

Chapter Fifteen

Gear Housing

Engine torque is transferred through the upper drive shaft housing to the lower gear housing by means of a drive shaft. A pinion and drive gear in the drive shaft housing changes the horizontal power flow from the engine to a vertical flow into the gear housing. A sliding clutch engages a forward or reverse gear in the gear housing, creating a direct coupling that transfers the power flow through the pinion and forward or reverse gear to the propeller shaft.

The gear housing can be removed from the drive shaft housing without removing the entire stern drive from the boat. This chapter covers removal, overhaul and installation of the Model I (includes Models 'I-R), Model II, Model II-TR, Model II-TRS and Model I-MR gear housings. Other Mercury Cruisers are manufactured for heavy-duty use including racing. Mercury Marine does not recommend service by amateur mechanics on such models. **Table I-3** are at the end of the chapter.

CAUTION

Elastic stop nuts should never be used more than twice. It is a good idea to replace such nuts with new ones each time they are removed. Never use worn-out stop nuts or non-locking nuts.

SERVICE PRECAUTIONS

Whenever you work on a stern drive unit, there are several precautions to keep in mind that will make your work easier, faster and more accurate.

1. Use special tools where noted. In some cases, it may be possible to perform the procedure with makeshift tools, but this is not recommended. The use of makeshift tools can damage the components and may cause serious personal injury.
2. Use a vise with protective jaws to hold housings or parts. If protective jaws are not available, insert blocks of wood on either side of the part(s) before clamping them in the vise.
3. Remove and install pressed-on parts with an appropriate mandrel, support and hydraulic press. Do not try to pry, hammer or otherwise force them on or off.
4. Refer to the appropriate table at the end of the chapter for torque values, if not given in the text. Proper torque is vital to assure long life and service from stern drive components.
5. Apply Perfect Seal (part No. C-92-34227) to the outer surfaces of all bearing carrier, retainer and housing mating surfaces during reassembly. *Do* not allow Perfect Seal to touch O-rings or enter the bearings or gears.

6. Apply Multipurpose Lubricant (part No. C-92-63250) to all O-rings and seal lips.
7. Apply Loctite Type A (part No. C-92-32609-1) on the outside diameter of all metal case oil seals.
8. Keep a record of all shims and where they came from. As soon as the shims are removed, inspect them for damage and write down their thickness and location. Wire the shims together for reassembly and place them in a safe place. Follow shimming instructions closely. If gear backlash is not properly set, the unit will be noisy and suffer premature gear failure. Incorrect bearing preload will result in premature bearing failure.
9. Work in an area where there is good lighting and sufficient space for components to be stored. Keep an ample number of containers available for storing small parts. Cover parts with clean shop cloths when you are not working with them.

MODEL I DRIVE

Figure 1 and **Figure 2** are exploded views showing the components of a typical Model I Drive gear housing. **Figure 3** is a cross-section of the Model I Drive that shows component relationships inside the gear housing.

Gear Housing Removal

1. Position the stem drive with the propeller shaft horizontal.
2. Place a container under the drain plug. Remove the drain and vent plugs. Drain the lubricant from the unit.

NOTE

If metallic particles are found in Step 3, remove and disassemble both the drive shaft and gear housings to inspect for damaged oil seals, O-rings and/or housing cracks. Clean all parts in solvent and blow dry with compressed air.

3. Wipe a small amount of lubricant on a finger and rub the finger and thumb together. Check for the presence of metallic particles.
4. Note color of gear lubricant. If white or cream in color, there is water in the lubricant. Inspect drain container for signs of water separation from the lubricant.
5. Bend propeller washer tabs away from splined washer (**Figure 4**).
6. Fit a piece of wood between the propeller and anti-cavitation plate to prevent the propeller from turning. Loosen prop nut (**Figure 4**).

7. Scribe a mark on the gear housing and trim tab for reassembly reference. Remove plastic plug from rear edge of gear housing. Remove trim tab screw with a 5/16 in. Allen head wrench. **See Figure 5**. Remove trim tab.
8. Remove 5/16 in. Allen head screw from inside trim tab cavity (**Figure 6**).
9. Remove 2 locknuts from the center bottom of the anti-cavitation plate (arrows, **Figure 6**).
10. Remove the locknut at the front of the gear housing mounting stud.

CAUTION

*If necessary to pry units apart in Step 11, pry only at front and rear of gear housing. Attempting to pry along the right side of the unit can cause damage to the interconnecting oil passage in the gear housing case. **See Figure 7**.*

11. Loosen the mounting locknuts on each side equally and drop the gear housing slightly. On badly corroded units, the water tubes and drive shaft may be frozen in the upper gear housing, making it necessary to pry the gear housing loose from the drive shaft housing. **See Figure 8**.
12. Holding the gear housing firmly, remove the loosened nuts and separate the gear housing from the upper unit.
13. Mount gear housing in a suitable holding fixture.
14. Remove prop nut, tab and splined washers, propeller and thrust hub. **See Figure 9**.

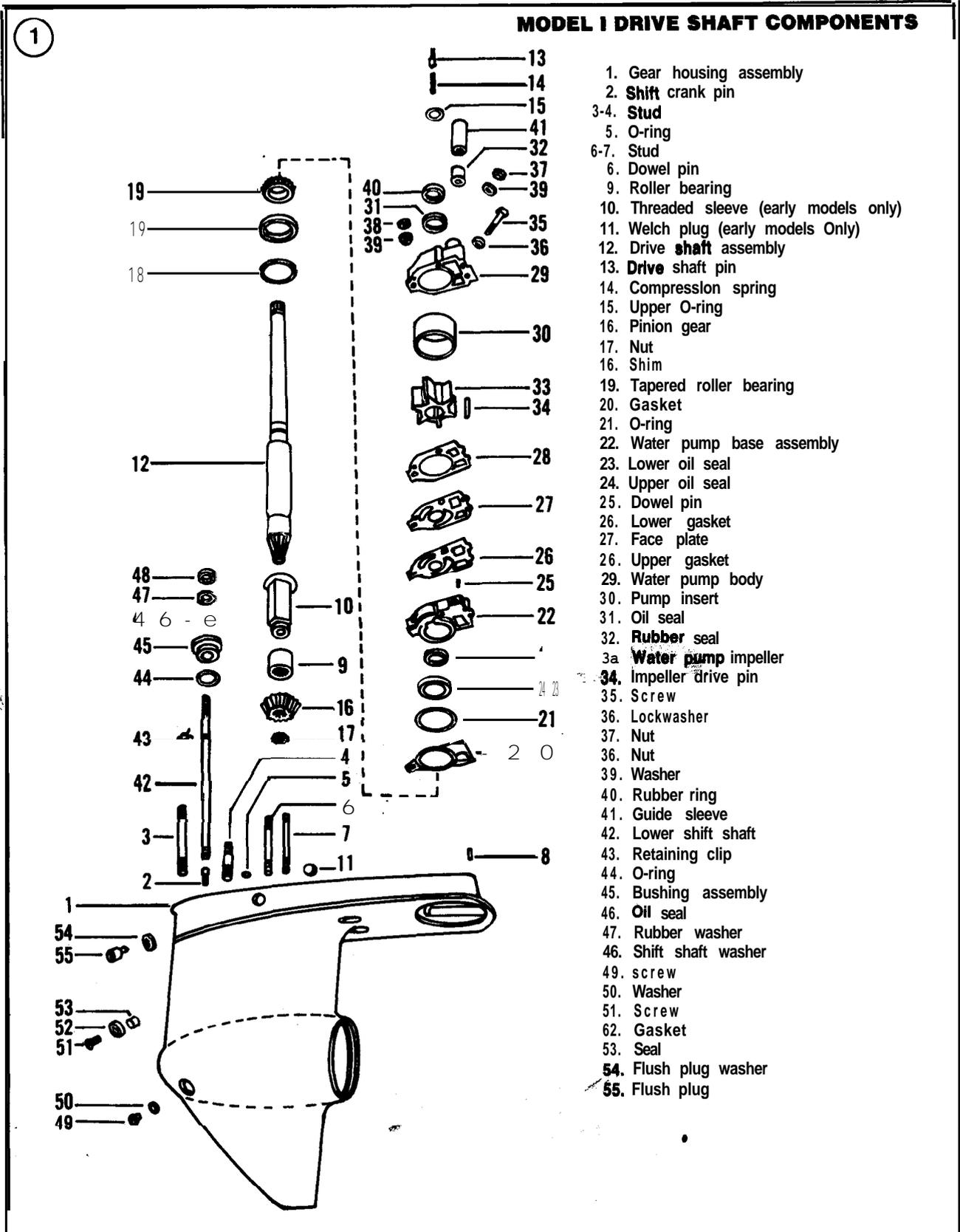
Gear Housing Installation

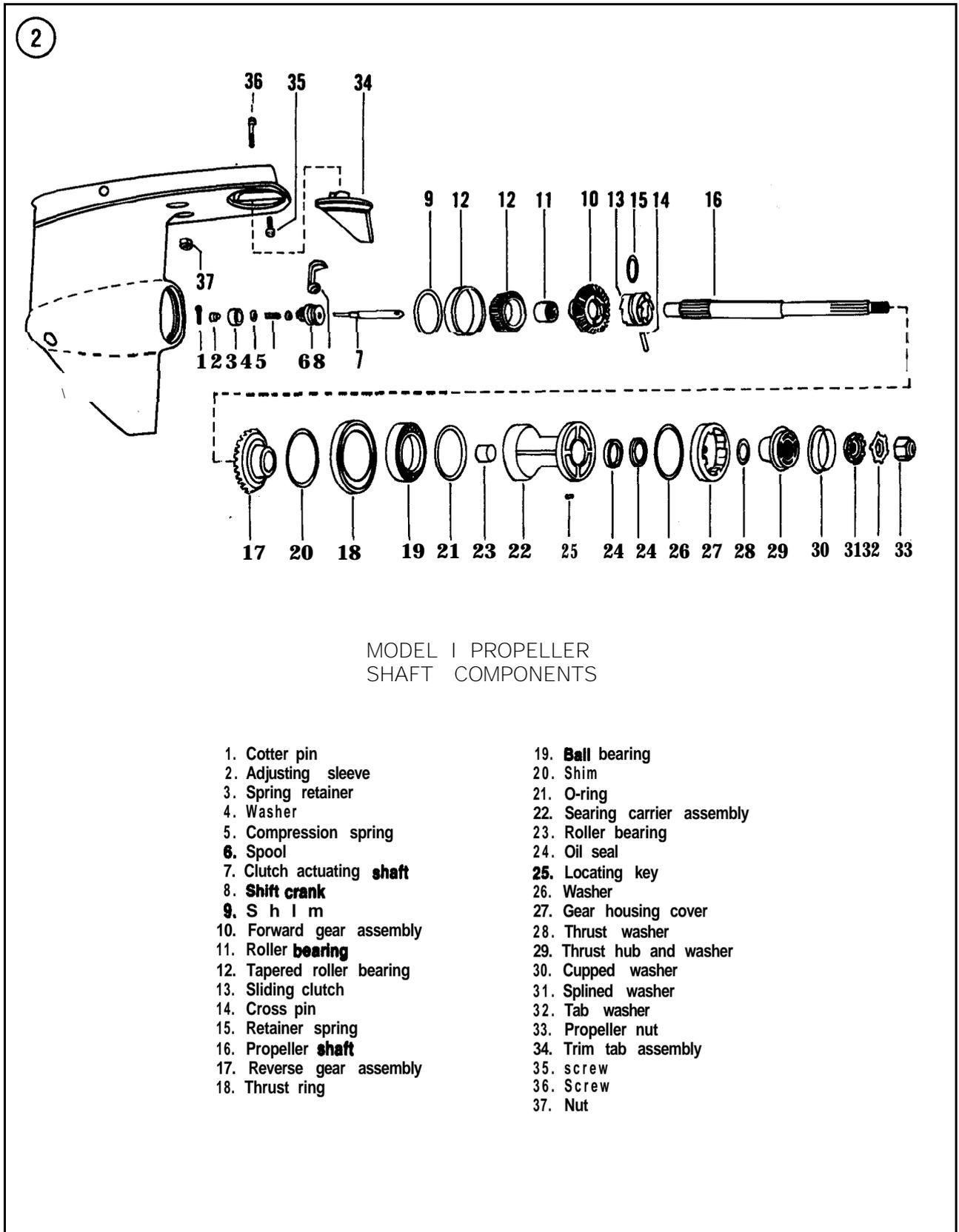
1. If water inlet tube came free when gear housing was removed, coat the upper end of the tube with Multipurpose Lubricant and reinsert in upper housing.
2. Coat lower end of water inlet tube with a light coat of Multipurpose Lubricant. Apply a heavy coat of **lubricant** to the drive shaft splines.
3. **Install** the trim tab screw through the top of the gear housing.
4. Install a new seal in the groove around the interconnecting oil passage. **See Figure 7**.

NOTE

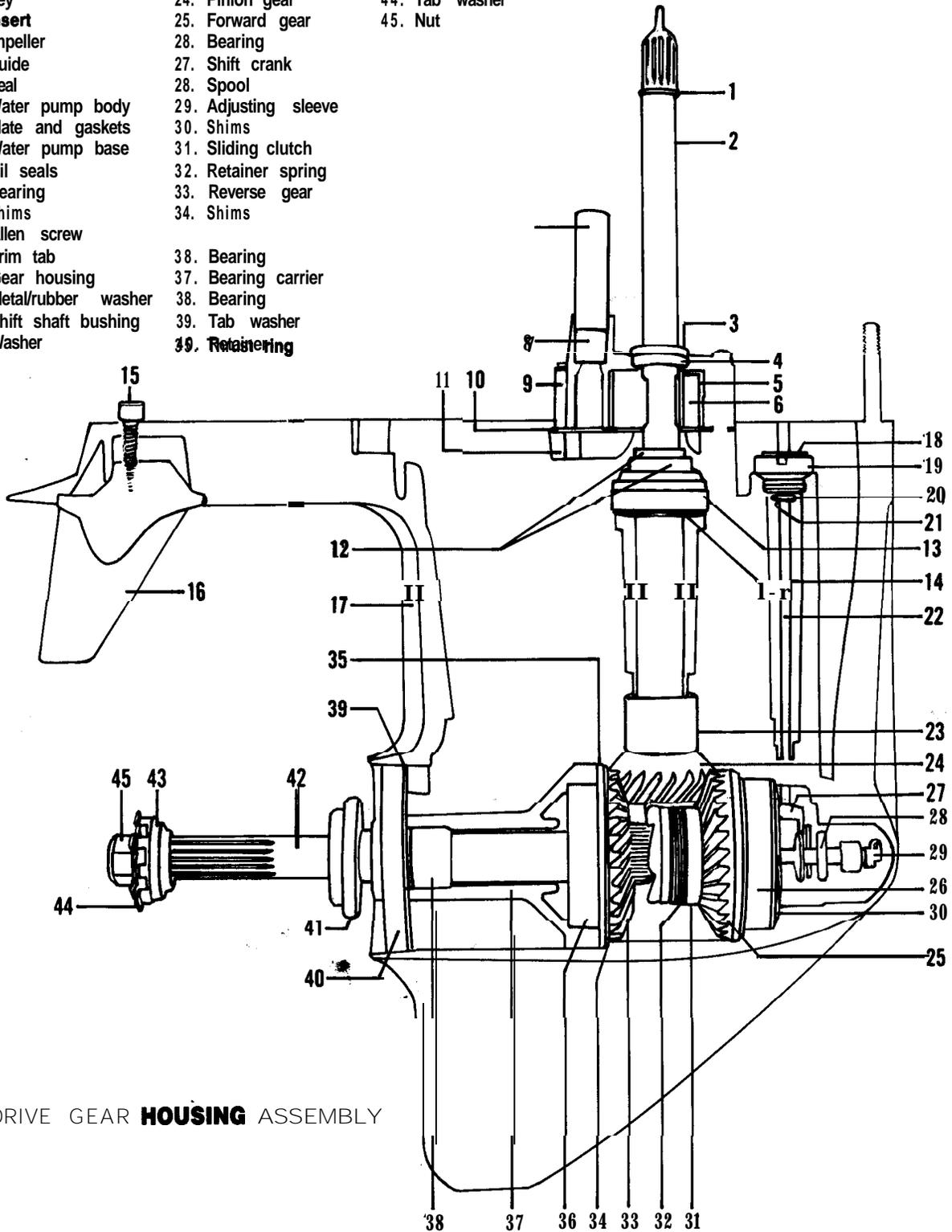
Slight pressure applied to the prop shaft in a counterclockwise direction will hold the gear housing unit in forward gear.

5. Install a shift shaft wrench over the shift shaft. Rotate wrench clockwise to shift **gearcase** into full

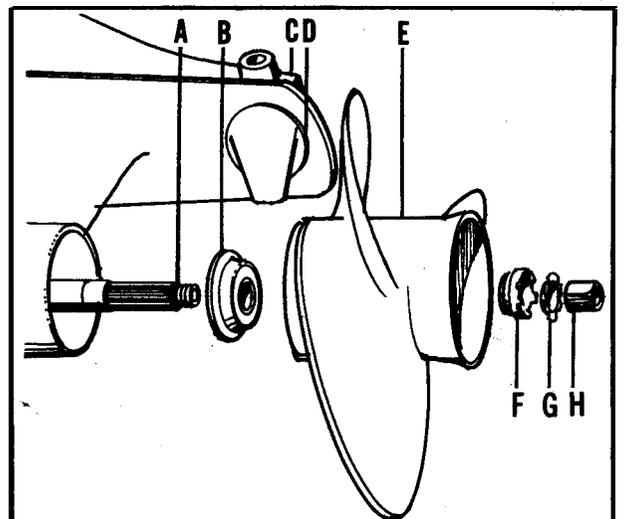
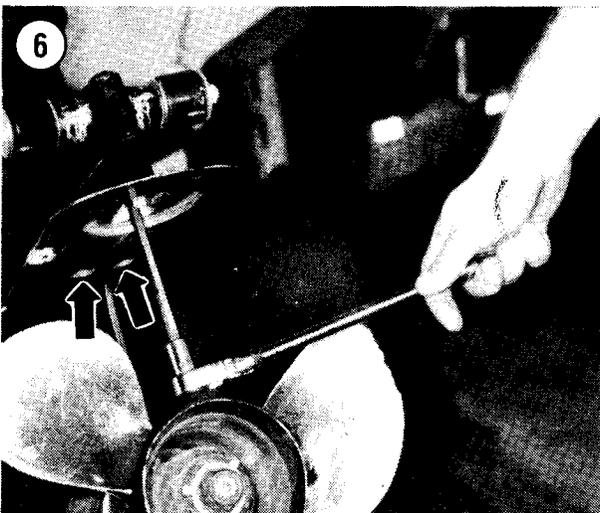
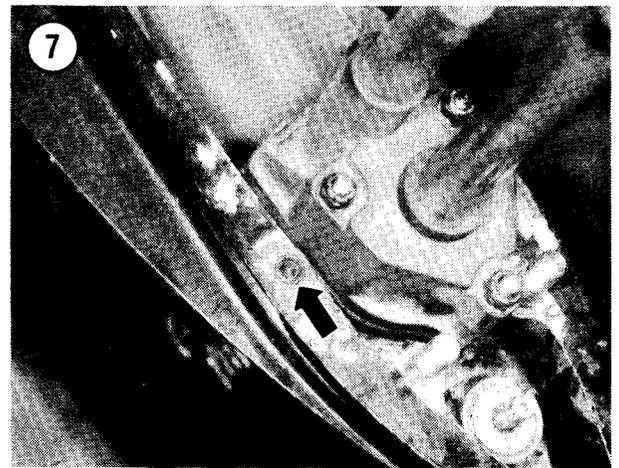
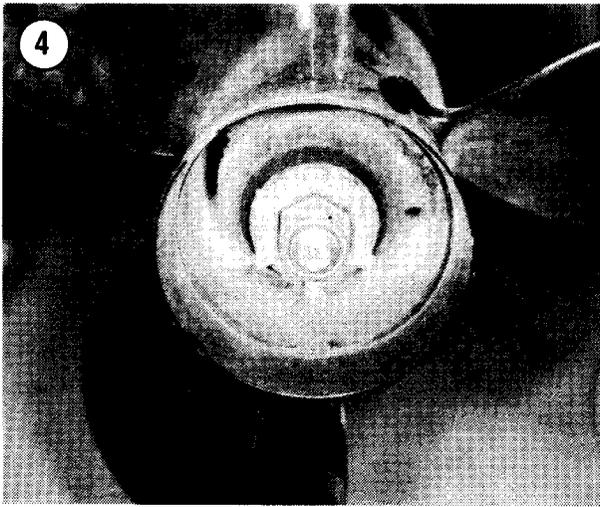




- | | | |
|-------------------------|-------------------------|---------------------|
| 1. O-ring | 21. Clip | 41. Thrust hub |
| 2. Drive shaft | 22. Shift shaft | 42. Propeller shaft |
| 3. Centrifugal slinger | 23. Drive shaft bearing | 43. Splined washer |
| 4. Key | 24. Pinion gear | 44. Tab washer |
| 5. Insert | 25. Forward gear | 45. Nut |
| 6. Impeller | 28. Bearing | |
| 7. Guide | 27. Shift crank | |
| 8. Seal | 28. Spool | |
| 8. Water pump body | 29. Adjusting sleeve | |
| 10. Plate and gaskets | 30. Shims | |
| 11. Water pump base | 31. Sliding clutch | |
| 12. Oil seals | 32. Retainer spring | |
| 13. Bearing | 33. Reverse gear | |
| 14. Shims | 34. Shims | |
| 15. Allen screw | 38. Bearing | |
| 18. Trim tab | 37. Bearing carrier | |
| 17. Gear housing | 38. Bearing | |
| 18. Metal/rubber washer | 39. Tab washer | |
| 18. Shift shaft bushing | 39. Retainer | |
| 20. Washer | | |



I-DRIVE GEAR **HOUSING** ASSEMBLY



PROPELLER COMPONENTS

- A. Propeller shaft
- B. Thrust hub
- C. Plastic plug
- D. Trim tab
- E. Propeller
- F. Splined washer
- G. lab washer
- H. Propeller nut

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forward gear. Make sure that the upper shift shaft in the drive shaft housing is also in its full forward position (straight ahead).

6. Align water inlet tube with water tube guide and drive shaft splines with upper drive shaft/shift shaft splines, then install gear housing to upper unit (Figure 10). It may be necessary to rotate the prop shaft counterclockwise to engage the drive shaft splines.

7. Once the 2 housings are coupled, install new elastic stop nuts on side and front mounting studs. Tighten stop nuts to specifications (Table 2).

8. Install anti-cavitation plate locknuts.

9. Install Allen head screw inside trim tab cavity and tighten to specifications (Table 2).

10. Install trim tab with scribed marks aligned. Tighten Allen head screw to specifications (Table 2). Install plastic plug over screw.

11. Install thrust hub (Figure 11) and lubricate prop shaft splines with Multipurpose Lubricant.

12. Install propeller, splined and tab washers and prop nut. Tighten nut securely (Figure 12).

13. Fill drive unit with the appropriate type and quantity of lubricant. See Chapter Four.

Bearing Carrier/Reverse Gear Removal

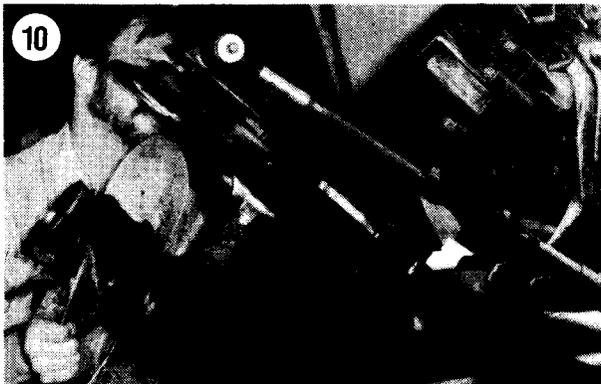
1. Remove the water pump. See Chapter Twelve.

2. Remove the propeller as described in Step 5 and Step 6 of *Gear Housing Removal*.

3. Bend the bearing carrier retainer washer lock tab away from the cover nut with a screwdriver and hammer (Figure 13).

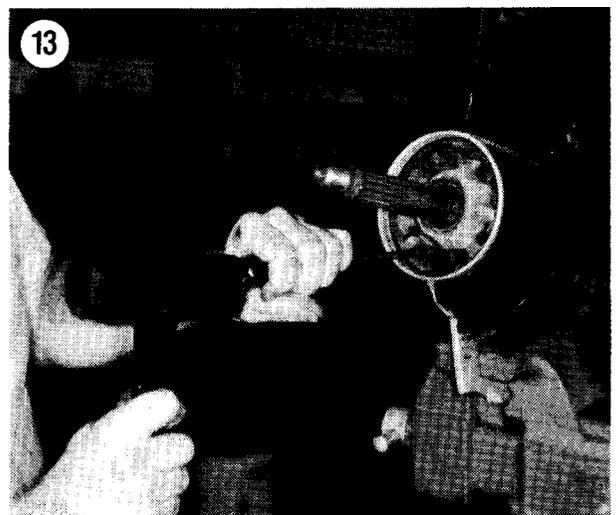
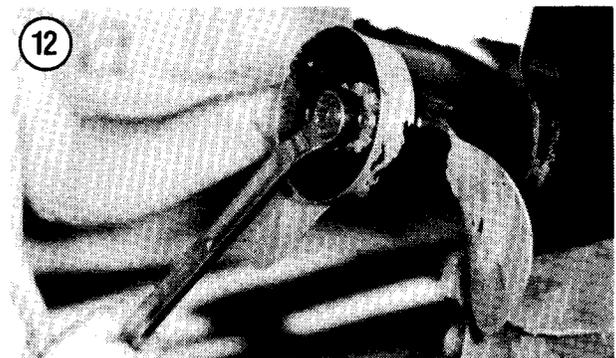
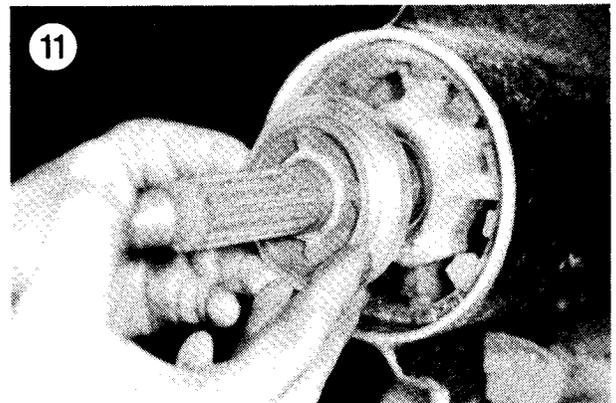
NOTE

If the cover nut is frozen in place and cannot be moved in Step 4, use an electric drill to drill out one side of the nut for easier removal. Discard cover nut after removal.



4. Install bearing carrier retainer wrench (part No. C-91-61069) (Figure 14) and rotate counterclockwise with a socket and breaker bar to loosen the cover nut.

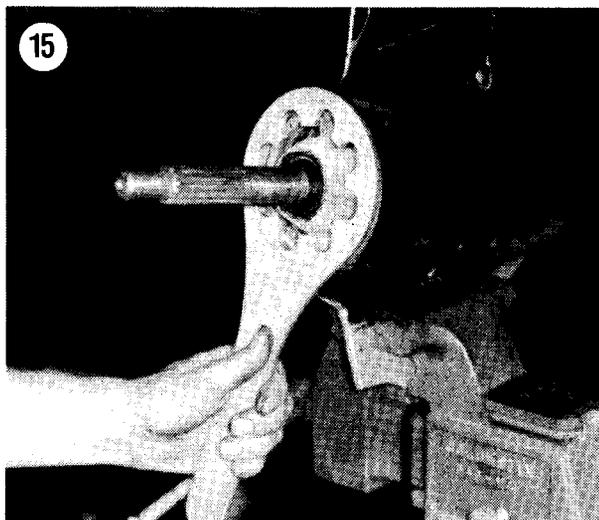
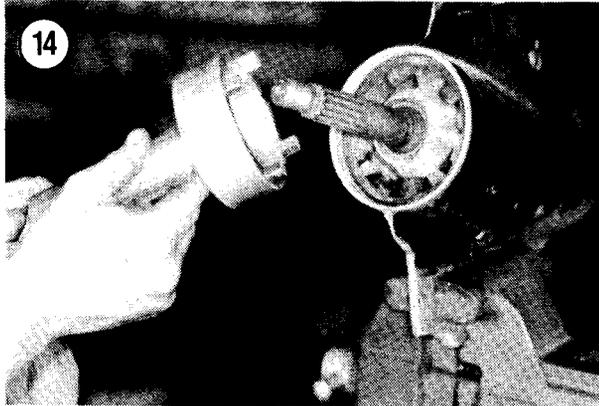
5. Install bearing retainer wrench (part No. C-91-36235) and remove the cover nut and tab washer. See Figure 15.



6. Install puller jaws (part No. C-9 1-46086A1) and puller bolt (part No. C-9 1-857 16). Bosses inside the bearing carrier should support the puller jaws.

NOTE

*If the bearing carrier is corroded, you may have to apply heat to the housing while pulling on the assembly in Step 7. Be **careful** not to overheat the housing, as this will cause distortion.*



7. Tighten the puller bolt until the bearing carrier comes loose. Remove puller jaws/bolt, then remove bearing carrier (Figure 16) and carrier-to-gear housing shims.

8. Wire the shims together and attach a tag indicating their location.

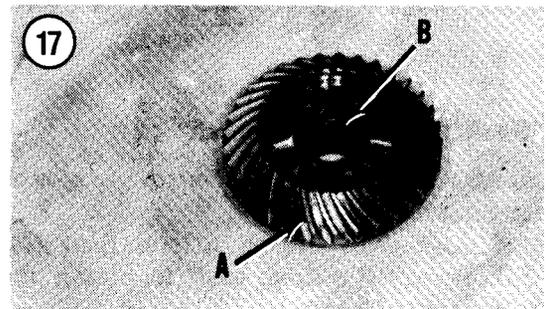
Bearing Carrier/Reverse Gear Cleaning and Inspection

1. Clean all parts in fresh solvent. Blow dry with compressed air.
2. Check prop shaft surface where oil seal lips touch shaft. If grooved, replace the shaft and oil seals.
3. Apply a light coat of oil to reverse gear ball bearing and rotate bearing to check for rough spots. Push and pull on bearing to check for side wear. If movement is excessive, replace bearing using an arbor press.
4. Check needle bearing contact points on prop shaft. If shaft shows signs of pitting, grooves, scoring, heat discoloration or embedded metallic particles, replace prop shaft and needle bearing.
5. Check reverse gear (A, Figure 17) for pitting, chipped, or broken teeth. Replace as required.
6. Inspect reverse gear clutch jaws (B, Figure 17). If surface is chipped or rounded off, replace gear.
7. Inspect cover nut for cracks or broken or corroded threads. Replace as required.

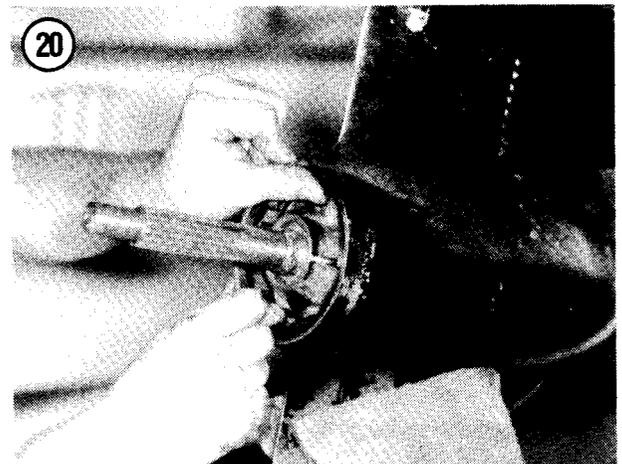
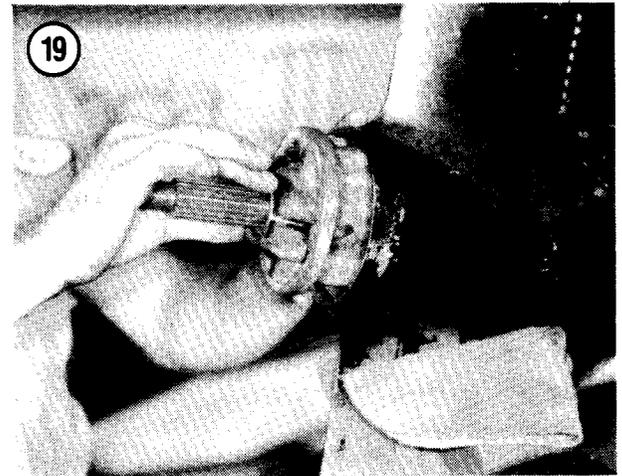
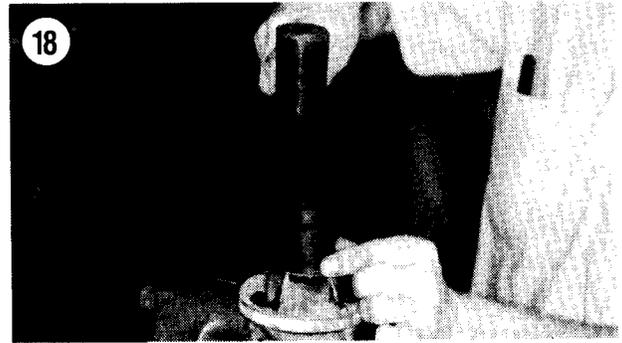
Bearing Carrier/Reverse Gear Installation

If bearing or oil seals do not require replacement, begin procedure with Step 10.

1. -Wipe OD of new carrier roller bearing with Universal Joint Lubricant (part No. C-91-74057A1).
2. Position bearing with numbered side facing upward and press into carrier with driver part No. C-91-37263 or equivalent.



3. Wipe OD of the new oil seals with Loctite Type A.
4. Fit one seal on the long shoulder side of driver part No. C-91-31 108 with lip facing *away* from shoulder to hold lubrication inside the housing. Install seal in carrier until driver bottoms.
5. Fit second seal on the short shoulder side of driver with lip facing *toward* shoulder to keep water out of the housing. Install seal in carrier until driver bottoms. See **Figure 18**.
6. Wipe off any excess Loctite and fill cavity between seals with Universal Joint Lubricant.
7. Pressing on bearing inner race only, install reverse gear ball bearing and thrust washer on reverse gear. Beveled side of thrust washer must face toward gear.
8. Wipe OD of reverse gear bearing with Universal Joint Lubricant. Position bearing carrier over reverse gear/bearing and press into place.
9. Install a new O-ring over the bearing carrier between the thrust washer and carrier housing.
10. Install shim(s) removed during disassembly in gear housing. If shim(s) were lost or damaged or if a new gear housing is being installed, start with 0.020 in. thick shim.
11. Install bearing carrier in gear housing with **keyway** facing up (**Figure 19**). Push down on carrier to seat on the shim(s).
12. Install key in carrier **keyway**.
13. Install carrier retainer tab washer (**Figure 20**). Align "V" tab on washer with "V" notch on carrier.
14. Thread cover nut into the gear housing. Tighten nut to specifications, then check forward and reverse gear backlash as described under **I-Drive Shimming** in this chapter.
15. After backlash has been measured (and corrected, if necessary), remove bearing carrier and apply a liberal quantity of Perfect Seal to its outer diameter as well as to the gear housing threads. **Do not** let sealer enter ball bearing or reverse gear.
16. Repeat Steps 11- 14 to reinstall components. Tighten cover nut to specifications, then bend one tab on tab washer into one of the cover nut slots.



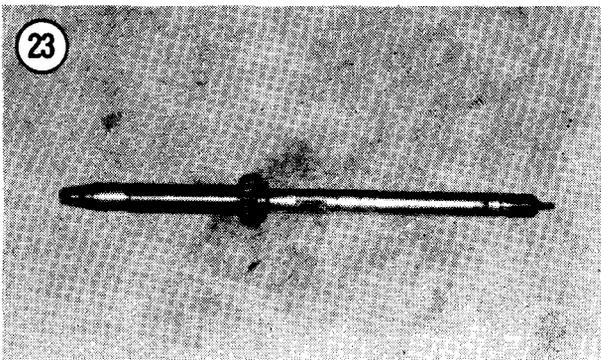
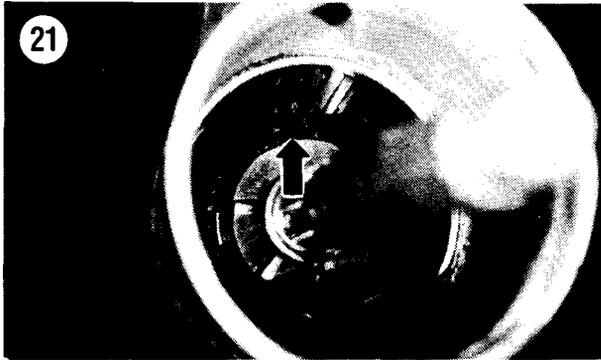
Drive Shaft/Pinion Gear Removal

1. Remove bearing carrier retainer/reverse gear as described in this chapter.
2. Install drive shaft wrench adaptor (part No. C-91-56775) over the drive shaft to protect the splines from possible damage.

NOTE

If pinion nut adaptor is not available, a thin box-end wrench can be substituted in Step 3.

3. Install pinion nut adaptor (part No. C-91-61067A1) over prop shaft and onto pinion gear nut. See pinion gear nut location in **Figure 21**.



4. Fit an appropriate size socket and breaker bar over the drive shaft adaptor and turn counterclockwise while holding the pinion nut to break the nut free.

5. Clamp drive shaft as close as possible to gear housing in a vise with protective jaws. Hold a block of wood against housing and drive the gear from end of drive shaft.

6. Tilt housing downward while holding prop shaft toward bottom of housing. Catch pinion gear as it falls out of housing. See Figure 22.

Drive Shaft/Pinion Gear Cleaning and Inspection

1. Clean all parts in fresh solvent. Blow dry with compressed air.

2. Check pinion gear for pitting, excessive wear or broken or chipped teeth. Replace as required.

3. Check drive shaft (Figure 23) where roller bearing rides. Replace drive shaft and bearing if pitting, scoring, grooves, heat discoloration or embedded metallic particles are found.

4. Check drive shaft tapered roller bearing cup. Replace bearing and cup if pitting, scoring, grooves, heat discoloration or embedded metallic particles are found.

5. Check splines on each end of drive shaft (Figure 23) for excessive wear or damage.

6. Suspend drive shaft between V-blocks and check straightness with a dial indicator.

Driveshaft/Pinion Gear Installation

1. Install pinion gear in gear housing below drive shaft bore. Gear teeth must mesh with teeth of forward gear.

2. Hold pinion gear in position and install drive shaft (Figure 24). Rotate drive shaft to align and engage its splines with those of the pinion gear.

3. Install pinion gear nut with adaptor (part No. C-9 1-6 1067A1) to hold nut in position under drive shaft. Rotate drive shaft by hand to start the nut.

4. Install adaptor (part No. C-91-56775) on drive shaft, then tighten pinion gear nut to specifications (Table 2) using an appropriate size socket and torque wrench.

5. Check pinion gear depth as described in this chapter.

6. Remove pinion gear nut and wipe its threads with Loctite Type A. Reinstall nut and tighten to specifications (Table 2).

7. Install bearing carrier retainer/reverse gear as described in this chapter.

Propeller Shaft/Forward Gear Removal/Disassembly

Refer to **Figure 25** for this procedure.

1. Remove bearing carrier retainer/reverse gear as described in this chapter.

2. Remove drive shaft/pinion gear as described in this chapter.

3. Move outer end of prop shaft to one side of gear housing and disengage spool from shift crank in housing. Lift assembly from housing. See **Figure 26**.

4. Slip a small screwdriver blade under one end of the sliding clutch cross pin retaining spring and feed spring up and over the clutch (**Figure 27**).

5. Remove cross pin with an appropriate size punch or screwdriver blade (**Figure 28**).

6. Remove spool assembly, forward gear, sliding clutch and actuating shaft from prop shaft. See **Figure 29**.

7. Remove cotter pin from end of spool assembly. Unscrew adjusting castle nut.

8. Clamp spool in vise with protective jaws. Remove retainer cap with channel lock pliers. Remove spring and washer.

9. If tapered roller bearing or forward gear is to be replaced, press bearing from gear with appropriate puller plate and mandrel. When bearing is replaced, remove and discard bearing cup from inside housing. Retain shims under cup for reassembly.

10. If forward gear roller bearing is to be replaced, split the case with a chisel and remove broken bearing.

Propeller Shaft/Forward Gear Cleaning and Inspection

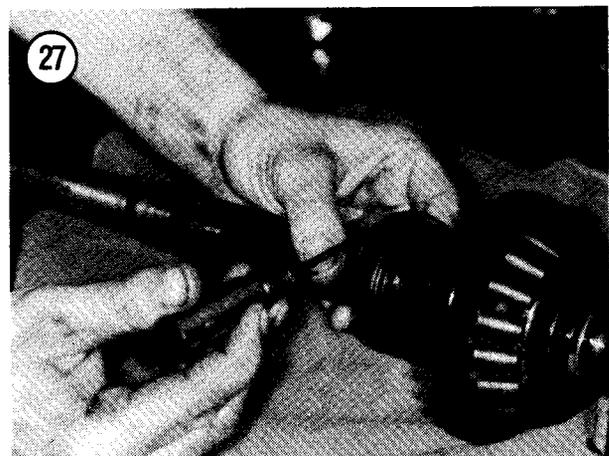
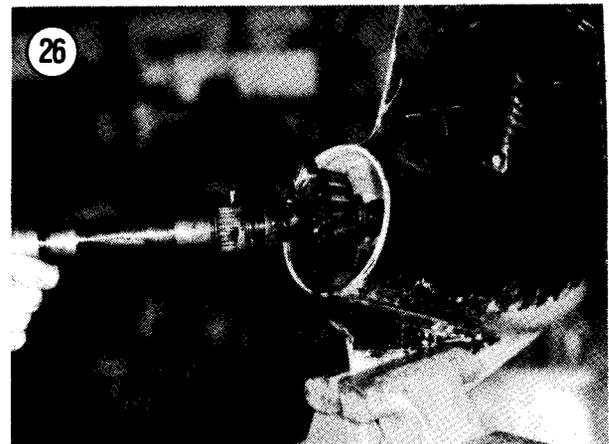
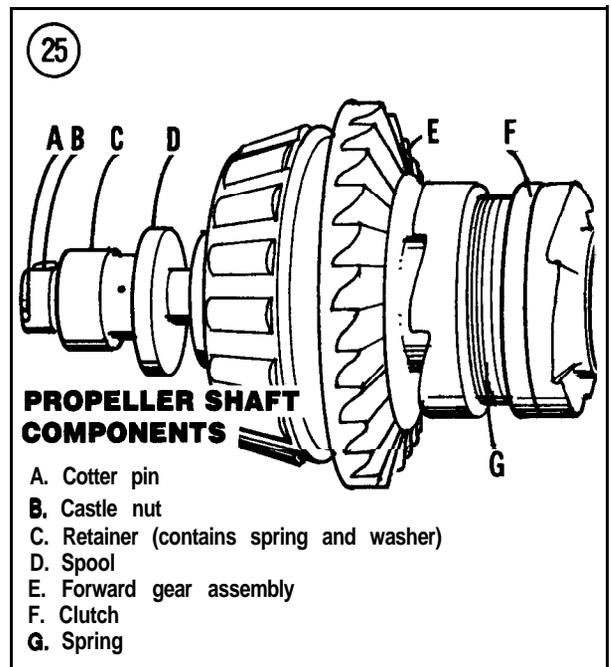
1. Clean all parts in fresh solvent. Blow dry with compressed air.

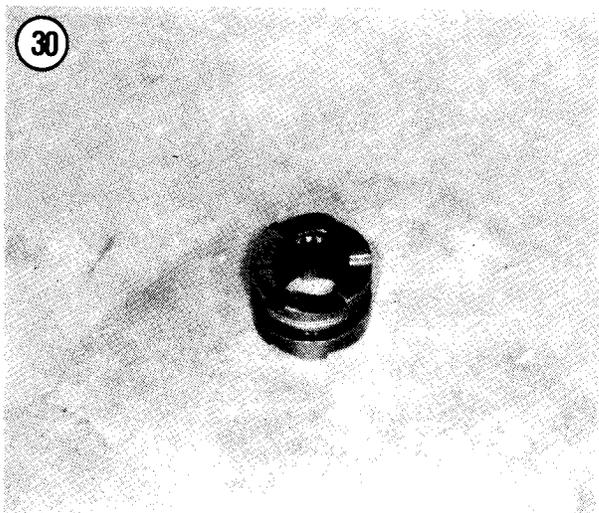
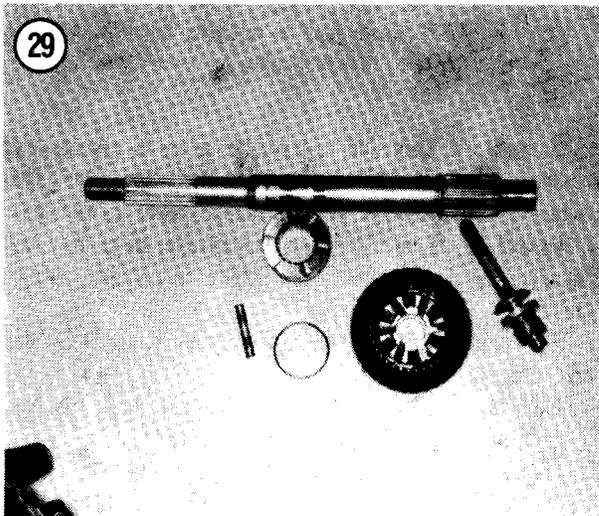
2. Check forward gear for broken or chipped teeth, chipped or rounded-off clutch jaws, pitting or excessive wear.

3. Check engaging jaws of sliding clutch (**Figure 30**) for chipped or rounded-off condition.

4. Install prop shaft on balance wheels and check for wobble at prop end of shaft. Replace if bent.

5. Install prop shaft on V-blocks and rotate shaft. Replace shaft if prop end wobbles.





6. Install prop shaft between lathe centers and check needle bearing contact area with dial indicator. Replace shaft if indicator reading exceeds 0.005 in. during one shaft revolution.

7. Clean prop shaft splines with a wire brush to remove any corrosion. If splines are partially corroded away, replace shaft.

8. Check forward gear roller bearing and drive shaft area where bearing rides. If any signs of pitting, grooving, scoring, heat discoloration or embedded metallic particles are noted, replace shaft and bearing.

9. Check shift spool for excessive or uneven wear.

Propeller Shaft/Forward Gear Assembly/Installation

1. If forward gear tapered roller bearing was removed, wipe inner bore of new bearing with Universal Joint Lubricant and press bearing onto the forward gear. Apply pressure against the center race only.

2. If forward gear needle bearing was removed, wipe forward gear bore with Universal Joint Lubricant and press new bearing into bore with its lettered side facing upward. Bearing must seat against inner gear shoulder.

NOTE

Early model clutches have copper coated clutch teeth and no grooves. The side with the copper coating faces toward the forward gear.

3. Install sliding clutch on prop shaft. Grooved end of clutch should face reverse gear end of shaft. Align cross pin holes in clutch and shaft.

4. Install cross pin through sliding clutch, prop shaft and actuating shaft.

CAUTION

Use care not to excessively stretch spring during installation in Step 5.

5. Install cross pin retainer spring over sliding clutch inside retainer groove. See Figure 25.

6. Install forward gear/bearing assembly on prop shaft. Gear must face sliding clutch (Figure 25).

7. Install first washer, spring and second washer into shift actuating spool, then thread retainer in place and tighten securely.

8. Slip spool assembly over clutch actuating shaft. Thread adjusting nut onto shaft until it barely touches the washer, providing slight resistance to further turning.

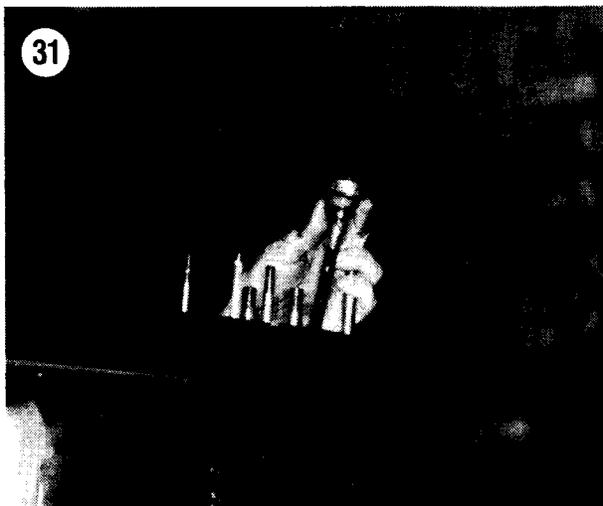
NOTE

The spool must turn freely on the shaft when installation is completed in Step 9. Do not over-tighten adjusting nut or spring becomes useless.

9. Back sleeve off until first cotter pin slot aligns with shaft hole and install a new cotter pin.
10. Insert prop shaft into gear housing and tilt prop end of shaft toward oil fill hole side of gear housing to engage shift actuating shaft spool with shift crank.
11. Straighten prop shaft in housing and operate shift shaft to make sure installation is correct. Only the sliding clutch should move when the shift shaft is turned in this step.
12. Install drive shaft and pinion gear as described in this chapter.
13. Install bearing carrier retainer/reverse gear as described in this chapter.

Shift Shaft Removal

1. Remove bearing carrier retainer/reverse gear as described in this chapter.
2. Remove drive shaft/pinion gear as described in this chapter.
3. Remove propeller shaft/forward gear as described in this chapter.
4. Remove the metal and rubber washers from the shift shaft.
5. Remove shift shaft bushing with bushing remover part No. C-91-31 107.
6. Pull shift shaft from gear housing (**Figure 31**).
7. Reach inside gear housing and remove shift crank from its locating pin. See **Figure 32**.

**Shift Shaft****Cleaning and Inspection**

1. Clean all parts in fresh solvent. Blow dry with compressed air.
2. Check shift shaft splines for wear and/or corrosion.
3. Check shift shaft bushing for corrosion. Replace O-ring.
4. Check shift crank for excessive wear.

Shift Shaft Installation

Refer to **Figure 33** for this procedure.

1. Drive oil seal through top of bushing and install a new seal with the lip facing upward.
2. Install clip in shift shaft groove.

NOTE

On non-EZ shift gear housings, install shift crank with the notches facing to the left in Step 3.

3. Reach all the way into the gear housing and position shift crank on locating pin. "Throw" side of crank should face oil fill side of gear housing.
4. Insert shift shaft with retaining clip in gear housing and engage with shift actuating crank splines.
5. Position retaining washer over shift shaft on top side of retaining clip.
6. Lubricate shift shaft bushing oil seal lip and O-ring with Universal Joint Lubricant.
7. Install shift shaft bushing in gear housing. Tighten securely with shift shaft tool part No. c-91-31 107.



8. Install rubber washer on shift shaft. Wipe upper metal washer with a thick coat of Universal Joint Lubricant and install on shift shaft.

Gear Housing Inspection

1. Clean housing in fresh. solvent. Blow dry with compressed air.
2. Check housing for impact damage.

CAUTION

If drive shaft roller bearing has failed and original bearing case has turned in housing, replace the housing. Loose fitting roller bearings will move out of position and cause continuous premature failure.

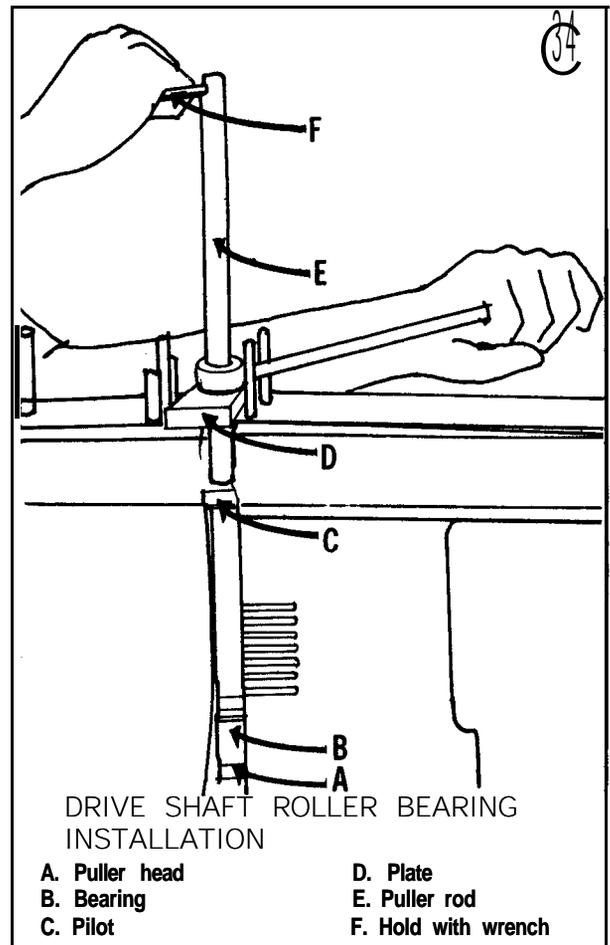
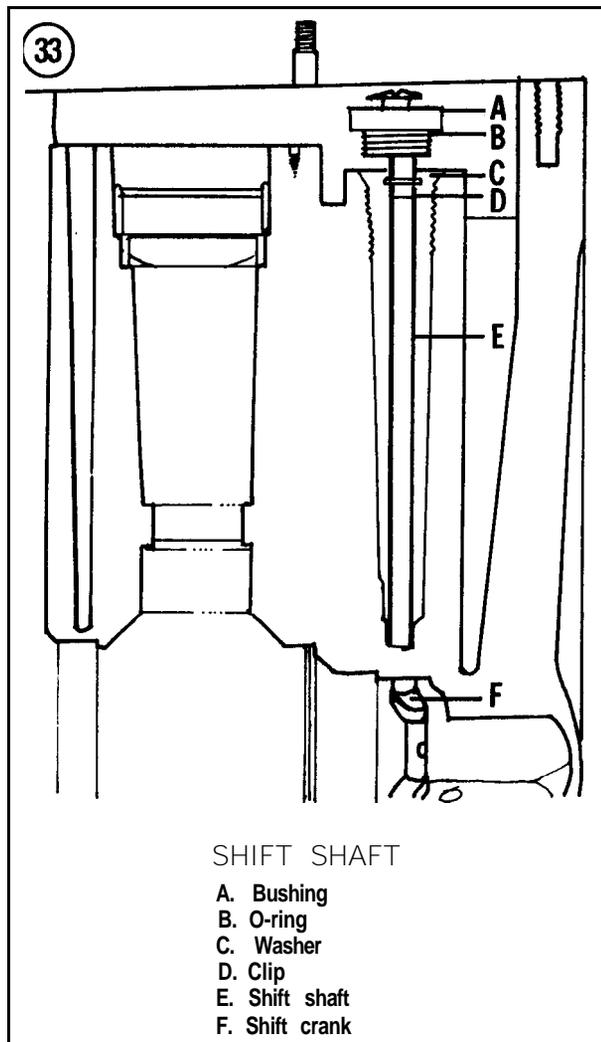
3. Check bearings/cups for looseness or signs that they have spun.

4. Check gear housing carrier retainer threads for corrosion or stripped threads.

**Drive Shaft Roller Bearing,
Drive Shaft and Forward
Gear Bearing Cups**

Gear housing bearings or cups should only be removed if they have failed. None should be reused after removal.

1. Remove drive shaft roller bearing from gear housing with special tool part No. C-91-36569 and a suitable driver.
2. Wipe a new bearing with Multipurpose Lubricant and install in drive shaft bore with its numbered side facing upward.
3. Install and seat roller bearing with puller rod and nut (part No. C-91-31229), pilot (part No. C-91-36571), plate (C-91-29310) and puller head (part No. C-91-38628). See Figure 34.



4. Pull bearing up into bore until it bottoms on the gear housing shoulder.
5. Install forward gear bearing cup shims in gear housing.
6. Place bearing cup in housing and install with driver cup (part No. C-91-36577), driver rod (part No. C-91-37323) and adaptor (part No. C-91-37263). See Figure 35.
7. Repeat Step 6 with driver cup (part No. C-91-34379), driver rod (part No. C-91-37323) and adaptor (part No. C-91-37263) to install drive shaft tapered roller bearing cup and shims.

I-Drive Shimming

Three shimming procedures must be performed to properly set up the lower unit. The pinion gear must be shimmed to a correct depth, the forward gear must be shimmed to the pinion gear for proper backlash and the reverse gear must be shimmed to the pinion gear for proper backlash.

Pinion gear depth

1. Push in on the propeller shaft and rotate it to seat the roller bearings.

NOTE

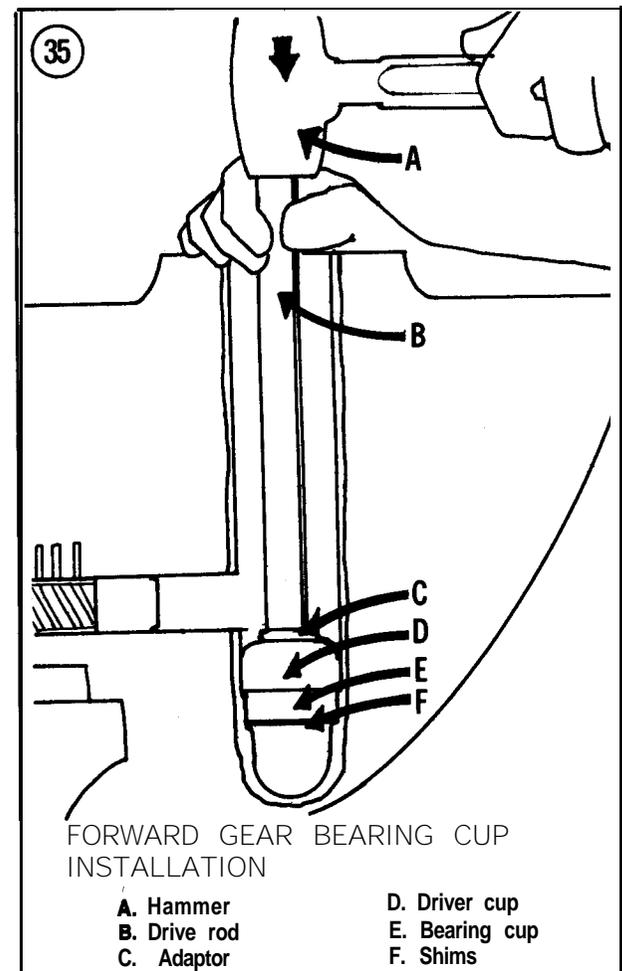
Model 90 requires use of shimming tool part No. C-91-56050 in Step 2.

2. Insert pinion gear shimming tool (part No. C-91-56048) into the drive shaft opening.
3. Insert a 0.025 in. feeler gauge between the high point of the shimming tool and one of the pinion gear teeth. If the clearance is correct, continue gear housing reassembly.
4. If not correct, determine how much clearance exists, then remove the shimming tool, pinion gear, drive shaft and bearing cup. Add shims if clearance is too large; remove shims if clearance is too small. Reinstall bearing cup, drive shaft and pinion gear and repeat procedure.

Forward and Reverse Gear Backlash

1. Rotate drive shaft clockwise several times to align roller bearings.
2. Install dial indicator to gear housing. Install backlash indicator rod (part No. C-91-53459) to drive shaft. See Figure 36.
3. Shift into full forward position and turn drive shaft clockwise to make sure sliding clutch engages fully.

4. Watching the shift shaft, slowly turn the prop shaft clockwise until the shift shaft stops moving. At this point, apply pressure on the shift shaft toward forward gear to friction-lock the sliding clutch and forward gear as a single unit.
5. Move dial indicator plunger to the "T" line on the backlash indicator rod. Holding inward pressure on the drive shaft, lightly rotate shaft and pinion gear assembly back and forth *without* allowing prop shaft to turn.
6. Read dial indicator and compare to specifications in Table 1. If correct, continue with the procedure. If backlash is too small, remove shims from forward gear bearing race; if too great, add shims.
7. Shift into full reverse position and turn drive shaft clockwise to make sure sliding clutch engages fully.
8. Watching the shift shaft, slowly turn the prop shaft counterclockwise until the shift shaft stops



moving. At this point, apply pressure on the shift shaft toward reverse gear to friction-lock the sliding clutch and forward gear as a single unit.

9. Move dial indicator plunger to the "I" line on the backlash indicator rod. Holding inward pressure on the drive shaft, lightly rotate shaft and pinion gear assembly back and forth *without* allowing prop shaft to turn.

10. Read dial indicator and compare to specifications in **Table 1**. If correct, continue with assembly of unit. If backlash is too small, add shims between the reverse gear thrust washer and gear housing; if too great, remove shims.

MODEL II DRIVE

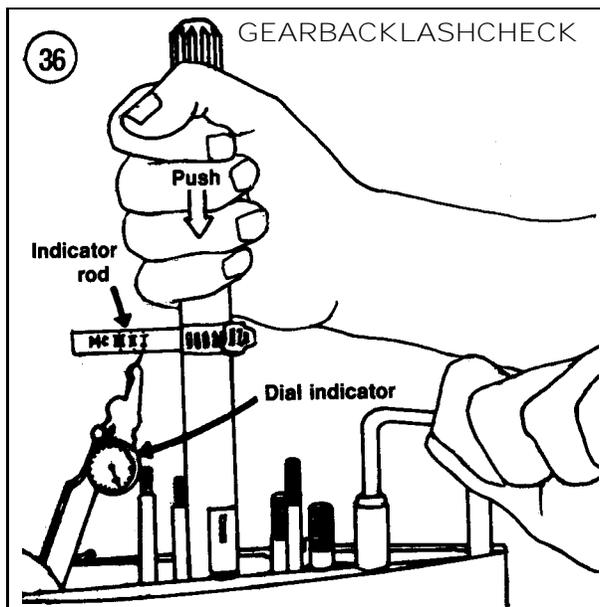
Figure 37 is an exploded view of a typical Model II gear housing.

Gear Housing Removal

1. Position the stern drive with the propeller shaft horizontal.
2. Place a container under the drain plug. Remove the drain and vent plugs and drain the lubricant from the unit.

NOTE

If metallic particles are found in Step 3, remove and disassemble both the drive shaft and gear housings to inspect for damaged oil seals, O-rings and/or housing cracks. Clean all parts in solvent and blow dry with compressed air.



3. Wipe a small amount of lubricant on a finger. Rub the finger and thumb together to check for the presence of metallic particles.

4. Note color of gear lubricant. If white or cream in color, there is water in the lubricant. Inspect container for signs of water separation from the lubricant.

5. Fit a piece of wood between the propeller and anti-cavitation plate to prevent the propeller from turning. Loosen and remove prop nut, tab and splined washers, propeller and thrust hub.

6. Scribe a mark on the gear housing and trim tab for reassembly reference. Remove plastic plug from rear edge of gear housing. Remove trim tab screw with a 5/16 in. Allen head wrench. Remove trim tab.

7. Remove 5/16 in. Allen head screw from inside trim tab cavity.

8. Remove 2 Allen head screws from the center bottom of the anti-cavitation plate.

9. Remove 3 hex head cap screws (**Figure 38**) from front of unit.

10. Loosen the mounting hex nuts on each side equally and drop the gear housing slightly. On badly corroded units, the drive shaft may be frozen in the upper gear housing, making it necessary to pry the gear housing loose from the drive shaft housing.

11. Holding the gear housing firmly, remove the loosened nuts and separate the gear housing from the upper unit.

12. Mount gear housing in a suitable holding fixture.

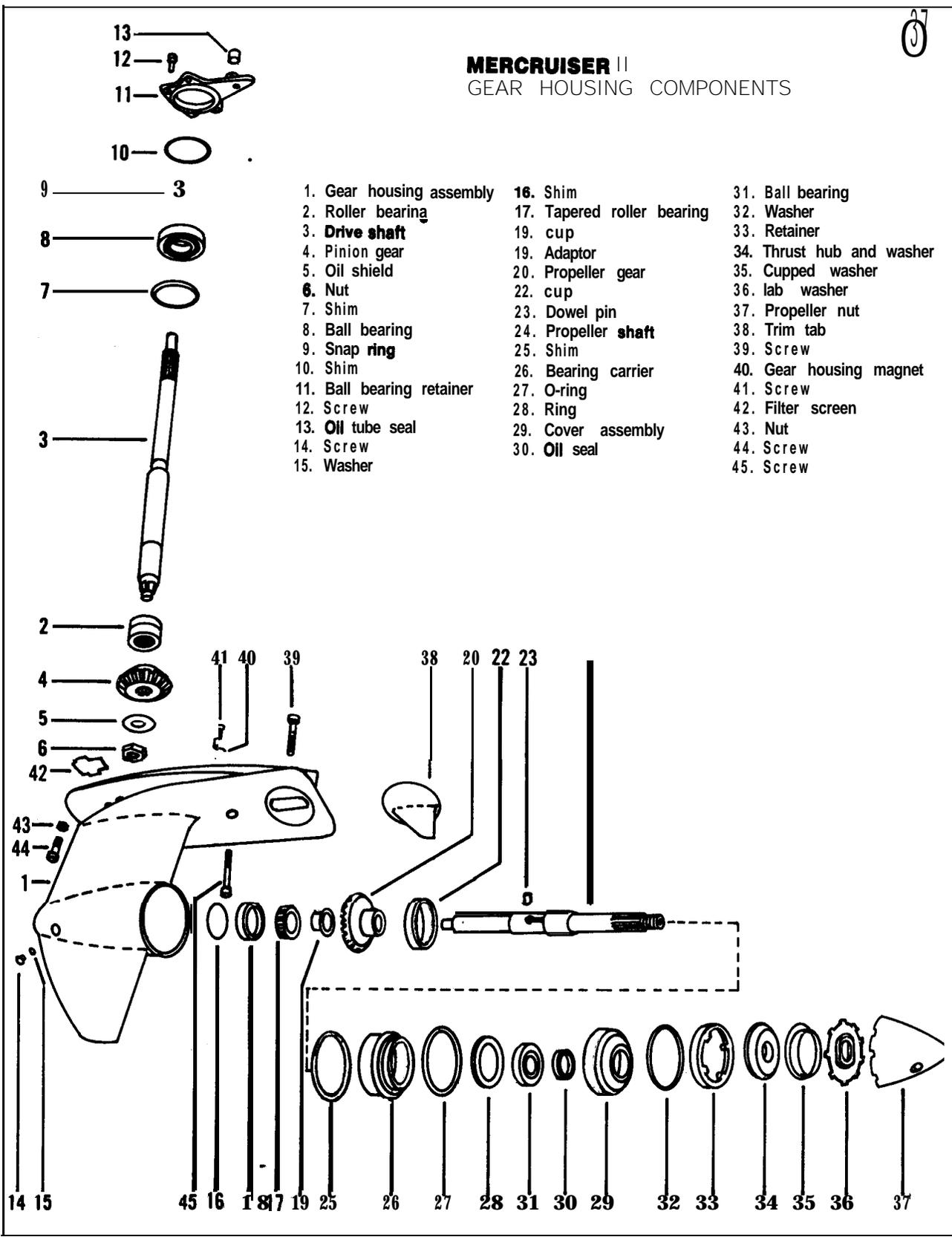
Gear Housing Installation

If complete gear housing assembly is replaced on units with a serial No. 1602 186 and below, do not install oil tube in gear housing; the drive shaft housing is not machined to accept it. Remove oil tube seal from ball bearing retainer.

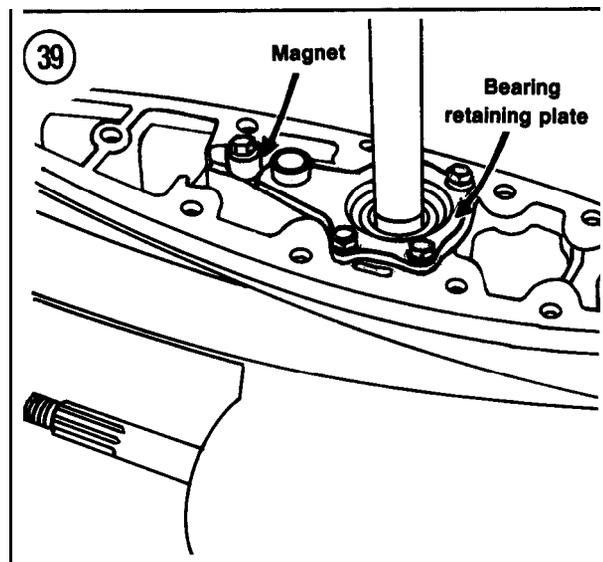
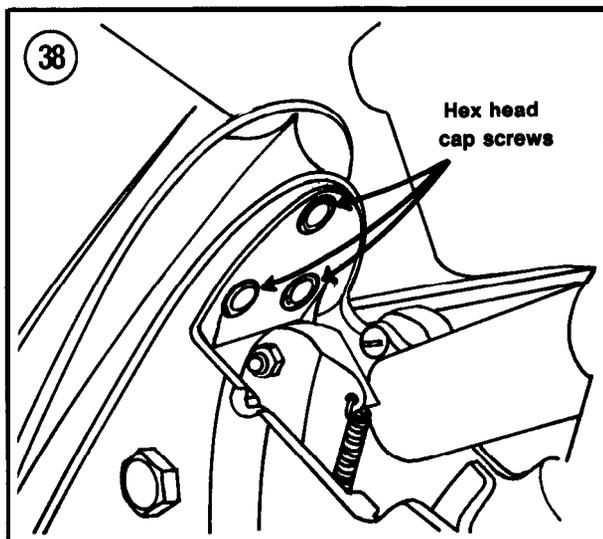
1. Position a new gasket on the drive shaft housing.
2. Position trim tab Allen head screw.
3. Install oil tube in drive shaft housing, if required.
4. Install gear housing to drive shaft housing. Install hex nuts along underside of housing and tighten securely, then reinstall Allen head screws under anti-cavitation plate and hex head capscrews at front of unit. Tighten all fasteners securely.
5. Fill drive unit with the appropriate type and quantity of lubricant. See Chapter Four.



MERCUISER II
GEAR HOUSING COMPONENTS



- | | | |
|---------------------------|----------------------------|---------------------------|
| 1. Gear housing assembly | 16. Shim | 31. Ball bearing |
| 2. Roller bearing | 17. Tapered roller bearing | 32. Washer |
| 3. Drive shaft | 19. cup | 33. Retainer |
| 4. Pinion gear | 19. Adaptor | 34. Thrust hub and washer |
| 5. Oil shield | 20. Propeller gear | 35. Cupped washer |
| 6. Nut | 22. cup | 36. lab washer |
| 7. Shim | 23. Dowel pin | 37. Propeller nut |
| 8. Ball bearing | 24. Propeller shaft | 38. Trim tab |
| 9. Snap ring | 25. Shim | 39. Screw |
| 10. Shim | 26. Bearing carrier | 40. Gear housing magnet |
| 11. Ball bearing retainer | 27. O-ring | 41. Screw |
| 12. Screw | 28. Ring | 42. Filter screen |
| 13. Oil tube seal | 29. Cover assembly | 43. Nut |
| 14. Screw | 30. Oil seal | 44. Screw |
| 15. Washer | | 45. Screw |



Propeller Shaft Removal

1. With gear housing mounted in a suitable holding fixture, install cover retainer tool (part No. C-9 1-53 126) and remove cover nut and washer.
2. Remove gear housing from holding fixture and clamp prop shaft in a vise with protective jaws as close as possible to the gear housing.
3. Tap lightly and evenly on skeg and gear housing until prop shaft breaks free with components.
4. Remove gear housing and remount in holding fixture.
5. If propeller shaft components must be disassembled, take shaft to a dealer or machine shop.

Propeller Shaft Installation

1. Insert prop shaft assembly in gear housing.
2. Install bearing cup carrier and shims over the proper shaft. Seat them in the gear housing.
3. Install a new O-ring in the carrier recess.
4. Install prop shaft oil seal sleeve (part No. C-91-32326) over shaft. Slide cover assembly over shaft until it bottoms on bearing cup carrier in housing.
5. Install an anti-galling washer in the cover recess.
6. Lubricate cover nut threads with Perfect Seal. Thread nut into housing and tighten securely with tool part No. C-91-53126.
7. Install a dial indicator to the gear housing. Install backlash indicator rod (part No. C-91-53459) to the drive shaft. Push in on prop shaft and pull up on drive shaft to check gear lash. Lash should be 0.008-0.012 in.

NOTE

Altering shim thickness under the front (small) bearing cup in Step 8 will change prop shaft bearing preload. If shims are removed or added from under the front bearing cup, an equal amount of shimming must be removed or added under the rear bearing carrier to maintain prop shaft bearing preload.

8. If lash is not within specifications, add or remove a sufficient amount of shimming from under the front (small) bearing cup in the housing or from under the drive shaft ball bearing.
9. Try moving prop shaft fore and aft without over-preloading the bearings. Proper preload will allow the shaft to rotate smoothly with a slight amount of resistance. If the shaft rotates freely or is hard to turn, the bearings are not properly preloaded. Refer to Step 8.

Drive Shaft Removal

1. Install an old sliding clutch on the drive shaft and clamp clutch and shaft in a vise with protective jaws. This will prevent the shaft from rotating.
2. Insert an appropriate size wrench through the prop shaft opening in the housing and remove the drive shaft pinion nut.
3. Remount the gear housing in a holding fixture.
4. Remove the ball bearing plate and magnet with shims (Figure 39).
5. Reclamp the drive shaft in a vise with protective jaws. Place a block of wood on the gear

housing and tap with a hammer to break the drive shaft free.

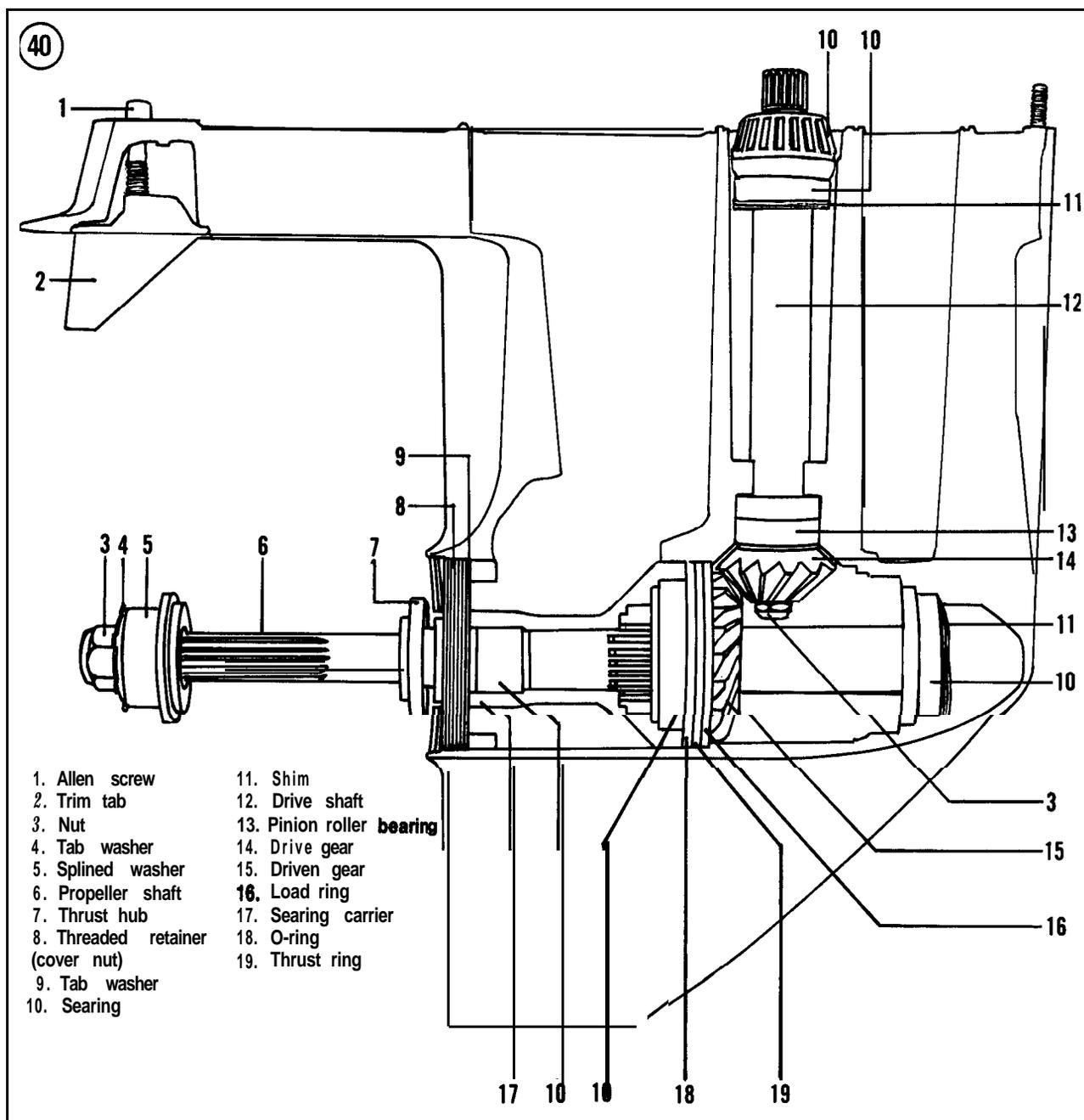
NOTE

The drive shaft bearing rollers in 1.78:1 drives can dislodge during Step 6, as they are loosely stacked in their cage.

6. Remove drive shaft, pinion gear and shims from gear housing.

Drive Shaft Installation

1. Coat drive shaft bearing rollers of 1.78: 1 drives with a liberal quantity of Multipurpose Lubricant to help hold them in place.
2. Install shims in gear housing. Check pinion bearing roller seating, lubricate OD of ball bearing and install drive shaft into housing.
3. Seat bearing with a 7 1/2 in. length of 1 1/2 in. OD pipe.



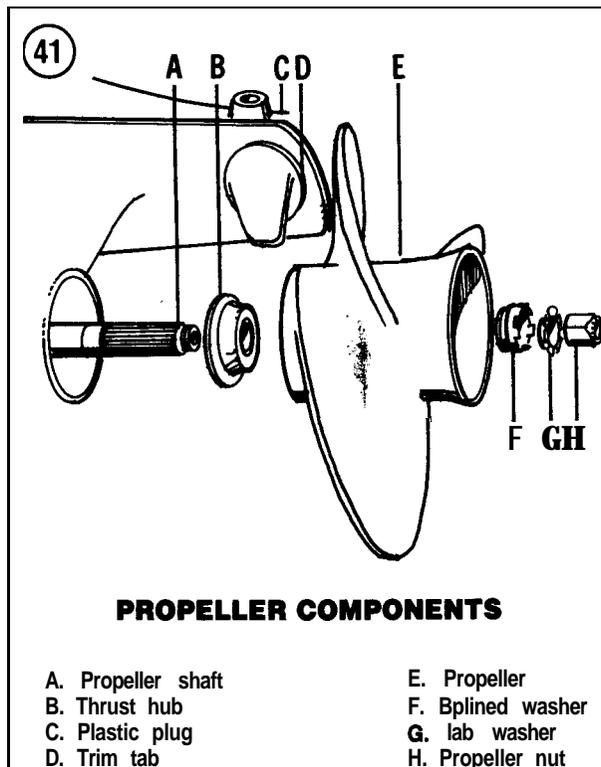
4. Install shims on top of ball bearing, then install bearing retainer. Tighten screws to 20 ft.-lb. if original shims are reinstalled.
5. Press retainer down firmly and hold in that position while measuring the gap between the retainer and gear housing mating surface.
6. Remove shims equal in thickness to the gap between the retainer and gear housing to prevent up or down bearing movement in housing.
7. Install an old sliding clutch on the drive shaft and clamp clutch and shaft in a vise with protective jaws. Install pinion gear with chamfered side of nut facing gear. Tighten nut to specifications.

**MODEL II-TR AND II-TRS
GEAR HOUSING**

Figure 40 shows a cross-section of a typical Model II-TR or II-TRS gear housing.

Gear Housing Removal

1. Position the stem drive with the propeller shaft horizontal.
2. Place a container under the drain plug. Remove the drain and vent plugs and drain the lubricant from the unit.



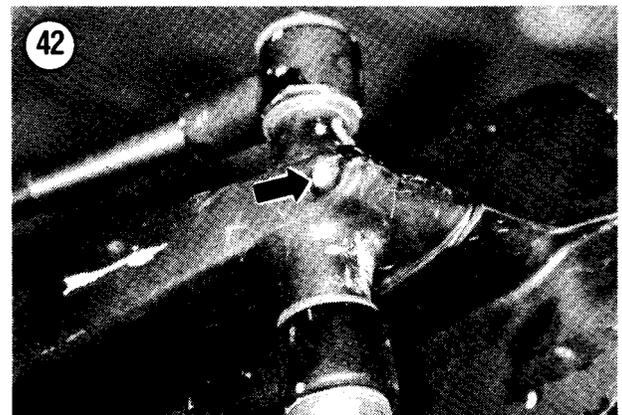
NOTE

If metallic particles are found in Step 3, remove and disassemble both the drive shaft and gear housings. Inspect for damaged oil seals, O-rings and/or housing cracks. Clean all parts in solvent and blow dry with compressed air.

3. Wipe a small amount of lubricant on a finger. Rub the finger and thumb together to check for the presence of metallic particles.
4. Note color of gear lubricant. If white or cream in color, there is water in the lubricant. Inspect container for signs of water separation from the lubricant.
5. Bend propeller washer tabs away from splined washer.
6. Fit a piece of wood between the propeller and anti-cavitation plate to prevent the propeller from turning. Loosen and remove prop nut, tab and splined washers, propeller and thrust hub. See Figure 41.
7. Scribe a mark on the gear housing and trim tab for reassembly reference. Remove plastic plug from rear edge of gear housing. See Figure 42. Remove trim tab screw with a 5/16 in. Allen head wrench. Remove trim tab.
8. Remove 5/16 in. Allen head screw from inside trim tab cavity.
9. Loosen the 7 locknuts along the gear housing.
10. Holding the gear housing firmly, remove the loosened nuts and separate the gear housing from the upper unit.

Gear Housing Installation

If gear housing, drive shaft housing, lower drive shaft or lower drive shaft components have been replaced, perform bearing preload procedure as

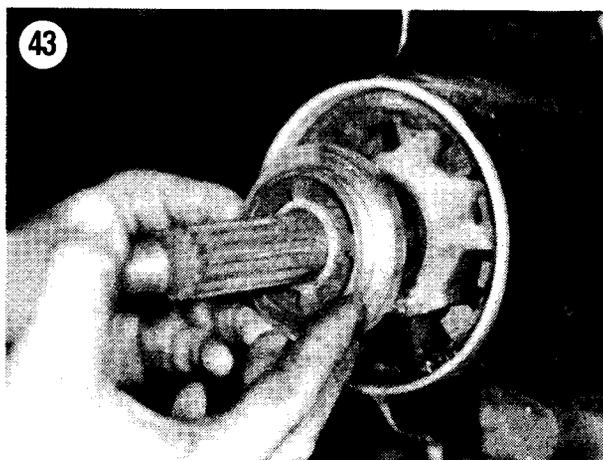


described in this chapter before reinstalling the gear housing.

1. Apply a heavy coat of Multipurpose Lubricant to the drive shaft splines.
2. Install the trim tab Allen screw in gear housing hole.
3. Install a new O-ring around lower drive shaft bearing cup in drive shaft housing. Install a new O-ring in gear housing groove around recirculating passage.
4. Fit gear housing to drive shaft housing and install 7 new elastic stop nuts. Tighten nuts evenly and recheck overall preload. *See Bearing Preload* in this chapter.
5. Install Allen head screw inside trim tab cavity and tighten to specifications (**Table 2**).
6. Install trim tab with scribed marks aligned. Tighten Allen head screw to specifications (**Table 2**). Install plastic plug in access hole.
7. Install propeller thrust hub (**Figure 43**) and lubricate prop shaft splines with Multipurpose Lubricant.
8. Install propeller, splined and tab washers and prop nut (**Figure 41**).
9. Tighten propeller nut securely (**Figure 44**).
10. Fill drive unit with the appropriate type and quantity of lubricant. See Chapter Four.

Bearing Carrier Removal

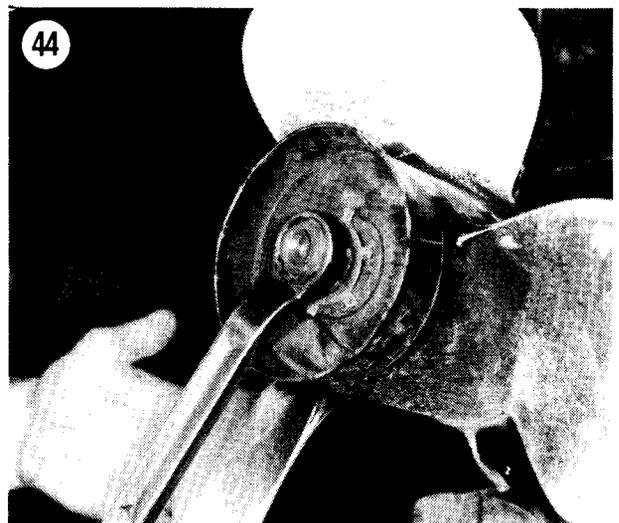
1. Bend propeller washer tabs away from splined washer.
2. Fit a piece of wood between the propeller and anti-cavitation plate to prevent the propeller from turning. Loosen and remove prop nut, tab and splined washers, propeller and thrust hub. See **Figure 41**.



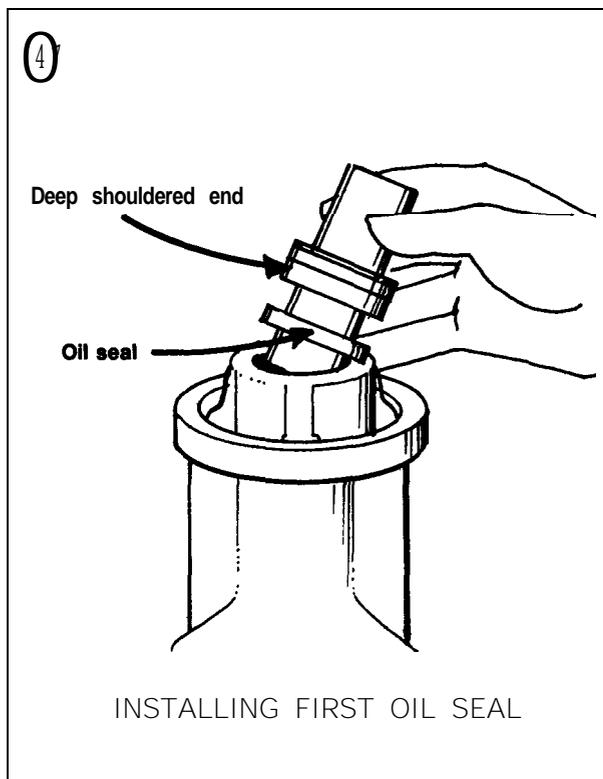
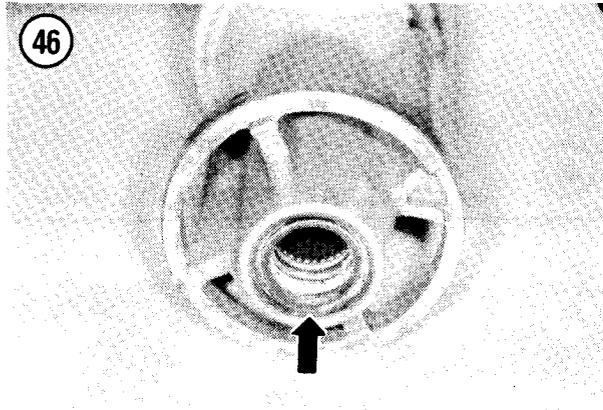
3. Attach a dial indicator just behind bearing carrier so plunger contacts machined surface of propeller shaft. Push shaft to one side and hold, then zero the indicator. Without turning the shaft, push it to the other side as far as it will go. Repeat procedure to push shaft up and down. If shaft deflects more than 0.003 in. in either direction, check shaft and needle bearing for excessive wear.
4. Mount gear housing in a suitable holding fixture.
5. Bend the bearing carrier retainer washer lock tab away from the cover nut with a screwdriver and hammer.

NOTE

If the cover nut is frozen in place and cannot be moved in Step 6, use an electric drill to drill out one side of the nut for easier removal.



6. Install bearing carrier retainer wrench (part No. C-91-54873) and rotate counterclockwise to loosen the cover nut. Remove tool and turn cover nut out by hand. Remove nut and tab washer.
7. Install carrier puller (part No. C-9 1-45086A 1) to a slide hammer. Fit puller into bearing carrier. Bosses inside the carrier should support the puller jaws.

**NOTE**

If the bearing carrier is corroded, you may have to apply heat to the housing while pulling on the assembly in Step 8. **Be careful not to overheat the housing, as this will cause distortion.**

8. Operate the slide hammer until the bearing carrier comes loose. Remove puller jaws from carrier, then remove bearing carrier (**Figure 45**) from gear housing. Be sure to retrieve carrier locating key.

NOTE

Older models use shims instead of a load ring. If your gear housing contains shims, remove and wire them together for reassembly.

Bearing Carrier Cleaning and Inspection

1. Clean all parts in fresh solvent. Blow dry with compressed air.
2. Check prop shaft bearing cup for signs of pitting, grooving, scoring, heat discoloration or embedded metallic particles. Replace bearing and cup if such signs are noted.
3. Check prop shaft machined surface where oil seals contact it. If area shows signs of grooving, replace shaft and oil seals.
4. Check oil seals in bearing carrier (**Figure 46**) for wear, tears, roughness and proper spring position. Replace seals if in doubt about their serviceability.
5. Check needle bearing contact points on prop shaft. If shaft shows signs of pitting, grooves, scoring, heat discoloration or embedded metallic particles, replace prop shaft and needle bearing.
6. Inspect cover nut for cracks or broken or corroded threads. Replace as required.

Bearing Carrier Installation

If bearings or oil seals do not require replacement, begin procedure with Step 7.

1. Press new tapered roller bearing cup in carrier with suitable driver.
2. Install new needle bearing in carrier with adaptor tool (part No. C-91-55918).
3. Wipe OD of new oil seals with Loctite Type A.
4. Install one seal with the deep shoulder side of driver part No. C-91-559 16. Seal lip must face *inward* to hold lubrication inside the housing. Install seal in carrier until driver bottoms. See **Figure 47**.

5. Install second seal with the shallow shoulder side of driver. Seal lip must face *outward* to keep water out of the housing. Install seal in carrier until driver bottoms. See **Figure 48**.

6. Wipe off any excess Loctite and fill cavity between seals with Multipurpose Lubricant.

7. Install carrier assembly with locating key in gear housing. Load ring, thrust ring and O-ring *are not* installed at this time.

8. Thread cover nut in place without tab washer (**Figure 49**), then install retainer wrench (part No. C-91-61069) and slowly tighten nut to apply sufficient preload on prop shaft bearings to check pinion gear backlash.

9. Check pinion gear backlash as described under **Shimming** in this chapter.

NOTE

If any internal gear components or gear housing have been replaced on models equipped with a load ring, install a new load ring in Step 10.

10. Remove bearing carrier and install load ring, thrust ring and O-ring in gear housing.

11. Apply a liberal quantity of Perfect Seal to carrier outer diameter as well as to the gear housing threads.

12. Reinstall carrier and locating key in gear housing.

13. Install tab washer. Coat cover nut threads with Perfect Seal and install cover nut.

CAUTION

Proper torque is very important in Step 14. Excessive torque will collapse load ring.

14. Tighten cover nut slowly while periodically checking prop shaft bearing preload (**Figure 50**) with inch-pound torque wrench until correct preload of 8- 15 in.-lb. is obtained.

15. Bend one tab on tab washer into one of the cover nut slots.

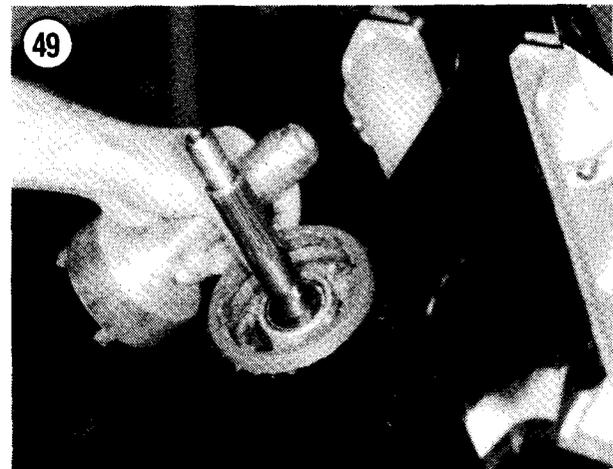
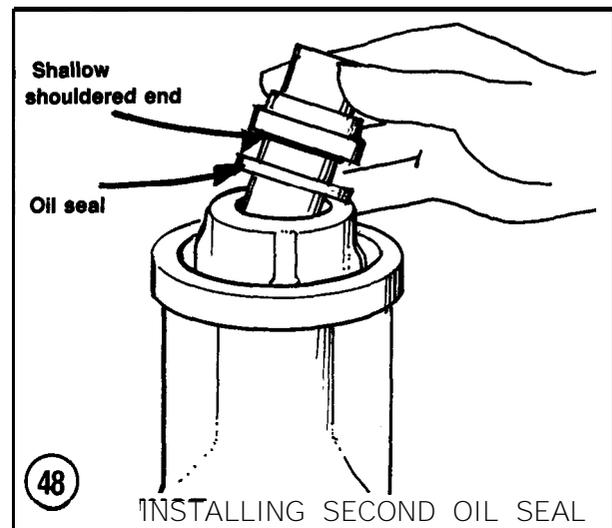
Drive Shaft/Pinion Gear Removal

1. Remove bearing carrier as described in this chapter.

2. Reinstall cover nut to protect gear housing threads.

3. Install drive shaft wrench adaptor (part No. C-91-63620A1) over the drive shaft to protect the splines from possible damage.

4. Fit an appropriate size socket and breaker bar over the drive shaft adaptor.



5. Hold pinion gear nut with a wrench and turn drive shaft counterclockwise to break pinion gear nut free.

6. Thread puller tool (part No. C-91-63616) into end of drive shaft. Attach a slide hammer to puller tool and separate drive shaft from pinion gear. Remove drive shaft from gear housing (**Figure 51**).

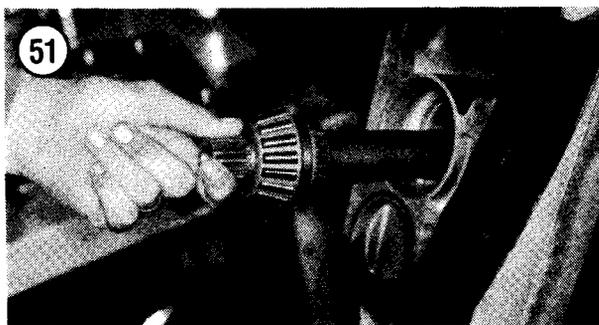
7. Remove pinion gear.

Drive Shaft/Pinion Gear Cleaning and Inspection

1. Clean all parts in fresh solvent. Blow dry with compressed air.

2. Check pinion gear for pitting, excessive wear or broken or chipped teeth. Replace as required.

3. Check drive shaft where roller bearing rides. Replace drive shaft and bearing if pitting, scoring,



grooves, heat discoloration or embedded metallic particles are found.

4. Check drive shaft upper and lower tapered roller bearing cup(s). Replace bearing(s) and cup(s) if pitting, scoring, grooves, heat discoloration or embedded metallic particles are found.
5. Check splines on each end of drive shaft for excessive wear or damage.
6. Suspend drive shaft between V-blocks and check straightness with a dial indicator.

Drive Shaft/Pinion Gear Installation

1. Install drive shaft with bearing assembly in gear housing.
2. Install pinion gear. Install dished washer with concave side facing pinion gear. Install pinion nut and tighten to specifications.
3. Install shimming tool (part No. C-91-63622) in gear housing.
4. Push down on drive shaft to simulate preload and rotate slightly to seat bearings. Hold drive shaft in this position and insert a feeler gauge in tool opening to measure clearance between tool and gear. Clearance should be 0.025 in.

5. If clearance is incorrect, remove tool, drive shaft, pinion gear and drive shaft small bearing cup. Add or remove shimming under the bearing cup equal to the difference between your reading and 0.025 in. Reinstall bearing cup, drive shaft and pinion gear.
6. Wipe inside of pinion gear nut threads with Loctite Type A and tighten nut to specifications. Repeat Step 3 and Step 4 to recheck clearance.
7. Install bearing carrier retainer as described in this chapter.

Propeller Shaft Assembly Removal/Installation

1. Remove bearing carrier retainer as described in this chapter.
2. Remove drive shaft/pinion gear as described in this chapter.
3. Lift prop shaft straight up 3-4 in. and unseat thrust ring, O-ring and load ring.
4. Restore prop shaft to normal running position and remove thrust ring, O-ring and load ring.
5. Move outer end of prop shaft toward anti-cavitation plate to prevent damage to prop shaft bearing when shaft is removed. Lift shaft up and remove at this angle.
6. Installation is the reverse of removal.

Propellor Shaft Assembly Cleaning and Inspection

1. Clean all parts in fresh solvent. Blow dry with compressed air.
2. Check driven gear for broken or chipped teeth, chipped or rounded-off clutch jaws, pitting or excessive wear. Replace as required.
3. Check prop shaft tapered roller bearing cups for signs of pitting, scoring, grooving, heat discoloration or embedded metallic particles. Replace bearing and cup if any of these are noted.
4. Check prop shaft area where carrier needle bearing rides for the same defects as in Step 3. Replace shaft and needle bearing if any of these are noted.
5. Check prop shaft surface where carrier oil seal lips ride. Replace shaft and oil seals if any grooving is noted.
6. Install prop shaft on balance wheels and check for wobble at prop end of shaft. Replace if bent.
7. Install prop shaft on V-blocks and rotate shaft. If prop end of shaft wobbles, replace the shaft.

8. Install prop shaft between lathe centers and check needle bearing contact area with dial indicator. If indicator variation exceeds 0.005 in. as shaft revolves, replace it.
9. Clean corrosion from prop shaft splines and check spline condition. If partially corroded away, replace shaft.
10. Replace O-ring.

Gear Housing Inspection

1. With all components removed, wash housing in solvent and blow dry with compressed air.
2. Check housing for impact damage.
3. Inspect for loose fitting bearing cups and bearings. Replace as required.
4. Check cover nut threads in gear housing for corrosion or stripped threads.

Shimming

Pinion gear backlash

1. Install a dial indicator and backlash indicator rod (part No. C-91-53549) as shown in **Figure 52**.
2. Position indicator rod and indicator plunger according to model being checked. The "II" mark is used for II-TR and the "III" mark for II-TRS.
3. Push in on drive shaft to simulate bearing preload. Hold prop shaft from turning. Rotate drive shaft/pinion gear back and forth and read dial indicator.
4. If reading exceeds 0.011-0.015 in. (II-TR) or 0.009-0.013 in. (II-TRS), remove sufficient shimming from under prop shaft front bearing cup to bring backlash into specifications.
5. If reading is less than 0.011-0.015 in. (II-TR) or 0.009-0.013 in. (II-TRS), add sufficient shimming under prop shaft front bearing cup to bring backlash into specifications.

Bearing preload

During assembly of Model II-TR, and II-TRS gear housings, bearing preload is established and set for each shaft as described in this chapter. However, the lower drive shaft receives its preload from a shim pack in the upper drive shaft housing. For this reason, its preload cannot be checked like that of other shafts.

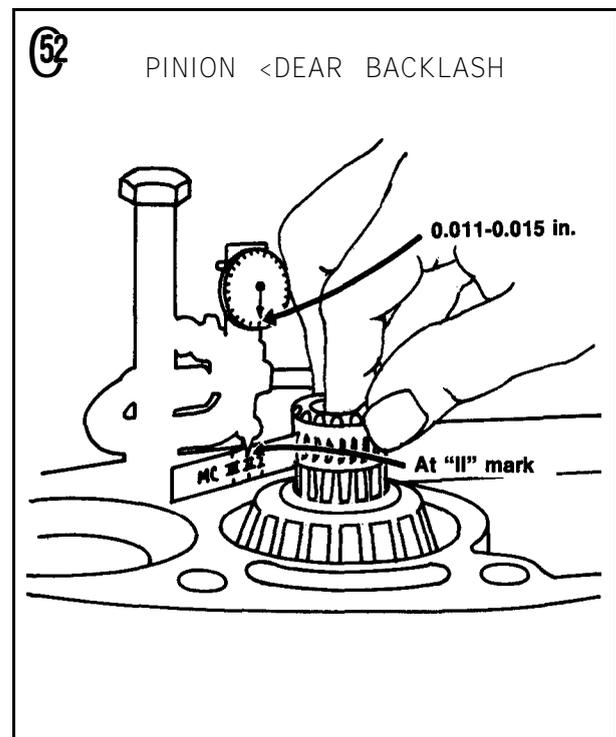
The gear housing complete preload consists only of prop shaft preload, as the lower drive shaft bearings remain unloaded until shimmed into the drive shaft housing. To find out if the lower drive

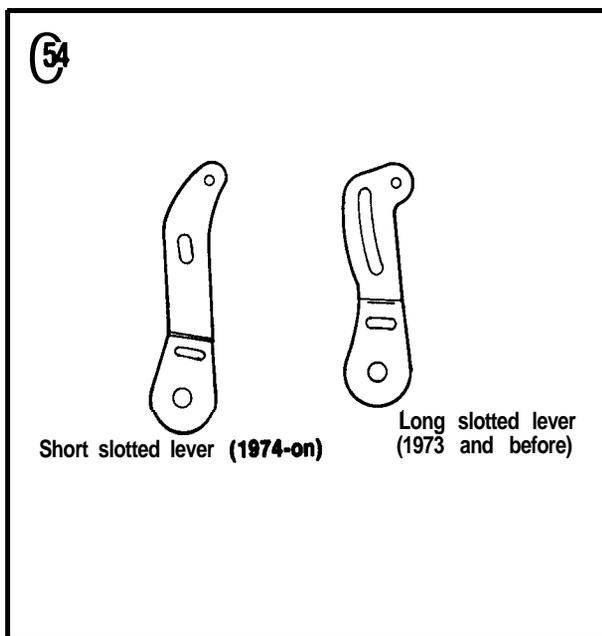
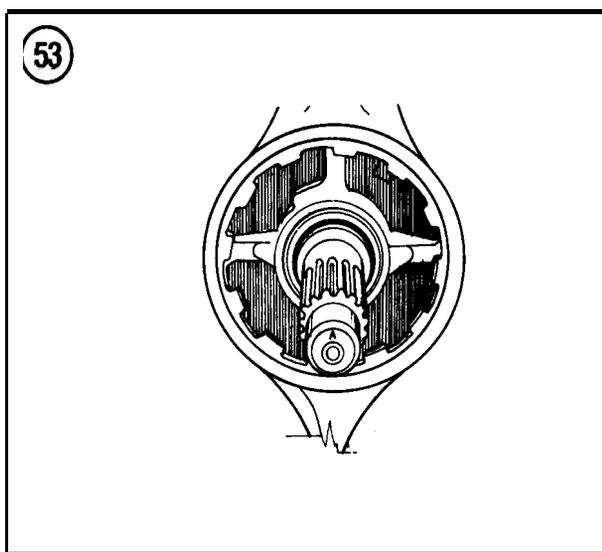
shaft preload is correct, complete drive unit preload (at the prop shaft) is compared to the total of prop shaft and drive shaft housing preload. The total drive unit preload as described should be 2-6 in.-lb. more than the total prop shaft and drive shaft housing preload.

A more complete treatment of bearing preload is presented in Chapter Sixteen, since it is more appropriate to drive shaft housing overhaul. Its primary importance in this chapter is to acquaint you with the subject, which must be considered whenever the gear housing, drive shaft housing, lower drive shaft or any of its components have been replaced.

If any of these items have been replaced, the preload on the lower drive shaft tapered roller bearings must be overshimmed by at least 0.060 in. as follows.

1. Install spacer and 0.060 in. shim pack on lower drive shaft bearing cup.
2. Install gear housing to drive shaft housing. Install nuts but do not tighten at this time.
3. Refer to appropriate preload torque chart (see Chapter Sixteen) to determine drive shaft housing overall bearing preload torque (top line). Locate prop shaft bearing preload torque along left side of chart. The 2 figures in the intersecting block of the preload chart are the upper/lower limits of the





drive unit's overall bearing preload torque, as measured at the prop shaft.

4. Tighten the housing nuts installed in Step 2 evenly to keep an even gap between the housings until the bearing preload torque (at the prop shaft) is within the limits specified on the chart.

5. Measure the gap between the housings on each side of the drive shaft and average the readings. Remove the gear housing and subtract that amount of shimming from the over-shimmed bearing cup.

6. Reinstall cup and continue with gear housing installation as described in this chapter.

MODEL I-MR DRIVE

The new MR series gear housing was introduced as a running change on 1985 model stern drives. For the first year of production (beginning in June 1984), the MR gear housing is identified by an "A" stamped in the end of the propeller shaft (Figure 53). It can also be identified by the lack of a preload pin at the top of the drive shaft. The MR gear housing is interchangeable with the previous Model I and can be installed as a replacement for any 1974 and later MerCruiser Model I drive with a short slot in the shift plate lever (Figure 54). See Table 3 for application.

MR Gear Housing

The MR gear housing is a completely redesigned version of the Model I intended to provide extended service life. It incorporates the following major changes as shown in Figure 55:

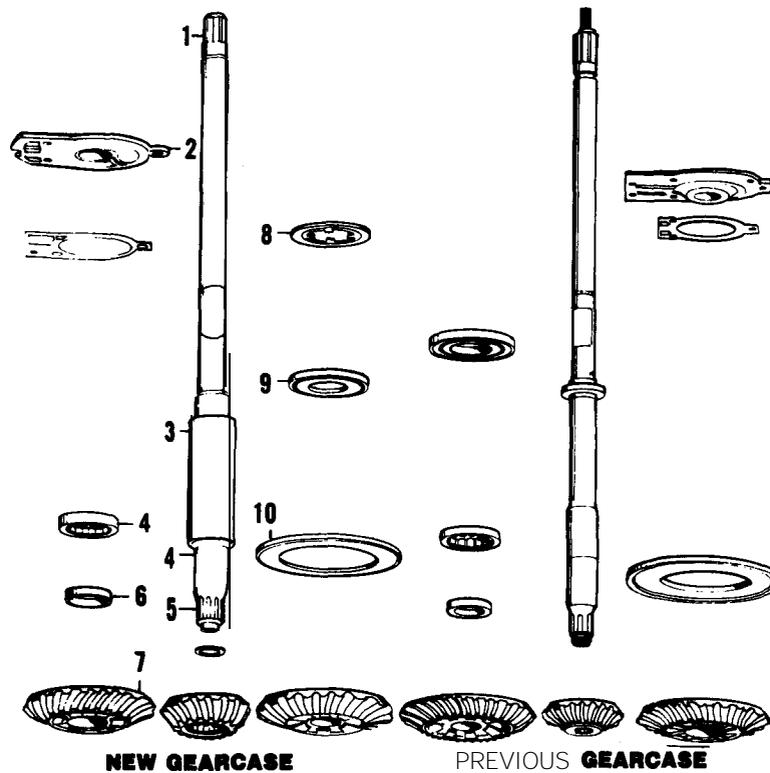
- a. Gears are manufactured of a higher strength steel and the spiral angle of their teeth has been reversed. This results in an increased load carrying capacity.
- b. The drive shaft bearing is pressed onto the shaft with its taper facing up (opposite the old Model I) and held in place by a threaded retainer. This design accommodates the upward thrust created by the new gears.
- c. A thicker steel ring is used to position reverse gear more precisely.
- d. A closer fit propeller shaft bearing is used to reduce gear deflection under high loads.
- e. The drive shaft journal and bearing areas have been enlarged to reduce gear and shaft deflection. A preload pin is no longer required, as the threaded bearing retainer controls upward movement of the shaft. The number of splines on the shaft has been increased from 11 to 13.
- f. A new water pump base and housing provides clearance for the oil circulation passage.
- g. Internal machining of the gear housing differs to accommodate the new bearings and retainer.

Figure 56 is an exploded view of the MR gear housing.

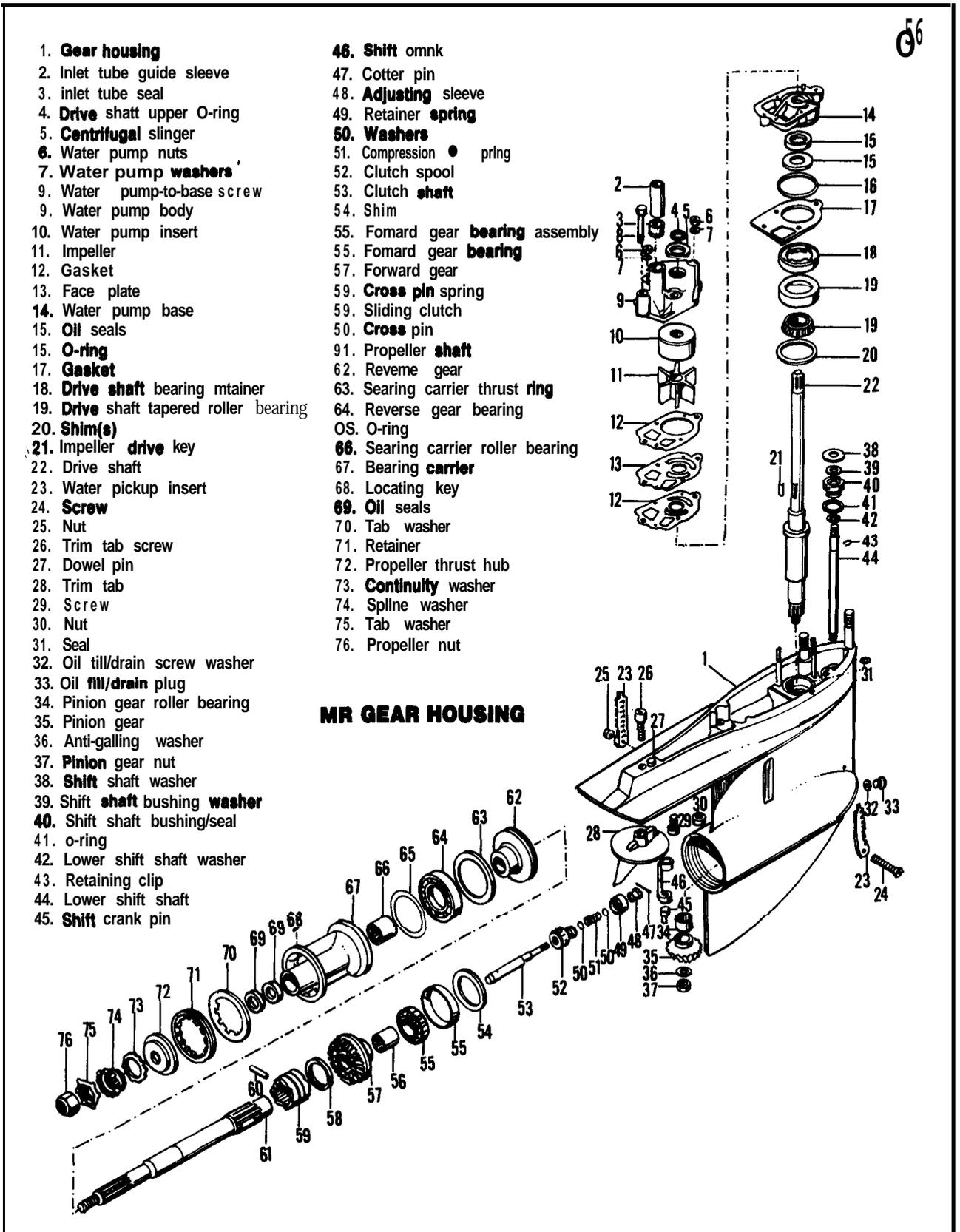
Special Tools

New special tools are required to service the MR gear housing as follows:

55



1. No **preload** pin
2. Modified water pump base
3. 70 percent increase in drive **shaft** midsection
4. 25 percent increase in drive shaft journal and bearing area
5. 13 **splines** instead of previous 11
6. **Precision** bearing reduces clearance with prop shaft
7. Opposite hand **spiral** gear set
8. Bearing retainer nut
9. Reduced deflection taper **bearing**
10. Steel thrust washer instead of powdered metal to reduce deflection



- a. Drive shaft bearing preload tool (part No. 91-44307A1). This tool provides the necessary upward pressure on the drive shaft to seat the bearing when pinion gear height and gear backlash is checked. See Figure 57.
- b. Drive shaft bearing retainer tool (part No. 91-43506). This tool is necessary to remove and install the threaded retainer. See Figure 58.
- c. Pinion nut adaptor wrench (part No. 91-61967A2). This tool supercedes the previous wrench (part No. 91-61607A1) and can be used with the Model I gear housing as well as the Model I-MR. See Figure 59.

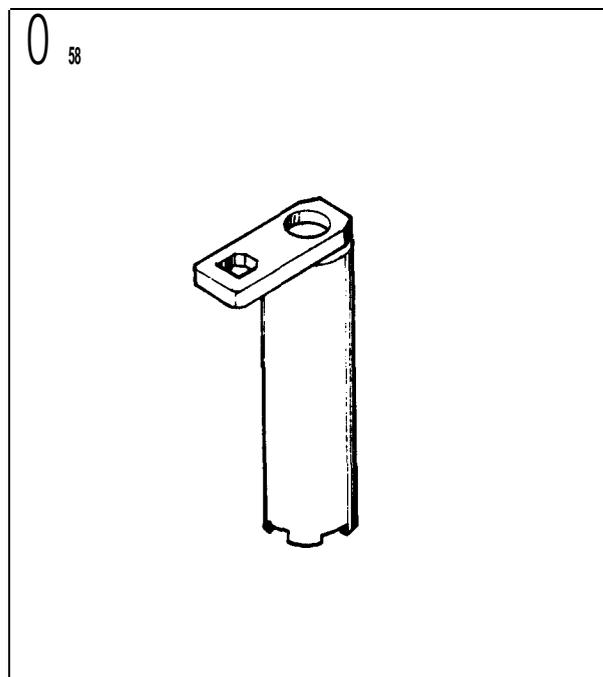
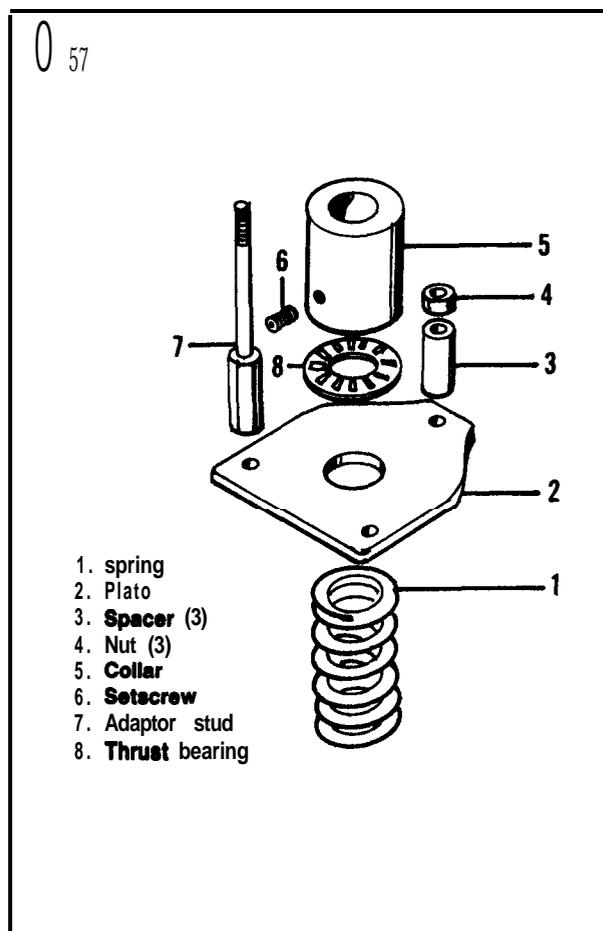
Gear Housing Removal

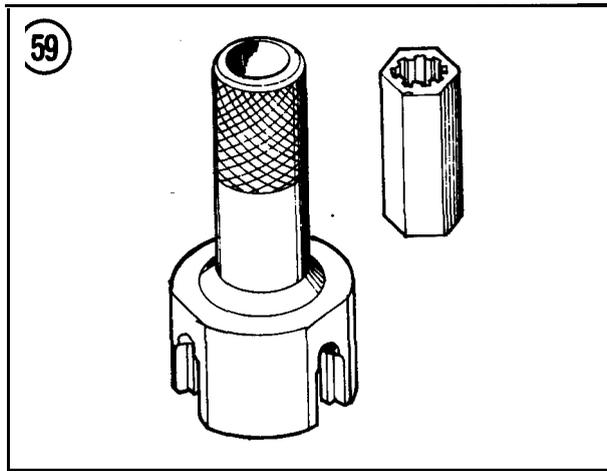
1. Trim the drive to its full OUT position.
2. Place a container under the drain plug. Remove the drain and vent plugs. Drain the lubricant from the unit.

NOTE

If metallic particles are found in Step 3, remove and disassemble both the drive shaft and gear housings to inspect for damaged oil seals, O-rings and/or housing cracks. Clean all parts in solvent and blow dry with compressed air.

3. Wipe a small amount of lubricant on a finger and rub the finger and thumb together. Check for the presence of metallic particles.
4. Note color of gear lubricant. If white or cream in color, there is water in the lubricant. Inspect drain container for signs of waer separation from the lubricant.
5. Bend propeller washer tabs away from splined washer.
6. Fit a piece of wood between the propeller and anti-cavitation plate to prevent the propeller from turning. Loosen the prop nut.
7. Scribe a mark on the gear housing and trim tab for reassembly reference. Remoe plastic plug from rear edge of gear housing. Remove trim tab screw with a 3/8 in. Allen head wrench. Remove trim tab.
8. Remove 5/16 in. Allen head screw from inside trim tab cavity.
9. Remove two locknuts from the center bottom of the anti-cavitation plate.
10. Remove the locknut at the front of the gear housing mounting stud.



**CAUTION**

If necessary to pry units apart in Step 11, pry only at front and rear of gear housing. Attempting to pry along the right side of the unit can cause damage to the interconnecting oil passage in the gear housing case.

11. Loosen the mounting locknuts on each side equally and drop the gear housing slightly. On badly corroded units, the water tubes and drive shaft may be frozen in the upper gear housing, making it necessary to pry the gear housing loose from the stern drive housing.

12. Holding the gear housing firmly, remove the loosened nuts and separate the gear housing from the upper unit.

13. Mount gear housing in a suitable holding fixture.

14. Remove prop nut, tab and splined washers, propeller and thrust hub.

Gear Housing Installation

1. If water inlet tube came free when gear housing was removed, coat the upper end of the tube with 2-4-C Multi-Lube and reinsert in upper housing.
2. Coat lower end of water tube with a light coat of 2-4-C Multi-Lube. Apply a heavy coat of lubricant to the drive shaft splines.
3. Install the trim tab screw through the top of the gear housing.
4. Wipe a new seal with Special Lubricant 101 or 2-4-C Multi-Lube and install in the groove around the interconnecting oil passage.

5. Install a shift shaft wrench over the shift shaft. Rotate wrench clockwise to shift drive shaft housing assembly into full forward gear. Make sure that the upper shift shaft in the gear housing is also in its full FORWARD position.

6. Align water inlet tube with water tube guide and drive shaft splines with upper drive shaft/shift shaft splines, then install gear housing to upper unit. It may be necessary to rotate the prop shaft counterclockwise to engage the drive shaft splines.

7. Once the 2 housings are coupled, install new elastic stop nuts on side and front mounting studs. Tighten Stop nuts to specifications (Table 2).

8. Install anti-cavitation plate locknuts.

9. Install Allen head screw inside trim tab cavity and tighten to specifications (Table 2).

10. Install trim tab with scribed marks aligned. Tighten Allen head screw to specifications (Table 2). Install plastic plug over screw.

11. Install thrust hub and lubricate prop shaft splines with 2-4-C Multi-Lube.

12. Install propeller, splined and tab washers and prop nut. Tighten nut securely.

13. Fill drive unit with the appropriate type and quantity of lubricant. See Chapter Four.

Bearing Carrier/Reverse Gear Removal

See Model I Drive in this chapter.

Bearing Carrier/Reverse Gear Cleaning and Inspection

See Model Z Drive in this chapter.

Bearing Carrier/Reverse Gear Installation

See Model I Drive in this chapter.

Drive Shaft/Pinion Gear Removal

1. Remove bearing carrier retainer/reverse gear as described in this chapter.

2. Install drive shaft bearing retainer tool (part No. 91-43506) and loosen bearing retainer at least 2 full turns (do not remove the retainer at this time).

3. Install drive shaft nut wrench (part No. 91-56775) over the drive shaft to protect the splines from possible damage.

4. Pull the drive shaft upward and install pinion nut adaptor (part No. 9 1-6 1607A2) over prop shaft and onto pinion gear nut.

NOTE

If the drive shaft is broken, install pinion nut adaptor (part No. 91-61607A1 over prop shaft and onto pinion gear nut. Install prop shaft tool (part No. 91-61077) over prop shaft. Shift unit into FORWARD gear and rotate prop shaft counterclockwise to remove pinion nut.

5. Fit an appropriate size socket and breaker bar over the drive shaft adaptor and turn counterclockwise while holding the pinion nut to break the nut free.
6. Remove the pinion nut adaptor, reach into the gear housing and unscrew the pinion nut. Remove nut and anti-galling washer.

NOTE

The 18 pinion roller bearings may fall out of the outer bearing race in Step 7. If so, be sure to retrieve all 18 or a new set will have to be installed during reassembly.

7. Remove the drive shaft bearing retainer loosened in Step 2. Lift drive shaft with bearing and bearing cup from gear housing. Remove and tag shims for reinstallation reference.

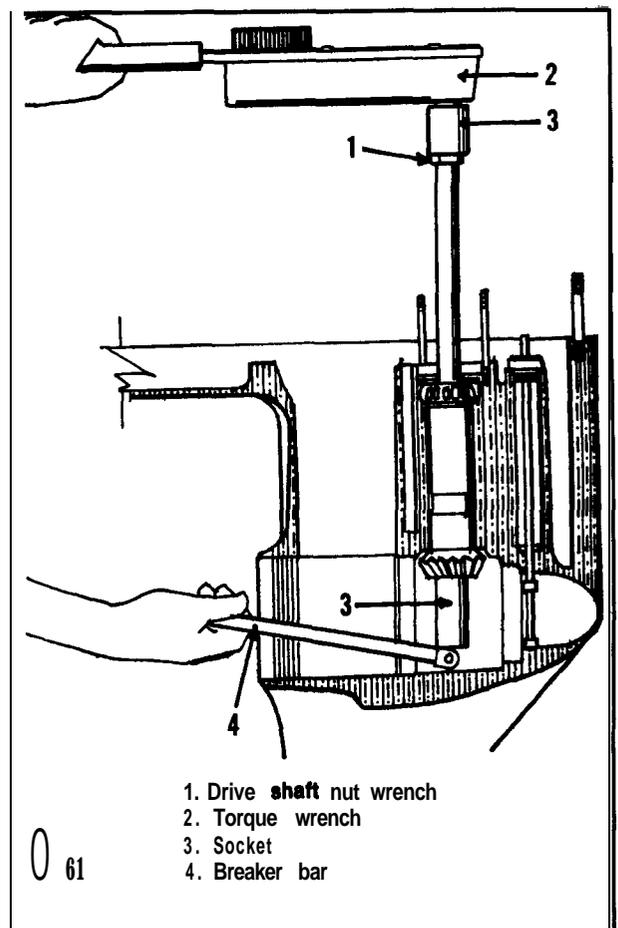
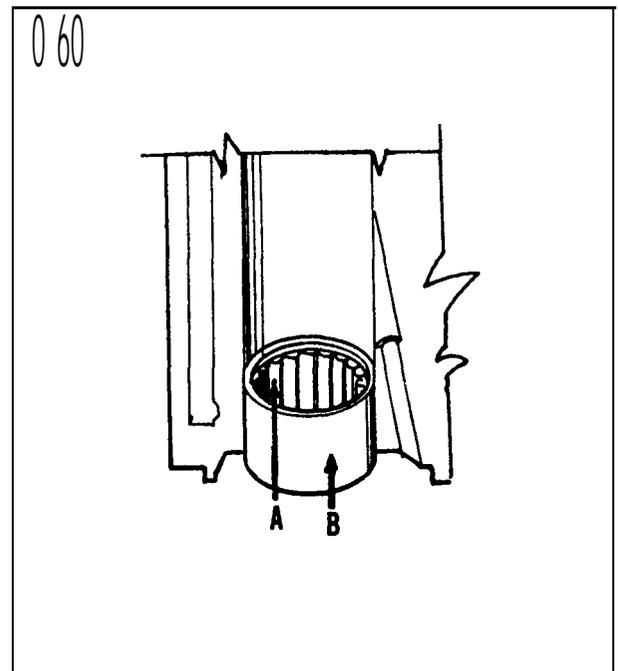
**Drive Shaft/Pinion Gear
Cleaning and Inspection**

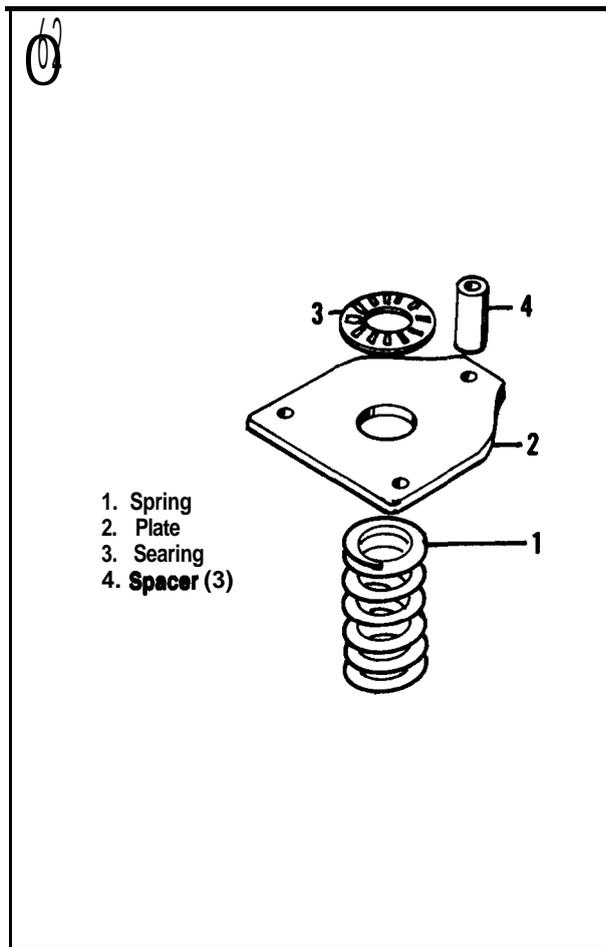
See Model Z Drive in this chapter.

**Drive Shaft/Pinion
Gear Installation**

The unit does not require reshimming if no new parts are installed.

1. If rollers (A, **Figure 60**) fell out of drive shaft roller bearing race (B, **Figure 60**) during removal, coat all 18 rollers with Quicksilver Needle Bearing Assembly Lubricant and reinstall.
2. Install shim(s) removed during disassembly in drive shaft housing bore.
3. Glue the pinion gear washer to the pinion gear with 3M Adhesive (part No. 92-25234), Quicksilver Bellows Adhesive (part No. 92-86266) or equivalent.
4. Position pinion gear and washer in gear housing. Gear teeth must mesh with FORWARD gear teeth.





5. Hold pinion gear in place and insert drive shaft in housing bore. Rotate drive shaft to align and engage its splines with those of the pinion gear. Install but do not tighten pinion gear nut.

6. Install the drive shaft bearing cup over the tapered roller bearings, then thread retainer in place until all threads are engaged.

7. Install drive shaft bearing tool (part No. 91-43506) and tighten retainer to specifications (Table 2).

8. Install adaptor (part No. 91-56775) on drive shaft, then tighten pinion gear nut to specifications (Table 2) using appropriate sockets, a breaker bar and torque wrench. See Figure 61.

9. Check pinion gear height as described in this chapter.

10. Remove pinion gear nut and wipe its threads with Loctite Type A. Reinstall nut and tighten to specifications (Table 2).

11. Install bearing carrier retainer/reverse gear as described in this chapter.

Propeller Shaft/Forward Gear Removal/Disassembly

See *Model I Drive* in this chapter. Disassembly of the spool assembly usually results in damage and is not recommended unless its components show obvious signs of damage. The spool assembly can be cleaned satisfactorily without disassembly.

The forward gear needle bearing case is manufactured of a very high tensile steel and cannot be easily split with a chisel and hammer. If replacement is required, use a high-speed grinder to cut one or more notches in the bearing case as required for removal.

Propeller Shaft/Forward Gear Cleaning and Inspection

See *Model I Drive* in this chapter.

Propeller Shaft/Forward Gear Assembly/Installation

See *Model I Drive* in this chapter.

Shift Shaft Removal

See *Model Z Drive* in this chapter.

Shift Shaft Cleaning and Inspection

See *Model I Drive* in this chapter.

Shift Shaft Installation

See *Model I Drive* in this chapter.

Gear Housing Inspection

See *Model I Drive* in this chapter.

Drive Shaft Roller Bearing, Drive Shaft and Forward Gear Bearing Cups

See *Model Z Drive* in this chapter.

Pinion Gear Height

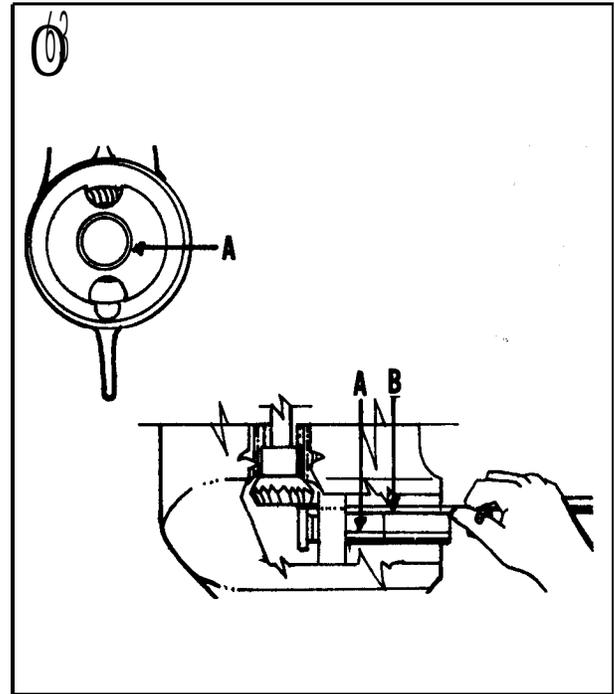
1. Push in on the propeller shaft and rotate it to seat the bearings.

2. Install bearing preload tool (part No. 91-44307A1) components over the drive shaft in the order shown in Figure 62.

3. Install and tighten the water pump stud nuts until they just bottom.
4. Fit the collar from tool part No. **91-44307A1** over the drive shaft. Align its setscrew with the water pump impeller **keyway**.
5. Pull upward on the drive shaft and push downward on the collar. Holding both assemblies in this position, tighten the setscrew securely.
6. Back off the water pump stud nuts 3-4 turns, then rotate the drive **shaft** clockwise at least 2 full turns to seat its bearings.
7. Insert pinion gear shimming tool (part No. 91-56048) in gear housing. See A, **Figure 63**.
8. Insert a 0.025 in. feeler gauge between the high point of the shimming tool and one of the pinion gear teeth. See B, **Figure 63**. The feeler gauge should just fit.
9. Repeat Step 8 to take 2 more readings, rotating the drive shaft 120° between each reading. This will provide 3 readings taken at 120° intervals or 1 full rotation of the drive shaft.
10. If the clearance is not exactly 0.025 in. at each reading, determine how much clearance exists, then remove the shimming tool, pinion gear, drive shaft and bearing cup. Add shims if clearance is too great; remove shims if clearance is insufficient. Reinstall bearing cup, drive shaft and pinion gear, then repeat procedure.

Forward and Reverse Gear Backlash

1. Perform Steps 1-6 of **Pinion Gear Height** in this chapter.
2. Thread the stud adaptor from tool part No. **91-44307A1** onto the rear water pump stud (starboard side) and install a dial indicator to the adaptor.
3. Install backlash indicator rod (part NO. 91-53459) to drive shaft.
4. Move dial indicator plunger to the "T" line on the backlash indicator rod. Set indicator scale to zero.
5. Install puller jaws (part No. **46086A1**) and puller bolts (part No. 91-85716) to bearing carrier and propeller shaft. Tighten puller bolt to 45 in.-lb. (**85 N•m**).



6. Rotate drive shaft back and forth lightly without allowing prop shaft to turn. The dial indicator should read 0.017-0.028 in. (0.43-0.71 mm).
7. Repeat Step 6 to take 3 more readings, rotating the drive shaft 90° between each reading. This will provide 4 readings taken at 90 degree intervals or 1 full rotation of the drive shaft.
8. If backlash readings are within specifications, continue with procedure. If backlash is too small, remove shims from the forward gear bearing race; if too great, add shim(s) as required.
9. Remove the puller jaws and bolt installed in Step 5. Shift gear housing into full REVERSE position and turn drive shaft clockwise to make sure sliding clutch engages fully.
10. Install pinion nut adaptor (part No. 91-6 1607A2) on propeller shaft. Install TR belleville washer (part No. 12-54048) with its concave side facing away from the gear housing. Install propeller nut and tighten to 45 in.-lb. (**5 N•m**).
11. Rotate drive shaft back and forth lightly without allowing prop shaft to turn. The dial indicator should read 0.028-0.052 in. (0.7 1-1 .32 mm).
12. If backlash is correct, continue with assembly. If backlash is too small, add shims between the gear housing and bearing carrier, if too great, check for improper installation of bearing carrier.

Table 1 MODEL I GEAR HOUSING BACKLASH SPECIFICATIONS

	Gear teeth No. (pinion/drive)	
	14/28 (MerCruiser I)	19/32 (MerCruiser IA, IB, IC 120, 140, 180, 185)
Forward gear backlash	0.006-0.008 in. (0.15-0.20 mm)	0.006-0.008 in. (0.15-0.21 mm)
Reverse gear backlash	0.015-0.020 in. (0.38-0.51 mm)	0.015-0.020 in. (0.38-0.51 mm)
	20/33 (120, 140, 185, 470 485, 888, 898, 225-S 228, 233, 250, 280)	17/28 120,140, 185,470 485, 888, 898, 225-S, 228, 233, 250, 280)
Forward gear backlash	0.010-0.012 in. (0.25-0.30 mm)	0.020-0.023 in. (0.51-0.58 mm)
Reverse gear backlash	0.040-0.060 in. (1.02-1.52 mm)	0.040-0.080 in. (1.02-1.52 mm)
<p>. MerCruiser 120, 140 and 185 drive units serial No. 3780849 and below and 888 drive. units Serial No. 3784374 and below have a short clutch travel and will not function with the high backlash specified. Set reverse gear backlash @ 0.025-0.030 in. (0.64-0.76 mm) on these units. If serial No. is unknown, remove propeller shaft and check shift shaft rotation. If unit has long clutch travel, shift shaft will rotate about 270°; with short clutch travel, it will rotate only about 35°.</p>		

Table 2 GEAR HOUSING TIGHTENING TORQUES

Fastener	in.-lb.	ft.-lb.
MODEL I		
Gear housing		
To drive shaft housing screw		28
Cover, retainer spool		150
Pinion nut		60-80
Propeller shaft nut		55
Trim tab to gear housing screw	180	
Plastic water pump housing		
Early models		
Screw	15-20	
Stud nuts		
1/4×28	25-30	
5/16×24	35-40	
Late models		
Aft bolt	20-30	
Aft and forward nuts	50-60	
(continued)		

Table 2 **GEAR HOUSING TIGHTENING TORQUES** (continued)

Fastener	in.-lb.	ft.-lb.
MODEL II		
Gear housing		
To drive shaft housing screw		60
7/16×14		12
1/4×20		250
Cover, retainer spool		160
Pinion nut		200
Lower gear bearing cup retainer		160
Forward/reverse gear locknut		35-45
Propeller shaft nut		
MODEL 215		
Gear housing		
To driveshaft housing screw		50
Stud nut		35
Cover, retainer spool		250
Pinion nut		150
Propeller shaft nut		35-45
Prop shaft preload (without prop)		18-20
Trim tab to gear housing screw	160	
MODEL III-390		
Gear housing		
To drive shaft housing screw		50
Cover, retainer spool		250
Stud bearing retainer nut		30
To drive shaft housing stud nut		
9/16×18		60
7/16×20		35
Pinion nut		175
Gear housing preload @ drive shaft		
New		30-40
Serviceable		10-20
Propeller shaft nut		35-45
Trim tab to gear housing screw	160	
MODEL II-TR		
Gear housing		
To drive shaft housing screw		50
To drive shaft housing stud nut		35
Cover, retainer spool		See Note 1
Pinion nut		150
Propeller shaft nut		35-45
Trim tab to gear housing screw	160	
MODEL II-TRS		
Gear housing		
To drive shaft housing screw		50
To drive shaft housing stud nut		35
Cover, retainer spool		See Note 2
Pinion nut		150
Propeller shaft nut		35-45
Trim tab to gear housing screw	160	

(continued)

Table 2 GEAR **HOUSING TIGHTEN** TORQUES (continued)

Fastener	in.-lb.	ft.-lb.
MODEL I-MR		
Bearing carrier retainer nut		210
Drive shaft bearing retainer		100
Gear housing		
Nuts		35
Screw		28
Pinion gear nut		60-80
Shift shaft bushing		50
Trim tab screw		23
Water pump body		
Nuts	60-90	
Screw	30-40	
<p>1. Serial No. 3788859 and below, 200 ft.-lb. Serial No. 3788880 and up, tighten cover until specified propeller shaft bearing preload is obtained.</p> <p>2. lighten cover until specified propeller shaft bearing preload is obtained.</p>		

Table 3 **I-MR** HOUSING APPLICATIONS

MerCruiser model	Serial No.
120 and 140	3780850
165	3782025
888	3784375
All others	All