

Chapter 5 Engine electrical systems

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Specifications

General

Spark plug/coil wire resistance	not to exceed 16,000 ohms per meter (3.28 ft)
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Ignition coil

Primary resistance

Pre-1979	1.3 to 1.7 ohms
1979 thru 1985	0.9 ohms \pm 10% at 68-degrees F
1986 and 1987	1.15 \pm 0.12 ohms
1988	1.0 to 1.3 ohms
1989	
B2200	1.0 to 1.3 ohms
B2600	
Test 1	0.77 to 0.95 ohms
Test 2	0.9 to 1.1 K-ohms
1990 and later	
With carb	1.0 to 1.3 ohms
With EFI	0.81 to 0.99 ohms

Secondary resistance

1986 and 1987	
Hanshin	10.2 ohms
Mitsubishi	8.35 ohms
1988	
B2200	6 to 30 K-ohms
B2600	10 to 20 K-ohms
1989 and later	6 to 30 K-ohms
Insulation resistance (1986 and later)	More than 10 M-ohms
External resistor resistance (1988 B2600 only)	1.0 to 1.5 ohms

1 General information and precautions

The engine electrical systems include all ignition, charging and starting components. Because of their engine-related functions, these components are considered separately from chassis electrical devices like the lights, instruments, etc.

Be very careful when working on the engine electrical components. They are easily damaged if checked, connected or handled improperly. The alternator is driven by an engine drivebelt which could cause serious injury if your hands, hair or clothes become entangled in it with the engine running. Both the starter and alternator are connected directly

to the battery and could arc or even cause a fire if mishandled, overloaded or shorted out.

Never leave the ignition switch on for long periods of time with the engine off. Don't disconnect the battery cables while the engine is running. Correct polarity must be maintained when connecting battery cables from another source, such as another vehicle, during jump starting. Always disconnect the negative cable first and hook it up last or the battery may be shorted by the tool being used to loosen the cable clamps.

Additional safety related information on the engine electrical systems can be found in *Safety first* near the front of this manual. It should be referred to before beginning any operation included in this Chapter.

2 Battery — removal and installation

Refer to illustration 2.2

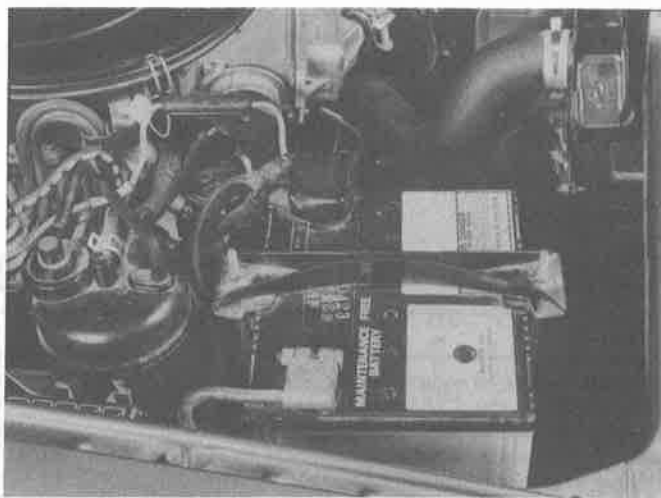
- 1 Disconnect both cables from the battery terminals. **Caution:** Always disconnect the negative cable first and hook it up last or the battery may be shorted by the tool being used to loosen the cable clamps.
- 2 At the battery, remove the bolt and the hold down clamp (see illustration).
- 3 Lift out the battery. Special straps that attach to the battery posts are available — lifting and moving the battery is much easier if you use one.
- 4 Installation is the reverse of removal.

3 Battery — emergency jump starting

Refer to the *Booster battery (jump) starting* procedure at the front of this manual.

4 Battery cables — check and replacement

- 1 Periodically inspect the entire length of each battery cable for damage, cracked or burned insulation and corrosion. Poor battery cable connections can cause starting problems and decreased engine performance.
- 2 Check the cable-to-terminal connections at the ends of the cables for cracks, loose wire strands and corrosion. The presence of white, fluffy deposits under the insulation at the cable terminal connection is a sign that the cable is corroded and should be replaced. Check the terminals for distortion, missing mounting bolts and corrosion.
- 3 When replacing the cables, **always disconnect the negative cable first and hook it up last** or the battery may be shorted by the tool used to loosen the cable clamps. Even if only the positive cable is being replaced, be sure to disconnect the negative cable from the battery first.
- 4 Disconnect and remove the cable. Make sure the replacement cable is the same length and diameter.
- 5 Clean the threads of the relay or ground connection with a wire brush to remove rust and corrosion. Apply a light coat of petroleum jelly to the threads to prevent future corrosion.



2.2 The battery is secured by a clamp across the top — to remove, unscrew the nut on the threaded rod

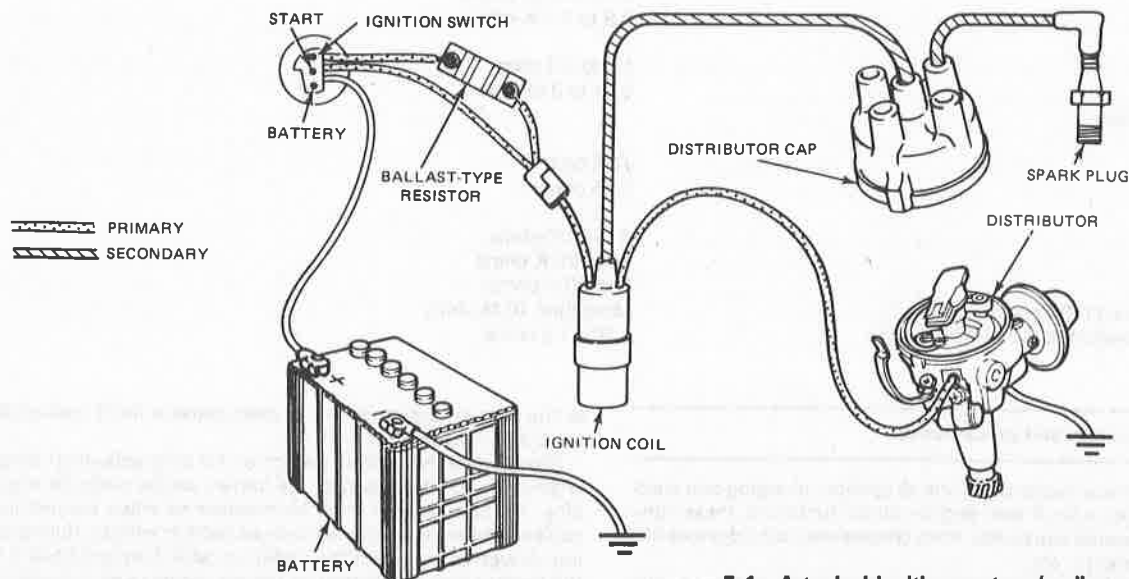
- 6 Attach the cable to the relay or ground connection and tighten the mounting nut/bolt securely.
- 7 Before connecting the new cable to the battery, make sure that it reaches the battery post without having to be stretched.
- 8 Connect the positive cable first, followed by the negative cable.

5 Ignition system — general information

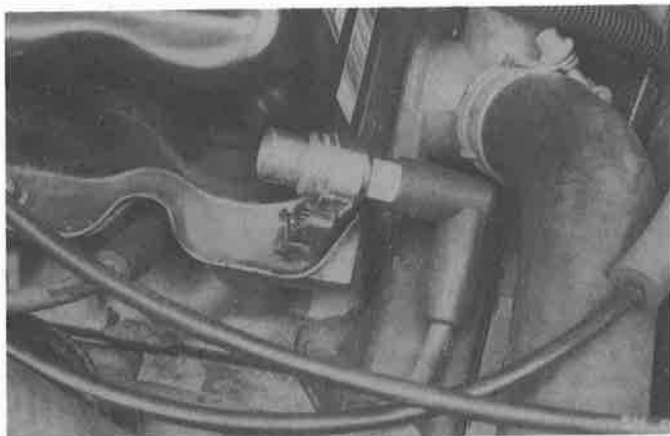
Refer to illustration 5.1

Earlier Mazda pickups are equipped with conventional ignition systems consisting of a battery, an ignition switch, a ballast resistor, an ignition coil, a distributor (with either single or dual contact points) and the spark plugs and wires (see illustration).

In 1979, some models were equipped with "breakerless" ignition systems which substituted an ignition amplifier and module for mechanical breaker points. By 1986, all vehicles employed this type of ignition system.



5.1 A typical ignition system (earlier points-type shown, newer breakerless systems similar)



6.2 To use a calibrated Ignition tester, disconnect a spark plug wire, attach the wire to the tester, clip the tester to a convenient ground and operate the starter — if there's enough power to fire the plug, sparks will be visible between the electrode tip and the tester body

6 Ignition system — check

Refer to illustration 6.2

Warning: Because of the very high secondary (spark plug) voltage generated by the ignition system, extreme care should be taken when this check is done.

Calibrated ignition tester method

- 1 If the engine turns over but won't start, disconnect the spark plug lead from any spark plug and attach it to a calibrated ignition tester (available at most auto parts stores).
- 2 Connect the clip on the tester to a bolt or metal bracket on the engine (see illustration), crank the engine and watch the end of the tester to see if bright blue, well-defined sparks occur.
- 3 If sparks occur, sufficient voltage is reaching the plug to fire it (repeat the check at the remaining plug wires to verify that the distributor cap and rotor are OK). However, the plugs themselves may be fouled, so remove and check them as described in Chapter 1 or install new ones.
- 4 If no sparks or intermittent sparks occur, remove the distributor cap and check the cap and rotor as described in Chapter 1. If moisture is present, use WD-40 (or something similar) to dry out the cap and rotor, then reinstall the cap and repeat the spark test.
- 5 If there's still no spark, detach the secondary coil wire from the distributor cap and hook it up to the tester (reattach the plug wire to the spark plug), then repeat the spark check.
- 6 If no sparks occur, check the primary (small) wire connections at the coil to make sure they're clean and tight. Refer to Section 7 and check the ignition coil. Make any necessary repairs, then repeat the check again.
- 7 If sparks now occur, the distributor cap, rotor, plug wire(s) or spark plug(s) (or all of them) may be defective.
- 8 If there's still no spark, the coil-to-cap wire may be bad (check the resistance with an ohmmeter and compare it to the Specifications). If a known good wire doesn't make any difference in the test results, the ignition coil, module or other internal components may be defective.

Alternative method

Note: If you're unable to obtain a calibrated ignition tester, the following method will allow you to determine if the ignition system has spark, but it won't tell you if there's enough voltage produced to actually initiate combustion in the cylinders.

- 9 Remove the wire from one of the spark plugs. Using an insulated tool, hold the wire about 1/4-inch from a good ground and have an assistant crank the engine.
- 10 If bright blue, well-defined sparks occur, sufficient voltage is reaching the plug to fire it. However, the plug(s) may be fouled, so remove and check them as described in Chapter 1 or install new ones.
- 11 If there's no spark, check the remaining wires in the same manner.

A few sparks followed by no spark is the same condition as no spark at all.

12 If no sparks occur, remove the distributor cap and check the cap and rotor as described in Chapter 1. If moisture is present, use WD-40 (or something similar) to dry out the cap and rotor, then reinstall the cap and repeat the spark test.

13 If there's still no spark, disconnect the secondary coil wire from the distributor cap, hold it about 1/4-inch from a good engine ground and crank the engine again.

14 If no sparks occur, check the primary (small) wire connections at the coil to make sure they're clean and tight. Refer to Section 7 and check the ignition coil. Make any necessary repairs, then repeat the check again.

15 If sparks now occur, the distributor cap, rotor, plug wire(s) or spark plug(s) (or all of them) may be defective.

16 If there's still no spark, the coil-to-cap wire may be bad (check the resistance with an ohmmeter and compare it to the Specifications). If a known good wire doesn't make any difference in the test results, the ignition coil, module or other internal components may be defective.

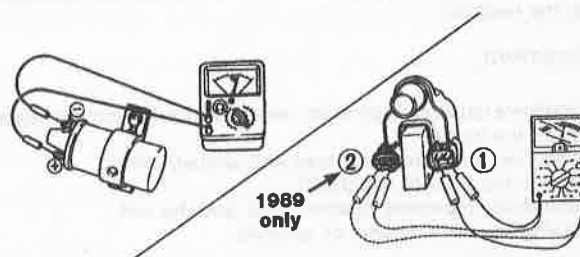
7 Ignition coil — check and replacement

Refer to illustrations 7.4, 7.5, 7.6 and 7.8

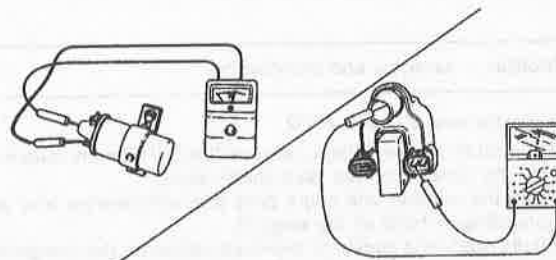
Check

Coil

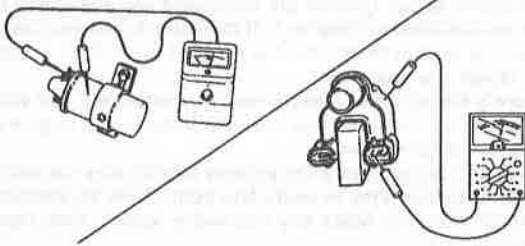
- 1 Inspect the ignition coil for chips, cracks or other damage. If any physical deterioration is visible, replace the coil.
- 2 Start the engine and allow it to run for a few minutes to heat up the coil to its normal operating temperature.
- 3 Stop the engine and detach the cable from the negative terminal of the battery.
- 4 Using an ohmmeter, measure the primary coil resistance by touching one lead of the meter to the positive primary terminal and the other to the negative primary terminal (see illustration). Compare your reading to the specified primary coil resistance. If the indicated measurement does not correspond to the specified primary resistance, replace the coil.
- 5 Using an ohmmeter, measure the secondary coil resistance by touching one lead of the meter to the positive primary terminal and the other to the high tension terminal (see illustration). Compare your



7.4 To check the primary resistance of the coil, touch one lead of an ohmmeter to the primary positive terminal and the other to the primary negative terminal and compare your measurement to the specified primary resistance



7.5 To check the secondary resistance of the coil, touch one lead of an ohmmeter to the primary positive terminal and the other to the high tension terminal and compare your measurement to the specified secondary resistance



7.6 To check the insulation resistance of the coil, touch one lead of an ohmmeter to the primary negative terminal and the other to the coil case and compare your measurement to the specified insulation resistance

reading to the specified secondary coil resistance. If the indicated measurement does not correspond to the specified secondary resistance, replace the coil. **Note:** *This test cannot be performed on earlier coils — prior to 1986, no secondary resistance values were provided by the manufacturer.*

6 Using an ohmmeter, measure the insulation resistance of the coil housing by touching one lead of the meter to a primary terminal and the other to the case (see Illustration). Compare your reading to the specified insulation resistance of the coil. If the indicated measurement does not correspond to the specified insulation resistance, replace the coil. **Note:** *This test cannot be performed on earlier coils — prior to 1986, no insulation resistance values were provided by the manufacturer.*

External resistor (1988 B2600 models only)

Note: *The external resistor is located to the left of the coil, above and forward of the alternator.*

7 Detach the cable from the negative terminal of the battery.

8 Using an ohmmeter, measure the resistance of the external resistor by touching the leads of the meter to the two resistor terminals (see Illustration). Compare your reading to the specified resistance. If the indicated measurement does not correspond to the specified resistance, replace the resistor.

Replacement

Coil

9 If you have not already done so, detach the cable from the negative terminal of the battery.

10 Disconnect the distributor lead and primary wires.

11 Remove the boot (if equipped).

12 Remove the mounting bracket bolts and the coil.

13 Installation is the reverse of removal.

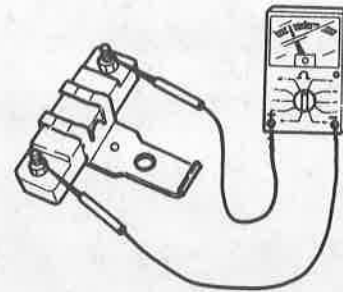
External resistor

14 If you have not already done so, detach the cable from the negative terminal of the battery.

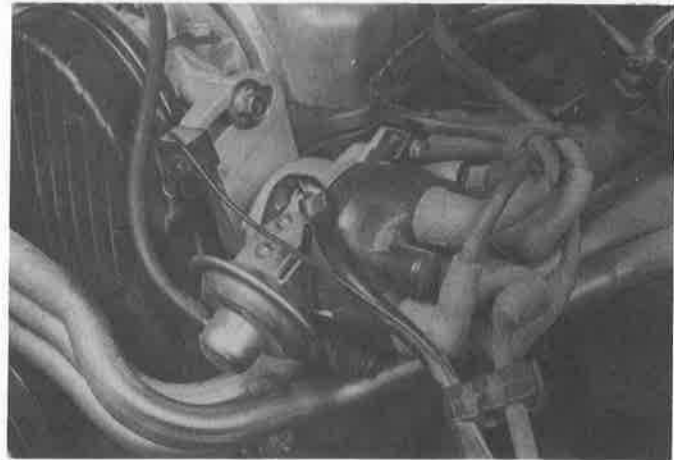
15 Disconnect the wires from the resistor.

16 Remove the mounting bracket bolt and the resistor.

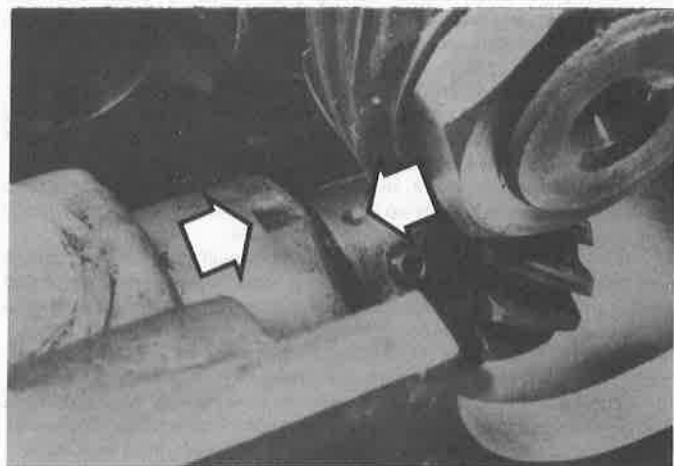
17 Installation is the reverse of removal.



7.8 To check the resistance of the external resistor, touch the leads of an ohmmeter to the terminals of the resistor and compare your measurement to the specified resistance



8.1 All spark plug wires, electrical connections and the vacuum advance hose should be carefully marked and numbered with pieces of tape before removing from the distributor body



8.10 When installing the distributor, make sure that the drilled mark on the driven gear is aligned with the dimple on the distributor base (arrows)

8 Distributor — removal and installation

Refer to illustrations 8.1 and 8.10

1 After carefully marking them, remove the coil wire and spark plug wires from the distributor cap (see Illustration).

2 Remove the number one spark plug (the one nearest you when you are standing in front of the engine).

3 Manually rotate the engine to top-dead-center on the compression stroke for number one piston (see Chapter 2A for this procedure).

4 Carefully label then disconnect the vacuum hose from the vacuum advance diaphragm.

5 Disconnect the electrical wires to the distributor.

6 Use a small brush and paint, or a scribe to mark the rotor position in relation to the body of the distributor. Make another mark between

the distributor body and the mating surface on the engine cylinder head.

7 Remove the distributor hold down nut.

8 Remove the distributor. **Caution:** *Do not rotate the engine with the distributor out.*

9 Before starting installation of the distributor, make certain the number one piston is at top-dead-center on the compression stroke.

10 Align the drilled mark on the driven gear with the dimple on the distributor housing (see Illustration). Insert the distributor into the engine with the adjusting clamp centered over the hold-down hole. Make sure that the gear does not turn as the distributor is inserted.

- 11 Install the hold-down nut. The marks previously made on the distributor housing and on the rotor and cylinder head should be aligned before the bolt is tightened.
- 12 Install the distributor cap.
- 13 Connect the wiring for the distributor.
- 14 Install the spark plug wires.
- 15 Install the vacuum hoses as previously marked.
- 16 Time the engine as described in Chapter 1, *Ignition timing — adjustment*.

9 Charging system — general information and precautions

The charging system includes the alternator, either an internal or an external voltage regulator, a charge indicator, the battery, a fusible link and the wiring between all the components. The charging system supplies electrical power for the ignition system, the lights, the radio, etc. The alternator is driven by a drivebelt at the front of the engine.

The purpose of the voltage regulator is to limit the alternator's voltage to a preset value. This prevents power surges, circuit overloads, etc., during peak voltage output.

The fusible link is a short length of insulated wire integral with the engine compartment wiring harness. The link is four wire gauges smaller in diameter than the circuit it protects. Production fusible links and their identification flags are identified by the flag color. See Chapter 12 for additional information regarding fusible links.

The charging system doesn't ordinarily require periodic maintenance. However, the drivebelt, battery and wires and connections should be inspected at the intervals outlined in Chapter 1.

Be very careful when making electrical circuit connections to a vehicle equipped with an alternator and note the following:

- a) When reconnecting wires to the alternator from the battery, be sure to note the polarity.
- b) Before using arc welding equipment to repair any part of the vehicle, disconnect the wires from the alternator and the battery terminals.
- c) Never start the engine with a battery charger connected.
- d) Always disconnect both battery leads before using a battery charger.

10 Charging system — on-vehicle check

- 1 If a malfunction occurs in the charging circuit, don't automatically assume that the alternator is causing the problem. First check the following items:
 - a) The battery cables where they connect to the battery. Make sure the connections are clean and tight (see Chapter 1).
 - b) Check the external alternator wiring harness and the connectors at the alternator and voltage regulator. They must be in good condition, clean and tight.
 - c) Check the drivebelt condition and tension (see Chapter 1).
 - d) Make sure the alternator mounting and adjustment bolts are tight.
 - e) Check the fusible link located between the starter relay (refer to Section 19) and the alternator. If it's burned, determine the cause, repair the circuit and replace the link (see Chapter 12).
 - f) Run the engine and check the alternator for abnormal noise.
- 2 Using a voltmeter, check the battery voltage with the engine off. It should be approximately 12-volts.
- 3 Start the engine and check the battery voltage again. It should now be approximately 14-to-15 volts.
- 4 If the voltage reading is less or more than the specified charging voltage above, replace the voltage regulator (see Section 12).

11 Alternator — removal and installation

Refer to illustration 11.4

- 1 Detach the cable from the negative terminal of the battery.
- 2 Unplug the electrical connectors from the alternator and the voltage regulator.
- 3 Loosen the alternator adjustment and pivot bolts and detach the drivebelt (see Chapter 1).



11.4 This view shows the alternator adjustment bolt, which is within the slotted portion of the bracket. The pivot bolt runs through a flange at the bottom of the alternator

- 4 Remove the adjustment and pivot bolts and separate the alternator from the engine (see illustration).
- 5 Installation is the reverse of removal.
- 6 After the alternator is installed, adjust the drivebelt tension (see Chapter 1).

12 Voltage regulator — removal and installation

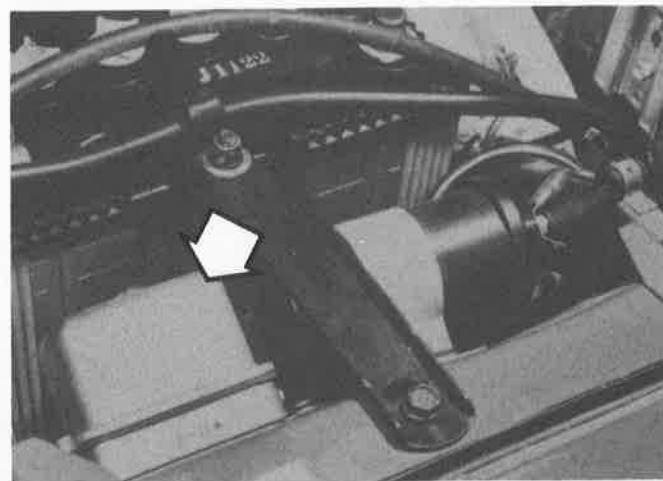
Refer to illustration 12.2

External

- 1 Detach the cable from the negative terminal of the battery.
- 2 Locate the voltage regulator (see illustration) at the front of the engine compartment, next to the coil.
- 3 Unplug the electrical connector from the regulator.
- 4 Remove the regulator mounting bolts and remove the regulator from the vehicle.
- 5 Installation is the reverse of removal.

Internal (IC regulator)

- 6 Remove the alternator and either exchange it for a rebuilt unit or have the IC regulator replaced.



12.2 A typical external voltage regulator assembly

13 Starting system — general information

The function of the starting system is to crank the engine. The starting system is composed of a starter motor, solenoid and battery. When the ignition switch is turned to Start, electrical energy is supplied by the battery to the solenoid, which completes the circuit to the starter motor, cranking the engine over by turning the ring gear on the flywheel.

A neutral start switch is incorporated into the starting system so that the starter motor can only be operated when the clutch pedal is depressed (manual transmission) or the shift lever is in Park or Neutral (automatic transmission).

Never operate the starter motor for more than 30 seconds at a time without pausing to allow it to cool for at least two minutes. Excessive cranking can cause overheating, which can seriously damage the starter.

14 Starter motor — in-vehicle check

Note: Before diagnosing starter problems, make sure that the battery is fully charged.

- 1 If the starter motor does not turn at all when the switch is operated, make sure that the shift lever is in Park (automatic transmission) or that the clutch pedal is depressed (manual transmission).
- 2 Make sure that the battery is charged and that all cables, both at the battery and starter solenoid terminals, are secure.
- 3 If the starter motor spins but the engine is not cranking, then the overrunning clutch in the starter motor is slipping and the starter motor must be replaced.
- 4 If, when the switch is actuated, the starter motor does not operate at all but the solenoid clicks, then the problem lies with either the battery, the main solenoid contacts or the starter motor itself.
- 5 If the solenoid plunger cannot be heard when the switch is actuated, the solenoid itself is defective or the solenoid circuit is open.
- 6 To check the solenoid, connect a jumper lead between the battery positive terminal and the terminal on the solenoid. If the starter motor

now operates, the solenoid is OK and the problem is in the ignition switch, neutral start switch or in the wiring.

7 If the starter motor still does not operate, remove the starter/solenoid assembly and have it repaired or replace it.

8 If the starter motor cranks the engine at an abnormally slow speed, first make sure that the battery is charged and that all terminal connections are tight. If the engine is partially seized, or has the wrong viscosity oil in it, it will crank slowly.

9 Run the engine until normal operating temperature is reached, then disconnect the coil wire from the distributor cap and ground it on the engine.

10 Connect a voltmeter positive lead to the "S" (Starter motor) terminal of the solenoid and connect the negative lead to ground.

11 Turn the ignition switch to Start and take a voltmeter reading as soon as a steady figure is indicated. Do not allow the starter motor to turn for more than 30 seconds at a time. A reading of 9 volts or more, with the starter motor turning at normal cranking speed, is normal. If the reading is 9 volts or more but the cranking speed is slow, the motor is faulty. Have it repaired or replace it. If the reading is less than 9 volts and the cranking speed is slow, the solenoid contacts are probably burned, or the interlock switch or the starter wiring is faulty.

Note: If the magnetic switch is hot, it may not function, even though the voltage is adequate. Also the cranking speed is greatly affected by engine oil viscosity.

15 Starter motor — removal and installation

- 1 Disconnect the cable from the negative terminal of the battery.
- 2 Remove the carburetor air cleaner and air intake tube for access.
- 3 Disconnect the battery cable from the starter solenoid 'B' terminal and the ignition switch wire from the '50' or 'S' terminal.
- 4 Raise the front of the vehicle and place it securely on jackstands.
- 5 Working from below, remove the starter attaching nuts, washers and bolts.
- 6 Remove the starter from below.
- 7 Installation is the reverse of the removal procedure.