GROUP 8

STEERING GEAR AND LINKAGE

SECTIONS IN GROUP 8

SECTION 8-A

MANUAL STEERING GEAR

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
Bolt	Lower Coupling Flange Pinch	3/8-24	20-35
Bolt	Gear Side Cover to Housing	3/8-16	25-40
Bolt & Nut	Idler Arm Support to Front Suspension Cross Member	3/8-24	30-40
Bolt & Nut	Gear Housing to Front Suspension Cross Member	7/16-20	60-70
Nut	Steering Wheel to Steering Shaft	1/2-20	20-35
Nut	Pitman Arm to Pitman Shaft	7/8-14	100-14[illegible]
Nut	Lash Adjuster Lock	7/16-20	18-27
Nuts	Lower Coupling Flange to Steering Shaft Flange		15-20

b. Steering Gear Specifications

Items	Specification
Gear Type	Recirculating Ball Worm and Nut
Make	Saginaw
Housing Material	Cast Aluminum
Ratio, Gear Only	28 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"

Items	Specification
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 - Lbs. Pull at Wheel Rim	1/2 to 1 lb. Higher than worm Bearing Preload
Worm Bearing Preload - Torque at Spline	2 to 7 in. lbs.
Pitman Shaft Overcenter - Torque at Spline	4 to 8 in. lbs. Higher than worm Bearing Preload

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.

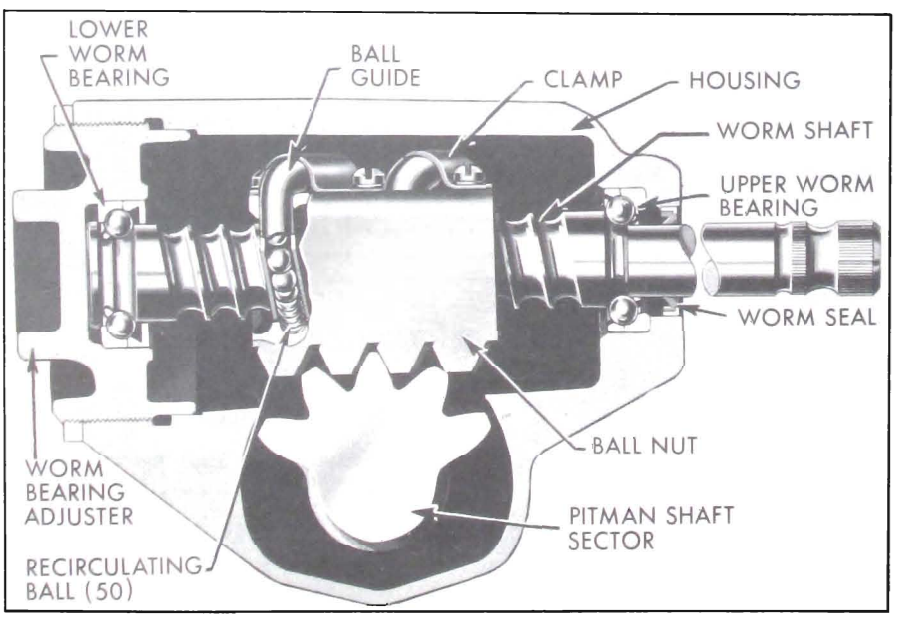

Figure 8-1—Steering Gear Worm and Ball Nut

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 a lash adjuster screw which extends through the gear housing side cover. The head of lash adjuster 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 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 or cup of the upper worm bearing is pressed into the gear housing.

The outer race or cup of the lower worm bearing is pressed into the worm bearing adjuster

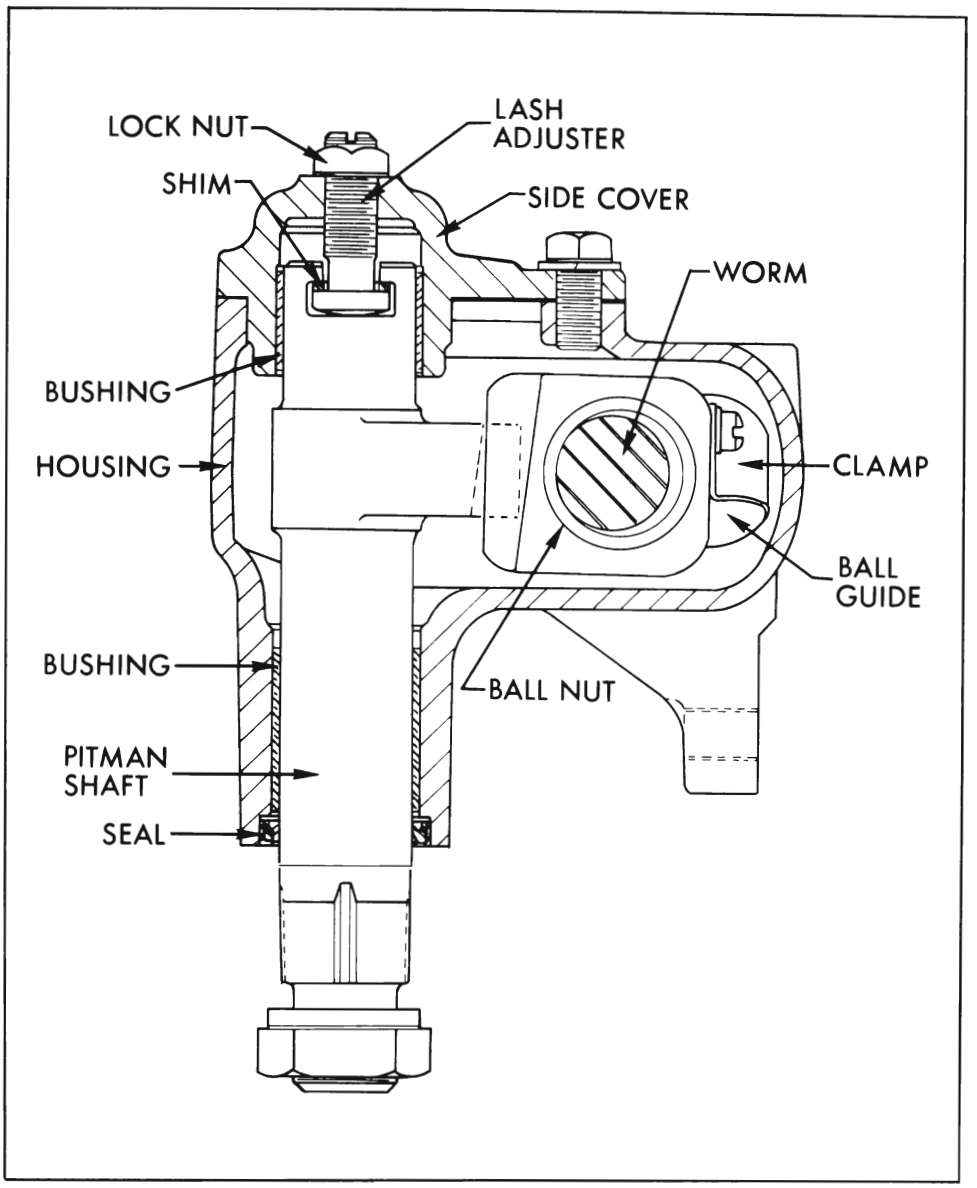

Figure 8-2—Steering Gear Pitman Shaft and Ball Nut

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 and lower ends are supported by ball bearings.

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 worm shaft and the steering shaft.

8-3 TROUBLE DIAGNOSIS MANUAL STEERING GEAR

This paragraph covers steering malfunctions which are most likely to be caused by the steering gear assembly or tie rods. Steering malfunctions which are most likely to be caused by chassis suspension members are covered in paragraph 7-4.

a. Excessive Play or Looseness in Steering System

1. Front wheel bearings loosely adjusted (par. 7-8).

2. Worn upper ball joints (par. 7-9).

3. Steering wheel loose on shaft, loose pitman arm, tie rods, steering arms or steering linkage ball studs.

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 front suspension (par. 1-2).

3. Excessive steering shaft coupling misalignment.

4. Steering gear adjusted too tight (par. 8-4).

5. Front wheel alignment incorrect (par. 7-15).

c. Rattle or Chuckle in Steering Gear

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

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 mounting bolts.

4. Loose or worn steering shaft bearing.

d. Poor Returnability

1. Steering gear adjusted too tight (par. 8-4).

2. Front wheel alignment incorrect (par. 7-15).

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

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.

a. Adjustment of Steering Gear in Car

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.

There are two adjustments on the steering gear: worm bearing preload, and pitman shaft overcenter preload. See Figure 8-3.

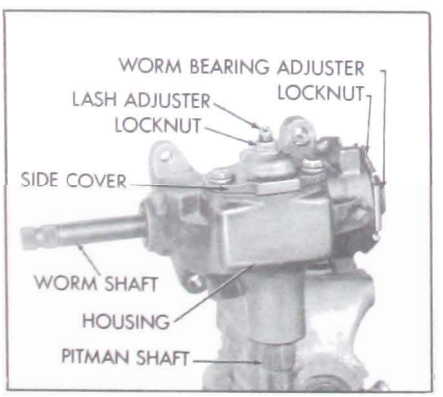

Figure 8-3—Manual Steering Gear Adjusters

1. Torque steering gear to cross member bolts to 60-70 lb. ft.

2. Disconnect intermediate rod from pitman arm by removing ball stud cotter pin, nut. Then using Remover J-3295, screw remover onto intermediate rod stud and tap on end of remover to separate parts. Support pitman arm to avoid undue pitman arm strain.

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. Any excessive misalignment must be corrected before steering gear can be properly adjusted.

4. Remove cap from steering wheel hub.

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 25-40 lb. ft.

9. Check Pitman Shaft Overcenter 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 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. Adjust pitman shaft lash adjuster if necessary. Total "overcenter" pull should not exceed 13 inch pounds.

11. Adjust Pitman Shaft Overcenter Preload. Loosen lock nut 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 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.

12. Attach pitman arm to intermediate rod. Torque ball stud

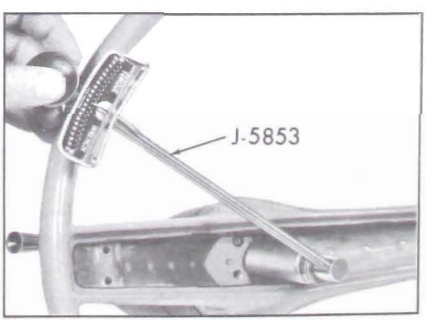

Figure 8-4—Checking Adjustments in Car

attaching nut to 45 lb. ft., then tighten to nearest slot and insert new cotter pin. Do not back off nut to install cotter pin.

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 adjustment must be made within 1/2 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 1/2 the total number of turns. This places the steering gear on the "high point".

5. Turn pitman shaft lash adjuster clockwise 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 the 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 (Figure 8-9) and check tie rods for equal adjustment and toe-in (Group 7). It is important to have the steering gear in the no-lash range when car is moving straight forward.

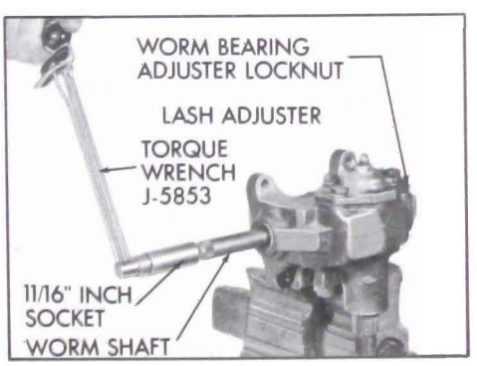

Figure 8-5—Checking Adjustments on Bench

8-5 STEERING WHEEL REMOVAL AND INSTALLATION

a. Removal of Steering Wheel

1. Unplug large curved connector on mast jacket to prevent horn from blowing.

NOTE: Connector has locking tabs on outside edges. Lift tab to release.

2. On deluxe steering wheels, remove the actuator cap and pull out lead plug in steering wheel. See Figure 8-6.

On standard steering wheels, pry off cap, remove three Phillips head screws and take off spacer bushing, receiver cup and Belleville spring. See Figure 8-7.

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 8-8. 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. See Figure 8-9.

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.

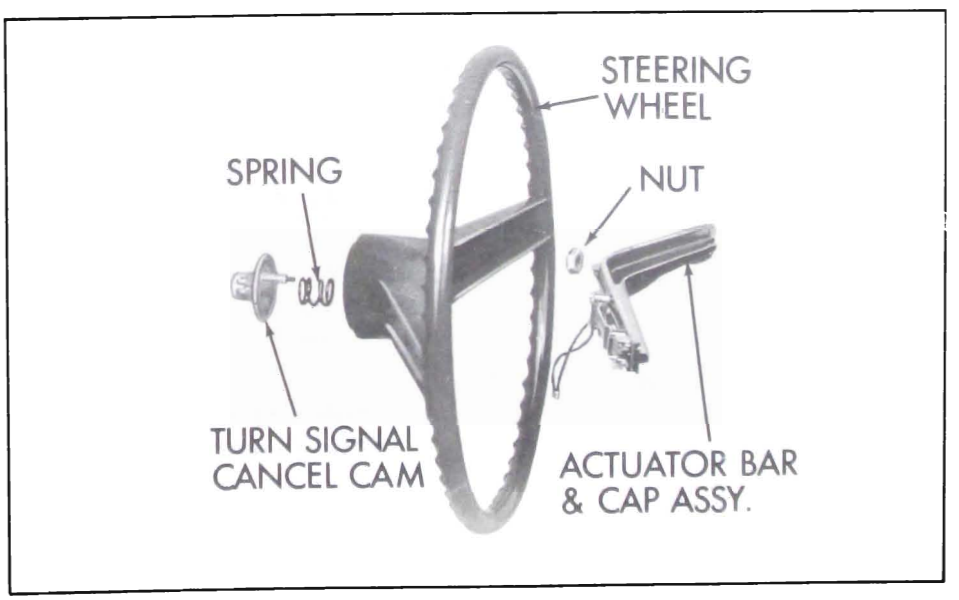

Figure 8-6—Deluxe Steering Wheel Installation

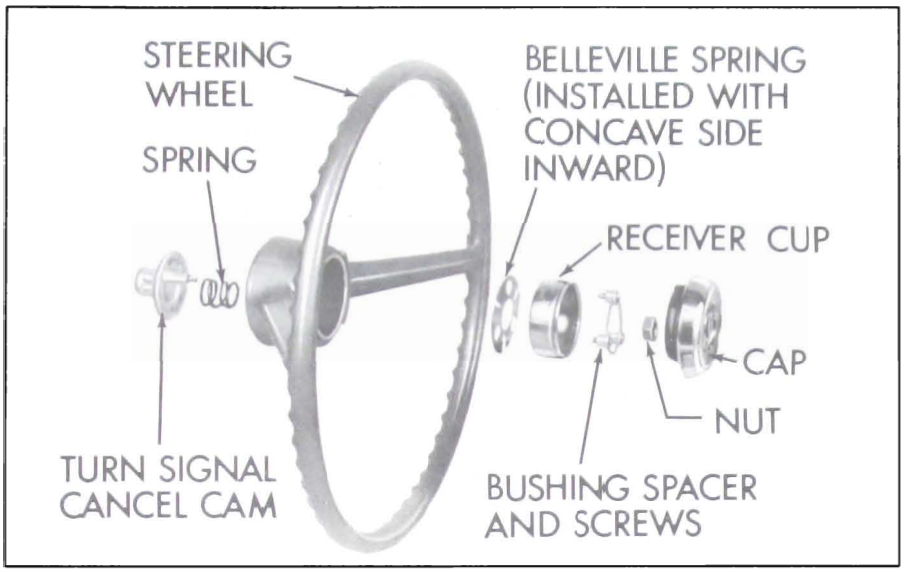

Figure 8-7—Standard Steering Wheel Installation

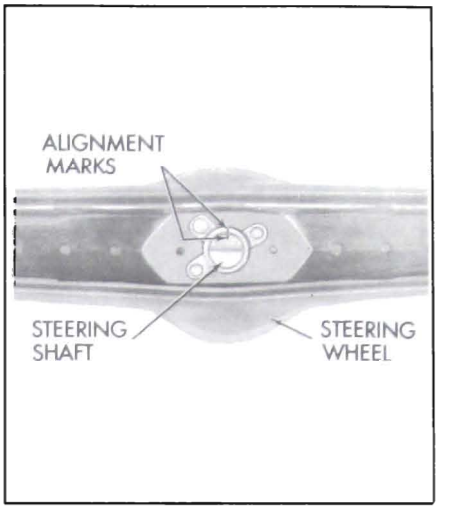

Figure 8-9—Steering Wheel and Shaft Alignment Marks

2. With wheel properly located on shaft, install nut and tighten to 30 lb. ft.

3. On deluxe steering wheels install lead plug into steering wheel and reassemble actuator cap onto steering wheel.

4. On standard steering wheels reassemble the belleville spring, receiver cup, and spacer bushing into steering wheel hub and secure in place with screws. Install cap.

NOTE: When installing belleville spring be sure concave side of spring faces inward. Also locate receiver cup so that slot in cup is uppermost.

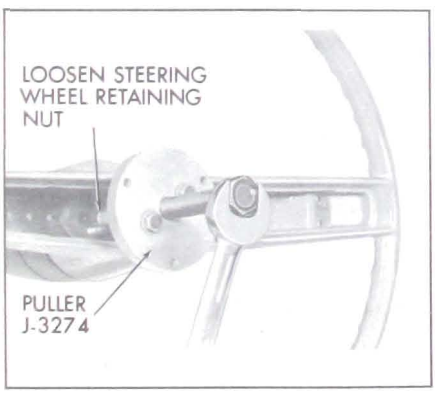

Figure 8-8—Removing Steering Wheel

8-6 REMOVAL AND INSTALLATION OF MANUAL GEAR ASSEMBLY

a. Removal of Steering Gear

1. Remove two nuts securing lower coupling flange to steering shaft flange.

2. Jack up car. Remove pitman nut and disconnect pitman shaft from gear by use of Puller J-5504.

CAUTION: When pulling pitman arm from pitman shaft, do not hammer on end of puller as damage will result to gear side cover. If necessary, tapping on side of pitman arm may help in removing arm.

3. Remove three steering gear to frame bolts and remove gear assembly. See Figure 8-10.

b. Installation of Steering Gear

NOTE: If gear lower coupling was removed be sure to reinstall coupling so that tab on coupling is aligned with mark on gear worm shaft. See Figure 8-11.

1. Align studs on gear lower coupling with holes in steering shaft lower coupling, and install gear onto frame. Secure in position with three bolts. Torque bolts 60-70 lb. ft.

2. Install two nuts on studs of gear lower coupling and tighten to 15-20 lb. ft.

3. Reconnect pitman arm to gear pitman shaft and torque pitman nut 100-140 lb. ft.

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

a. Disassembly of Steering Gear

NOTE: 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 8-17.

1. Thoroughly clean exterior of gear assembly with a suitable solvent.

2. Place steering gear in a soft jaw vise. See Figure 8-3. Do not

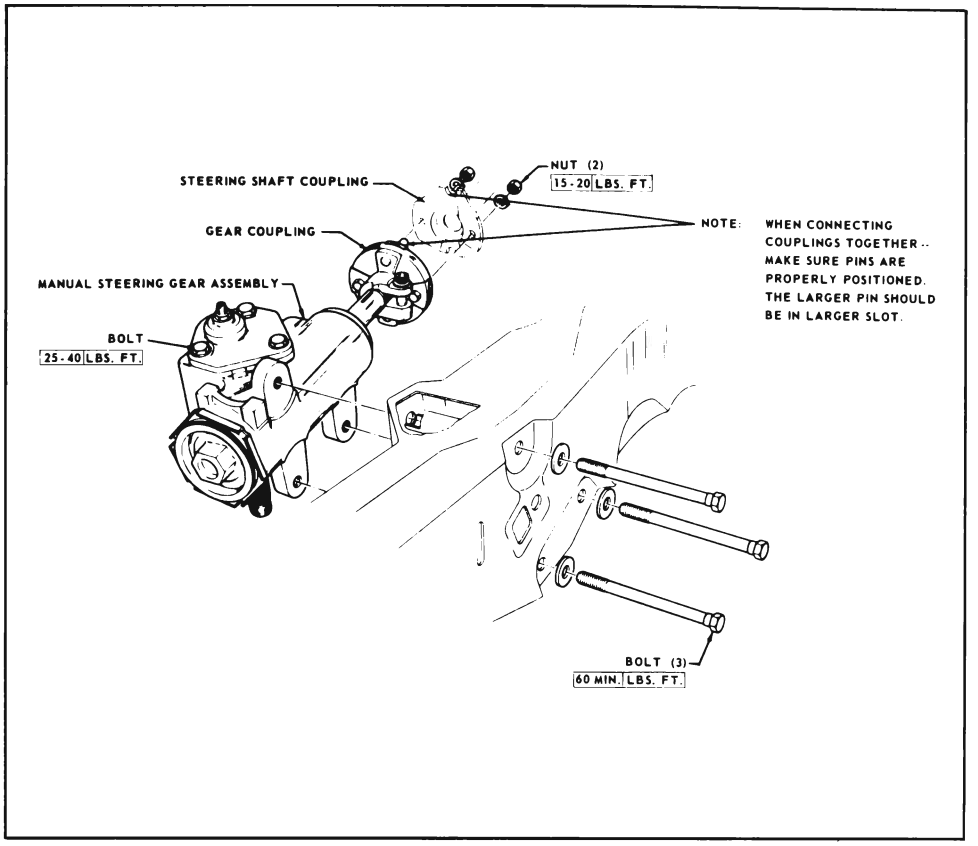

Figure 8-10—Manual Steering Gear Installation

clamp too tightly in vise as aluminum housing may be damaged.

NOTE: 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.

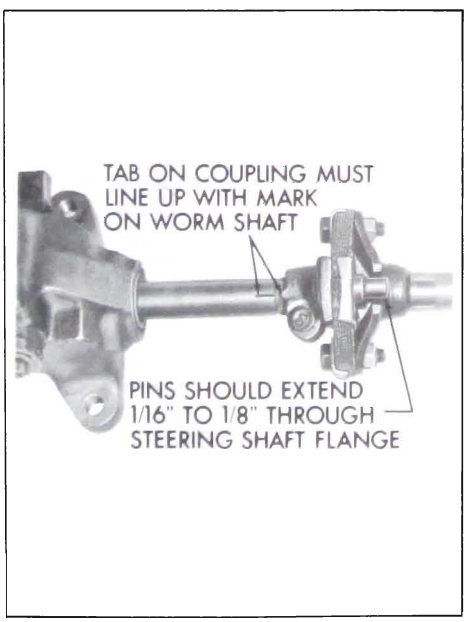

Figure 8-11—Gear Lower Coupling Installation

3. Rotate worm shaft to center of travel, approximately 3-1/2 turns from either extreme.

4. Remove pitman shaft lash adjuster lock nut. Remove three side cover bolts and lock washers.

5. 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.

6. 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.

7. Loosen worm bearing adjuster lock nut with a punch and remove worm bearing adjuster and lock nut.

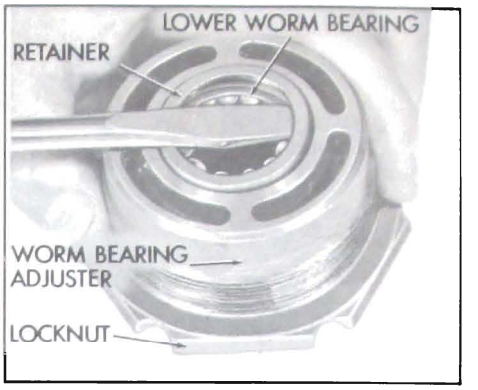

Figure 8-12—Removing Lower Worm Bearing Retainer

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

9. Remove lower worm bearing from adjuster by prying retainer out with a screwdriver. See Figure 8-12.

10. 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.

11. 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 cloth.

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. See Figure 8-13.

NOTE: J-8811 may be used for installing pitman shaft seal in housing when pitman shaft is removed.

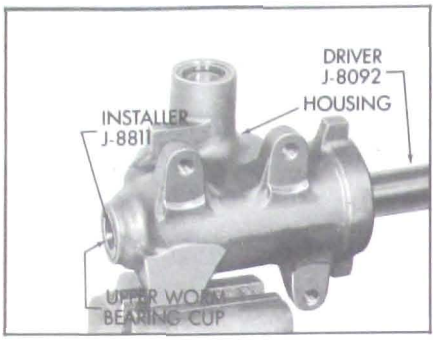

Figure 8-13—Installing Upper Worm Bearing Cup

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 Drive Handle J-8092. See Figure 8-14.

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".

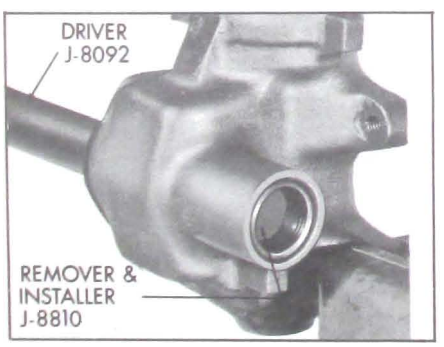

Figure 8-14—Installing Pitman Shaft Bushing

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 and lock nut 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 bolts 25-40 lb. ft.

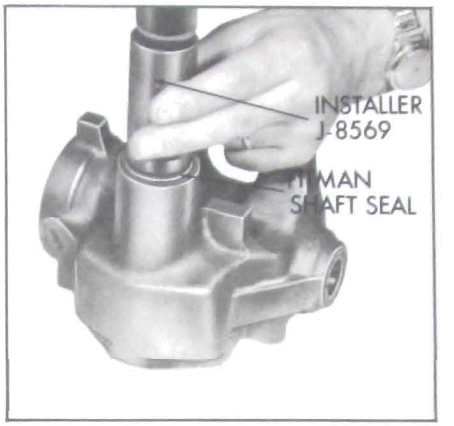

Figure 8-15—Installing Pitman Shaft Seal

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 8-15.

9. Install new worm shaft seal using Installer J-8564. See Figure 8-16. Drive seal flush with surface of housing.

10. Fill steering gear with multi-purpose gear lubricant. Gear is now ready for final adjustment as described in Paragraph 8-4.

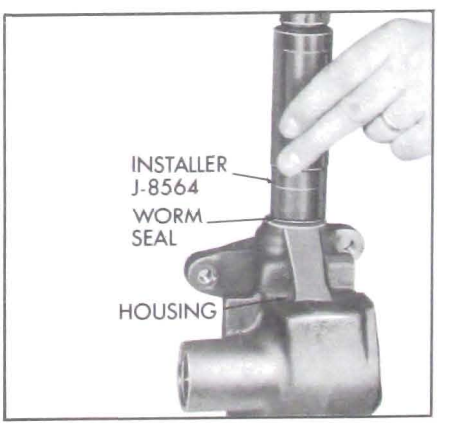

Figure 8-16—Installing Worm Shaft Seal

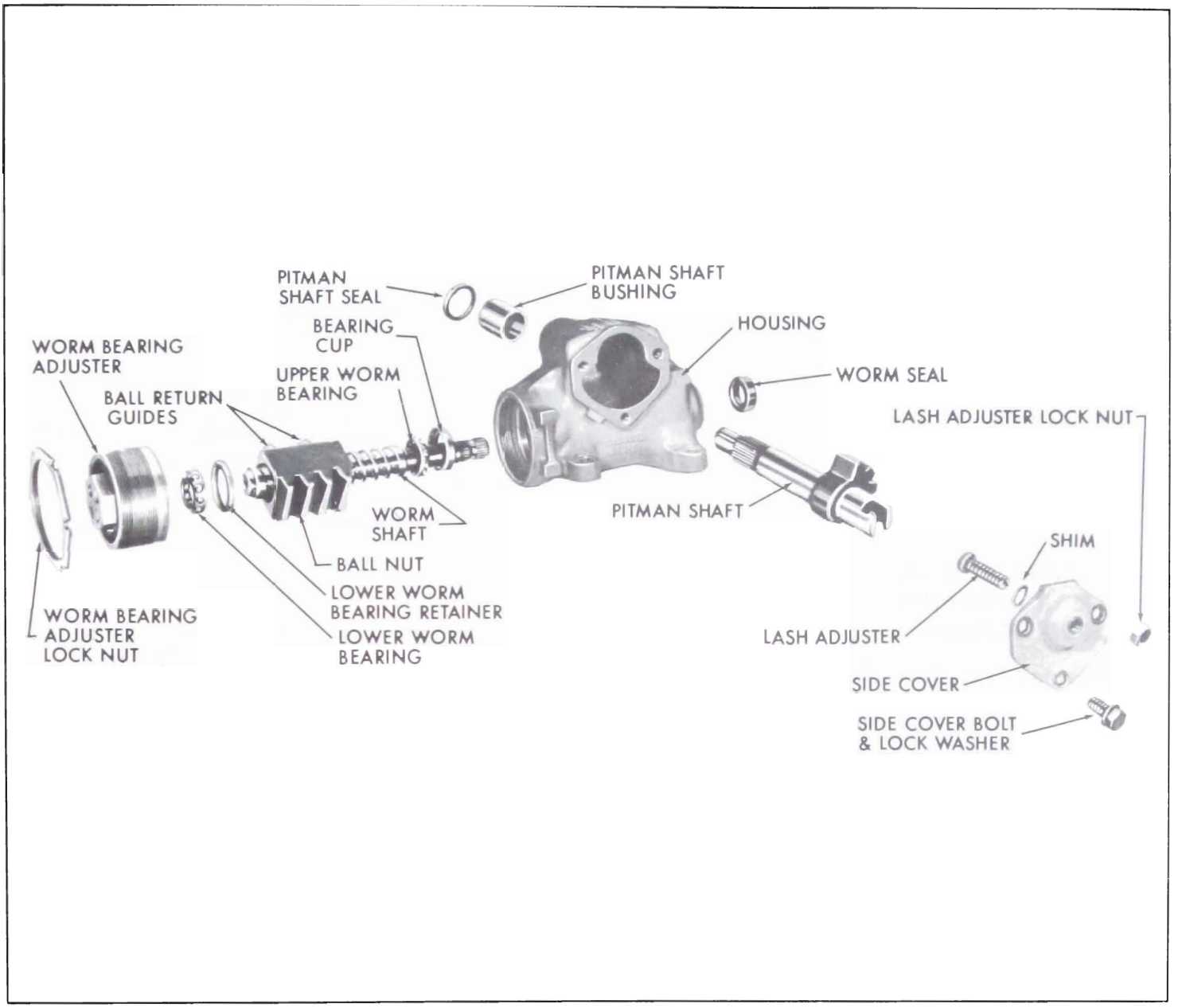

Figure 8-17—Manual Steering Gear (Exploded View)