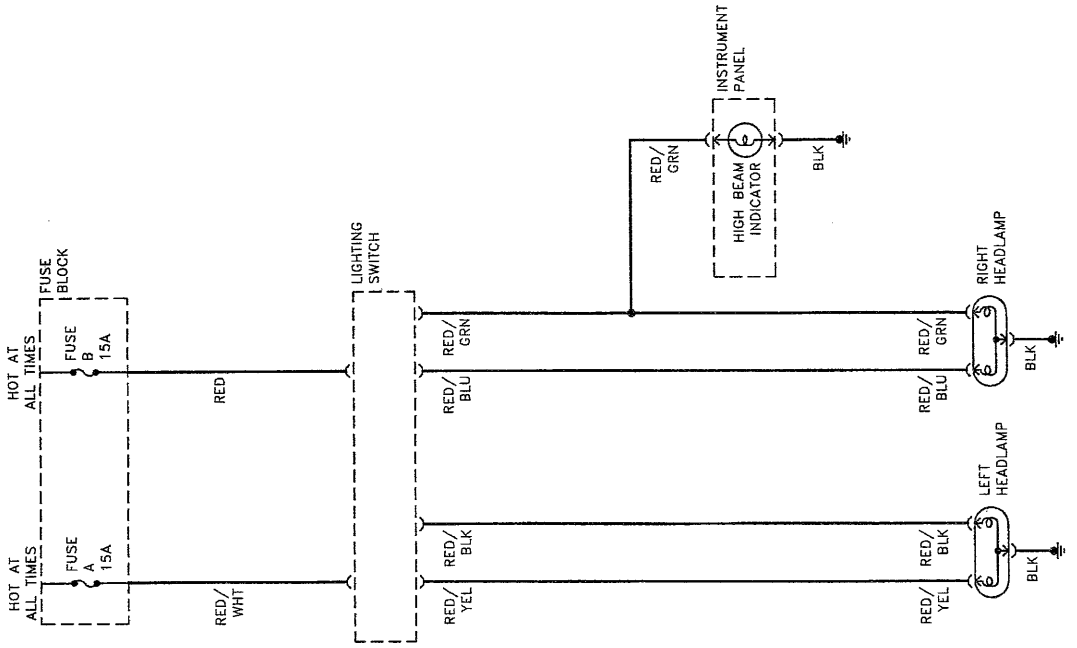
Gauges and warning light system - 1991 and later models with TB42S and RB30S engines



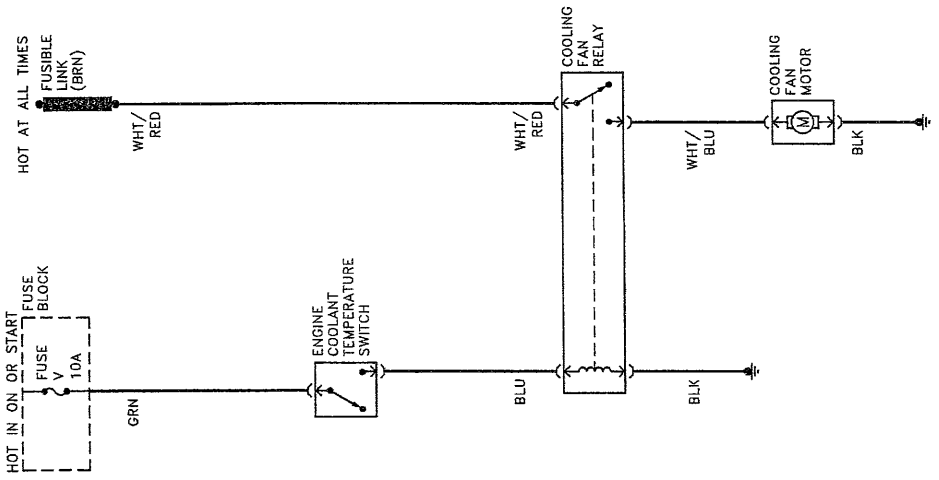
Engine control system - 1991 through 1994 fuel-injected models



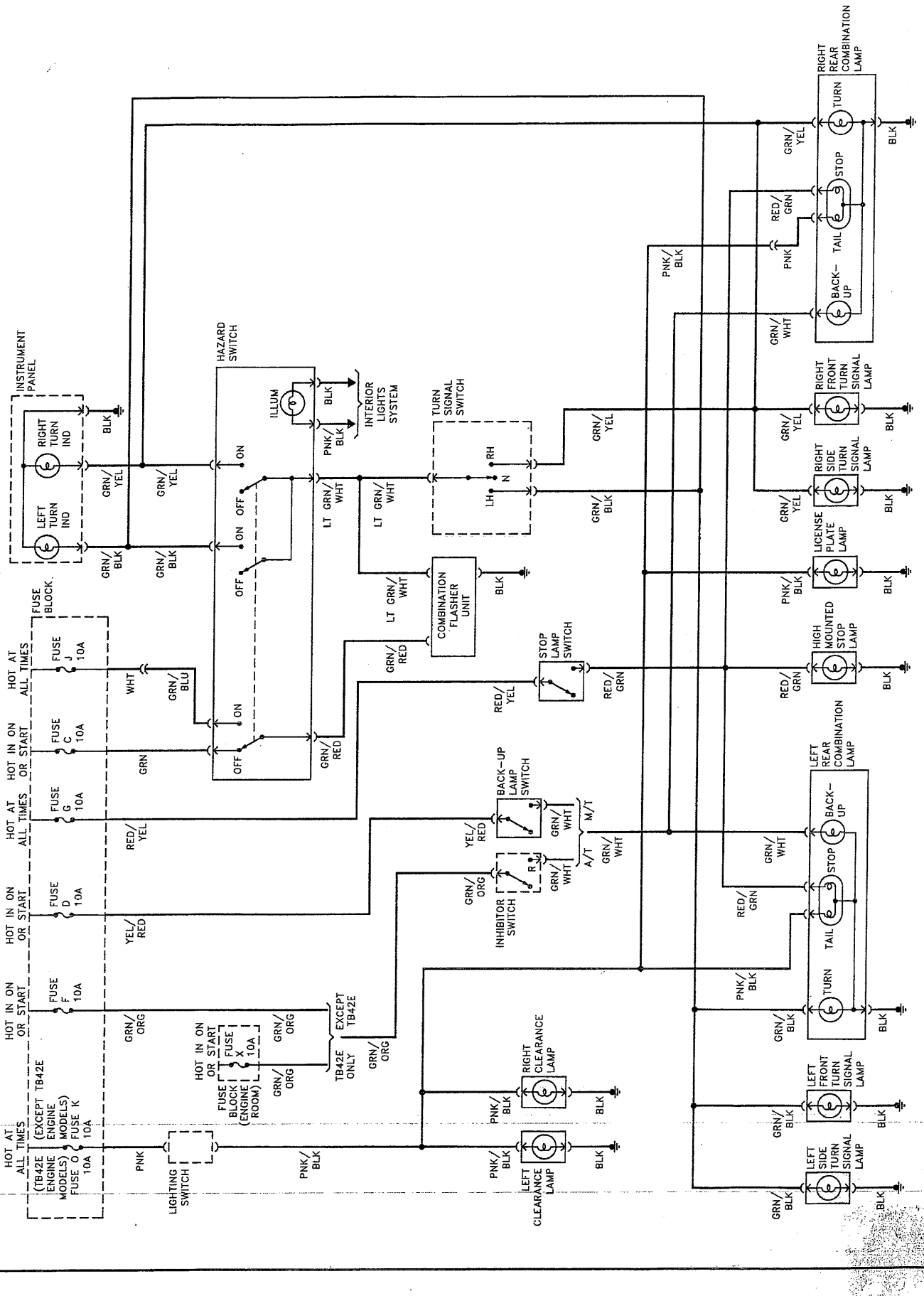
Engine control system - 1995 and later fuel-injected models



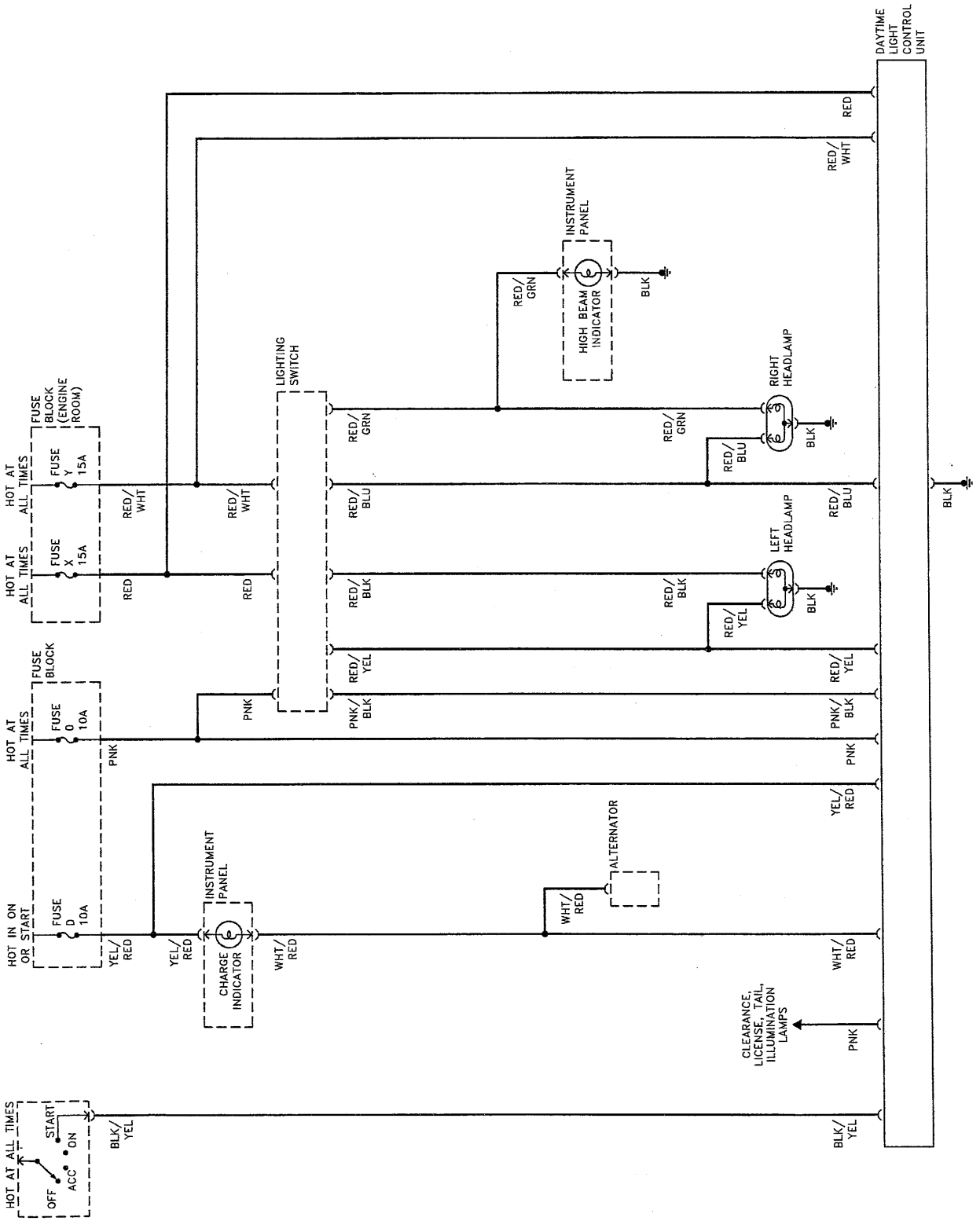
Headlight system (without daytime running lights or dim-dip system)



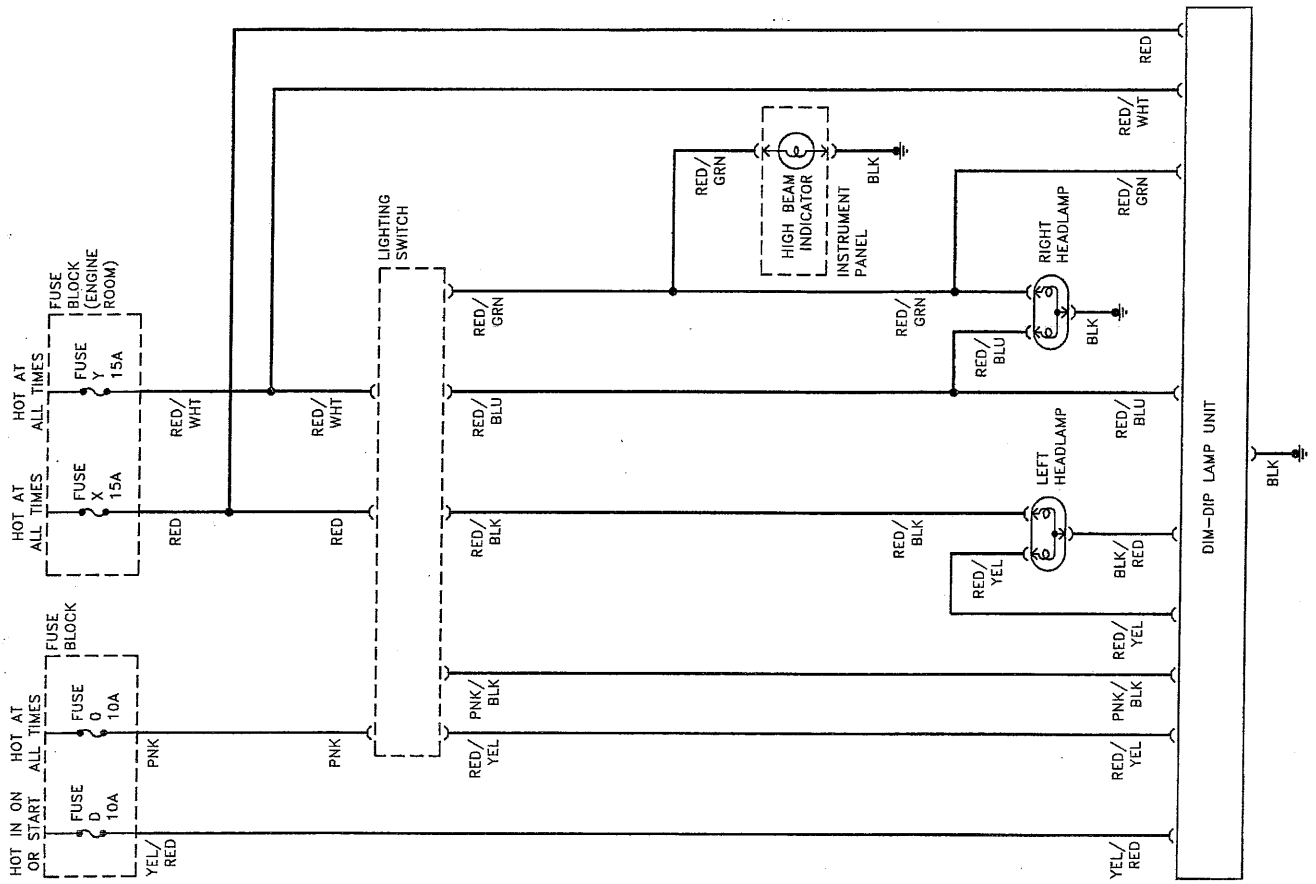
Electric cooling fan system



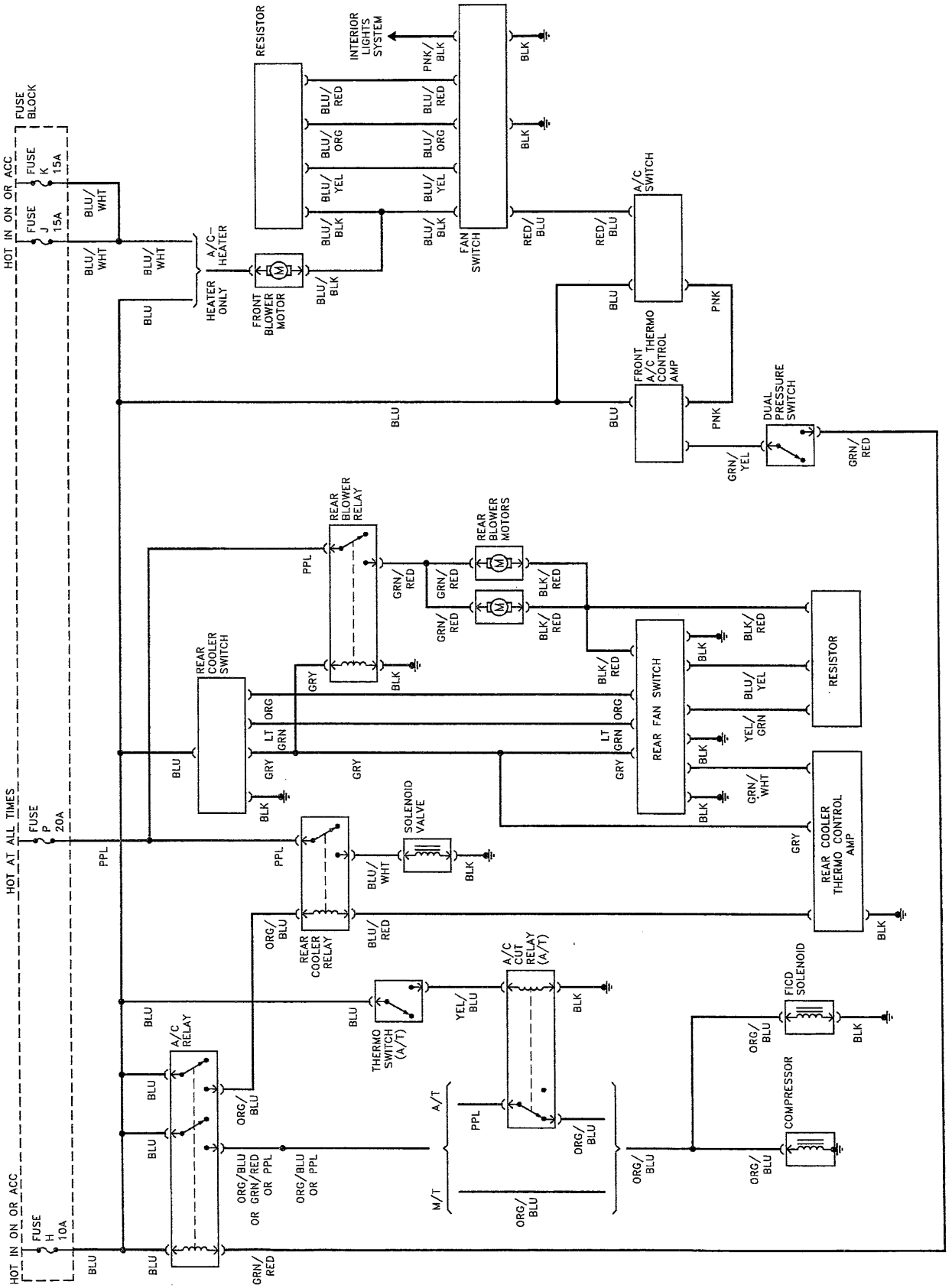
Exterior lighting system (except headlights)



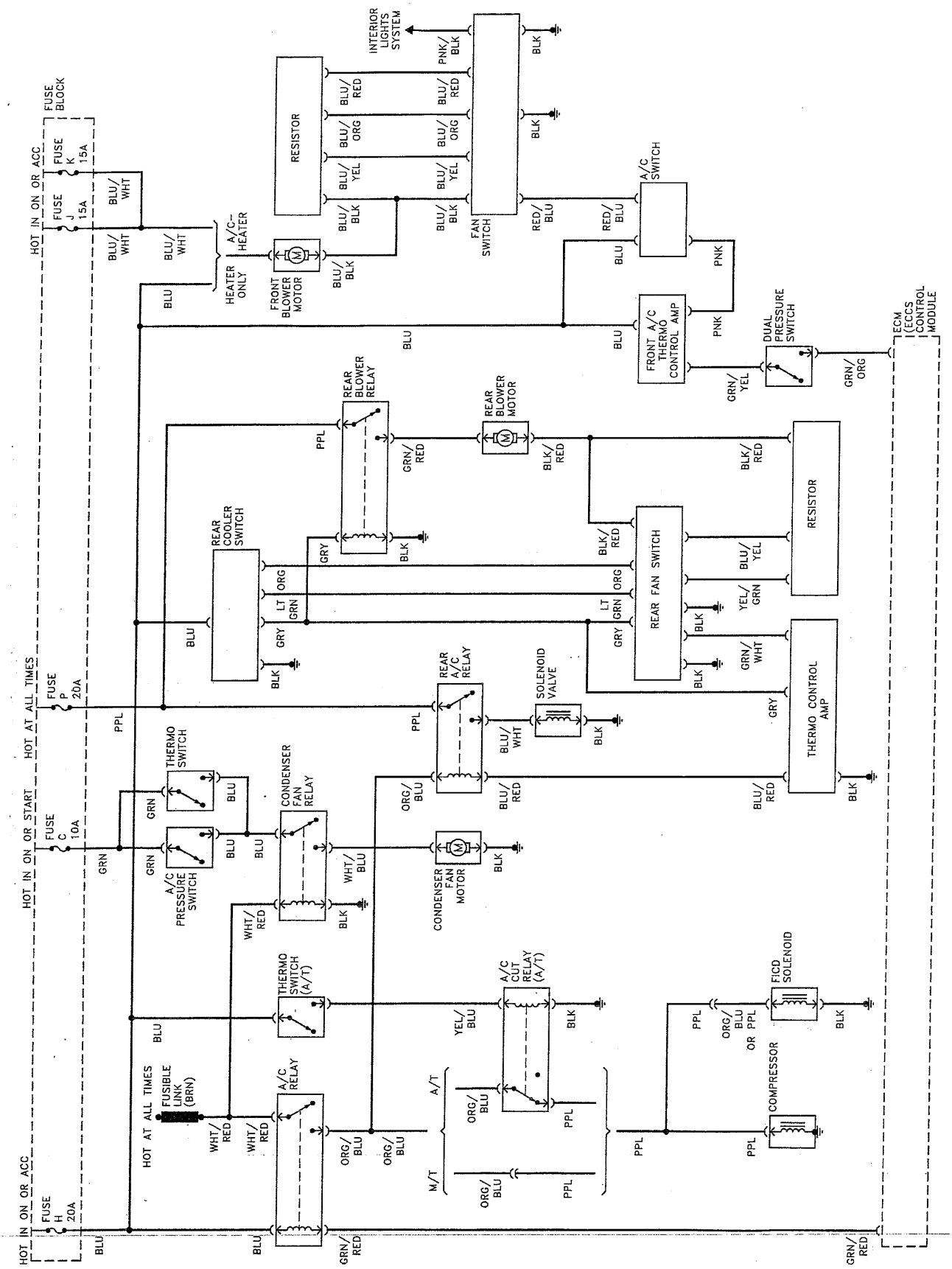
Headlight system (with daytime running lights)



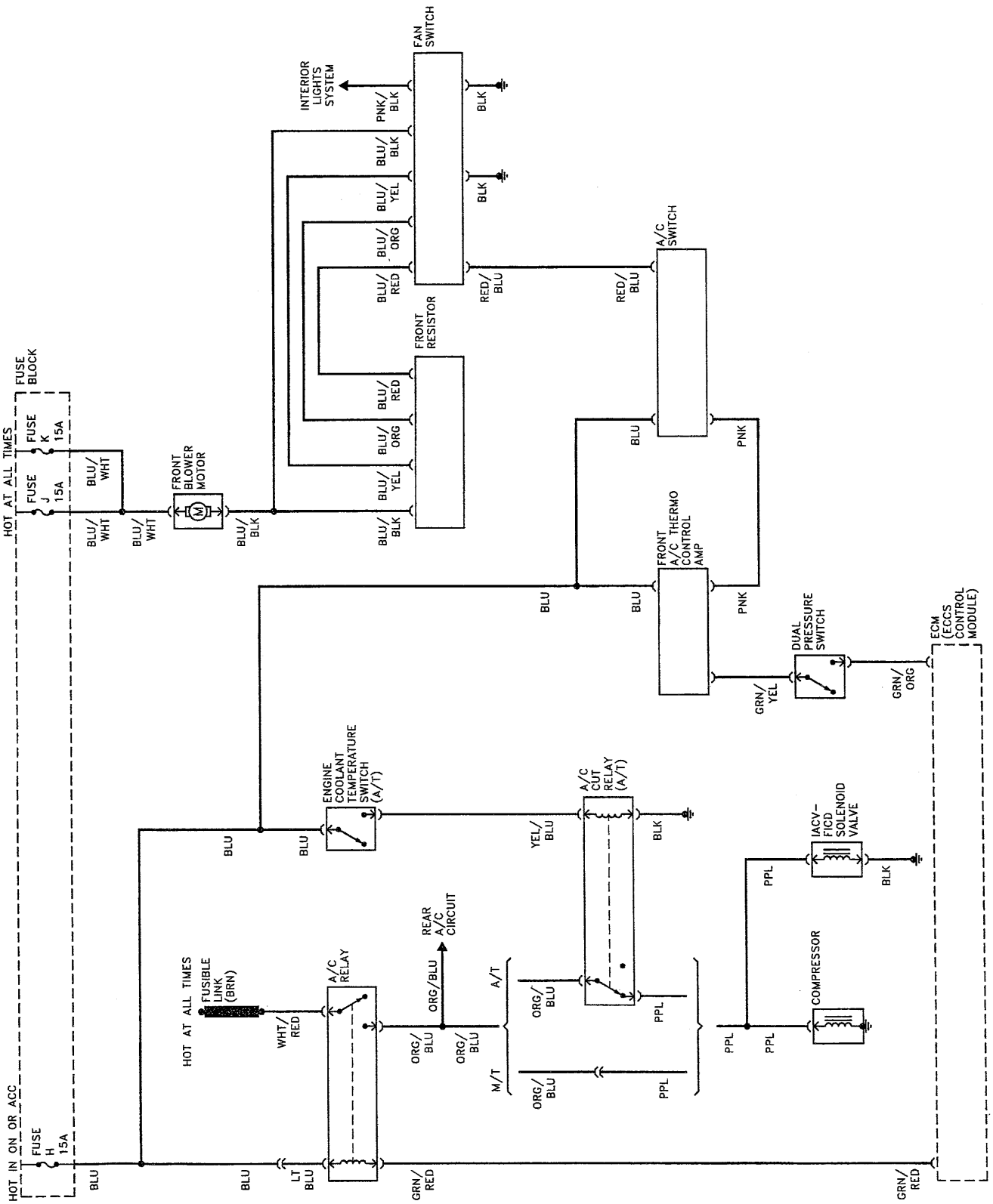
Headlight system (with dim-dip system)



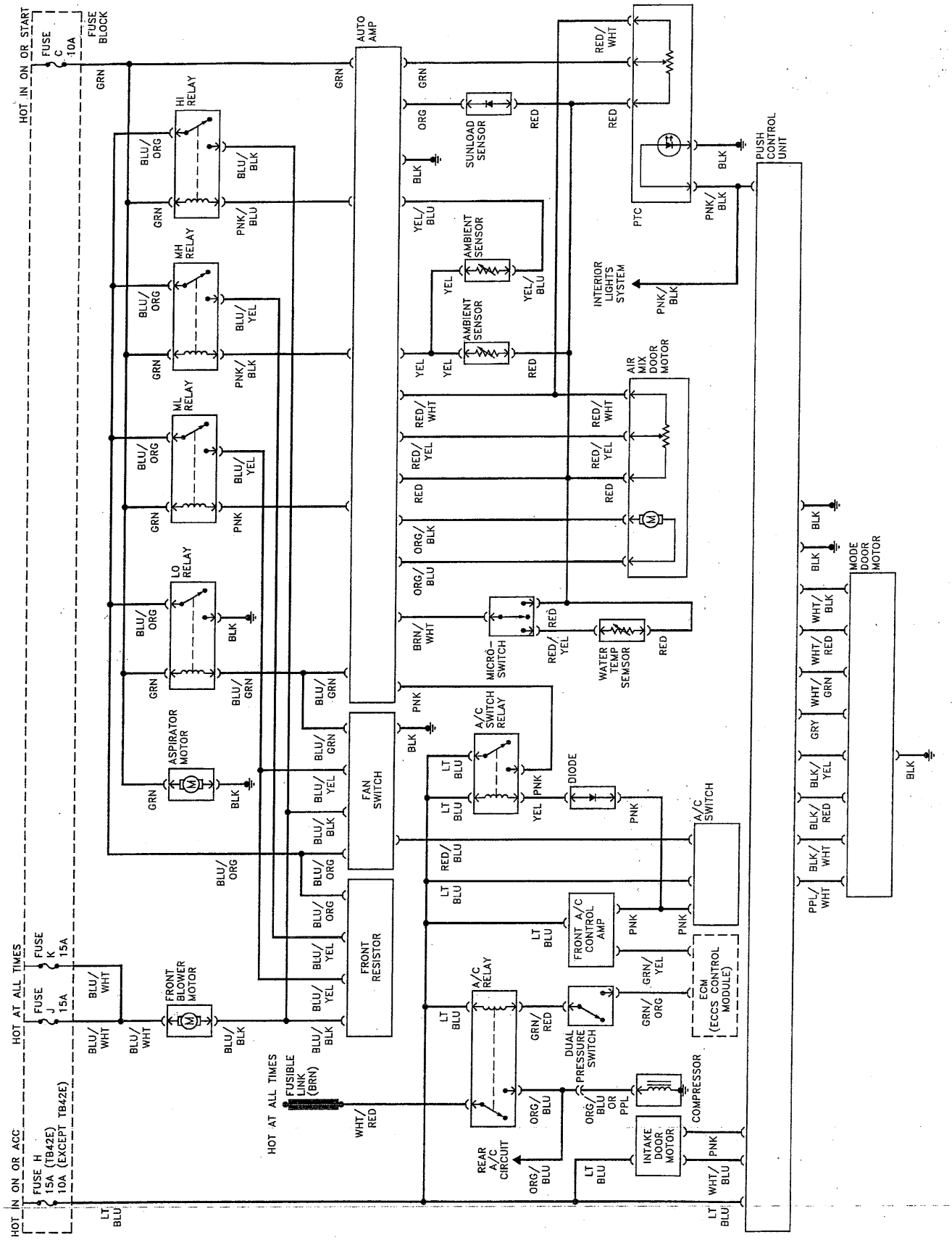
Heating and air conditioning system - 1990 and earlier models



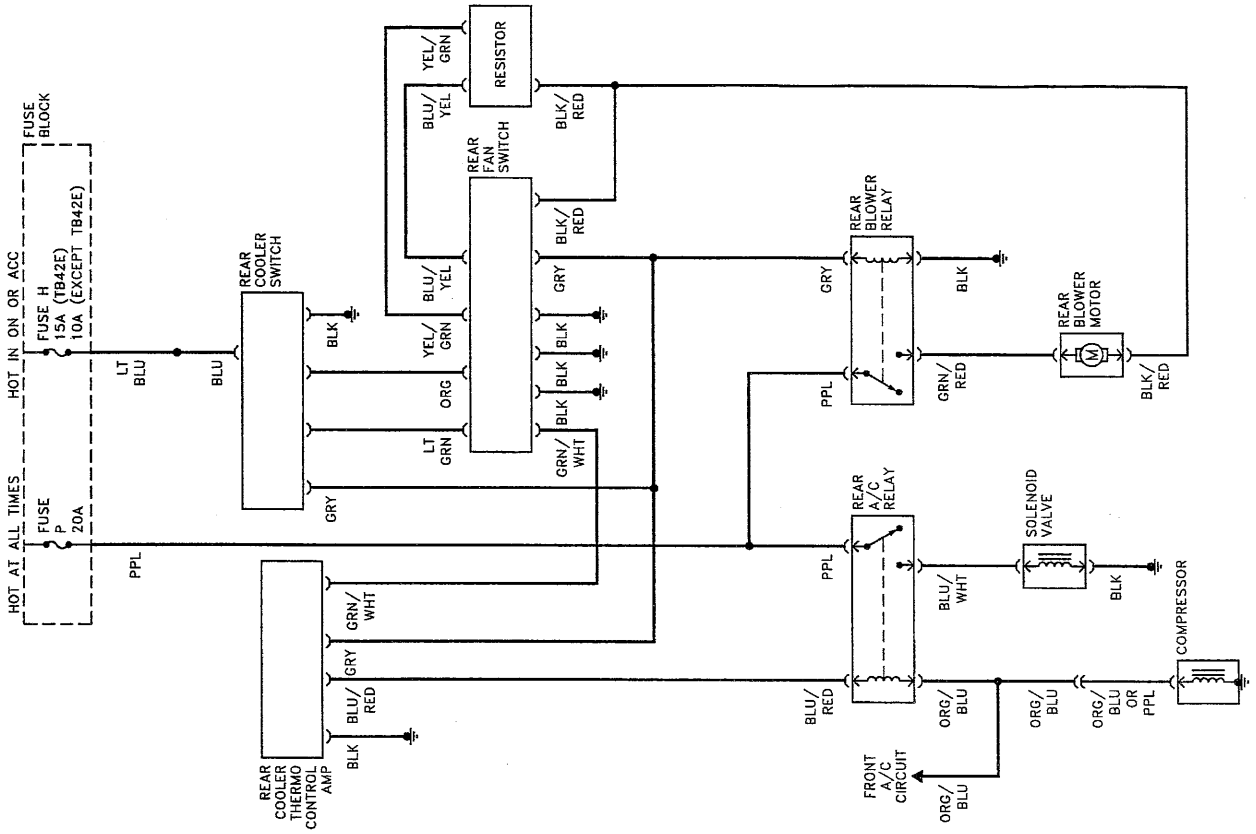
Heating and air conditioning system - 1991 through 1993 models



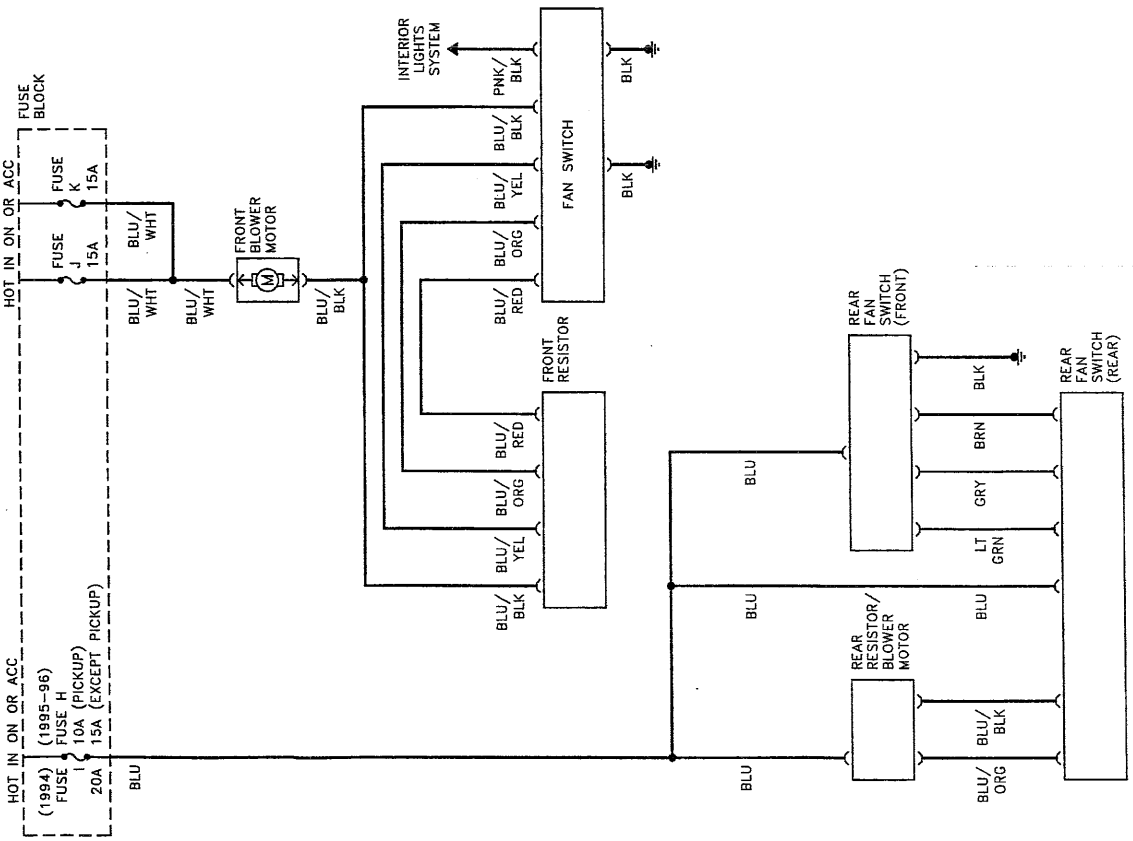
Manual air conditioning system - 1994 and later models



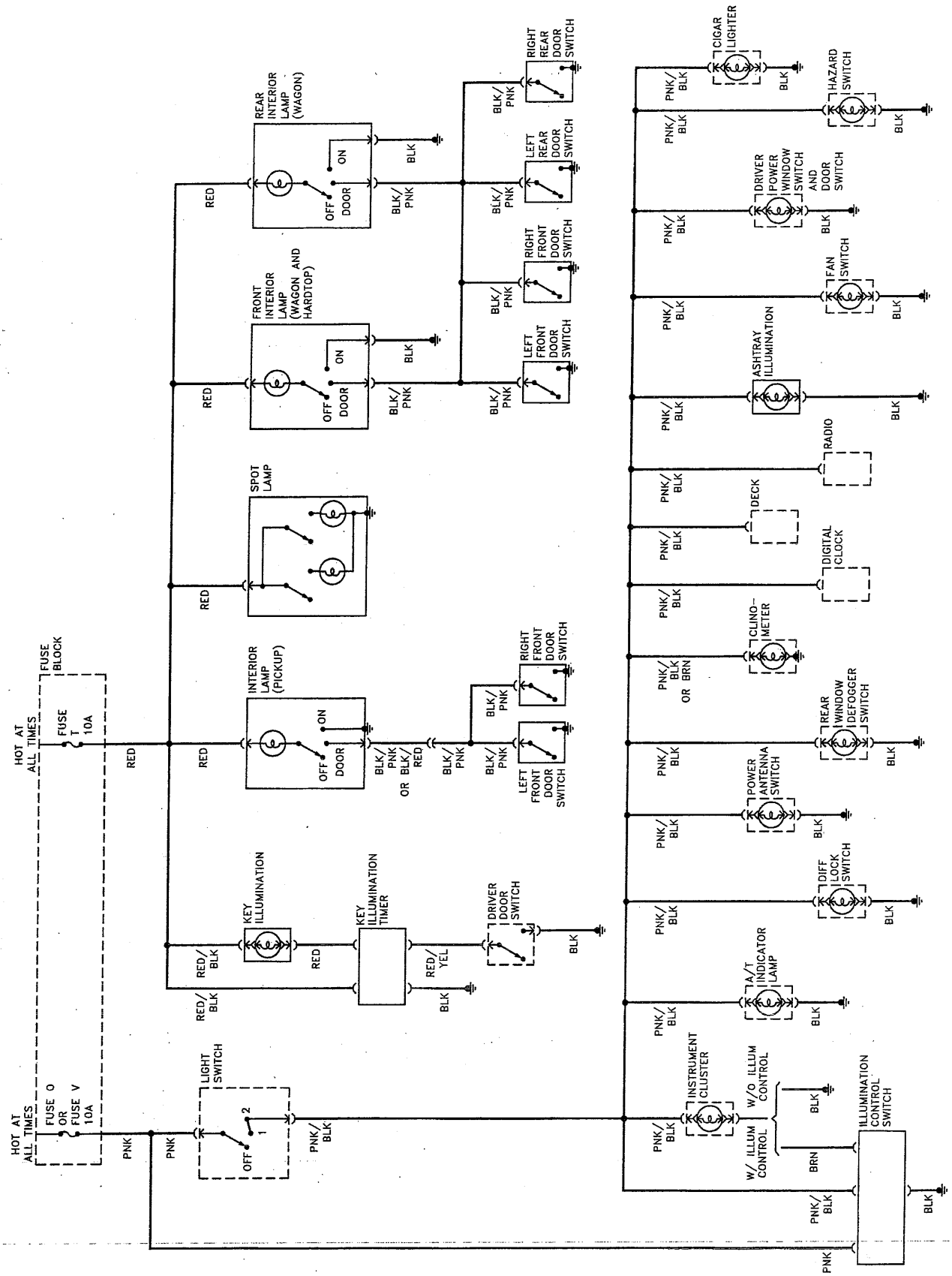
Automatic air conditioning system - 1994 and later models



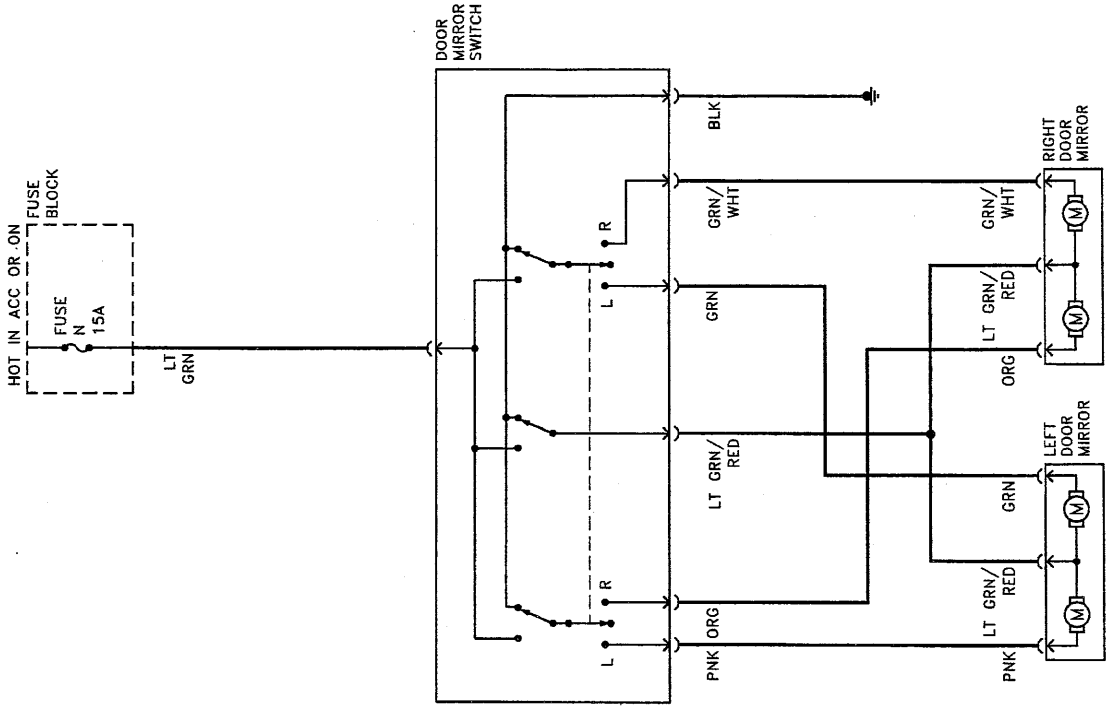
Rear air conditioning system - 1994 and later models



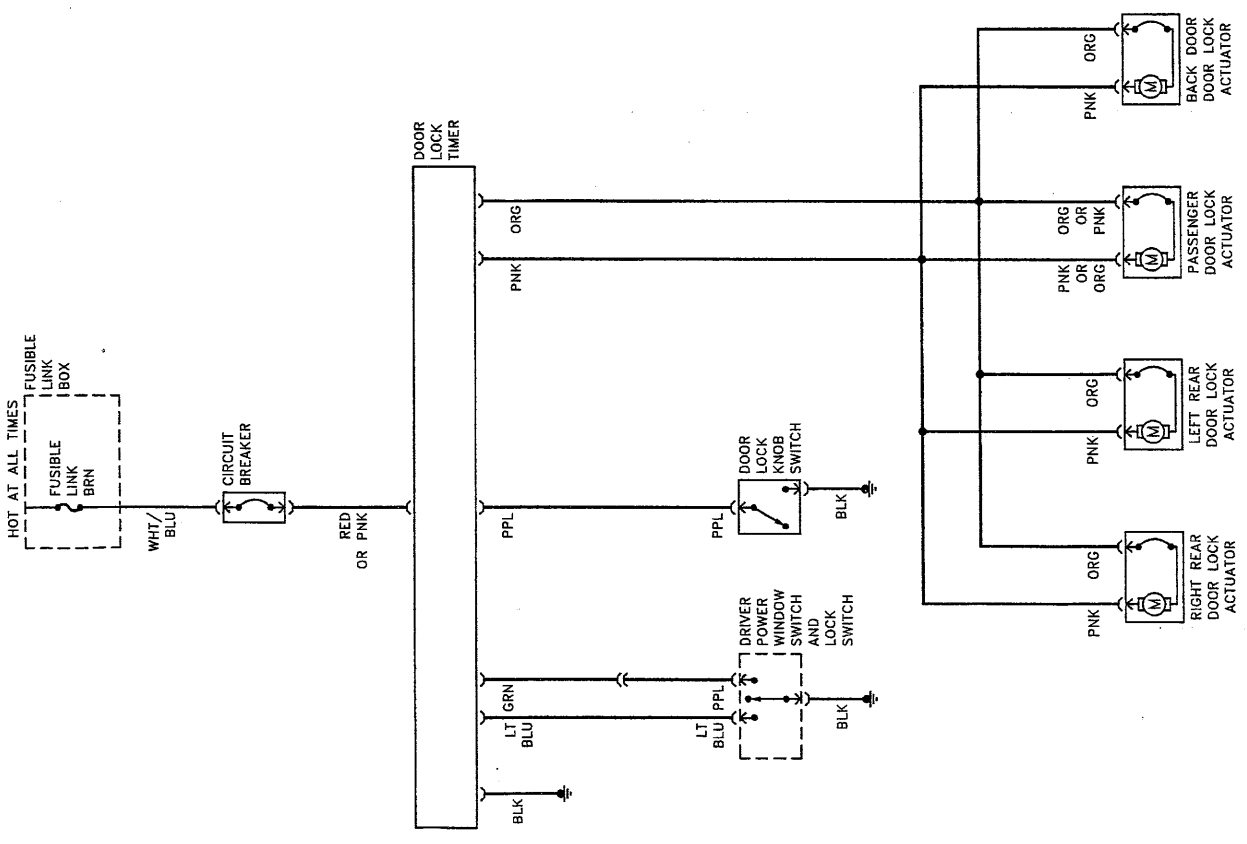
Heating system - 1994 and later models



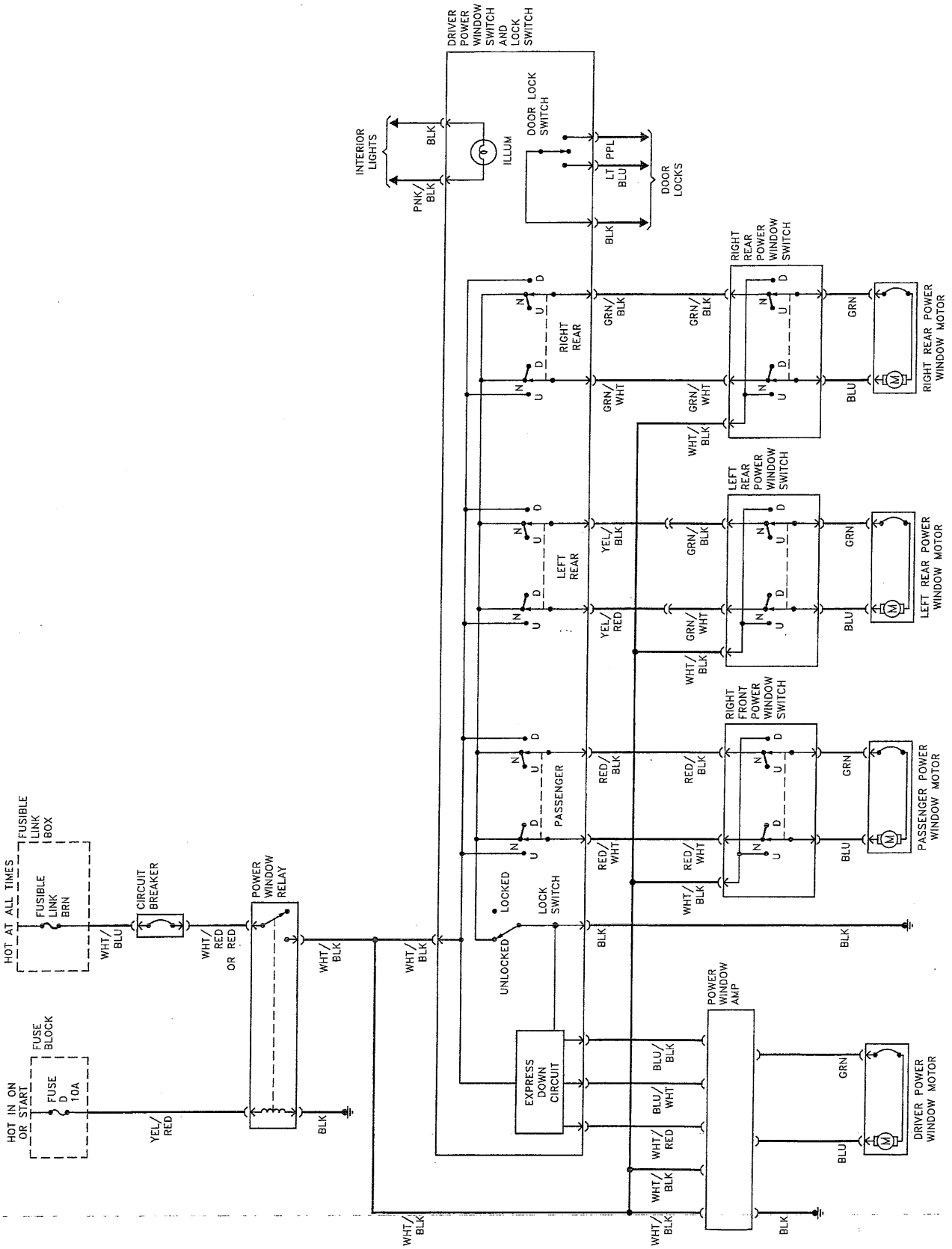
Interior lighting system



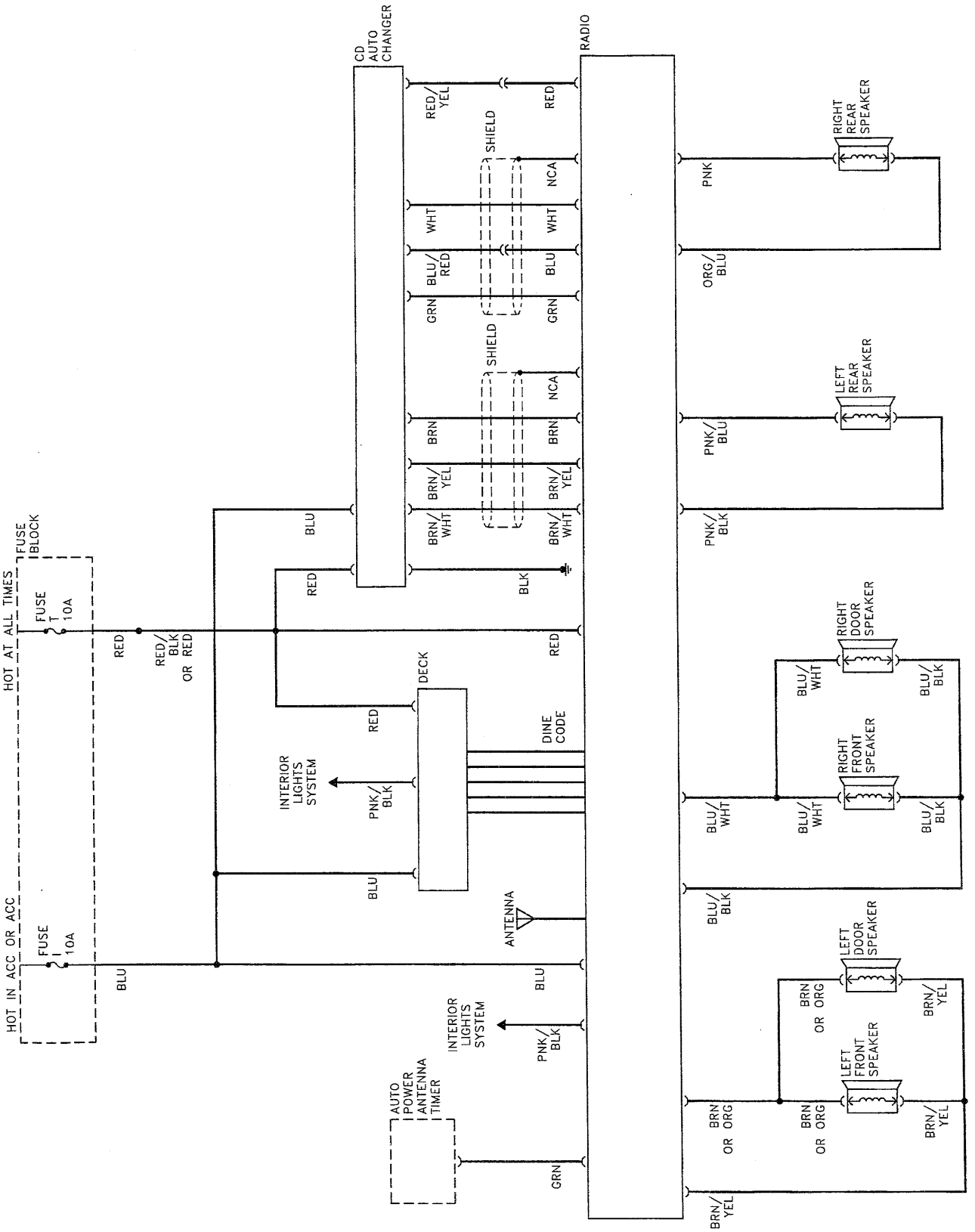
Power mirror system



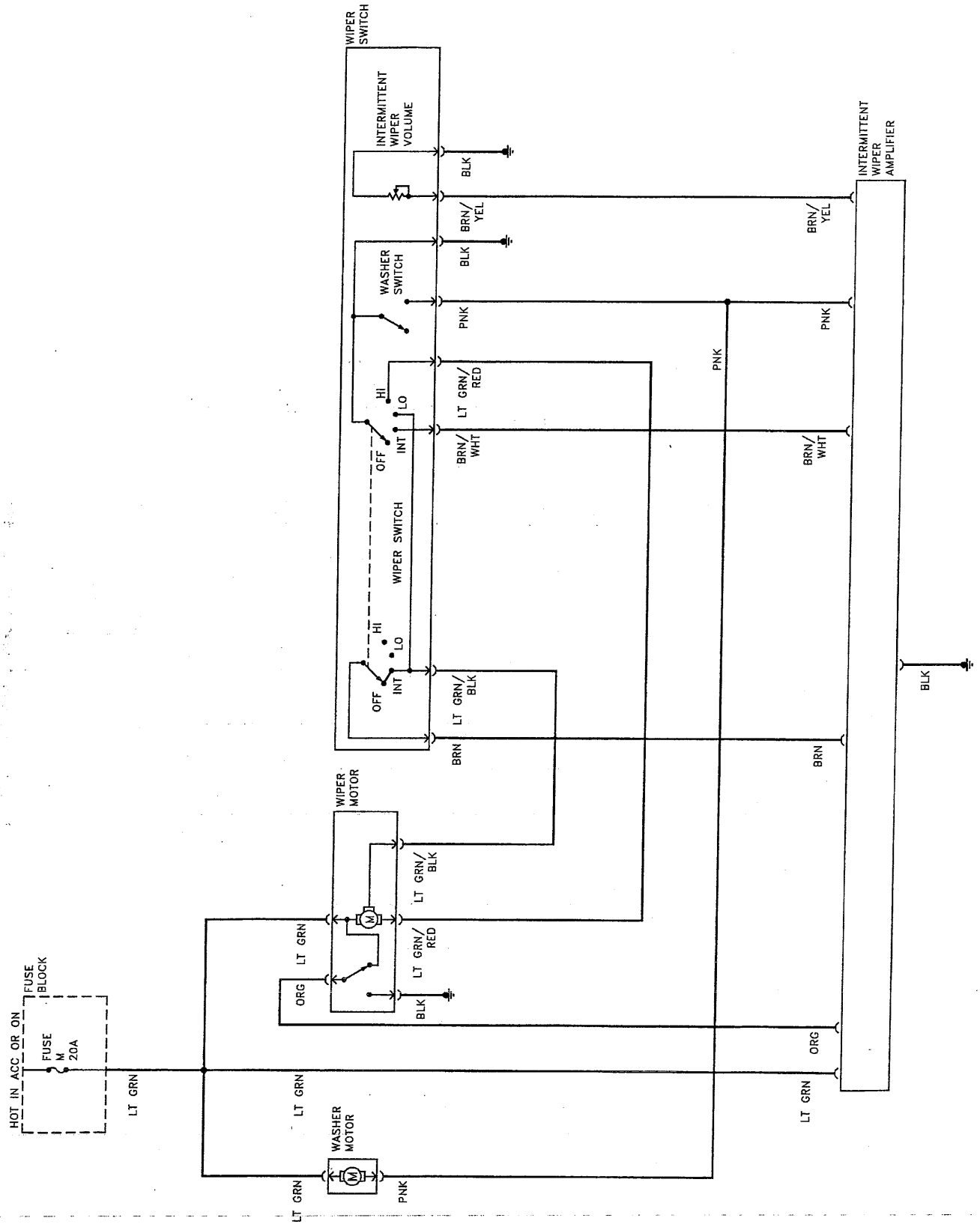
Power door lock system



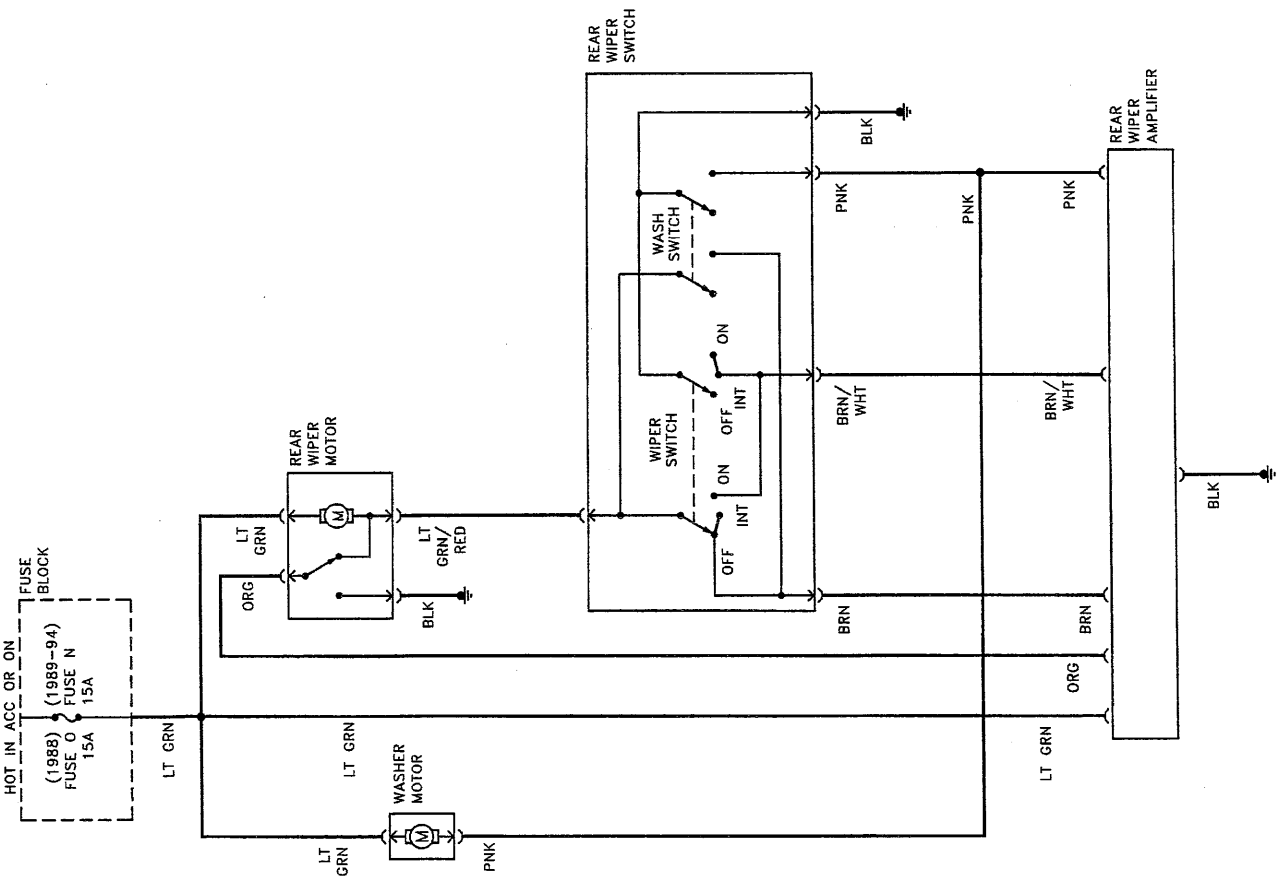
Power window system



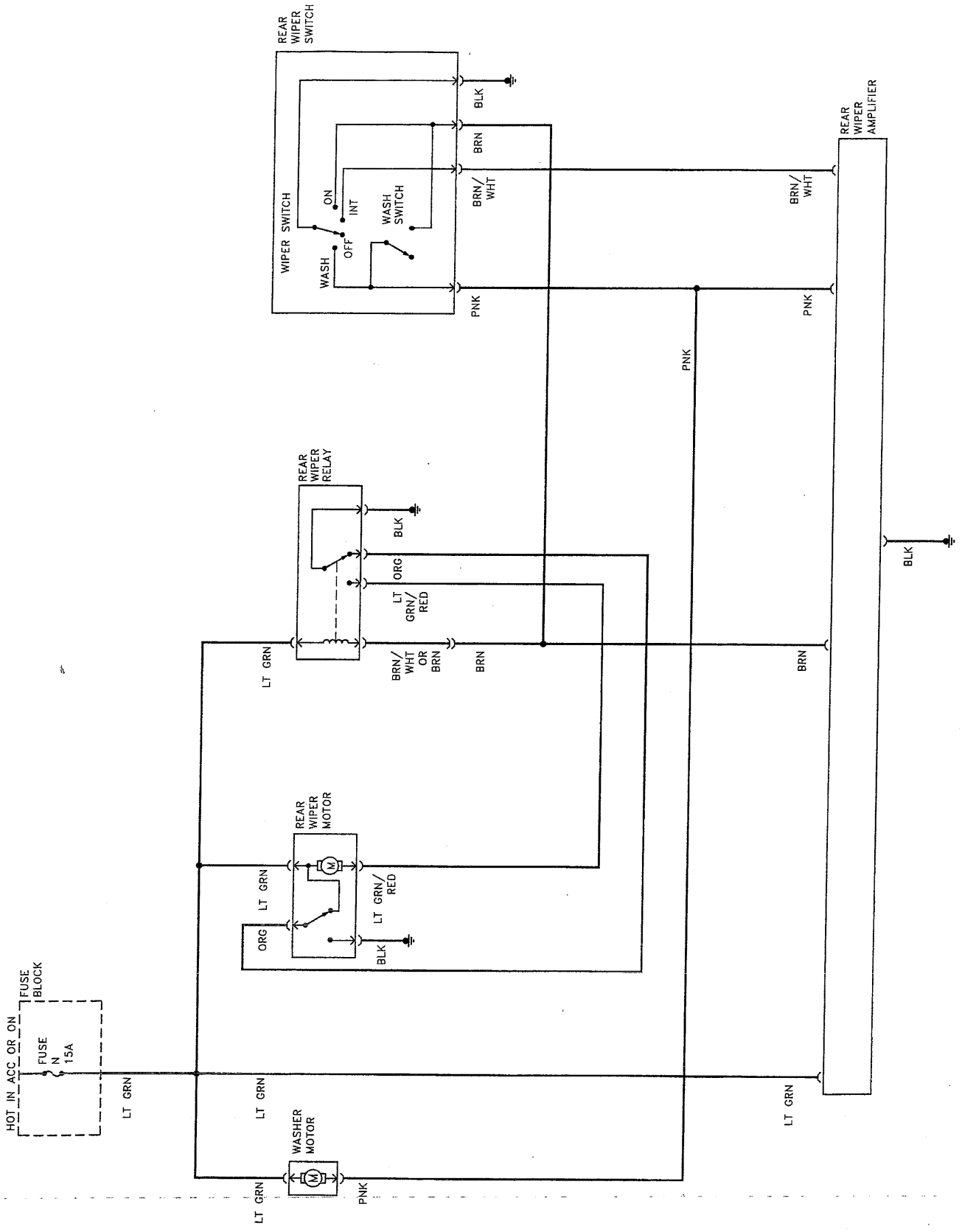
Audio system



Windshield wiper and washer system



Back glass wiper and washer system - 1994 and earlier



Back glass wiper and washer system - 1995 and later