

# GROUP 8

## STEERING GEAR AND LINKAGE

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## SECTION 8-A

### MANUAL STEERING GEAR

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## 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 & Nut	Lower Coupling Clamp . . . . .	5/16-18	20-35
Bolt	Gear Side Cover to Housing . . . . .	3/8-16	25-40
Bolt	Gear Housing to Frame . . . . .	7/16-14	60-75
Nut	Lash Adjuster Lock . . . . .	7/16-20	18-27
Nut	Steering Wheel to Steering Shaft . . . . .	1/2-20	20-35
Nut	Pitman Arm to Pitman Shaft . . . . .	7/8-14	90-110

### b. Steering Gear Specifications

Items	Specifications
Gear Type . . . . .	Recirculating Ball Worm and Nut
Make . . . . .	Saginaw
Ratio, Gear Only . . . . .	28.0 to 1
Ratio, Overall (Including Linkage) . . . . .	33 to 1
Turns of Wheel, Lt. to Rt. (Gear connected) . . . . .	5
Lubrication . . . . .	Plug in Housing
Oil Capacity . . . . .	11 oz.
Steering Wheel Diameter . . . . .	16"
Number and Type of Pitman Shaft Bearings . . . . .	2 Bushings

**b. Steering Gear Specifications (Cont'd)**

Items	Specifications
Number and Type of Worm Shaft Bearings	2 Ball Bearings
Worm and Nut Balls - No. and Diameter	50, 9/32"
Lash Adjusting Screw and Shim Clearance in Pitman Shaft Adjustments	0 to .002"
<b>Worm Bearing Preload</b>	
Torque at Worm or Steering Shaft	2 to 7 in. lbs.
Lbs. Pull at Steering Wheel Rim	1/4 to 3/4 lb.
<b>Pitman Shaft "Overcenter"</b>	
Torque at Worm or Steering Shaft	4 to 8 in. lbs. Higher than Worm Bearing Preload
Lbs. Pull at Steering Wheel Rim	1/2 to 1 lb. Higher than Worm Bearing Preload
Total "Overcenter" Pull Should Not Exceed	13 in. lbs. or 1 5/8 lbs.

**8-2 DESCRIPTION OF MANUAL STEERING GEAR**

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.

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

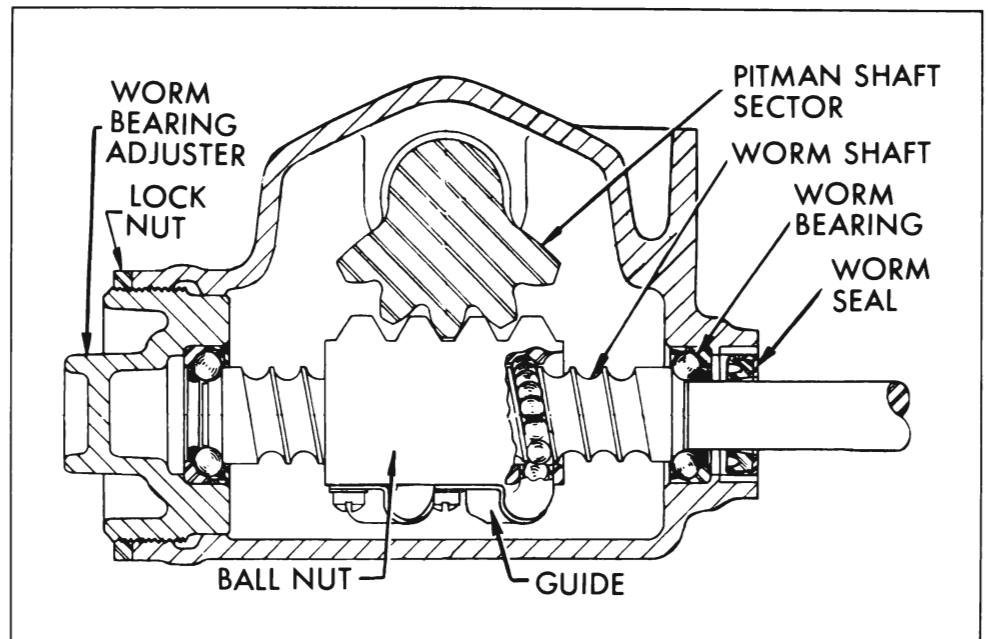


Figure 8-1—Steering Gear Worm and Ball Nut

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 a lash adjuster screw which extends through the gear housing side cover. The head of adjuster 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.

The pitman shaft is carried by a bushing in the steering gear housing and a bushing in the housing

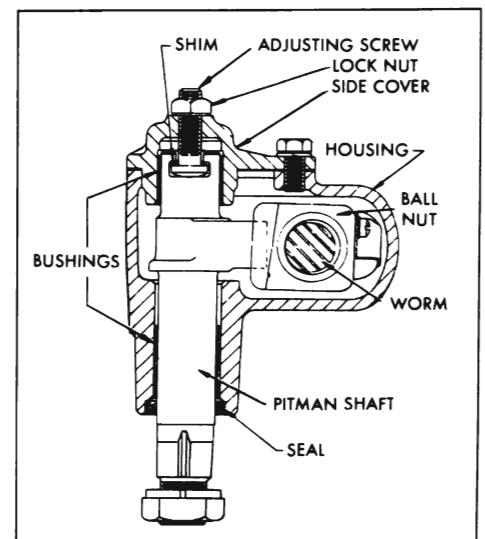


Figure 8-2—Steering Gear Pitman Shaft and Ball Nut

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 bearing; its lower end by an adapter and ball bearing assembly.

The upper steering shaft is connected to the steering worm shaft through a universal joint type coupling. This coupling allows slight variations in alignment between the steering gear assembly and the steering column jacket assembly.

### 8-3 TROUBLE DIAGNOSIS— MANUAL STEERING GEAR

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

#### a. Excessive Play or Looseness in Steering System

1. Front wheel bearings loosely adjusted (Group 7).
2. Worn upper ball joints (Group 7).

3. Steering wheel loose on shaft, loose pitman arm, tie rods, steering linkage ball studs 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. 1-2)

2. Insufficient or improper lubricant in steering gear or loss of lubricant in front suspension (par. 1-3)

3. Excessive steering shaft coupling misalignment.

4. Steering gear adjusted too tight, or idler arm binding on support (par. 8-21).

5. Front wheel alignment incorrect Group 7.

6. Improper position of mast jacket to lower coupling (See Figure 8-71).

#### c. Rattle or Chuckle in Steering Gear

1. Insufficient or improper lubricant in steering gear (par. 1-3)

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, or steering gear loose at frame.

4. Loose steering shaft bearings.

### 8-4 ADJUSTMENT OF MANUAL STEERING GEAR

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.

NOTE: If an inch pound torque wrench is not available, a spring scale may be used to check adjustment following specifications in paragraph 8-1, b.

#### 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 70 ft. lbs. Torque pitman arm nut to 100 ft. lbs.

2. Remove pitman nut. Disconnect pitman arm from pitman shaft using Puller J-5504. See Figure 8-28.

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 worn bearings, or excessive misalignment of steering shaft coupling. Any excessive misalignment must be corrected before steering gear can be properly adjusted.

4. Remove cap from steering wheel. See Figure 8-6.

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

6. Attach Torque Wrench J-5853 to steering wheel retaining nut and check the torque required to turn the wheel steadily in the range where lash exists between ball nut and pitman shaft sector. See Figure 8-4. The torque required to keep wheel turning should be between 2 and 7 inch pounds. Adjust worm bearing preload if necessary.

7. Adjust Worm Bearing Preload. Loosen worm bearing adjuster lock nut using a drift. See Figure 8-3. Turn bearing adjuster as required to bring pull between 2 and 7 inch pounds. Tighten lock nut, then recheck preload.

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

9. Check Pitman Shaft Over-center Preload. Turn steering wheel from one extreme to the other while counting the total turns, then turn wheel back 1/2 the number of turns. This positions steering gear on "high

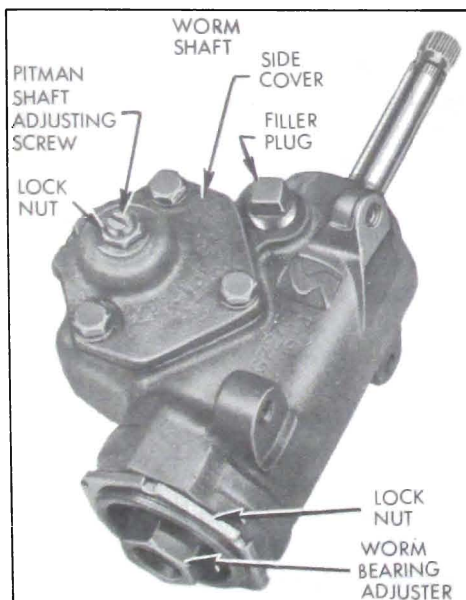


Figure 8-3—Manual Steering Gear Adjusters

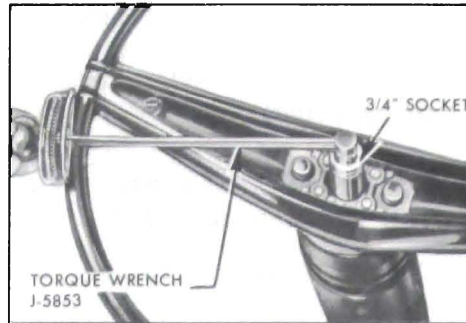


Figure 8-4—Checking Adjustments in Car

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

10. Check the torque required to turn wheel through the "high point" range. Torque should be between 4 and 8 inch pounds higher than worm bearing preload. Total "overcenter" pull should not exceed 13 inch pounds.

11. Adjust Pitman Shaft Over-center Preload. Loosen locknut and turn pitman shaft lash adjuster screw as required to bring torque between 4 and 8 inch pounds higher than worm bearing preload. After tightening locknut, 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.

12. When installing pitman arm on pitman shaft, torque nut to 100 ft. lbs.

**b. Adjustment of Steering Gear on Bench**

1. Attach Torque Wrench J-5853 to worm shaft and turn shaft to extreme right or left position. See Figure 8-5.

2. Turn worm bearing adjuster to obtain a reading of 2 to 7 inch pounds with worm shaft turning slowly. Worm bearing preload

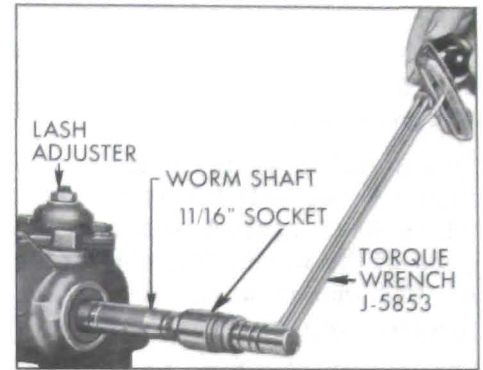


Figure 8-5—Checking Adjustments on Bench

adjustment must be made within 1/2 turn of worm shaft from extreme position.

3. Tighten worm bearing adjuster locknut and recheck reading.

4. Turn worm shaft from one extreme to the other while counting turns, then turn back 1/2 the total number of turns. This places the steering gear on the "overcenter" or "high point" position.

5. Loosen pitman shaft lash adjuster locknut and turn lash adjuster until a reading of 4 to 8 inch pounds higher than worm bearing preload is obtained while rotating worm shaft through the "overcenter" range. Tighten lock nut and recheck reading. Total "overcenter" pull should not exceed 13 inch pounds.

**c. 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 (Group 7). It is important to have the steering gear in the no-lash "overcenter" range when car is moving straight forward.

**8-5 STEERING WHEEL REMOVAL AND INSTALLATION**

**a. Removal of Steering Wheel**

1. Unplug horn ground wire connector at mast jacket to prevent horn from blowing.
2. Remove actuator cap, actuator bar, springs and ground plate from steering wheel. See Figure 8-6.
3. Loosen steering wheel retaining nut several turns. Do not remove nut.
4. Attach Puller J-3274 to wheel hub and pull wheel up to nut. See Figure 8-7. 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.

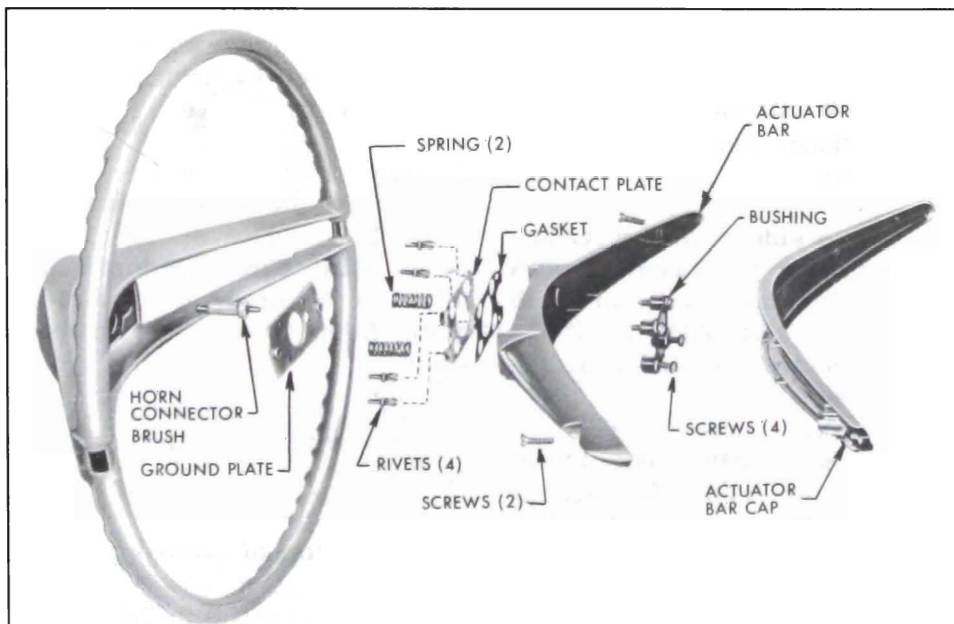


Figure 8-6—Steering Wheel Assembly

**b. Installation of Steering Wheel**

1. Apply lubriplate to horn contact brush and ring.
2. Install steering wheel with location marks on shaft and hub of wheel in line. See Figure 11-92.

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. See Figure 8-8.

3. With wheel properly located on shaft, install Stake nut and tighten to 30 ft. lbs. in place.
4. Install horn parts on steering wheel.
5. Plug horn wires together at mast jacket.

**8-6 REMOVAL AND INSTALLATION OF MANUAL STEERING GEAR**

**a. Removal of Steering Gear Assembly**

1. Remove steering shaft to gear

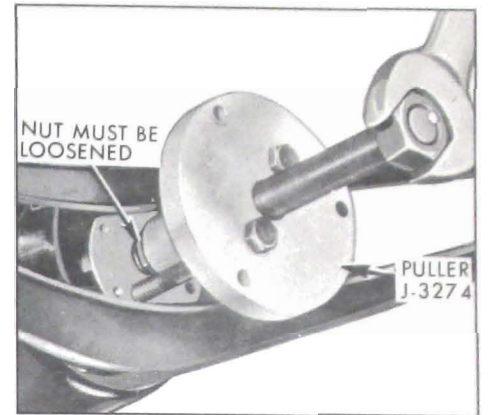


Figure 8-7—Removing Steering Wheel

coupling clamp bolt and nut. Slide clamp off coupling.

2. Jack up car and remove the pitman shaft nut and lock washer, then remove the pitman arm, using Puller J-5504. See Figure 8-28.

3. Loosen the three steering gear to frame bolts to complete removal of gear.

**b. Installation of Steering Gear Assembly**

1. Install the gear assembly by reversing the procedure for removal. Make sure that slot in coupling lines up with mark on worm shaft. See Figure 8-9.
2. Torque the pitman arm nut to 100 ft. lbs. and frame to gear bolts to 70 ft. lbs.

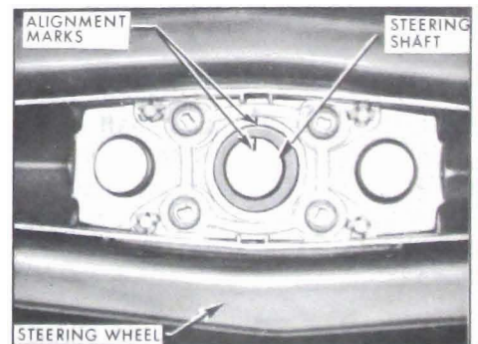


Figure 8-8—Steering Wheel and Shaft Alignment Marks

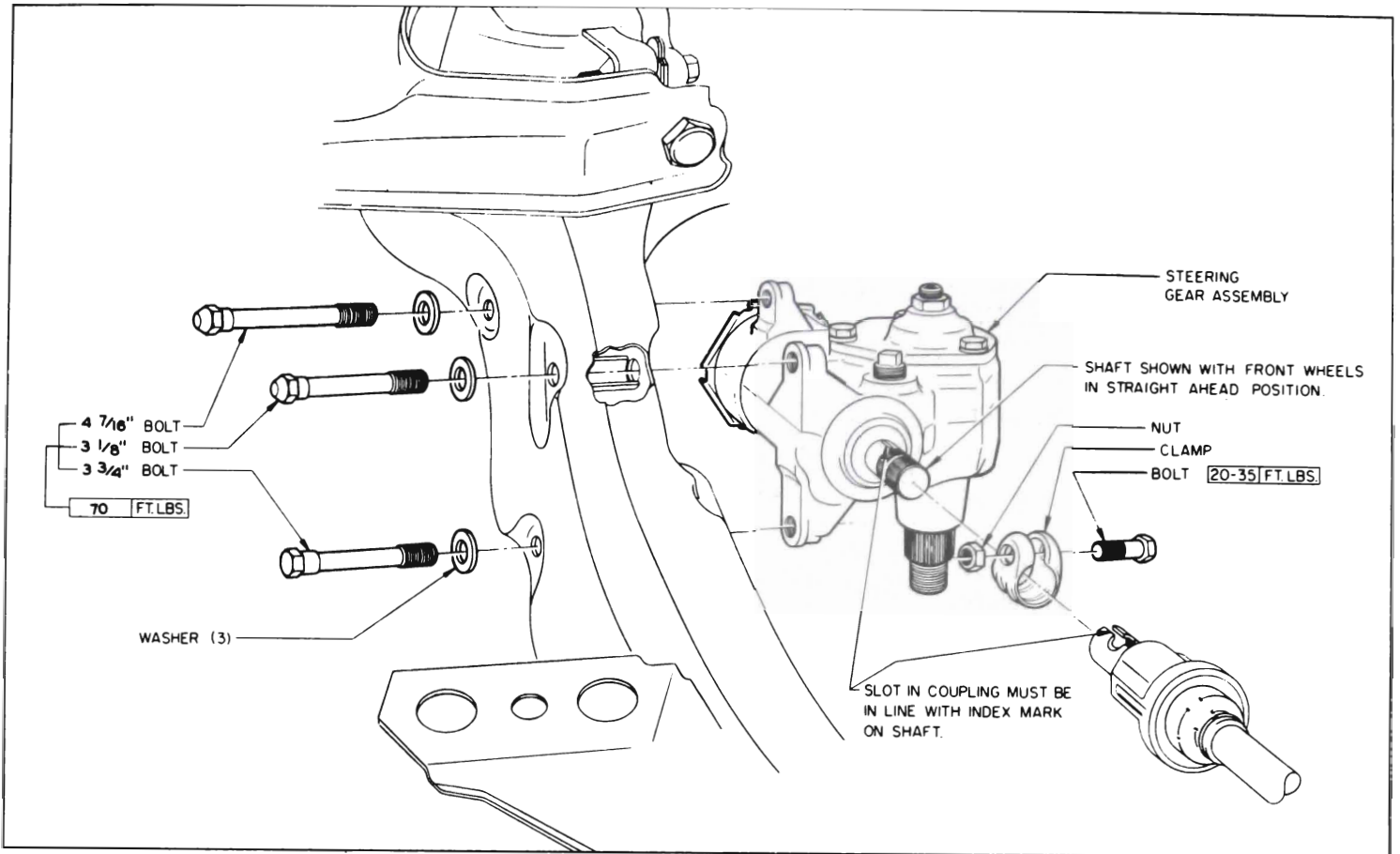


Figure 8-9—Manual Steering Gear Installation

3. Position clamp on coupling and install bolt and nut. Torque to 35 ft. lbs.

### 8-7 DISASSEMBLY, INSPECTION, ASSEMBLY OF MANUAL STEERING GEAR AND STEERING SHAFT COUPLING

#### a. Disassembly of Steering Gear

It is not necessary to disassemble gear to replace worm shaft seal. Remove worm seal with awl being careful not to damage housing or shaft and install a new seal with Installer J-8564. See Figure 8-12.

1. Mount steering gear assembly in a vise.

If only pitman shaft seal is going

to be replaced do not disassemble pitman shaft and side cover, but remove and install as an assembly.

2. Rotate worm shaft to center of travel.

3. Remove pitman shaft adjusting screw locknut. Remove three side cover bolts.

4. Remove side cover by turning lash adjuster clockwise through cover. Slip lash adjuster with shim from slot end of pitman shaft. Remove and discard side cover gasket.

5. Remove pitman shaft from housing by lightly tapping on spline end with a soft mallet. Pry pitman shaft seal out of housing with a screwdriver. Discard seal.

6. Loosen worm bearing adjuster locknut with a punch and remove

worm bearing adjuster and locknut.

7. Remove worm shaft and ball nut assembly and upper worm bearing from housing.

8. Remove lower worm bearing from adjuster by prying retainer out with a screwdriver.

9. Remove ball return guide clamp and guides from ball nut. Turn ball nut over and rotate worm shaft back and forth until all balls (50) drop out into a clean cloth. Remove ball nut from worm shaft.

10. Pry worm shaft seal from housing with screwdriver. Discard seal.

#### b. Inspection of Steering Gear

1. Wash all parts in clean solvent and wipe dry with a clean lint free cloth.

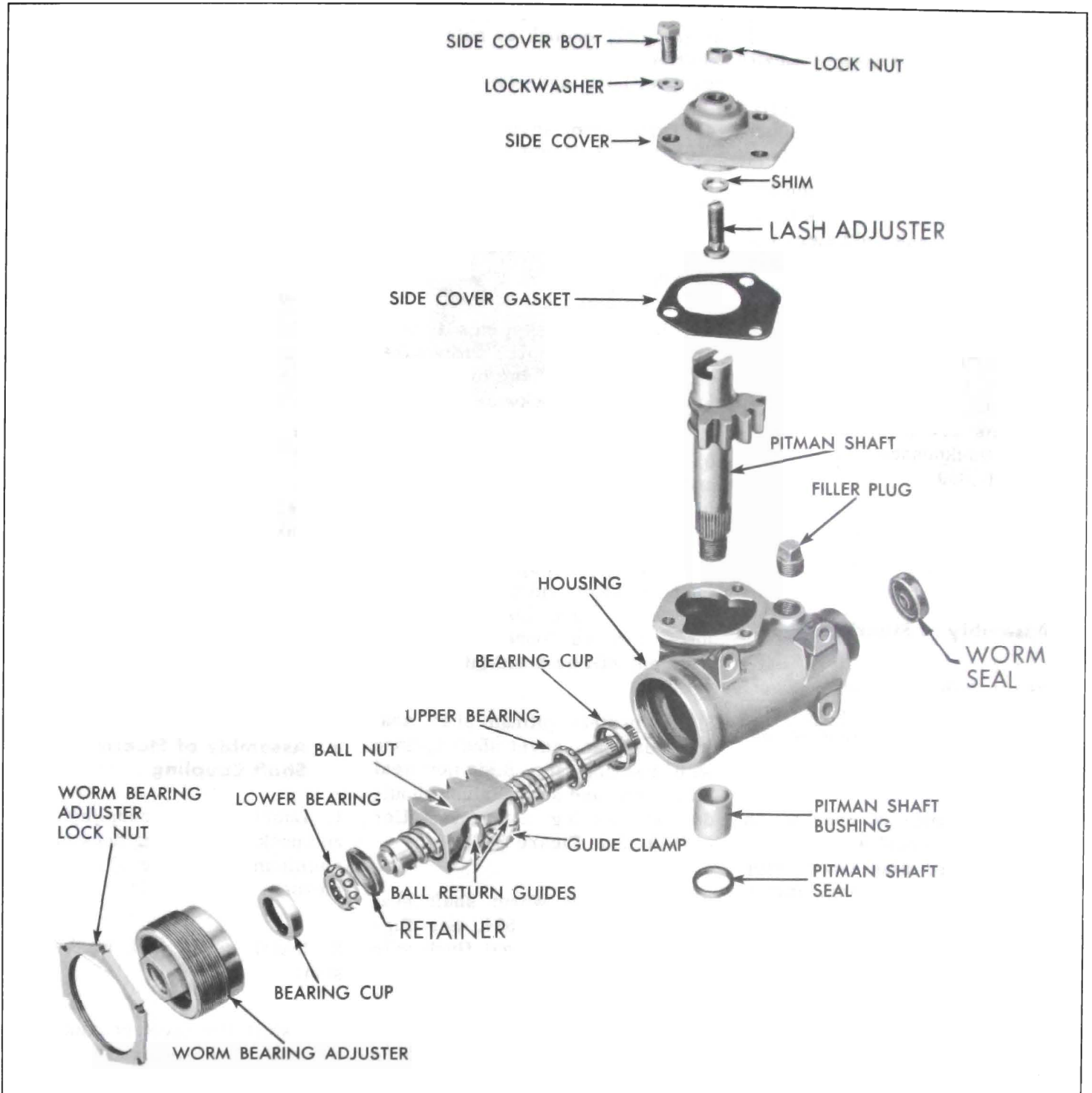


Figure 8-10—Manual Steering Gear - Exploded View

2. Inspect worm bearings and cups for damage or excessive wear. Replace bearings if necessary. The lower worm bearing cup is not replaced separately, but is serviced with the worm bearing adjuster. If upper worm bearing cup is defective, drive cup out of housing with a punch

and install new cup using Installer J-8811 with Driver Handle J-8092.

3. Check fit of the pitman shaft in the bushing in side cover. If bushing is worn, side cover must be replaced as bushing is not serviced separately.

4. Inspect the worm and nut balls and the grooves of worm and nut for damage or excessive wear. Replace parts as necessary.

5. Inspect teeth of ball nut and pitman shaft for pitting or scoring which would require replacement of nut or pitman shaft.



Inspect pitman shaft bushing for excessive wear or scoring. If necessary, remove pitman shaft bushing and install a new bushing with Remover and Replacer J-8810 and Driver Handle J-8092.

6. Check pitman shaft surface for wear or scoring, then check fit of pitman shaft lash adjuster and shim in the slot in end of pitman shaft by inserting feeler gauge between the head of screw and bottom of slot. Adjuster must be free to turn and end play should not exceed .002". If end play exceeds .002" install proper shim. The shims are available in four different thicknesses .063", .065", .067" and .069".

7. Check ball guides for damage and replace if necessary.

### c. Assembly of Steering Gear

NOTE: Lubricate all seals, bushings, bearings and gears with multi-purpose gear lubricant just before assembling.

1. Position ball nut over worm shaft so that deep side of teeth will be toward side cover when installed in gear housing. Install 19 balls in each circuit (rock worm shaft slightly to aid in installing balls). Place 6 balls in each return guide, using grease to hold balls in place. Install return guides, clamp and screws. Rotate worm through its complete travel several times to insure balls are installed correctly and rotate freely.

2. Place upper bearing on worm shaft and slide worm shaft assembly into housing.

3. Place lower bearing in worm bearing adjuster and install bearing retainer with Installer J-8564. Install adjuster assembly with

locknut in housing. Tighten adjuster only enough to hold worm bearings in place. Final adjustment will be made later.

4. Turn worm shaft until center groove in ball nut lines up with center of pitman shaft bushing. Install pitman shaft and lash adjuster with shim so that center tooth meshes with center groove in ball nut.

5. Place new gasket on side cover. Install side cover with gasket on lash adjuster by turning adjuster counterclockwise.

6. Install three side cover bolts and lock washers. Torque to 30 foot pounds.

7. Turn lash adjuster so that teeth on shaft and ball nut engage but do not bind. Install lash adjuster lock nut loosely. Final adjustment will be made later.

8. To protect pitman shaft seal from damage, cover shaft splines with masking tape. Slide new seal into place and seat against shoulder in housing using Installer J-8569. See Figure 8-11.

9. Install new worm shaft seal using Installer J-8564. See Figure 8-12. Drive seal flush with surface of housing.

10. Fill steering gear with multi-purpose gear lubricant. Gear is

now ready for final adjustment on bench is described in paragraph 8-4.

### d. Disassembly of Steering Shaft Coupling

1. Remove steering gear (par. 8-6).

2. Remove coupling seal retainer. See Figure 8-13.

3. Mark steering shaft in line with slot in coupling clamp area and slide coupling housing off shaft, being careful not to allow parts to fall out on floor.

4. Remove the anti-click spring and the two pivot bearings.

5. Remove washer from shaft.

6. Remove seal if it is going to be replaced.

### e. Assembly of Steering Shaft Coupling

1. Lubricate the coupling parts and pack the coupling housing with aluminum soap type chassis lubricant.

2. Install seal and washer on shaft.

3. Install the pivot bearings and the anti-click spring on shaft pin

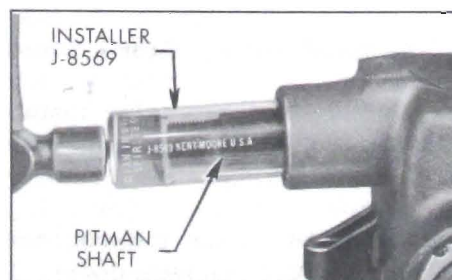
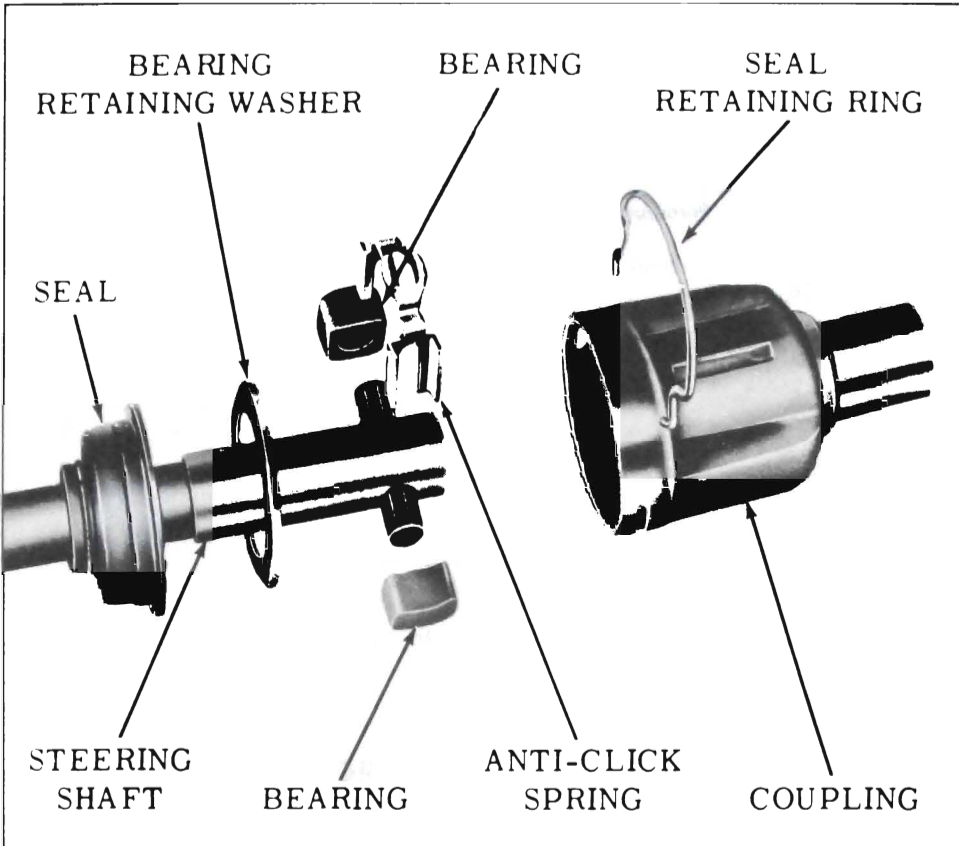


Figure 8-11—Installing Pitman Shaft Seal



Figure 8-12—Installing Worm Shaft Seal





so that the two machined surfaces of the bearings will be against side of coupling housing.

4. Install coupling housing on the steering shaft with the slot of coupling clamp surface aligned with mark on shaft.

5. Insert the seal into coupling housing and install retainer ring.

6. Install steering gear (par. 8-6).

Figure 8-13—Manual Steering Shaft Coupling Assembly