

## CHAPTER FOUR

### ENGINE

The RX-2 and RX-3 use Mazda's version of the Wankel rotary engine. A sandwich arrangement of 5 housings contains 2 rotors, which are equivalent to the pistons in a conventional engine. The rotors revolve around, and turn, an eccentric shaft (equivalent to a conventional crankshaft). The rotors ride on eccentric journals on the shaft. Shaft motion turns a conventional flywheel. Compression ratio is 9.4:1. Displacement is 70 cu. in. (1146cc).

The engine uses a 4-stroke cycle basically the same as that of a conventional piston engine. Each side of the rotor acts as the base of a combustion chamber. The walls of the chamber are formed by the intermediate housing and end housing. The top of the chamber is formed by the rotor housing. Combustion chamber size changes as the rotor turns.

Refer to **Figure 1**. Each side of the rotor passes and uncovers 2 intake ports, one in the end housing and one in the intermediate housing (A). The side of the rotor then turns to face the top of the housing (B). This enlarges the combustion chamber, creating a vacuum that pulls in air-fuel mixture. The rotor then turns to the left-hand side of the housing, compressing the fuel mixture and placing it next to the spark plugs (C). One or both of the plugs fires, depending on engine temperature, speed, and load.

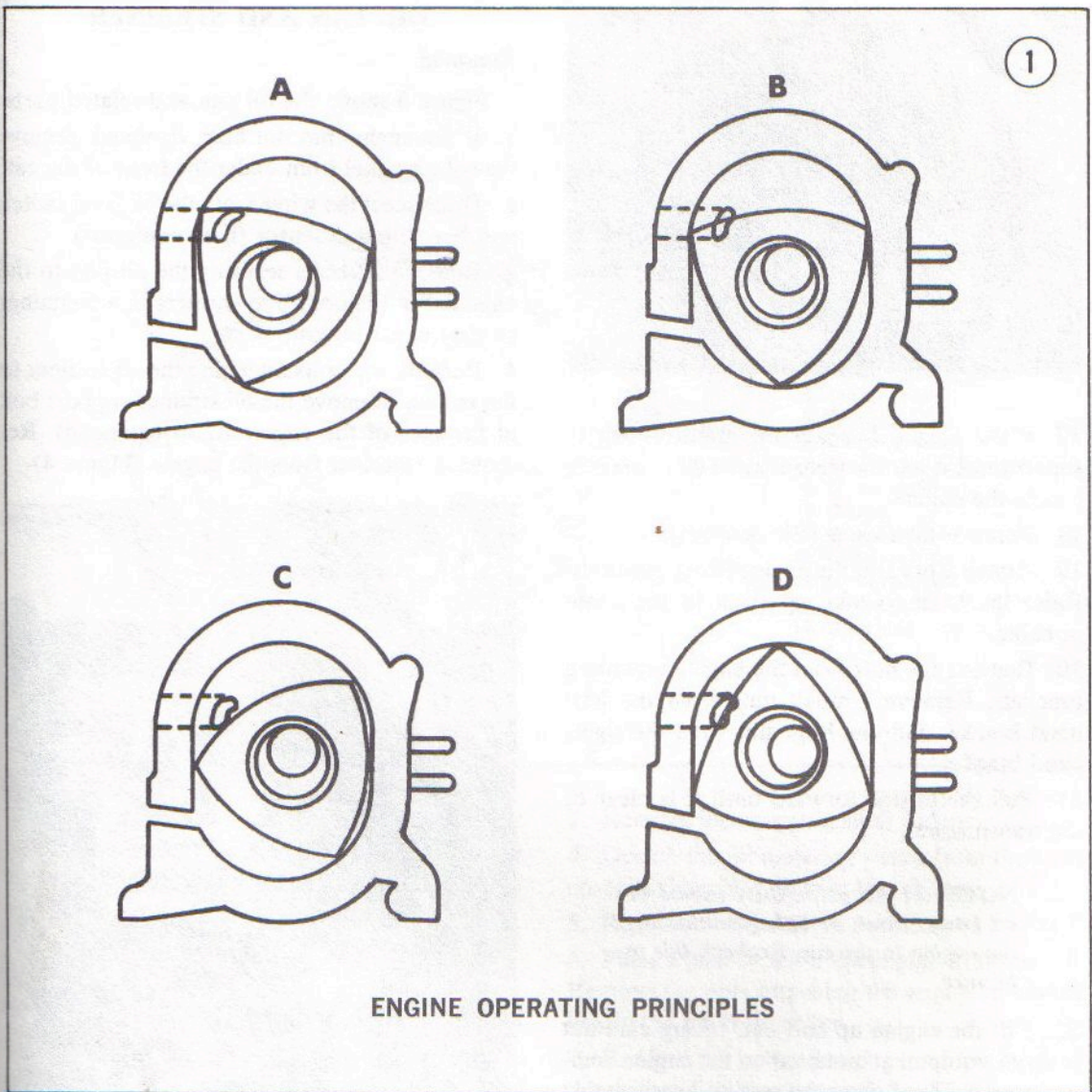
The expanding gas turns the rotor until the tip passes the exhaust port, located in the right-hand side of the rotor housing (D). The rotor continues turning toward the narrow portion of the rotor housing, reducing combustion chamber size and forcing the exhaust gas out.

Once the exhaust gas is expelled, the rotor surface moves past the intake ports, beginning the combustion cycle again.

See **Tables 1 and 2** at the end of the chapter for specifications and tightening torques.

#### ENGINE REMOVAL

1. Remove the hood.
2. Remove the splash panel from under the front of the car.
3. Drain the cooling system and oil pan.
4. Disconnect negative cable from the battery.
5. Referring to Chapter Five, remove the air cleaner and support bracket. Then disconnect the choke cable, throttle cable, fuel lines, and evaporative emission control line.
6. Disconnect the engine ground cable from the thermostat housing (Chapter Six). After disconnecting the cable, reinstall the thermostat housing nut. On 1974 cars, disconnect the wires from the temperature switch at the back of the thermostat housing.



7. Disconnect the brake booster tube from the intake manifold.

8. Remove the radiator shroud and fan. Disconnect the upper and lower radiator hoses. See Chapter Six.

9. Disconnect the primary wiring between distributor(s) and ignition coils. Disconnect the spark plug wires and remove distributor caps.

10. Label and detach the wires from the starter, alternator, temperature sender, and oil pressure sender.

11. Label and disconnect the wires from the air supply valve solenoid (1971-72); anti-afterburn

valve and coasting valve solenoids (1971-73); and deceleration valve solenoids (1974). See Chapter Five, Figures 18-21.

12. Disconnect the wires from the coolant thermostat sensor on top of the engine.

13. Disconnect the heater hoses from the engine.

14. Place a drain pan beneath the engine, then disconnect the oil cooler hoses from the engine front cover and rear end housing.

15. Remove the clutch release cylinder (see Chapter Eight).

16. Disconnect the exhaust and air pipes from the thermal reactor (**Figure 2**).



17. Place a jack beneath the transmission to support it. Unbolt the transmission from the rear end of the engine.
18. Remove the starter (Chapter Seven).
19. Attach a hoist to the engine lifting brackets. Raise the hoist to take up slack in the chain or cable.
20. Remove the nuts from the engine mounting brackets. Remove 2 small nuts from the left-hand bracket and one large nut from the right-hand bracket.
21. Pull the engine forward until it is clear of the transmission.

**NOTE:** *At this point, there should be no hoses, wires, or linkages attaching the engine to the car. Recheck this to be sure.*

22. Lift the engine up and out, taking care not to strike equipment mounted on the engine compartment walls. Lower the engine to a suitable support and disconnect it from the hoist.

### ENGINE INSTALLATION

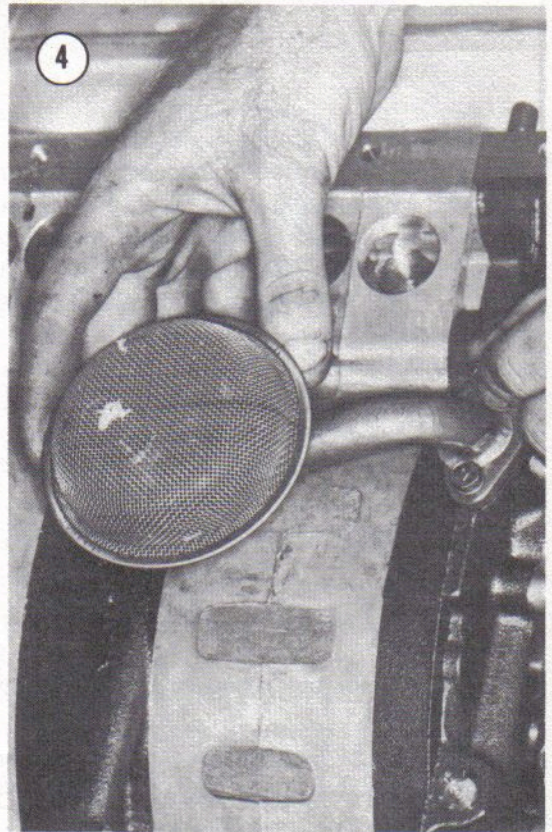
Engine installation is simply the reverse of removal. Fasten the engine to the transmission and to its mounting brackets before connecting anything else.

Bleed and adjust the clutch as described in Chapter Eight. Fill the engine (and transmission, if removed) with lubricants recommended in Chapter Two. Fill cooling system with a 50/50 mixture of ethylene glycol-based anti-freeze and water. After installation, run the engine and check for leaks.

### OIL PAN AND STRAINER

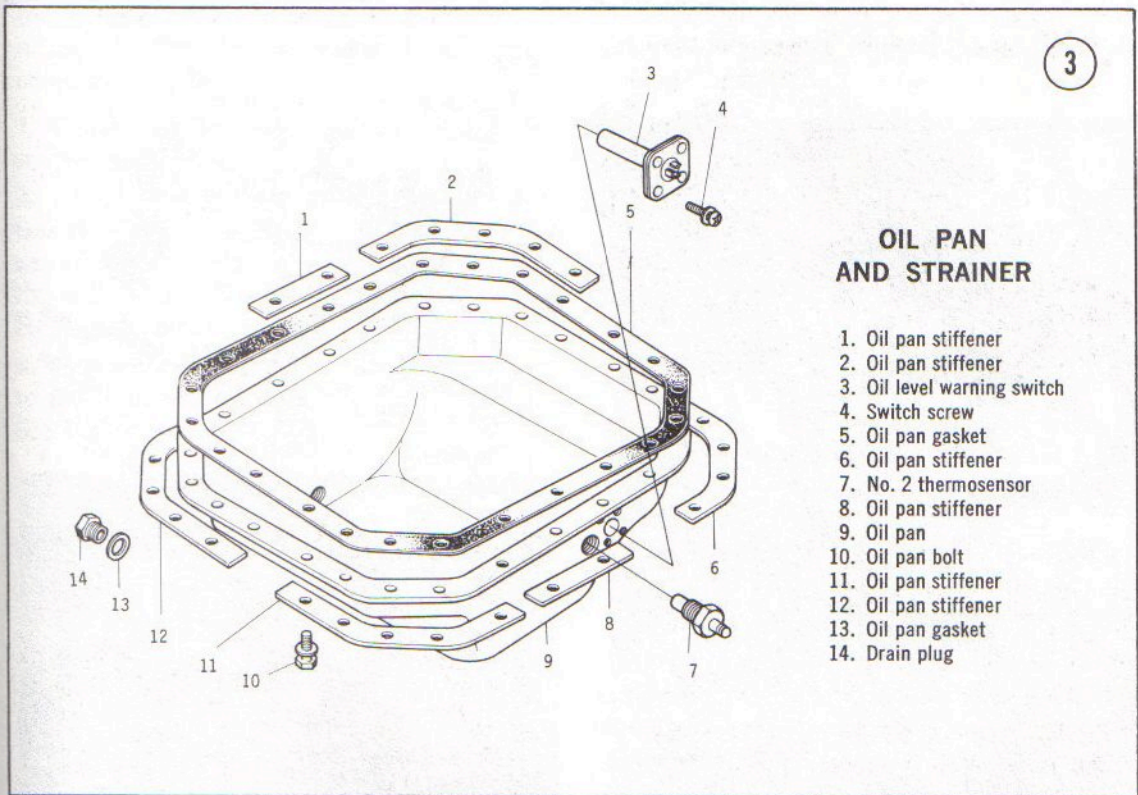
#### Removal

- Figure 3** shows the oil pan and related parts.
1. If the engine has not been removed, remove the splash panel from under the front of the car.
  2. Disconnect the wires from the oil level switch and No. 2 thermosensor (if so equipped).
  3. Remove 22 bolts securing the oil pan to the engine. Put the bolts and washers in a container so they won't be lost.
  4. Remove the bolts attaching the oil strainer to the engine. Remove the oil strainer support bolt at the rear of the engine (if so equipped). Remove the strainer from the engine (**Figure 4**).



#### Inspection

1. Thoroughly clean the oil pan and strainer in solvent.
2. Check the oil pan for cracks and dents. Check the gasket surface for bending. Straighten or replace as necessary.



### OIL PAN AND STRAINER

1. Oil pan stiffener
2. Oil pan stiffener
3. Oil level warning switch
4. Switch screw
5. Oil pan gasket
6. Oil pan stiffener
7. No. 2 thermosensor
8. Oil pan stiffener
9. Oil pan
10. Oil pan bolt
11. Oil pan stiffener
12. Oil pan stiffener
13. Oil pan gasket
14. Drain plug

3. Check the wire screen in the oil strainer for holes or obstructions. Check for a clogged oil pickup tube. Remove any obstructions. Replace the strainer if damaged.

#### Installation

1. Remove all traces of gasket from the oil pan mounting surface on the engine.
2. Position the oil strainer and gasket on the engine. Securely tighten the attaching bolts.
3. Install the oil pan and gasket. Use gasket sealer on both sides of the gasket.
4. Place the oil pan stiffeners around the edge of the pan. Install the oil pan bolts and tighten to 7 ft.-lb. (1 mkg). Tighten in several stages, working around the edge of the pan.

#### FRONT COVER AND OIL SEAL

##### Removal/Installation

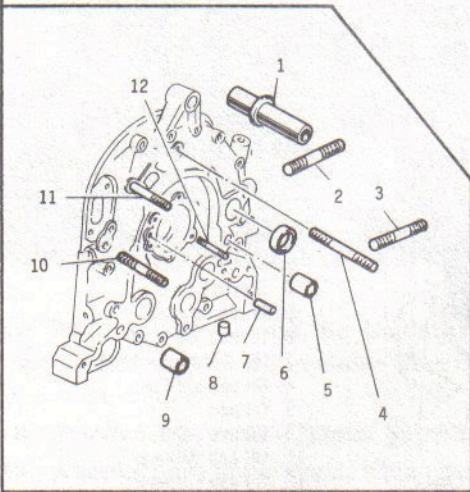
Figure 5 shows front cover and related parts.

1. Remove the oil pan as described earlier.
2. Remove fan and water pump (Chapter Six).

3. Remove the eccentric shaft pulley.
4. Detach the oil metering pump from the front cover as described later in this chapter.
5. Remove distributor(s). See Chapter Seven.
6. Place a jack beneath the engine to support it. Remove the nuts attaching the engine mounting bracket to the front cover.
7. Remove the bolts attaching the front cover to the engine. Lift the cover off. See Figure 6.
8. Remove the O-ring from the front end housing (Figure 7).
9. Carefully pry the oil seal from the front cover. Do not gouge any metal surfaces.
10. Installation is the reverse of these steps. Use a new water pump gasket, front cover gasket, and O-ring. Tighten the front cover bolts to 15 ft.-lb. (2 mkg). Use gasket sealer on the eccentric shaft pulley's crush washer. Use Loctite on pulley bolt threads. Tighten to 47 ft.-lb. (6.5 mkg).

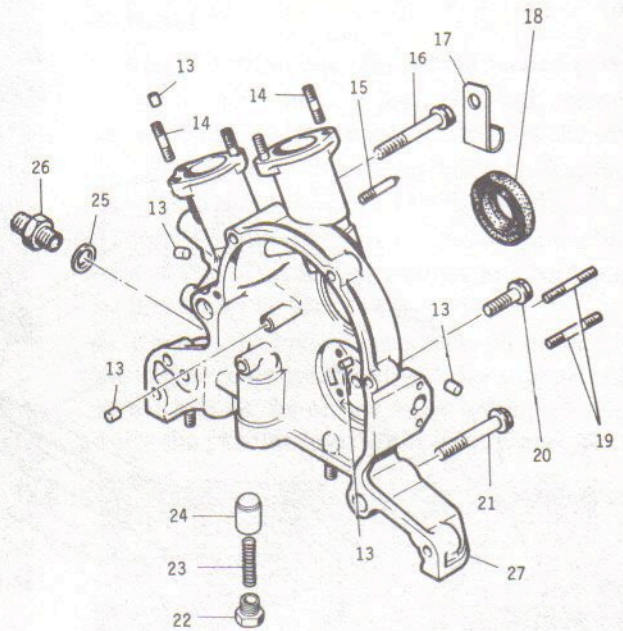
**NOTE:** The front cover gasket may protrude below the oil pan gasket surface. Trim off any excess gasket so the oil pan gasket can lie flat.

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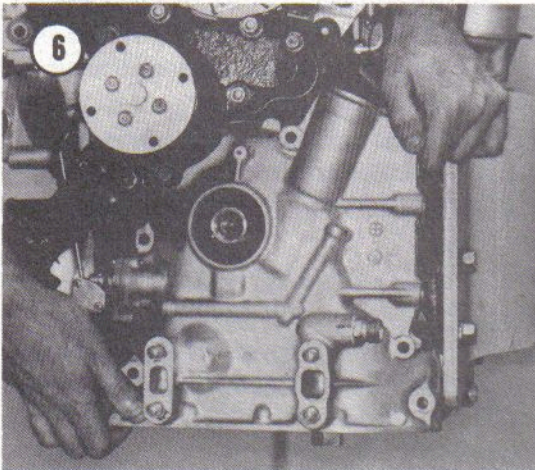


**FRONT COVER AND OIL SEAL**

- |                       |                  |
|-----------------------|------------------|
| 1. Alternator bracket | 8. Blind plug    |
| 2. Stud               | 9. Tubular dowel |
| 3. Stud               | 10. Stud         |
| 4. Stud               | 11. Stud         |
| 5. Tubular dowel      | 12. Stud         |
| 6. Water passage plug | 13. Blind plug   |
| 7. Dowel pin          | 14. Stud         |

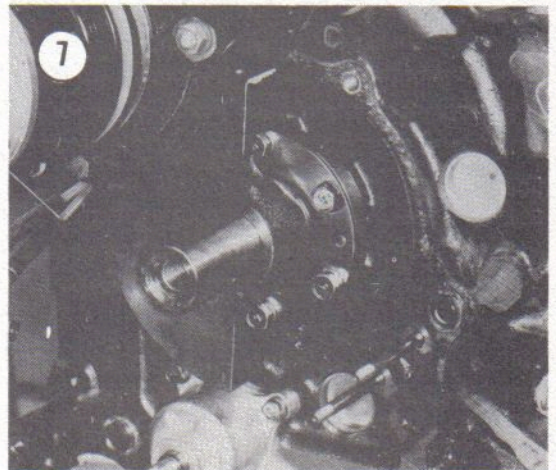


- |                      |                 |
|----------------------|-----------------|
| 15. Timing pointer   | 22. Plug        |
| 16. Front cover bolt | 23. Spring      |
| 17. Wiring bracket   | 24. Plunger     |
| 18. Oil seal         | 25. Gasket      |
| 19. Studs            | 26. Union joint |
| 20. Front cover bolt | 27. Front cover |
| 21. Front cover bolt |                 |



**OIL PUMPS**

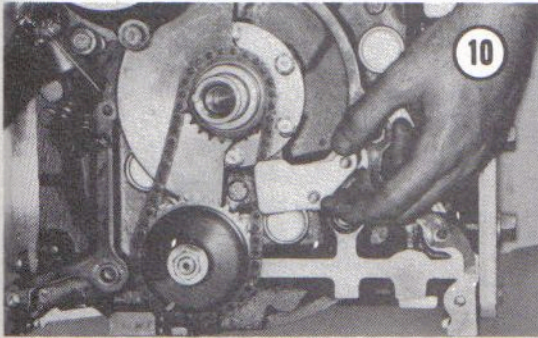
The engine uses 2 oil pumps. The main pump, mounted inside the front cover, feeds oil to the eccentric shaft bearing journals. Squirt holes in



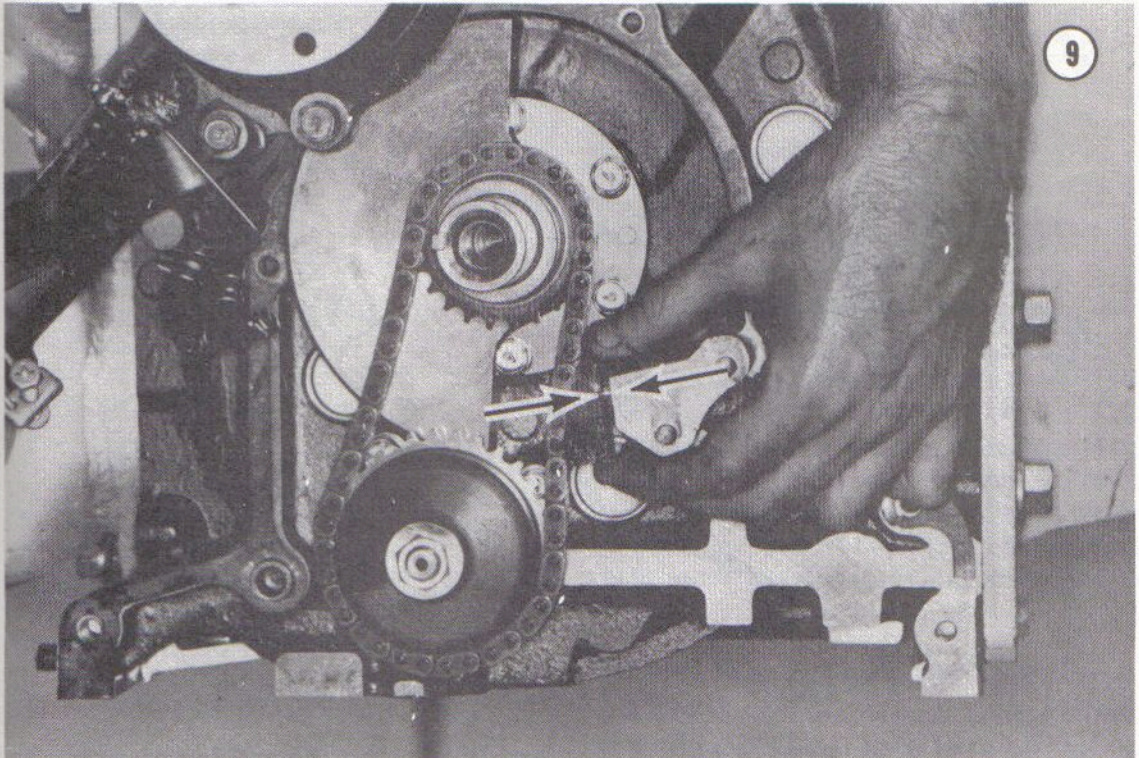
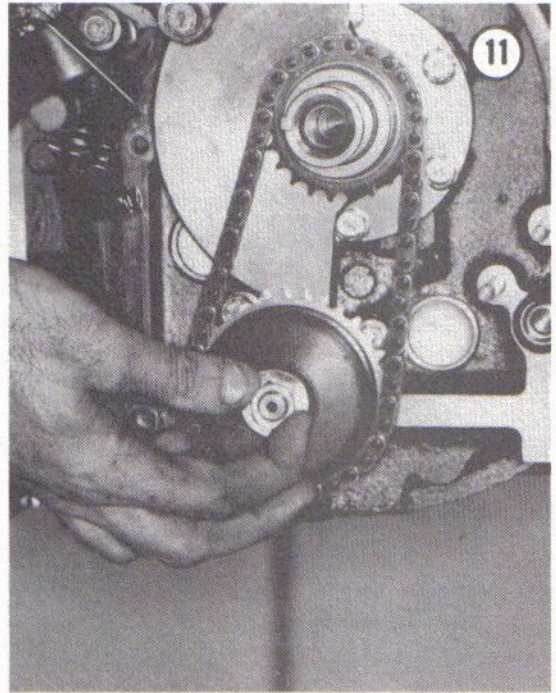
the eccentric shaft spray oil onto the rotors to cool them. The metering pump, mounted on the right front corner of the engine, feeds oil into the carburetor. The oil is fed into the engine with

the air-fuel mixture to lubricate the rotor and housing friction surfaces. **Figure 8** (next page) shows the oil pumps.

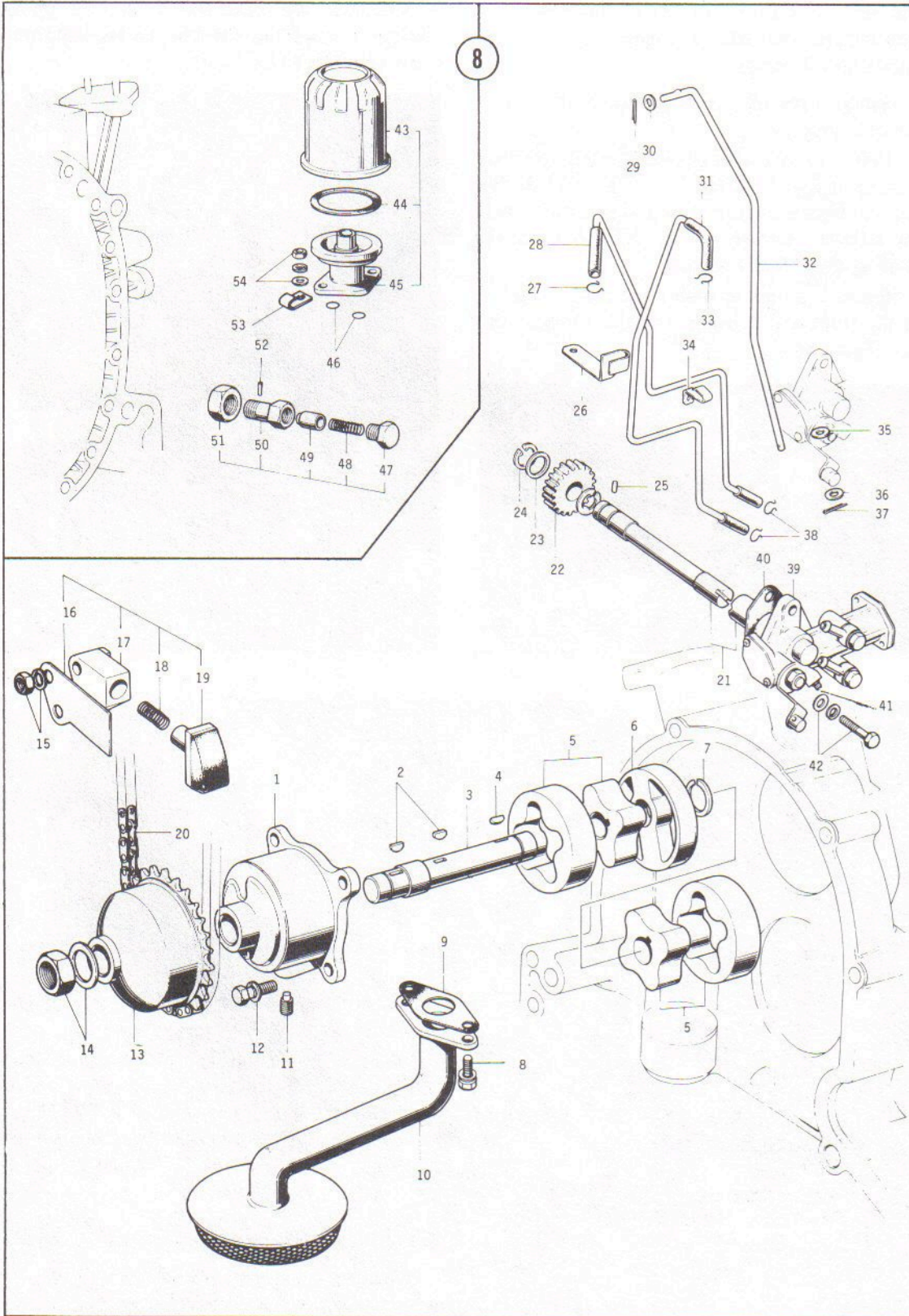
1. Remove the oil pan and front cover as described earlier.
2. Before disassembling further, check the protrusion of the chain adjuster (**Figure 9**). If the gap shown in the figure exceeds 0.47 in. (12mm), the adjuster is worn or the chain is stretched. Replace the defective part.
3. Remove 2 nuts attaching the chain adjuster to the front end housing. Lift the adjuster off. See **Figure 10**.



4. Straighten the bent tab on the oil pump sprocket lockwasher. Remove the nut and lockwasher (**Figure 11**).



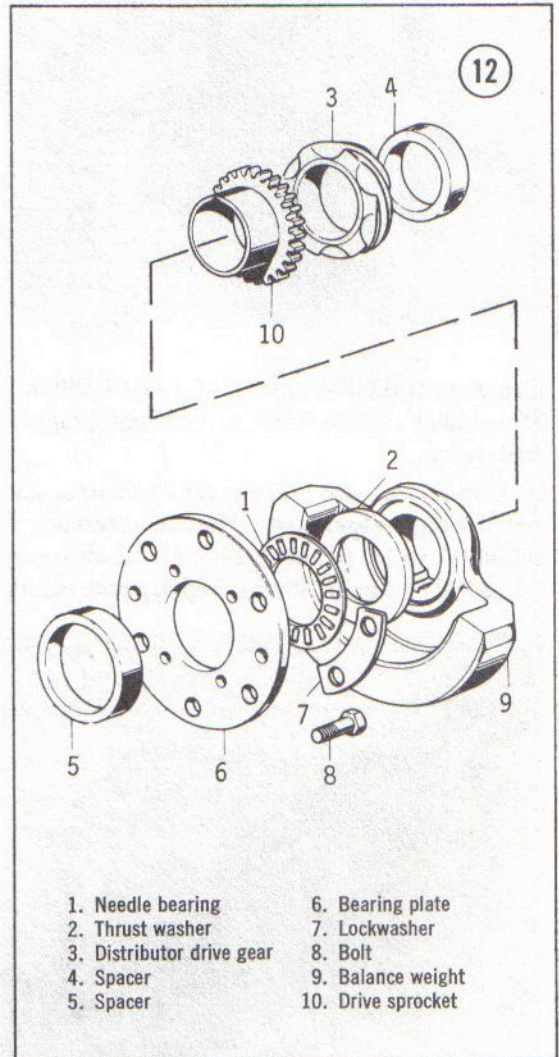
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## MAIN AND METERING OIL PUMPS

1. Oil pump body
2. Woodruff keys
3. Oil pump shaft
4. Woodruff key
5. Oil pump rotors
6. Oil pump middle plate
7. Snap ring
8. Oil strainer bolt
9. Oil strainer gasket
10. Oil strainer
11. Oil pump lock bolt
12. Oil pump bolt
13. Oil pump sprocket
14. Oil pump nut and washer
15. Chain tension nut and lockwasher
16. Chain tension guide plate
17. Chain tensioner body
18. Spring
19. Chain tensioner pad
20. Chain
21. Oil metering pump shaft
22. Driven gear
23. Shim
24. Snap ring
25. Pin
26. Oil tube bracket
27. Hose clamp
28. Hose
29. Cotter pin
30. Washer
31. Hose
32. Tube
33. Hose clamp
34. Oil tube bracket
35. Washer
36. Washer
37. Cotter pin
38. Hose clamp
39. Oil metering pump
40. Gasket
41. Adjusting screw
42. Metering pump bolt and washers

5. Remove the oil thrower, spacer, distributor drive gear, oil pump drive sprocket, chain, and driven sprocket. See **Figure 12**.



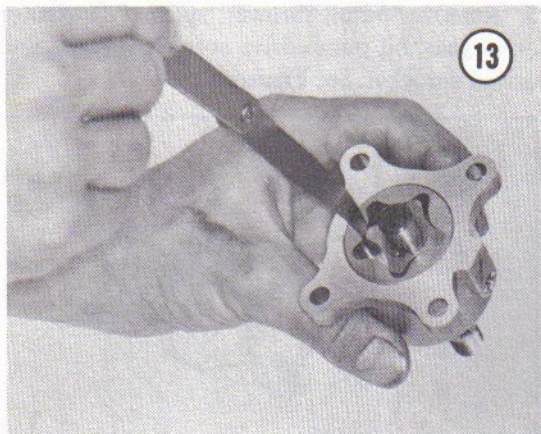
6. Remove 4 bolts attaching the oil pump to the front end housing. Lift the pump off.

7. Installation is the reverse of these steps. Place the chain over both sprockets before installing the sprockets. Use a new lockwasher on the oil pump driven sprocket nut. Tighten the oil pump bolts to 5 ft.-lb. (0.8 mkg). Tighten the driven sprocket nut to 25 ft.-lb. (3.5 mkg).

### Main Oil Pump Inspection and Repair

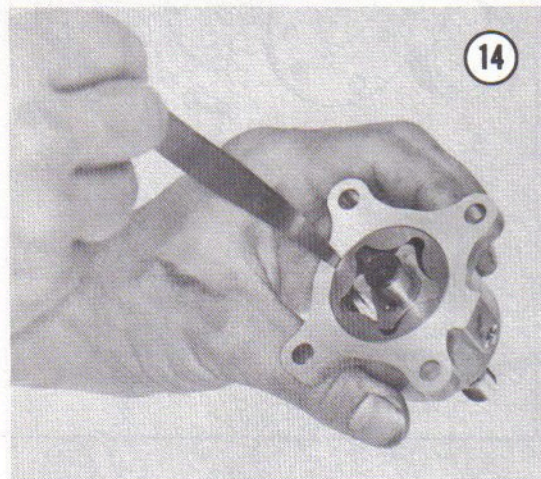
1 Check the clearance between inner and outer rotors with a feeler gauge (**Figure 13**). Normal





clearance is 0.0004-0.0035 in. (0.01-0.09mm). If clearance exceeds 0.006 in. (0.15mm), replace both rotors.

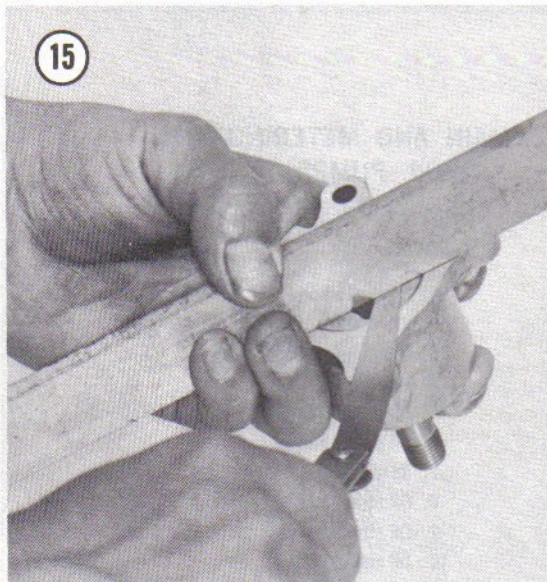
2. Check clearance between the outer rotor and pump body (Figure 14). Normal clearance is 0.008-0.010 in. (0.200-0.245mm). If clearance exceeds 0.012 in. (0.30mm), replace both rotors.



3. Check rotor end clearance. Place an accurate straightedge across the pump body. Measure clearance between the straightedge and rotors with a feeler gauge (Figure 15). Normal clearance is 0.001-0.005 in. (0.030-0.125mm). If clearance exceeds 0.020 in. (0.30mm), have the pump body machined or replace both rotors.

4. Remove the snap ring from the oil pump shaft (7, Figure 8).

5. Remove the rear rotors from the pump body, then remove the middle plate (6, Figure 8).



6. Measure front rotor clearance as described in Steps 1 and 2. Replace the rotors if clearances are excessive.

7. Reinstall the middle plate, rear rotors, and snap ring.

#### Oil Metering Pump Adjustment

1. Disconnect one of the metering pump tubes from the carburetor. Place the end of the tube in a container graduated in cubic centimeters.

2. Run the engine at 2,000 rpm for 6 minutes. The pump should have discharged 2.4-2.9cc. If necessary, adjust pump output by turning the pump adjusting screw (Figure 16). Turn the screw clockwise to increase pump output, or counterclockwise to decrease it.

3. If the adjusting screw won't bring pump output within specifications, the pump control lever can be shifted to one of the other holes in the pump connecting rod.

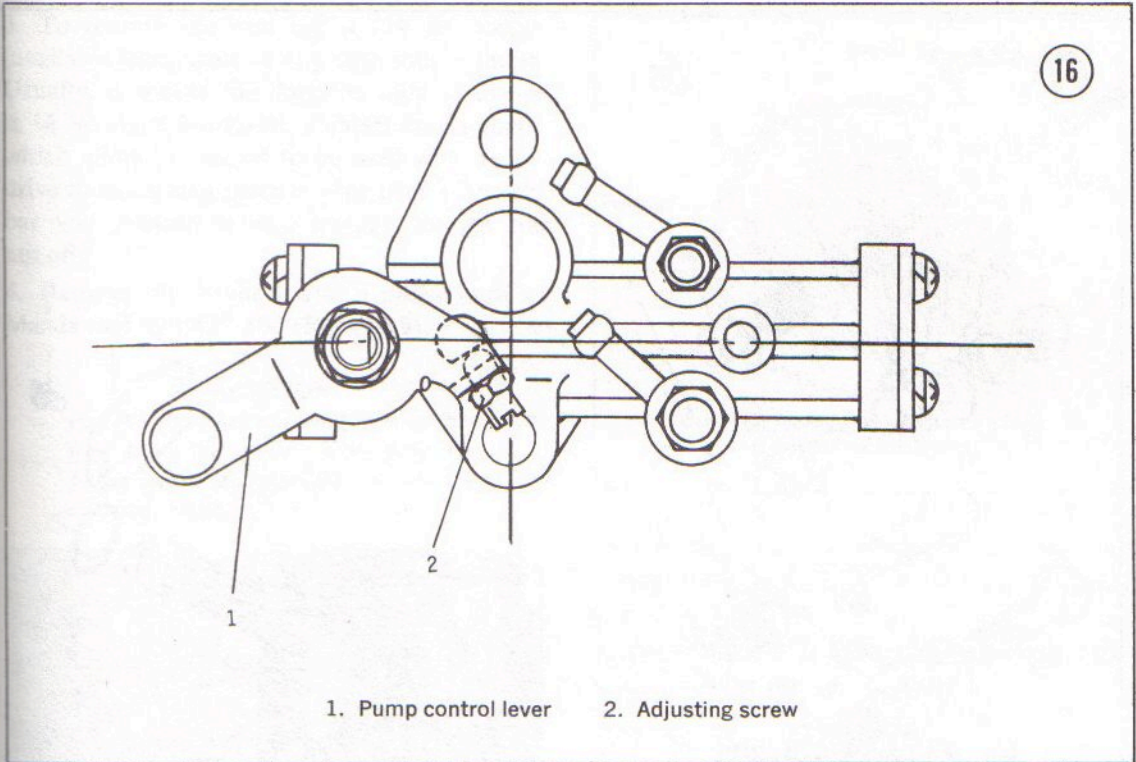
#### Oil Metering Pump Removal/Installation

1. Place a container beneath the pump to catch dripping oil.

2. Disconnect both oil tubes and the connecting rod from the pump (Figure 8).

3. Remove 2 bolts attaching the metering pump to the front cover. Lift the pump off.

4. Installation is the reverse of these steps.



1. Pump control lever      2. Adjusting screw

**Oil Metering Pump Overhaul**

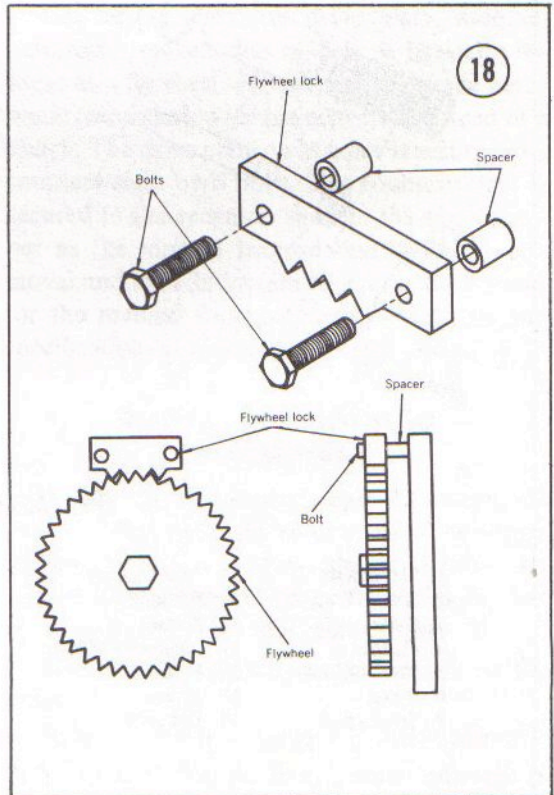
If the metering pump can't be adjusted within specifications, disassemble it, referring to **Figure 17** (next page). Clean all components, especially the strainers. Check all parts for wear and damage. Replace defective parts.

**FLYWHEEL**

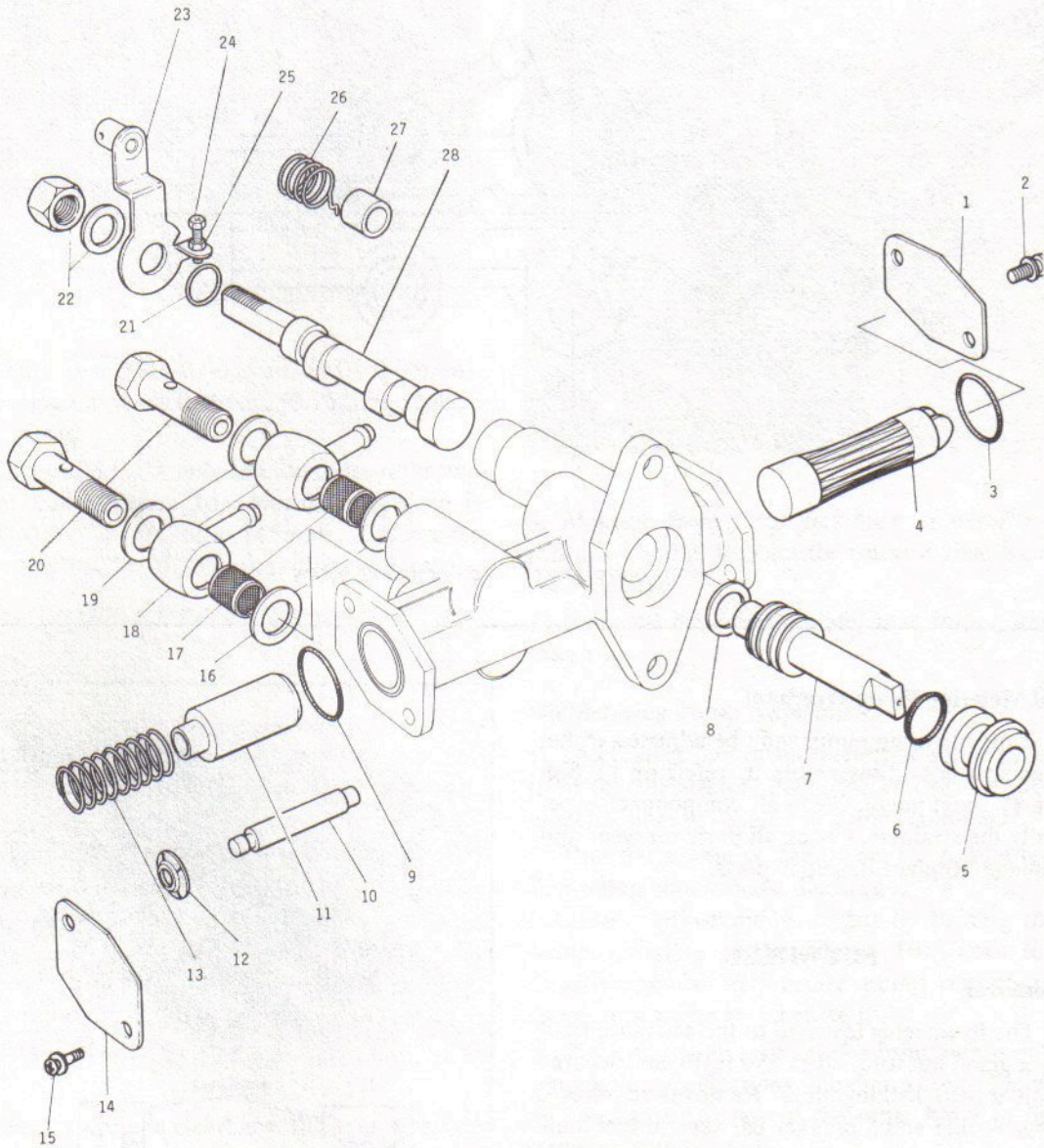
**Removal**

The flywheel is fastened to the eccentric shaft by a gland nut torqued to 350 ft.-lb. and secured with thread locking fluid. Removal requires a large socket and a breaker bar several feet long. If you are near a dealer, the easiest, safest, and least expensive method is to take the entire engine in and have the flywheel removed. If not, use the following method.

1. Straighten the tab on the flywheel washer.
2. Secure the flywheel so it won't turn when the nut is being removed. A flywheel lock like the one shown in **Figure 18** can be made from a piece of steel  $\frac{3}{8}$  in. thick. Cut the spacers from a pipe or use a stack of washers.



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## OIL METERING PUMP

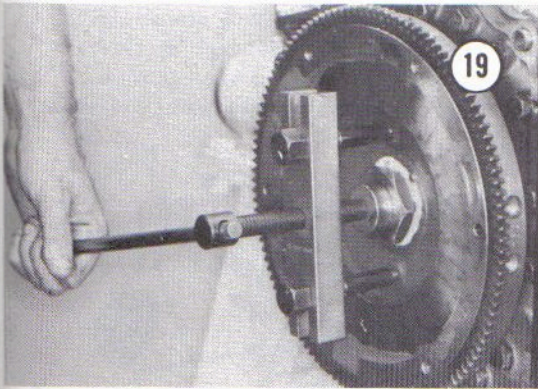
- |                 |                          |                      |                                 |
|-----------------|--------------------------|----------------------|---------------------------------|
| 1. Thrust plate | 8. Thrust washer         | 15. Screw            | 22. Nut and lockwasher          |
| 2. Screw        | 9. O-ring                | 16. Connector washer | 23. Control lever               |
| 3. O-ring       | 10. Plunger              | 17. Filter           | 24. Adjusting screw             |
| 4. Plunger      | 11. Differential plunger | 18. Connector        | 25. Adjusting screw locknut     |
| 5. Worm bearing | 12. Push nut             | 19. Connector washer | 26. Control lever return spring |
| 6. O-ring       | 13. Spring               | 20. Connector bolt   | 27. Cap                         |
| 7. Driving gear | 14. End plate            | 21. Gasket           | 28. Control pin                 |

3. To remove the nut, use a 2½ in. socket (available from Sears or any auto supply shop). Usually, a socket this large is only available in ¾ in. drive. However, adapters are available which allow the socket to be used with ½ in. drive tools. A long piece of pipe over a breaker bar will provide enough leverage to get the nut off.

4. Remove the flywheel with a puller such as Mazda tool 49 0823 300 (**Figure 19**).

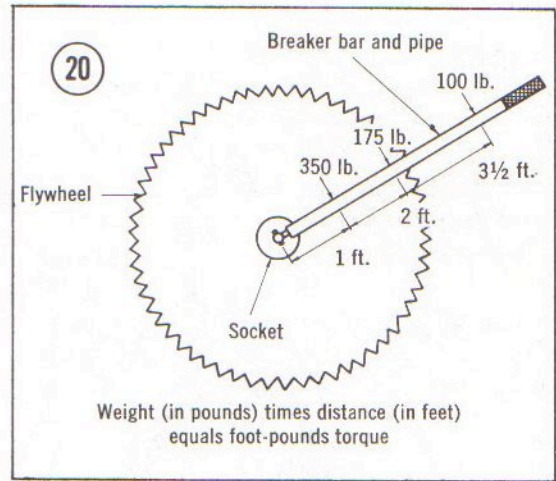
#### CAUTION

*Put the flywheel nut part way on before using the puller. Otherwise the puller could damage the end of the eccentric shaft.*



#### Installation

1. Be sure the flywheel mounting surface on the end of the eccentric shaft is clean.
2. Install the flywheel on the eccentric shaft.
3. Install the flywheel lockwasher. Coat the eccentric shaft threads with Loctite or a similar material.
4. Install the flywheel nut and tighten to 350 ft.-lb. If you don't have the necessary torque wrench, use the socket and breaker bar used for removal. To measure the torque with these tools, first determine how many pounds you can apply to the breaker bar. Divide this number into 350. The answer is the distance (in feet) from the center of the socket that the weight must be applied. As shown in **Figure 20**, 350 pounds applied to the breaker bar one foot from the center of the socket gives 350 ft.-lb. of torque. One hundred seventy-five pounds applied 2 feet



from the center gives the same result. One hundred pounds applied 3½ feet from the center also gives 350 ft.-lb.

5. Once the nut is tightened, bend the lockwasher against the nut to secure it.

#### TORQUE CONVERTER DRIVE PLATE

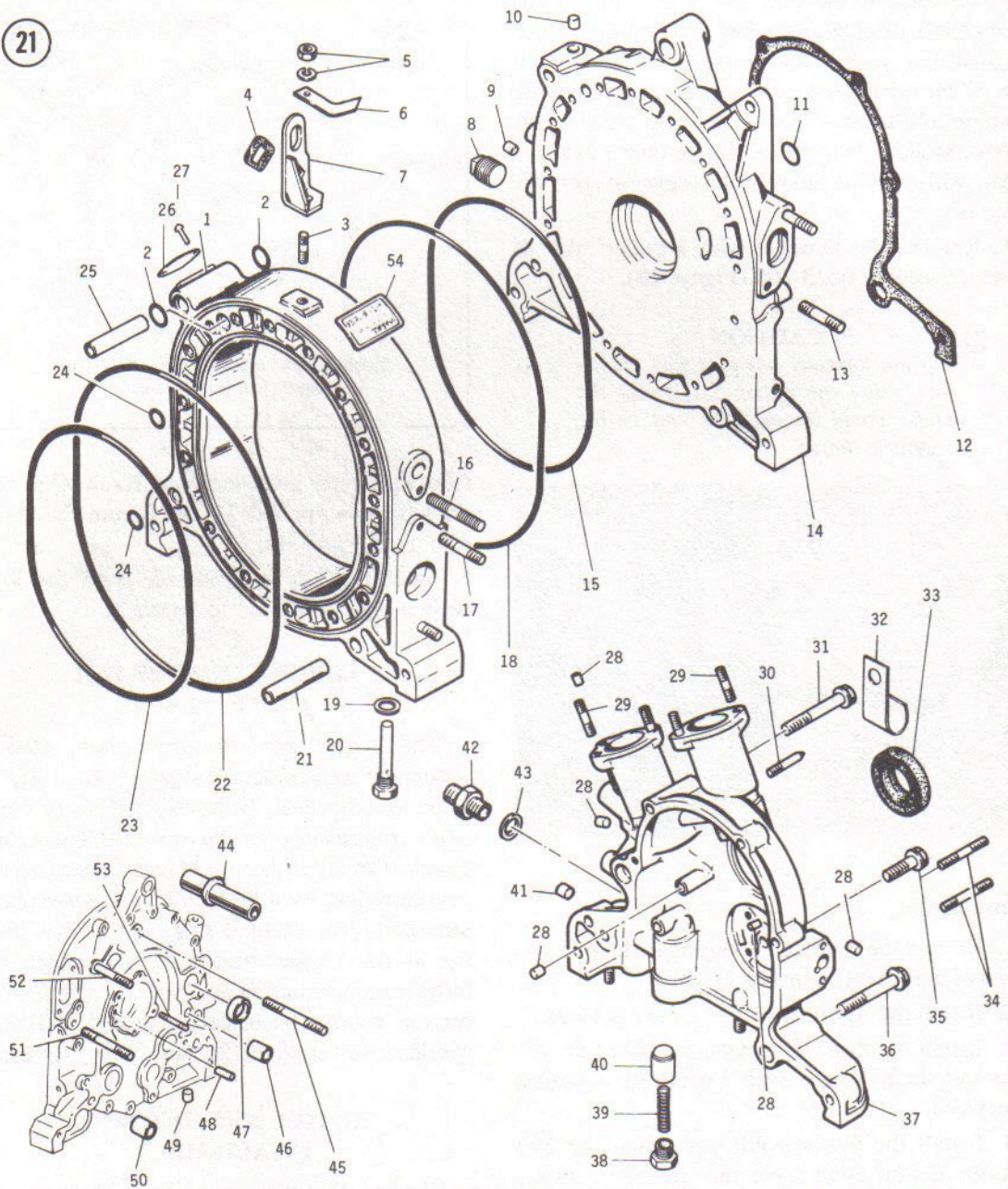
The torque converter drive plate, used on automatic transmission models, is basically the same as a flywheel. However, it turns the automatic transmission torque converter instead of a clutch. The drive plate on Mazdas is secured to a counterweight by 6 bolts. The counterweight is secured to the eccentric shaft in the same manner as the manual transmission flywheel. Removal and installation are basically the same as for the manual transmission flywheel. Torque specifications are given in Table 2 on page 64.

#### ROTOR AND HOUSING DISASSEMBLY

**Figures 21** (next page) and **22** (page 44) show the front and rear rotor and end housings. **Figure 23** (page 46) shows the front rotor and related parts. **Figure 24** (page 48) shows the rear rotor, eccentric shaft, and related parts.

1. Remove all external components from the engine.
2. Remove oil pan, front cover, and flywheel.
3. Remove the oil pump and chain adjuster as described earlier in this chapter.

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## FRONT ROTOR AND END HOUSINGS

- |                        |                          |                    |                          |                        |
|------------------------|--------------------------|--------------------|--------------------------|------------------------|
| 1. Front rotor housing | 11. O-ring               | 21. Dowel          | 31. Front cover bolt     | 42. Union joint        |
| 2. O-ring              | 12. Front cover gasket   | 22. O-ring         | 32. Wiring bracket       | 43. Gasket             |
| 3. Stud                | 13. Stud                 | 23. O-ring         | 33. Front cover oil seal | 44. Alternator bracket |
| 4. Protector           | 14. Front end housing    | 24. O-ring         | 34. Studs                | 45. Stud               |
| 5. Nut and lockwasher  | 15. O-ring               | 25. Dowel          | 35. Front cover bolt     | 46. Dowel              |
| 6. Bracket             | 16. Stud                 | 26. Label          | 36. Front cover bolt     | 47. Water passage plug |
| 7. Engine slinger      | 17. Stud                 | 27. Label rivet    | 37. Front cover          | 48. Dowel pin          |
| 8. Heater passage plug | 18. O-ring               | 28. Blind plug     | 38. Plug                 | 49. Blind plug         |
| 9. Blind plug          | 19. Packing washer       | 29. Stud           | 39. Spring               | 50. Dowel              |
| 10. Blind plug         | 20. Air injection nozzle | 30. Timing pointer | 40. Plunger              | 51. Stud               |
|                        |                          |                    | 41. Blind plug           | 52. Stud               |
|                        |                          |                    |                          | 53. Stud               |

4. Slide the balance weight, thrust washer, and needle bearing off the front end of the eccentric shaft. See Figure 23.

5. Remove 6 bolts securing the bearing housing. Lift the bearing housing, needle bearing, spacer, and thrust plate off the eccentric shaft.

6. Before disassembling further, make large identifying marks on the front and rear rotor housings with an indelible felt pen. Although they look the same, the rotor housings are not interchangeable. They must be reinstalled in the positions from which they were removed.

7. Referring to **Figure 25**, remove the tension bolts that hold the housings together.

#### CAUTION

*The tension bolts must be loosened evenly, or the housings may be warped. Go through the sequence in Figure 25 several times, loosening a little at a time.*

8. Lift the rear end housing off the engine.

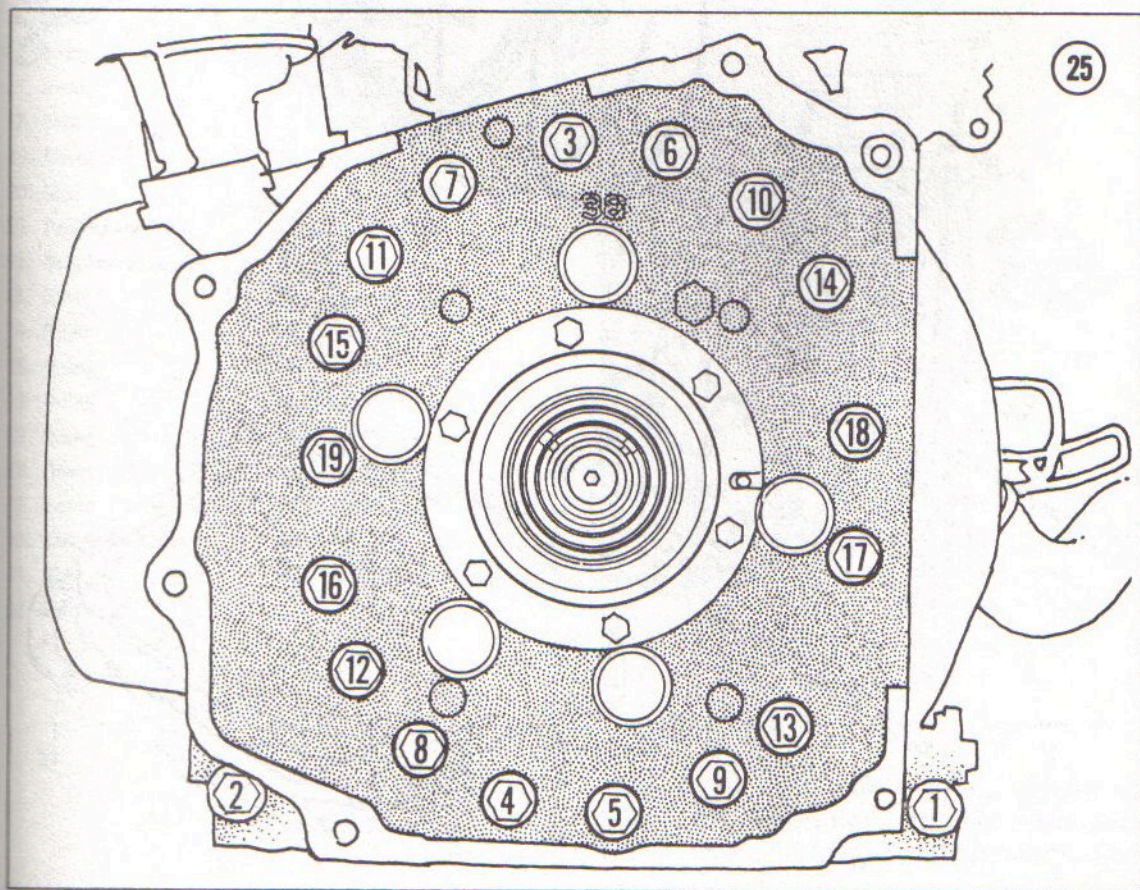
9. See if any rotor side seals have stuck to the friction surface of the rear end housing. If any have, take them off and return them to their original positions in the rotor.

10. The rotor should have an identification mark near each corner seal and side seal. Make sure these are there. If not, make your own with an indelible felt pen.

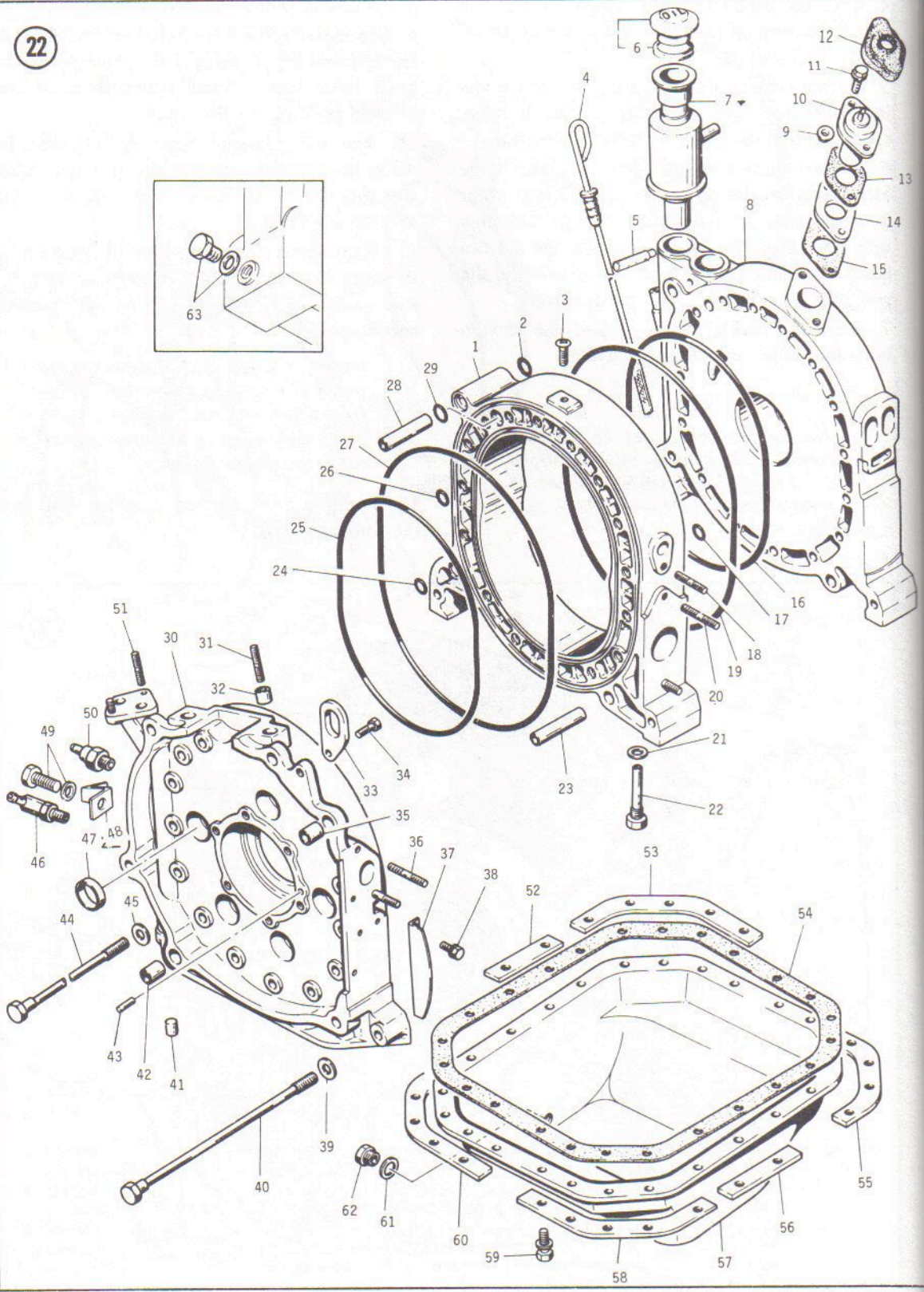
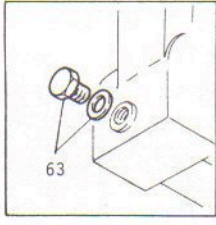
11. Remove the following from the rear face of the rotor: 3 corner seals, 3 corner seal springs, 6 side seals, and 6 side seal springs. Discard the corner seal springs.

*NOTE: The seals must be identified so they can be reinstalled in the grooves from which they were removed. Make a box with a separate, labeled section for each seal and its spring.*

12. Remove 2 O-rings and 2 rubber seals from the rotor housing.



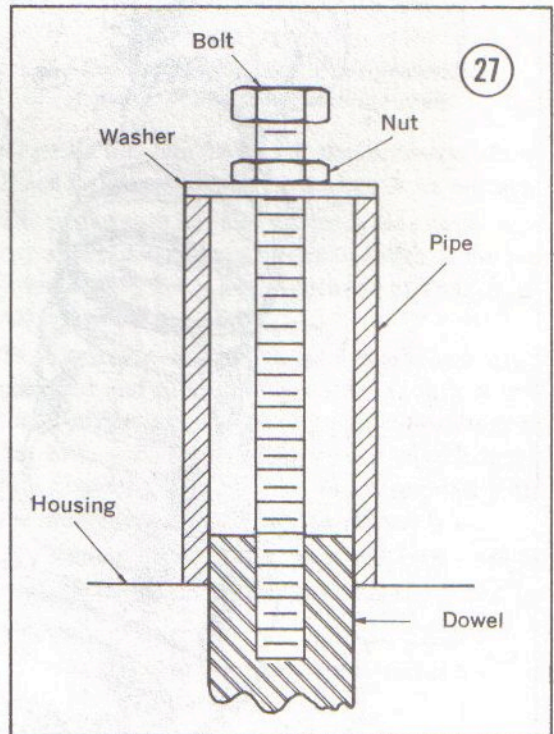
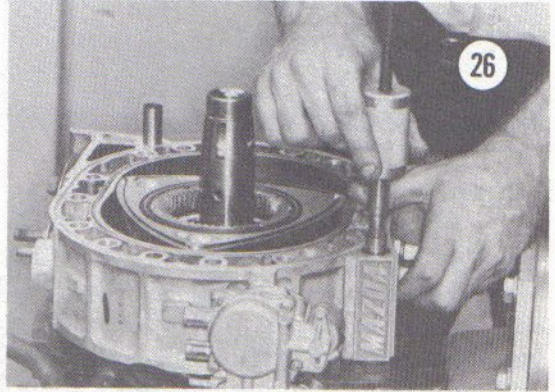
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## REAR ROTOR AND END HOUSINGS

- |                              |                             |
|------------------------------|-----------------------------|
| 1. Rear rotor housing        | 33. Engine slinger          |
| 2. O-ring                    | 34. Bolt                    |
| 3. Screw                     | 35. Tubular pin             |
| 4. Dipstick                  | 36. Stud                    |
| 5. Tube                      | 37. Dust cover              |
| 6. Oil filler cap and gasket | 38. Bolt                    |
| 7. Oil filler neck           | 39. Washer                  |
| 8. Intermediate housing      | 40. Tension bolt            |
| 9. Washer                    | 41. Blind plug              |
| 10. No. 1 thermosensor       | 42. Tubular pin             |
| 11. Bolt                     | 43. Dowel pin               |
| 12. Rubber boot              | 44. Tension bolt            |
| 13. Gasket                   | 45. Washer                  |
| 14. Insulator                | 46. Heater hose fitting     |
| 15. Gasket                   | 47. Water passage plug      |
| 16. O-ring                   | 48. Clamp                   |
| 17. O-ring                   | 49. Bolt and lockwasher     |
| 18. Stud                     | 50. Oil pressure switch     |
| 19. O-ring                   | 51. Stud                    |
| 20. Stud                     | 52. Oil pan stiffener       |
| 21. Packing washer           | 53. Oil pan stiffener       |
| 22. Air injection nozzle     | 54. Oil pan gasket          |
| 23. Dowel                    | 55. Oil pan stiffener       |
| 24. O-ring                   | 56. Oil pan stiffener       |
| 25. O-ring                   | 57. Oil pan                 |
| 26. O-ring                   | 58. Oil pan stiffener       |
| 27. O-ring                   | 59. Oil pan bolt            |
| 28. Dowel                    | 60. Oil pan stiffener       |
| 29. O-ring                   | 61. Gasket                  |
| 30. Rear end housing         | 62. Drain plug              |
| 31. Stud                     | 63. Housing plug and gasket |
| 32. Tubular pin              |                             |

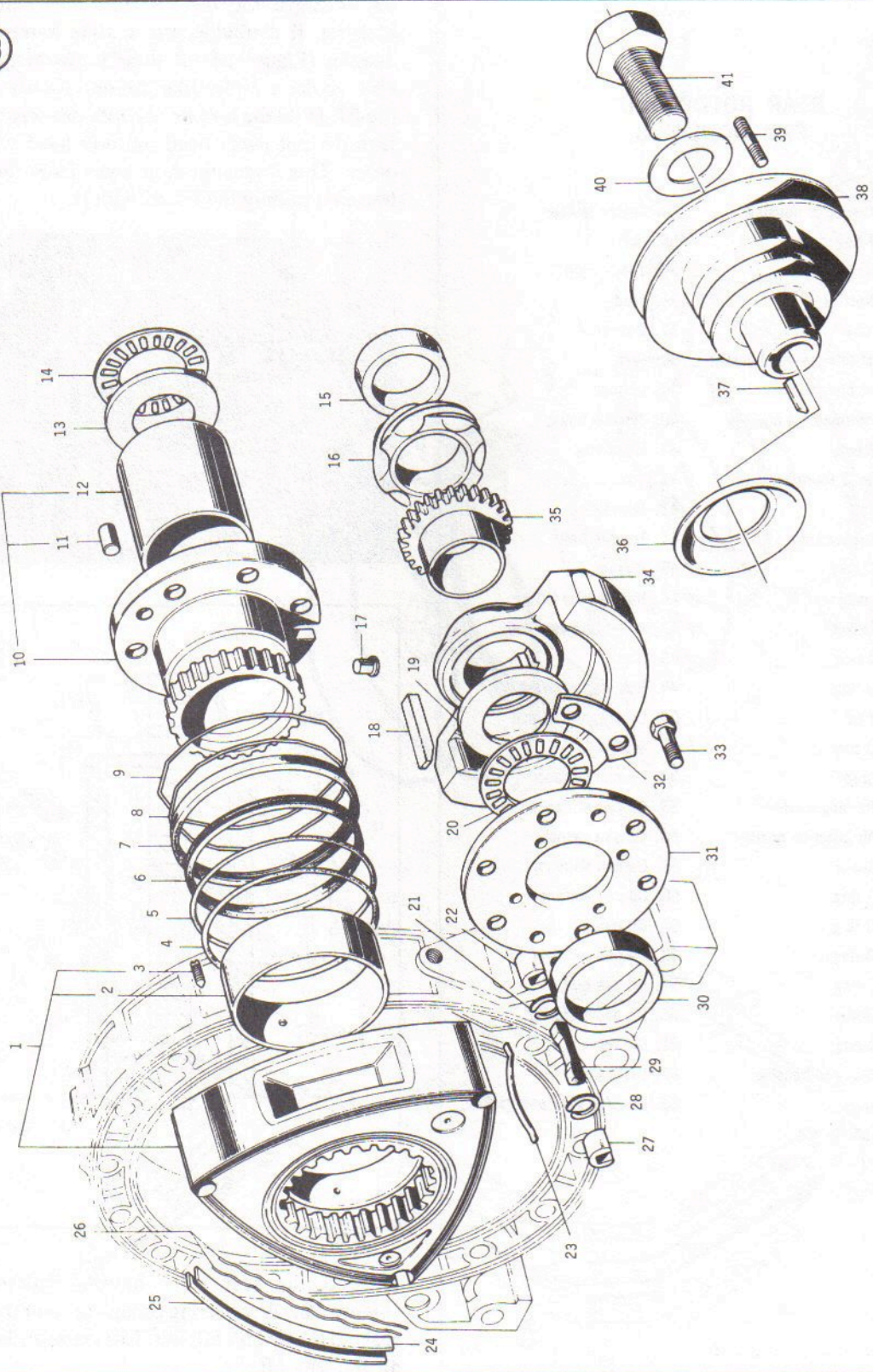
13. Remove the dowels from the rear rotor housing. If available, use a slide hammer and adapter (**Figure 26**). If these tools aren't available, make a puller like the one shown in **Figure 27**. Hold the bolt steady with one wrench and turn the nut away from the bolt head with another. This forces the bolt away from the rotor housing, pulling the dowel with it.



14. Lift the rear rotor housing halfway off (**Figure 28**). Wrap string or tape around the apex seals so they won't fall out. Lift the rotor housing all the way off.

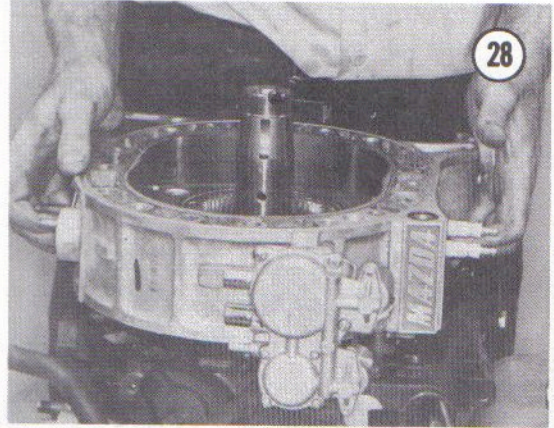


23



## FRONT ROTOR

- |                                    |                             |                        |                            |
|------------------------------------|-----------------------------|------------------------|----------------------------|
| 1. Front rotor assembly            | 12. Stationary gear bearing | 22. Corner seal        | 32. Lockwasher             |
| 2. Rotor bearing                   | 13. Thrust plate            | 23. Apex seal spring   | 33. Bolt                   |
| 3. Bearing securing screw          | 14. Needle bearing          | 24. Inner side seal    | 34. Balance weight         |
| 4. O-ring                          | 15. Spacer                  | 25. Outer side seal    | 35. Drive sprocket         |
| 5. O-ring                          | 16. Distributor drive gear  | 26. Side seal spring   | 36. Oil baffle plate       |
| 6. Inner oil seal                  | 17. Locating pin            | 27. Corner seal        | 37. Woodruff key           |
| 7. Outer oil seal                  | 18. Key                     | 28. Corner seal spring | 38. Eccentric shaft pulley |
| 8. Inner oil seal spring           | 19. Thrust washer           | 29. Apex seal          | 39. Stud                   |
| 9. Outer oil seal spring           | 20. Needle bearing          | 30. Spacer             | 40. Pulley washer          |
| 10. Front stationary gear assembly | 21. Corner seal spring      | 31. Plate              | 41. Pulley bolt            |
| 11. Dowel pin                      |                             |                        |                            |



15. Unscrew the air injection nozzles from the bottom of the rear rotor housing.

16. Remove the apex seals from the rotor. Mark the seals on the bottoms and fronts. They must be reinstalled in their original slots, facing in their original directions. It is a good idea to put them in a box with separate, labeled compartments for each seal.

## CAUTION

*Mark apex seals with a felt pen only.  
A punch or scribe will damage seals.*

17. Lift the rear rotor off the eccentric shaft. Place it rear side down on a clean work surface.

18. Make sure none of the front side seals, corner seals, or seal springs have fallen from the rotor. If they have, put them back in their original positions.

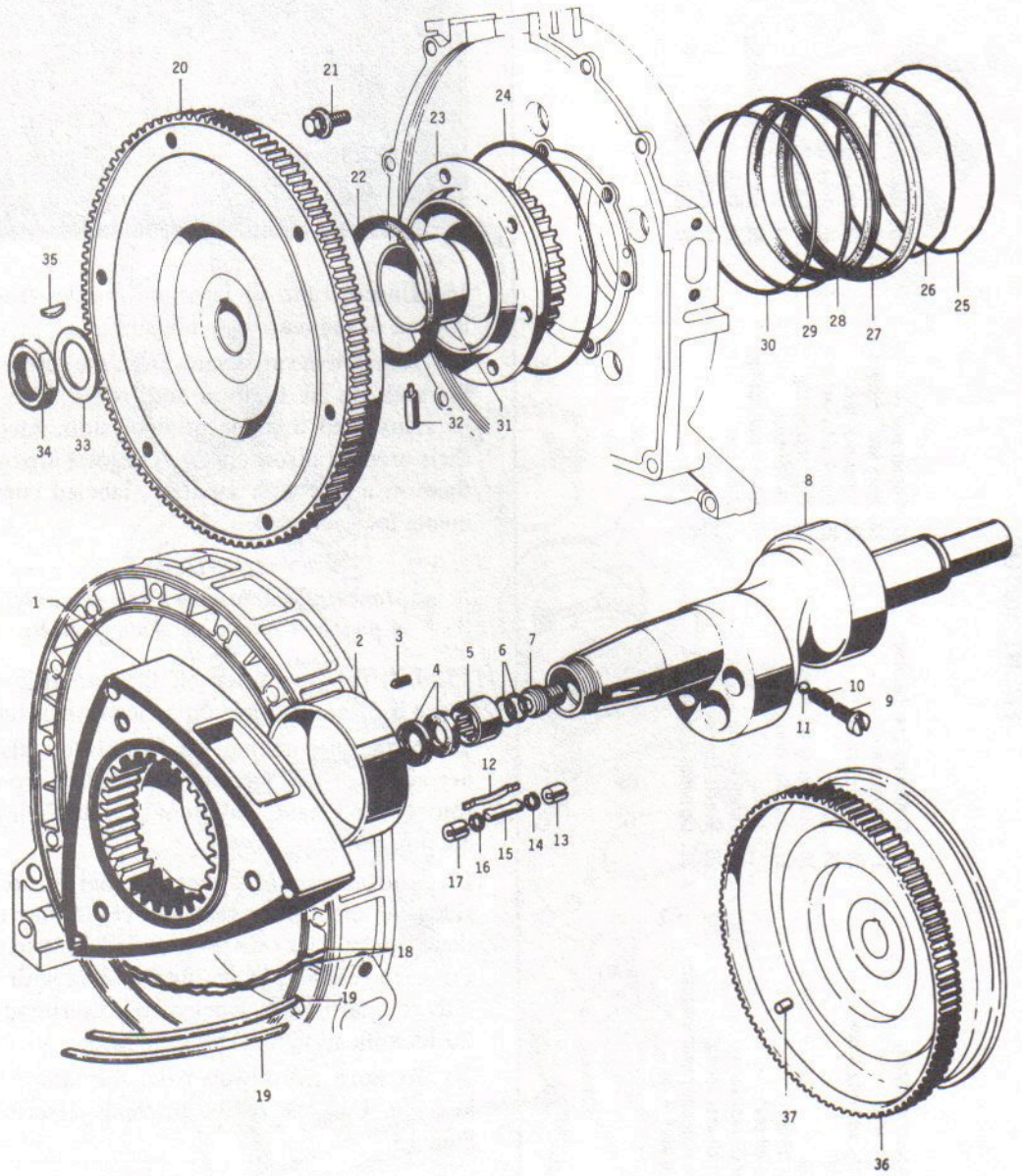
19. Look for an identification mark near each side seal and corner seal groove. If they aren't there, make your own with an indelible felt pen. Put each seal and its spring in a box with separate compartments, labeled to correspond with the identification marks on the rotor.

20. Remove the dowels from the intermediate housing. Use one of the methods described in Step 13.

*NOTE: The next step will be easier if done by 2 people.*

21. Remove the intermediate housing. To do this, lift the eccentric shaft up slightly. While holding it up, carefully lift the intermediate housing up, over the rear rotor journal, and off the eccentric shaft.

24



## REAR ROTOR

1. Rear rotor
2. Rotor bearing
3. Bearing securing screw
4. Oil seal
5. Needle bearing
6. O-rings
7. Blind plug
8. Eccentric shaft
9. Oil jet plug
10. Spring
11. Valve ball
12. Apex seal spring
13. Corner seal
14. Corner seal spring
15. Apex seal
16. Corner seal spring
17. Corner seal
18. Side seal springs
19. Side seals
20. Flywheel
21. Bolt
22. Stationary gear oil seal
23. Stationary gear
24. Stationary gear O-ring
25. Oil seal spring
26. Oil seal spring
27. Oil seal
28. Oil seal
29. O-ring
30. O-ring
31. Stationary gear (main) bearing
32. Bearing lock pin
33. Flywheel lockwasher
34. Flywheel nut
35. Woodruff key
36. Ring gear
37. Flywheel dowel pin

22. Lift the eccentric shaft out of the engine.
23. Remove the dowels from the front rotor housing as described in Step 13.
24. Remove the front rotor housing and rotor, following the procedure for the rear housing and rotor.

## ROTOR AND HOUSING INSPECTION AND REPAIR

### Intermediate and End Housings

Inspection procedures are basically the same for the intermediate housing and both end housings. None of the housings are repairable. If defective, they must be replaced.

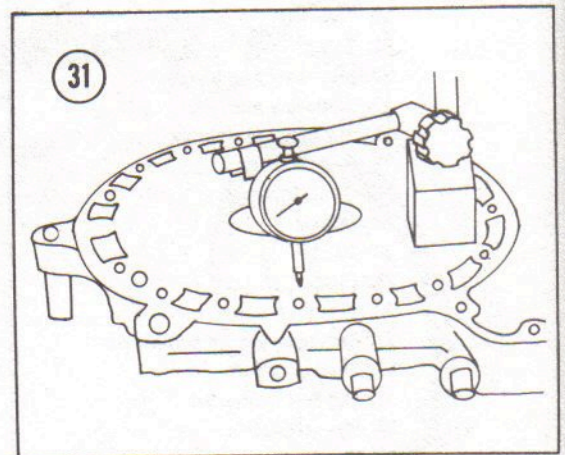
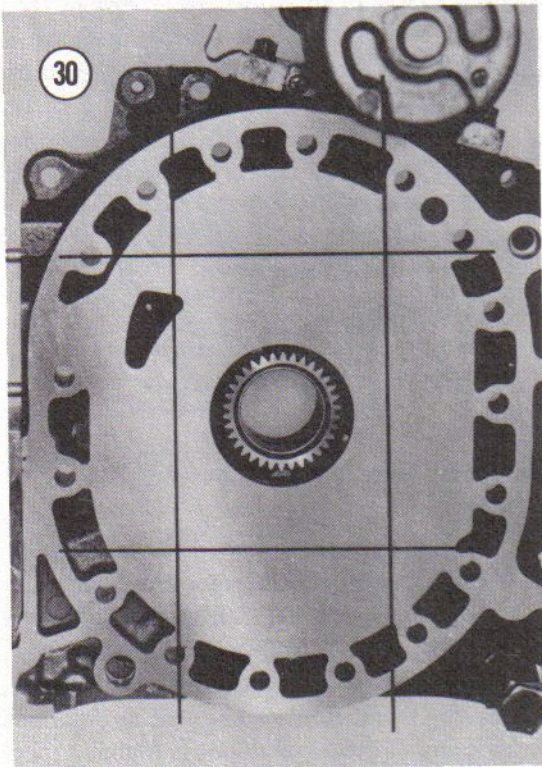
1. Before cleaning, check each housing for coolant residue or signs of gas leakage. This may indicate a warped housing.
2. Thoroughly clean the housing in solvent. Carefully remove all carbon, using a scraper or very fine emery paper if necessary. Do not scratch the machined surfaces.
3. Check for a warped housing. Place an accurate straightedge across the housing surface. If there is any gap between the straightedge and the housing, measure it with a feeler gauge (**Figure 29**). Measure in the 4 directions shown in **Figure 30**. Replace the housing if the gap exceeds 0.0023 in. (0.04mm).
4. Check the rotor friction areas on the housing for wear. Use a dial indicator as shown in **Figure 31**, or have the measurement done by a machine shop. Replace the housing if wear exceeds 0.004 in. (0.10mm).

*NOTE: Wear is normally greatest in a narrow area along the left and right sides of the housing surface.*

### Stationary Gear and Main Bearing Inspection

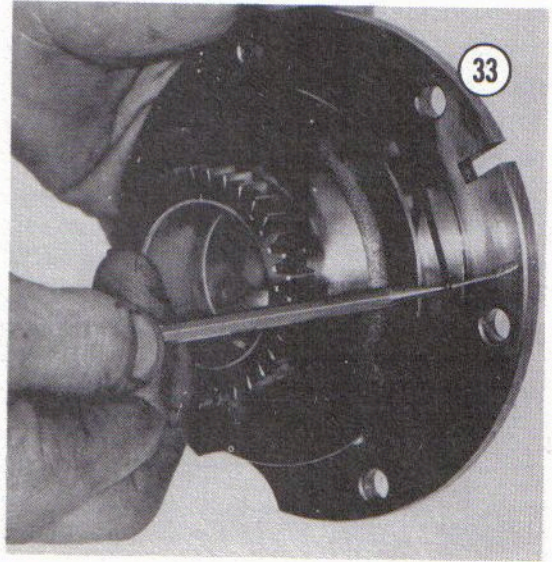
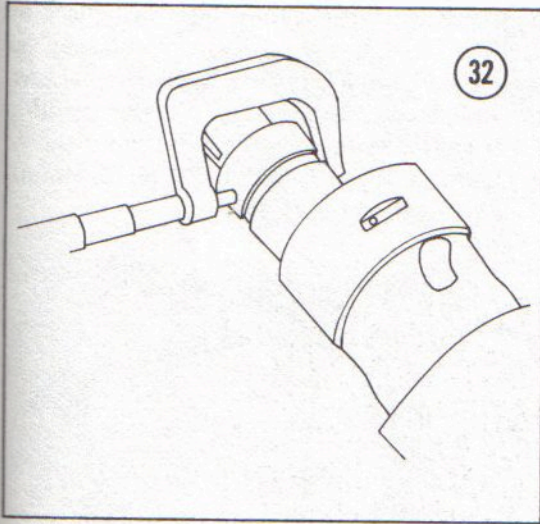
The stationary gears, bolted to the front and rear end housings, control rotor movement. The main bearings, located inside the stationary gears, support the eccentric shaft.

1. Check the stationary gear for worn, damaged, or missing teeth. Replace the gear as described later if any of these conditions is found.



2. Check the main bearing for visible scoring, wear, or damage. Replace if any of these is detected.

3. Check main bearing clearance. To do this, measure the main bearing journal on the eccentric shaft with a micrometer (**Figure 32**). Measure main bearing bore diameter with a bore gauge.

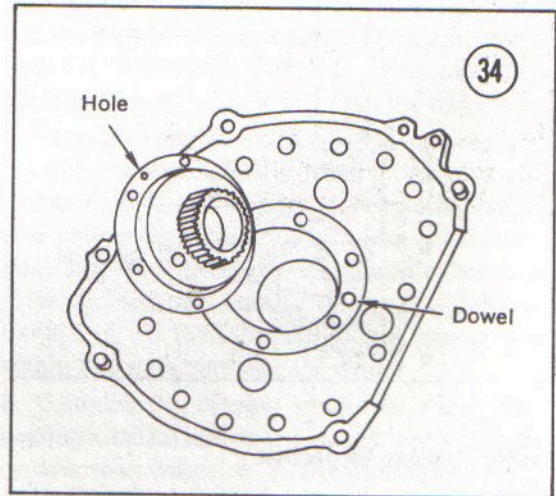


**NOTE:** A machine shop will do this for a nominal charge if you don't have the equipment.

The difference between the 2 measurements is main bearing clearance. The normal clearance is 0.0016-0.0028 in. (0.04-0.07mm). If the clearance exceeds 0.0039 in. (0.10mm), replace the main bearing as described later in this chapter.

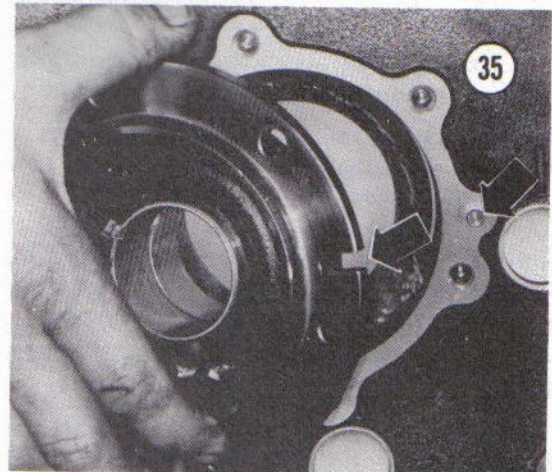
**NOTE:** If the front stationary gear and main bearing are serviceable, leave them in place. The next step applies to the rear stationary gear only.

4. Remove the stationary gear as described in the following procedure. Replace the O-ring shown in **Figure 33**. Coat the new O-ring with grease, then install the stationary gear.



### Stationary Gear Removal/Installation

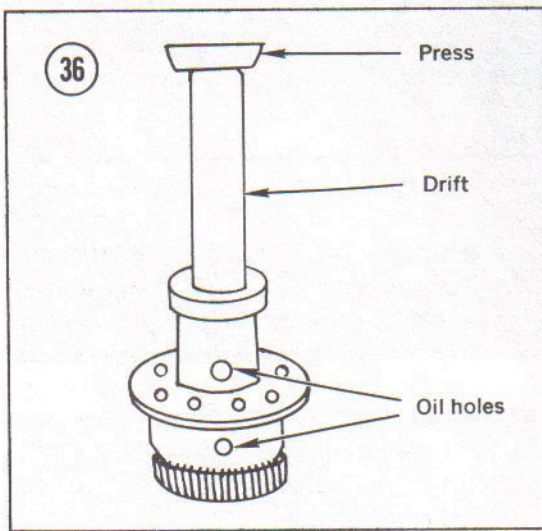
1. To remove, undo the bolts attaching the stationary gear to the end housing. Tap the gear out with a suitable drift.
2. To install, coat the stationary gear with oil and insert it in the end housing. Tap the gear in with a drift if necessary. On front stationary gears, make sure the dowel on the end housing aligns with the hole in the stationary gear (**Figure 34**). On rear stationary gears, make sure the dowel aligns with the slot in the gear (**Figure 35**).
3. Install the gear attaching bolts and tighten to 15 ft.-lb. (2 mkg).



### Main Bearing Replacement

Replacement procedures are the same for front and rear main bearings.

1. Remove the stationary gear as described in the previous procedure.
2. Place the gear on a press support tool, toothed end up. Using a drift such as Mazda tool 49 0813 235, press the old bearing out of the gear.
3. Turn the gear over. Press in a new bearing as shown in **Figure 36**. Be sure the oil holes in the bearing and gear are lined up after the bearing is pressed in.



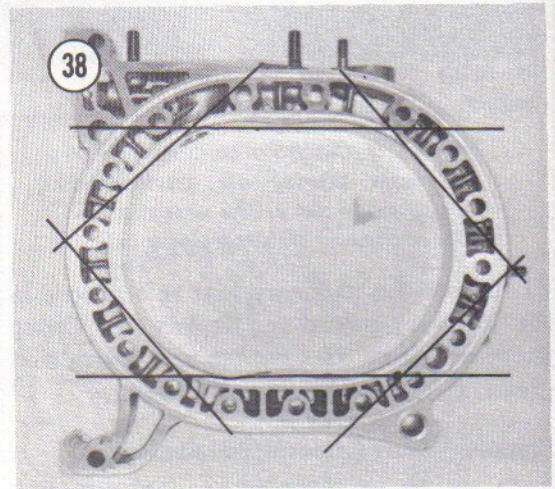
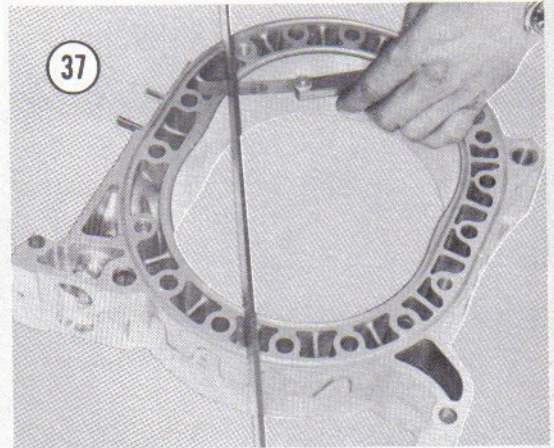
### Rotor Housing Inspection

1. Before cleaning, check the rotor housing inner edges for coolant residue or combustion gas leaks. These may indicate a distorted housing.
2. Carefully clean all carbon from the inside rotor surfaces with a rag and solvent.

**NOTE:** The inside rotor surfaces are chrome plated. Do not clean with a scraper or abrasives.

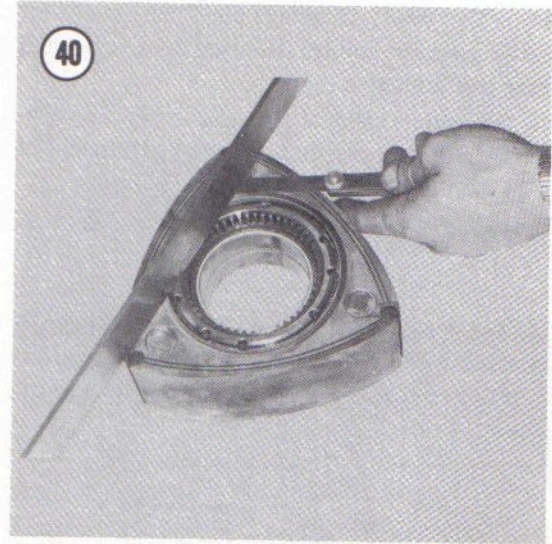
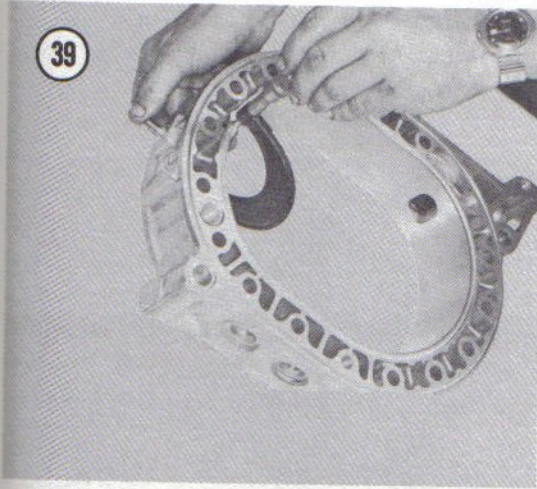
3. Remove all foreign material from the rotor housing coolant passages. A brush may be used if care is taken not to damage the aluminum.
4. Examine the inside surface of each rotor housing. If the chrome is peeling, scored, or otherwise damaged, the housing must be replaced.

5. Check for warped rotor housings. Place an accurate straightedge across the housing as shown in **Figure 37**. If there is any gap between the straightedge and housing, measure it with a feeler gauge. Measure in the 6 directions shown in **Figure 38**. If gap exceeds 0.002 in. (0.04mm), the housing must be replaced.



6. Using a micrometer as shown in **Figure 39**, measure rotor housing thickness. Take at least 8 measurements around the inner edge of the housing. If the difference between minimum and maximum thickness is more than 0.0031 in. (0.08mm), the rotor housing must be replaced. Standard housing thickness is 2.7559 in. (70mm).

**NOTE:** Write down the minimum rotor housing thickness. It will be needed for later procedures.



### Rotor and Seal Inspection

1. Before cleaning, examine the front and rear surfaces of the rotor near the seals. Carbon buildup on these surfaces indicates that combustion gas has been blowing by the seals. The seals may be worn.

Check the color of the carbon on the rotor combustion surfaces. While this varies according to engine condition just before disassembly, brown carbon on the leading side and black carbon on the trailing side is normal.

2. Clean all carbon from the rotor surfaces and seal grooves. A scraper or very fine emery paper may be used, but be careful not to damage the rotor. After removing carbon, clean the rotor in solvent and blow dry with compressed air.

3. Examine the rotor and its internal gear. Replace the rotor if it is obviously worn or damaged. Rotor replacement is also necessary if the internal gear has cracks or defective teeth.

4. Measure the distance the oil seals protrude from the rotor. Use a straightedge and feeler gauge (Figure 40). It should be 0.020 in. (0.5mm). Measure the width of the oil seal lips. They should be less than 0.031 in. (0.8mm) wide. Replace the seals if they don't meet specifications.

5. Pry the oil seals out, even if they are serviceable. The seals must be removed to measure rotor land protrusion. If you plan to reuse the seals, pry them out carefully so they won't be damaged.

6. Measure rotor land protrusion in the same manner as oil seal protrusion. Minimum protrusion is 0.004-0.006 in. (0.10-0.15mm). Replace the rotor if protrusion is less than the minimum.

7. Measure rotor thickness with a micrometer. Normal rotor thickness is 2.750 in. (69.85mm). Compare thickness with the rotor housing thickness written down during *Rotor Housing Inspection*, Step 6. The standard difference between rotor thickness and housing thickness is 0.0051-0.0067 in. (0.13-0.17mm). If the gap is not within this range, replace the rotor.

8. Examine the bearing inside the rotor. The bearing must be replaced if scored, visibly worn, or otherwise defective. Rotor bearing failure is relatively rare, and is usually accompanied by serious engine damage.

**NOTE:** *The next step can be done by a machine shop if you don't have the necessary equipment.*

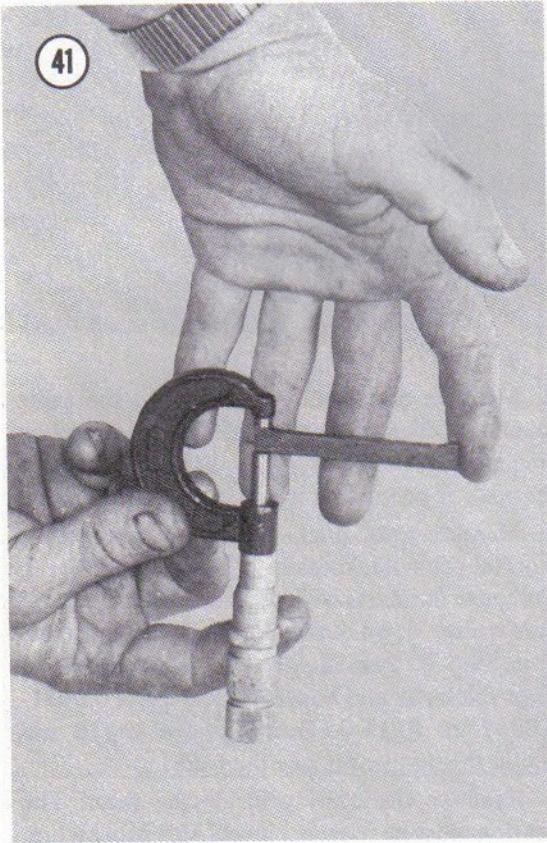
9. Check rotor bearing clearance. Measure bearing diameter with a bore gauge. Measure diameter of the eccentric shaft rotor journal with a micrometer. The difference between these 2 measurements is bearing clearance. If it exceeds 0.0039 in. (0.10mm), replace the rotor bearing as described in this chapter.

10. Carefully clean the apex seals in solvent. Don't use abrasives or a scraper. These will ruin



the seals. While cleaning, check the seals for visible wear or damage. Replace apex seals with these conditions.

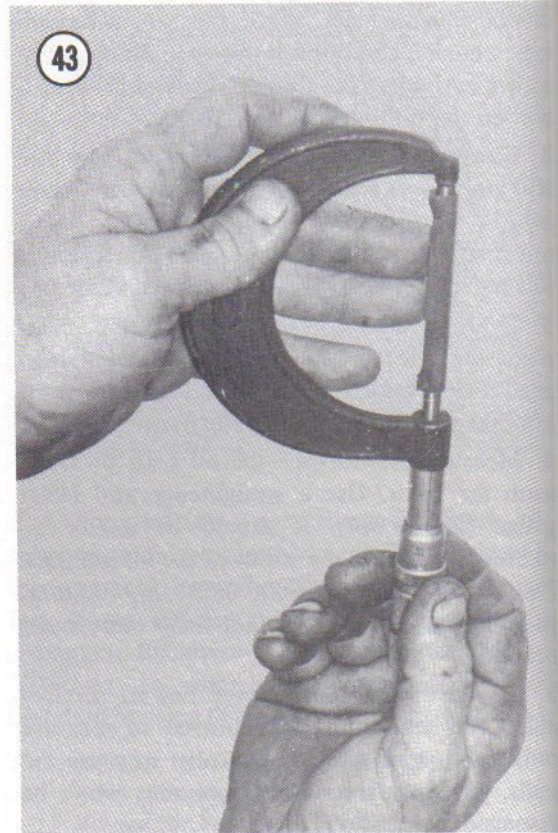
11. Measure height of the apex seals. See **Figure 41**. Replace any that are worn to a height of less than 0.394 in. (10mm)



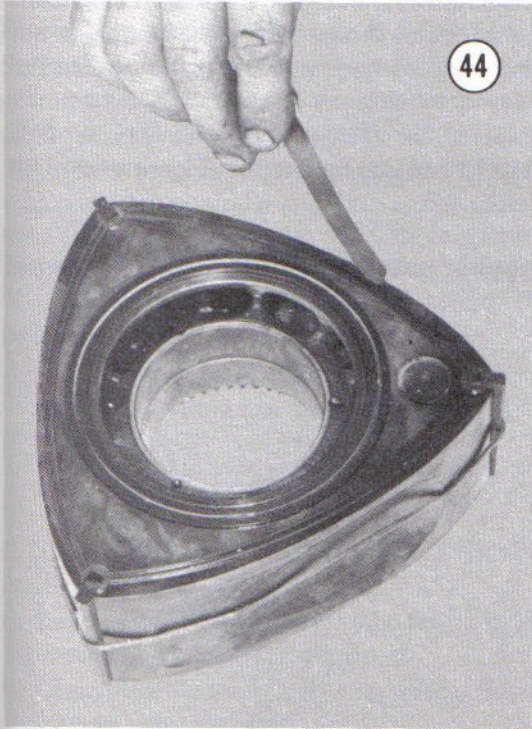
12. Place each apex seal in its groove in the rotor. Measure the gap between rotor and seal with a feeler gauge. Insert the feeler gauge all the way into the groove as shown in **Figure 42**. Replace any apex seal with a gap greater than 0.004 in. (0.10mm).

13. Measure apex seal length (**Figure 43**). Compare this measurement with rotor housing thickness, written down during *Rotor Housing Inspection*, Step 12. If the difference between seal length and housing thickness is more than 0.006 inch (0.15mm), replace the apex seal.

14. Thoroughly clean the side seals, corner seals, and seal springs. Replace any seals or springs with visible wear or damage. Replace corner seal springs as a general practice.



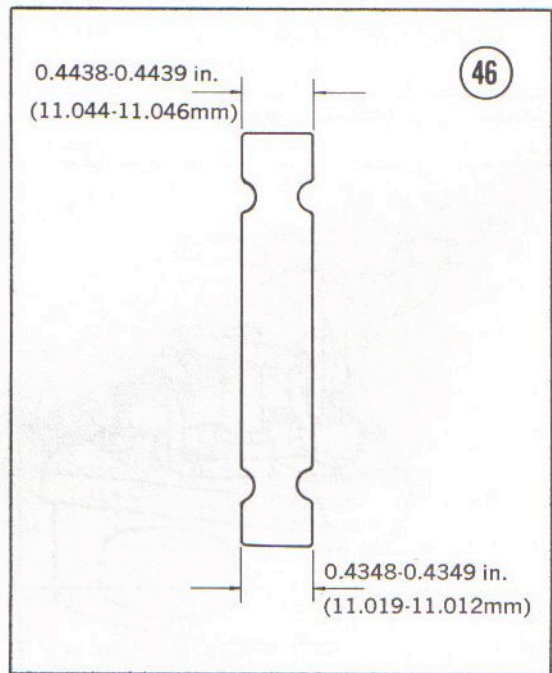
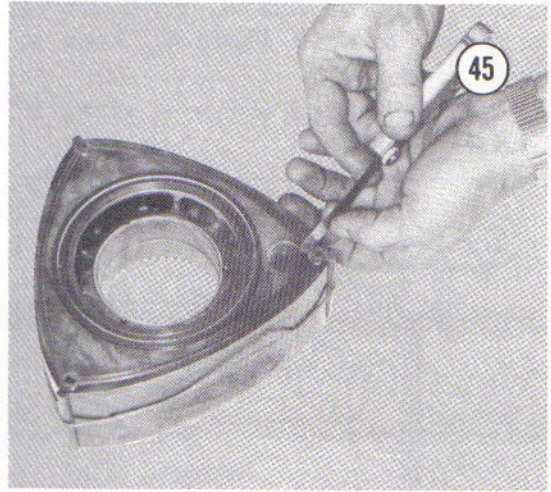
15. Measure the gap between the side seals and their grooves (**Figure 44**). Normal gap is 0.002-0.003 in. (0.028-0.078mm). Replace any side seals with gaps greater than 0.004 in. (0.1mm).



16. Check the gap between side seals and corner seals. Measure on the leading side of each corner seal (the side that faces in the rotation direction of the rotor). See **Figure 45**. Replace any side seals with gaps greater than 0.016 in. (0.4mm).

**NOTE:** When installing new side seals, be sure the gap measured in Step 16 is 0.002-0.006 in. (0.05-0.15mm). If necessary, file the trailing end of each side seal to increase the gap.

17. Check the gap between the corner seal and its bore in the rotor. Normal gap is 0.0008-0.0019 in. Maximum permissible is 0.0031 inch (0.08mm). If the gap is at or beyond the limit, discard the corner seal and measure the bore for wear. To measure, use a bar gauge such as Mazda tool 49 0839 165 (**Figure 46**). If neither end of the gauge fits in the bore, use a standard corner seal. If the small end fits in the bore, use a 0.0012 in. (0.03mm) oversize corner seal, but do **NOT** ream the corner seal bore. If



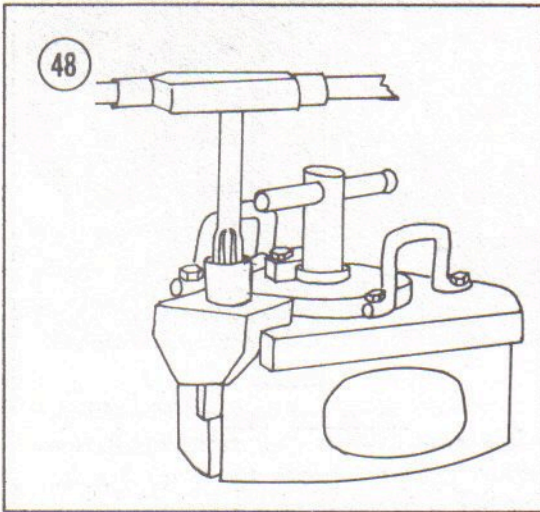
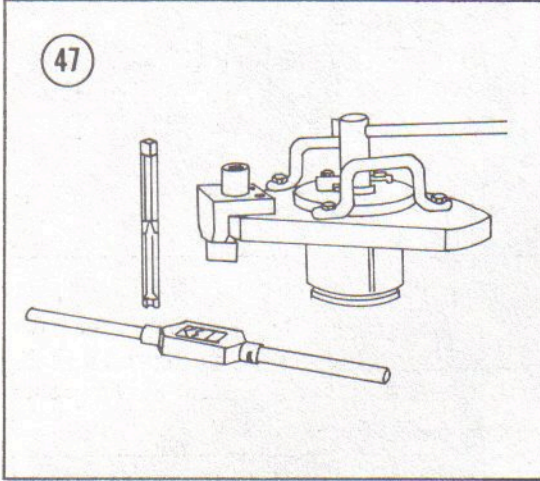
the large end of the gauge fits in the bore, ream the bore for a 0.0079 in. (0.2mm) oversize corner seal. See the following procedure.

### Reaming Corner Seal Bores

This is a precise job that should be left to a Mazda dealer or competent automotive machine shop. This procedure is provided in case you are not near a dealer, and your local machine shop is not familiar with the Mazda. A 0.441 in.

(11.2mm) reamer is required, as well as a jig like the one shown in **Figure 47**. Ream as follows.

1. Attach the jig and reamer as shown in **Figure 48**.



2. Lubricate the reamer with engine oil. The reamer *MUST* be well lubricated at all times during this procedure.

3. Ream the groove with at least 20 turns of the reamer. This is necessary to obtain the correct surface finish.

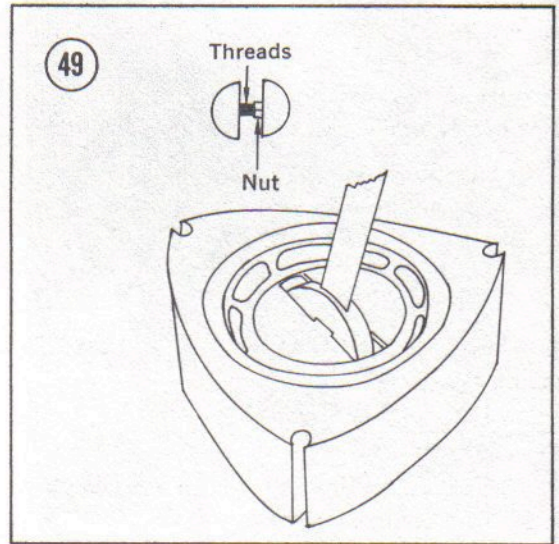
#### CAUTION

*Do not remove the reamer from the groove until reaming is complete. Reaming in 2 stages may damage the finish.*

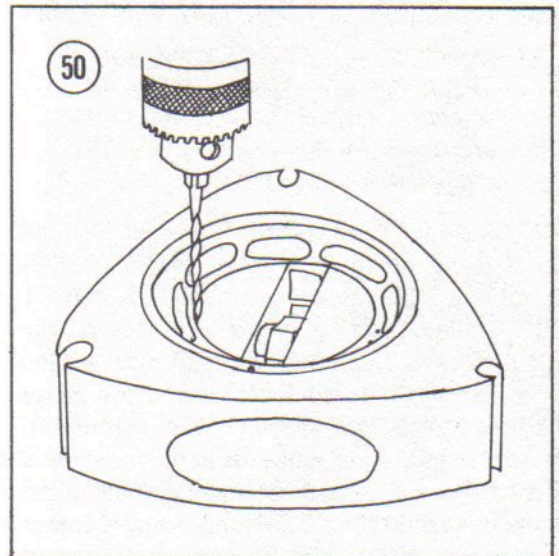
### Rotor Bearing Replacement

This, like the previous procedure, is a precise job that should be left to a dealer or machine shop. While the tools or an acceptable substitute are not difficult to obtain, a mistake could damage the rotor. In addition, if the bearing is not secured properly, it may come loose when the engine is running, causing severe damage.

1. Insert an expander such as Mazda tool 49 0813 245 into the bearing (**Figure 49**).



2. Drill a hole 0.14 in. (3.5mm) wide and 0.28 inch (7mm) deep in each of the locking screws securing the bearing to the rotor. See **Figure 50**.



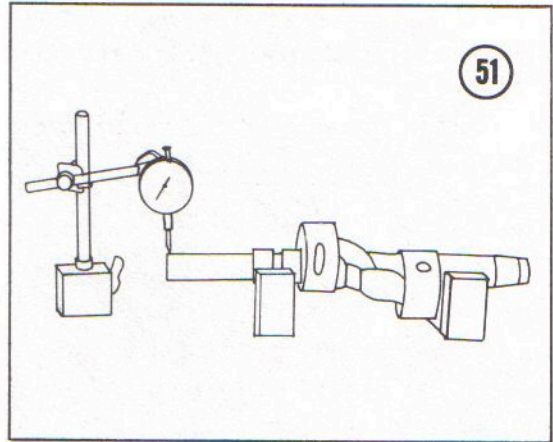
3. Place the rotor on a press support tool with the internal gear upward. Remove the bearing with a press and drift.
4. Examine the bearing bore in the rotor. If it is scored or burred, smooth it with emery paper. Blow off any foreign matter with compressed air.
5. Place the rotor on the support tool, internal gear upward. Press in a new bearing. Be sure the oil holes in bearing and rotor line up after pressing.
6. Insert the expander in the bearing. Drill holes 0.14 in. (3.5mm) wide and 0.28 in. (7mm) deep, part of each hole in the bearing and part of each hole in the rotor. Locate the holes 0.28 inch (7mm) to one side of the original holes.

**NOTE:** All holes must be in the same direction (clockwise or counterclockwise) from the original holes. The center of each hole must be 0.020 in. (0.5mm) from the rotor bore.

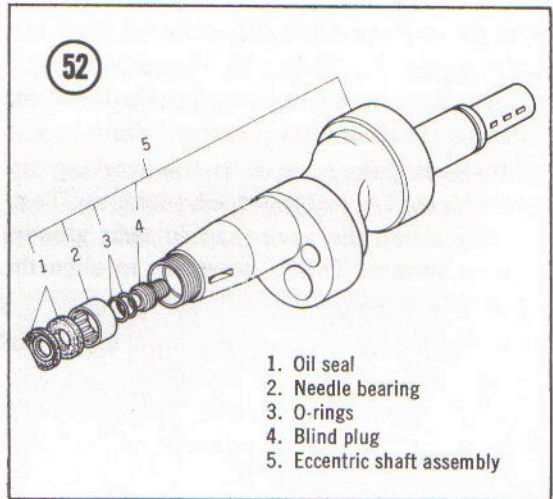
7. Thread the new holes with a M4x0.70 metric tap.
8. Install new locking screws in the holes. Stake the screws in place with a punch.
9. Clean the rotor thoroughly with solvent. Blow it dry with compressed air.

### Eccentric Shaft Inspection

1. Thoroughly clean the shaft in solvent. Blow out the oil passages with compressed air. While cleaning, check the shaft for visible wear or damage, especially on the main bearing and rotor journals. Be sure the oil passages are open. Check the plug inside the rear end of the shaft for looseness or oil leakage. If necessary, repair as described later in this section.
2. Measure shaft journal diameter with a micrometer. A machine shop will do this for a nominal fee if you don't have a micrometer. Compare with specifications at the end of the chapter. Replace the eccentric shaft if worn beyond specifications.
3. Check the eccentric shaft for runout. Mount it between accurate centers, such as V-blocks or a lathe, and set up a dial gauge as shown in **Figure 51**. Rotate the shaft one full turn and note the reading on the gauge. Replace the shaft if runout exceeds 0.0008 in. (0.02mm).



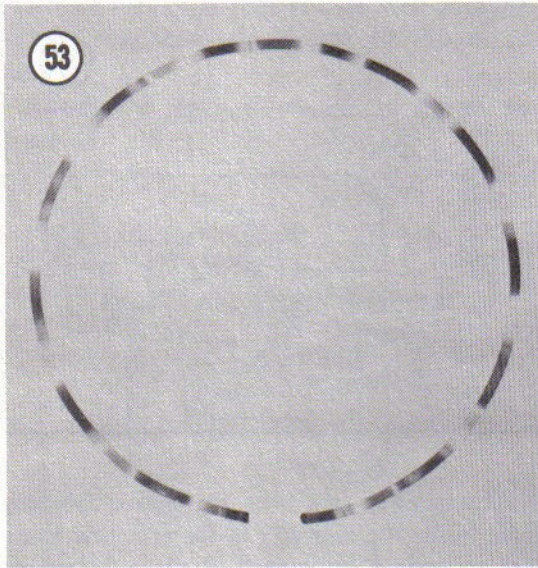
4. If necessary (see Step 1) remove the plug from inside the rear end of the eccentric shaft. Use a metric Allen wrench. Replace the rubber O-rings (3, **Figure 52**).



5. On manual transmission models, check the pilot bearing inside the rear end of the eccentric shaft for wear or damage. See **Figure 52**. Place the eccentric shaft over the transmission main drive shaft and check for smooth bearing movement. If necessary, remove the bearing with a suitable puller. Then install a new bearing with a drift such as Mazda tool 49 0823 072.

### ENGINE ASSEMBLY

1. Place the front rotor on a clean work surface. Place the oil seal springs (**Figure 53**) in their grooves so the gaps are opposite each other.



2. Install new O-rings in the oil seals.
3. Lubricate the oil seal grooves in the rotors with engine oil. Place the oil seals in their grooves. Be sure the seals are installed with the white-marked sides down (toward the rotor).
4. Place the front rotor on a clean working surface with the internal gear teeth facing up. Temporarily install the apex seals in their grooves without springs. This is necessary to align the corner seals.
5. Coat the corner seals and new corner seal springs with engine oil. Install them in their bores. Remove the apex seals. Be sure the corner seals protrude 0.050-0.060 in. (1.3-1.5mm) from the rotor.
6. Oil the side seal springs, then install them in their grooves with the ends facing up (away from the rotor). Oil the side seals, then install them in their grooves.

*NOTE: There are 4 different types of side seals: front inner, front outer, rear inner, and rear outer. Be sure each is installed in its correct groove.*

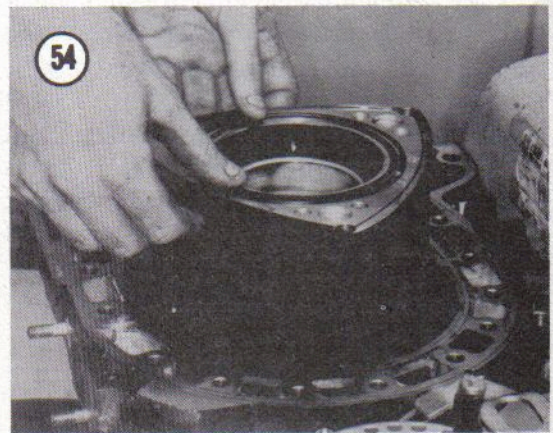
After installation, make sure the seals protrude about 0.040 in. (1mm) from the rotor. Make sure they move freely.

7. Lay the front end housing on a clean work surface or attach it to an engine stand. Carefully place the front rotor on the housing. Mesh the

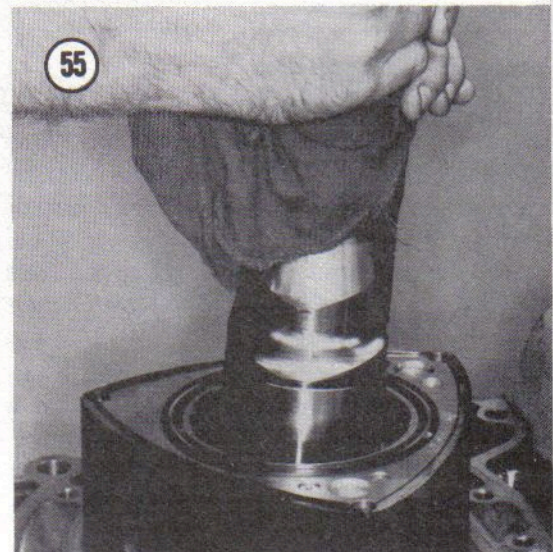
internal and stationary gears. One of the 3 rotor apexes must point at the top of the engine as shown in **Figure 54**.

#### CAUTION

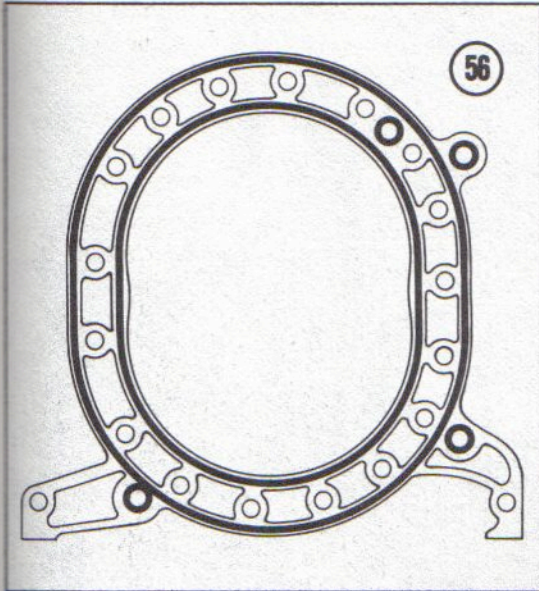
*Be sure the corner seals don't fall into the intake port.*



8. Liberally coat the front main and rotor journals on the eccentric shaft with engine oil. Gently lower the eccentric shaft into the front housing and rotor (**Figure 55**). Be careful not to damage the main or rotor bearings.

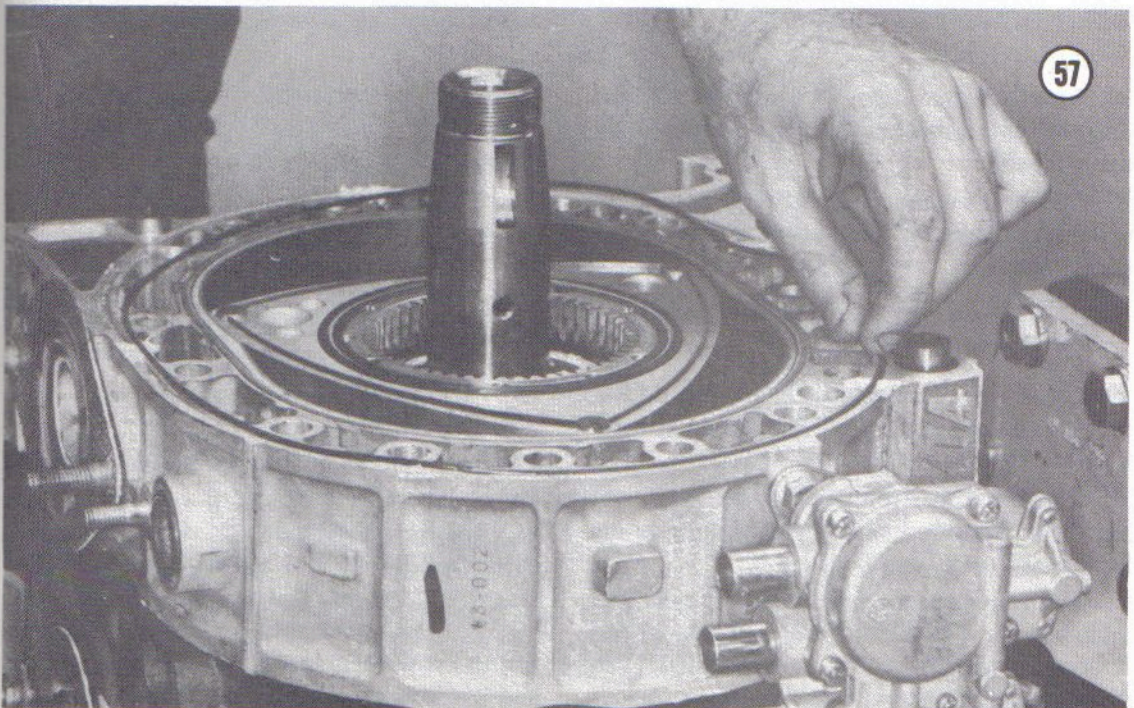


9. Install the air injection nozzles in the front rotor housing.
10. Lightly apply gasket sealer to the sealing ring grooves on the front side of the front rotor housing. See **Figure 56**.

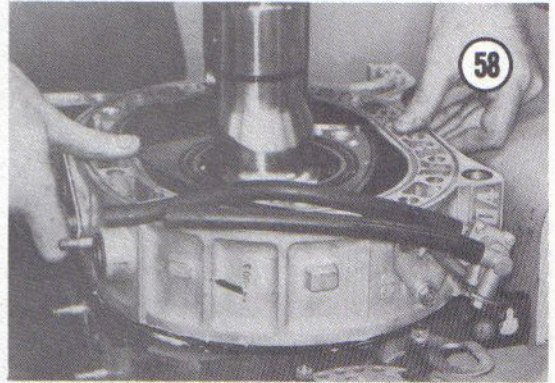
**CAUTION**

*Be sure no gasket sealer gets in oil or water passages.*

11. Lightly coat the 3 O-rings and 2 large sealing rings with rubber grease so they will stay in place. Install them on the front rotor housing. **Figure 57** shows a sealing ring being installed.



12. Carefully install the front rotor housing (**Figure 58**). Be sure the O-rings and sealing rings stay in place.

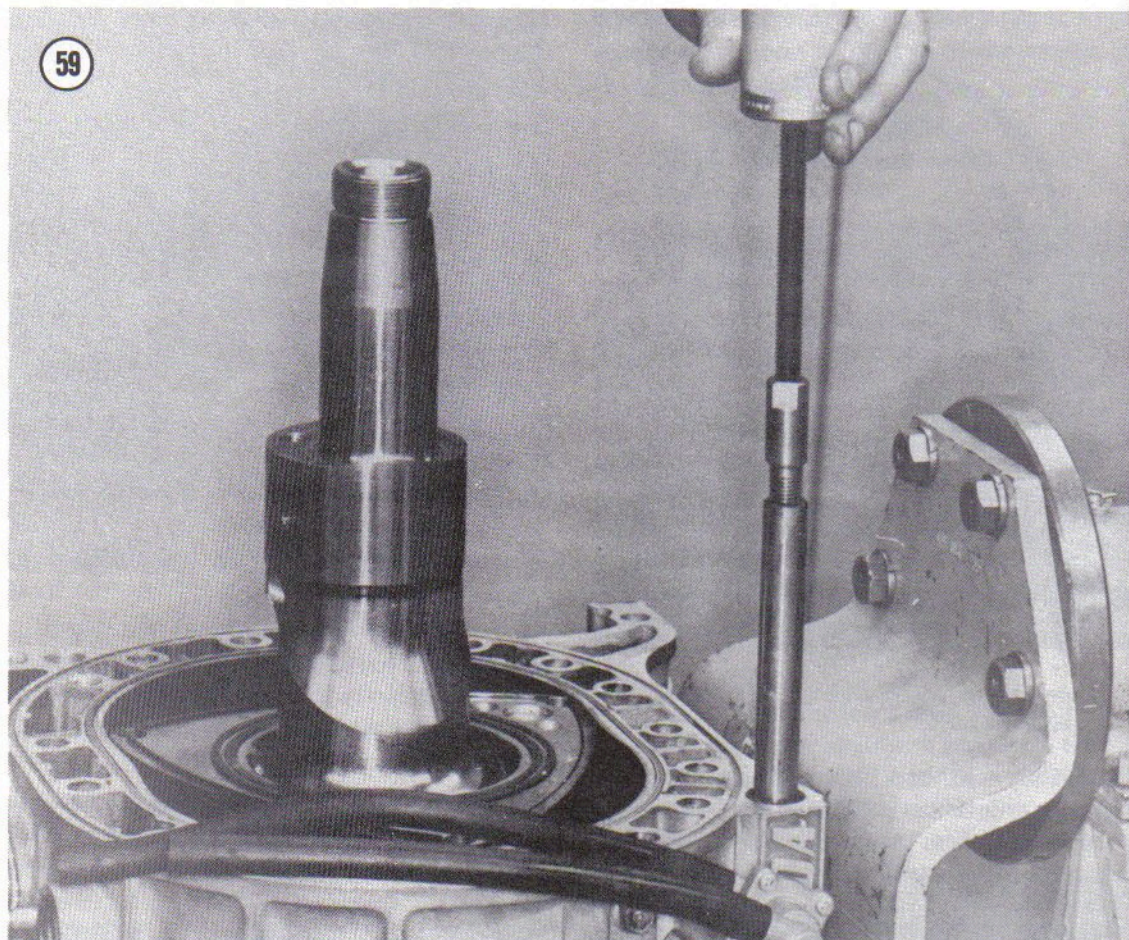


13. Coat the dowels with engine oil. Insert them through the front rotor housing into the front end housing. See **Figure 59**.

14. Coat the apex seals and springs with engine oil. Install them in their grooves on the rotor.

15. Coat the friction surface of the front end housing with engine oil.

16. Install the O-rings and sealing rings on the rear side of the rotor housing in the same manner as on the front side.



17. Install the side seals and corner seals on the rear side of the rotor in the same manner as on the front side.

18. Carefully inspect the front rotor housing to make sure there is nothing inside it that doesn't belong there.

*NOTE: The next step is easier if done by 2 people.*

19. Lift up on the eccentric shaft, but do not pull it out of the bearings. Install the intermediate housing (**Figure 60**).

20. Install the rear rotor seals, rear rotor, and rear rotor housing in the same manner as the front seals, rotor, and housing.

21. Liberally coat the rear stationary gear and main bearing with engine oil. Install the rear end housing. If necessary, turn the rotor slightly so internal gear meshes with rear stationary gear.

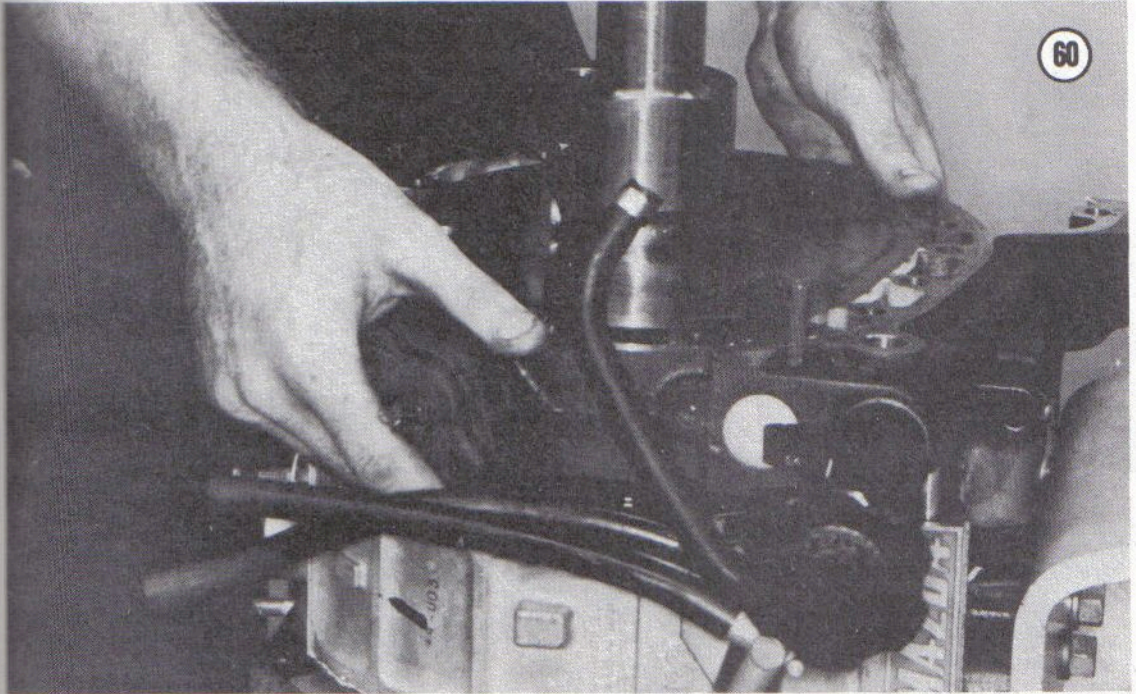
22. Install the tension bolts and tighten each 2-3 turns. Then tighten to 24 ft.-lb. in the order shown in **Figure 61**.

#### CAUTION

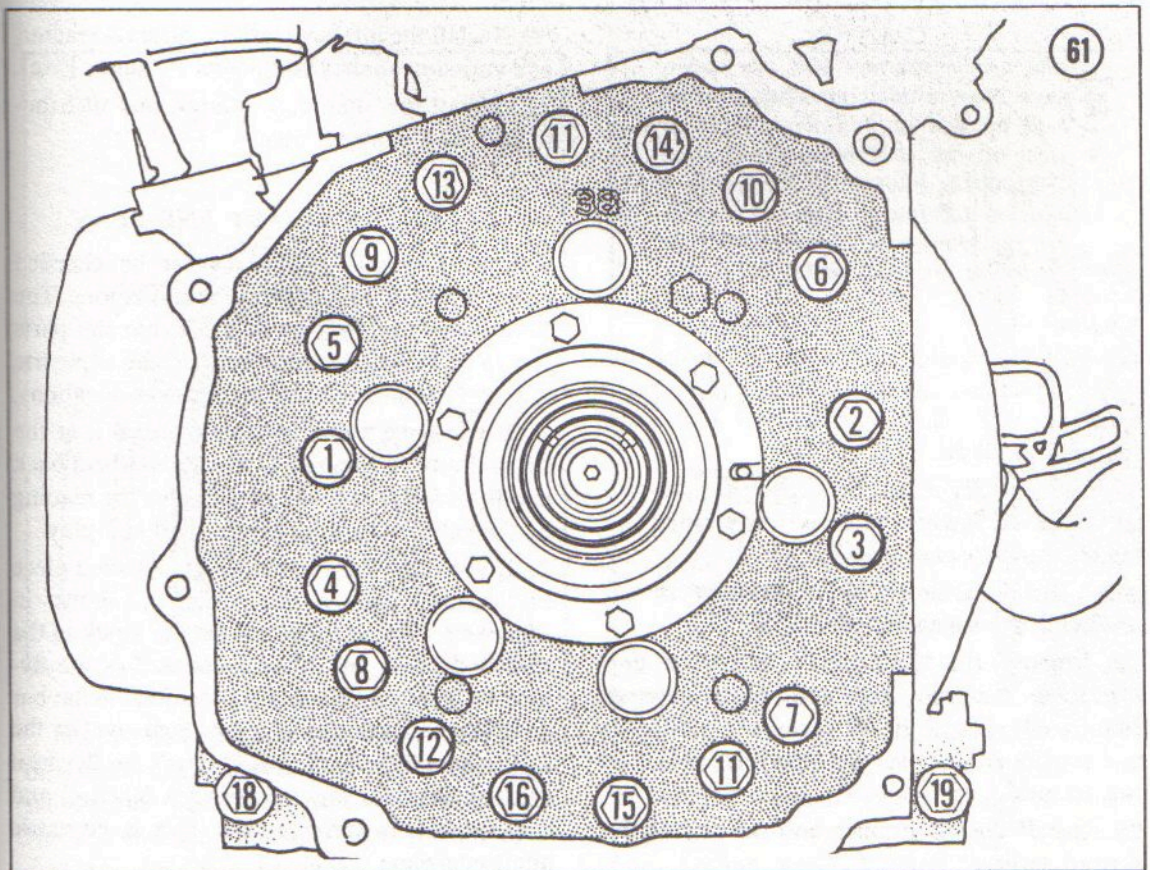
*Go through the tightening sequence in several stages, tightening the bolts a little at a time. Do not tighten the bolts all at once, or the engine housings may be warped.*

23. Install the oil pumps as described earlier in this chapter.

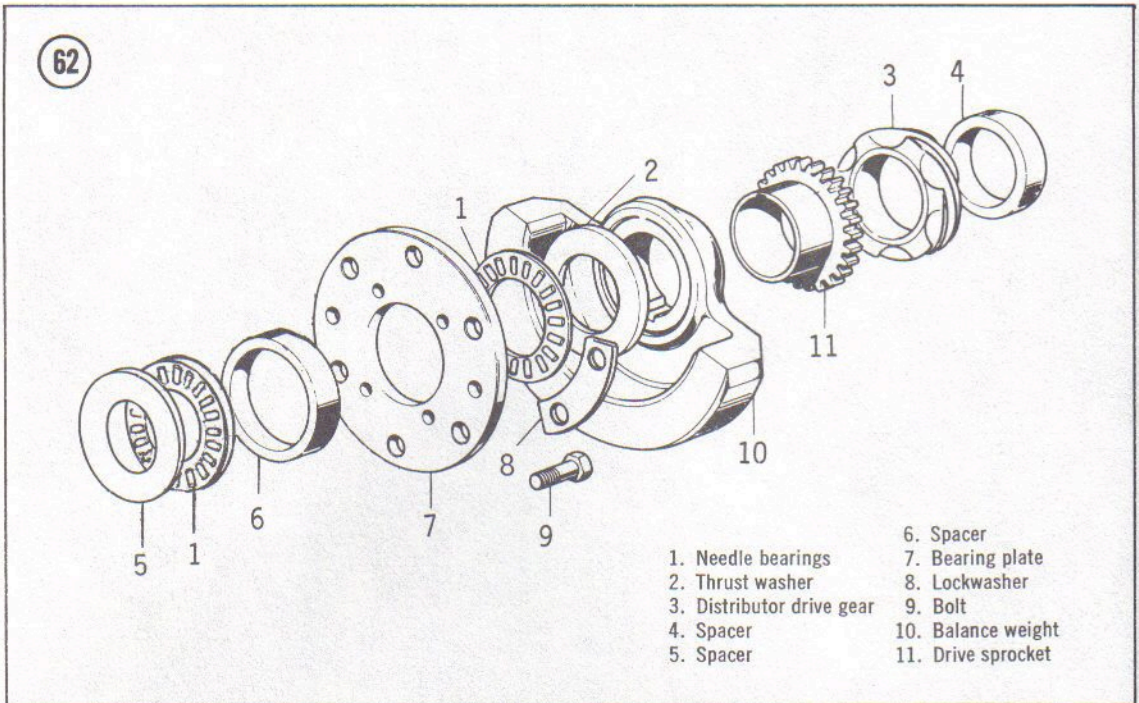
24. Referring to **Figure 62**, oil the following parts, then install them on the front end of the eccentric shaft: thrust plate spacer, needle bearing, bearing housing, second needle bearing, and thrust washer. Install bearing housing bolts and lockwashers. Tighten to 15 ft.-lb. (2 mkg).



4







### CAUTION

*The needle bearings will slip downward after installation. They must be held up with a thin screwdriver or piece of wire, and the spacer inserted **INSIDE** the bearings. If the spacer is allowed to rest against the needle rollers, the bearings will be destroyed immediately after the engine is started.*

25. Again referring to Figure 62, install the following parts: balance weight, oil pump sprockets and chain, distributor drive gear, spacer, and oil thrower.

26. Temporarily install the eccentric shaft pulley. Hold the flywheel to keep from turning and tighten the pulley bolt to 47 ft.-lb.

27. Measure eccentric shaft end-play as described in the following procedure.

28. Remove the front pulley. Install a new O-ring in the front end housing oil passage (**Figure 63**). Install the oil pump chain adjuster and engine front cover as described earlier in this chapter.

29. Install the oil strainer and oil pan as described earlier.

30. Install the intake manifold, thermal reactor, and emission control equipment (Chapter Five).

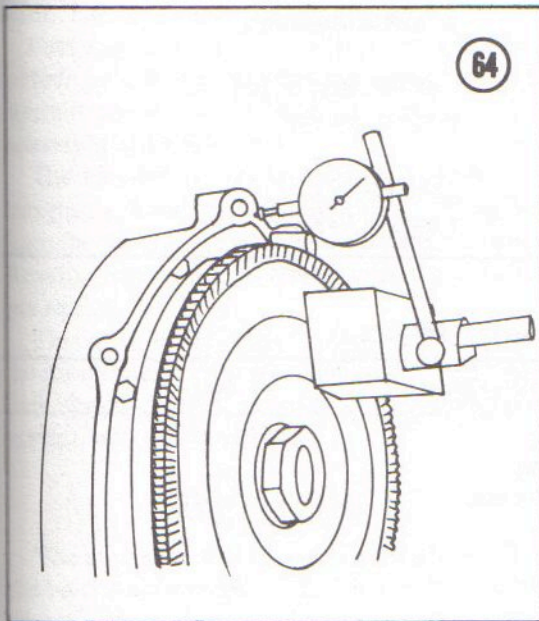
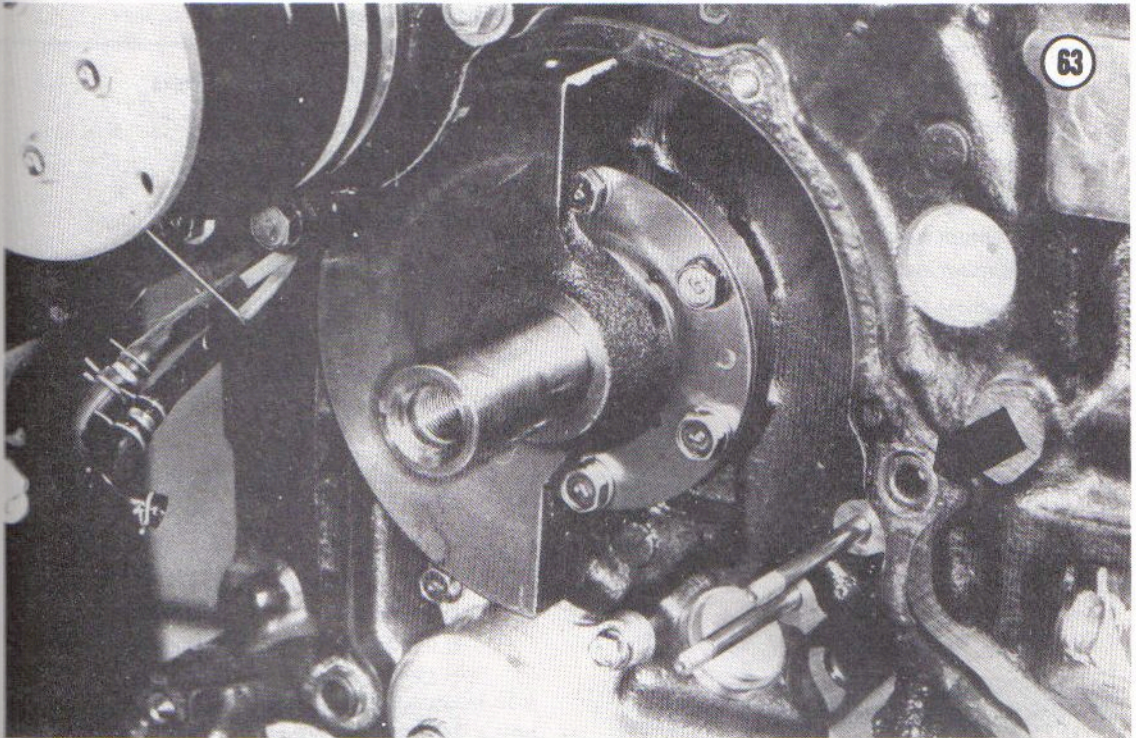
31. Install the alternator, starter, and distributor(s). See Chapter Seven.

### ECCENTRIC SHAFT END-PLAY

Eccentric shaft end-play must be checked after reassembling the housing and rotors. The front cover need not be in place, but the parts shown in Figure 62 must be, and the eccentric shaft pulley must be tightened to specifications.

1. If you have a dial indicator, attach it at the point shown in **Figure 64**. Pry the flywheel back and forth as far as it will go and note the reading on the gauge. This is eccentric shaft end-play.

2. If you don't have a dial gauge, attach a piece of threaded stock to the engine as shown in **Figure 65**. Attach a piece of flat bar stock to the threaded stock, but leave it loose. Pry the flywheel away from the engine. Position the flat bar so it just touches the flywheel, then tighten the nut to hold it in that position. Push the flywheel in, then measure the gap between flywheel and flat bar with a feeler gauge. This is eccentric shaft end-play.



Normal end-play is 0.0016-0.0018 in. (0.04-0.07mm). If end-play is not within this range, remove the spacer from behind the oil thrower. Reduce end-play with a thicker spacer, or increase it with a thinner spacer.

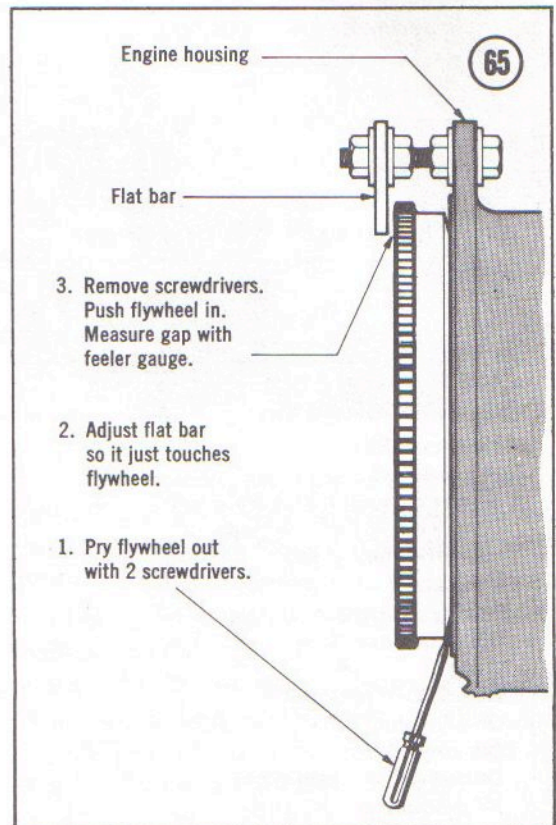


Table 1 ENGINE SPECIFICATIONS

Displacement	35 cu. in. (573cc) x two rotors
Compression ratio	9.4:1
Compression pressure at 220 rpm	95 psi (6.7 kg/cm <sup>2</sup> )
End housings	
Maximum wear	0.004 in. (0.10mm)
Maximum distortion	0.002 in. (0.05mm)
Intermediate housing	
Thickness	1.9685±0.0039 in. (50±0.1mm)
Maximum wear	0.004 in. (0.10mm)
Maximum distortion	0.002 in. (0.5mm)
Rotor housings	
Thickness	2.7551-2.7559 in. (69.98-70mm)
Maximum distortion	0.002 in. (0.04mm)
Rotors	
Inner diameter	3.1497-3.1504 in. (80.000-80.018mm)
Land protrusion	0.004-0.006 in. (0.10-0.15mm)
Width, apex seal groove	0.2362±0.0004 in. (6±0.009mm)
Diameter, corner seal bore	0.4331-0.4338 in. (11-11.018mm)
Width, side seal groove	0.0394 in. (1mm)
Apex seal length	
Standard	2.7536 in. (69.94mm)
Minimum	2.7528 in. (69.92mm)
Apex seal height	
Standard	0.3898-0.3937 in. (9-10mm)
Minimum	0.315 in. (8mm)
Eccentric shaft	
Rotor journal diameter	2.9134 in. (74mm)
Main journal diameter	1.6929 in. (43mm)

Table 2 TIGHTENING TORQUES

	Foot-pounds	Mkg
Tension bolts	24	3.3
Flywheel nut	350	45
Torque converter drive plate bolts	101-116	14-16
Torque converter drive plate nut	350	45
Eccentric shaft pulley	47	6.5
Front cover	15	2
Bearing housing	15	2
Rear stationary gear	15	2
Oil pan	7	1
Oil pressure regulator	25	3.5
Oil drain plug	20	3
Oil pump	5	0.8
Oil pump driven sprocket nut	25	3.5
Oil pressure switch	10	1.5