Section X

STEERING

CONTENTS

MANUAL STEERING

POWER STEERING

STEERING

DATA AND SPECIFICATIONS

MODELS	C-71	C-72	C-73	C-70
Tread—Front	60.4	60.4	61.3	61.3
Rear	59.6	59.6	60.4	60.8
Wheel Base	126.0	126.0	133.0	149.5
Camber	¼ degree + or − ⅜ degree			
	Preferred Left + ½ degree, Right 0 degree			
*Caster	−2 degree to 0 degree with Manual Steering			
	0 degree with Power Steering			
Toe-In (Outside Thread Inches)	⅛ Inch Preferred			
Toe-Out on Turns	21½ degrees + or − 1 degree (inner wheel when outer wheel is 20 degrees)			
*King Pin Inclination at Camber (Degree)	5.5 degrees at 0 degree			7 degrees at 0 degree
King Pin Diameter	.7953 in.			
King Pin Bushings (Manual Steering) Type				
Upper	Needle Type Bearing			
Lower	Bushing			
King Pin Bushings (Power Steering) Type				
Upper	Floating Bushing (Needle Type Bearing, C-73 only)			
Lower	Floating Bushing			
Dimensions of Lower Bushings				
Inside Diameter	.787 to .789 in.			
Outside Diameter	.823 to .825 in.			
Length	1.195 to 1.205 in.			
Ream After Installation	.7960 to .7975 in.			

*Any difference in caster between left and right wheels should make the left side 0 to ¾ degree more negative caster than right side.

POWER STEERING

MODELS	C-71, C-72, C-73, C-70
Fluid Capacity of Hydraulic System	2 qts.
Fluid Capacity of Worm Housing	1 pt.
Type of Fluid	Automatic Transmission Fluid Type A
Maximum Pump Pressure	750 to 800 psi.
Maximum Fluid Flow at 3,000 R.P.M.	2 gal. (Minimum)
Maximum Pump Rotor Clearances:	
Between Rotor Lobes	.008 in.
Between Outer Rotor and Bushing	.006 in.
End Clearance (Between Rotors and Face of Body)	.001 to .002 in.
Flow Control Valve Spring	
Free Length	2.13 in.
Working Length	1.20 in.
Force at Working Length	14 lbs. $\pm 1\frac{1}{2}$ lbs.
Pressure Relief Valve Spring	
Free Length	1.51 in.
Working Length	1.18 in.
Force at Working Length	30 to 33 lbs.
Front End Alignment	
Steering Gear Ratio	16.2:1
Piston Rod Snap Ring Gap (upper and lower)	$\frac{25}{64}$ in.

SPECIAL TOOLS

MANUAL STEERING

Tool Number	Tool Name
C-328	King Pin Bushing Remover and Installer Puller
C-3394	Tie Rod End Remover
C-3402	Pitman Arm Puller
C-3428	Steering Wheel Puller
C-369	King Pin Bushing Reamer (.7950 inch)
C-379	King Pin Bushing Reamer (.9375 inch)
C-630	King Pin Bushing Reamer Pilot
C-631	King Pin Bushing Reamer Pilot

POWER STEERING

Tool Number	Tool Name
C-3102	Checking Gauge—Power Steering Gear
C-3128	Pliers—Snap Ring
C-3185	Puller—Pump Cover Bushing
C-3211	Hose—High Pressure
C-3214	Puller—Oil Pump Body Babbitt Bushing
C-3227	Wrench—Flange Holding
C-3228	Thimble—Pump Shaft Installing
C-3229	Pliers—Gear Shaft Adjusting Screw Snap Ring
C-3230	Driver—Pump Shaft Oil Seal
C-3233	Driver—Pump Shaft Bushing
C-3234	Puller Adapter for C-3214
C-3251	Driver—Babbitt Bushing

POWER STEERING (Continued)

Tool Number	Tool Name
C-3309	Gauge—Pressure Check
C-3318	Hose—Low Pressure
C-3319	Adjusting Nut—Worm Shaft Bearing
C-3320	Nut Wrench—Worm Shaft
C-3321	Holding Spanner—Worm Connector
C-3322	Removing and Installing—Worm Bearing
C-3323	Fixture—Holding
C-3326	Nut Spanner—Worm Connector
C-3328	Nut Spanner—Upper Piston Rod
C-3333	Driver—Gearshaft Bearing
C-3344	Installing—Piston and Ring
C-3350	Remover and Installer—Gear Shaft Seal
C-3392	Wedge—Coupling Removing
C-3393	Thimble—Valve Control Spacer Seal Installing
C-3395	Installer—Piston Rod Seal and Housing Head Seal
C-3401	Thimble—Gear Shaft Adjusting Screw "O" Ring Installing
C-3428	Puller—Steering Wheel
C-3437	Protector—Lower Piston Rod Seal
C-3445	Rod—Control Valve Centering
C-3450	Seal Remover—Upper Piston Rod
C-3469	Flange—Oil Leak Testing
C-3482	Bracket—Steering Pump Body Holding (Vane Type)
C-3486	Driver—Steering Pump Shaft Seal
C-625-75	Puller—Gear Shaft Bearing
C-760	Pliers—End Plug Retainer Snap Ring

TIGHTENING REFERENCE

MANUAL STEERING

	Foot-Pounds
Steering Gear to Frame Bolt	50
Steering Gear Pitman Arm Nut	125
Steering Wheel Nut	40
Steering Knuckle Tie Rod Clamp Bolt	15
Steering Knuckle Tie Rod End Ball Nut	75

POWER STEERING

	Thread Size	Foot-Pounds
Hose Fitting Nut	7/16 x 20	*3/8 to 5/8 Turn or 12 to 18
Hose Fitting Nut	5/8 x 18	*3/8 to 5/8 Turn or 25 to 30
Pump to Generator Bolt	5/16 x 18	17
Reservoir to Pump Bolt	1/4 x 20	12
Steering Gear Arm Attaching Bolt	5/8 x 18	120
Steering Gear Housing to Bracket Bolt	9/16 x 12	75
Steering Gear Bracket to Frame Bolt	7/16 x 20	56
Pump on Generator Coupling Flange Lock Screw	1/4 x 20	15
Pump Body to Cover Bolts	—	35
Steering Gear Arm to Shaft Nut	—	125
Steering Arm to Drag Link Nut	—	55
Steering Wheel to Steering Shaft Nut	—	40
Shroud to Instrument Panel Screws	—	20
Tie Rod Clamp Bolts	—	15
Tie Rod to Steering Knuckle Arm Nuts	—	75

TIGHTENING REFERENCE

POWER STEERING (Continued)

	Thread Size	Foot-Pounds
Pump Flow Control and Relief Valve Adapter (Retaining)	—	50
Pump Coupling Flange Attaching Screw	—	15
Upper Piston Rod Nut	—	30
Gear Shaft Cover Screws	—	30
Ball Guide Clamp Screws	—	12
Worm Housing to Gear Housing Screws	—	30
Gear Shaft Adjusting Screw Lock Nut	—	40

*The number of turns specified in tightening tube fittings and hose fittings is after initial finger tightening.

RESERVOIR

	Thread Size	Foot-Pounds
Reservoir Cover Bolt	5/16 x 24	8
Relief Valve Assembly Cap	1 x 8	8
Hose Connector Inlet	5/8 x 18	30

PUMP

	Thread Size	Foot-Pounds
Pump Assembly Bolt	5/16 x 18	20
Hose Connector Outlet	5/8 x 18	30
By-Pass Plug	3/4 x 16	50
Relief Valve Plug	1 x 14	50
Flow Divider Valve Plug	1 1/4 x 12	50

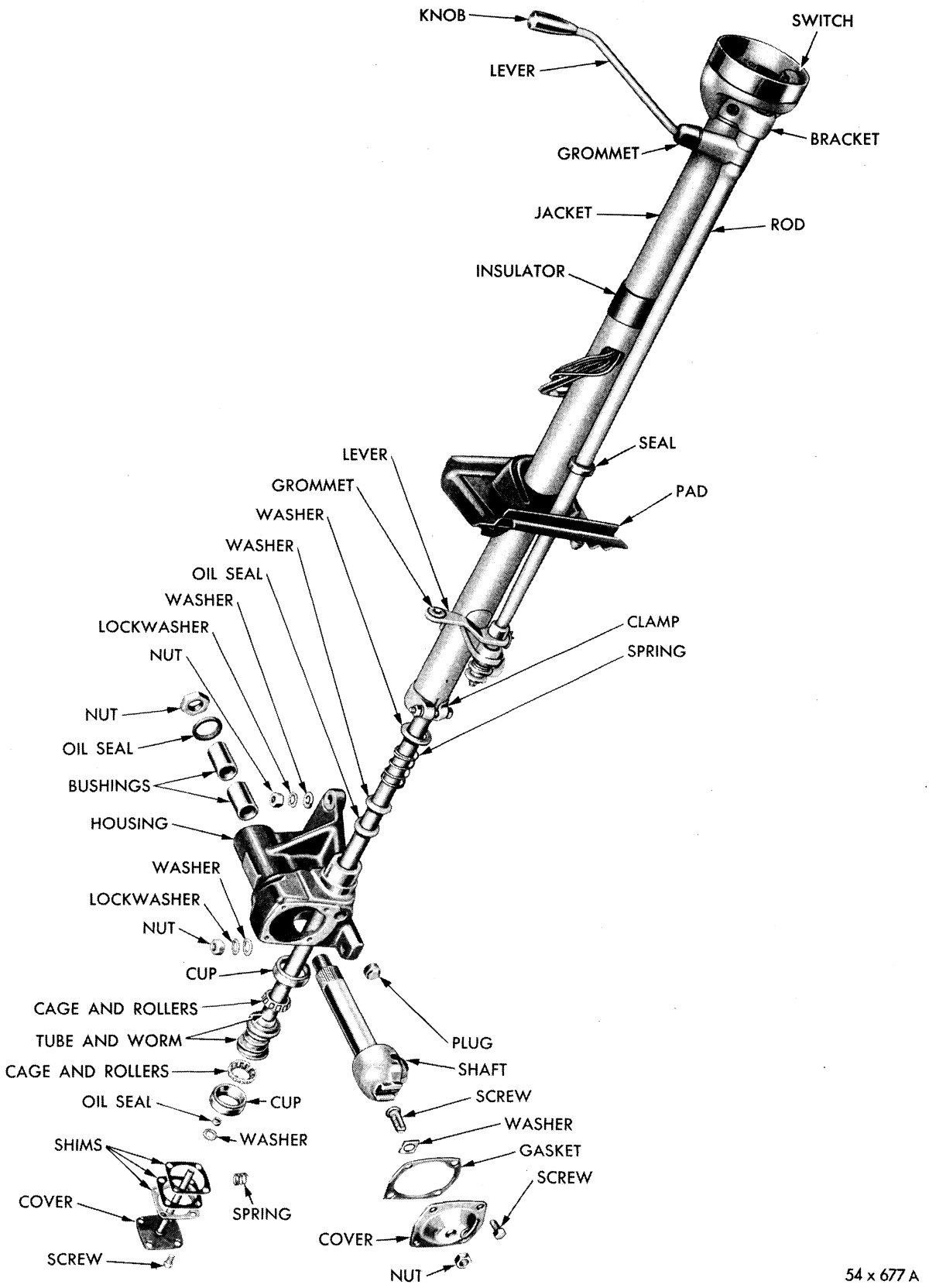

Fig. 1.—Typical Steering Gear (Exploded View)

Section X
STEERING
MECHANICAL

1. STEERING GEAR (Fig. 1)

A three-tooth roller is mounted on needle roller bearings on a steel cross shaft inserted through the steering gear shaft.

The worm is integral with the steering tube and is supported at each end by tapered roller bearings. The worm bearing pre-load is adjusted by means of shims placed between housing and housing end cover. The steering gear shaft rotates in two bronze bushings pressed into the steering gear housing. The three-tooth roller on shaft is meshed with worm. When the steering wheel is turned, the worm rotates the steering gear shaft and roller, moving the steering gear arm, which is splined to end of shaft and held in place with a nut.

Backlash between steering gear shaft roller tooth and worm is controlled by an adjusting screw that is threaded through shaft and roller cover. The base end of adjusting screw is engaged in a slot in end of the steering gear shaft. Correct backlash can be obtained by turning adjusting screw in or out, as required.

The steering wheel and arm are splined to the steering tube and steering gear shaft, respectively. Both steering wheel and steering gear arm have master serrations to insure correct installation.

The high point is the point of least clearance between the worm and roller and is at midpoint of worm and roller travel.

An oil seal is installed in bore of steering gear housing at outer end of shaft to prevent oil leakage and to keep foreign material from entering the steering unit.

2. REMOVAL OF STEERING WHEEL ASSEMBLY

Disconnect battery and center steering wheel in the straight-ahead position. Press down on horn blowing ring ornament and turn counterclockwise. Lift out ornament retaining spring and pad. Disconnect horn wire from terminal on travel plate and insulator assembly. Remove bushing, travel plate, horn blowing contact ring spring, and triangular ground plate. Curl and push horn wire into steering gear tube to make room for steering wheel puller pilot. Remove steering wheel nut. Attach puller and remove steering wheel.

3. REMOVAL OF STEERING GEAR ASSEMBLY

It is not necessary to remove the complete steering column and mast assembly from car for servicing the gear chuck and worm shaft. Disconnect battery, press down on horn ring ornament while rotating it, and remove ornament. Remove steering column worm shaft nut. Pull steering wheel with puller. Loosen jacket bracket bolts at instrument panel. Remove dust pad retaining screws. Raise front of car and remove steering gear arm from gear shaft. Loosen jacket to gear chuck clamp bolt. Remove gear chuck to frame attaching bolts and work gear chuck and shaft assembly out of jacket. Remove assembly from lower side of car.

4. DISASSEMBLY OF STEERING GEAR — (Unit Removed from Car)

Drain lubricant from steering gear housing. Mount gear assembly in a suitable bench vise, holding assembly by the housing to chassis mounting flange, with steering column in the horizontal position. Remove shaft cover attaching cap screws, cover, gasket and steering gear shaft, and roller tooth assembly.

Loosen column jacket clamp bolt, pry open clamp and remove column jacket from steering housing. Remove steering worm, lower oil seal housing cover bolts, cover and shims. Pull steering tube and worm assembly bearing cups and bearing cages out of lower end of steering housing.

Clean steering gear housing shaft, bearings and other parts thoroughly with a suitable

cleaning solvent. Inspect roller tooth shaft, shaft serrations, bearings, bearing cups, oil seals, worm and tube for wear, nicks and flat spots. Replace with new parts as necessary.

Remove roller tooth assembly shaft cover adjusting screw nut and locking plate. Check adjusting screw threads in cover and on adjusting screw. Replace if necessary.

5. ASSEMBLY OF STEERING GEAR — (Unit Removed from Car)

NOTE

When the steering gear assembly is disassembled, it is advisable to install new seals and gaskets to insure against oil leaks.

If either of worm thrust tapered roller bearings are damaged, it is advisable to replace both bearings. After thoroughly cleaning all parts, assemble parts without any lubrication. Lubrication should be done after adjustments have been completed. If bushings or needle bearings have been removed, press new bushings or needle bearings into place. Use new oil seals.

Insert worm and tube into housing with bearings and cups in proper order, as shown in Figure 2. Install shims and lower housing cover, making sure that bearings are seated in cups before tightening screws. Tighten cover screws evenly, turning worm tube at intervals to be sure no bind occurs. Final tightening of screws should cause end play to just disappear with torque required to rotate wheel ⅜ to ¾ of a pound, when measured with pull applied at rim of wheel. If bind in rotation of tube occurs when cover screws are fully tightened, it will be necessary to add shim thickness until bind just disappears. If end play is present after final tightening, less shim thickness is required. Shims are available in .003, .006, .011 and .025 inch. By using a micrometer to measure shims, the proper combination can be chosen.

(Refer to Figs. 1 and 2.) Install roller shaft bearing in housing. Before installing cover, turn adjusting screw all the way out (counterclockwise). When roller shaft assembly is completely installed, with exception of steering gear arm, adjust as follows:

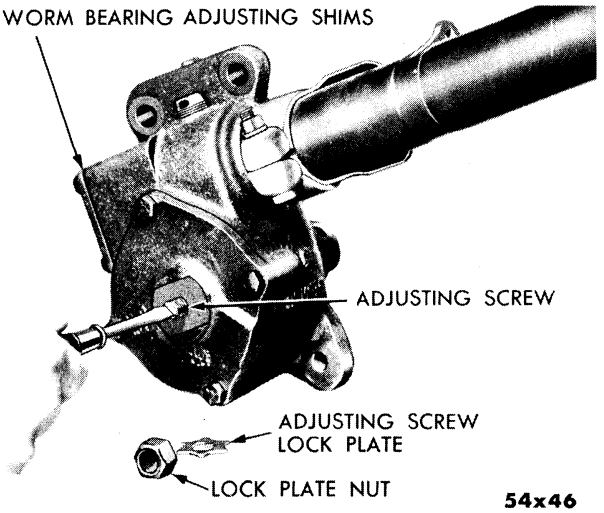

Fig. 2—Steering Gear Adjustments

Place steering wheel on tube and rotate wheel in either direction to end of its travel. Rotate in opposite direction to end of travel while counting the turns. Rotate the wheel back ½ the full number of turns. This is center of travel (mid-travel or high point). Turn adjusting screw in (clockwise) until all end play in roller shaft disappears. Roll wheel back and forth several times. There should be no bind. Rotate wheel to one of ends of travel and apply a spring scale or torque wrench. With pull applied at rim of wheel, tension should measure from one to two pounds. Rotate wheel back to center and on past center position. The greatest tension should be felt as wheel is rotated through center position. Adjust bearing load by turning adjusting screw in or out of cover, as required. Install lockplate, nut, and steering gear arm. Fill gear housing with SAE 90 Fluid Gear Lubricant. Rotate wheel back and forth through its full travel several times to be sure all parts are fully lubricated and check for leaks.

6. ADJUSTING WORM BEARINGS (In Car)

Rotate steering wheel to extreme right or left and turn back ¼ turn. Press finger at joint between bottom of steering wheel hub and shell. Have another mechanic shake front wheels hard sideways, but not enough to turn steering wheel. Any end play in worm bearings can be felt at steering wheel hub. There should be no end play at hub. End play should not be confused with clearance between roller and worm. If any excessive end play exists,

remove steering gear arm, drain housing, and disconnect horn wire at connector between steering gear and horn.

Remove cap screws which hold grease retainer cover at bottom of steering gear housing. Remove shims of sufficient thickness between this cover and housing to eliminate end play in worm, but not enough to cause binding when cover is bolted tightly in place. Turn steering wheel from extreme right to left. If any stiffness exists, too many shims have been removed, or steering gear assembly is misaligned on car.

7. INSTALLATION AND ALIGNMENT OF STEERING GEAR ASSEMBLY

a. Installation

Raise front of car, insert worm shaft into jacket and move gear chuck assembly up into position.

It may be necessary for an assistant to guide top of worm shaft through upper jacket alignment bearing. Install gear chuck to bracket attaching bolts and tighten forward bolt to a snug fit. Lower car to floor. Center jacket in instrument panel and tighten bracket bolts. Install and tighten dust pad retaining screws. Install steering wheel horn ring and ornament. Raise front of car. Tighten attaching bolts. Install steering gear arm and tighten nut.

b. Alignment (All Models)

A slight bind of steering gear is sometimes caused by shifting of body due to loosened bolts. If this condition occurs, body bolts should first be tightened. Then, the steering gear should be loosened at frame, frame bracket and dash bracket, and allowed to seek its natural position. Position center of steering column in center of instrument cluster. If this cannot be accomplished by shifting of bracket, as provided for by oversize and elongated mounting screw holes, it will be necessary to add metal washer shims between frame and frame bracket. Tighten dash bracket and tighten steering gear to frame.

NOTE

Be sure body to frame bolts are tight and spacers are in place. With body bolts tight, loosen gear housing mounting bolts to allow steering gear to move in relation to frame. Tighten mounting bolts to 50 foot-pounds torque. Loosen steering column bolts that hold column to instrument panel to determine if column shifts its position in relation to support.

8. ADJUSTMENT OF ROLLER TOOTH AND WORM (In Car)

End play of steering arm shaft and mesh of roller tooth with steering worm may be adjusted as follows:

Remove steering gear arm from shaft and install another arm for making adjustments. Turn steering wheel to mid-position, attempt to move steering gear arm back and forth to determine whether or not there is any backlash. There should be **no** backlash. But if backlash exists, the roller tooth and worm should be adjusted.

Remove roller tooth shaft adjustment screw lock nut. Slide off lock plate far enough to clear lock boss on roller tooth shaft cover. Tighten roller tooth shaft adjusting screw (Fig. 2) enough to eliminate free play between roller tooth shaft and worm; **but, it must not bind.** Slide lock plate in position against roller tooth shaft cover and lock it. Install and tighten roller tooth shaft adjustment screw lock nut. Check steering gear operation again for binding and backlash. Correct any inaccuracies in adjustments. Install steering gear arm with tie rods.

9. SERVICING IDLER ARM

Service of idler arm is restricted to replacement and adjustment. When replacing idler arm, disconnect relay rod (center link) from idler arm. Remove bracket attaching screws from bracket and frame and remove idler assembly. Screw new idler arm into bracket until shoulder on arm contacts face of bracket. Turn arm out of bracket one complete turn. It may be necessary to rotate arm slightly to line up bracket for installing attaching bolts.

POWER STEERING

10. DESCRIPTION

The Power Steering Unit (Fig. 3) incorporates two basic gear mechanisms, a worm and worm connector, and rack and sector gear.

The hydraulic system of power steering gear consists of a double-acting piston, a valve (which fits inside the piston), and hydraulic reaction chamber (which gives driver "feel" of road). Axial positioning of valve directs high pressure oil to one side or the other of double-acting piston.

Other components of hydraulic system are a generator-driven oil pump with pressure relief valve and flow control valve, filter and an oil reservoir.

SERVICE PROCEDURES

11. REMOVAL OF POWER STEERING GEAR COLUMN JACKET

Remove steering wheel ornament and steering wheel. Remove directional signal switch operating arm (arm is threaded into signal switch) and loosen two screws attaching directional switch to jacket tube.

Remove two screws attaching jacket tube housing shroud at instrument panel, disengage shroud at rubber retainer at floor, and remove shroud. Remove two Phillips head screws at steering post bracket clamp at instrument panel.

Disconnect direction indicator wires and horn wire at Wade connectors below instrument panel. Loosen two screws and nuts at steering gear housing jack at lower clamp. Grasp column jack at upper end and, while carefully turning assembly clockwise, pull upward to remove column jack assembly.

12. INSTALLATION OF POWER STEERING GEAR COLUMN JACKET

Install column jacket over steering column tube and position jacket over the power steering gear housing. Be sure rubber sleeve is in posi-

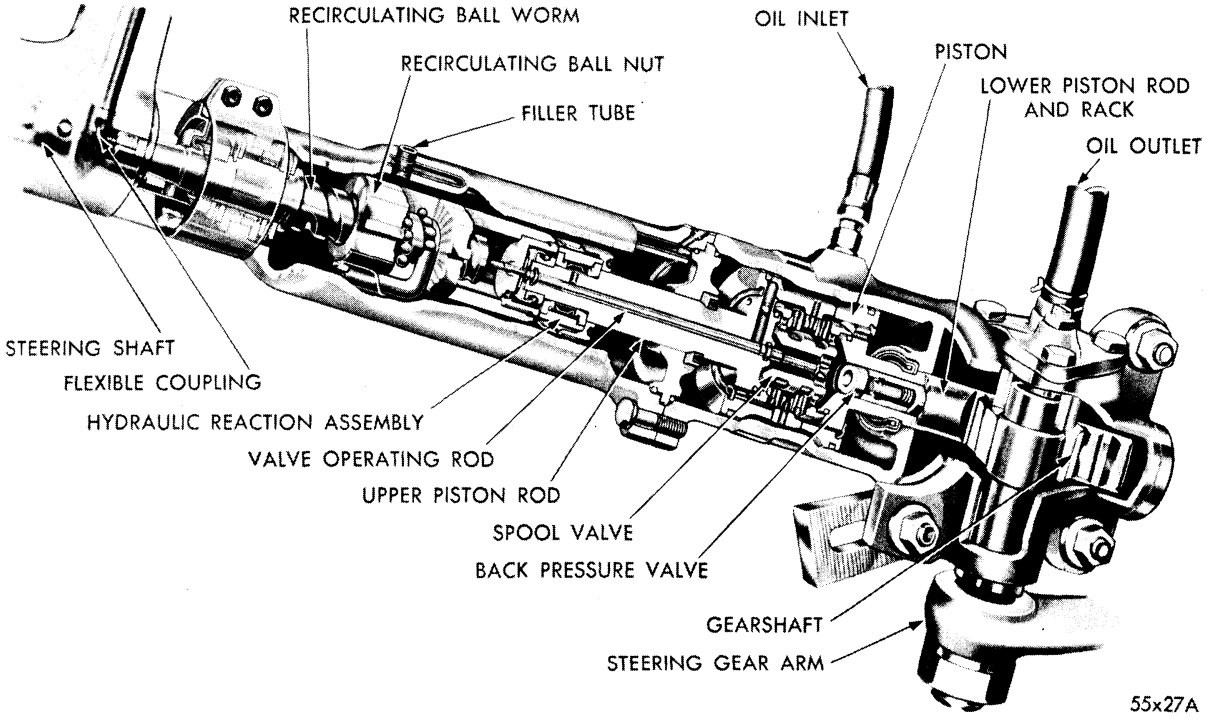

Fig. 3—Power Steering Gear (Cross Sectional View)

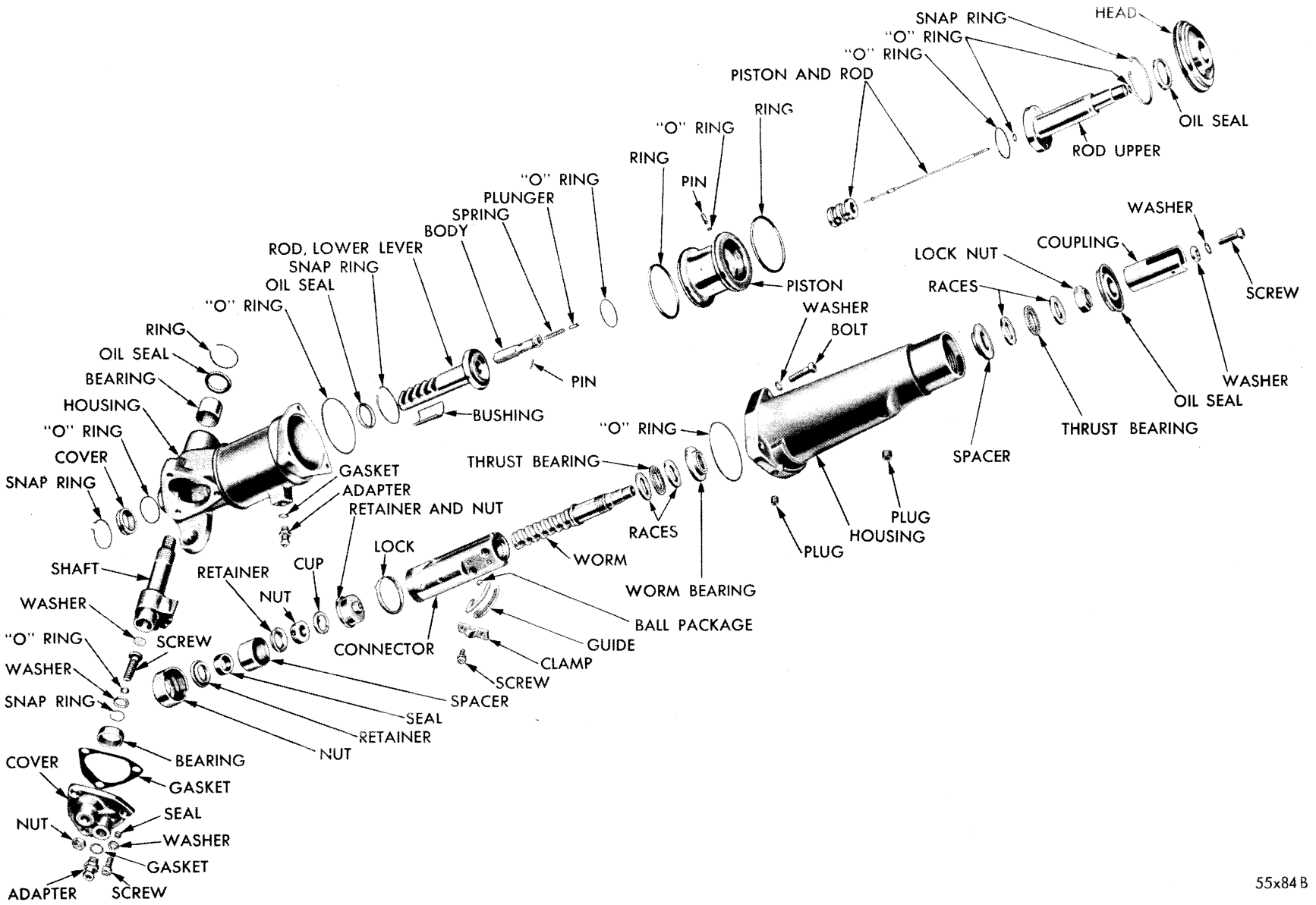

Fig. 4—Power Steering Unit (Disassembled)

tion before installing steering post bracket clamp on instrument panel. Do not tighten clamp bolts at this time.

Connect direction indicator wires and horn wire at Wade connectors, and install junction block into retaining clip below instrument panel.

Position directional switch over column tube and tighten two switch attaching screws. Install switch operating arm.

With front wheels in straight-ahead position, install steering wheel and steering wheel nut. Tighten nut 40 foot-pounds torque.

NOTE

Check to make certain that cancelling dogs on steering wheel actuate the directional switch. Move column jacket up or down to obtain proper steering wheel to column jacket clearances and for proper operation of directional switch.

With steering wheel positioned, tighten clamp bolts at power steering housing and screws at instrument panel bracket clamp.

Install horn button ground plate with three lockwashers and screws. Install horn contact travel plate, horn ring, three rubber bushings, screws and washers. Connect horn wire at travel plate and install steering wheel ornament.

Install steering gear column jacket shroud by engaging lower end in rubber grommet at floor panel and installing two screws and nuts at instrument panel.

13. REMOVAL OF POWER STEERING UNIT FROM CAR

Remove horn ring ornament from steering wheel. Disconnect horn wire and remove horn ring. Remove steering wheel with puller and remove turn signal lever and plate. Loosen steering column to instrument panel bracket.

Loosen steering column jacket clamp screws. Remove floor mat retaining plate and rubber dust pad. Raise front of car. Disengage drag link from steering gear arm and pull steering gear arm with Tool C-3402. Loosen three gear housing to frame attaching bolts. Disconnect pressure and return hoses. Drain gear assembly by slowly rotating steering wheel until all

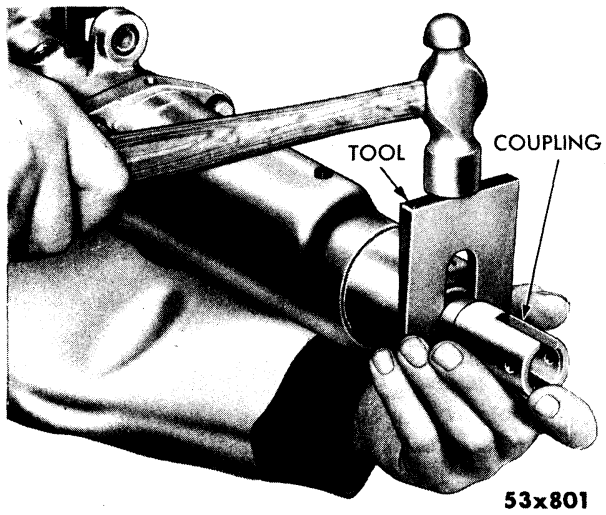

Fig. 5—Removing Coupling (Tool C-3392)

oil is expelled from unit. Fasten disconnected ends of hoses above oil level in reservoir to prevent further loss of oil, and cap ends to prevent any foreign matter from entering. Remove gear housing to frame attaching bolts and alignment wedge. Remove gear assembly from under side of car.

14. DISASSEMBLING THE POWER STEERING UNIT (FIG. 4)

a. Precautions to Follow During Disassembly and Assembly

Cleanliness is absolutely essential. The unit should be thoroughly cleaned when removed from vehicle.

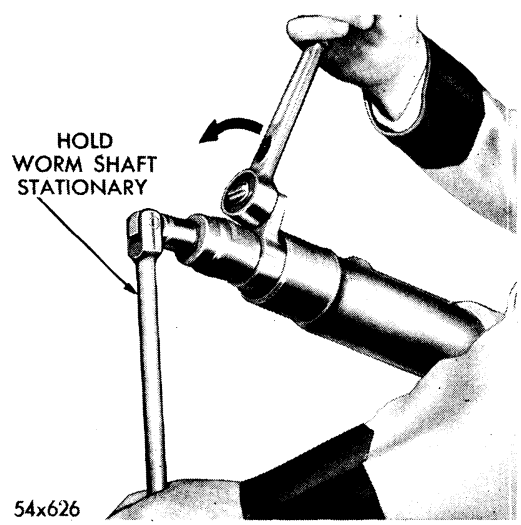

Fig. 6—Removing or Installing Bearing Adjusting Nut (Tools C-3320 and C-3319)

When disassembling, each part should be placed in solvent, washed, and dried by compressed air. Handle parts carefully to avoid nicks and burrs. Crocus cloth may be used to remove small nicks and burrs, provided it is used carefully. When used on valve spool, use extreme care not to round off the sharp edge portion. Replace all "O" rings and seals with new parts.

b. Removal of Worm Housing from Gear Housing

Drain lower portion of steering gear through pressure and return connections by turning steering tube coupling from one extreme of travel to other. Using a 3/16 inch Allen wrench, remove worm housing filler plug and drain worm (upper) housing. Attach holding fixture to unit and place in vise. Use concave type washers when mounting steering housing on tool. Remove tube coupling screw, lockwasher, and washer from center of coupling. Remove coupling from worm shaft, as shown in Figure 5.

Remove oil seal from worm housing. **Do not damage housing when removing seal.** Unlock bearing adjusting nut by bending tang of lockwasher (only one tang locks nut in position). Place tools over worm shaft, as shown in Figure 6. Holding worm stationary with special splined nut and wrench, remove worm bearing adjusting nut, lockwasher and thrust washer. **The worm bearing adjusting nut is tapered on bearing side.** Remove worm outer bearing race and bearing roller from worm. Remove worm housing (three screws and concave washers).

It may be necessary to tap housing lightly due to interference fit with "O" ring seal between housing head and housing. The concave side of washers fit against housing. Use care to avoid dropping inner bearing during this operation. Remove lower bearing roller from housing. Inspect bearing roller and upper and lower bearing cups in housing. Do not remove bearing cups unless inspection reveals it is necessary. Use Tool C-3322 to remove upper and lower bearing cups, as shown in Figure 7.

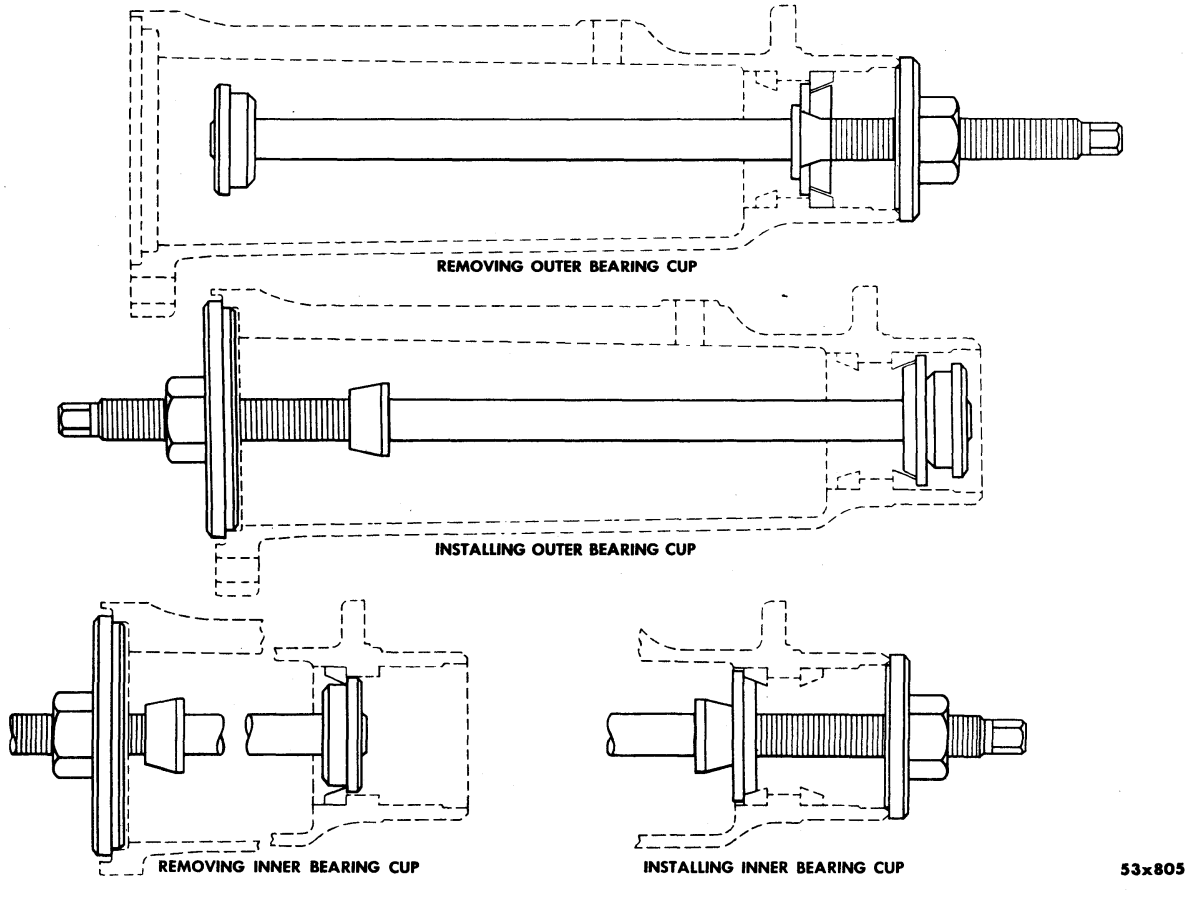

Fig. 7—Removing or Installing Upper and Lower Bearing Cups (Tool C-3322)

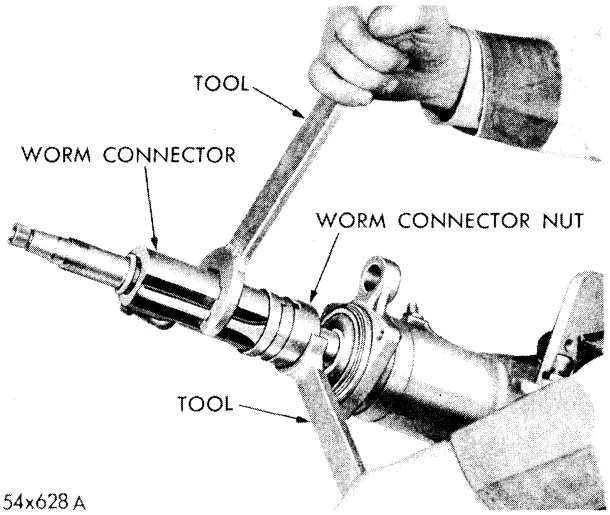

Fig. 8—Removing or Installing Worm Connector Nut (Tools C-3321 and C-3326)

c. Removal of Worn Connector

Remove housing head "O" ring. Unlock worm connector nut lock and slide lock back sufficiently to loosen worm connector nut. With Tool C-3321 attached to worm connector, remove connector nut, (Fig. 8). **It may be necessary to rotate steering gear shaft (by installing steering gear arm) to raise worm connector in order to permit installation of Tool C-3326.** Slide worm connector assembly from valve control spacer.

d. Disassembly of Worm Connector Assembly

Disassembly of worm connector and worm shaft assembly is not recommended unless damaged or worn. If disassembly is required, proceed as follows:

CAUTION

Do not bottom worm shaft in outward direction upon disassembly or assembly. Bottoming worm shaft may damage ball guides and cause a tight and rough operating worm.

Remove worm connector ball guide clamp screws and lockwashers. Remove guide clamp (Fig. 9). Using care to avoid losing any worm balls, carefully remove ball guide from worm connector. Worm balls are a select fit with each other. If any are damaged and require replacing, it is recommended that a complete set (40 balls) be installed.

Turn worm connector assembly over. Carefully thread remaining worm balls out of worm

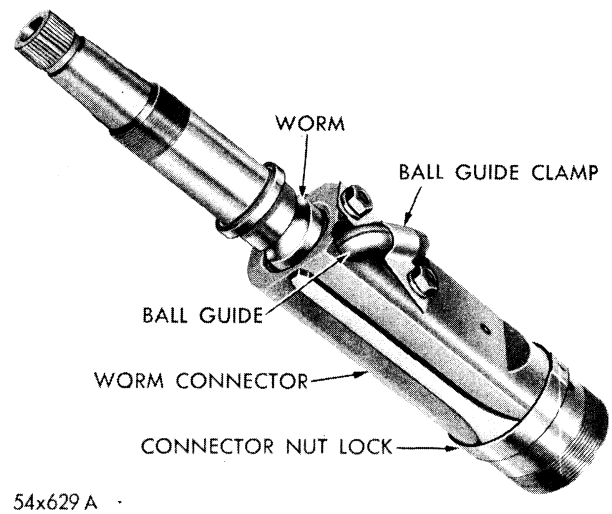

Fig. 9—Ball Guide and Guide Clamp

connector by turning worm in and out. Count worm balls which were removed (there should be 40 balls). Remove worm from connector and slide connector nut lock from connector. Inspect guide rails on connector for nicks and burrs.

e. Disassembly of Gear Housing

Remove steering gear shaft lock ring. Slide threaded portion of Tool C-3350 over steering shaft and screw it tightly into seal. To do this, install tool nut on steering gear shaft and force threaded portion of tool into seal. Install two half collars to lock tool together and install the half collar retaining ring (Fig. 10). Turn outer nut, holding inner tool nut, to pull seal out of housing.

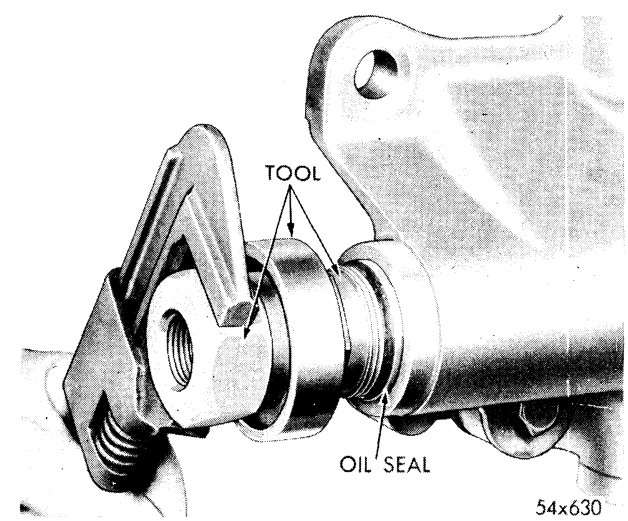

Fig. 10—Removing Gear Shaft Oil Seal with Tool C-3350

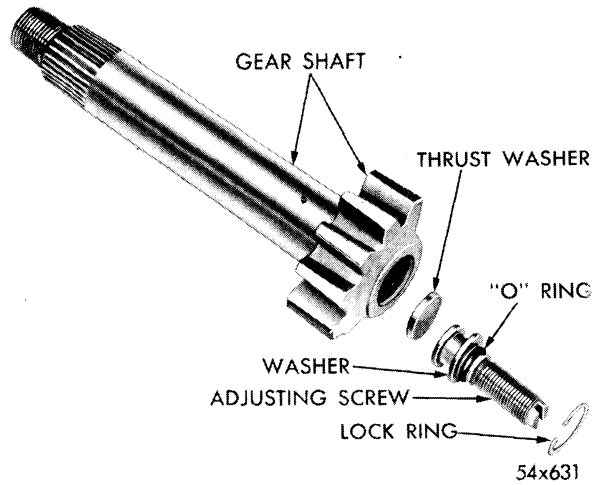

Fig. 11—Gear Shaft Adjusting Screw Assembly

Remove lock nut from shaft adjusting screw. Remove three screws from cover. Remove steering gear shaft cover from housing by turning adjusting screw **in.** Remove steering gear shaft assembly from gear housing by tapping it lightly with a fiber hammer. **Align gear on gearshaft to clear opening in lower housing before attempting removal.** Removal of adjusting screw is not necessary unless screw is damaged. Remove screw as follows:

Remove adjusting screw retainer snap ring with Tool C-3229. Remove adjusting screw, thrust washer and washer from steering gear shaft (Fig. 11). Remove adjusting screw "O" ring. Inspect bearing surface on shaft for pitting or scoring. Inspect condition of teeth on shaft. Place suitable container under housing

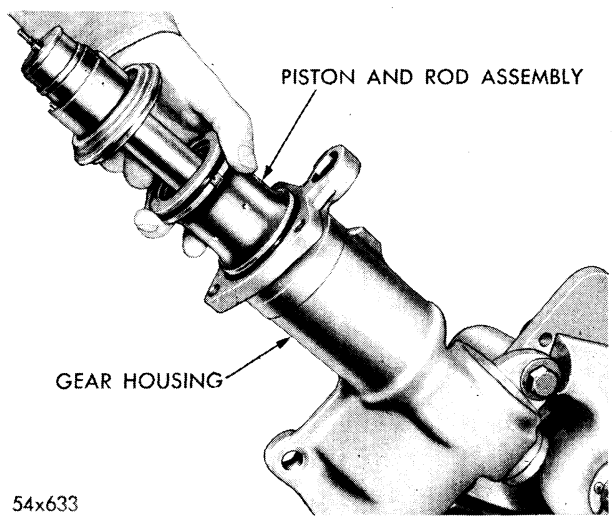

Fig. 12—Removing and Installing Piston and Rod Assembly (Typical View)

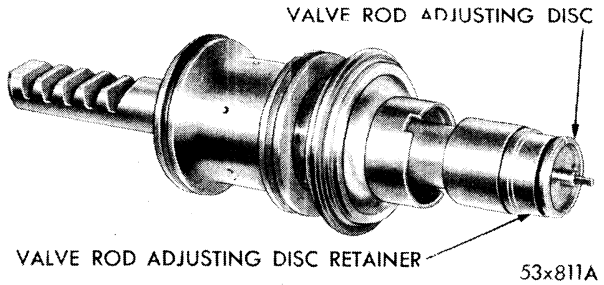

Fig. 13—Removing Valve Rod Adjusting Disc

assembly to catch trapped oil and slide piston and rod assembly from gear housing (Fig. 12).

NOTE

Use care in handling parts to avoid damaging the sealing surfaces on housing head.

f. Disassembly of Piston and Rods

Remove valve rod adjusting disc from valve rod (Fig. 13). **Do not damage disc or retainer.** Slide valve rod adjusting disc retainer from upper piston rod. Remove upper piston rod nut lock cap and upper piston rod nut with Tool C-3328 (Fig. 14).

Slide valve control spacer assembly from upper piston rod (Fig. 15), and remove spacer seal retainers from valve control spacer. Remove worm connector nut from upper piston rod. Slide housing head off upper piston rod (Fig. 16). Remove housing head "O" ring. Remove upper piston rod seal (lip type) from housing head. Remove the "D" type (neoprene)

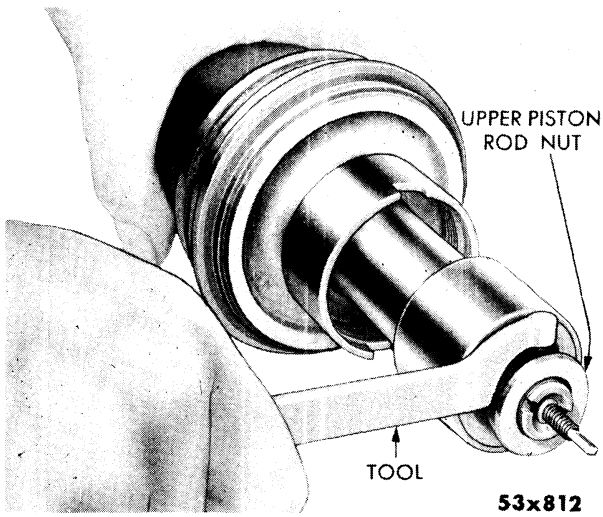

Fig. 14—Removing Upper Piston Rod Nut with Tool C-3328

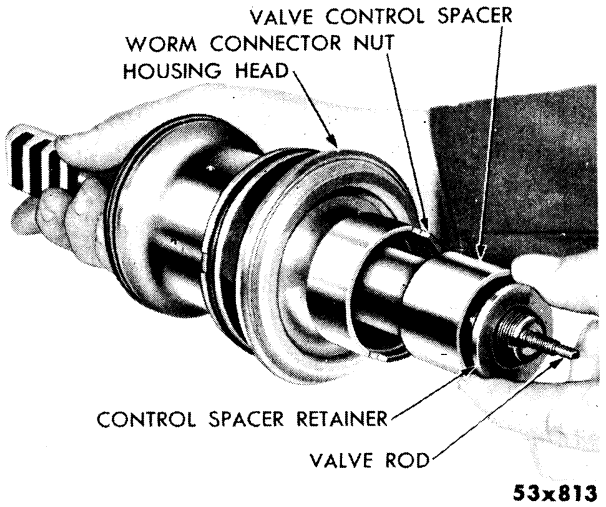

Fig. 15—Removing Valve Control Spacer Seal Assembly and Seal Retainer

piston rings from piston. With snap ring pliers, remove lower piston rod snap ring and slide lower piston rod from piston.

Use care not to bend valve piston rod and slide valve assembly from piston assembly (Fig. 17). Using a ¼ inch straight punch, drive piston pin into upper piston rod flange, as shown in Figure 18.

Use snap ring pliers and remove upper piston rod snap ring. Note position and construction of snap ring.

Remove upper piston rod from piston, as shown in Figure 19. Using a wire hook, remove piston pin and "O" ring from piston rod (Fig. 20). Make sure oil passage is open. Inspect sealing surface on piston rod for being scored. Remove two small valve rod "O" rings from bore of upper piston rod (one in each end). Remove large upper piston rod "O" ring.

Remove lower piston rod "O" ring. Inspect rack teeth and sealing surfaces on lower piston rod.

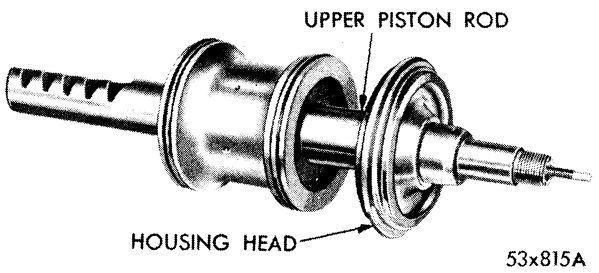

Fig. 16—Removing and Installing Housing Head

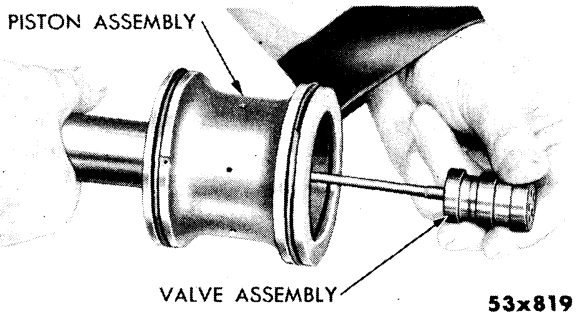

Fig. 17—Removing or Installing Valve Piston Rod

g. Removal of Relief Valve Assembly

Thread a $\frac{5}{16}$ inch 24 UNF bolt into threads provided in plug (Fig. 21). Clamp bolt head in vise and pull on lower piston rod to remove plug. Should end plug be seized in rod, a fiber hammer may be used to tap on retaining flange of lower piston rod. Inspect piston for nicks and burrs and make sure all oil passages are open and free from dirt.

h. Disassembly of Steering Gear Housing

Inspect steering gear shaft needle bearing in gear housing for broken or rough needles. If it is necessary to remove needle bearing, use puller Tool C-3333 (Fig. 22).

Use snap ring pliers to remove gear housing cover snap ring (tapered) at bottom of housing. Remove housing cover and remove "O"

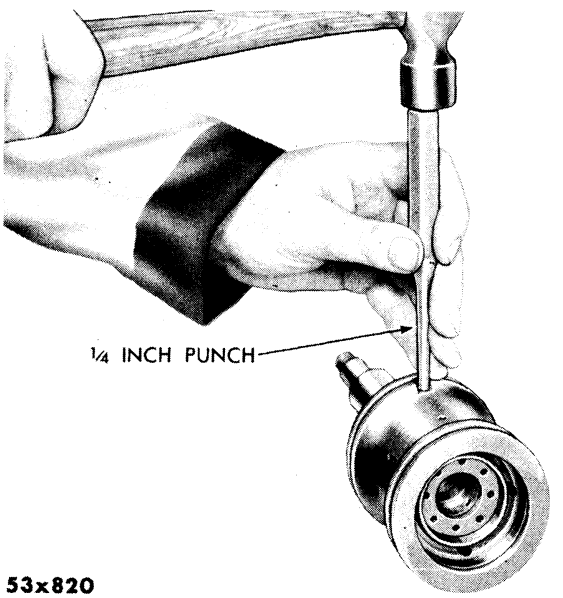

Fig. 18—Removing Piston Pin

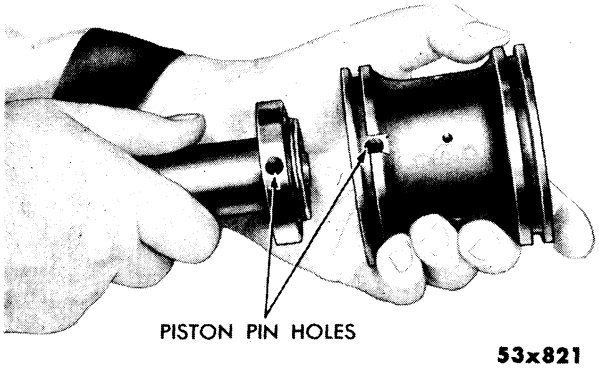

Fig. 19—Removing Upper Piston Rod

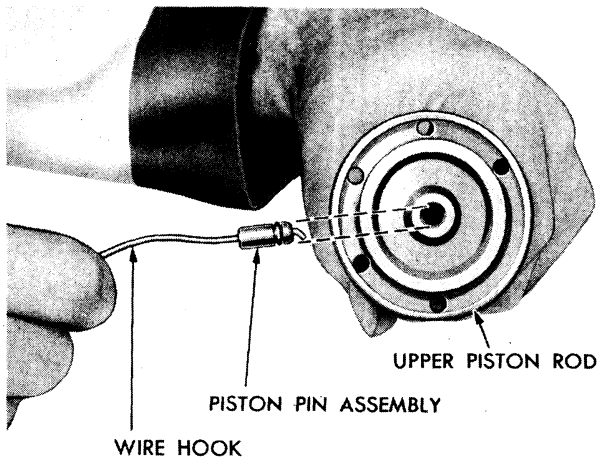

Fig. 20—Removing Piston Pin from Upper Piston Rod

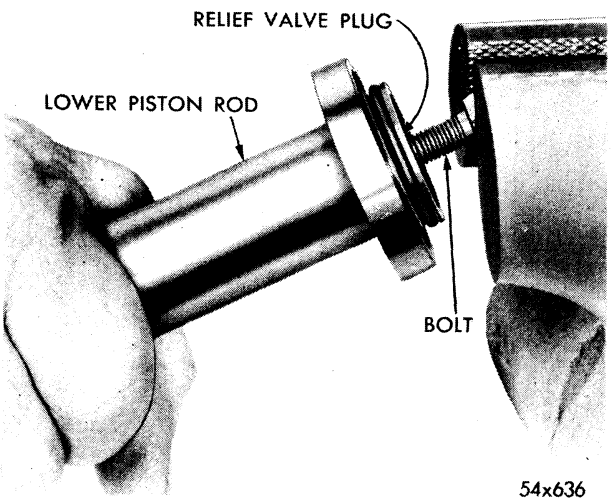

Fig. 21—Removing Lower Piston Rod Relief Valve Plug

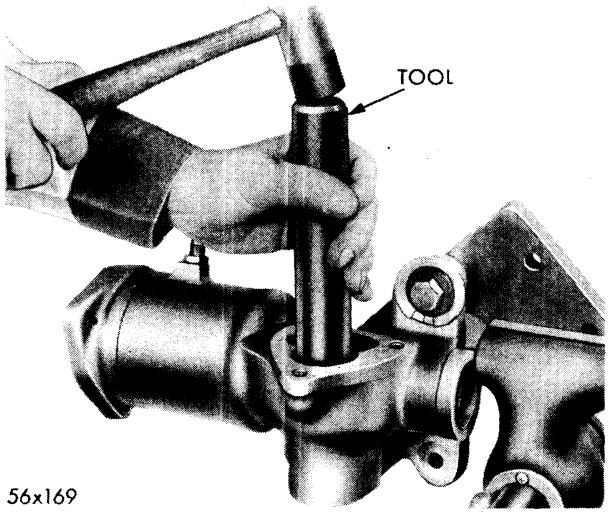

Fig. 22—Removing Gear Shaft Bearing with Tool C-3333

ring from housing. Use extreme care when removing lower plugs to prevent cocking. A cocked plug can result in broken gear housing.

Inspect bearing in gear shaft cover. If bearing rollers are rough or broken, replace cover and bearing assembly. Remove lower piston rod seal (lip type) from housing with Tool C-3450 (Fig. 23). The lower rod is supported by a half bushing. The bushing is friction fit over a dowel pin.

15. ASSEMBLING THE POWER STEERING GEAR

a. Assembly of Power Steering Gear Housing

Place new piston rod seal over driver, Tool C-3395 so that lip will be facing up or to inside of cylinder when installed. Insert seal aligning pilot of tool in end of driver and drive lower piston rod seal into position in gear housing (Fig. 24).

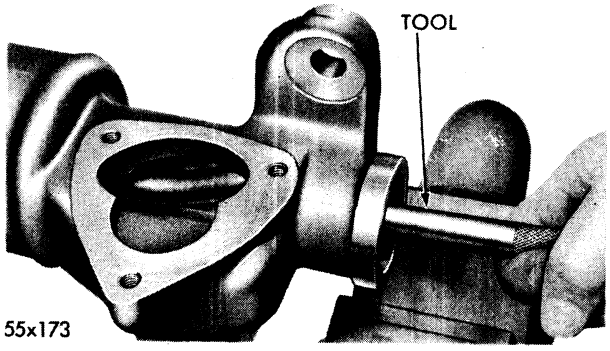

Fig. 23—Removing Lower Piston Rod Seat with Tool C-3450

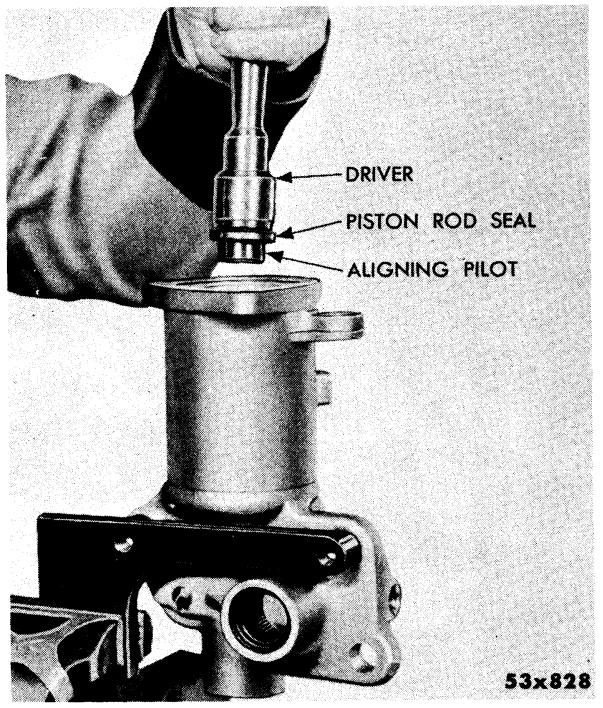

Fig. 24—Installing Lower Piston Rod Seal with Tool C-3395 (Typical View)

NOTE

If early type driver, Tool C-3331, with tapered end, is used, remove seat garter spring before installing seal to prevent damage to spring.

Using driver Tool C-3333, install housing shaft needle bearing assemblies in gear housing until bearings bottom in bores (if removed). Always drive on letter side of bearing; otherwise damage to bearing may result. Install piston rod support bushing in housing, making sure bushing is properly seated over dowel, as shown in Figure 25.

b. Assembly of Piston and Rods

Insert milled end of relief valve into lower piston rod, followed by spring and plunger. Press new end plug into lower piston rod until plug just contacts valve body. The plug must hold valve, just tight enough to hold valve stationary. Check by inserting a rod (Ice pick) through oil passage at top of rack teeth.

NOTE

A suitable adapter will be required to press end plug into place; otherwise, damage to rod will result. If plug is not pressed in far enough to properly seat against valve body, it will produce a rattling or clattering sound when hydraulic pressure is applied. If plug is pressed in too lightly, it will cause relief ports in valve body to collapse and restrict plunger, creating high back pressure. This can result in lack of steering assistance and a hissing noise.

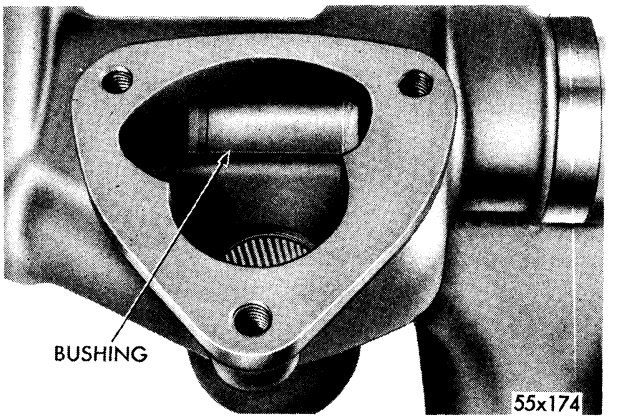

Fig. 25—Piston Rod Support Bushing Installed

Remove all burrs from around end plug. Install "O" ring on lower piston rod (with rack) and install lower piston rod into end of piston assembly opposite pin hole.

NOTE

Using snap ring pliers, install snap ring with tapered side away from piston so tapered side is visible after installation. Measure gap between ends of snap ring to make sure ring is seated. The minimum permissible gap is 25/64 inch. Make certain ports in end of piston rod are not restricted by snap ring.

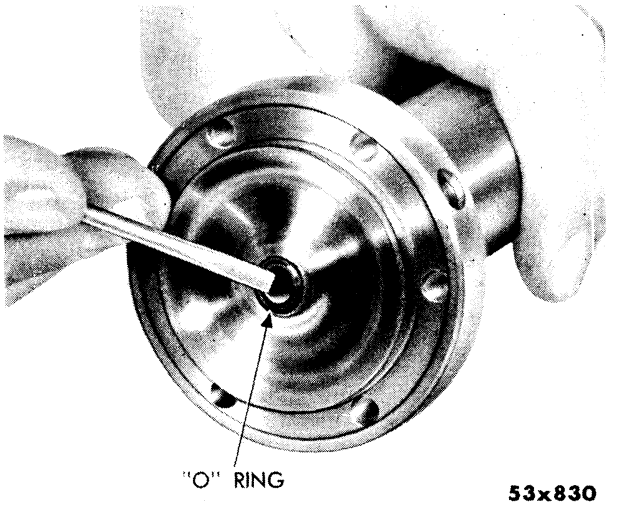

Fig. 26—Installing Valve Rod "O" Ring

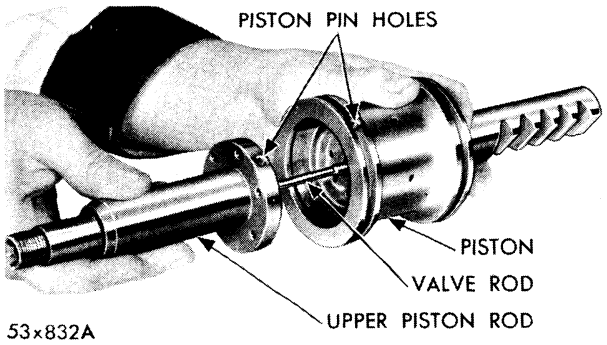

Fig. 27—Installing Upper Piston Rod

Lubricate two valve rod "O" rings with Lubriplate and install one in each end of upper piston rod (Fig. 26). **Make certain rings are seated properly.** Lubricate two large "O" rings and install one on upper piston rod and the other on lower piston rod, making sure rings are seated properly in grooves.

Lubricate valve assembly with Lubriplate and slide into position in upper piston rod. Work with care to avoid damaging "O" rings. Align piston pin hole in upper piston rod (Fig. 27). Install upper piston rod and valve assembly into piston. Lubricate and install a new "O" ring on piston (Fig. 28).

With piston pin holes aligned in both piston and upper piston rod, insert piston pin (tapered end first). Use ¼ inch punch and tap piston pin flush or slightly below bottom of piston ring groove. **If piston pin is too high in groove, piston ring will not properly seal and**

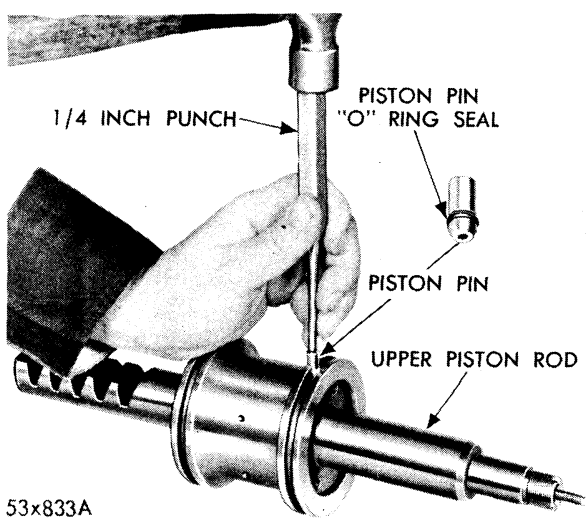

Fig. 28—Installing Piston Pin

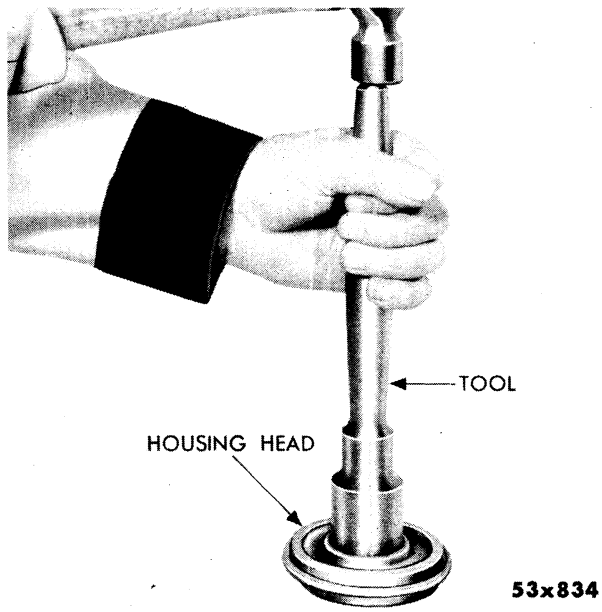

Fig. 29—Installing Upper Piston Rod Seal in Head (Tool C-3395)

will cause unequal pressure when valve is centered in piston.

Install upper piston rod snap ring. Follow same precautions and specifications, as previously used, in positioning lower piston rod snap ring. Select snap ring of sufficient thickness to prevent turning of snap ring after it is installed. **If it is too loose, the piston will move with relation to piston rod and adjustment of control valve cannot be maintained.** Place a new upper piston rod seal on driver (lip of seal facing tool). Lubricate seal with Lubriplate and drive into position in housing head (Fig. 29).

NOTE

If early type driver with tapered end is used, remove the seal garter spring before installing to prevent damage to garter spring.

Install housing head assembly (single shoulder first) onto upper piston rod. Follow the

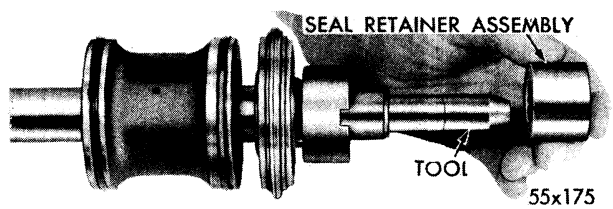

Fig. 30—Installing Valve Control Spacer (Tool C-3393)

same precautions to protect sealing surfaces on housing head as used when disassembling. Slide connector unit onto upper piston rod with open threaded end away from piston. Lubricate the valve control spacer seal with Lubriplate and install in center of valve control spacer. Should it be necessary to replace valve control spacer or upper piston rod, for any reason, always select spacer to match. The spacer must be free of burrs. The length of valve control spacer selected must be the same as distance between seat of valve control spacer seal retainer and seated upper piston rod nut. Place tool over threaded end of upper piston rod (Fig. 30).

Lubricate valve control spacer retainers with Lubriplate and place into position (small diameter first) so they nest in valve control spacer. Slide spacer seal and retainer assembly over tool into position on piston rod, and remove tool.

Install upper piston rod nut and tighten securely with Tool C-3328. Lock in place, using piston rod nut lock, by tapping outer diameter of lock into nut recess, as shown in Figure 31.

Slide valve rod adjusting disc retainer (largest diameter first) over end of upper piston rod. Thread valve rod disc (extended lock thread section outward) onto valve rod until approximately three threads show to aid in later adjustment. When installing disc on rod, considerable resistance should be noticed. If not,

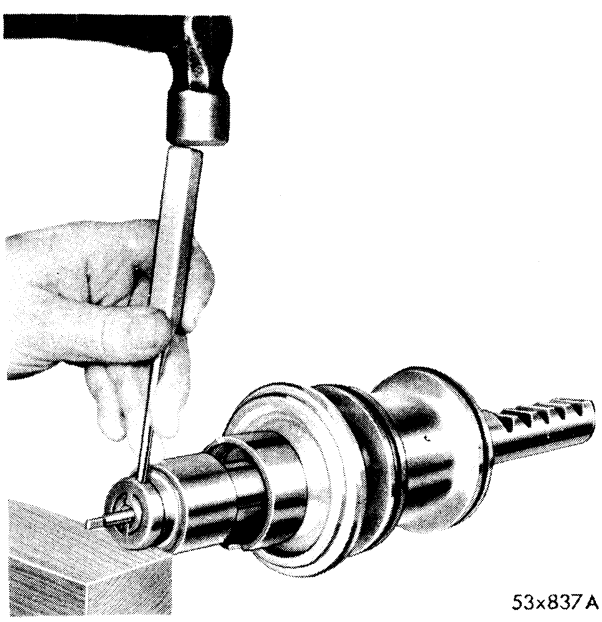

Fig. 31—Locking Upper Piston Rod Nut Lock Cap

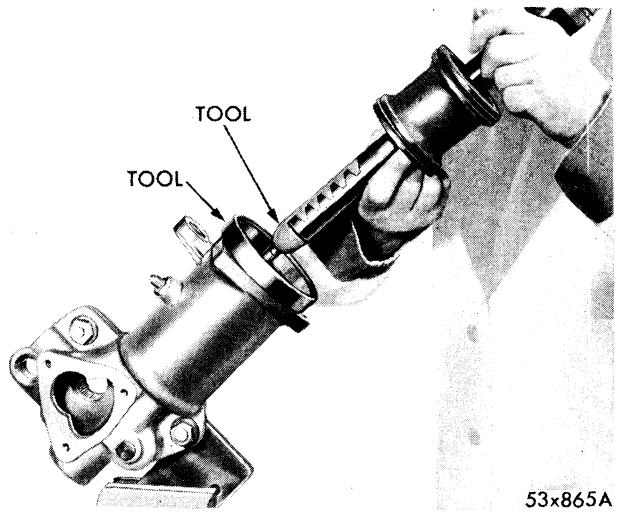

Fig. 32—Installing Piston and Rod Assembly (Tool C-3437 and C-3344)

crimp end of disc slightly to cause threads of disc to bind on rod. However, maximum torque required to turn disc on rod should not exceed 20 inch-pounds. Place lock sleeve on worm connector (tang of sleeve toward threaded end).

Lubricate two "D" type (neoprene) piston rings with Lubriplate and install on piston. To aid in installation of rings, slide rings over ring lands and to center of piston, and then slide rings into position in ring lands.

c. Installation of Piston and Rod Assembly in Gear Housing

Lubricate lower piston rod, teeth of rack and Tool C-3437 (Fig. 32) and position tool in teeth of rack. Lubricate large "O" rings and

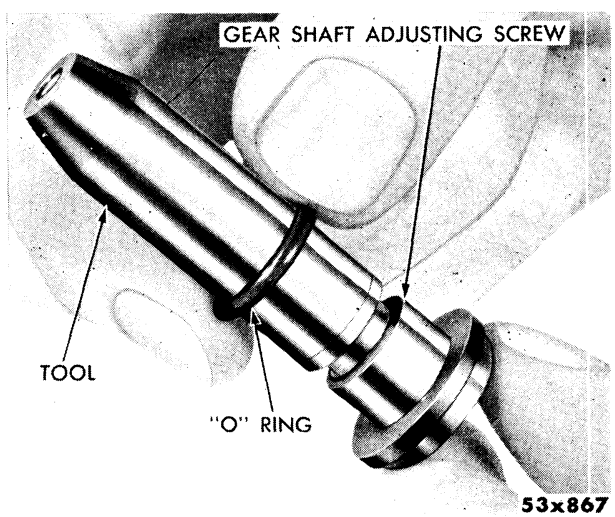

Fig. 33—Installing Gear Shaft Adjusting Screw "O" Ring with Tool C-3401

install on side of housing head that faces piston assembly (single shoulder).

Place ring compressing Tool C-3344 on gear housing. Position piston and rod assembly so teeth on rack are 180 degrees from bushing support, and install assembly into gear housing. **Use extreme care when performing this operation to avoid damaging housing oil seal or piston rings. Do not use screwdriver to compress piston rings.** To further aid in installation, piston and cylinder may be lubricated with Lubriplate. If rack is not positioned properly when installed, it may be corrected by rotating lower piston rod with screwdriver through opening in end of gear housing. Remove ring compressing tool. Remove tool from teeth of rack through opening in end of gear housing.

d. Installing Gear Shaft

Install thrust button washer in gear shaft. Position Tool C-3401 over thread of adjusting screw (Fig. 33). Lubricate gear shaft adjusting screw "O" ring with Lubriplate and slide over tool and into position on adjusting screw. Remove tool and insert adjusting screw into gear shaft. Lock in position by installing internal snap ring. Use pliers, Tool C-3229, and make sure snap ring is fully seated.

Position center groove (third from either end) of rack over center line of gear shaft cover opening in gear housing as shown in Figure 34. Install gear shaft into housing, timing gear shaft center tooth with third tooth groove in rack.

CAUTION

It is extremely important to mesh the gear shaft and rack teeth to the proper position. Failure to mesh gears properly will result in a broken gear housing.

Install gasket and cover over screw, turning screw into cover as far as possible. Install cover attaching screws and tighten screws evenly.

e. Installing Seal

Before attempting to install a new gear shaft seal, thoroughly clean sealing surfaces on gear shaft and counterbore of steering gear shaft. Oil seal with Lubriplate and place seal (lip down) on piece of clean paper. Carefully install tapered end of sleeve (part of Tool C-3350) in

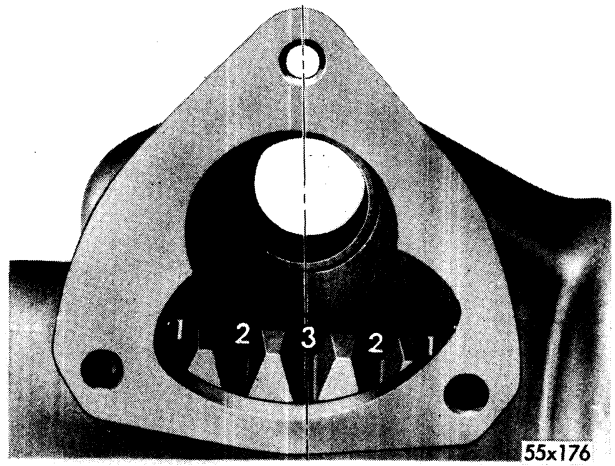

Fig. 34—Positioning Rack for Timing

seal and slide back approximately ¼ inch on sleeve (Fig. 35). Install this assembly (lip of seal toward housing) over steering gear shaft until seal contacts counterbore in housing. Push seal into position by installing adaptor over sleeve, and installing coupling nut on shaft threads until shoulder of adaptor contacts housing. Remove nut and adaptor. Wrap friction tape around sleeve to provide a firm grip and, with turning motion, remove sleeve from seal and gear shaft (Fig. 36). Seal is then positioned properly. Install oil seal lock ring (circular section) and make sure it is properly seated. Install gear shaft adjusting screw lock nut, but do not tighten.

f. Assembly of Worm Connector (If Disassembled)

Insert worm into connector and visually align

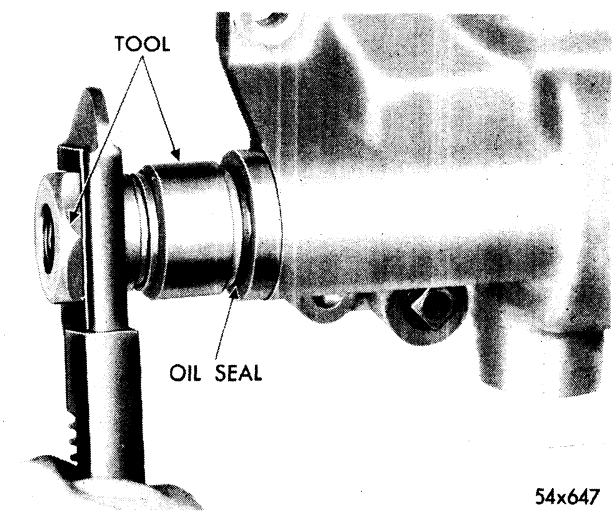

Fig. 35—Installing Gear Shaft Oil Seal (Tool C-3350)

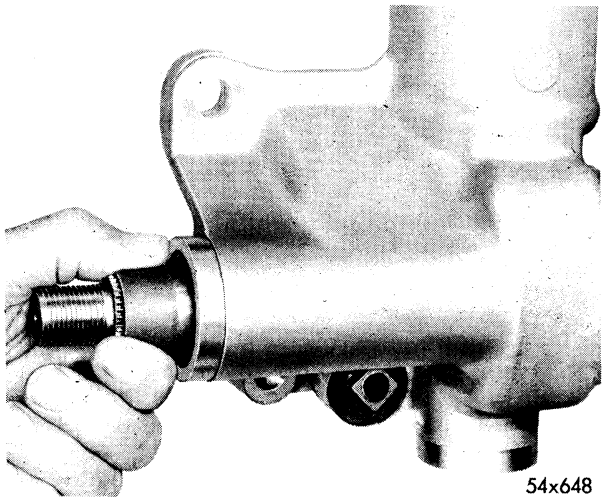

Fig. 36—Removing Sleeve (Part of Tool C-3350) with Friction Tape

upper portion of passages with ball guide holes. The balls, which are used in worm connector, are a select fit with each other. **If any become lost or damaged, a complete new set (40 balls) must be installed. Balls which fit tightly will result in increased and erractic steering effort and also lack of returnability. Balls which fit too loosely will result in free play of steering wheel before valve actuation or steering is accomplished.**

Insert 30 worm balls (one at a time) into lower hole by tapping them in gently (use the rubber end of a lead pencil or similar object) while slightly oscillating the worm. When 30 balls have been inserted, the first one installed should be visible in the upper hole. Place remaining worm balls (10) in either half of worm connector ball guide. Grease end balls to help hold them in place and add the other half of ball guide assembly. Insert assembly into holes until it seats on worm connector. Place ball guide clamp into position on ball guide, install two lockwashers and screws, and tighten 12 foot-pounds torque. Check operation of worm, making sure it is free to turn maximum travel of worm shaft. Care should be exercised not to bottom worm in outward direction; otherwise, damage to ball return guide may result and cause a rough or tight operating worm.

Slide worm connector and worm shaft assembly over control spacer and screw worm connector nut onto connector. Pull worm shaft up about one inch and wrap several layers of masking tape around worm to prevent nut from bottoming. Hold worm connector with Tool C-3321. Using Tool C-3326, tighten nut. Stake ring with punch and remove masking tape.

g. Assembly of Worm Housing

If bearing cups were removed from worm housing during disassembly, refer to Figure 7, and proceed as follows: Install worm housing upper bearing cup (wide section of cup first) into worm housing. Make sure cup seats properly in housing. Install worm housing lower bearing cup (wide section of cup first) into worm housing. Make sure cup seats properly in housing.

h. Installation of Worm Housing

Lubricate worm housing inner bearing race with Lubriplate, and slide (wide section of cone first) over threaded end of worm until it seats. Lubricate upper housing head "O" ring and install on housing head pilot opposite piston side. Install "O" ring on **inner** land of housing head. **If it is installed on outer land, damage to housing will result when installed.**

Drop inner bearing into housing and hold in place. Guide worm housing over rails on worm connector (ball guide down) until it is flush with gear housing. If flanges cannot be installed flush, the housing head "O" ring is installed on outer land rather than on inner land and will have to be changed. Worm housing cannot be installed if bearing is installed on worm shaft prior to installing housing.

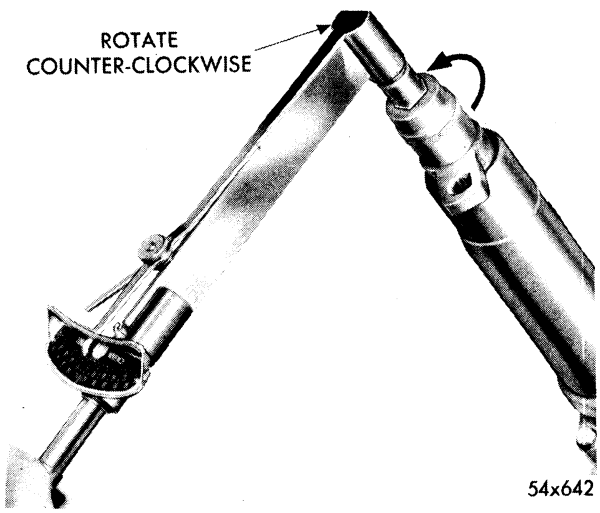

Fig. 37—Adjusting Worm Housing Bearings

Install three screws and concave washers, draw down evenly and tighten 30 foot-pounds torque. Lubricate worm outer bearing roller and install in bearing cup. Position race in bearing. Slide thrust washer over worm and against outer bearing race, and follow with worm bearing nut lockwasher. Turn worm shaft out until lower race seats in bearing. Install worm housing bearing adjusting nut over shaft (tapered end first). Slide Tool C-3320 over worm shaft, followed by Tool C-3319. Using Tool C-3319 and torque wrench, turn worm shaft counter-clockwise (Fig. 37) to 20 foot-pounds torque against inner bearing.

While holding worm shaft against bearing at 20 foot-pounds torque, tighten adjusting nut clockwise to 15 foot-pounds torque, as shown in Figure 38, using Tool C-3320 and another torque wrench.

Rotate worm shaft several times in order to properly seat bearings. Loosen adjusting nut and hold worm shaft a 5 foot-pounds torque (counter-clockwise) against inner bearing, using Tool C-3319 and torque wrench.

Retighten adjusting nut clockwise to 5 inch-pounds torque, as shown in Figure 39. Lock adjusting nut in position by bending tang of lockwasher to index with slot in nut. Only one tang is necessary to lock nut. **A loose adjustment will result in free play and too tight an adjustment will result in lack of returnability.** Install worm housing oil seal by lightly tapping with plastic or rubber hammer until seal

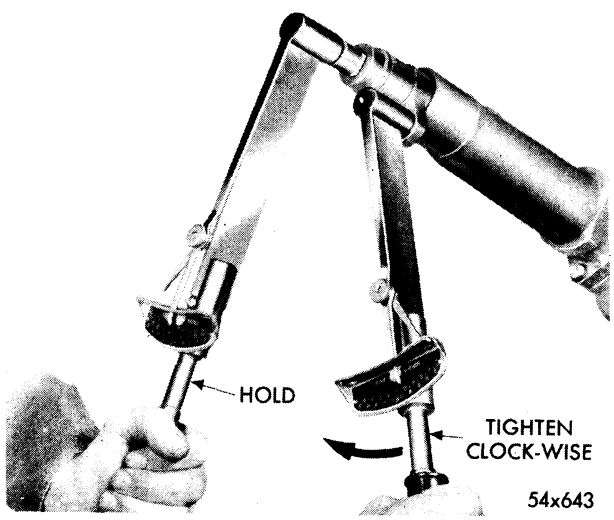

Fig. 38—Adjusting Worm Housing Bearings (Outer)

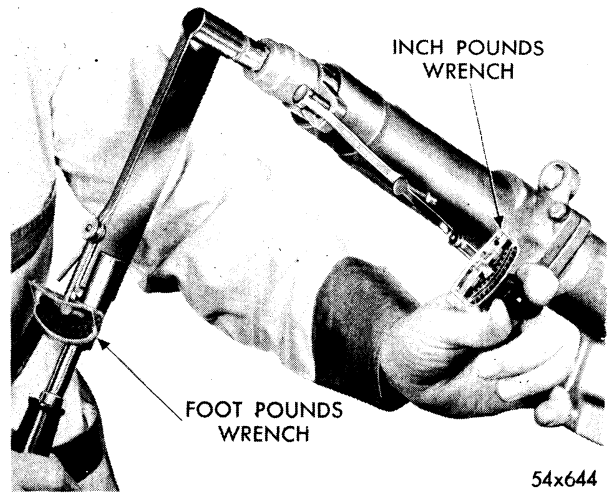

Fig. 39—Final Worm Housing Bearing Adjustment

is seated in housing. Install steering gear arm, lockwasher and nut, and tighten 100 to 120 foot-pounds torque. Work arm back and forth, forcing piston to its full length of travel.

Adjust gear shaft into a backlash condition, and tighten lock nut. **This adjustment is necessary before adjusting manual control valve to neutral position and is not to be considered a final adjustment.**

Filling worm housing with Automatic Transmission Fluid Type "A" is very important since there is no hydraulic connection between the worm and gear housing. Add Automatic Transmission Fluid Type "A" to worm housing through worm housing filler hole. Keep gear assembly in its approximate mounting position to facilitate filling. Install worm housing oil filler plug and tighten to equivalent of 50 inch-pounds torque.

16. ADJUSTING POWER STEERING GEAR ASSEMBLIES

a. Valve Neutral Position

Connect test hoses to hydraulic pump on car and to steering assembly. Remove oil reservoir cover, start engine, and operate at idle. Fill reservoir to level mark and allow system to warm up. Oil level must be maintained above filter while hydraulically centering valve.

Insert manual control valve centering tool (slotted end first) into worm shaft and engage slot in tool with tang on control valve operating rod. (Tool C-3445 can be rotated by using a tap wrench).

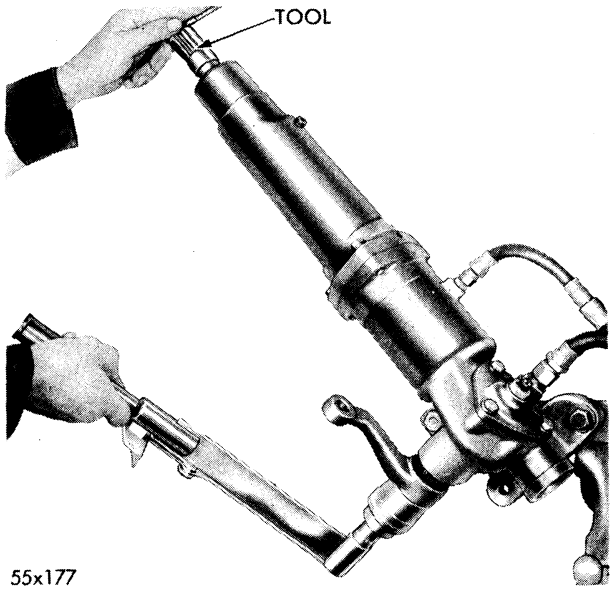

Fig. 40—Adjusting Manual Control Valve to Neutral Position with Tool C-3445

If steering gear arm moves to one extreme or other and stays there, rotate tool in either direction until arm starts to move. Then, slightly rotate tool in opposite direction until arm stops moving. Install a $1\frac{7}{16}$ inch socket on a torque wrench and place on steering gear arm retaining nut. Rotate gear shaft in both directions from one extreme of travel to the other. The torque required to move shaft should be the same in both directions.

Where torque is higher in one direction than in opposite, rotate valve adjusting tool (Fig. 40) slightly in opposite direction to direction in which steering gear arm has highest torque reading. Change valve position in slight variations, at a time, to prevent overadjusting. When torque is same in both directions, remove tool. When valve is properly centered torque should not exceed 40 foot-pounds torque in either direction.

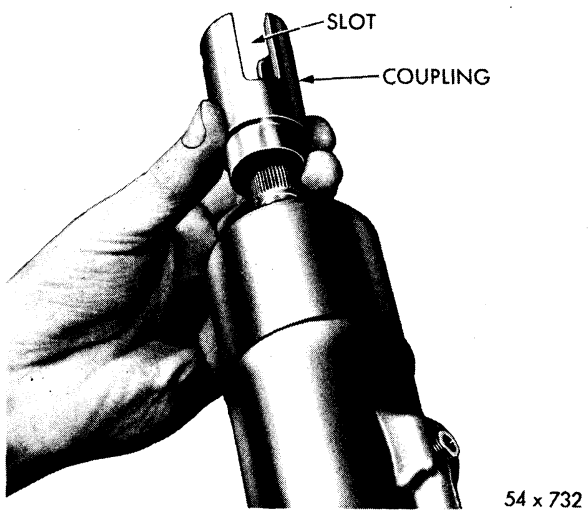

Fig. 41—Installing Coupling

NOTE

Where gear shaft requires more than 40 foot-pounds torque to rotate it, and/or where torque is uneven at any point through full travel of shaft, it probably has a cocked gear shaft cover, dirt has entered interior, or circulating balls are defective or improperly installed.

b. Installing Coupling at Center of No Backlash Position and Gear Shaft Adjustment

The steering tube coupling must be installed with slot in coupling in vertical plane (Fig. 41). There are no master serrations on either worm shaft or coupling. **A mark is scribed on coupling. This mark should be set at 12 o'clock when steering worm shaft is at center so steering tube master serration will be in position to allow for proper installation of steering wheel.**

c. Adjustment

Center steering tube coupling or steering wheel to overall travel of steering gear. With gear in center position, loosen adjustment until there is some backlash. Slowly turn adjusting screw "in" until backlash disappears. Then, turn adjusting screw "in" three-fourths of turn and lock in position.

17. INSTALLATION OF POWER STEERING GEAR IN CAR

Install Power Steering Gear Assembly from under car and up through the dash panel into the jacket. Install housing to frame attaching bolts, flat washers, swivel washers and nuts, but do not tighten. Swivel washers permit alignment of housing to dash.

Slide steering column jacket down over worm housing. Install turn signal lever, being sure column jacket does not restrict lever. Tighten jacket to steering gear housing clamp. Connect turn signal wires. Install steering column to instrument panel bracket and install steering wheel. If clearance between steering column jacket and steering wheel is less than $\frac{1}{8}$ inch,

adjust steering column jacket to provide proper clearance. Install horn ring and horn wire in steering wheel and install horn ring ornament. Install dust pads and retaining plate.

Tighten front upper and lower gear housing to frame attaching bolts 20 foot-pounds torque. Install wedge over rear bolt between housing and frame, tapping it **lightly** in place. Tighten three attaching bolts 70 foot-pounds torque. Connect hoses from steering gear to hydraulic pump.

18. ADJUSTMENT OF POWER STEERING GEAR (INSTALLED)

Adjusting Manual Control Valve (Centering Hydraulically) in Car.

Where it is difficult to rotate steering wheel in one direction but not in other direction, or where wheels turn of their own accord, equalize tire pressure and check front wheel alignment. If above conditions still exist, it is an indication that control valve is out of alignment.

Remove parts, as necessary, to gain access to steering tube coupling. Remove coupling retaining screw, lockwasher, and plain washer from worm shaft. Insert manual control valve centering tool (slotted end first) into worm shaft and engage tool with tang on control valve operating rod. Two men are required to center valve.

One man moves valves, as directed, while the other checks torque required to move steering gear arm through its travel in both directions. Move steering gear arm through travel from one extreme to the other with torque wrench (Tool C-3005 and $1\frac{7}{16}$ inch socket), and observe torque reading. The torque should be same in both directions. Turn adjusting rod, as required, until an equal torque reading is obtained. The steering gear arm retaining nut should be tightened to 120 foot-pounds torque.

NOTE

Where gear shaft requires more than 40 foot-pounds torque to rotate it, and/or where torque is uneven at any point through full travel of shaft, it probably has a cocked gear shaft cover, dirt has entered interior, or circulating balls are defective or improperly installed.

19. REPLACING STEERING GEAR SHAFT OIL SEAL

The steering gear shaft oil seal may be replaced (with the unit in car) similar to the method outlined in Paragraph 15, **e.**

20. HYDRAULIC STEERING PUMP PRESSURE CHECK

Should lack of steering assistance (in both directions) be encountered and other checks fail to reveal cause, a pressure check should be made to determine if pump is operating properly, as follows:

Connect tachometer leads to coil and ground. Install gauge C-3309 in pressure line between pump and hose. Refill reservoir to proper level. Open valve on gauge, start engine, and run until power steering oil pump reaches operating temperature. With engine idling (475-500 r.p.m.), turn shut-off valve on gauge to closed position.

CAUTION

Do not keep valve closed more than a few seconds or accelerate engine with valve closed: otherwise, damage to the pump and/or belt may result.

If pressure does not gradually increase to at least 700 psi. as valve is closed, it is possibly due to following conditions:

Fan belt slipping. To correct, adjust the belts. Where two belts are used, make sure

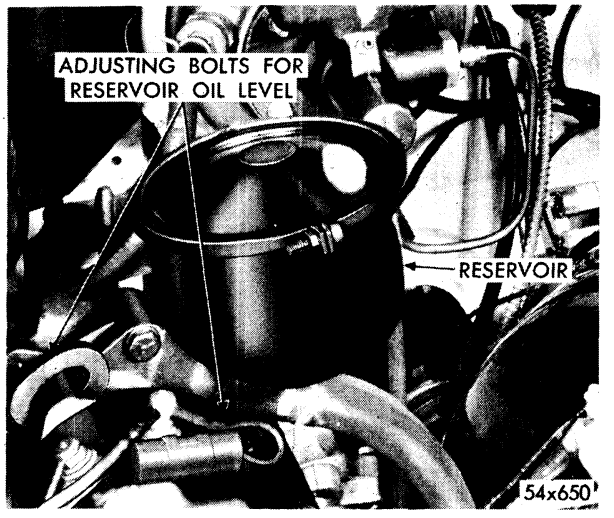

Fig. 42—Adjusting Oil Pump to Level Oil in Reservoir (Typical View)

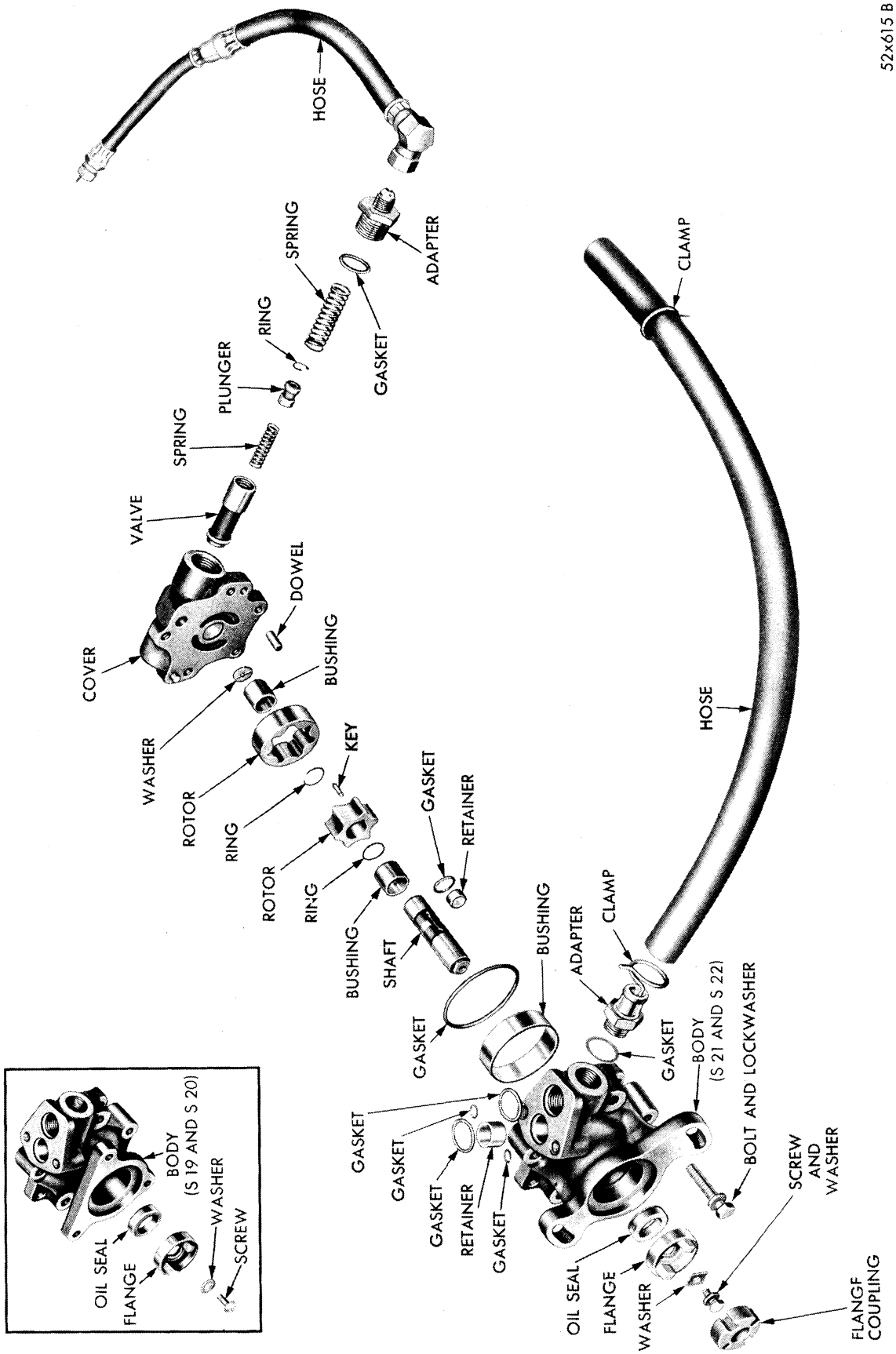

Fig. 43—Power Steering Oil Pump (Disassembled View) (Eaton Pump)

both belts are adjusted, or condition will still exist.

Flow control valve stuck in open position. To check, remove the high pressure hose at pump fitting and insert a ¼ inch clean blunt rod against valve plunger. If plunger moves inward 3/16 to ¼ inch, the plunger was stuck. To correct, remove flow control and relief valve assembly and inspect for nicks, burrs, or foreign matter. Small nicks or burrs may be removed by using crocus cloth. When reinstalling valve assembly, make sure it fits freely in bore of pump cover. Recheck pump pressure after installation. If pump pressure does not increase 700 psi. as valve is closed, proceed as follows:

With cover removed from reservoir, start engine and observe whether oil is flowing through filter. If it does not, remove pump from generator (it is not necessary to disconnect hose) and inspect for broken coupling flange. If either coupling flange is broken, disconnect hose, and remove pump and reservoir assembly from vehicle. Disassemble pump and determine cause of coupling flange breaking.

21. REMOVAL AND INSTALLATION OF POWER STEERING HYDRAULIC PUMP ASSEMBLY

a. Removal

Disconnect pressure and return hoses from pump assembly. Loss of oil will be noted when hoses are removed. Keep both hose ends up to prevent excessive loss of oil. Ends of hose should be covered or capped to prevent the entrance of foreign matter.

Remove pump to generator mounting screws and lockwashers. Remove pump and reservoir assembly from generator. Remove rubber coupling.

b. Installation

Place rubber coupling in position in pump assembly. Place pump and reservoir assembly in level position on back of generator, and index coupling carefully. Pump mounting brackets have slotted holes to allow level positioning of pump reservoir (Fig. 42). Install pump to generator mounting bolts, lockwashers, and washer. Draw down evenly and tighten to 17 foot-pounds torque. Connect pressure and return hoses to pump and tighten. Refill reservoir.

22. SERVICING THE HYDRAULIC PUMP (FIG. 43)

a. Disassembly

Do not disassemble hydraulic pump in dirty surroundings or on a dirty work bench. Use clean paper on bench. After pump has been disassembled place parts in suitable cleaning solvent and protect them from dirt and chips. Remove cover on reservoir and remove filter.

Remove two reservoir to pump attaching bolts and lockwashers, unscrew filter element standpipe, and separate reservoir from pump. There are four rubber "O" seal rings between reservoir and pump body. Using holding Tool C-3227, remove coupling locking screw, lockwashers and coupling. The locking screw is a special type for torquing purposes and should not be replaced with any other type. Place pump body in vise equipped with protective jaws and remove five body to cover attaching bolts. Remove cover and "O" seal ring. Remove outer pump rotor by inverting and tapping pump body on wooden block. Remove pump shaft and inner rotor from pump body. Remove inner pump rotor from pump shaft by removing rear circular section snap ring and sliding rotor and drive key off shaft.

To remove combination control and relief valve in pump cover, remove 1¼ inch hexagon spring retainer cap fitting and circular section

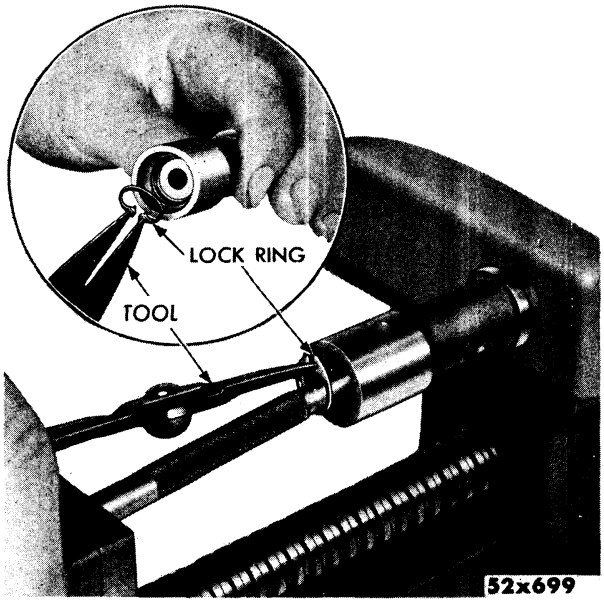

Fig. 44—Disassembly and Assembly of Pressure Relief and Flow Control Valve with Tool C-3229

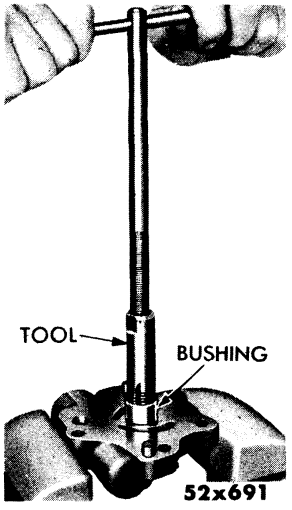

Fig. 45—Removing Pump Cover Bushing (Tool C-3185)

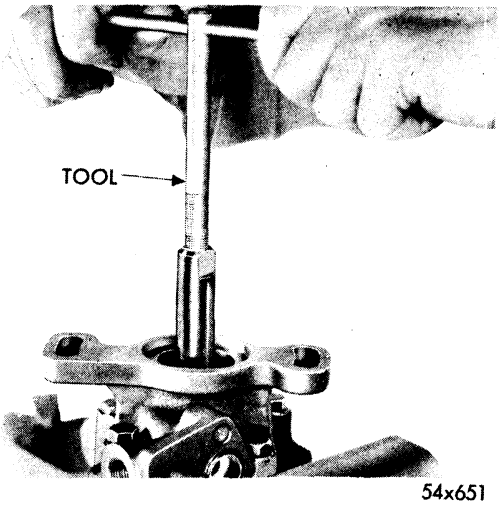

Fig. 47—Removing Pump Body Shaft Bushing with Tool C-3185

rubber "O" ring. Lift out flow control valve spring. Tap cover on wooden block to remove flow control and relief valve combination. To remove pressure relief valve and spring from flow control valve body, remove internal snap ring (Fig. 44).

b. Inspection

Clean all parts in suitable solvent and blow dry with compressed air. Inspect pump motor babbitt bushing in pump body for wear or scoring. Inspect bronze pump shaft bearing in cover and pump body. Inspect pump rotors and shaft for scoring and wear.

Position rotor and shaft in pump body. Use straightedge and feeler gauge to check end clearance. The specified limits are .001 to .002 inch. Inspect pressure relief and flow control valves for scoring and replace if necessary.

c. Replacement of Pump Cover Bushing

Install tool, and tap threads into bushing with outer section of tool (Fig. 45). When tool has been threaded into bushing sufficiently, screw the "T"-handle section of tool into cover until it bottoms, and continue turning to remove bushing. Install bushing with Tool C-3233 (Fig. 46).

d. Replacement of Pump Body Bushings

Place pump body in vise equipped with protection jaws. Place pump cover on pump body and

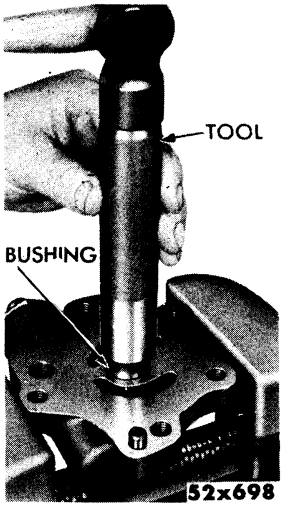

Fig. 46—Installing Pump Cover Bushing (Tool C-3233)

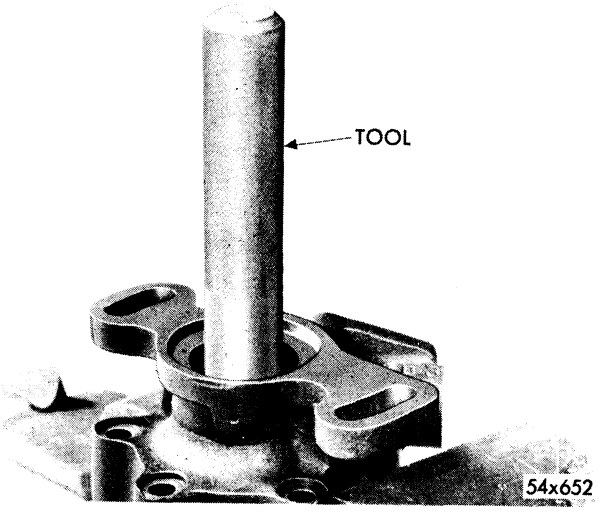

Fig. 48—Installing Shaft Bushing in Body with Tool C-3233

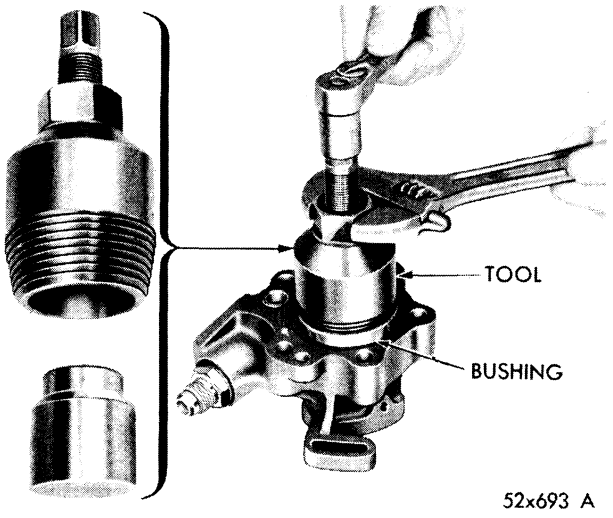

Fig. 49—Removing Babbitt Bushing from Body with Tools C-3214 and C-3234

install attaching bolts. Install tool in cover bushing hole and thread tool into housing bushing to remove bushing and seal (Fig. 47). Remove bushing and seal. (Use new seal when bushing is replaced). Place bushing on tool (Fig. 48), start bushing squarely in housing and drive into place.

e. Replacement of Outer Rotor Bushing (Babbitt)

Thread tool into pump body (cover removed). Using adaptor, remove bushing (Fig. 49). Clean all parts thoroughly in suitable solvent and blow dry with compressed air.

f. Installation of Pump Body Outer Bushing (Babbitt)

Start bushing squarely and drive into place with Tool C-3251 (Fig. 50).

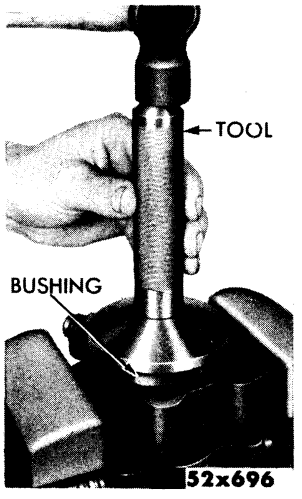

Fig. 50—Installing Babbitt Bushing in Body (Tool C-3251)

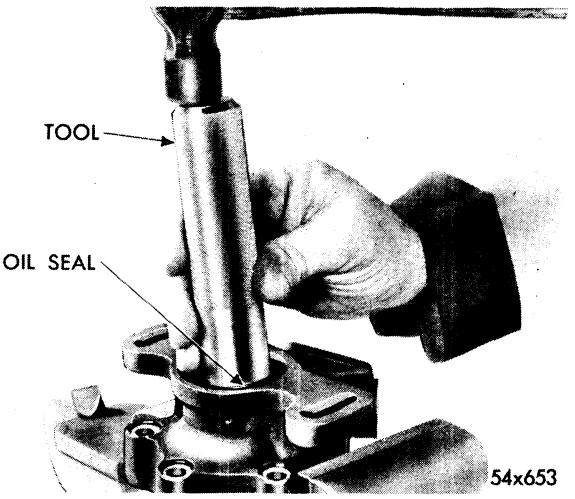

Fig. 51—Installing Pump Shaft Oil Seal with Tool C-3230

g. Installation of Pump Shaft Oil Seal

Reposition pump body in vise. Place seal on tool, (Fig. 51). Drive seal into position in pump body. To assemble pump, refer to Figure 43, and proceed as follows:

Lubricate all moving parts with clean SAE 10-W engine oil or Automatic Transmission Fluid, Type "A". Coat "O" seal rings with Lubriplate.

Reassemble combination flow control and relief valve by inserting spring and relief valve, with small end first. Compress valve and spring and install snap ring. Make sure snap ring seats properly. Install combination flow control

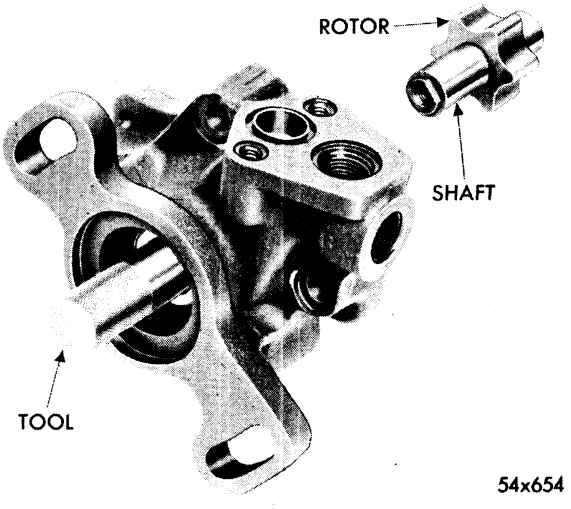

Fig. 52—Installing Pump Shaft (Tool C-3228)

and relief valve assembly into pump body, with narrow land first. Insert spring gasket, and adaptor. Tighten adaptor to 50 foot-pounds torque.

Install inner pump rotor and drive key on shaft, and install snap ring. Install shaft protector thimble in pump body until it bottoms (Fig. 52). Carefully insert rotor and shaft assembly (with coupling end first) into pump body to avoid damaging babbitt bushings. Insert outer rotor into pump body. Coat "O" seal ring with Lubriplate and position on pump body. Place cover into position on pump body and install five attaching bolts and lockwashers. Tighten to 35 foot-pounds torque.

Tap coupling flange on pump body until it bottoms and install special square washer, screw and lockwasher. Use Tool C-3227 to hold coupling (Fig. 53) and tighten screw to 12 foot-pounds torque. To attach reservoir to pump, coat "O" seal rings with Lubriplate. Install two large "O" rings and two small "O" rings on reservoir mounting surface of pump. Place reservoir on pump, install filter standpipe stud and two reservoir to pump attaching screws. Tighten screws to 17 foot-pounds torque. Install filter element and tighten filter retaining screw assembly until it seats on screw shoulder. Install cover to keep dirt out of pump.

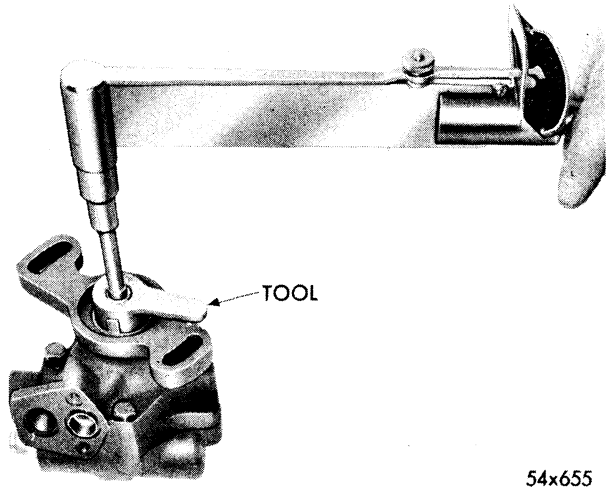

Fig. 53—Tightening Coupling Screw with Tool C-3227

FRONT WHEEL ALIGNMENT

23. CHECKING FRONT WHEEL ALIGNMENT

Correct front wheel alignment produces easy, positive steering with a minimum of scuffing action between tire and road. Normally, when checking front wheel alignment, car should be empty (all luggage or load should be removed). If a constant load is carried, such as when a car is used by salesman for carrying samples, etc., car should be loaded with its normal amount of weight before checking front wheel alignment.

All factors of front wheel alignment are interrelated, but each angle has specific purpose. Four different angles are used in positioning front wheels for proper steering under varying conditions of weight and speed. Position car so that all four wheels are on the same level, inspect tires for wear and inflate to recommended pressure. Refer to Section XVII, Wheels and Tires. Check for wheel wobble, unbalanced wheel and tire assemblies, weak or damaged springs, bent frame, worn, damaged or bent front suspension parts, loose or damaged steering gear parts, and dragging brakes. **For procedure of checking height of front springs, refer to Paragraph 10, Front Wheel Suspension, Sec-**

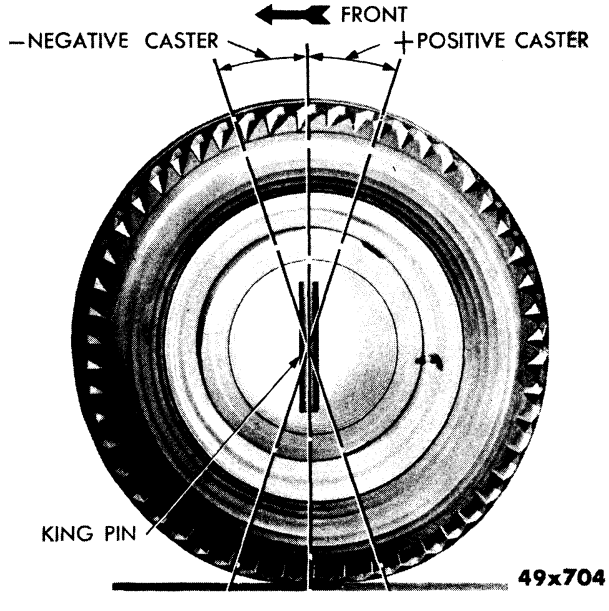

Fig. 54—Caster Angle

tion 1. With no load in car except spare tire, jounce front end up and down several times to permit springs and shock absorbers to settle in normal positions.

NOTE

If equipment other than that shown in the following procedures is used in checking front end alignment factors, follow the manufacturer's instructions.

24. ADJUSTING CASTER AND CAMBER

Caster is amount in degrees that king pins lean from vertical toward front of car and positive caster indicates that king pins lean toward rear.

(Refer to Figure 54 and 55). Specified caster angle is obtained by proper assembly of upper and lower constrol arms. A slight change in adjustment can be made by turning upper control arm eccentric bushing. If caster is not within limits recommended in Specification, inspect front suspension system for bent parts.

Camber is amount that front wheels lean outward or inward from the vertical, when viewed from front of car (Fig. 56). With positive camber, wheels are farther apart at top than at bottom. With negative camber, this condition is reversed. Check camber, as shown in Figure 57.

Adjust camber by loosening lockscrew and turning eccentric bushing. Correct setting can be obtained with ½ revolution in either direction from starting point. Do not turn eccentric bushing so that it binds against either side of upper control arm. Adjust camber to limits shown in Specifications.

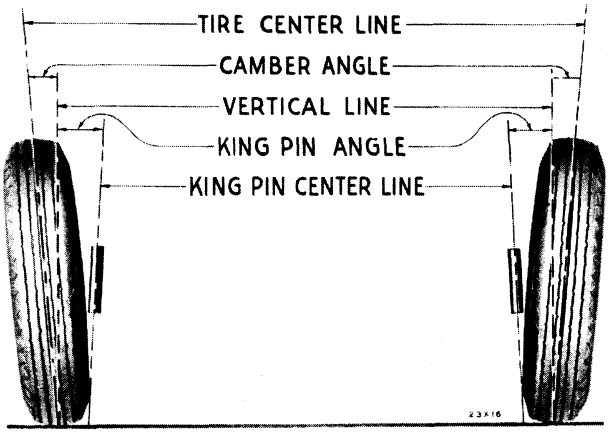

Fig. 56—Camber Angle and King Pin Inclination

If camber cannot be adjusted satisfactorily and spring height is correct, measure king pin inclination, as described in Paragraph 25 and inspect front suspension system for bent parts.

25. MEASURING KING PIN INCLINATION

King pin inclination is amount in degrees that king pins lean away from vertical toward center of car (Fig. 56). If Camber can be adjusted within recommended limits, it is usually unnecessary to check king pin inclination.

Inflate tires to recommended pressure, place front wheels in straight-ahead position on turn-

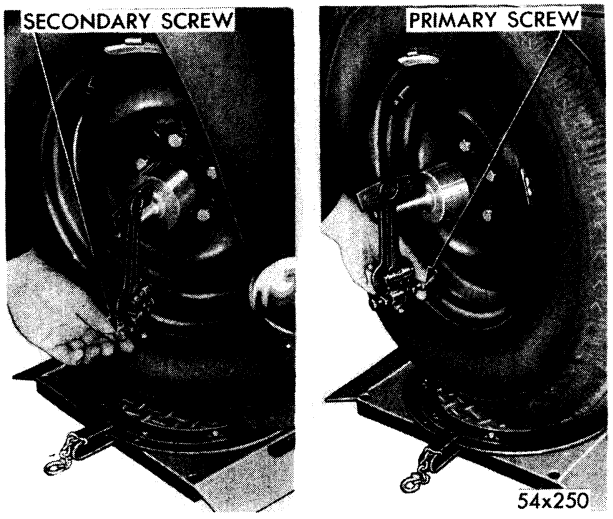

Fig. 55—Checking Caster (Right Wheel) Gauge C-3409

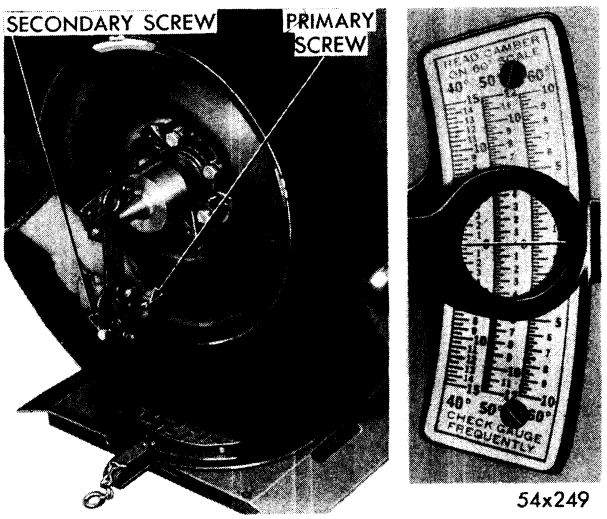

Fig. 57—Checking Camber (Gauge C-3409)

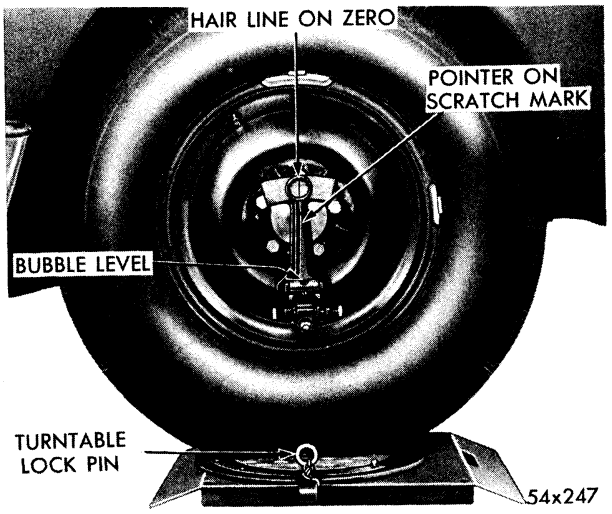

Fig. 58—Gauge C-3409 and Turntable DD-435 (Right Wheel)

tables and set foot brakes. Grasp front bumper at center and move front end of car up and down several times to permit front suspension parts to settle in "normal", unloaded position.

Assemble gauge to right front wheel (Fig. 58) and pull out turntable lock pins. Turn front wheels to left until right wheel has turned more than 20 degrees, as indicated by turntable scale. Allow wheel to back off to exactly 20 degrees. Adjust secondary screw (Fig. 59) until bubble is centered in spirit level. **Do not disturb gauge setting or release brakes.**

Turn front wheels to right until right wheel is turned to an angle of more than 20 degree mark. Adjust primary screw (Fig. 55) until bubble centers in spirit level. The reading on 40-degree scale of gauge will be king pin angle for right wheel.

To check angle of left front wheel, place gauge on left wheel, turn front wheels to right and repeat procedure outlined above.

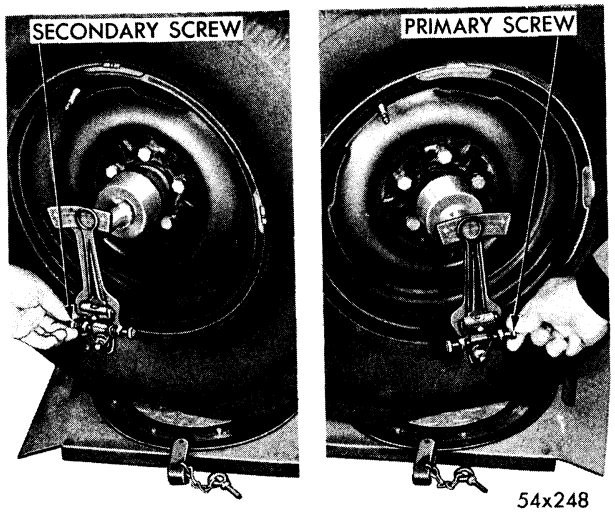

Fig. 59—Checking King Pin Inclination (Right Wheel) Gauge C-3409)

NOTE

If king pin inclination does not conform with limits listed in Specifications, check for bent frame, steering knuckle or control arm.

26. MEASURING AND ADJUSTING TOE-IN

Toe-In means that the front wheels are closer together at front than they are at rear.

(Refer to Figure 60.) To measure, spin front wheels and scribe a thin line in center of tread of each tire. Jounce front end up and down several times and position wheels in straight-ahead position on turntables. Gauge and scriber Tool C-695 can be used to measure toe-in for scribing tire treads.

Measure distance at hub height between points A and B, Figure 60. The distance between point B should be ⅛ inch less than distance between point A, Figure 60. To adjust toe-in, lengthen or shorten the tie rods an equal amount until toe-in is ⅛ inch, plus or minus $\frac{1}{32}$ inch (⅛ inch preferred) and recheck measurements at points A and B.

NOTE

The steering wheel hub, steering gear arm, steering tube and steering gear roller shaft are machined with master serrations to place front wheels straight-ahead when steering wheel is in center position. Do not alter these serrations

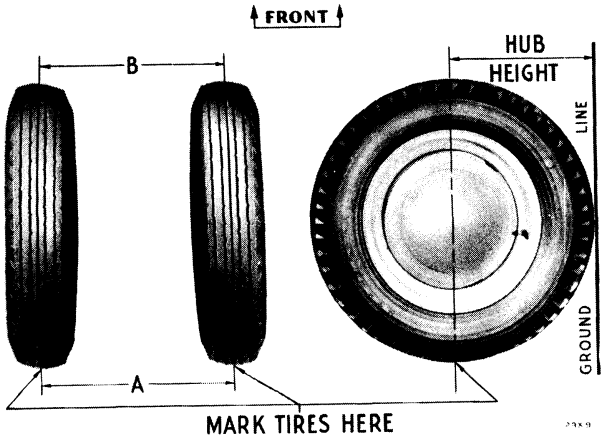

Fig. 60—Front Wheel Toe-In

to change position of these parts. Improper position of steering wheel must be corrected by adjusting tie rods.

27. TOE-OUT ON TURNS

When car makes a turn, front wheels travel in circles which have a common center. The arc of circle traveled by inside front wheel is smaller than arc of circle traveled by outside front wheel. Consequently, when turned to right or left, the wheels will be farther apart at front than at rear. The amount that front wheels toe-out depends upon how far they are turned.

With front wheels on turntables, set right wheel to 20 degrees. The turntable under left wheel should indicate 21½ degrees, plus or minus 1 degree. If reading is not within these limits, the steering knuckle arm or steering gear arm may be bent. Before above check is made, make sure that camber, caster, king pin inclination and toe-in are within limits.

SERVICE DIAGNOSIS (MANUAL STEERING)

28. EXCESSIVE PLAY OR LOOSENESS IN THE STEERING WHEEL

a. If excessive play exists in steering wheel without moving steering gear arm, refer to Steering Gear Adjustments, Paragraph 8.

b. Check steering linkage ends for wear. If any appreciable amount is evident, replace with new end assemblies.

c. Refer to Front Suspension System for procedure check and replacing king pins and bushings.

d. Refer to Front Suspension System for procedure checking and adjusting wheel bearings.

e. Check for looseness between steering gear arm and steering gear shaft, while turning steering wheel back and forth. If looseness is evident, inspect serrations and correct as necessary.

f. Rotate steering wheel and check steering gear housing. If movement is noted, align assembly and tighten attaching bolts securely.

g. Check steering gear arms for looseness and tighten to specified torque.

29. HARD STEERING

a. Check and correct tire pressure, as required. Refer to Wheels and Tires Section for correct tire pressure.

b. Check level of lubricant, and if found below, add correct amount. Refer to Lubrication Section.

c. Disconnect steering gear arm at steering gear shaft. Turn steering wheel to both extremes. If binding is evident near ends of travel, the cause can usually be traced to either a misaligned steering gear assembly, improperly adjusted gears, or worn bearings. If binding is evident in center position only, the gear mesh adjustment is too tight.

The steering gear assembly can be correctly aligned as follows: Loosen housing to frame bracket, frame bracket to frame bolts and instrument panel bolts and realign assembly to frame and instrument panel. There must be no misalignment at either frame or instrument panel. If gears are improperly adjusted, refer to Paragraph 8.

If binding was evident before steering gear arm was disconnected but disappeared after being disconnected, check steering linkage for dry or binding tie rod ends. Lubricate or replace tie rod ends as necessary. Also check for .005 to .010 inch clearance around king pin, between knuckle and support.

For other possible conditions that may be encountered pertaining to steering, refer to Front Wheel Alignment in this Section.

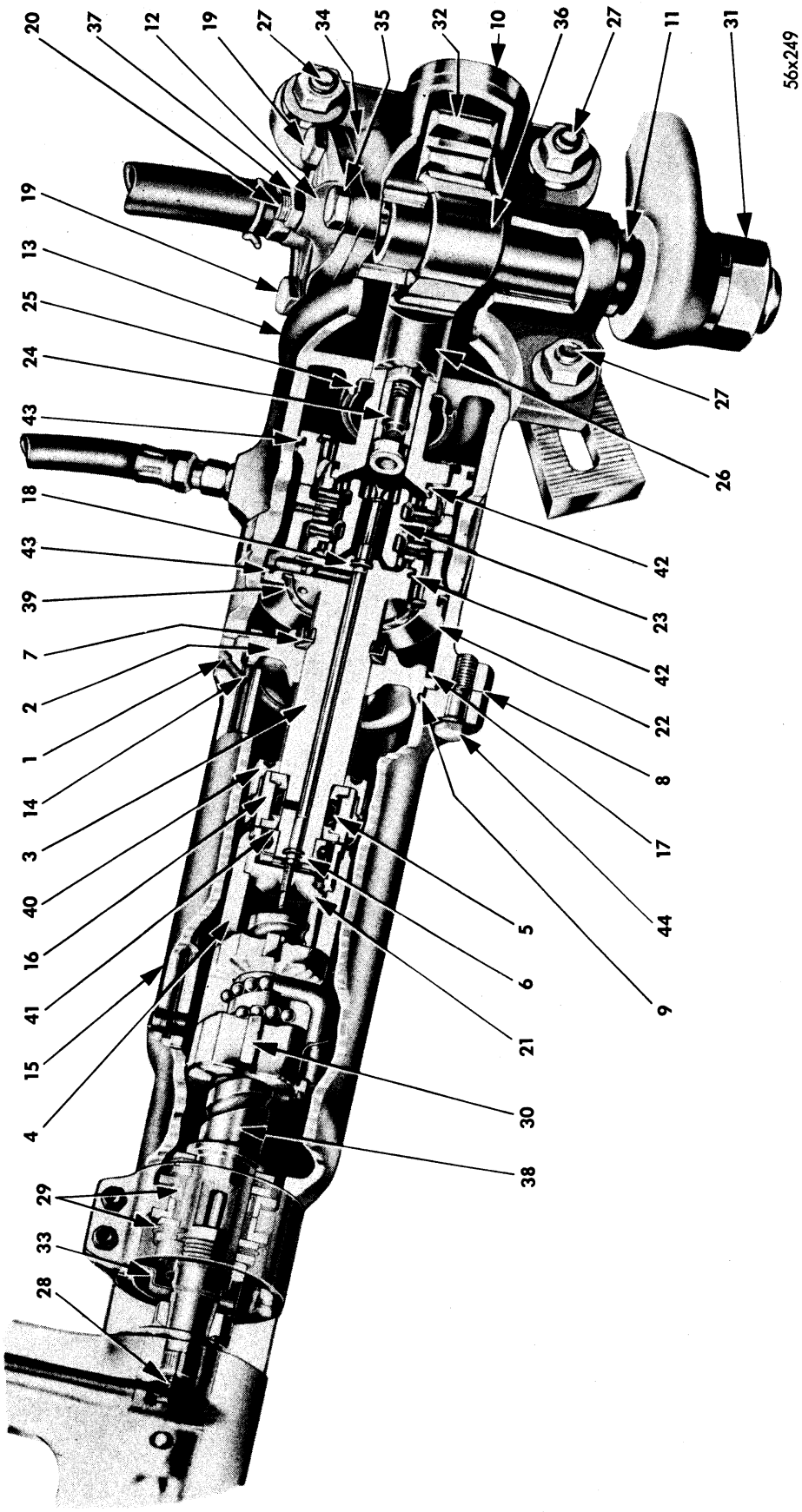

Fig. 61—Power Steering (Sectional View)

FULL TIME POWER STEERING (FIG. 61)

When a check is made on a report of an oil leak, be sure to keep in mind the difference between oil **leakage** and oil seepage. An oil spot on driveway, or one that drops on outside of gear housing, doesn't necessarily mean there's an oil leak in power steering unit. The only way to tell whether it's seepage or leakage is to find out whether owner has had to add oil to reservoir to maintain proper level.

Seepage can be caused by one or more of following:

a. Overfilling of upper housing. If a unit is filled level with filler plug opening, instead of using proper measured amount of oil, (14 oz.) it may show signs of seepage at vent due to expansion.

b. The normal breathing action of unit will leave a light film of oil around vent opening.

c. Recently installed units. Oil becomes trapped in vent passage during shipping and drains out when unit is operated, at mating surface between upper and lower housing.

If turning force is continued to be exerted on steering wheel after front wheels have reached their limit of travel and engine is accelerated excessively, it is possible to build up pump pressure in excess of 1,000 psi., which causes the power steering unit to flex at point when two housings are bolted together as shown in Figure 61 (8). Constant flexing at this point will cause seepage at the "O" ring. **THIS IS DEFINITELY AN ABNORMAL OPERATING CONDITION.**

If some doubt exists as to whether or not a unit has internal leakage into the upper housing, proceed as follows:

Insert a pipe cleaner into upper housing vent (1) to absorb any oil which may be trapped in opening. Start engine and turn steering wheel from one extreme of travel to other, holding it a short time against each wheel stop.

CAUTION

Do not exceed 1,400 engine RPM or hold against stops longer than 15 seconds, as it is possible to damage power units, fan belt and/or oil pump.

If there was no emission of oil from vent (1) during this test, the condition existing was one of seepage or, all of oil has been lost from upper housing due to neoprene plug (14) missing from vent passage inside housing,

30. LEAKAGE

If oil was observed coming from vent (1) during above test, remove chuck assembly from the vehicle and proceed as follows to determine source of leak:

Special Service Tool C-3469 as shown in Figure 62, Dummy Flange Bulkhead Retaining has recently released. This tool is essential in locating upper housing leaks in power steering unit.

Place chuck in holding fixture Tool C-3323. Connect test hoses Tool C-3211 and C-3318 so gear can be operated under pressure. Drain and remove upper housing (Fig. 61, 15). Using Tool C-3469, secure housing head (2). Remove all traces of oil around housing head (2), upper piston (3) and connector assembly (4). Start engine and check for source of leaks.

NOTE

To build up pressure in unit when testing, it

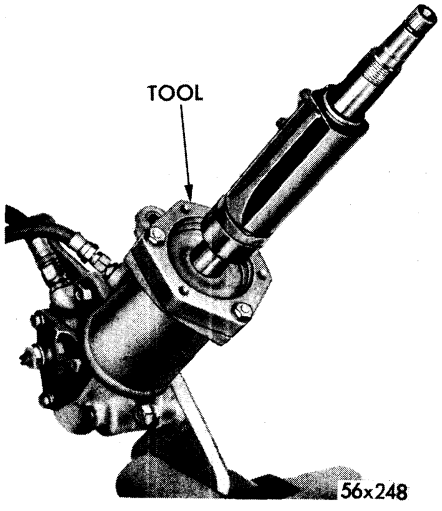

Fig. 62—Testing Steering Gear for Leaks, Tool C-3469 Installed

will be necessary to move control valve off center in each direction with adjusting Tool C-3445.

31. REACTION SEAL (5)

Determined by oil coming from connector assembly (4). Inspect seal for signs of shrinkage or being damaged and replaced with new seal marked with silver "M". Check new seal prior to installation for snug fit in valve control spacer (16). Also inspect upper rod (3) for being scratched at seal sealing surface.

32. CONTROL VALVE ROD UPPER "O" RING (6)

Determined by oil coming from connector assembly (4). Remove "O" ring and inspect "O" ring seat for foreign material, nicks, or burrs. Install new "O" ring making sure it is seated properly in groove and cannot possibly come out of groove when pressure is applied. **Always** install new upper and lower valve rod "O" rings (6-18) whenever gear is disassembled.

33. UPPER PISTON ROD SEAL (7)

Due to oil leaking around the upper piston rod at housing head (2). Replace seal, at the same time inspecting seat in housing head for nicks and burrs; also check sealing surface on upper piston rod (3) for scratches. Make sure seal is properly seated in housing head.

34. POROUS HOUSING HEAD (2)

This can be noted by oil seeping through pores in housing head. If this condition exists, replace housing head.

35. LEAKAGE AT MATING SURFACE BETWEEN THE UPPER AND LOWER HOUSINGS (8)

May be caused by looseness of three attaching screws (34) which secure upper and lower housings. These screws should be torqued to 30 foot-pounds. If leakage was not caused by looseness of three attaching screws, or an abnormal operating condition, inspect for improperly seated or damaged "O" rings (9-17) on housing, especially the one located on pressure side (17). Inspect the "O" ring seating surfaces on housing head and gear housing for nicks, burrs, and foreign material. Install new "O" rings.

CAUTION

Make sure upper "O" ring (9) is installed properly, on upper or smaller diameter step, or damage to housing will occur when bolts are tightened.

36. LOWER HOUSING COVER OR PLUG (10)

Caused by damaged "O" ring or porous cover. Replace "O" ring and/or cover.

CAUTION

Cover should be installed with cupped side in, or damage will occur to lower gear housing.

37. GEAR SHAFT OIL SEAL (11)

Caused by damaged or improperly seated seal and/or snap ring. Replace seal. Remove steering arm with puller Tool C-3402. Remove old seal and install new seal with Tool C-3350.

38. GEAR SHAFT COVER (12)

Leaks at gear shaft cover can be corrected with removal of unit from vehicle.

a. Between gear shaft cover (12) and housing (44). Due to loose cover attaching screws (19) or damaged gasket. Tighten attaching screws (19) to 20 foot-pounds torque. If leak persists, remove cover and replace gasket. Inspect mating surfaces of cover and housing for nicks, burrs, etc.

b. Around cover attaching screws. Two of these screws (19) have neoprene seals, the one adjacent to engine (35) does not. Make sure seals are installed properly or replace with new ones if needed.

c. Around threads of gear shaft adjusting screw (20). Due to damaged "O" ring. Remove cover and replace adjusting screw "O" ring. **AROUND LOWER PISTON ROD ROLLER SUPPORT PIN.**

Due to damaged roller support pin "O" rings or foreign matter in seal groove which may prevent proper seating. Inspect pin for roughness and replace "O" rings, making sure they are seated in gear housing. Use Tool C-3401 to protect "O" ring during installation.

39. GEAR HOUSING (LOW PRESSURE AREA) (34)

Check for porosity of housing. Can be corrected by peening the porous area.

40. NOISE IN CHUCK ASSEMBLY

Squealing (high pitched). If squeal is encountered only while applying turning force to steering wheel, it is an indication that generator and water pump drive belt adjustment is too loose. Make sure both top and bottom belts are adjusted to proper tension using Tool C-3379.

Once it has been ascertained that squealing noise is in chuck assembly, it possibly is caused by vibrating condition set up by control valve rod. Remove unit and install a new type (Part No. 1670685) valve rod adjusting disc (21). This new disc is counterbored on the lower surface. In rare instance where replacement of disc fails to correct a squealing noise, it may be necessary to replace piston (22) and valve (23) assemblies.

41. HISSING NOISE (NO LOAD)

Caused by low oil level or improper operation of back pressure valve (24), in lower position rod. Fill reservoir to proper level and recheck for noise. If noise is not eliminated, make following pressure checks:

Connect pressure gauge Tool C-3309 between the pump and pressure hoses. Open gauge valve and run engine at idle (475-500 RPM). With engine idling, no turn effort being applied to steering wheel, and unit at operating temperature the gauge should show a pressure between 70-100 psi. If pressure is below 70 psi., it is an indication that lower piston rod relief valve is not operating properly. If pressure is considerably above 100 psi., the plunger may be sticking and preventing normal return pressure. If pressure is not within limits, install new back pressure valve assembly, (24) making sure end plug is seated tightly against valve body.

(A) Hissing Noise (Right Turn Only)

This is caused by oil leaking past lower piston rod gear housing seal (25). Remove seal, with Tool C-3450, inspect lower piston rod and seal seat in gear housing for nicks, burrs, scratches, etc. Install new seal being sure it is properly seated in gear housing. Install seal with Tool C-3331.

(B) Hissing Noise Accompanied by Loss of Oil Through Upper Housing Vent (Left Turn Only)

This is caused by oil leaking past upper piston rod housing head oil seal, (7). Remove seal, inspect upper piston rod and seal seat in housing head for nicks, scratches, burrs, etc. Install new seal being sure it is properly seated in housing head. Use same tools that were used on lower piston rod seal.

42. CREAKING NOISES ON TURNS

Probably due to loose gear to frame mounting bolts (27). Tighten bolts to 55-60 foot-pounds torque. If noise still persists, install new equal tooth sector or gear shaft (36) the new type shaft can be identified by absence of chamfer on center tooth. It is further identifiable by letter "O" stamped on threaded ends of shaft.

A new sector can be installed as follows without removing unit from vehicle:

Using puller Tool C-3402, remove steering gear arm. (Do not use a wedge for removing this arm).

Remove gear shaft cover. Align sector gear with cover opening. Push old gear shaft out of housing. Install new gear shaft. Install new gear shaft oil seal. Adjust gear for no-backlash throughout its entire travel. With gear in center position, adjust screw (20) until backlash disappears. If no backlash exists, loosen adjusting screw (20) until backlash appears and adjust to point of no backlash. Then tighten adjusting screw (20) ¾ turns beyond no backlash position. Tighten lock nut (37) to 30 foot-pounds.

43. SNAPPING NOISES

This is usually an intermittent noise which is produced when direction of steering wheel rotation is suddenly reversed. Tighten steering gear to frame mounting bolts (27). If noise still exists, remove steering check from vehicle and proceed as follows:

a. Check coupling screw (28) for tightness.

b. Check lower piston rod bushing dowel pin for being too high.

c. Remove bushing and inspect for any foreign matter which may be under bushing, preventing it from seating properly.

d. Inspect bearing surface of bushing for signs of excessive roughness.

e. Install new bushing if needed, making sure it is seated properly in gear housing and head of dowel pin is slightly below bearing surface of bushing.

f. Check lower piston rod (26) to assure a tight fit exists at piston (22). If looseness exists, it could possibly be due to too thin a snap ring or too wide a snap ring groove.

g. Replace necessary parts to assure a tight fit.

44. CHUCKLE NOISE

This noise will be most noticeable when vehicle is being operated on rough or choppy roads and usually is accompanied by wheel wander. This condition can be caused by any one or more of following items, each of which should be checked in following sequence:

a. Steering gear arm nut (31) loose on gear shaft. Tighten to 100 to 120 foot-pounds torque.

b. Loose front wheel bearing. Adjust bearings.

c. Gear shaft (36) adjusted too loose. Adjust gear shaft.

d. Excessive king pin end play. There should be .006 to .008 inch clearance between steering knuckle and knuckle support. Adjust as needed by use of shims.

e. Steering tube coupling screw (28) loose. Tighten screw.

f. Worm bearing (29) preload adjustment too loose. Adjust to proper preload with Tool C-3319 and C-3320 in combination with correct torque wrenches.

g. Excessive worm shaft end play in connector assembly (30). Replace worm and connector as an assembly (Part No. 1671270).

45. WANDER (STEERING WHEEL FREEPLAY)

This is a condition whereby operator has to constantly turn steering wheel in order to hold vehicle in a straight course. To determine whether or not this condition is caused by power steering unit, proceed as follows:

With front wheels in straight ahead position and resting on floor, start engine. Using a very light feather touch on steering wheel, check for freeplay. This should not exceed 5/8 inch.

CAUTION

Extreme care should be used when checking steering wheel freeplay, as it is rather difficult to check exact point freeplay begins and ends.

If steering wheel freeplay exceeds 5/8 inch, without moving steering linkage, it is an indication that this difficulty is caused by one of following items in power unit, and should be checked in following sequence:

a. Gear Shaft adjustment too loose. Adjust gear shaft (20).

b. Steering tube coupling screw loose. Tighten screw (28).

c. Worm bearing (29) preload adjustment too loose. Adjust to proper preload with Tools C-3319 and C-3320 and in combination with correct torque wrenches.

d. Excessive worm shaft end play in connector assembly (30). Replace worm and connector as an assembly. (Part No. 1670687) (30).

If steering wheel freeplay does not exceed 5/8 inch, it is an indication that the difficulty is caused by one of following:

a. Steering gear arm nut loose on gear shaft. Tighten to 100-120 foot-pounds torque (31).

b. Loose front wheel bearings. Adjust.

c. Steering linkage. Check for worm or loose tie rod ends, loose steering knuckle arms, drag links, etc. Tighten or replace necessary parts to eliminate freeplay.

d. Front wheel alignment. Align front wheel.

46. POOR RETURNABILITY (BOTH DIRECTIONS)

This is a condition whereby front wheels will

not return to straight ahead position without assistance of operator. A primary cause of this condition is often due to low tire pressure, therefore, prior to checking further, inflate tires to proper pressure and road test. If condition still exists, check returnability of power unit as follows to determine if condition is caused by power unit or front wheel alignment.

Disconnect linkage from steering gear arm and start engine. With engine idling, use torque wrench on steering gear arm nut (31) and check torque required to turn gear shaft through center from one extreme to other.

The torque reading should be approximately equal in each direction and should not exceed 40 foot-pounds, + or — 10 pounds. If torque reading does not exceed 40 foot-pounds + or — 10 pounds, it is an indication that difficulty is caused by one of following and not power steering unit:

a. Check all tie rod ends, steering knuckles, king pins and bushings for binding. If a bind is found to exist in any of these parts, replace as necessary.

b. Front wheel alignment. Align front wheels.

If torque readings exceed 40 foot-pounds, + or — 10 pounds, in either direction, it is an indication that the condition is caused by the power steering unit. To determine an exact source, it will be necessary to start engine and recheck amount of torque required to turn gear shaft each time one of following items is checked.

a. Steering wheel to column jacket interference. Adjust to give necessary clearance.

b. Steering column jacket bearing. Remove steering wheel, with puller Tool C-3428, jacket and shroud assembly and steering tube. Recheck torque, if reading is 40 foot-pounds or below, the difficulty is caused by steering column jacket bearings, replace bearing. If reading was not below 40 foot-pounds, proceed as follows:

c. Gear shaft adjustment too tight. Adjust gear shaft (36) for "no freeplay" 150 degrees each side of center and recheck torque reading. If condition still exists, and torque reading increases considerably when passing through center of gear travel, it is possibly due to excessive chamfer on center tooth of gear shaft (36).

CAUTION

This does not apply to units which have equal tooth gear shaft. (Identified by absence of chamfer on center tooth).

Remove gear shaft from lower housing and check for excessive chamfer on center tooth of gear shaft. The width of chamfer flat on center tooth should not exceed $\frac{1}{16}$ inch. If it does, replace gear shaft. If torque reading still remains above 40 foot-pounds, remove power steering unit and proceed as follows:

d. Worm bearing preload too tight (29). Place unit in special holding fixture Tool C-3323, connect test hoses and refill reservoir. Remove worm shaft oil seal (33). Start engine and recheck torque reading. If torque reading remains above 40 pounds, check worm bearing preload for being too tight. Readjust preload. If reading still remains above 40 foot-pounds, proceed as follows:

e. Worm shaft binding in connector (30). Remove upper housing (15) and using Tool C-3469, secure housing head (2). Start engine and recheck torque reading. If reading is 40 pounds or below, difficulty is due to either worm shaft (38) binding in connector (30) or connector guide rails binding on housing. Inspect and replace necessary parts.

47. POOR RETURNABILITY (ONE DIRECTION ONLY)

This is a condition whereby front wheels will not return to straight ahead position without assistance of operator. A primary cause of this condition is often due to low tire pressure, therefore, prior to checking further, inflate tires to proper pressure and road test. If condition still exists, check returnability of power unit as follows to determine if condition is caused by power unit or front wheel alignment:

a. Disconnect linkage from steering gear arm and start engine.

b. With engine idling, use a torque wrench on steering gear arm nut, (31) and check torque required to turn gear shaft through

center from one extreme to other. The readings should be approximately equal and not exceed 40 foot-pounds in either direction. If torque readings are equal and do not exceed 40 foot-pounds, then difficulty is caused by front wheel alignment and not power unit.

c. Align front wheels. If this does not correct condition, then proceed as follows:

d. Center the control valve until equal torque readings are obtained in each direction.

48. UNEQUAL STEERING EFFORT (SEVERE CASES SELF STEERING)

A condition whereby operator finds that it takes very little effort to turn steering wheel in one direction, while considerable force is required, in the opposite. In severe cases of unequal steering effort it is possible that vehicle will have a tendency to self steer unless steering wheel is held.

Unequal steering effort is often mistaken for "lack of assist in one direction," and since causes for each are entirely different, make sure difficulty is diagnosed properly before attempting to correct. To establish which condition exists, check turning effort of steering wheel as follows:

a. With engine idling and front wheels resting on floor, turn steering wheel at normal rate of RPM from one extreme to other, noting amount of turning force required. Turn steering wheel in same manner except at much higher rate of RPM and again noting amount of turning force required.

CAUTION

Do not exceed 60 steering wheel RPM's when making this check.

If turning force did increase considerably with higher rate of steering wheel rpm's, then refer to "lack of assist" (one direction). If amount of turning force did not increase appreciably with increased steering wheel rpm, then it is reasonable to assume that condition is unequal steering effort. Proceed as follows:

b. Disassemble unit as required.

49. CONTROL VALVE ADJUSTMENT (23)

Disconnect linkage and center control valve so that an equal amount of torque is required to turn gearshaft from one extreme to other. If proper adjustment cannot be maintained after it has been set, then refer to "INABILITY TO MAINTAIN CONTROL VALVE ADJUSTMENT", Paragraph 51.

50. UPPER PISTON ROD (3) MOVEMENT IN PISTON (22)

Check fit of snap ring (39) which retains upper piston rod (3) in piston (22), by attempting to rotate it. If snap ring can be rotated, it will allow upper piston rod to move axially with respect to piston thus displacing control valve in relation to valve body. This can cause self steering in either direction; however, it is usually most noted to be to the left. To correct, replace piston (22) making sure snap ring seats properly.

51. CONNECTOR NUT (40)

Anything which will cause valve rod adjusting disc to be loose in connector (4), will result in self steering. Check for connector nut (40) not tightening sufficiently to lock valve rod adjusting disc (21) and reaction assembly in connector. To accomplish this, remove worm connector (30) and reaction assemblies (16) from upper piston rod. Reassemble by placing the adjusting disc, adjusting disc retainer and valve control spacer in their respective positions in worm connector. Install worm connector nut and tighten securely. Insert small punch or screwdriver through bottom of connector and attempt to rotate adjusting disc. If it cannot be rotated, it is properly locked.

52. CONTROL VALVE LOOSE ON ROD (23)

The control valve rod is connected to control valve by peening. Check for any movement between the two. If movement exists, replace control valve and rod. Do not attempt to tighten by peening.

53. UPPER PISTON ROD NUT LOOSE (41)

Tighten to proper torque.

54. UPPER PISTON ROD (3)

Inspect upper piston rod for being scored at

reaction seal retainer bearing surfaces and replace if needed.

55. REACTION ASSEMBLY (16)

If above mentioned items have failed to correct unequal steering effort, replace all reaction parts. Make definitely sure valve control spacer is matched to upper piston rod. The length of valve control spacer must be identical to distance between the seat of lower valve control spacer retainer and the seated upper piston rod nut.

56. INABILITY TO MAINTAIN CONTROL VALVE ADJUSTMENT

This condition can be caused by one of following: Reaction spacer (16) being too long, too short, or by burrs, or out of squareness of any reaction area parts which are held inside connector by connector nut, including nut. Anything which causes unseating of reaction retainers when no turning force is applied will make accurate valve adjustment impossible. This can also be caused by one of following:

a. Valve Control Rod Loose in Disc (21). The valve control rod is locked in position by threads in adjusting disc. The locking effort of adjusting disc can be increased by slightly compressing locking portion in a vise.

CAUTION

The turning torque for valve control rod in threads of valve rod adjusting disc should be 10-12 inch pounds to prevent any looseness at this point. Do not exceed 20 inch pounds otherwise damage to valve rod and/or adjusting tool may result.

b. Upper piston rod nut (14) loose. Tighten to proper torque.

c. Control valve (23) loose on rod. The control valve rod is connected to control valve by peening. Check for any movement between the two. If movement exists, replace control valve and rod. Do not attempt to tighten by peening.

d. Upper piston rod (3) loose in piston (22). Check for movement of upper piston rod in piston. If movement exists, replace piston.

57. LACK OF ASSIST (ONE DIRECTION)

This is a condition whereby operator finds that considerable more effort is required to turn steering wheel in one direction than it does the other. Since lack of assist in one direction is often mistaken for "Unequal Steering Effort" and causes for each are entirely different, make sure difficulty is properly diagnosed before attempting to correct. To determine which condition exists, refer to "Unequal Steering Effort" for method of establishing. Lack of assist in one direction usually is found to be caused by one of following:

a. Piston Ring (43) (Neoprene). Check for damaged neoprene piston ring.

b. Housing Head Oil Seal (7) Upper Piston Rod. A damaged or improperly seated housing head oil seal will cause lack of assist when turning to left, and will also be accompanied by loss of oil out vent in upper housing. Inspect sealing surface on upper piston rod for being scratched. Replace if necessary. Install new housing head oil seal making sure it is properly seated in housing head.

c. Valve Rod Lower "O" Ring (18). Inspect for damaged lower valve rod "O" Ring in upper piston rod. Inspect groove for any foreign matter. Install new "O" Ring making sure it is seated properly in groove.

d. Piston Rod "O" Rings (42). Inspect for damaged "O" rings on both upper and lower piston rods which may be causing leakage between piston and rods. Install new "O" rings making sure they fit properly in grooves.

58. LACK OF ASSIST (BOTH DIRECTIONS)

This is a condition whereby operator notes that considerable amount of effort is required to turn steering wheel in both directions. To locate cause of condition, check following possibilities in manner in which listed:

a. Tire pressure too low. Inflate to proper pressure.

b. Generator Drive Belt slipping or broken. Adjust belts to proper tension, or replace if needed.

CAUTION

Where two belts are used, make definitely sure both top and bottom belts are adjusted, otherwise condition will remain.

c. Low fluid level. Fill reservoir to proper level.

d. Should lack of assist still be encountered, a pressure check should be made to determine if pump is at fault.