Servicing GM Charging and Starting Systems
Part III

Courtesy General Motors Corp.

Section II-Component Identification and Replacement

This section is broken into two major subsections: alternators and starters. Each of the subsections contains information on how to identify the manufacturer of the component to be tested and guidelines for removal and installation.

Each subsection also contains an application chart which identifies most domestic and import vehicles. Use these charts along with the specific manufacturer identification information given to determine the manufacturer of the component to be tested. After identifying the manufacturer, refer to Section 1 for testing procedures.

Alternators

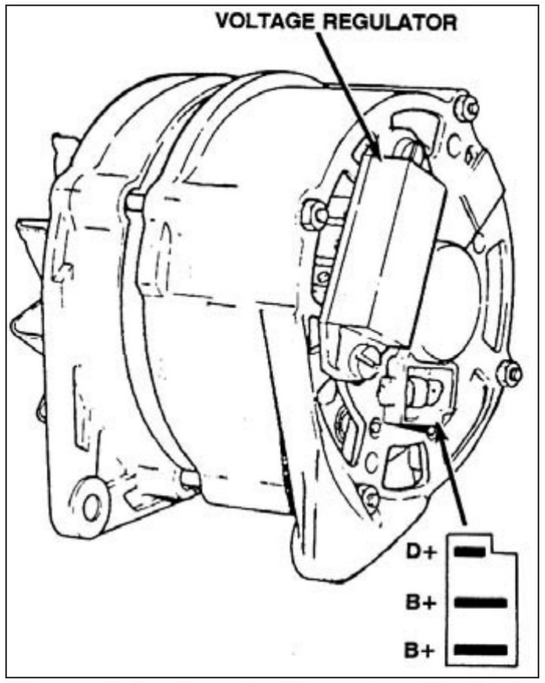

Figure 2-1—Bosch Alternator -Typical

To determine the manufacturer of the alternator to be tested, refer to the following application charts.

Bosch Alternators

Bosch alternators are of the conventional three-phase, self-rectifying type and are original equipment on most European-made vehicles and on some

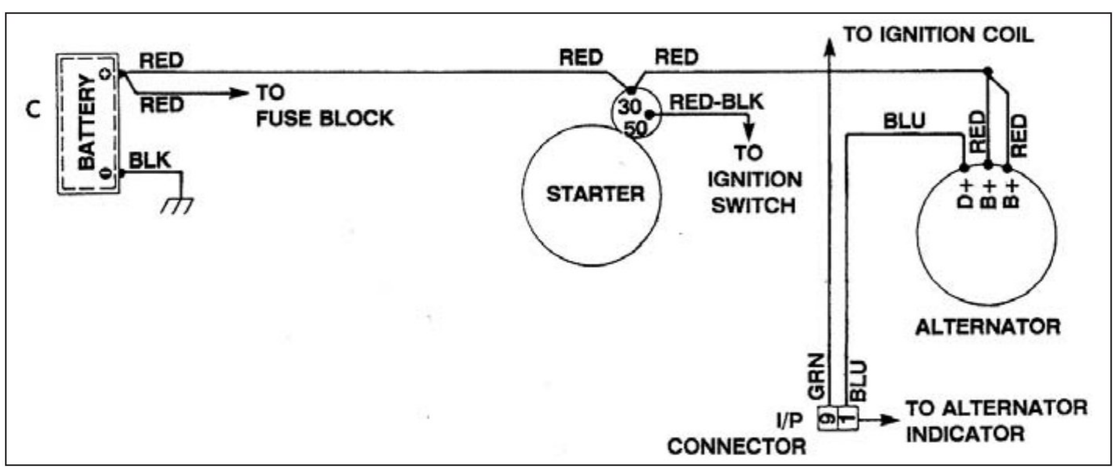

Figure 2-2—Bosch Charging Circuit -Typical

ALTERNATOR APPLICATIONS

Vehicle Manufacturer/Model and/or Year			Bosch	Chrysler	Delco-Remy	Duceiller/Paris-Rhone	Hitachi	Mitsubishi	Motorcraft	Motorola	Nippondenso
ACURA	All										X
AMC	1975				X					X	
	1976				X				X		
	1977–1978								X		
	1979–1980	8 cylinder	X								
		4 and 6 cylinder			X						
	1981–1987—Except Alliance and Encore				X						
	1983–1987—Alliance, Encore and Fuego					X					
CHRYSLER (except import)	1975–1983—All			X							
	1984–1990—RWD			X							X
	1984–1990—FWD		X					X			
CHRYSLER (import)	Except 1978 and 1979 Arrow/Colt w/o hatchback w/1600cc engine							X			
	1978 and 1979 Arrow/Colt w/hatchback and 1600cc engine										X
EAGLE	1984–1990—Except Medallion				X						
	Medallion					X					
FORD	1975–1990—Except 1975–1978 Capri, XR4TI, Scorpio, Fiesta, Festiva, Tracer and Probe								X		
	Probe, Festiva and Tracer							X			
	1975–1978 Capri, XR4TI, Scorpio and Fiesta		X								
GENERAL MOTORS	1975–1990—Except Sprint, 1985–1988 Spectrum, Chevette and T1000, w/Diesel and 1986–1988 Nova				X						
	Chevette and T1000 w/Diesel							X			
	Sprint, 1985–1988 Spectrum and1986–1988 Nova										X
GEO	1989–1990—Metro, Prism, Spectrum and Tracker										X
	1989–1990—Storm						X				
ISUZU	1982–1990						X				
HONDA	All[1]										X
MAZDA								X			
HYUNDAI	1987–1990							X			
MITSUBISHI								X			
NISSAN/DATSUN	1975–1990[2]						X	X			
	1984–1988—300 ZX Turbo							X			
TOYOTA	1975–1990										X
VOLKSWAGEN/AUDI	1975–1990		X							X	
VOLVO	1975–1990		X								

[1]Some 1989 Civic vehicles use a Mitsubishi alternator.
[2]Beginning in the 1989 model year, some vehicles use either a Hitachi or Mitsubishi alternator.

domestic vehicles with imported engines. Bosch K-1 alternators use an integral, case mounted regulator for most vehicles made after 1982 (Figure 2-1).

Alternators with a part number beginning with 400 and 450 use a remote, vibrator type or solid-state regulator. These are usually found on vehicles built prior to 1982 and are not adjustable.

Bosch alternators can be identified by the exposed brown or orange band of the stator core, and by the square black or round white rear-mounted electronic voltage regulator. For the specific vehicle output rating, refer to the Alternator Output Specifications reference manual.

Output voltage can be checked at either B+ terminal if a wiring problem is suspected. Ensure that the alternator is properly grounded.

A voltage regulator bypass ("full field") test is not recommended.

Refer to Figure 2-2 for a typical Bosch charging circuit diagram.

Chrysler (MOPAR) Alternators

Chrysler alternators are usually one of two basic designs. From 1975 through about 1980, Chrysler alternators have an internal fan and an external electro-mechanical or electronic regulator. They can be recognized by their "bird-cage" appearance (Figure 2-3). Later alternator designs have external fans and the regulator is incorporated in the electronic engine control unit (Figure 2-4).

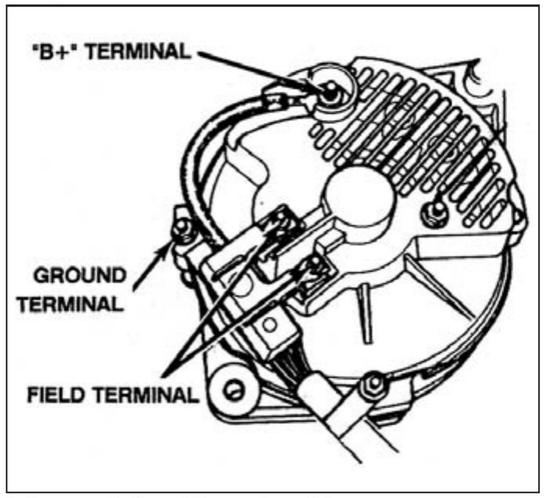

Figure 2-4—Chrysler Alternator—Regulator Located in ECU -Typical

For specific vehicle alternator output, refer to the Alternator Output Specifications reference manual.

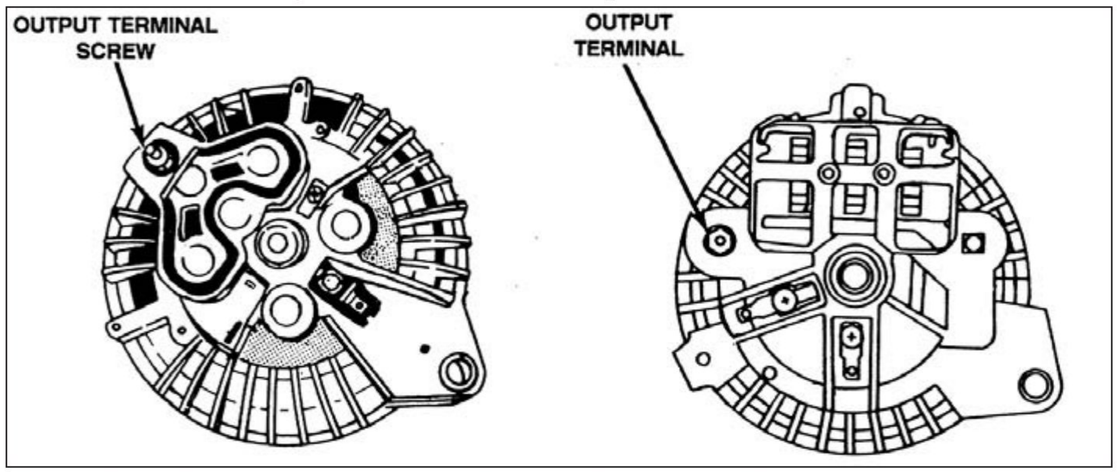

Figure 2-3—Chrysler Alternator—External Regulator -Typical

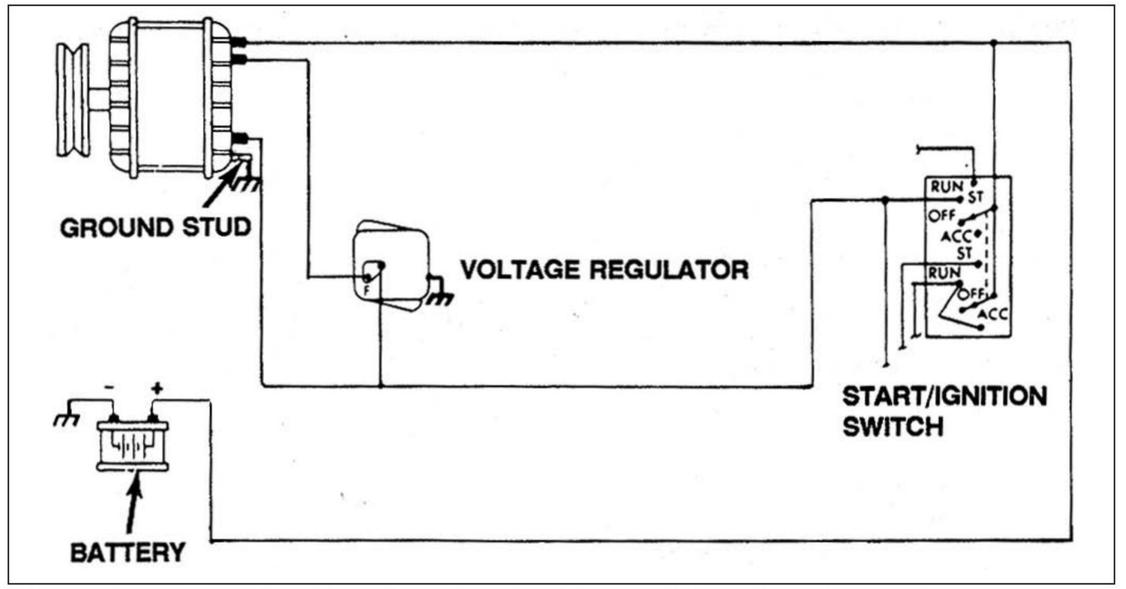

Figure 2-5—Chrysler Charging Circuit—External Regulator -Typical

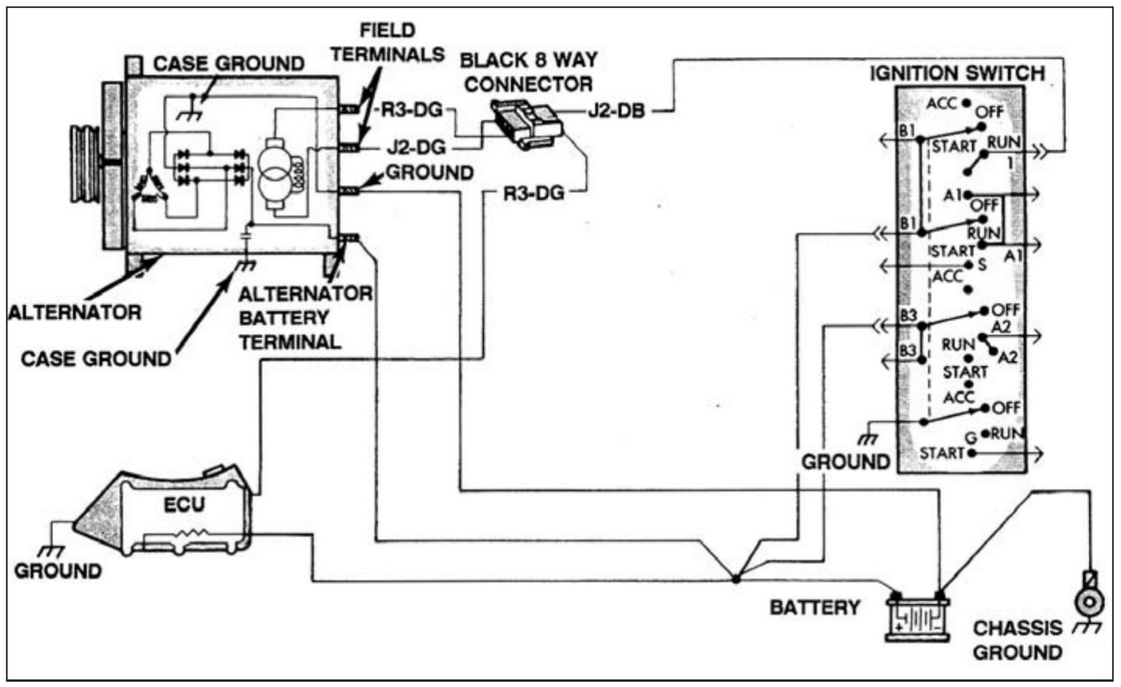

Figure 2-6—Chrysler Charging Circuit—Regulator Integrated with Engine ECU -Typical

Output voltage can be checked at the output/battery terminal located approximately 180 degrees from the alternator pivot mounting lug.

Note: A voltage regulator test can be performed only on vehicles with a remote voltage regulator.

Refer to Figures 2-5 and 2-6 for typical Chrysler charging circuit diagrams.

Delcotron, Delco-Remy Alternators

General Motors domestic vehicles and some American Motors vehicles use two types of Delco-Remy alternators. They are classified as the SI and the CS type, both of which use an integral electronic voltage regulator.

SI alternators (Figure 2-7), are the conventional diode design and are available in many output and mounting variations to suit a large number of applications. Testing, however, remains the same for all SI alternators.

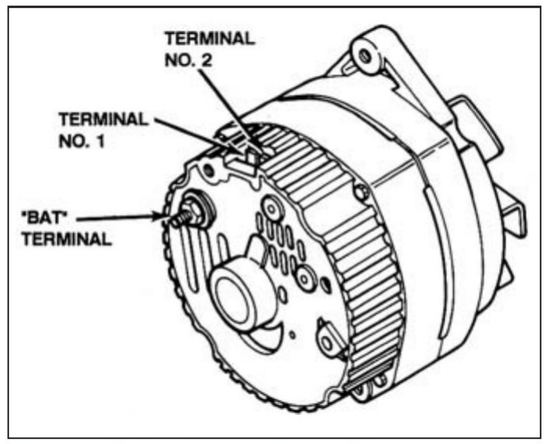

Figure 2-7—Delco-Remy SI Alternator -Typical

CS alternators (Figure 2-8) use a six-diode rectifier rather than a diode trio, and have a built-in voltage regulator with a fault detection capability that can be accessed through the vehicle's diagnostics system. CS alternators have higher amperage output over the SI type. For specific vehicle alternator output, refer to the Alternator Output Specifications reference manual.

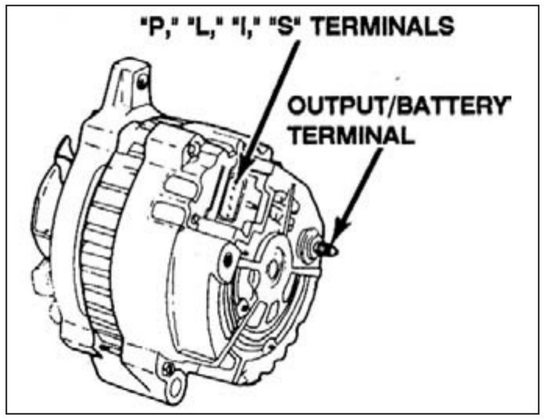

Figure 2-8—Delco-Remy CS Alternator -Typical

Output voltage at the alternator can be checked at the battery terminal stud on the back of the alternator if a wiring problem is suspected.

Refer to Figures 2-9 and 2-10 for typical charging circuit diagrams.

Ducellier and Paris-Rhone Alternators

AMC Alliance, Encore and Fuego models use either a Ducellier or a Paris-Rhone alternator, which are interchangeable (Figure 2-11). The voltage regulator for both designs is the integrally mounted, electronic type. Charging circuits for both alternators are similar. For specific vehicle alternator output, refer to the Alternator Output Specifications reference manual.

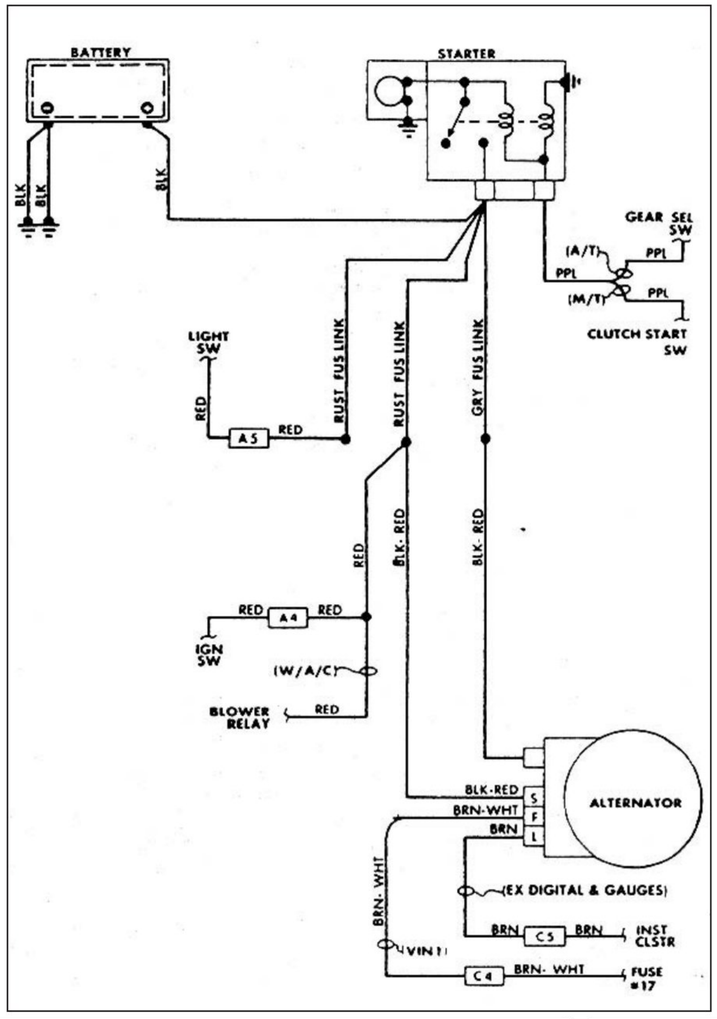

Figure 2-10—CS Charging Circuit -Typical

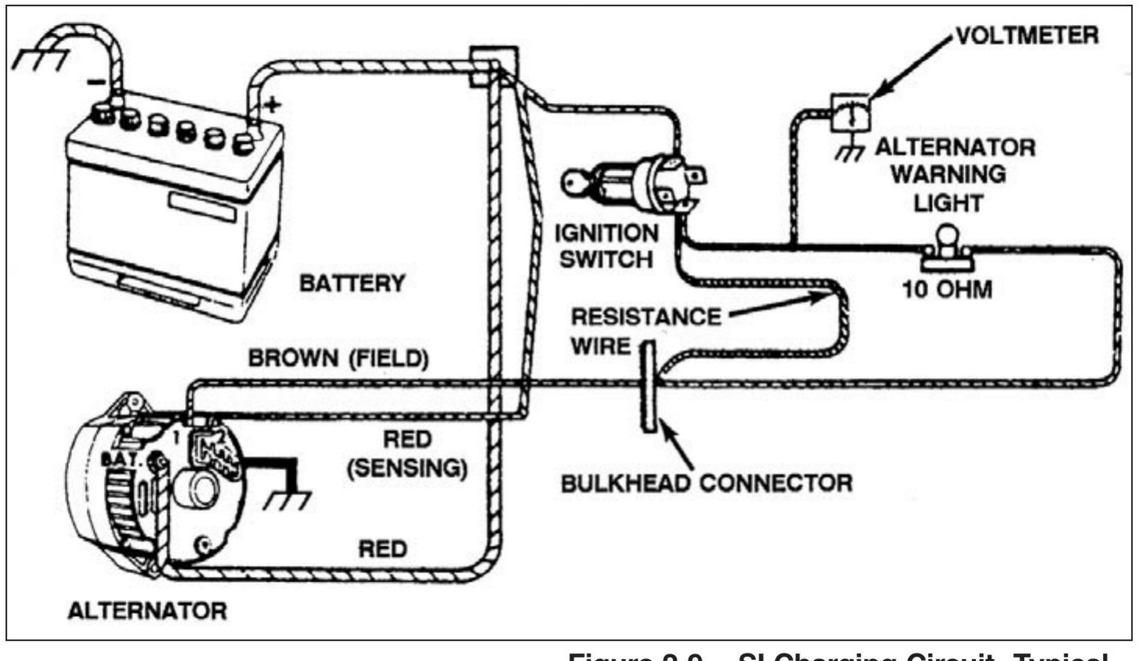

Figure 2-9—SI Charging Circuit -Typical

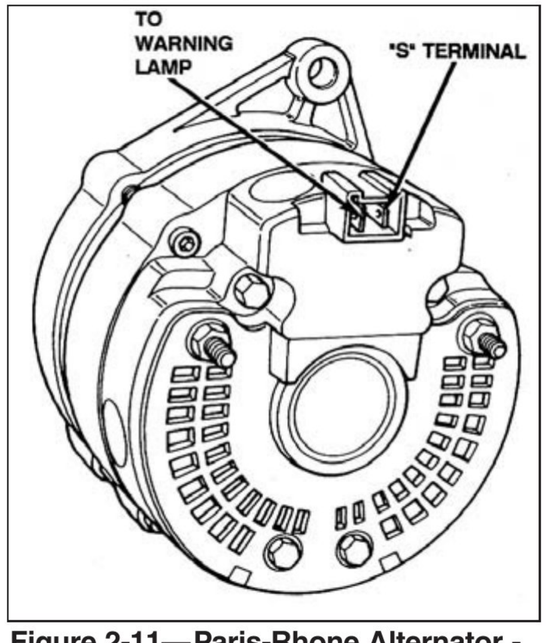

Figure 2-11—Paris-Rhone Alternator - Typical

Alternator output voltage can be checked at the "S" terminal connection at the alternator if a wiring problem is suspected.

A voltage regulator bypass ("full field") test is not recommended.

Hitachi Alternators

Hitachi alternators are the conventional diode type and are used on many GEO, Honda, Isuzu, Nissan and Subaru vehicles (Figure 2-12). Most Hitachi alternators use an integral voltage regulator that needs no adjustment. Some Isuzu models (I-Mark, Trooper II) may use a remote electro-mechanical voltage regulator. For specific vehicle alternator output, refer to the Alternator Output Specifications reference manual.

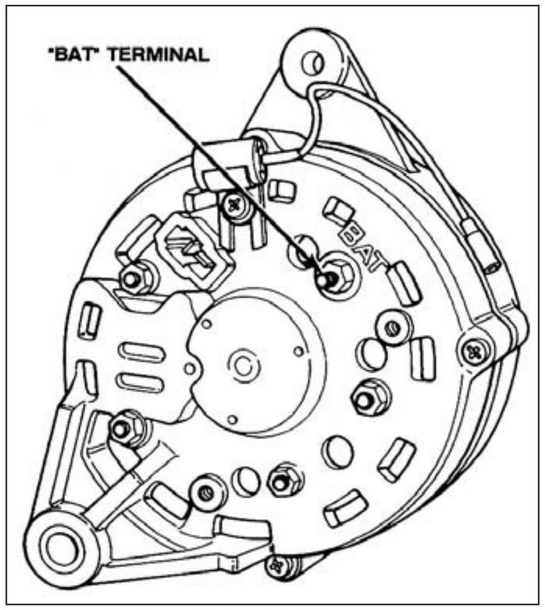

Figure 2-12—Hitachi Alternators - Typical

Alternator output voltage can be checked at the "BAT" terminal of the regulator on the back of the alternator if a wiring problem is suspected.

A voltage regulator bypass ("full field") test is not recommended on alternators with the integral regulator.

Note: Diesel engines use the alternator to drive the vacuum pump on many applications. Ensure that any replacement alternator is of the same design as the one removed.

Refer to Figure 2-13 for a typical Hitachi charging circuit diagram.

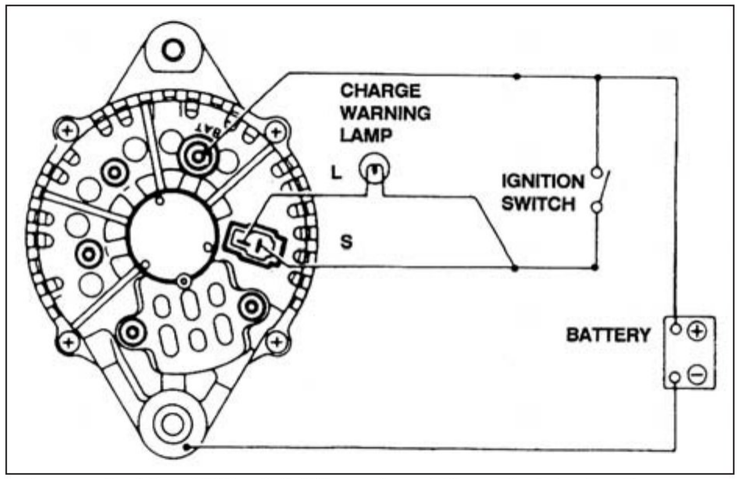

Figure 2-13—Hitachi Charging Circuit -Typical

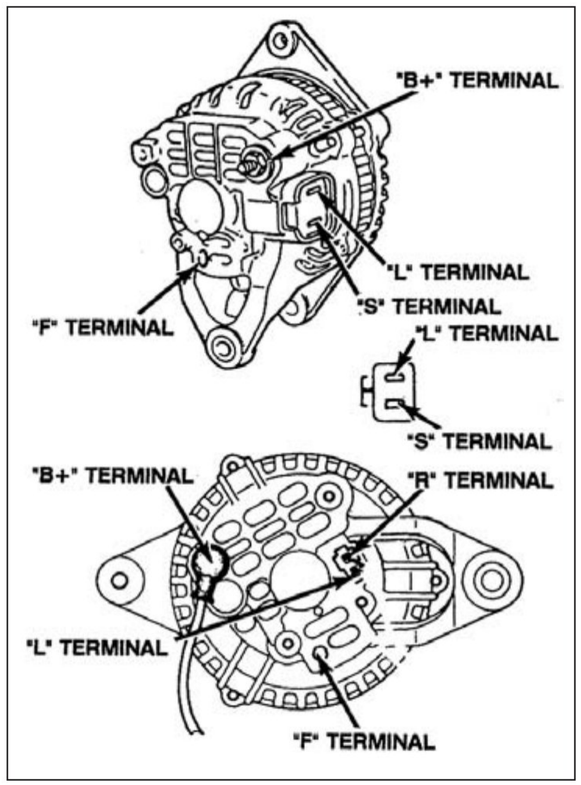

Figure 2-14—Mitsubishi Alternators - Typical

Mitsubishi Alternators

Mitsubishi alternators are the conventional diode type using a case mounted electronic voltage regulator (Figure 2-14). They are used on Acura, Hyundai, Mazda, Mitsubishi and some Nissan vehicles and on Chrysler imports. For specific vehicle alternator output, refer to the Alternator Output Specifications reference manual.

Alternator output voltage can be checked at the B+ terminal on the back of the alternator if a wiring problem is suspected.

A voltage regulator bypass ("full field") test is not recommended.

Refer to Figure 2-15 for a typical Mitsubishi charging circuit diagram.

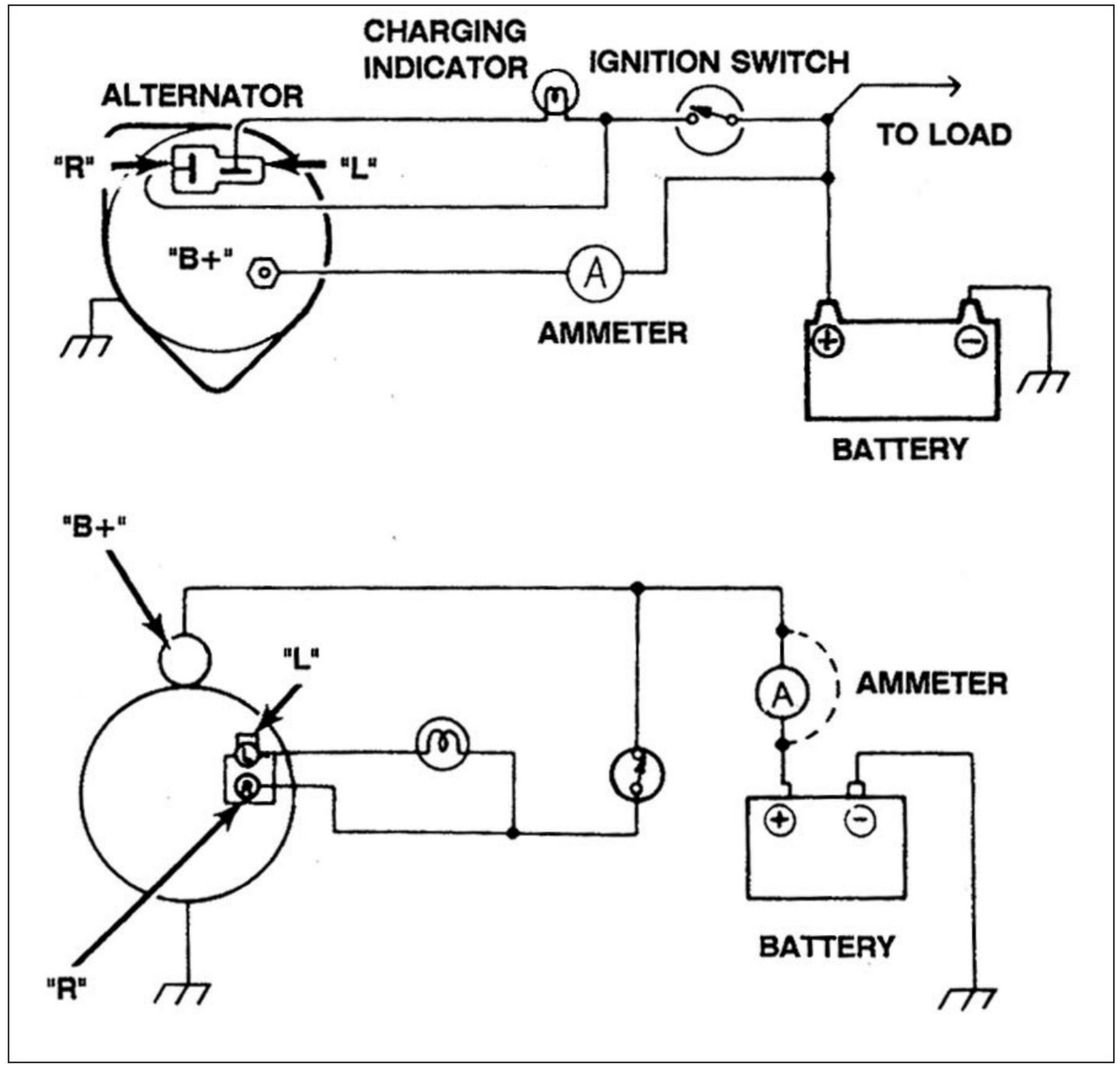

Figure 2-15—Mitsubishi Charging Circuits -Typical

Motorcraft Alternators

Ford Motor Company and some American Motors vehicles use Motorcraft alternators. There are two basic design types: alternators using a remote mounted voltage regulator are used on some vehicles (Figure 2-16), and alternators using an integral electronic regulator are used on vehicles equipped with the Integral Alternator-Regulator (IAR) system (Figure 2-17).

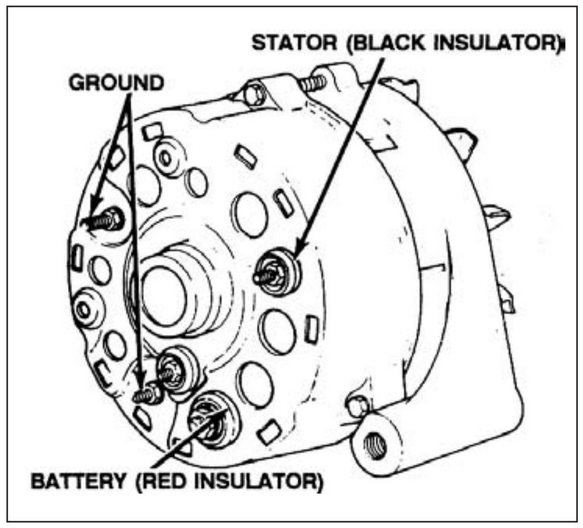

Figure 2-16—Motorcraft Alternator used with Remote Voltage Regulator

Alternators that use a remote mounted voltage regulator usually have their output rating stamped on the end casting. The remote voltage regulators are not adjustable, but can be replaced. For specific vehicle alternator output, refer to the Alternator Output Specifications reference manual.

Motorcraft alternators with an integral regulator can be identified by the gray plastic module marked with the letters "A," "S," "I" and "Motorcraft." High output alternators can be identified by a brown two-wire connector at a location marked with "FLD" and "STA." The stud type battery cable connector is located near the brown connector. "Motorcraft" is also stamped into the rear housing.

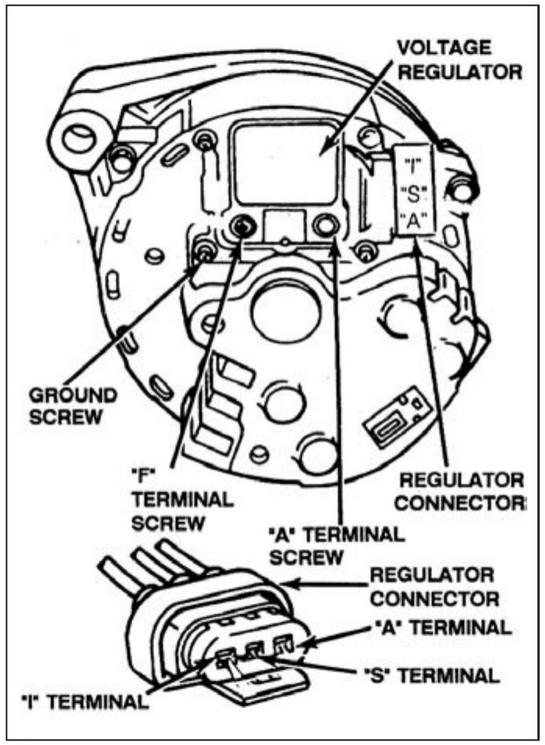

Figure 2-17—Motorcraft Alternator with Internal Voltage Regulator – Typical

Note: A voltage regulator bypass ("full field") test can be performed only on vehicles with a remote voltage regulator.

Refer to Figures 2-18 and 2-19 for typical Motorcraft charging circuit diagrams.

Motorola Alternators

Motorola alternators are the conventional three-phase, self-rectifying type with an integral voltage regulator (Figure 2-20). They are used on some Volkswagen/Porsche/Audi vehicles. Motorola alternators can usually be identified by the logo stamped on the front housing, visible when facing the pulley, and the integral voltage regulator that mounts on the back of the alternator. For specific vehicle alternator output, refer to the Alternator Output Specifications reference manual.

Alternator output can be checked at the B+ terminal on the alternator if a wiring problem is suspected.

A voltage regulator bypass ("full field") test is not recommended.

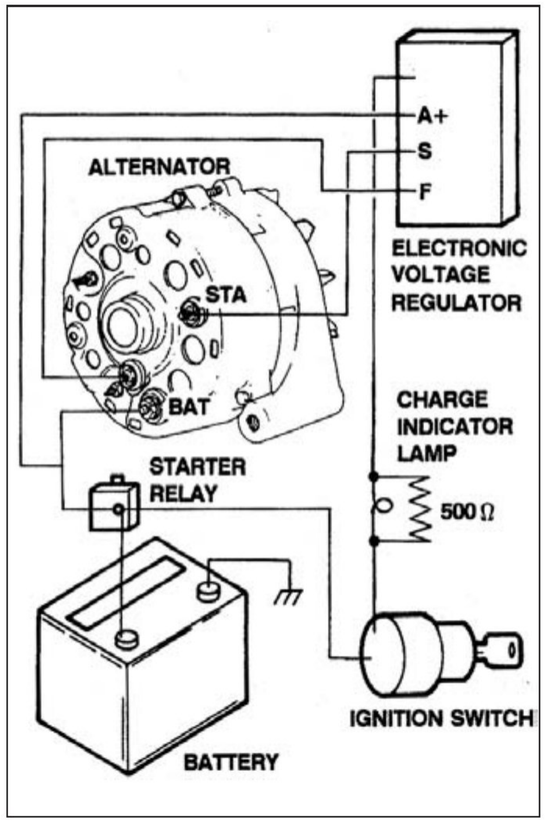

Figure 2-18—Charging Circuit – Remote Mounted Regulator – Typical

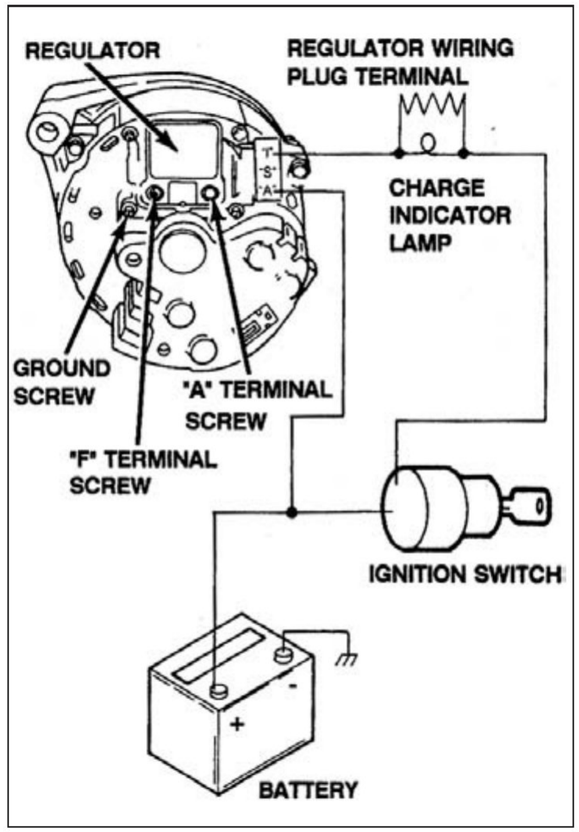

Figure 2-19—Charging Circuit – Integral Regulator – Typical

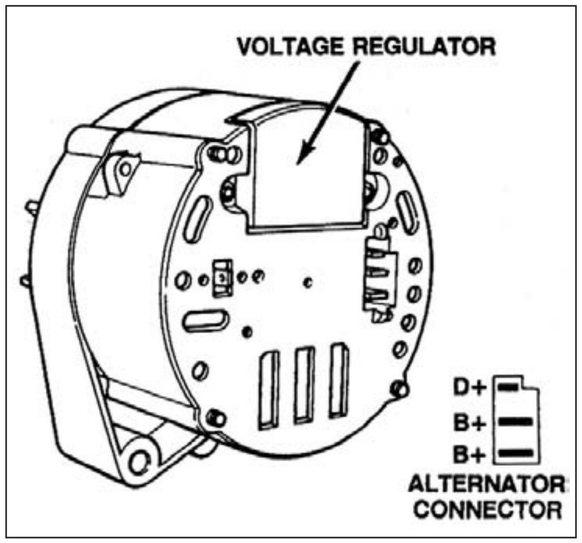

Figure 2-20—Motorola Alternator – Typical

Refer to Figure 2-21 for a typical Motorola charging circuit diagram.

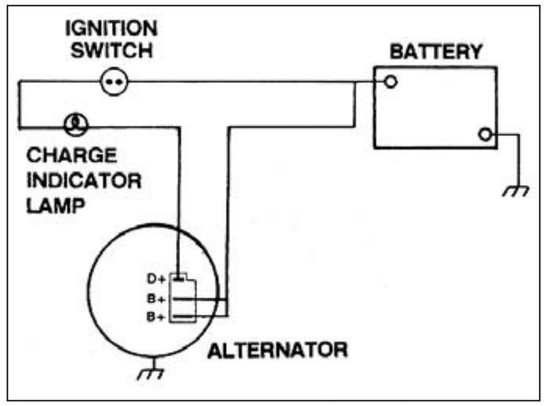

Figure 2-21—Motorola Charging Circuit – Typical

Nippondenso Alternators

Nippondenso alternators are used by Chrysler imports, some GM imports, GEO, Isuzu, Honda, Subaru and Toyota (Figure 2-22).

Nippondenso alternators are the conventional type using six diodes to rectify current. Voltage regulators are the remote electro-mechanical, remote electronic or the integral electronic design. The remote voltage regulator is usually found on vehicles built prior to 1984. For specific vehicle alternator output, refer to the Alternator Output Specifications reference manual.

Note: A voltage regulator bypass ("full field") test can be performed only on vehicles with a remote voltage regulator.

Refer to Figure 2-23 for a typical Nippondenso charging circuit diagram.

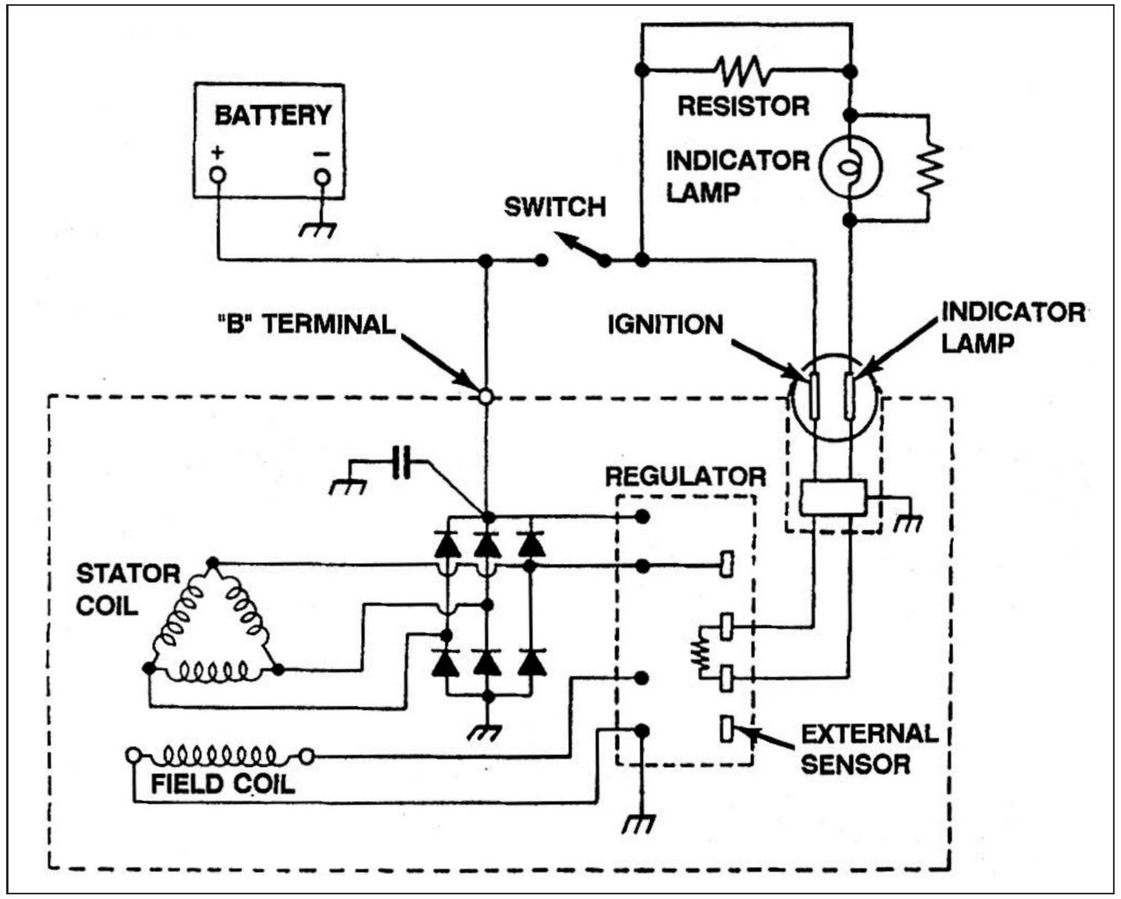

Figure 2-23—Nippondenso Charging Circuit with Integral Alternator and Regulator – Typical

Alternator Replacement

Removal

Note: It may be necessary to remove, loosen, or relocate other components (brackets/braces, hoses, power steering pump, etc.) to gain access to the alternator. It may also be helpful to tag all disconnected wires, removed nuts, bolts and other components to aid in installation.

1. Disconnect battery negative cable.
2. Remove alternator drive belt(s) as follows:
   A. V-Belt—Loosen adjusting bolt retaining alternator to adjusting bracket. Loosen pivot bolt, rotate alternator and disconnect belt from alternator pulley. Allow belt to hang from other pulley(s).
   B. Serpentine Belt—If vehicle is equipped with an automatic tensioner, rotate tensioner to relieve tension and remove belt. If vehicle is equipped with a manual tensioner, loosen tensioner mounting, then loosen adjusting bolt/nut until belt can be disconnected from alternator pulley. Allow belt to hang from other pulley(s) (Figure 2-24).

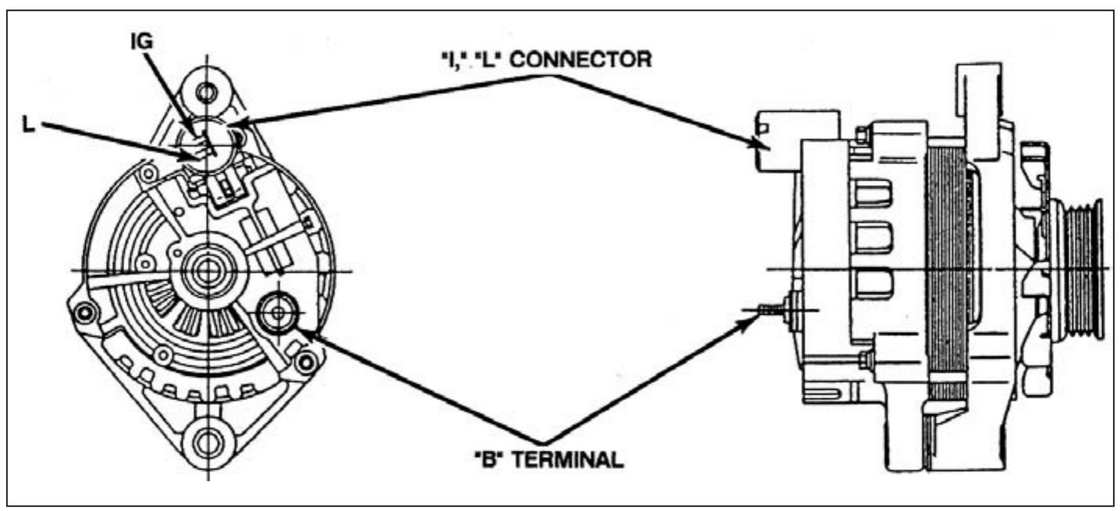

Figure 2-22—Nippondenso Alternator with integral Regulator – Typical

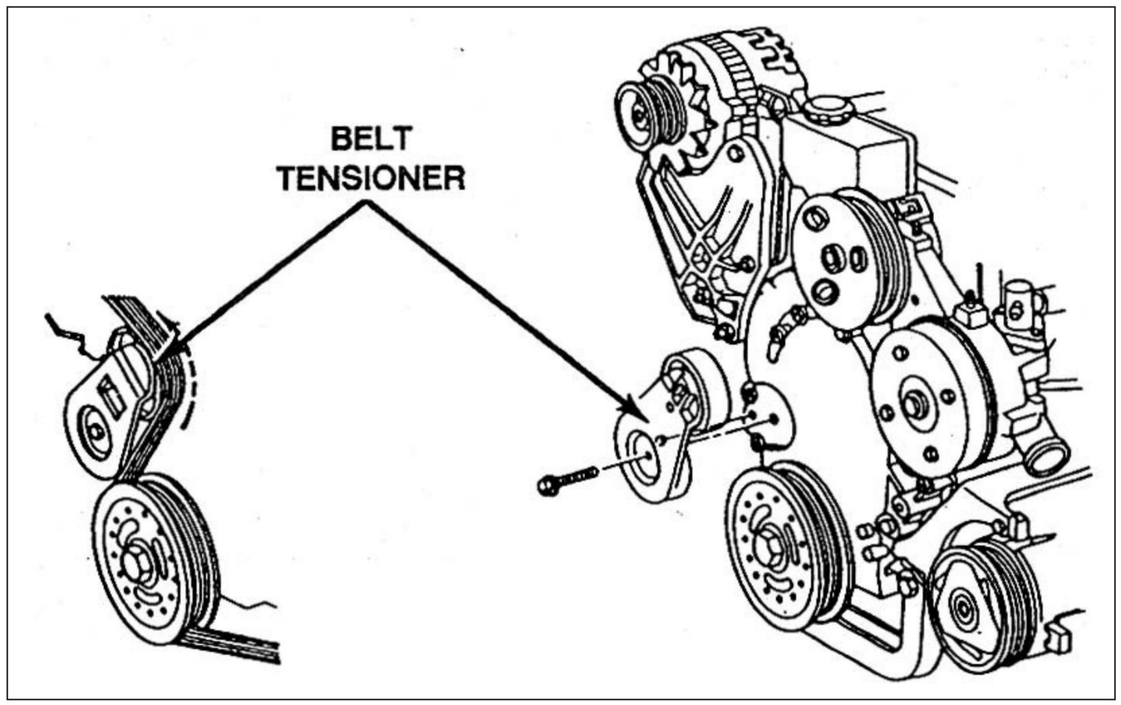

Figure 2-24—Automatic Belt Tensioner – Typical

3. Loosen and/or remove any components that interfere with removal of alternator.
4. Disconnect all wiring from alternator. Caution: Use care while disconnecting wires. Some wires are held on with nuts while others are plug-in connectors. Be sure to release any clips or spring tabs that retain the connectors.
5. Remove all alternator retaining bolts and/or nuts and remove alternator.

Installation

Note: Before installing the alternator, make sure the shaft length and pulley position match the alternator removed. Spin the pulley by hand to be sure that there is no binding. Inspect drive belt(s) and replace if worn, frayed or otherwise damaged.

1. Position alternator on engine and loosely install retaining bolts and/or nuts. Note: On vehicles equipped with serpentine belt systems, tighten all alternator bolts at this time.
2. Connect all wiring to alternator.
3. Install any components that were removed to gain access to alternator.
4. Install drive belts as follows:
   A. V-Belt—Position belt(s) on alternator pulley, making sure that belt is aligned on all pulleys. Rotate alternator until belt is properly tensioned (approximately one-half inch deflection per foot of free length). Tighten alternator adjusting and pivot bolts.
   B. Serpentine Belt—If vehicle is equipped with an automatic tensioner, rotate tensioner and install drive belt onto alternator pulley, making sure that belt is aligned on all pulleys (Figure 2-25). If vehicle is equipped with a manual tensioner, position belt on alternator and check alignment on all pulleys. Tighten adjusting bolt/nut until drive belt is tensioned.

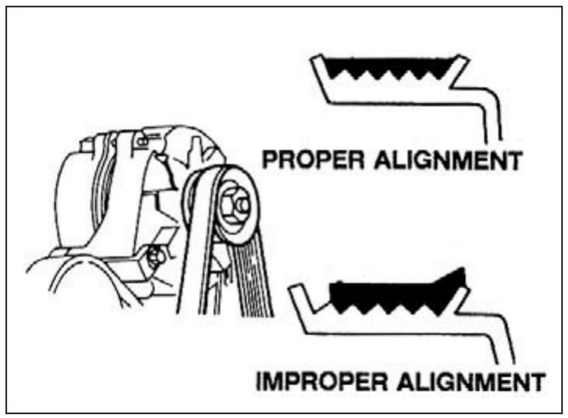

Figure 2-25—Serpentine Belt Installation

5. Check and correct belt tension as necessary per manufacturer's recommendations. Do not overtension belt.
6. Connect negative battery cable.
7. Check for proper operation of alternator and charging system.

Starters

To determine the manufacturer of the starter to be tested, refer to the following application charts.

Starting systems on all modern vehicles are very similar in testing and operation. Two circuits, a supply circuit and a control circuit, are common to all starting systems.

The supply circuit provides the high current to the starter needed to crank the engine over. The control circuit provides the lower current to actuate the solenoid.

The solenoid, mounted on the starter, engages the starter drive through an actuating fork. The starter drive can be one of two types: direct or reduction gear.

Direct drive starters engage directly with the flywheel or flex plate ring gear as in any gear-to-gear arrangement (Figure 2-26). Reduction gear starters use an extra set of gears to change the ratio of starter motor rotation to starter drive rotation (Figure 2-27).

Starter Replacement

Removal

Note: If may be necessary to remove, loosen, or relocate components (brackets/braces, exhaust components, heat shields, etc.) to gain access to the starter. It may also be helpful to tag all disconnected wires, removed nuts, bolts and other components to aid in installation.

1. Disconnect battery negative cable.
2. Raise and suitably support vehicle in a position high enough to gain easy access to starter.
3. Loosen and/or remove any components that interfere with removal of starter.
4. Disconnect all wiring from starter or solenoid.
5. Remove any brackets and/or heat shields attached to starter.
6. Remove all retaining bolts and shims, if used, from starter motor and remove starter. Note: If shims are present when starter is removed, they must be reinstalled during replacement starter instal-

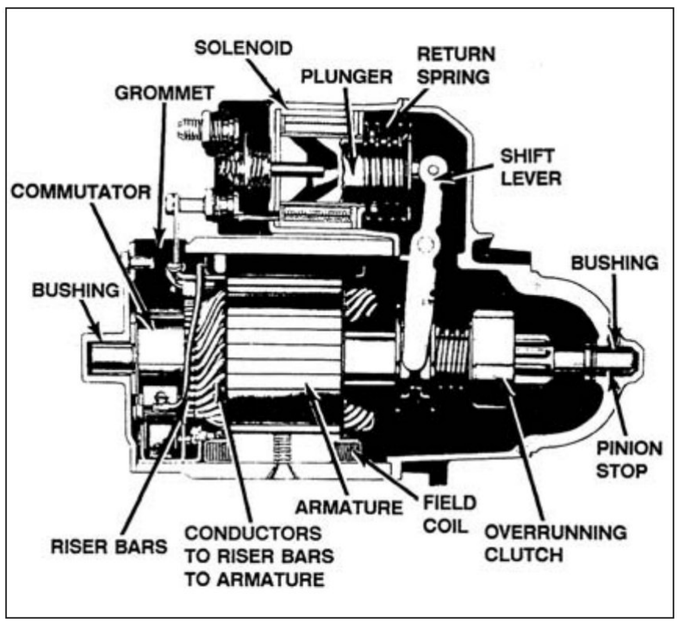

Figure 2-26—Starter – Direct Drive – Typical

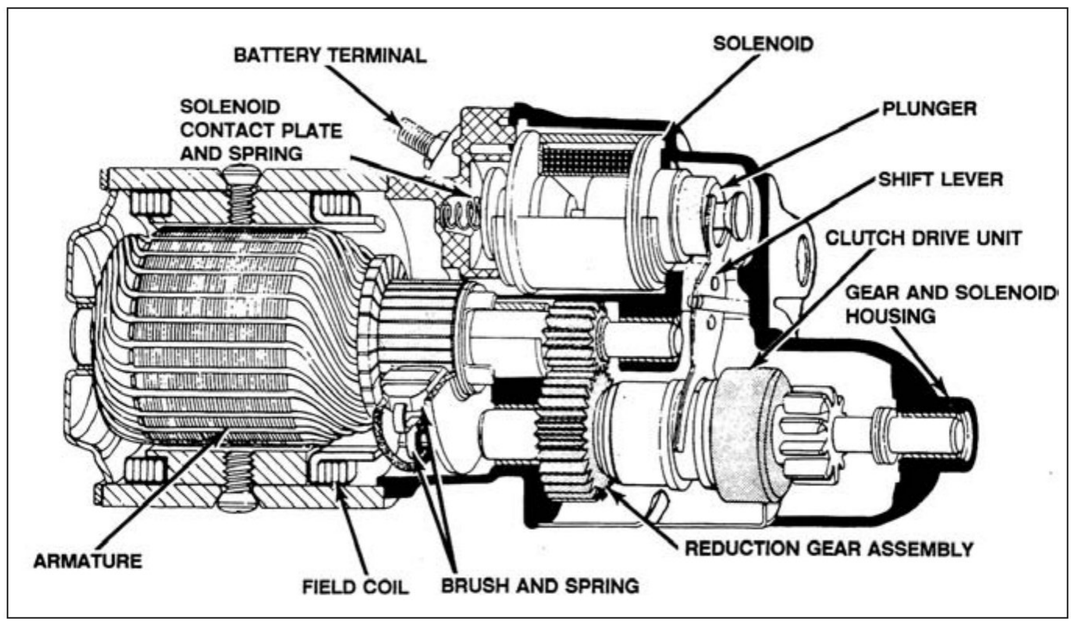

Figure 2-27—Starter – Reduction Gear – Typical

lation (Figure 2-28). Refer to Starter Shimming (this page).

Installation

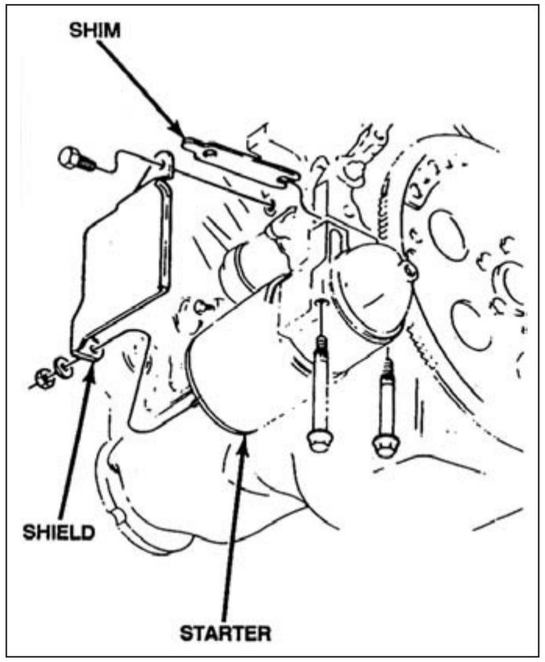

Figure 2-28—Starter Installation Using Shims

1. Transfer any brackets, braces and/or heat shields onto new starter.
2. Position starter to engine and install shims and retaining bolts previously removed. Note: Start with the same amount of shims found during removal. This will be the best starting point for shimming this type of starter.
3. Install any heat shields, braces and/or brackets.
4. Connect all wiring to starter motor or solenoid.
5. Install, connect and/or tighten components that were removed to access starter motor.
6. Lower vehicle.
7. Connect negative battery cable.
8. Check starter operation. Note: If starter is noisy, refer to Noise Diagnosis. If a noisy starter requires shims, refer to Starter Shimming before diagnosing any noise.

Starter Shimming

1. Disconnect battery negative cable.
2. Loosen all starter retaining bolts/nuts.
3. Remove outer starter retaining bolt.
4. For noise *during* cranking, remove one .38 mm (.015 inch) double shim or add single .38 mm (.015 inch) shim to outer retaining bolt *only*.
5. For noise after engine starts, add .38 mm (.015 inch) shims until noise is eliminated. *Do not exceed 1.14 mm (.045 inch) in shims*

STARTER APPLICATIONS

Vehicle Manufacturer/Model and/or Year			Bosch	Chrysler	Delco-Remy	Duceiller/Paris-Rhone	Hitachi	Mitsu-bishi	Motor-craft	Nippon-denso
ACURA										X
AMC	1975–1978 —Except 1979–1980 4 and 6 cylinder								X	
	1979–1980—4 and 6 cylinder				X					
	1981–1983	4 cylinder			X					
		6 cylinder							X	
	1983–1987—Alliance, Encore and Fuego					X				
	1984–1986—4 and 6 cylinder								X	
CHRYSLER (except import)	1975–1983 —All			X						
	1978–1989—RWD			X						X
	1978–1990—FWD		X					X		X
CHRYSLER (import)								X		
EAGLE	1984–1987— Eagle								X	
	1988–1990— Except Medallion	4 cylinder	X						X	
		6 cylinder						X		
		Medallion				X				
FORD	1975–1990—Except 1975–1978 Capri, 1978 and 1979 Fiesta, Scorpio, Festiva, Tracer and Probe								X	
	Festiva and Tracer									X
	Probe—All							X		
	1975–1978 Capri, Fiesta and Scorpio		X							
GENERAL MOTORS	1975–1990—Except Sprint, 1987 and 1988 Spectrum, Chevette and T1000, w/Diesel and 1986–1988 Nova				X					
	Sprint, 1987 and 1988 Spectrum Chevette and T1000, w/Diesel									X
	1986–1988 Nova									X
GEO										X
ISUZU							X			X
HONDA							X			
HYUNDAI							X	X		
MAZDA								X		
NISSAN							X			X
SUBURU										X
TOYOTA										X
VOLKSWAGEN/AUDI			X							
VOLVO			X							