GROUP 8
STEERING GEAR AND LINKAGE

SECTIONS IN GROUP 8

SECTION 8-A

MANUAL STEERING GEAR AND LINKAGE

CONTENTS OF SECTION 8-A

8-1 MANUAL STEERING GEAR SPECIFICATIONS

a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for *clean and lightly lubricated threads only;* dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Part	Location	Thread Size	Torque-Ft. Lbs.
Bolt	Coupling Lower Flange Pinch	3/8-24	25-40
Bolt & Nut	Tie Rod Clamp	3/8-24	30-40
Bolt	Gear Side Cover to Housing	3/8-16	25-35
Bolt	Idler Arm Support to Frame	3/8-16	20-30
Bolt	Gear Housing to Frame	7/16-14	60-75
Nut	Tie Rod Ball Stud to Steering Arm	1/2-20	50-60
Nut	Steering Wheel to Steering Shaft	11/16-20	30-35
Nut	Pitman Arm to Pitman Shaft	7/8-14	90-110
Bushing	Idler Arm	7/8-11	100-115

b. Steering Gear Specifications

Items	
Gear Type	Recirculating Ball Worm and Nut
Make	Saginaw
Ratio, Gear Only	24.0 to 1
Ratio, Overall (Including Linkage)	29.3 to 1
Turns of Wheel, Lt. to Rt. (Gear connected)	5
Turning Circle Diameter (Curb to Curb)	
Series 4400-4600	44.0 ft.
Series 4700-4800	45.7 ft.
Lubrication	Plug in Housing
Oil Capacity	13 oz.
Steering Wheel Diameter	17″
Number and Type of Pitman Shaft Bearings	2 Bushings
Number and Type of Worm Shaft Bearings	2 Ball Bearings
Worm and Nut Balls—No. and Diameter	50, 9/32″
Adjusting Screw and Shim Clearance in Pitman Shaft	0 to .002″
Worm Bearing Preload—Lbs. Pull at Wheel Rim	1/4 to 3/4 lbs.
Pitman Shaft Overcenter (Including Worm Bearings)—Lbs. Pull at Wheel Rim	7/8 to 1 1/2 lbs.
Worm Bearing Preload—Torque at Spline	2 to 7 in. lbs.
Pitman Shaft Overcenter (Including Worm Bearings)—Torque at Spline	8 to 13 in. lbs.
Intermediate Rod Plug Adjustments	See fig. 8-5
Toe-in, Caster, Camber, etc.	See fig. 7-19

8-2 DESCRIPTION OF MANUAL STEERING GEAR AND LINKAGE

a. Steering Gear Assembly

The steering gear is the recirculating ball worm and nut type. The worm on lower end of the steering shaft and the ball nut which is mounted on the worm have mating spiral grooves in which steel balls circulate to provide a low-friction drive between worm and nut. See figure 8-1.

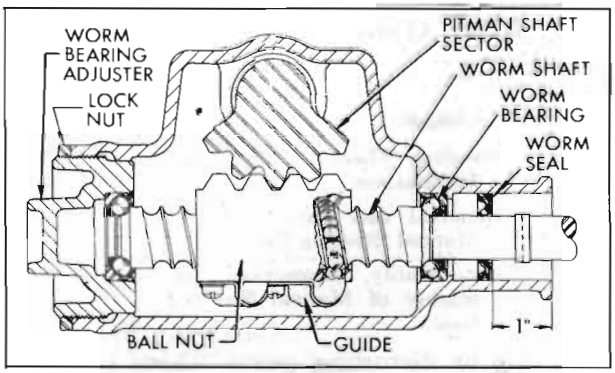

Figure 8-1—Steering Gear Worm and Ball Nut

Two sets of 25 balls are used, with each set operating independently of the other. The circuit through which each set of balls circulates includes the grooves in worm and ball nut and a ball return guide attached to outer surface of nut.

When the wheel and steering shaft turn to the left the ball nut is moved downward by the balls which roll between the worm and nut. As the balls reach the outer surface of nut they enter the return guides which direct them across and down into the ball nut, where they enter the circuit again. When a right turn is made, the ball nut moves upward and the balls circulate in the reverse direction. See figure 8-1.

Teeth on the ball nut engage teeth on a sector forged integral with the pitman shaft. The teeth on the ball nut are made so that a "high point" or tighter fit exists between the ball nut and pitman shaft sector teeth when front wheels are in the straight-ahead position. The teeth of sector are slightly tapered so that a proper lash may be obtained by moving the pitman shaft endways by means of an adjusting screw which extends through the gear housing side cover. The head of adjusting screw and a selectively fitted shim fit snugly into a T-slot in the end of the pitman shaft, so that the screw also controls end play of shaft. The screw is locked by an external lock nut. See figure 8-2.

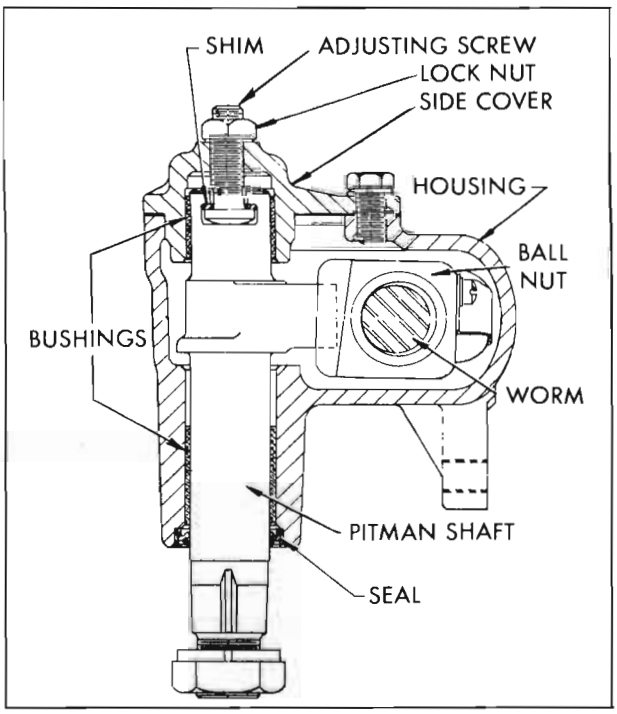

Figure 8-2—Steering Gear Pitman Shaft and Ball Nut

The pitman shaft is carried by a bushing in the steering gear housing and a bushing in the housing side cover. A seal in the housing prevents leakage of lubricant at the lower end of the shaft. See Figure 8-2.

The steering worm shaft is carried by two ball thrust bearings which bear against seats on the ends of the worm. The outer race of the upper worm bearing is pressed into the gear housing.

The outer race of the lower worm bearing is pressed into the worm bearing adjuster which screws into the housing and is locked by a nut.

This adjuster is turned to provide proper preloading of the upper and lower worm bearings. The steering gear housing is attached to the frame by three bolts.

The upper steering shaft is a separate shaft supported in the steering column jacket. Its upper end is supported by a ball bearing; its lower end by an adapter and ball bearing assembly. A nylon pin in the instrument panel support bracket fits in a slot in the mast jacket and locates it radially.

The upper steering shaft is connected to the steering worm shaft through a flexible coupling. This flexible coupling helps absorb minor shocks and vibrations, and gear rattle, and also allows slight variations in alignment between the steering gear assembly and the steering column jacket assembly.

b. Steering Linkage

The parallelogram type steering linkage is used to connect both front wheels to the steering gear pitman arm. As shown in figure 8-5, the right and left tie rods are connected to a tubular intermediate rod. The left end of the intermediate rod is supported by the pitman arm and the right end is supported by an idler arm which pivots on a support attached to the frame. The pitman and idler arms are always parallel with each other and move through symmetrical arcs.

Four ball studs are held between pairs of ball socket type bearings contained in the intermediate rod. The bearings are held in firm contact with the ball studs through pressure applied by heavy coil springs located at the pitman and idler arm stud bearings. Steel spacers transmit this spring pressure to the tie rod ball stud bearings. See figure 8-5.

The linkages used for manual steering and power steering are the same except for ratio and that the anti-wheel kick springs at the pitman arm ball have been eliminated on the power steering linkage, and the internal spline on the pitman arm is ⅛" larger.

Flanged steel bumpers extending through the springs act as spring guides, permit a restricted movement of ball studs and bearings as the springs absorb road shock, and prevent the bearings from spreading and releasing the ball studs in the event of spring breakage. The spring tension and clearances at ends of bumpers are adjusted by the threaded end plugs. See figure 8-5.

The openings through which the ball studs enter the intermediate rod are protected by steel dust covers to keep lubricant in and dirt and water out. Bearings and ball studs receive lubrication from inside the intermediate rod which is provided with two grease fittings.

The tie rod end, which connects each tie rod to a steering arm, is a spring-loaded ball stud and socket unit assembly. A rubber dust seal fits over the stud where it emerges from the socket, to provide protection against entrance of dirt and water. The tie rods are connected to the tie rod ends by internally threaded sleeves which provide for toe-in adjustment. The sleeves are slotted and provided with clamps at each end to lock them in place. See figure 8-5.

8-3 TROUBLE DIAGNOSIS—MANUAL STEERING GEAR AND LINKAGE

This paragraph covers improper steering actions which are most likely to be caused by the steering gear assembly or tie rods. Improper steering actions which are most likely to be caused by chassis suspension members are covered in paragraph 7-6.

a. Excessive Play or Looseness in Steering System

(1) Front wheel bearings loosely adjusted (par. 7-10).

(2) Worn upper ball joints (par. 7-11).

(3) Steering wheel loose on shaft, loose pitman arm, tie rods, or steering arms.

(4) Excessive pitman shaft sector to ball nut lash (par. 8-4).

(5) Worm bearings loosely adjusted (par. 8-4).

b. Hard Steering—Excessive Effort Required at Steering Wheel

(1) Low or uneven tire pressure (par. 1-1).

(2) Insufficient or improper lubricant in steering gear or front suspension (par. 1-1).

(3) Excessive steering shaft coupling misalignment.

(4) Steering gear or tie rods adjusted too tight, or idler arm binding on support (par. 8-4).

(5) Front wheel alignment incorrect (par. 7-17).

(6) Frame bent or broken (par. 12-1).

c. Rattle or Chuckle in Steering Gear

(1) Insufficient or improper lubricant in steering gear (par. 1-1).

(2) Excessive back lash between ball nut and pitman shaft sector in straight ahead position or worm thrust bearings adjusted too loose (par. 8-4). NOTE: *On turns a slight rattle may occur, due to the increased lash between ball nut and sector as gear moves off the center or "high point" position. This is normal and lash must not be reduced to eliminate this slight rattle.*

(3) Pitman arm loose on shaft, tie rod connections loose, or steering gear loose at mounting brackets.

(4) Loose adjustment of steering shaft bearings.

8-4 ADJUSTMENT OF MANUAL STEERING GEAR AND LINKAGE

IMPORTANT: *Never attempt to adjust the steering gear while it is connected to the intermediate rod. The steering gear must be free of all outside load in order to properly make any steering gear adjustment.*

a. Adjustment of Steering Gear in Car

There are two adjustments on the steering gear: worm bearing preload, and pitman shaft overcenter preload.

1. Torque steering gear to frame bolts to 60 ft. lbs. Torque pitman arm nut to 100 ft. lbs.

2. Disconnect intermediate rod from pitman arm by unscrewing end plug until bearings will release ball stud.

3. Turn steering wheel slowly from one extreme to the other. CAUTION. *Never turn the wheel hard against the stopping point in the gear, as damage to the ball nut assembly may result.*

Steering wheel should turn freely and smoothly through entire range. Roughness indicates faulty internal parts, requiring disassembly of the steering gear. Hard pull or binding indicates an excessively tight adjustment of worm bearings, or excessive misalignment of steering shaft coupling. Any excessive misalignment must be corrected before steering gear can be properly adjusted.

4. *Check Worm Bearing Preload.* Turn steering wheel gently in one direction until it stops. This positions gear away from "high point" load.

5. Apply Scale J-544 to a spoke at rim of wheel in opposite direction and exert a steady pull while keeping the scale at 90 degrees to spoke. The pull required to keep wheel turning slowly should be between ¼ and ¾ pounds. Adjust if necessary to obtain this bearing load.

6. *Adjust Worm Bearing Preload.* Loosen worm bearing adjuster lock nut using a drift. See Figure 8-3. Turn bearing adjuster as required to bring scale pull between ¼ and ¾ pounds. Tighen lock nut, then recheck preload.

7. Torque side cover bolts to 30 ft. lbs.

8. *Check Pitman Shaft Overcenter Preload.* Turn steering wheel from one extreme to the other while counting the total turns (6¼ turns), then turn wheel back ½ the number of turns (3⅛ turns). This positions steering gear

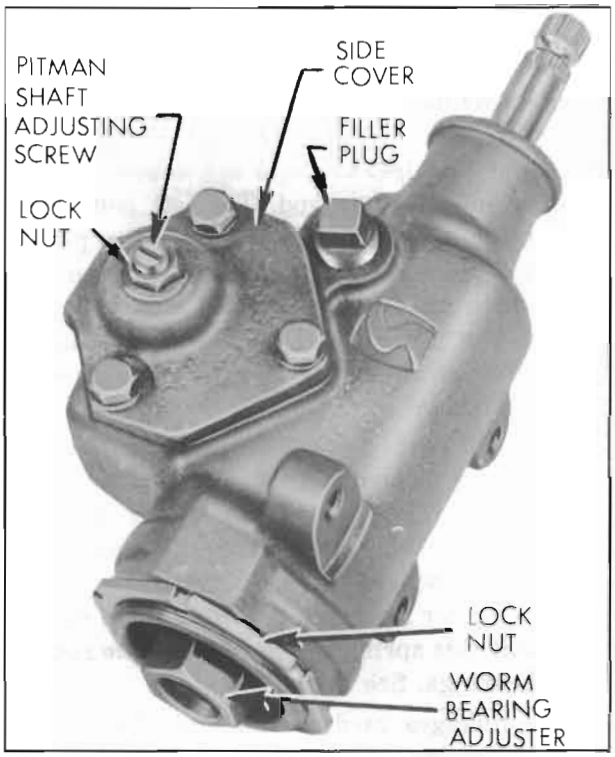

Figure 8-3—Steering Gear Adjusters

on "high point" where a preload should exist between ball nut and pitman shaft teeth.

9. Check pull at wheel with Scale J-544 as described above. The pull required to keep wheel moving through the "high point" should be between ⅞ and 1½ pounds. Adjust if necessary to obtain this overcenter load.

10. *Adjust Pitman Shaft Overcenter Preload.* Loosen lock nut and turn pitman shaft adjusting screw as required to bring scale pull between ⅞ and 1½ pounds. After tightening lock nut, rotate steering wheel back and forth through the "high point" and through the entire range to check for tight spots.

NOTE: *If lash cannot be removed at "high point," or if gear load varies greatly and feels rough, gear assembly should be removed for inspection of internal parts.*

b. Adjustment of Steering Gear on Bench

1. Place manual steering gear in vise. Then install Adjuster Adapter J-6281 on flexible coupling. See Figure 8-4.

2. Turn worm shaft to extreme right or left position. Apply Scale J-544 to adjuster at notched end. While pulling scale at 90 degrees to adjuster, turn worm bearing adjuster to obtain a reading of ¼ to ¾ pounds with worm shaft turning slowly. (Worm bearing preload

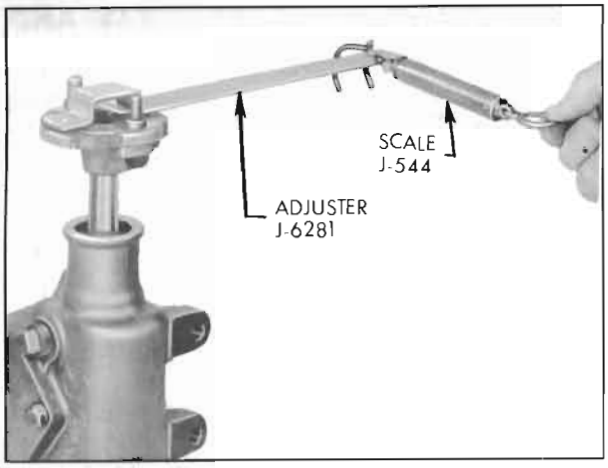

Figure 8-4—Checking Adjustments on Bench

adjustment must be made within ½ turn of worm shaft from extreme position.)

3. Tighten worm bearing adjuster lock nut and recheck reading.

4. Turn worm shaft from one extreme to the other while counting turns, then turn back ½ the total number of turns. This places the steering gear on the "high point".

5. Turn pitman shaft adjusting screw clockwise until a reading of ⅞ to 1½ pounds is obtained while pulling the adjuster through the "high point" range. Tighten lock nut and recheck reading.

c. Adjustment of Steering Linkage

The intermediate rod must be maintained in a level position to insure good steering action. This requires proper location of the idler arm on its support so that the idler arm ball stud will be level with the pitman arm ball stud. The support must be threaded into the idler arm bushing until the distance from the center of support lower bolt hole to the nearest face of idler arm is $2\frac{15}{16}$" to 3", as shown in Figure 8-5. After any adjustment of idler arm on its support the front wheels should be checked to insure proper toe-in.

IMPORTANT: If the idler arm support is dismounted from the frame for other work, such as removal of the lower crankcase, wire the support to the idler arm so that it cannot turn from its existing position and possibly change the toe-in of the front wheels.

Whenever the intermediate rod is being connected to the idler arm or pitman arm, be careful to properly seat the bearings around the ball stud and make sure that the pressed steel dust cover properly protects the opening around ball stud. On *idler arm* end of rod, turn the end plug up tight then back off ¼ to ½ turn (½ turn preferred) and install cotter pin. On *pitman arm* end of rod, on manual steering linkage, tighten end plug, then back off 4 ± ⅛ turns and install

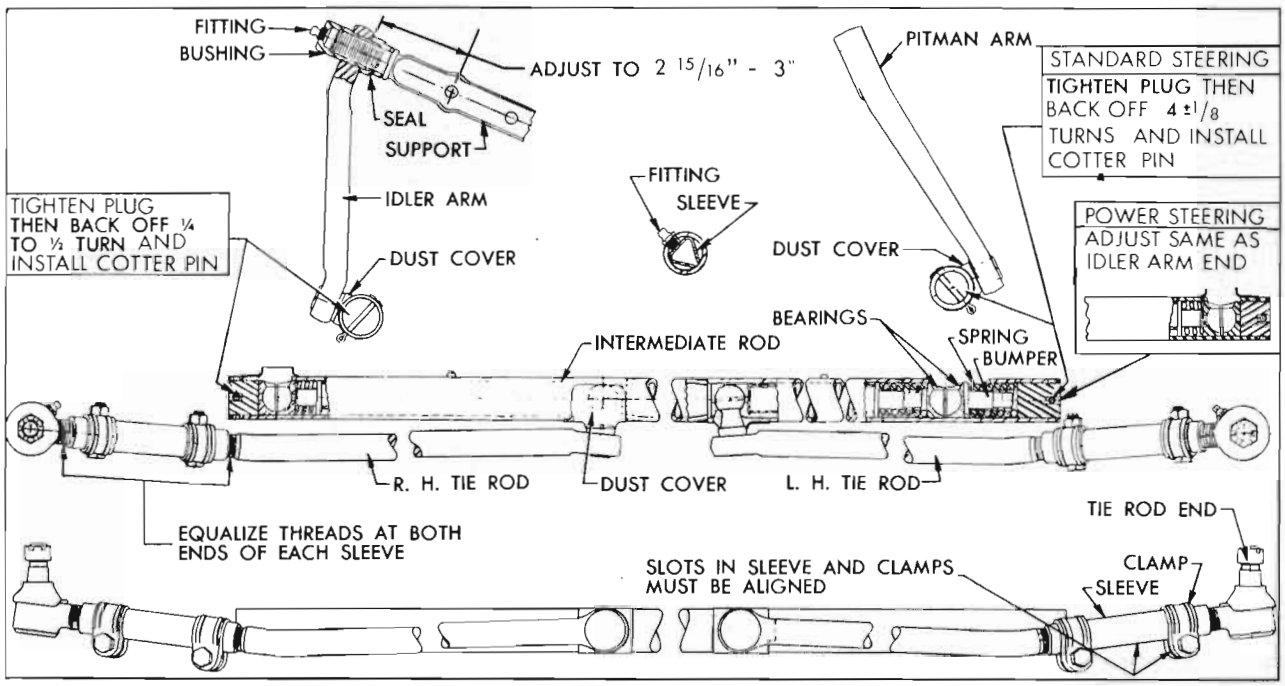

Figure 8-5—Steering Linkage (Manual and Power)

cotter pin. CAUTION: *If end plug becomes tight before head is flush with end of rod, check for improper position of two bearings around ball stud.*

On the power steering linkage, the pitman arm end plug adjustment is made in the same manner as idler arm end. NOTE: *After completing work on steering linkage, linkage should be lubricated.*

See paragraph 7-17 (subpar. e) for adjustment of tie rods to obtain proper toe-in of front wheels.

d. Road Test after Adjustment

Road test car for ease of steering. If steering gear was adjusted to specified load limits and hard steering exists, the front suspension members should be checked for lubrication and alignment and tire inflation pressures should be checked. When car is moving straight ahead, the steering wheel should be in the straight-ahead position, or not over 5/8" to either side of the straight-ahead position. If steering wheel is too far to either side, check wheel for proper position on steering shaft (par. 8-5) and check tie rods for equal adjustment and toe-in (par. 7-17). It is important to have the steering gear in the no-lash range when car is moving straight forward.

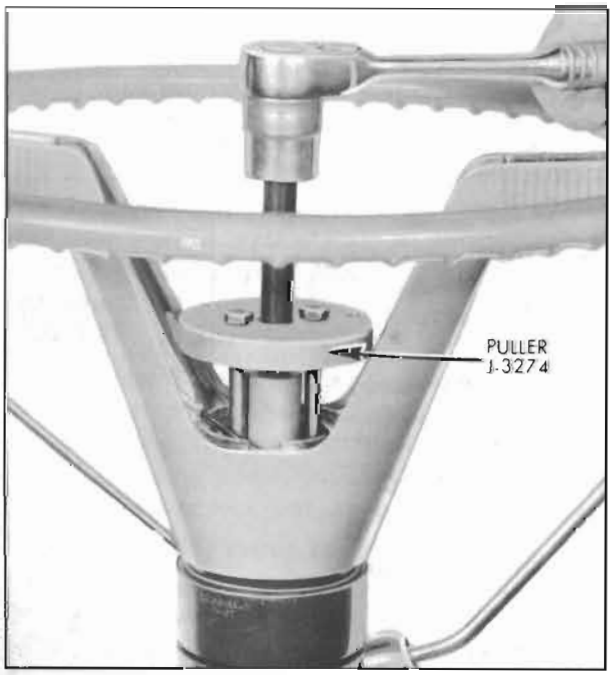

Figure 8-6—Removing Steering Wheel

8-5 STEERING WHEEL REMOVAL AND INSTALLATION

a. Removal of Steering Wheel

1. Disconnect wire at horn cable connector on steering column to prevent horn from blowing.

2. Remove horn emblem bezel from center of steering wheel (par. 10-52), unplug horn wire, and loosen steering wheel nut several turns.

3. Apply Puller J-3274 and pull wheel back to nut. See figure 8-6. NOTE: *If wheel hub is very tight on shaft, apply a moderate strain with puller then tap end of puller screw to break hub loose from shaft without distorting wheel hub.* Remove puller, nut, and steering wheel.

b. Installation of Steering Wheel

1. Install steering wheel with location marks on shaft and hub of wheel in line.

NOTE: *Location marks for proper installation of steering wheel on steering shaft are provided to insure a straight-ahead position of the steering wheel when front wheels are in straight-ahead position.*

2. With wheel properly located on shaft, install self-locking nut and tighten securely.

3. Plug horn connector in center of steering column shaft. Install horn emblem bezel in center of steering wheel (par. 10-52), and connect wire to horn cable connector on steering column.

8-6 REMOVAL AND INSTALLATION OF MANUAL STEERING GEAR

a. Removal of Steering Gear Assembly

1. Remove two nuts and lock washers holding flexible coupling to steering shaft flange.

2. Jack up car and remove the pitman shaft nut and lock washer, then remove the pitman arm.

3. Remove the three steering gear to frame bolts at outside of left frame rail.

4. Remove steering gear from under car.

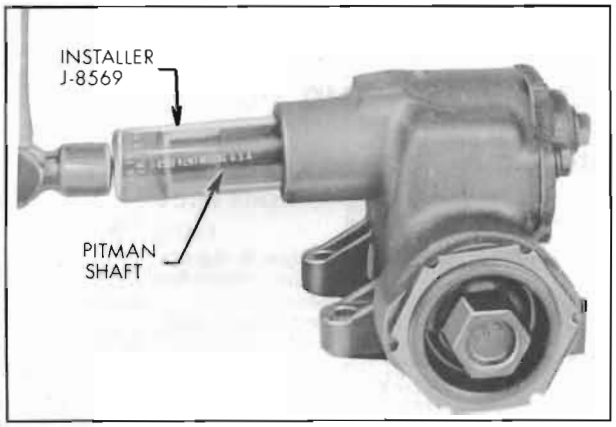

Figure 8-9—Installing Pitman Shaft Seal

is still in bore, it should first be driven in against shoulder to make room for new seal.

10. Slip flexible coupling over splines so that tang on coupling flange aligns with mark on worm shaft. Install flange pinch bolt.

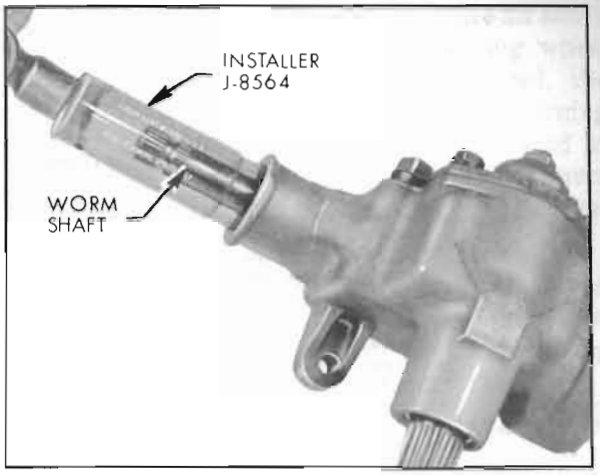

Figure 8-10—Installing Worm Shaft Seal

11. Fill steering gear with multi-purpose gear lubricant. Gear is now ready for final adjustment on bench as described in Paragraph 8-4,b.