GROUP 8
STEERING GEAR AND LINKAGE

SECTIONS IN GROUP 8

SECTION 8-A
MANUAL STEERING GEAR AND LINKAGE

CONTENTS OF SECTION 8-A

NOTES

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	Gear Housing Side Cover	3/8-16	30-35
Nut	Worm Thrust Bearing Adjuster Lock	——	50 min.
Bolt	Gear Housing to Frame Bracket	7/16-20	30-35
Nut	Steering Wheel to Steering Shaft	11/16-20	45-55
Nut	Pitman Arm	7/8-14	100-110
Nut	Tie Rod Clamp Bolt	3/8-16	20-25
Nut	Tie Rod End Ball Stud	1/2-20	50-60
Bolt	Idler Arm Support to Frame	3/8-16	30-35
Bushing	Idler Arm	——	100-115

b. Steering Gear Specifications

Items	
Gear Type	Recirculating Ball Worm and Nut
Make	Saginaw

Ratio, Actual	25.8 to 1
Turns of Wheel, Lt. to Rt. (Gear connected)	5
Turning Circle Diameter—Feet,	
Series 40-60	41.6
Series 50-70	43.0
Lubrication	Plug in Housing
Oil Capacity	13 oz.
Steering Wheel Diameter	18"
Number and Type of Pitman Shaft Bearings	3 Bushings
Number and Type of Steering Shaft Bearings	
Lower End	2 Roller Bearings
Upper End	1 Ball Bearing
Worm and Nut Balls—No. and Diameter	60, 9/32"
Adjusting Screw and Shim Clearance in Pitman Shaft	0 to .002"
Worm Thrust Bearing Adjustment—Lbs. Pull at Wheel Rim	7/8 to 1 1/8 lbs.
Pitman Shaft Lash Adjustment—Lbs. Pull at Wheel Rim	2 to 2 1/4
Intermediate Rod Plug Adjustments	See fig. 8-6
Toe-in, Caster, Camber, etc.	See fig. 7-16
Pitman Shaft Diameter—Long End	1.1205" to 1.1210"
Clearance in Bushings	.0035" to .0045"
Pitman Shaft Diameter—Short End	1.1235" to 1.1240"
Clearance in Bushing	.0015" to .0025"

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.

Two sets of 30 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.

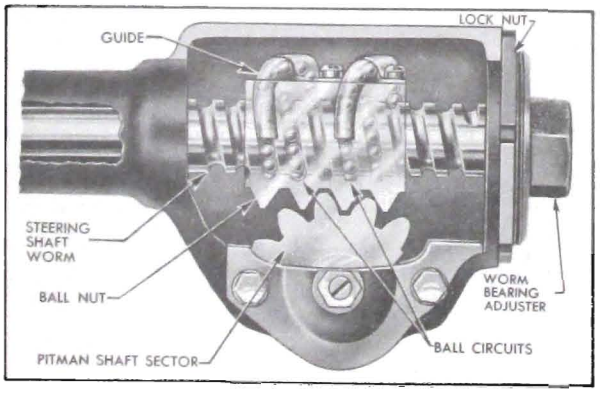

Figure 8-1—Steering Gear Worm and Nut, Showing Ball Circuits

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 end 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.

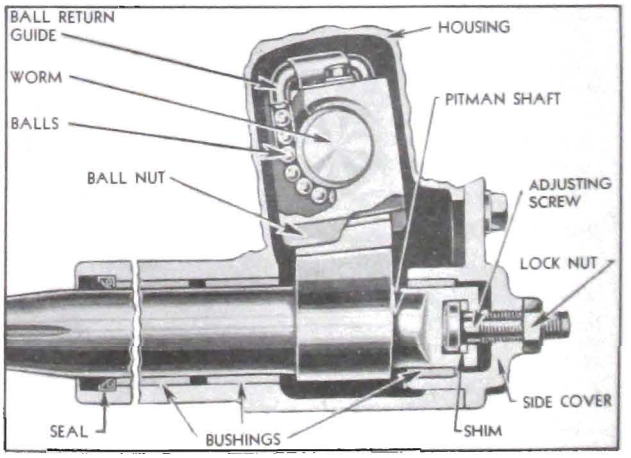

Figure 8-2—End Sectional View of Steering Gear

The pitman shaft is carried in two bronze bushings in steering gear housing and one bronze bushing in housing side cover. A spring-loaded seal in housing prevents leakage of

lubricant at outer end of the shaft. See figure 8-2.

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

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

The upper end of steering shaft is supported by a ball bearing mounted in the upper end of the steering column jacket. The upper end of steering shaft has a serrated taper seat for the steering wheel which is retained by a nut and lock washer.

The steering gear column jacket is clamped to a short lower jacket pressed into the gear housing. The column jacket houses the steering shaft and transmission control shaft, and the upper end provides a mounting for the control lever housing. A split bracket having an anti-squeak liner supports the column jacket below the instrument panel.

A nylon pin in the lower support bracket fits in the slot of the mast jacket and locates it radially.

A bracket on the frame side rail helps to support the steering gear housing which is attached to bracket and side rail by clamps and four long bolts. The front lower bolt serves as a pivot and the other bolts pass through slotted holes in the frame bracket and side rail to provide adjustment for vertical alignment of steering gear assembly. The clamps bear against the cylindrical extension of gear housing so that housing can be turned in clamps to provide for sideways alignment of the 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.

Each ball stud riveted to the tie rods, pitman and idler arms seats 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 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 opening through which the ball studs enter the intermediate rod are protected by pressed 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-load 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 incorrectly adjusted (par. 7-10).

(2) Worn steering knuckle bushings or king pins (par. 7-11).

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

(4) Excessive pitman shaft to ball nut lash (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) Steering gear to frame misalignment (par. 8-6).

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

(5) Front wheel alignment incorrect in one or more angles (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 fit at steering shaft upper bearing.

8-4 ADJUSTMENT OF MANUAL STEERING GEAR AND LINKAGE

IMPORTANT: *Never attempt to adjust steering gear while it is connected to intermediate rod. Steering gear must be free of all outside load in order to properly adjust worm thrust bearings and the lash between ball nut and pitman shaft teeth.*

a. Adjustment of Steering Gear

1. Disconnect intermediate rod from pitman arm by unscrewing end plug until bearings will release the ball stud. See figure 8-5. Check tightness of pitman arm nut with 18" wrench.

2. Turn steering wheel gently in one direction until it stops, then turn it back one revolution. CAUTION: *Never turn wheel hard against stopping point as damage to ball nut assembly may result.*

3. Check for lash between ball nut and pitman shaft by working the pitman arm. If a perceptible lash does not exist, loosen lock nut and turn

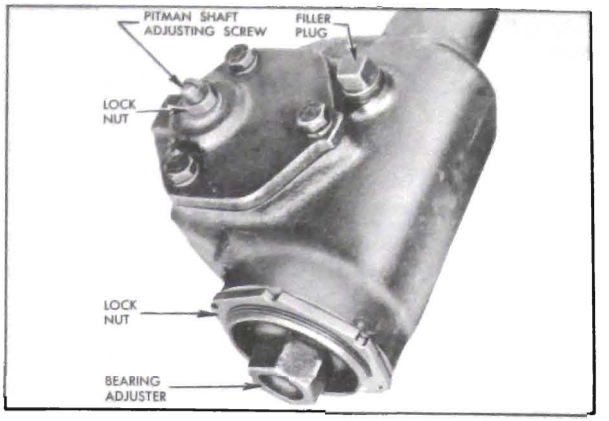

Figure 8-3—Steering Gear Adjustments

pitman shaft adjusting screw counterclockwise, until lash can be felt when working pitman arm. This separates the worm thrust bearing load from the "high point" load caused by close meshing of ball nut and pitman shaft teeth.

4. Turn steering wheel slowly from one extreme position to the other. Wheel should turn freely and smoothly through entire range. Roughness indicates faulty worm thrust bearings or brinelled races. Hard pull or binding indicates misalignment of steering gear assembly in mountings, or an excessively tight adjustment of worm thrust bearings. Any misalignment must be corrected before steering gear can be properly adjusted.

5. If binding exists, readjust the steering gear in its upper and lower mountings as described in paragraph 8-5. If binding still exists after removing any misalignment in the mountings, check the steering gear column jacket for evidence of being sprung which is usually indicated by a rippled or wavy surface, particularly at the lower end. A sprung jacket will throw the steering shaft upper bearing out of line with worm thrust bearings and create side pressure on steering shaft. NOTE: *If steering gear was out of alignment or jacket is sprung, check body mounting bolts which may have loosened and allowed body to shift. Also check the serrations on pitman shaft; if serrations are twisted, replace the shaft.*

6. Loosen worm thrust bearing adjuster lock nut. Turn thrust bearing adjuster until a slight load is felt when turning steering wheel near extreme positions, then tighten lock nut. See figure 8-3.

CAUTION: *Do not back out adjuster far enough to permit thrust bearings to get out of line with ends of worm.*

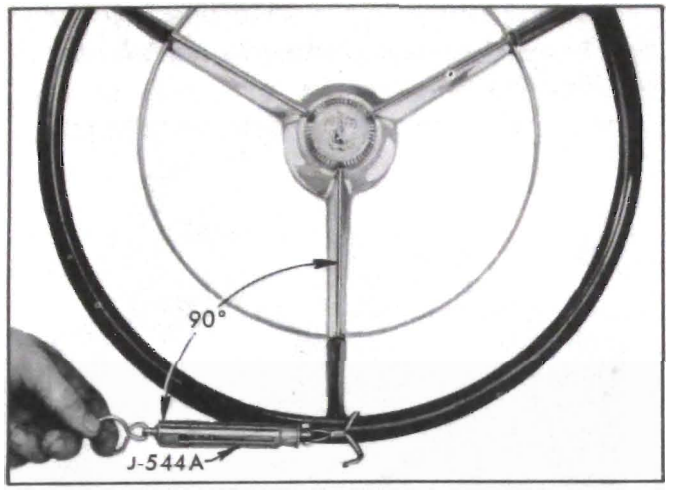

Figure 8-4—Checking Thrust Bearing or Lash Adjustment with Scale

7. After locking the bearing adjuster check the load on thrust bearings with steering wheel turned to near one extreme position. Apply Scale J 544-A to a spoke at rim of wheel and exert a steady pull while keeping the scale at 90 degrees to spoke as shown in figure 8-4. The pull required to keep wheel turning slowly should be between ⅞ and 1⅛ pounds. Readjust to obtain this bearing load if necessary.

8. Turn steering wheel from one extreme position to the other while counting the turns, then turn wheel back one-half the total number of turns and have the lower spoke pointing straight down. This places steering gear on the "high point" at which no lash should exist between ball nut and pitman shaft teeth.

9. Tighten housing side cover bolts. Loosen lock nut and turn pitman shaft adjusting screw clockwise until lash between ball nut and pitman shaft teeth is just removed. Work pitman arm back and forth to feel for lash. After tightening adjusting screw lock nut, rotate steering wheel back and forth through the "high point" range and check for tight spots. Check pull at wheel with Scale J 544-A as described above.

10. The pull required to keep wheel moving through "high point" should be between 2 and 2¼ pounds. Readjust if necessary to remove tight spots and obtain specified load at wheel rim. NOTE: *If lash cannot be removed at "high point," or if gear load varies greatly and feels rough, the gear assembly should be removed for inspection of internal parts.*

b. 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 $2\frac{21}{32}$" to 2¾", as shown in figure 8-5. After

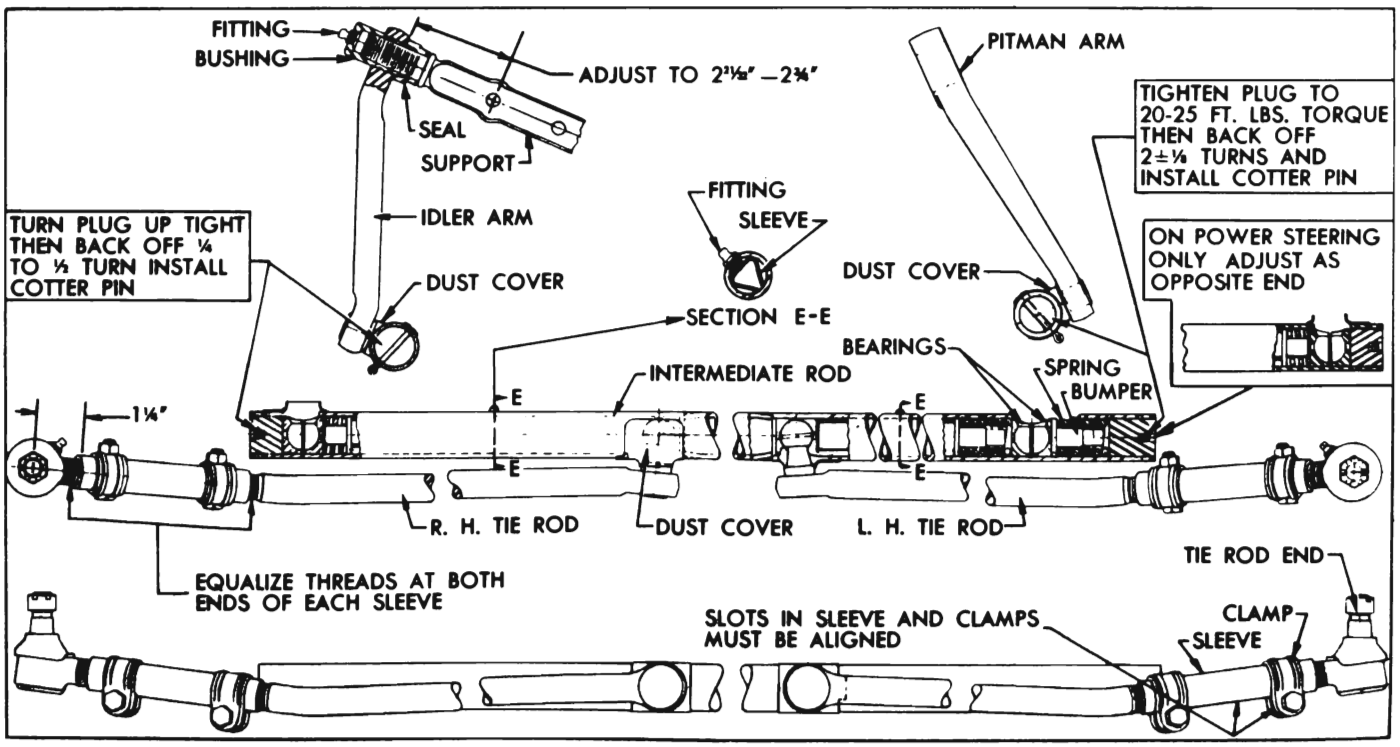

Figure 8-5—Steering Linkage

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 to 20-25 ft. lbs. torque then back off 1⅞ to 2⅛ turns and install cotter pin.

On the power steering linkage, the pitman arm end plug adjustment is made in the same manner as idler arm end.

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

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 lower spoke of steering wheel should be straight down, or not over ⅝" to either side of straight down position. If lower spoke is too far to either side, check steering 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.

8-5 STEERING WHEEL REMOVAL, INSTALLATION AND HEIGHT ADJUSTMENT

a. Removal of Steering Wheel

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

2. Remove horn button or operating ring (par. 10-52) then reinstall steering wheel nut, leaving it backed off several turns.

3. Set direction signal switch in "off" position to avoid possible damage to switch operating mechanism.

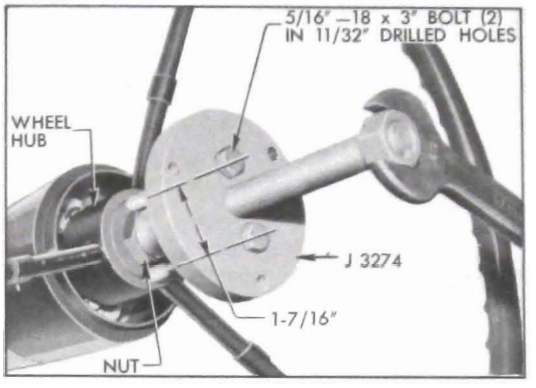

Figure 8-6—Removing Steering Wheel with Puller J 3274

4. 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. *Before installing steering wheel, set signal switch in "off" position* to prevent the switch operating pin from striking and damaging the switch operating mechanism.

2. Location marks for proper installation of steering wheel on steering shaft are provided to insure a vertical position of the steering wheel lower spoke when front wheels are in straight-ahead position. The upper end of steering shaft has a small location notch, the solid spoke wheel has a keyway, and the flexible wheel has a mark on the hub. These location marks on shaft and wheel must be in line when wheel is installed.

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

NOTE: *Nut with nylon insert may be installed either way, but the optional type with locking feature in the threads must be installed with score marked side UPWARD. Shaft must project above nut at least one thread.*

4. Install horn button or operating ring (par. 10-52) and connect wire to horn cable connector on steering column.

c. Adjustment of Steering Wheel Height

The height of the steering wheel may be ad-

justed by means of elongated vertical slots under the instrument panel at the steering column upper bracket. The following is the correct procedure for adjusting the steering wheel height:

1. Loosen steering gear to frame bolts on *manual steering cars*, or loosen steering column to lower support bracket bolts on *power steering cars*.

2. Loosen two steering column upper bracket to dash bolts.

3. Adjust steering wheel height as desired; total range of adjustment is approximately 1⅜" at instrument panel which corresponds to about 2" at steering wheel.

4. Tighten steering column upper bracket bolts.

5. Then tighten steering gear bolts on manual steering cars or tighten lower support bracket bolts on power steering cars.

6. On *power steering cars only*, rotate steering wheel a full turn in each direction and check for metal to metal contact in the flexible coupling. If there is interference in the flexible coupling, the steering column and steering gear must be aligned.

7. Check adjustment of transmission shift control linkage as specified in paragraph 4-11 for all synchromesh cars, or as specified in paragraph 5-12 for all dynaflow cars. Adjust shift controls if necessary.

8. On all manual steering cars or on power steering cars if the steering gear location was changed, check toe-in adjustment as specified in paragraph 7-17, e. Adjust toe-in if necessary.

8-6 REMOVAL AND INSTALLATION OF MANUAL STEERING GEAR

a. Removal of Steering Gear

1. Place car cover over left front fender then remove the battery hold down and battery.

2. Disconnect transmission shift rod from control shaft lower lever. On *synchromesh cars only*, remove selector lever from jacket clamp by removing retainer and spring washer. Loosen bolt in clamp which secures the column jacket to the short tube in gear housing.

3. Move front seat all the way back and cover the seat and back.

4. Disconnect and remove horn cable connector from steering column jacket.

5. Remove two screws holding the fuse block and lower fuse block.

6. Cover the steering column jacket with masking tape to prevent damage to the finish.

7. Remove steering wheel (par. 8-5) and the upper bearing spring and spring seats. Cover the horn contact and threaded end of steering shaft with masking tape.

8. Measure the vertical clearance between the column jacket and the lower surface of instrument panel and record this dimension so that column can be reinstalled in same position. This dimension affects steering wheel height, which may have been changed from normal height to suit the car owner.

9. Remove bolts holding the cap to steering column bracket, disconnect the bracket from instrument panel, then pull upward on column jacket to free it from steering gear.

10. Remove the cranking motor splash pan from car frame.

11. Remove the steering gear to frame lower bolts and clamps, then loosen upper bolts enough so that gear can be tilted sideways to provide room for pitman arm puller.

12. Remove nut and lockwasher, then remove pitman arm from pitman shaft, using Puller J-5504-B.

13. With another man inside the car to guide the steering column and prevent damage to the column jacket and front seat, carefully lift the steering gear assembly up and forward out of engine compartment, leaving column jacket assembly in the body.

NOTE: *As gear assembly is removed be careful not to damage or lose the control shaft return spring, which will be either on end of control shaft or loose on steering shaft.*

b. Installation of Steering Gear Assembly

Install the gear assembly by reversing the procedure for removal, paying attention to the following points.

1. Place control shaft return spring over lower end of control shaft before inserting steering shaft into control shaft.

2. When attaching the steering column bracket to instrument panel measure the vertical clearance between the column jacket and the lower surface of instrument panel.

NOTE: *When replacing the steering column bracket cap, be sure that the nylon pin in the cap enters the slot in column jacket.*

Maintain the same clearance and wheel height when steering gear is reinstalled.

NOTE: *The height of the steering wheel may be adjusted up or down about 1½ inches total range by means of elongated vertical slots under the instrument panel at the steering column upper bracket. It is not necessary to check toe-in adjustment unless the position of the steering gear has been changed. Because power steering gears have a flexible coupling in the shaft, the adjustment may be made without changing the location of the gear. The flexible coupling should be checked after the adjustment, however, to make sure it doesn't bind or have metal to metal contact between the upper and lower parts. If it is necessary to move the gear to realign the coupling, the toe-in must be checked.*

3. When installing transmission control lever, install parts as shown in figure 8-7.

4. Install steering wheel with location marks in line (par. 8-5).

5. Connect pitman arm to pitman shaft and tighten nut to 100-110 ft. lbs. torque.

6. After installation of horn operating ring, adjust steering column jacket on tube of gear housing as required to provide a clearance of .150" between the operating ring and signal switch housing. See figure 8-7. Tighten jacket clamp bolt and column bracket cap bolts securely.

7. On *Synchromesh* car, check for proper selection and shifting of transmission as specified in paragraph 4-13 (subpar. b, step 12).

7a. On *Dynaflow* car, adjust the transmission control shaft lever stop plate and control linkage as specified in paragraph 5-12.

8. Fill steering gear housing to filler plug opening with Multi-Purpose Gear Lubricant as specified for Synchromesh transmissions (par. 1-1).

9. Road test car for ease of steering as described in paragraph 8-4 (subpar. c).

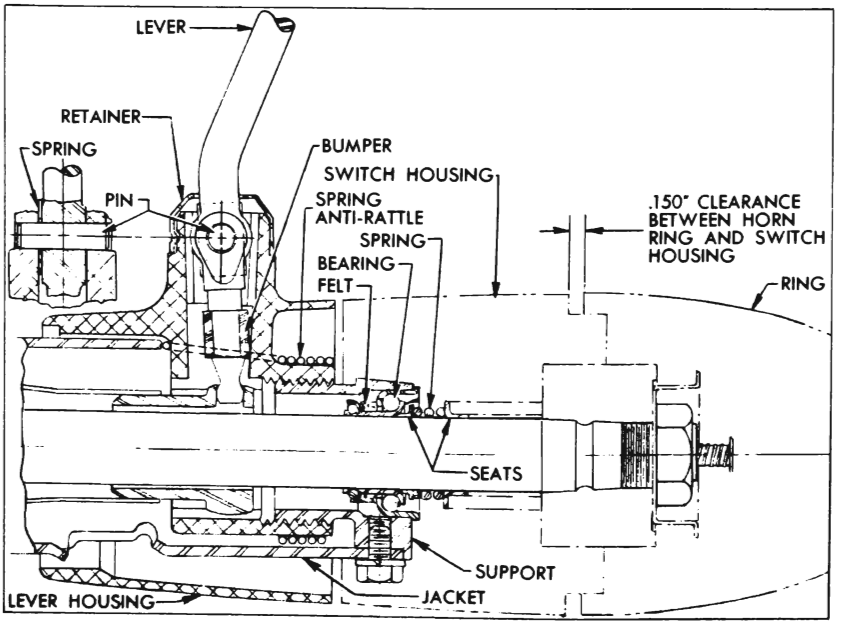

Figure 8-7—Control Lever and Adjacent Parts

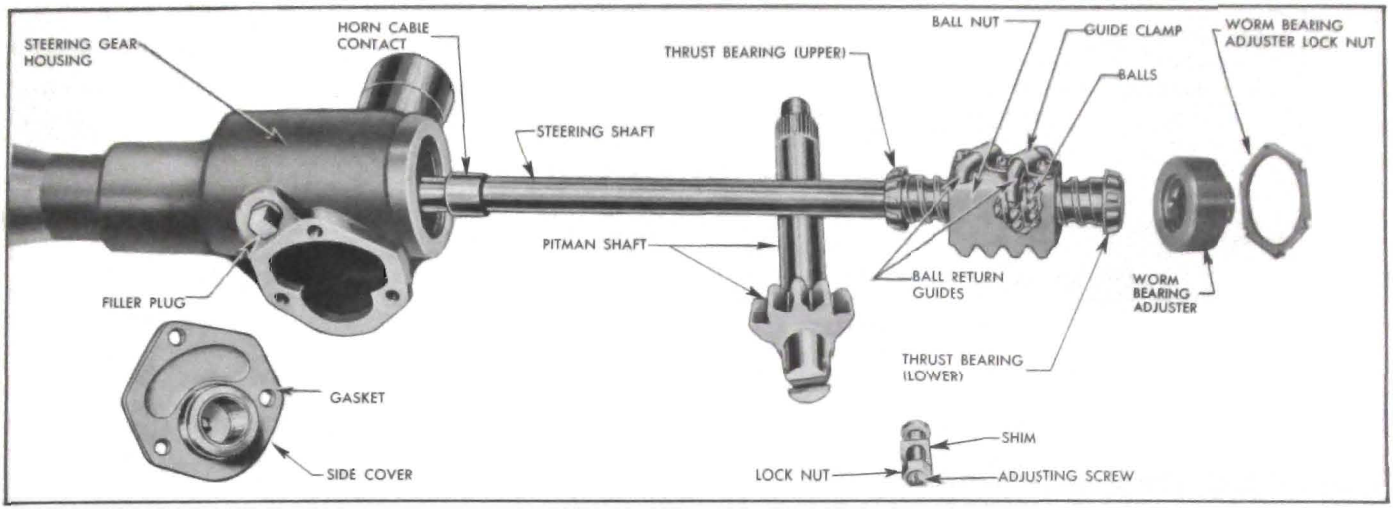

Figure 8-8—Manual Steering Gear Disassembled

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

a. Disassembly of Steering Gear

1. Loosen adjusting screw lock nut. Remove three side cover bolts and remove housing side cover by unscrewing the adjusting screw. See figure 8-8.

2. Loosen lock nut and remove worm thrust bearing adjuster. Remove lower thrust bearing, steering shaft, and upper bearing from housing.

3. Remove ball return guide clamps and guides from ball nut, turn ball nut over to remove balls, then remove ball nut from steering shaft worm.

b. Cleaning and Inspection of Steering Gear Parts

1. Clean and inspect all ball and roller bearings and races, including race in housing, as described in paragraph 1-10. Thoroughly wash all other parts in clean solvent and wipe dry with clean cloths.

2. Inspect pitman shaft bushings in gear housing and end cover. Replace bushings in housing and replace end cover if bushings are worn excessively.

3. It is advisable to replace the pitman shaft grease seal in housing to avoid possible leakage of lubricant. The seal must be installed with feather edge toward inside of housing.

4. Inspect steering shaft for wear or brinelling in ball and roller bearing races, which would require replacement of shaft; check shaft to make sure it is straight.

5. Inspect teeth of ball nut and pitman shaft. If scored or excessively worn it is advisable to replace both parts to insure proper mating of teeth. Check serrations of pitman shaft; if twisted, replace the shaft.

6. Check fit of pitman shaft adjusting screw and shim in the slot in end of pitman shaft. *With shim in place, screw head must be free to turn in slot with no perceptible end play to .002" loose.* If end play is excessive, selectively fit a new shim; these are furnished in four different thicknesses.

7. Inspect steering column jacket for distortion. A rippled or wavy feeling of jacket surface, particularly at lower end, will usually indicate a sprung jacket. Replace jacket if sprung or otherwise damaged.

8. Inspect control shaft bearing in tube of gear housing and the steering shaft upper bearing in control lever housing support (fig. 8-7). Replace worn or damaged parts.

c. Assembly of Steering Gear

To assemble the steering gear, reverse the sequence of steps given for disassembly. In addition, observe the following instructions that apply to assembly:

1. Lubricate bearings and gears with specified steering gear lubricant (par. 1-1) at time of assembly.

2. Use all new gaskets to avoid oil leaks.

3. When assembling ball nut on worm be sure to place 30 balls in each circuit, making a total of 60 balls.

4. When installing pitman shaft avoid damaging or turning the feather edge of the leather grease seal in gear housing.

5. Temporarily install steering wheel and adjust worm shaft thrust bearing for proper load and pitman shaft for proper gear lash as described in paragraph 8-4. Remove wheel.