DESCRIPTION AND OPERATION

This integral power steering gear (Fig. 1) is a torsion-bar type of hydraulic assisted system. The gear furnishes power to reduce turning effort at the steering wheel. It also reduces road shock and vibrations.

The torsion bar power steering unit includes a worm and one-piece rack piston, meshed to the gear teeth on the steering sector shaft. A hydraulic valve, input shaft and torsion bar assembly are mounted on the end of the worm shaft and activated by the twisting action of the torsion bar.

Because the rack-piston, worm and sector shaft are in one housing and the valve is in an attached housing (Fig. 1) fluid passes through internal passages between the valve and cylinder. The pressure and return hoses between the pump and gear assembly are the only external lines required.

The power cylinder is an integral part of the gear housing. The piston is double acting, in that fluid pressure may be applied to either side of the piston.

ADJUSTMENTS

Mesh Load

During the vehicle breaking-in period, some factory adjustments may change. These changes in adjustment will not necessarily affect operation of the steering gear assembly, and need not be adjusted unless there is excessive lash or other malfunctioning.

Adjustment In Vehicle

Adjust total over center position load, to eliminate excessive lash between the sector and rack teeth as follows. This is the only adjustment required.

1. Disconnect the Pitman arm from the sector shaft using Tool 64P-3590-F.
2. Disconnect the fluid return line at the reservoir and cap the reservoir return line pipe.
3. Place the end of the return line in a clean container and turn the steering wheel from left to right several times to discharge the fluid from the gear.
4. Turn the steering wheel to 45 degrees from the left stop.
5. Attach an in-lb. torque wrench to the steering wheel nut and determine the torque required to rotate the shaft.
slowly approximately one-eight turn from the 45 degree position.
6. Turn the steering gear back to center and determine the torque required to rotate the shaft back and forth across the center position. Loosen the adjuster nut and turn the adjuster screw (Fig. 2) until the reading is 11 to 12 in-lb greater than the torque at 45 degrees from the stop. Hold the screw in place, and tighten the lock nut.
7. Re-check torque readings and replace the Pitman arm and steering wheel hub cover.
8. Connect the fluid return line to the reservoir and fill the reservoir to specification (Part 13-01). Adjust belt tension, if necessary. **Do not pry against the reservoir to obtain proper belt load. Pressure may deform the reservoir and cause it to leak.**

**Rotary Valve Centering Check**
1. Install a 0-2000 psi pressure gauge (Tool T56L-3610-D) in the pressure line between the power steering pump outlet port and the integral steering gear inlet port. Be sure that the valve on the gauge is fully open.
2. Check the fluid level in the reservoir and add fluid if necessary.
3. Start the engine and turn the steering wheel from stop-to-stop to bring the steering lubricant to normal operating temperature. Turn off the engine and re-check the fluid level. Add fluid, if necessary.
4. With the engine running at approximately 1000 rpm and the steering wheel centered, attach an in-lb torque wrench to the steering wheel nut. Apply sufficient torque in each direction to get a gauge reading of 250 psi.
5. The torque wrench readings should be the same in both directions at 250 psi. If the difference between the readings exceeds 4 in-lb, remove the steering gear and replace the shaft and control assembly.
6. When performing the valve spool centering check outside the vehicle, use the procedures described above, except take the torque and pressure readings at the right and left stops instead of either side of center.

**NOTE:** A hissing noise is a normal characteristic of rotary valve steering gears and in no way effects steering. Do not replace the shaft and control assembly unless the hiss is EXTREMELY objectionable. A replacement valve will also exhibit slight noise, and is not always a cure for the complaint. Any metal-to-metal contacts, such as column grounding, coupling grounding, or sheet metal to steering components will transmit valve hiss noise into the passenger compartment.

The only service that can be performed on the new part is the replacement of the four valve sleeve O-rings on the valve sleeve.

**REMOVAL AND INSTALLATION**

**Removal**
Service the steering gear as follows:
1. Disconnect the pressure and return lines from the steering gear. Plug the lines and the ports in the gear to prevent entry of dirt. Disconnect brake lines from the steering gear bracket.
2. Remove the bolts that secure the flex coupling to the steering gear and to the column steering shaft assembly.
3. Raise the vehicle and remove the Pitman arm attaching nut, and washer.
4. Remove the Pitman arm from the sector shaft using Tool T64P-3900-F. Remove the tool from the Pitman arm. **Do not damage the seals.**
5. On vehicles with standard transmission remove the clutch release lever retracting spring to provide clearance for removing the steering gear.
6. Support the steering gear, and remove the steering gear attaching bolts.
7. Work the steering gear free of the flex coupling. Remove the steering gear from the vehicle.

**Installation**
1. Slide the flex coupling into place on
the steering shaft assembly. Turn the steering wheel so the spokes are in the horizontal position.

2. Center the steering gear input shaft.

3. Slide the steering gear input shaft into the flex coupling and into place on the frame side rail. Install the attaching bolts and tighten to specification.

4. Be sure the wheels are in the straight ahead position, then install the Pitman arm on the sector shaft. Install the Pitman arm attaching washer and nut. Tighten nut to specification.

5. Connect and tighten the pressure and return lines to the steering gear. Re-install the brake lines on the steering gear bracket.

6. Disconnect the coil wire. Fill the reservoir to specification (Part 13-01). Turn on the ignition and turn the steering wheel from left to right to distribute the fluid.

7. Re-check fluid level and add fluid, if necessary. Connect the coil wire, start the engine and turn the steering wheel from side to side. Inspect for fluid leaks.

**DISASSEMBLY AND ASSEMBLY**

Take the following precautions when servicing the steering gear:

1. Use a clean workbench and tools.

2. Thoroughly clean the exterior of the gear with solvent and drain off excess hydraulic fluid, if necessary.

3. Handle all parts carefully to avoid nicks, burrs, scratches and dirt.

4. Do not use solvent on seals.

**Steering Gear Disassembly**

1. Hold the steering gear upside down over a drain pan and cycle the input shaft several times to drain the fluid from the gear.

2. Secure the gear in a soft-jawed vise.

3. Remove the locknut from the adjusting screw (Fig. 1).

4. Turn the input shaft to either stop then, turn it back approximately one and three-quarter turns to center the gear.

5. Remove the sector shaft cover attaching studs, brake line bracket and identification tag.

6. Tap the lower end of the sector shaft with a soft-hammer to loosen it, and lift the cover and shaft from the housing as an assembly. Discard the O-ring.

7. Turn the sector shaft cover counterclockwise and remove it from the adjuster screw.

8. Remove the valve housing attaching bolts. Hold the piston to keep it from spinning off the shaft, and lift the valve housing off the steering gear housing. Remove the valve housing and control valve gasket. Discard the gasket.

9. Stand the valve body and piston on end with the piston end down. Rotate the input shaft counterclockwise out of the piston allowing the ball bearings to drop into the piston.

10. Place a cloth over the open end of the piston and turn it upside down to remove the balls.

11. Remove the screws that attach the ball guide clamp (Fig. 3) to the ball nut and remove the clamp and the guides.

12. Install the valve body assembly in the bench mounted holding fixture, Tool T57L-500-A, and loosen the Allen head race nut screw from the valve housing. Remove the worm bearing race nut as shown in Fig. 4.

13. Carefully slide the input shaft, worm and valve assembly out of the valve housing. Do not cock the spool or it may jam in the housing.
Steering Gear Assembly

1. Mount the valve housing in the bench mounted holding fixture, Tool T57L-500-A, with the flanged end up.
2. Apply a light coat of gear lubricant to the Teflon rings on the valve sleeve.
3. Carefully install the worm and valve in the housing.
4. Install the race nut in the housing and tighten to specification.
5. Install the Allen head race nut set screw through the valve housing and tighten to specification.
6. Place the piston on the bench with the ball guide holes facing up. Insert the worm shaft into the piston so that the first groove is in line with the hole nearest the center of the piston (Fig. 5).
7. Place the ball guide in the piston and insert 27 to 29 balls (depending on the piston design) in the ball guide (Fig. 3) while turning the worm in a clockwise direction as viewed from the input end of the shaft. If all of the balls have not been fed into the guide upon reaching the right stop, rotate the input shaft back and forth and install the remaining balls. After the balls are installed, do not rotate the input shaft or piston more than three and one-half turns from the right stop or the balls will fall out of the circuit.
8. Secure the guides in the ball nut with the clamp (Fig. 5).
9. Apply Vaseline or equivalent to the Teflon seal on the piston.
10. Place a new control valve gasket on the valve housing.
11. Slide the piston and valve into the gear housing being careful not to damage the Teflon seal.
12. Align the lube passage in the valve housing with the passage in the gear housing, and install, but do not tighten, the attaching bolts.
13. Rotate the ball nut so that the teeth are in the same plane as the sector teeth. Tighten the valve housing attaching bolts to specification.
14. Position the sector shaft cover O-ring in the steering gear housing. Turn the input shaft to center the piston.
15. Apply Vaseline or equivalent to the sector shaft journal, and position the sector shaft and cover assembly in the gear housing. Install the brake line bracket, identification tag, and sector shaft cover attaching bolts. Tighten bolts to specification.
16. Attach an in-lb torque wrench to the input shaft. Adjust mesh load to specification.

Steering Gear Housing Disassembly & Assembly

1. Remove the snap ring and spacer...
washer (Fig. 6) from the lower end of the steering gear housing.

2. Remove the lower seal from the housing as shown in Fig. 7. Lift the spacer washer from the housing.

3. Remove the upper seal as described in Step 2. Some housings will have only one seal and one spacer. Discard old seals.

4. Dip both sector shaft seals in gear lubricant.

5. Apply lubricant to the sector shaft seal bore of the housing and position the sector shaft upper seal in the housing with the lip facing inward. Press the seal into place using Tool 765P-3576-B (Fig. 8). Place an .090 inch spacer washer on top of the seal and apply more lubricant to the housing bore.

6. Place the lower seal in the housing with the lip facing inward and press it into place as shown in Fig. 9. Place an .090 inch spacer washer on top of the seal.

7. Position the snap ring in the housing and press into place to properly locate the seals. Be sure the snap ring engages in the groove.

**Valve Housing**

**Disassembly and Assembly**

1. Remove the dust seal (Fig. 10) from the rear of the valve housing using Tools T59L-100-B and T58L-101-A. Discard the seal.

2. Remove the snap ring from the valve housing.

3. Turn the bench mounted holding fixture to invert valve housing.

4. Insert Tools T65P-3624-A2 and T65P-

5. Push on back side of valve sleeve rings, insert knife blade carefully and cut ring without scratching valve sleeve.
opposite the oil seal end and gently tap the bearing and seal out of the housing as shown in Fig. 11. Discard the seal. **Do not damage the housing when inserting and removing the tools.**

5. Remove the fluid inlet and outlet tube seats with Tube Seat Remover T74P-3504-L if they are damaged.

6. Coat the fluid inlet and outlet tube seats with Vaseline or equivalent and install them in the housing with a Tube Seat Installer T74P-3504-M.

7. Coat the bearing and seal surface of the housing with a film of Vaseline or equivalent.

8. Position the bearing in the valve housing. Seat the bearing in the valve housing using Tool T65P-3524-A1 (Fig. 12). Be sure the bearing rotates freely.

9. Dip a new oil seal in gear lubricant and place it in the housing with the metal side facing outward. Drive the seal into the housing until the outer edge does not quite clear the snap ring groove (Fig. 13).

10. Place the snap ring in the housing and drive on the ring using Tool T65P-3524-A1 until the snap ring seats in its groove.

11. Place the dust seal in the housing with the dished side (rubber side) facing out. Drive the dust seal into place using Tool T65P-3524-A1. When properly installed, the seal will be located behind the undercut in the input shaft.

**Worm and Valve Sleeve Disassembly and Assembly**

1. Remove valve sleeve rings from sleeve by inserting the blade of a small pocket knife under them and cutting them off (Fig. 14).

2. Mount the worm end of the worm and valve sleeve assembly into a soft-jawed vise (Fig. 15).

3. Install mandrel Tool T75L-3517-A1 over the sleeve, slide one valve sleeve ring over the tool (Fig. 16).

4. Slide the pusher Tool T75L-3517-A2 over the mandrel; rapidly push down on the pusher tool, forcing the ring down the ramp and into the fourth groove of the valve sleeve. Repeat...
this step three more times, and each time add one of the spacers, Tool T75L-3517-A3, under the mandrel tool. By adding the spacer each time, the mandrel tool will line up with the next groove of the valve sleeve (Figs. 17 and 18).

5. After installing the four valve sleeve rings, apply a light coat of gear lubricant to the sleeve and rings.

6. Slowly install the sizing tube Tool T75L-3517-A4, over the sleeve valve end of the worm shaft onto the valve sleeve rings. Make sure that the rings are not being bent over as the tube is slid over them (Figs. 19 and 20).

7. Remove the sizing tube and check the condition of the rings. Make sure that the rings turn freely in the grooves.

8. Fig. 21 shows the complete set of tools needed to perform the above operations. The tool Kit Number for the complete set is T75L-3517-A.

**Piston and Ball Nut Disassembly and Assembly**

1. Remove the Teflon piston rings and O-ring (Fig. 3) from the piston and ball nut. Discard both rings.
2. Dip a new O-ring in gear lubricant and install it on the piston and ball nut.
3. Install a new Teflon piston ring on the piston and ball nut being careful not to stretch it any more than necessary.

**FORD INTEGRAL POWER STEERING GEAR SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Type</th>
<th>Recirc. Ball Torsion Bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio</td>
<td>17:1</td>
</tr>
<tr>
<td>Turns of Steering Wheel (Lock to Lock — Linkage Disconnected)</td>
<td>4</td>
</tr>
<tr>
<td>Fluid Capacity (included in Pump Reservoir Fill)</td>
<td>1.6 Pints (Approx.)</td>
</tr>
<tr>
<td>Fluid Specification</td>
<td>ESW-M2C128-D</td>
</tr>
<tr>
<td>Worm Bearing Preload</td>
<td>2-8 In-Lb</td>
</tr>
<tr>
<td>Total Meshload Over Mechanical Center</td>
<td>22 In-Lb (Max.)</td>
</tr>
<tr>
<td>Total Meshload Over Worm Bearing Preload</td>
<td>10-14 In-Lb</td>
</tr>
<tr>
<td>Worm to Piston Preload</td>
<td>1-3 In-Lb</td>
</tr>
</tbody>
</table>

*Not adjustable in field. Specification given for inspection purposes only.

**FORD INTEGRAL POWER STEERING GEAR TORQUE LIMITS**

<table>
<thead>
<tr>
<th>Component</th>
<th>Torque Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sector Shaft Cover Bolts</td>
<td>55-70 Ft-Lb</td>
</tr>
<tr>
<td>Mesh Load Adjusting Screw Lock Nut</td>
<td>35-45 Ft-Lb</td>
</tr>
<tr>
<td>Ball Return Guide Clamp Screw</td>
<td>42-70 In-Lb</td>
</tr>
<tr>
<td>Valve Housing to Gear Housing Bolt</td>
<td>35-50 Ft-Lb</td>
</tr>
<tr>
<td>Rack Retaining Nut</td>
<td>55-90 Ft-Lb</td>
</tr>
<tr>
<td>Set Screw Race Nut</td>
<td>15-25 In-Lb</td>
</tr>
<tr>
<td>Piston End Cap</td>
<td>70-100 Ft-Lb</td>
</tr>
<tr>
<td>Pressure Hose to Gear</td>
<td>16-25 Ft-Lb</td>
</tr>
<tr>
<td>Return Hose to Gear</td>
<td>25-34 Ft-Lb</td>
</tr>
<tr>
<td>Hose Clamps</td>
<td>1-2 Ft-Lb</td>
</tr>
<tr>
<td>Pitman Arm to Sector Shaft Nut</td>
<td>200-250 Ft-Lb</td>
</tr>
</tbody>
</table>

*Specified torque — Because the length of the tool required to torque the nut will affect the observed torque reading on the torque wrench, the torque reading should be computed using the length of the torque wrench and the nominal specified torque as follows:

\[
\text{Torque Reading} = \frac{\text{Length of Torque Wrench} \times 72 \text{ Ft-Lb}}{\text{Length of Torque Wrench} + 5.5 \text{ Inches (Using Tool T66P-3553-B)}}
\]

Example: With 13 inch torque wrench

\[
\frac{13 \text{ In.} \times 72 \text{ Ft-Lb}}{13 \text{ In.} + 5.5 \text{ In.}} = \frac{13 \text{ In.} \times 72 \text{ Ft-Lb}}{18.5 \text{ In.}} = 0.703 \times 72 \text{ Ft-Lb} = 50 \text{ Ft-Lb}
\]
### SPECIAL SERVICE TOOLS

<table>
<thead>
<tr>
<th>Tool Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T56L-33610-D</td>
<td>Pressure Testing Gauge Assembly</td>
</tr>
<tr>
<td>T64P-3590-F</td>
<td>Steering Pitman Arm Remover</td>
</tr>
<tr>
<td>T57L-500-A</td>
<td>Bench Mounted Holding Fixture</td>
</tr>
<tr>
<td>T66P-3553-C</td>
<td>Spacer</td>
</tr>
<tr>
<td>T66P-3553-B</td>
<td>Spanner Wrench</td>
</tr>
<tr>
<td>T74P-3504-L</td>
<td>Tube Seat Remover</td>
</tr>
<tr>
<td>T59L-100B</td>
<td>Slide Hammer — Short</td>
</tr>
<tr>
<td>T58L-101A</td>
<td>Puller Attachment</td>
</tr>
<tr>
<td>T65P-3524A1, A2, A3</td>
<td>Bearing Remover and Installer</td>
</tr>
<tr>
<td>T65P-3576-B</td>
<td>Sector Shaft Seal Installer</td>
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<tr>
<td>T74P-3504-M</td>
<td>Tube Seat Installer</td>
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<tr>
<td>T75L-3517-A</td>
<td>Rotary Valve Tool Kit</td>
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</tbody>
</table>

**FIG. 21** Rotary Valve Tool Kit No. T75L-3517-A