STARTER - DIRECT DRIVE

1990-92 ELECTRICAL Mazda Starters - Direct Drive

DESCRIPTION

Nippondenso direct drive starter is a conventional 12-volt, 4-pole, brush-type starter. The integral solenoid is attached to the drive housing. The overrunning clutch pinion drive is mounted directly on armature shaft drive end.

NOTE: For information on B2200 and Protege models with automatic transmissions, see STARTERS - GEAR REDUCTION article.

TROUBLESHOOTING

NOTE: See TROUBLE SHOOTING - BASIC PROCEDURES article in the GENERAL INFORMATION section.

TESTING (ON VEHICLE)

NOTE: Before testing, ensure battery is fully charged, battery cables and terminals are clean and tight and engine grounds are good.

CIRCUIT TESTING

1. Turn ignition switch to START position, depress clutch and ensure starter operates. If starter does not operate, use voltmeter to check voltage at "S" terminal when clutch is depressed and ignition is turned to START position. See **Fig. 1** .
2. If voltage is less than 8 volts, check starter interlock switch and ignition switch to starter wiring circuit for short to ground. If voltage is greater than 8 volts and starter is inoperative, starter has an internal fault. Repair or replace as required.

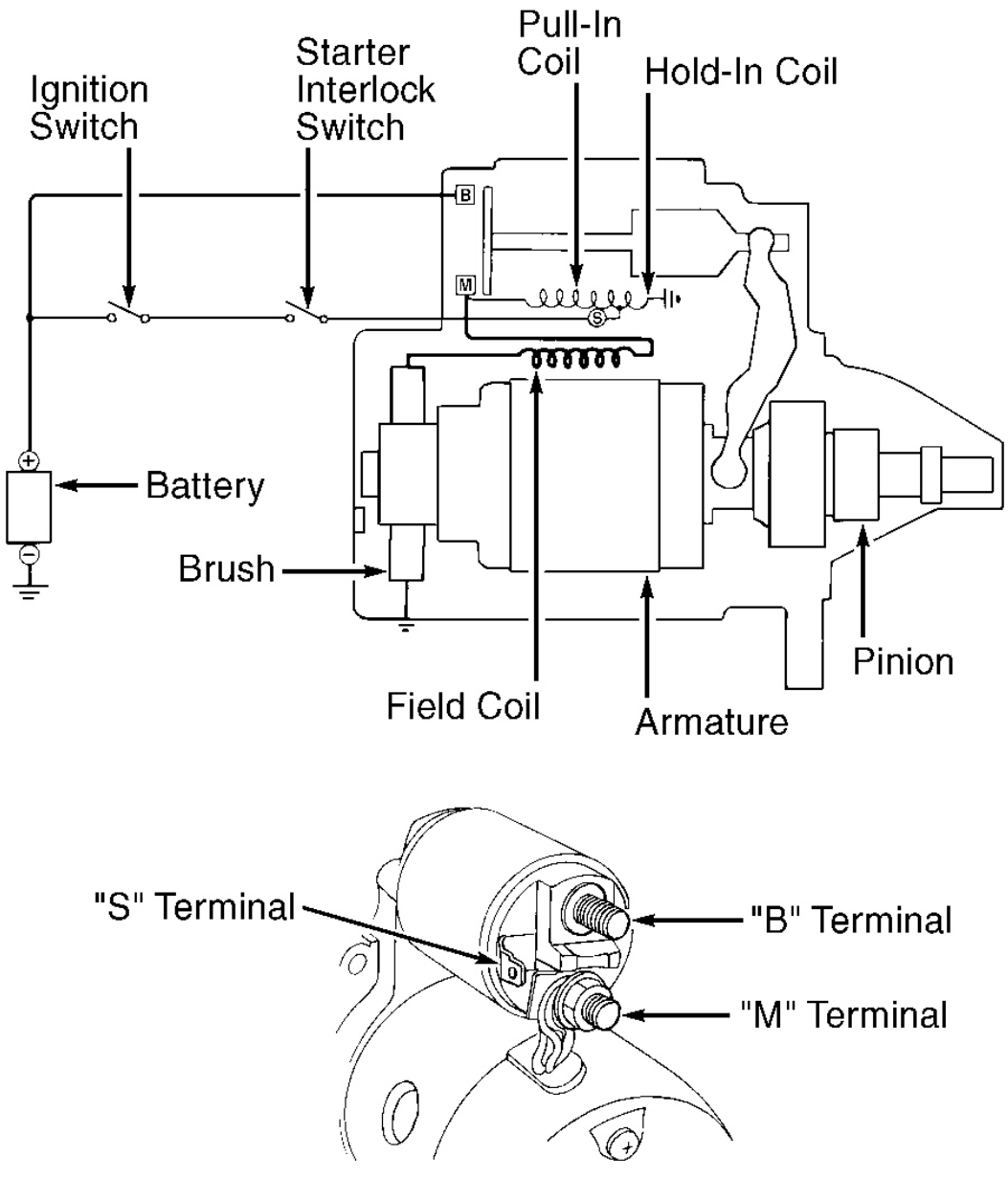

Fig. 1: Direct Drive Starter Circuit Diagrams
Courtesy of MAZDA MOTORS CORP.

STARTER INTERLOCK SWITCH (CLUTCH START SWITCH)

Switch is mounted on bracket near top front of clutch pedal. Disconnect switch harness connector. Using ohmmeter, ensure continuity exists between switch connector terminals when clutch pedal is depressed. If

continuity does not exist, adjust or replace switch.

BENCH TESTS (ASSEMBLED)

NO-LOAD TEST

Connect fully-charged 12-volt battery, voltmeter and ammeter to starter. See **Fig. 2** . Using remote starter wires or jumper, engage solenoid. Starter should spin smoothly. Note/record meter readings and check no-load specification. See NO-LOAD TEST SPECIFICATIONS table. If not within specification, disassemble and inspect starter components.

NO-LOAD TEST SPECIFICATIONS

Application	Specification
B2200 (M/T), Miata, Protege (M/T) & 323	
Voltage	11.5 Volts
Current	60 Amps Maximum
Shaft Speed	6500 RPM

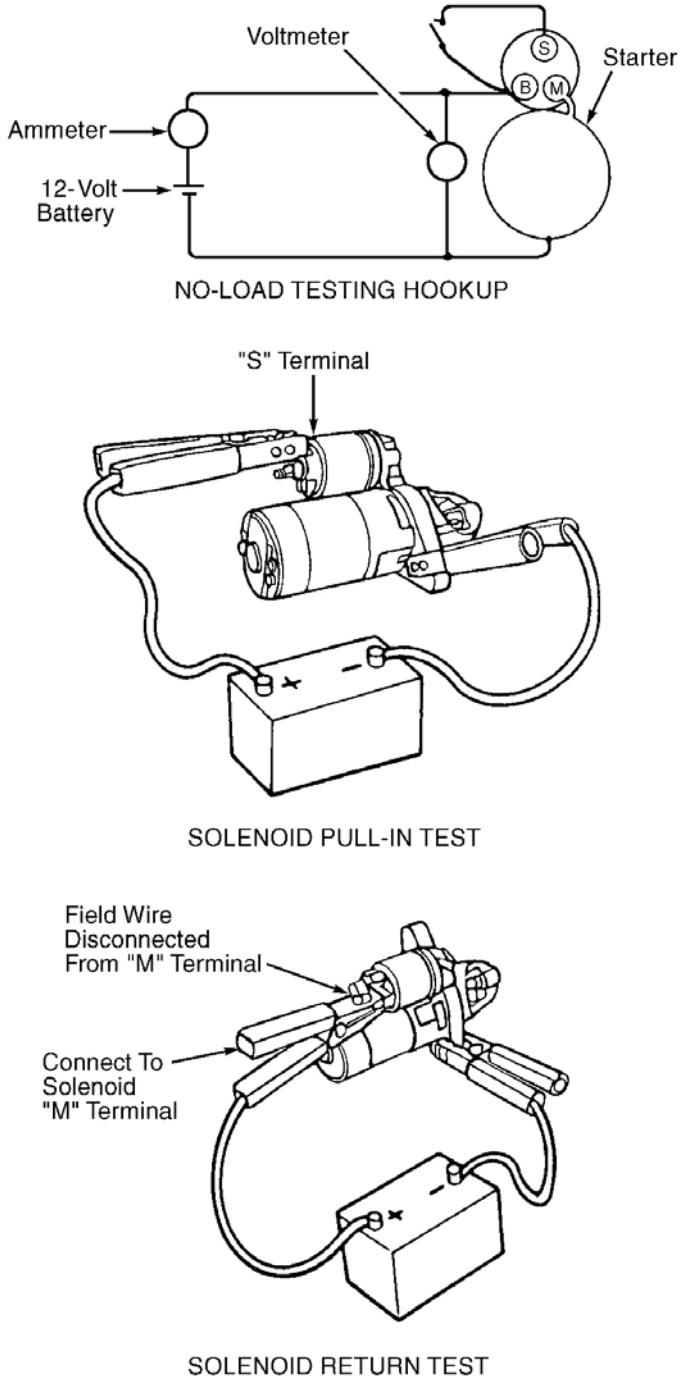

Fig. 2: Testing Direct Drive Starter Circuits
Courtesy of MAZDA MOTORS CORP.

SOLENOID TESTS

NOTE: Solenoid tests must be performed with starter assembled and field lead ("M" terminal wire) disconnected at the solenoid.

CAUTION: Do not engage starter solenoid for more than 10 seconds during testing or damage to coil winding may result.

SOLENOID PULL-IN TEST

Connect positive battery lead to solenoid "S" terminal and negative battery lead to solenoid case. Starter pinion drive gear should extend quickly and maintain this position. If starter pinion drive gear does not extend, replace solenoid. See **Fig. 2** .

SOLENOID RETURN TEST

Connect positive battery lead to solenoid "M" terminal and ground negative battery lead to starter body. Using screwdriver, pry overrunning clutch pinion drive outward. Release screwdriver and ensure overrunning clutch pinion drive returns to original position. See **Fig. 2** .

SOLENOID

1. Disconnect all wires to solenoid. Using ohmmeter, ensure continuity between "S" and "M" terminals, and between "S" terminal and solenoid body. See **Fig. 1** . If continuity does not exist between these terminals, solenoid must be replaced.
2. Next ensure continuity does not exist between "M" and "B" terminals. If continuity exists between these terminals, solenoid is shorted and must be replaced.

PINION GAP ADJUSTMENT

1. Ensure field wire is disconnected from solenoid "M" terminal. Connect positive battery lead to "S" terminal and negative battery lead to starter case. Starter pinion drive gear will extend outward and stop.
2. Quickly measure pinion gap clearance between end of pinion drive and circlip retainer. See **Fig. 3** . DO NOT operate starter solenoid for more than 10 seconds. Pinion gap clearance should be .02-.08" (0.5-2.0 mm).
3. If pinion gap clearance is not within specification, adjust by increasing or decreasing thickness of solenoid shims located between solenoid and drive housing.

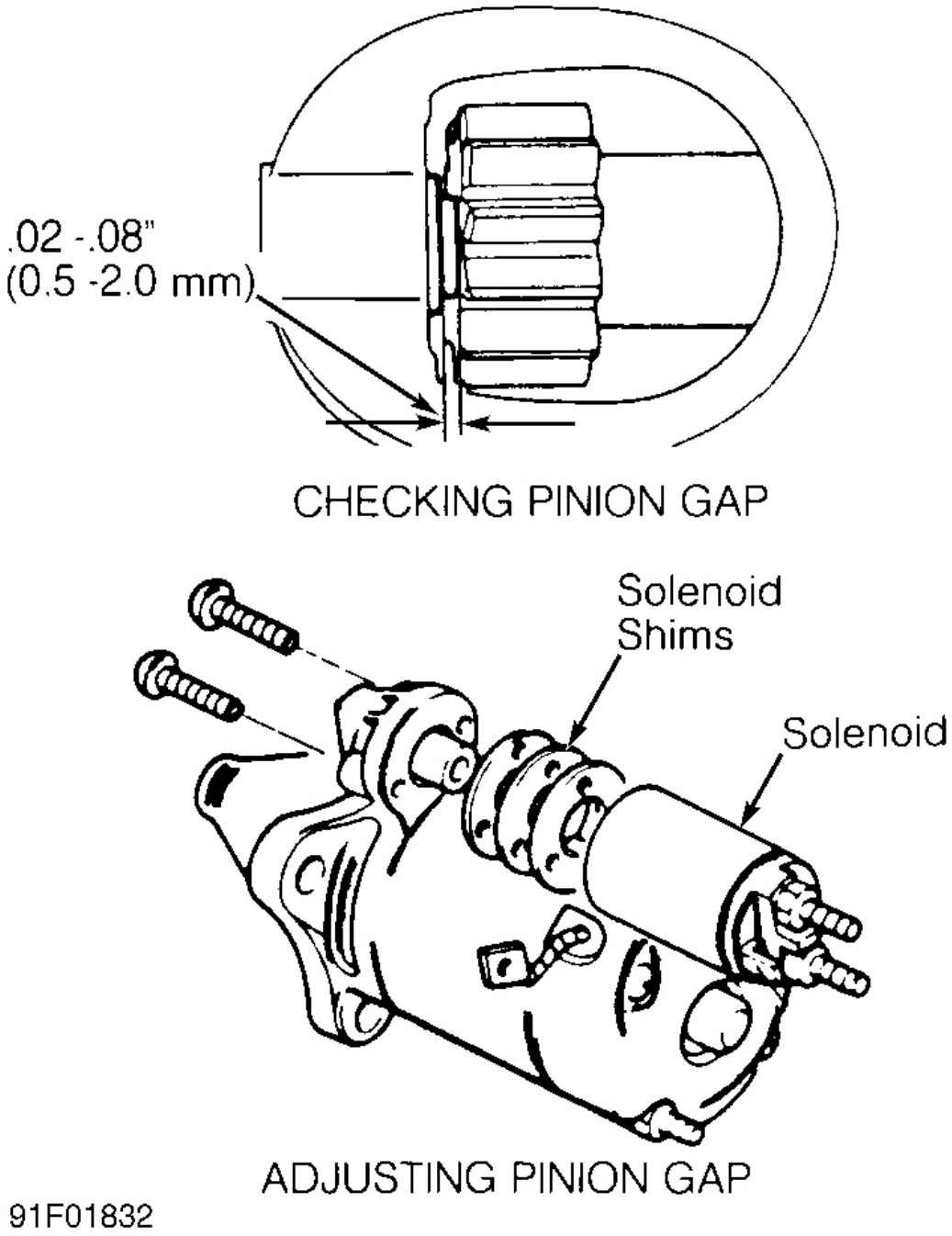

Fig. 3: Adjusting Pinion Gap
Courtesy of MAZDA MOTORS CORP.

BENCH TESTING (DISASSEMBLED)

ARMATURE TESTING

1. Place armature in growler. Turn on growler and hold a piece of hacksaw blade over armature. Slowly rotate armature. If hacksaw blade is attracted to core or if it vibrates, replace armature.
2. Remove armature from growler. Using an ohmmeter, check continuity between commutator and core. If continuity exists, the armature is shorted and must be replaced. Check continuity between commutator and shaft. If continuity exists, replace armature.
3. Check continuity between each commutator segment. If an open exists between any 2 segments, replace armature.

COMMUTATOR TESTING

1. Clean surface and polish with No. 400 sandpaper if required. If surface is scored, out of round or pitted, turn commutator in a lathe.
2. Maximum commutator runout and minimum diameter of commutator must not exceed specification after turning. See COMMUTATOR SPECIFICATIONS table.
3. Commutator mica undercut depth should be .02 -.03" (.5 -.8 mm). Minimum mica undercut depth is .008" (.20 mm). If not within specification, undercut to standard depth.

COMMUTATOR SPECIFICATIONS

Application	Maximum Runout In. (mm)	Minimum Diameter In. (mm)
B2200 (M/T)		
Protege (M/T) & 323	.004 (.10)	1.22 (31)
Miata	.001 (.03)	1.22 (31)

BRUSH TESTING

1. Connect ohmmeter lead to positive brush holder and other lead to negative brush holder. If continuity exists, brush holder assembly is shorted and must be replaced.
2. Check brush length. If less than specification, replace brushes. See BRUSH LENGTH SPECIFICATIONS table. Use brush spring scale to check spring tension. Spring tension is measured at point where spring separates from brush.Tension should be greater than 2 lbs. (0.9 kg). Tension specification for a new spring is 3.1-5.7 lbs. (1.4-2.6 kg). Brushes must move freely in holders.

BRUSH LENGTH SPECIFICATIONS

Application	Standard In. (mm)	Minimum In. (mm)
All Models	.67 (17.0)	.45 (11.5)

FIELD COIL TESTING

1. Connect one ohmmeter lead to field coil lead ("M" terminal lead). Connect other lead to soldered portion of brush lead. If continuity does not exist, repair or replace field coil.
2. Check field coil for shorts to ground by connecting ohmmeter lead to field coil lead. Connect other lead

to field coil housing. If continuity exists, repair or replace field coil.

OVERRUNNING CLUTCH PINION DRIVE

Hold overrunning clutch housing and turn pinion gear by hand. If pinion turns in both directions, clutch is faulty and must be replaced. DO NOT clean overrunning clutch with solvent, as it is packed with grease and sealed by manufacturer.

REMOVAL & INSTALLATION

1. Disconnect negative battery cable. Raise vehicle on hoist. Remove undercover. Disconnect wiring from starter. Remove differential lock assembly (4WD models). On Protege (M/T) and 323 models, remove support brace from under intake manifold. Remove starter mounting bolts. Remove lowest mounting bolt last. Remove starter from under side of vehicle.
2. To install starter, reverse removal procedure. Tighten mounting bolts to 23-24 ft. lbs. (31-46 N.m). Tighten battery terminal nut to 87-104 INCH lbs. (9.8-12 N.m).

OVERHAUL

DISASSEMBLY & ASSEMBLY

1. Mark rear cover, field coil housing and front drive housing for reassembly reference. Remove solenoid and shims, rear cover and brush plate. Remove field coil housing and pull armature and yoke lever from front drive housing. See **Fig. 4** & **Fig. 5** . Use arbor press to remove circlip, stopper and pinion drive from armature shaft. See **Fig. 6** .
2. To assemble, reverse removal procedures. Lubricate solenoid plunger, yoke lever and armature bushings. Use arbor press and pinion drive to install stopper and circlip on armature shaft. See **Fig. 6** . Ensure brush plate, rear cover and field coil housing are aligned when installing through bolts.

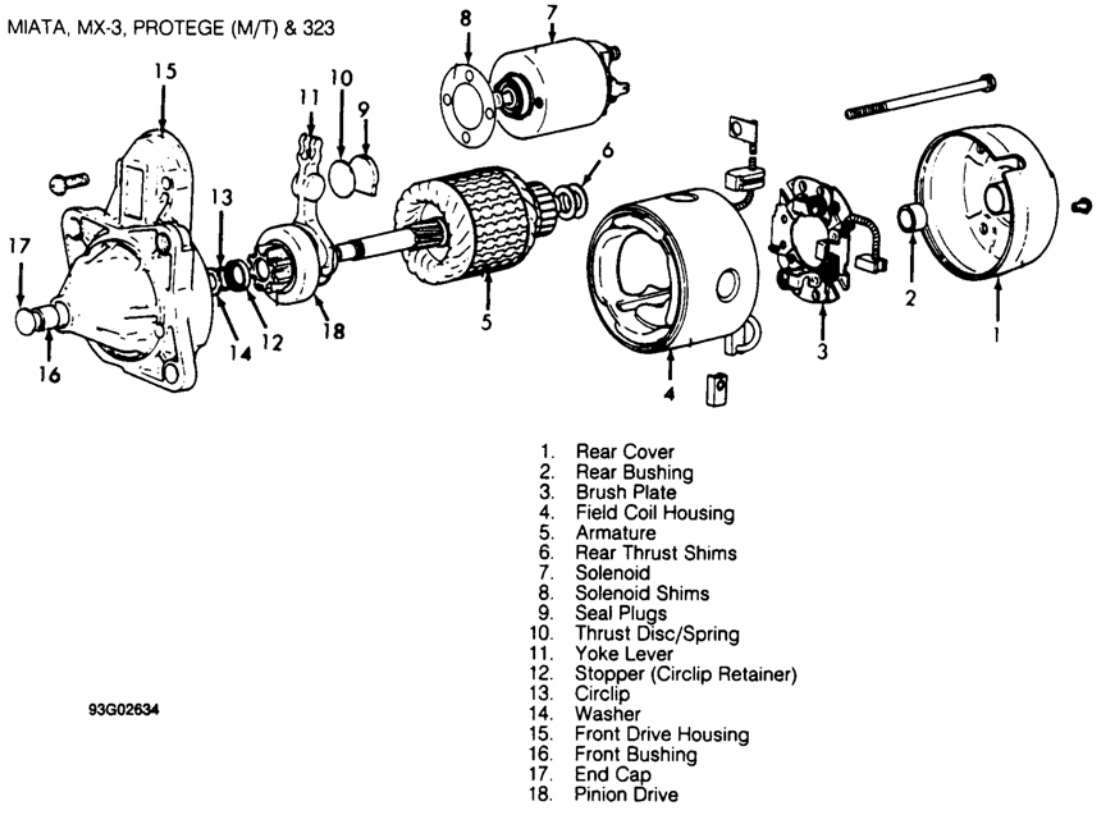

Fig. 4: View of Direct Drive Starters (Miata, Protege, 323 & MX-3)
Courtesy of MAZDA MOTORS CORP.

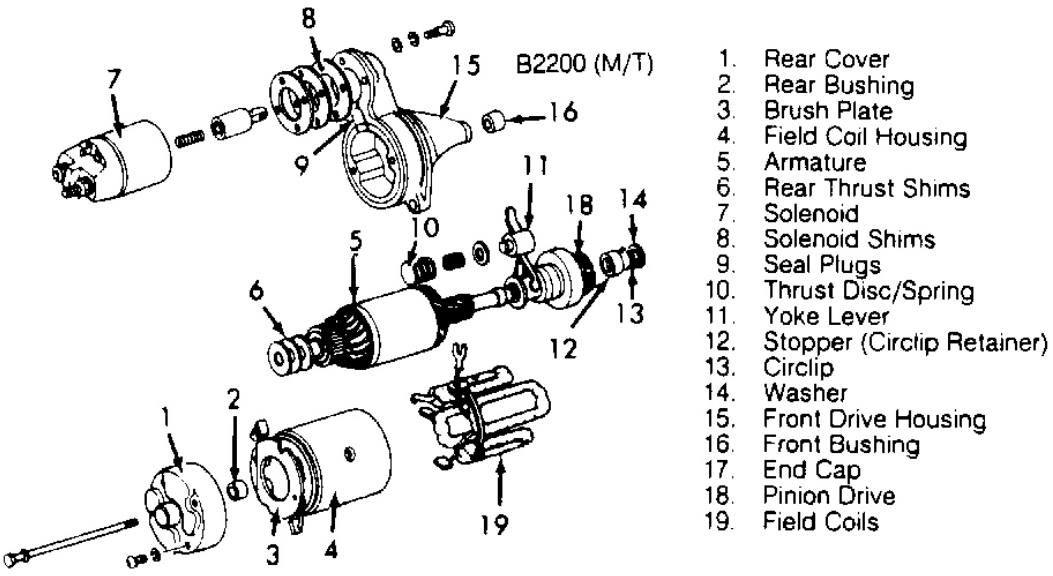

Fig. 5: Exploded View of Direct Drive Starters (B2200)
Courtesy of MAZDA MOTORS CORP.

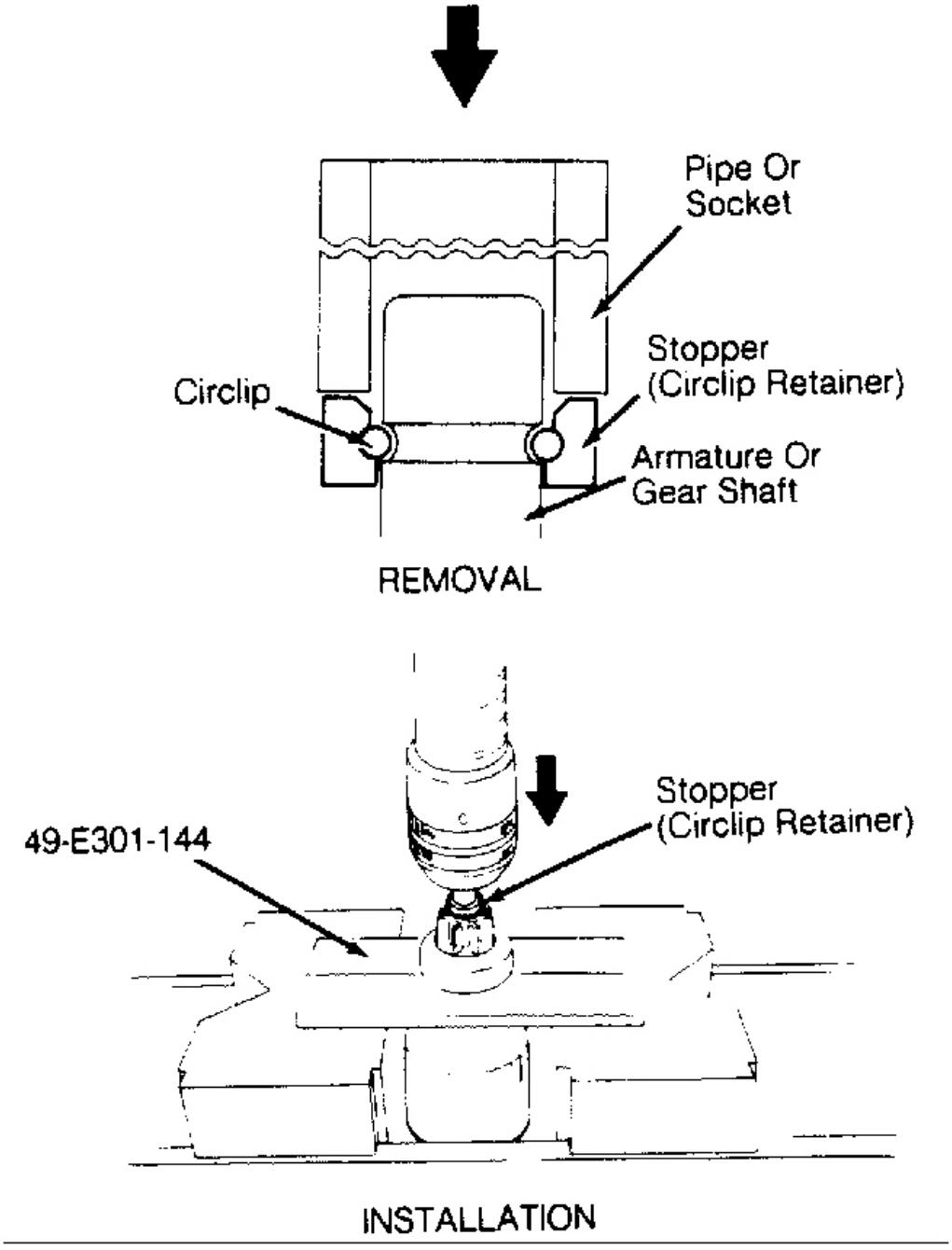

Fig. 6: Removing & Installing Armature Circlip & Stopper
Courtesy of MAZDA MOTORS CORP.