FRONT SUSPENSION AND STEERING

Front Suspension System

Coil type springs are used in the front suspension on all models. The lower end of the coil spring is seated on the control arm, and the upper end in a recess in the front crossmember.

Threaded steel bushings are used at the outer pivot pins of both the upper and lower control arms. The inner pivot shafts of both the upper and lower control arms have rubber bushings and require no lubrication.

Front stabilizer shafts are used on all models to improve steering stability and control body roll. The stabilizer shafts are mounted directly to the lower control arm in rubber bushings at two points on each arm.

Rubber rebound bumpers attached to the frame side rail directly above the ends of the front crossmember cushion the downward movement of the upper control arm.

Upward movement of the lower control arm is cushioned by rubber jounce bumpers which are mounted on the lower control arm.

Two tie rods, a reach rod, and a single bell crank (which is mounted in the center of the front crossmember) are used on all models. The reach rod, connected between the pitman arm and the bell crank, is located along the lower left side of the engine.

Caster and camber adjustments are made at the upper control arm in the outer pin (rear).

Direct acting type shock absorbers are used on all models. They are located within the coil springs and operate on a vertical plane.

Both bushings and bearings are used in the steering knuckles on all models. A bronze bushing is used in the upper section of the steering knuckle and a needle bearing is used in the lower section of the knuckle.

SPECIFICATIONS

	FLIGHTHAWK CHAMPION	POWERHAWK SKYHAWK COMMANDER PRESIDENT	GOLDENHAWK
Front wheel toe-in	1/16" - 1/8" (1,589 mm. - 3,174 mm.)	1/16" - 1/8" (1,589 mm. - 3,174 mm.)	1/16" - 1/8" (1,589 mm - 3,174 mm.)
Caster angle*	—1° - —2½°	—1° - —2½°	—1° - —2½°
Front wheel camber angle**	0° - +1°	0° - +1°	0° - +1°
King pin inclination	5¼°	5¼°	5¼°
Minimum road clearance***	W,F-6-13/16" (173,0 mm.)	W,F-7-7/16" (188,9 mm.) Y-7-7/16" (188,9 mm.)	
	C-6-15/32" (176,2 mm.) D-7-9/16" (192,1 mm.)	C,K-6-15/32" (176,2mm.) D-7-9/16" (192,1 mm.)	6-15/32" (176,2 mm.)

*Not more than¾° variation between wheels.
**½° more camber favored on driver's side.
***W, F, D, Y—at engine rear support crossmember.
C, K—at body front pillar crossmember

Turning diameter (right)	C models 40' (12,2 m.) W-F-D models 38½' (11,7 m.)	C-K-Y models 40' (12,2 m.) W-F-D models 38½' (11,7 m.)	40' (12,2 m.)
(left)	C models 41' (12,5 m.) W-F-D models 39½' (12,0 m.)	C-K-Y models 41' (12,5 m.) W-F-D models 39½' (12,0 m.)	41' (12,5 m.)
Tread—front	56-11/16" (1439,8 mm.)	56-11/16" (1439,8 mm.)	56-11/16" (1439,8 mm.)
—rear	55-11/16" (1414,4 mm.)	55-11/16" (1414,4 mm.)	55-11/16" (1414,4 mm.)
Inside wheel angle with outside wheel at 20°	22½° - 23½°	22½° - 23½°	22½° - 23½°

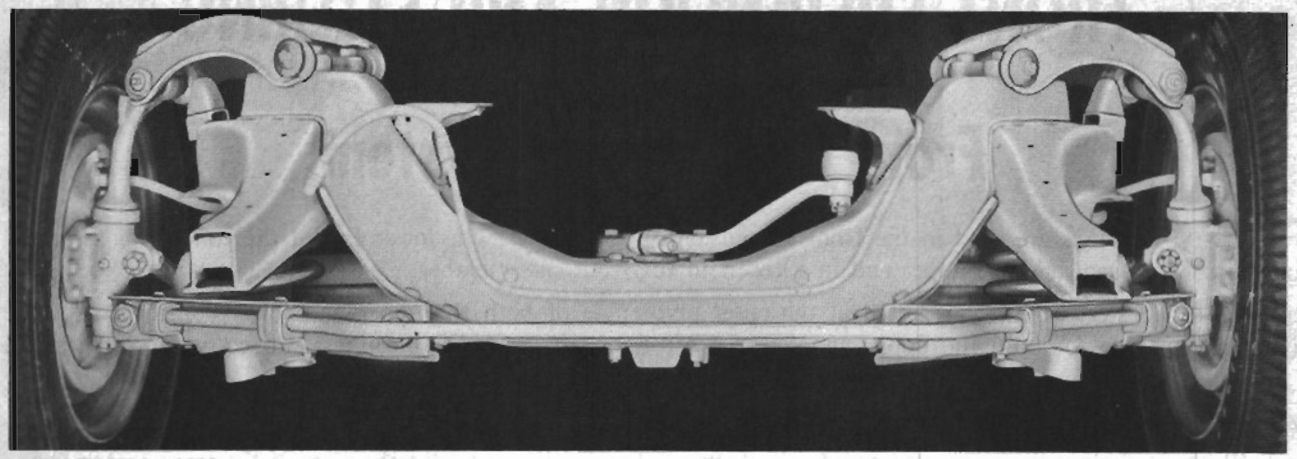

FIG. 1 FRONT VIEW OF FRONT SUSPENSION

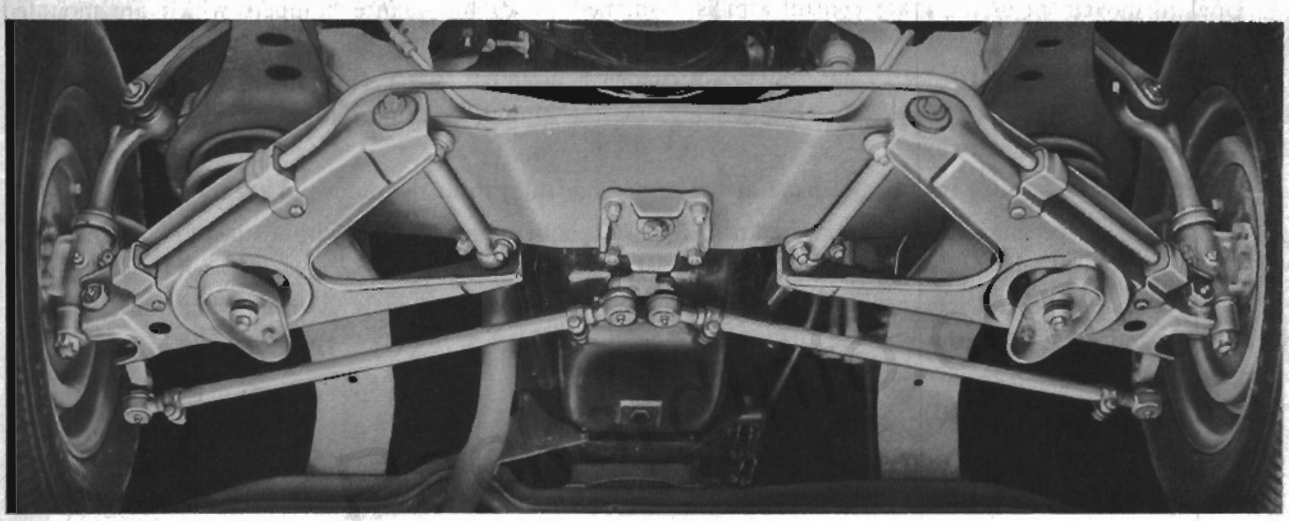

FIG. 2 BOTTOM VIEW OF FRONT SUSPENSION

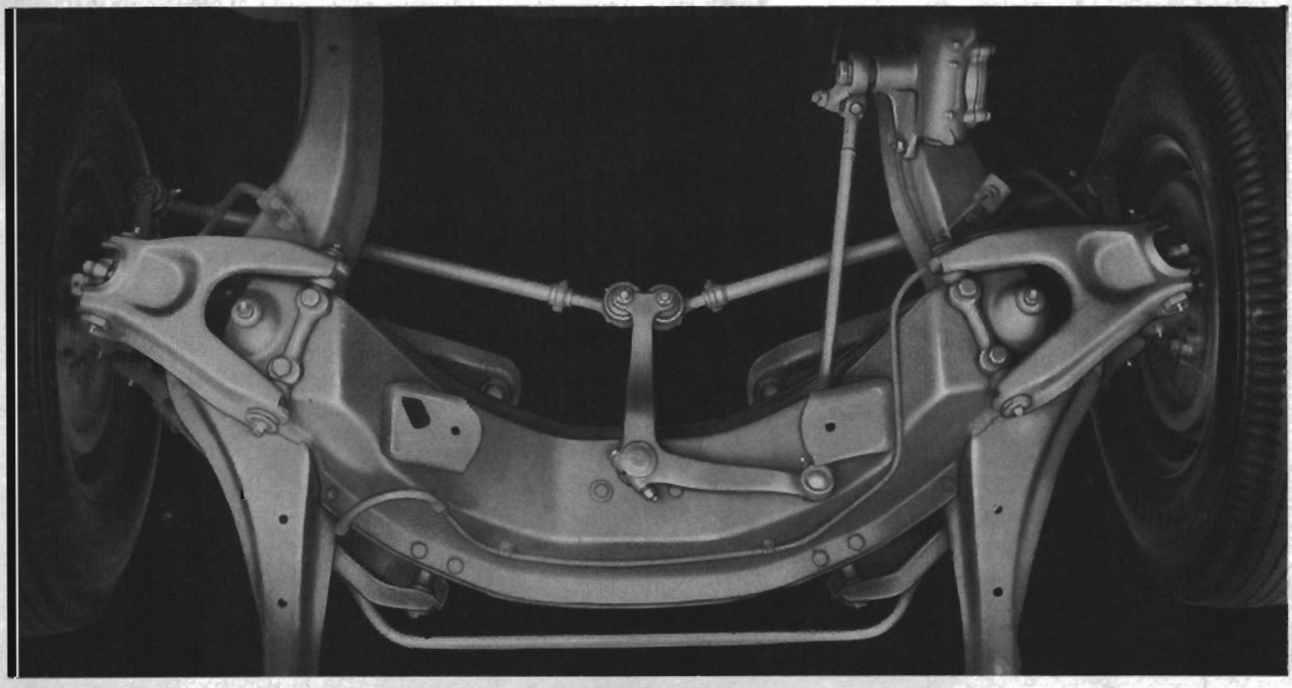

FIG. 3 TOP VIEW OF FRONT SUSPENSION

FRONT SPRING AND STABILIZER SHAFT

STABILIZER SHAFT

Removal—All Models

To remove the control arm stabilizer shaft, remove the four cap screws holding the shaft to the lower control arms and pull the shaft down and outward to free the shaft clips from the slots in the control arms (see Fig. 4). To remove the shaft bushings and brackets, locate the split in the bushing, spread and remove the bushing and bracket from the shaft.

Installation—All Models

Spread the bushings and install them on the stabilizer shaft. When installing the stabilizer shaft, place the shaft in position against the control arms with the bracket clips in the slots in the control arms. Then, using a pipe wrench, pull the lower end of the bracket under the control arm, align the hole in the bracket with the hole in the lower control arm, and install the cap screw, lock washer, and nut. Install the three remaining brackets, cap screws, lock washers, and nuts in the same manner.

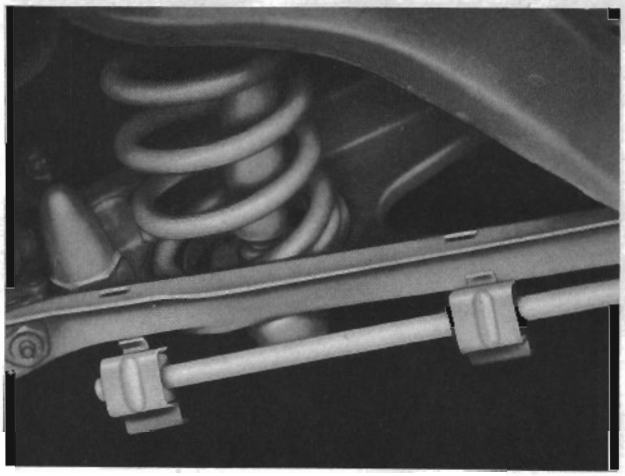

FIG. 4

FRONT SPRING

Removal—All Models

Raise the car and support it with stationary jacks under the frame just to the rear of the engine rear support crossmember. The car must be high enough to allow the inner end of the control arm to clear the floor when it is released. Place a roller jack (1, Fig. 5) under the center of the lower control arm inner shaft (2) and raise the jack so the pad of the jack just contacts the shaft. Remove the front shock absorber as outlined in the Springs and Shock Absorbers section, and disconnect the control arm stabilizer shaft from the control arm.

Remove the four inner shaft-to-crossmember retaining bolts. Release the jack slowly, and lower the control arm until the spring is unloaded. Remove the jack and swing the control arm outward, lifting the spring off its seat on the control arm. Then remove the spring. Remove the lower rubber spring pad from the spring seat.

If a hoist is available, an alternate method can be used to relieve the front spring pressure. Disconnect the stabilizer shaft, place a roller jack at the control arm inner shaft, and raise the car until the jack supports the weight of the car. Remove the inner shaft-to-crossmember bolts and remove the front shock absorber. Then using the hoist, raise the car and unload the spring.

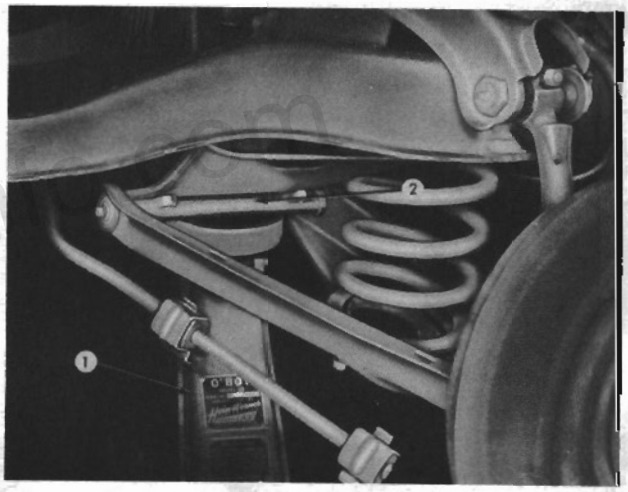

FIG. 5

1. Roller Jack
2. Lower Control Arm Inner Shaft

Installation—All Models

Be sure the shock absorber mounting bolts are in place in the control arm. Place the lower spring pad on the control arm spring seat. Position the spring on the upper spring seat. Holding the spring so that it remains seated and making sure that the upper spring pad does not slip, swing the control arm inward, seating the spring on the control arm seat. Position the pad of the roller jack under the center of the inner shaft (see Fig. 6).

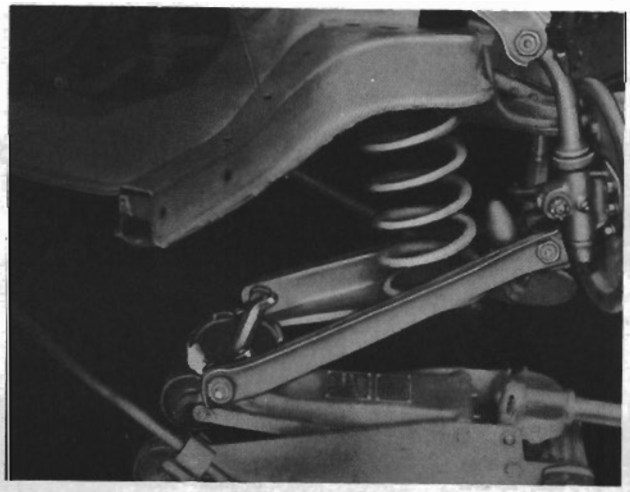

FIG 6

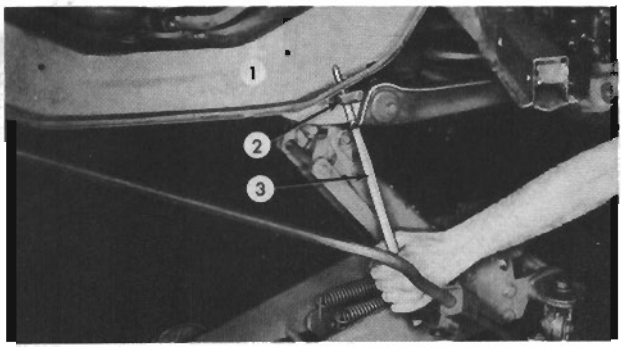

FIG. 7

1. Crossmember 2. Inner Shaft 3. Drift

Slowly raise the jack, lifting the inner end of the control arm and compressing the spring. As the inner shaft nears the crossmember (1, Fig. 7), align the holes of the inner shaft (2) and the holes in the flange of the crossmember with a drift (3); then continue to lift the inner shaft. With the inner shaft held in position at the crossmember by the jack, install the four retaining bolts and nuts, and tighten securely.

If the hoist method was used, after positioning the spring, lower the car slowly to compress the spring. Then align the holes of the inner shaft and the crossmember and install the retaining bolts.

Connect the stabilizer shaft to the lower control arm and install the front shock absorber as outlined in the Springs and Shock Absorbers section.

CONTROL ARM ASSEMBLIES

REBOUND AND JOUNCE BUMPERS

Rubber jounce bumpers (9, Fig. 8) are fastened to each of the lower control arms to prevent damage to the suspension parts on severe bumps. To remove the jounce bumper, remove the stud nut through the hole in the lower side of the lower control arm, and take the rubber bumper off the top of the arm.

Rubber rebound bumpers, which support the suspension when the car is lifted by the frame or when a wheel drops into a hole, are mounted on brackets on the top of the frame, just under the outer ends of the upper control arms. The bumpers are removed by pulling out the portions that are turned under the bracket and then slipping the bumper off the bracket.

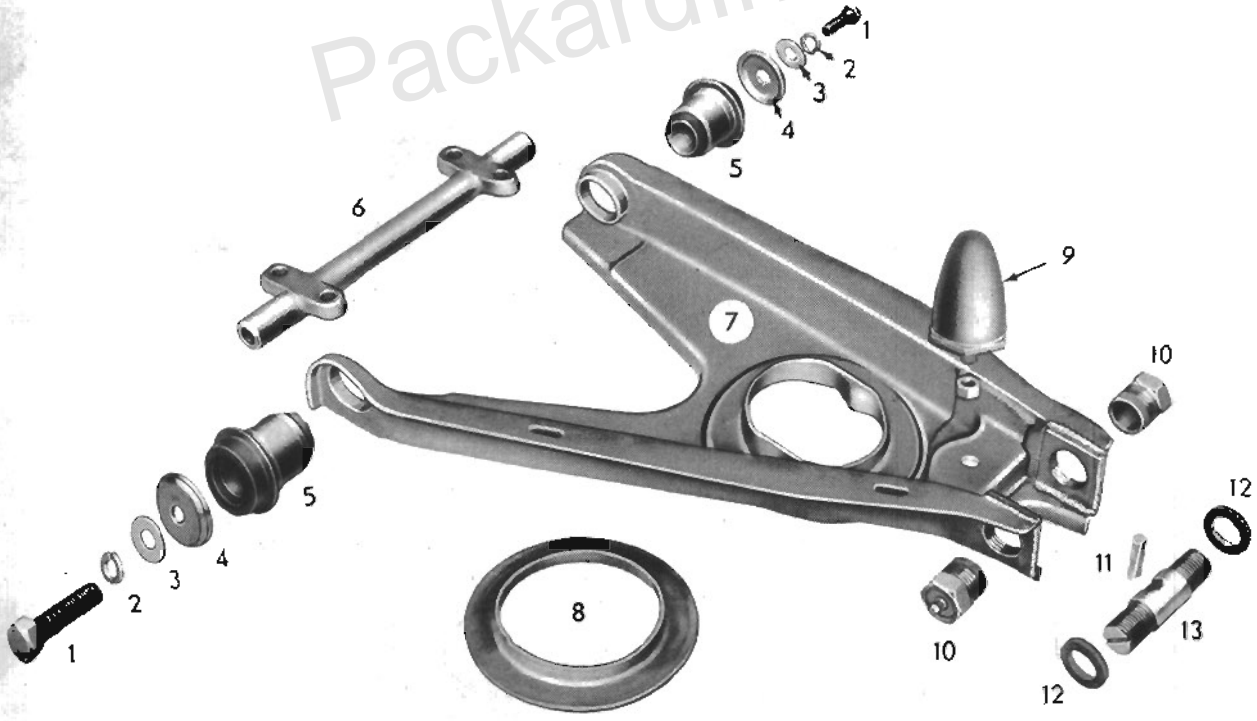

FIG. 8

1. Cap Screw
2. Lock Washer
3. Plain washer
4. Retainer
5. Bushing
6. Inner Shaft
7. Lower control arm
8. Spring pad
9. Jounce bumper
10. Bushing
11. Lock pin
12. Grease seal
13. Outer pin

LOWER CONTROL ARM ASSEMBLY

Removal and Disassembly—All Models

Raise the front end of the car high enough so that the lower control arm will clear the floor when the spring is relieved. Support it with stationary jacks under the frame just to the rear of the engine rear crossmember. Remove the wheel assembly. Disconnect the front stabilizer shaft from the lower control arm. Remove the front shock absorber as outlined in the Springs and Shock Absorbers section.

Disconnect the inner end of the lower control arm to allow the removal of the front spring and spring pad as outlined under Front Spring—Removal. Remove the threaded bushings (10, Fig. 8) from the outer end of the lower control arm (7). Remove the tapered lock pin (11) by driving it upward with a suitable pin punch. Then, using a brass drift, drive the lower control arm outer pin (13) out of the lower steering knuckle support, permitting removal of the lower control arm (7) and grease seals (12).

Before the inner shaft can be removed from the control arm, the rubber bushings must be removed. Use the J-5472 Tool Set to remove the bushings. First, place the J-5472-4 Large Receiver over one insulator and screw the ½" x 2½" cap screw into the other end of the shaft. Turn the inner shaft in the control arm as shown in Fig. 9, and install the J-5472-6 Large Spacer to prevent distortion of the control arm. Using an arbor press, move the inner shaft down so that the lugs on the shaft contact the outer shell of the lower insulator. Continue to press until the outer shell is flush with the flange on the control arm. Put the control arm in a vise, gripping near the partly removed insulator, and knock the insulator the rest of the way out with a hammer and blunt chisel. Remove the cap screw from the inner shaft and install it in the other end of the shaft. Using the large receiver and large spacer as before, remove the second bushing in the same manner.

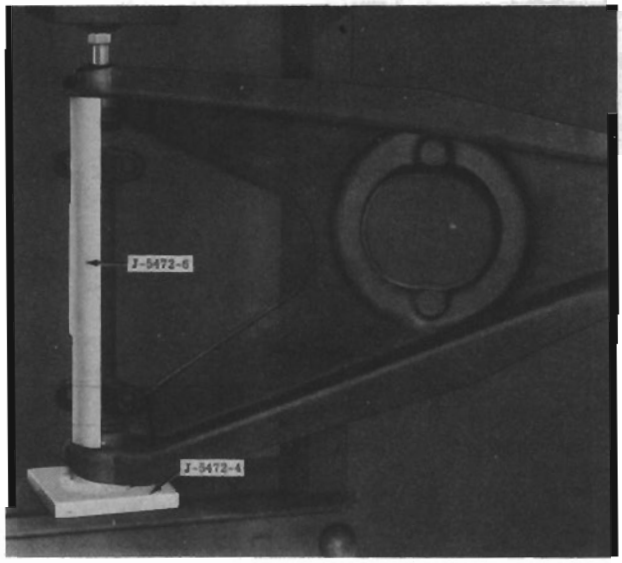

FIG. 9

J-5472-6 Large spacer J-5472-4 Large receiver

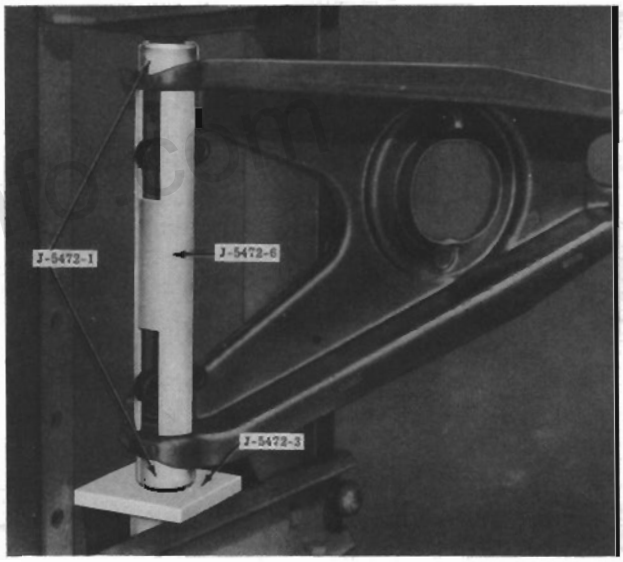

FIG. 10

J-5472-1 Large installer J-5472-6 Large spacer
J-5472-3 Small receiver

Reassembly and Installation—All Models

Insert one end of the inner shaft in one member of the control arm, push in as far as possible, swing the opposite end into position, and insert it in the other member of the arm. Then place the J-5472-6 Large Spacer in position between the ends of the control arm as shown in Fig. 10. Start the rubber bushings in the holes at either end of the control arm. Place a J-5472-1 Large Installer in position on each bushing and, using an arbor press, force both bushings in place until the shoulder on the outer sleeve of the bushing is seated against the control arm. Do not attempt to seat the flange of the bushing on the control arm. Install bushing caps (4, Fig. 8), flat washers (3), lock washers (2), and cap screws (1). After the control arm has been installed in the car and the weight of the car is on the springs, tighten the cap screws to 65 ft-lbs (9,0 kg-m) torque.

It is necessary to spread the outer ends of the lower control arm .015" (0,38 mm.) before installing the outer pin and threaded bushings. Determine the outside dimension by adjusting a pair of calipers so the setting includes a .015" (0,38 mm.) feeler gage which is inserted between the outside edge of the control arm and one prong of the calipers.

After setting the calipers, position the outer end of the lower control arm at the lower steering knuckle support and install the outer pin, with a grease seal, on the pin on each side of the steering knuckle support. Using a screw driver in the slot provided in the end of the outer pin, turn the pin and align the slot at the center of the outer pin and the hole of the lower knuckle support and install the lock pin.

Then install the Spreader Tool J-2044 between the inner surfaces of the outer ends and spread the outer

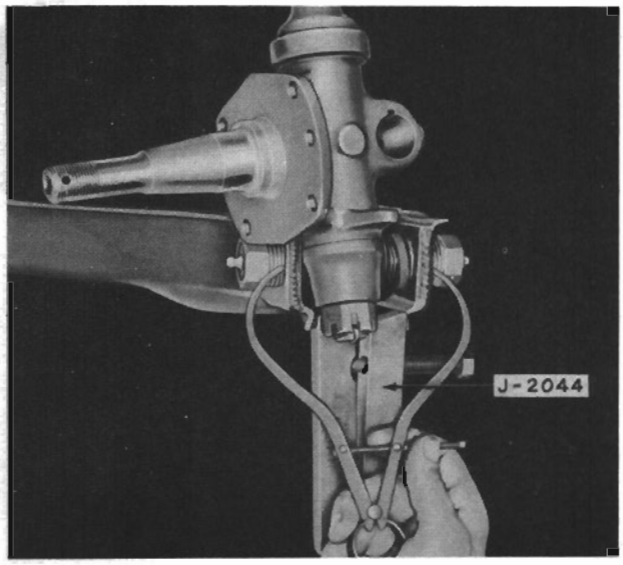

FIG. 11
J-2044, Spreader tool

ends until the outside dimension is equal to the setting of the calipers (see Fig. 11).

Centralize the outer end of the control arm on the outer pin. Install the bushings and tighten them securely. Then remove the spreader tool. Make sure that the control arm turns freely on the outer pin.

Be sure that the shock absorber mounting bolts are seated in the control arm before installing the spring. Install the front spring pad and spring and complete the installation of the lower control arm as outlined under Front Spring—Installation. Install the front shock absorber. Connect the stabilizer shaft and install the wheel assembly.

If new rubber bushings have been installed on the inner shaft, tighten the retaining cap screws to 65 ft-lbs (9,0 kg-m) torque.

UPPER CONTROL ARM ASSEMBLY

Removal and Disassembly—All Models

Raise the car and support it at the outer end of the lower control arm. Remove the front wheel assembly.

Remove the threaded bushings (9, Fig. 12) from the upper control arm outer pin.

Mark the top front of the control arm inner shaft (2) so that the shaft can be installed in the same position.

(The holes in the inner shaft are drilled off the centerline of the shaft and turning the shaft over will increase or decrease the camber slightly less than ¾°. Therefore, on reassembly it is important that the shaft be installed in its original position).

Remove the bolts and nuts (1) which hold the inner shaft to the frame bracket. Be careful not to drop the nuts or washers in the front frame crossmember. Shift the upper control arm to one side, turn the arm and lift it off the end of the pin as shown in Fig. 13. Then remove the arm by slipping it off the other end of the pin.

To remove the upper control arm bushings, use Tool No. J-5472.

Use the J-5472-3 Small Receiver, J-5472-5 Small Spacer, the ⅜" x 2½" cap screw, and J-5472-25 Bar as shown in Fig. 14. Insert the two short cap screws through the bar and inner shaft, and install the two

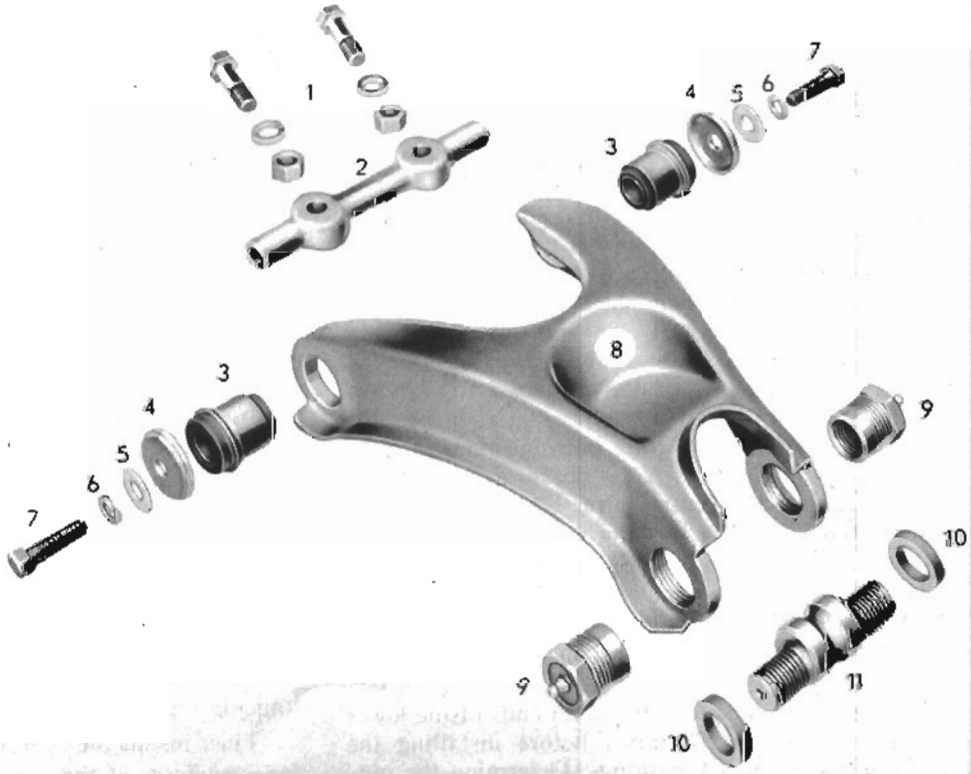

FIG. 12

1. Bolts, lock washers & nuts
2. Inner shaft
3. Bushing
4. Retainer
5. Plain washer
6. Lock washer
7. Cap screw
8. Upper control arm
9. Bushing
10. Grease seal
11. Outer pin

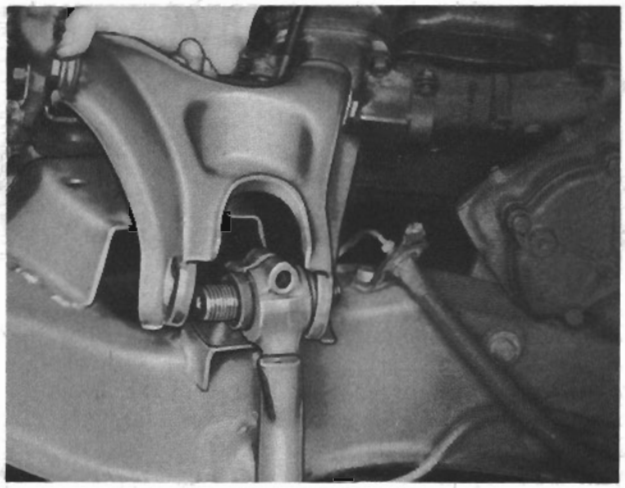

FIG. 13

thin nuts to hold the bar in position. Press on the cap screw in the end of the shaft as shown until the J-5472-25 Bar has pushed the shell of the bushing to the flush position. Then invert the control arm in the press, put the cap screw in the other end of the shaft, and press the second bushing to the flush position. Remove the arm from the press and knock the bushings out the rest of the way with a hammer and blunt chisel while the arm is held securely in a vise.

Reassembly and Installation—All Models

Insert one end of the inner shaft in one member of the control arm, push in as far as possible, swing the opposite end into position, and insert it in the other member of the arm. Then place the J-5472-5 Small Spacer in position between the ends of the control arm (see Fig. 15). Start the rubber bushing in the hole at either end of the control arm. Place a J-5472-2 Small Installer in position on each bushing and, using an arbor press, force the bushings in place until the shoulder on the outer sleeve of the bushing is seated on the control arm. Do not attempt to seat the flange of the bushing on the control arm. Install the bushing cap (4, Fig. 12), washer (5), lock washer (6), and screw (7). After the control arm has been installed in the car and the weight of the car is on the springs, tighten the cap screws to 35 ft-lbs (4.8 kg-m) torque.

Place one side of the outer end of the control arm over one end of the outer pin and install the opposite side of the control arm on the outer pin.

With the marked side of the inner shaft up, align the holes of the inner shaft and the holes of the frame bracket, and install the retaining bolts, washers, and nuts.

The outer end of the upper control arm must be spread .015" (0,38 mm.) before installing the outer shaft and bushings. Using calipers and a .015" feeler gage, determine the outside dimension. Install Spreader Tool J-2044, spread the ends of the control arm to the setting of the calipers, and start the bushings on the outer pin (see Fig. 16). Center the end of the king pin in the control arm and, with the spreader still in place, install the bushings.

Remove the spreader and install the wheel assembly.

Check and adjust camber and caster as necessary.

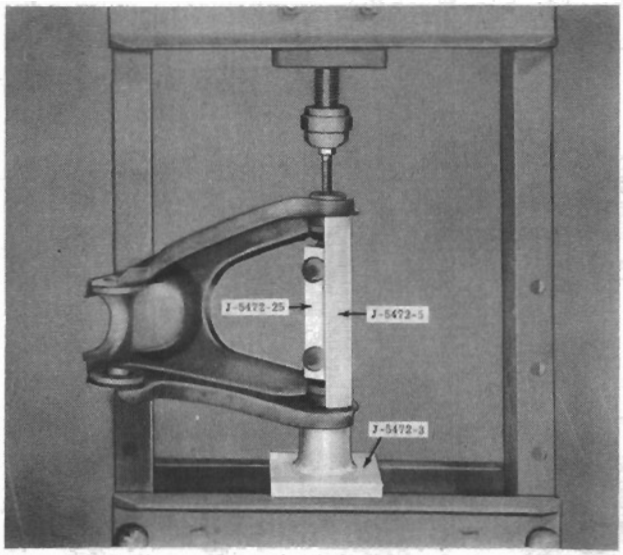

FIG. 14

J-5472-25 Bar J-5472-5 Small spacer J-5472-3 Small receiver

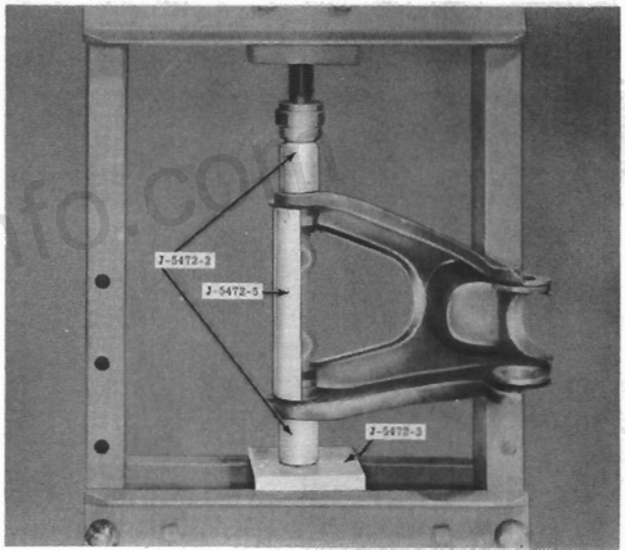

FIG. 15

J-5472-2 Small installer J-5472-5 Small spacer
J-5472-3 Small receiver

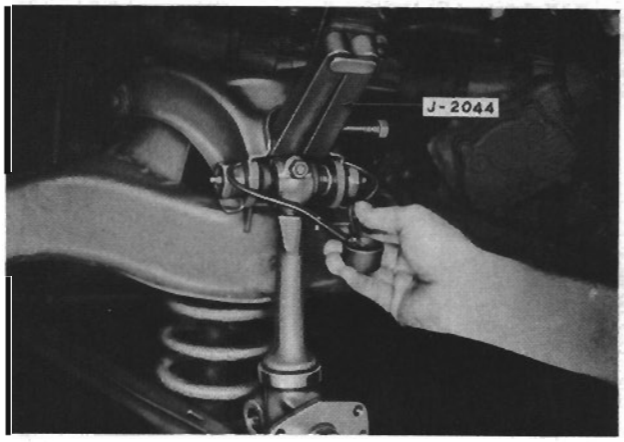

FIG. 16

J-2044 Spreader tool

STEERING KNUCKLE ASSEMBLY

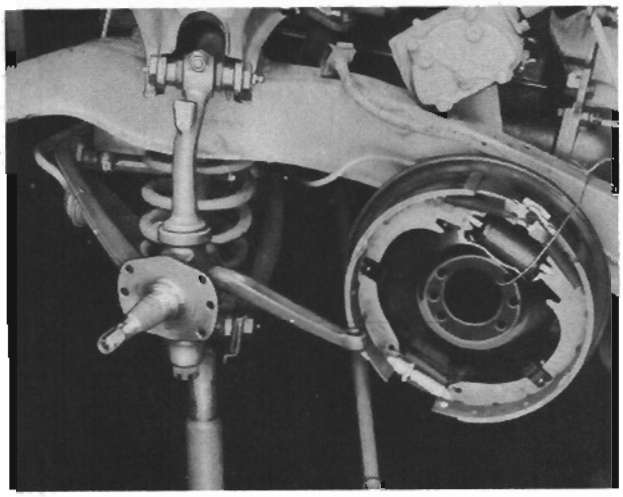

FIG. 17

Removal and Disassembly—All Models

Raise the car and support it at the outer end of the lower control arm. Remove the wheel, hub, and drum assembly. Remove the brake backing plate assembly from the steering knuckle flange without disconnecting the brake hose, and suspend the assembly in an out-of-the-way position. Do not allow the assembly to hang on the hose. Disconnect the tie rod from the steering knuckle arm (See Fig. 17).

Remove the cotter pin and king pin retaining nut (12, Fig. 18). Then, using a lead mallet, drive the king pin (3) upward out of the lower support (11). Remove the upper control arm outer pin bushings, and remove the king pin and steering knuckle assembly from the outer pin. Remove the Woodruff key (4) from the king pin, then remove the steering knuckle (8), shim (6), and thrust bearing (5). Remove the cork gasket (10) from the bottom end of the knuckle.

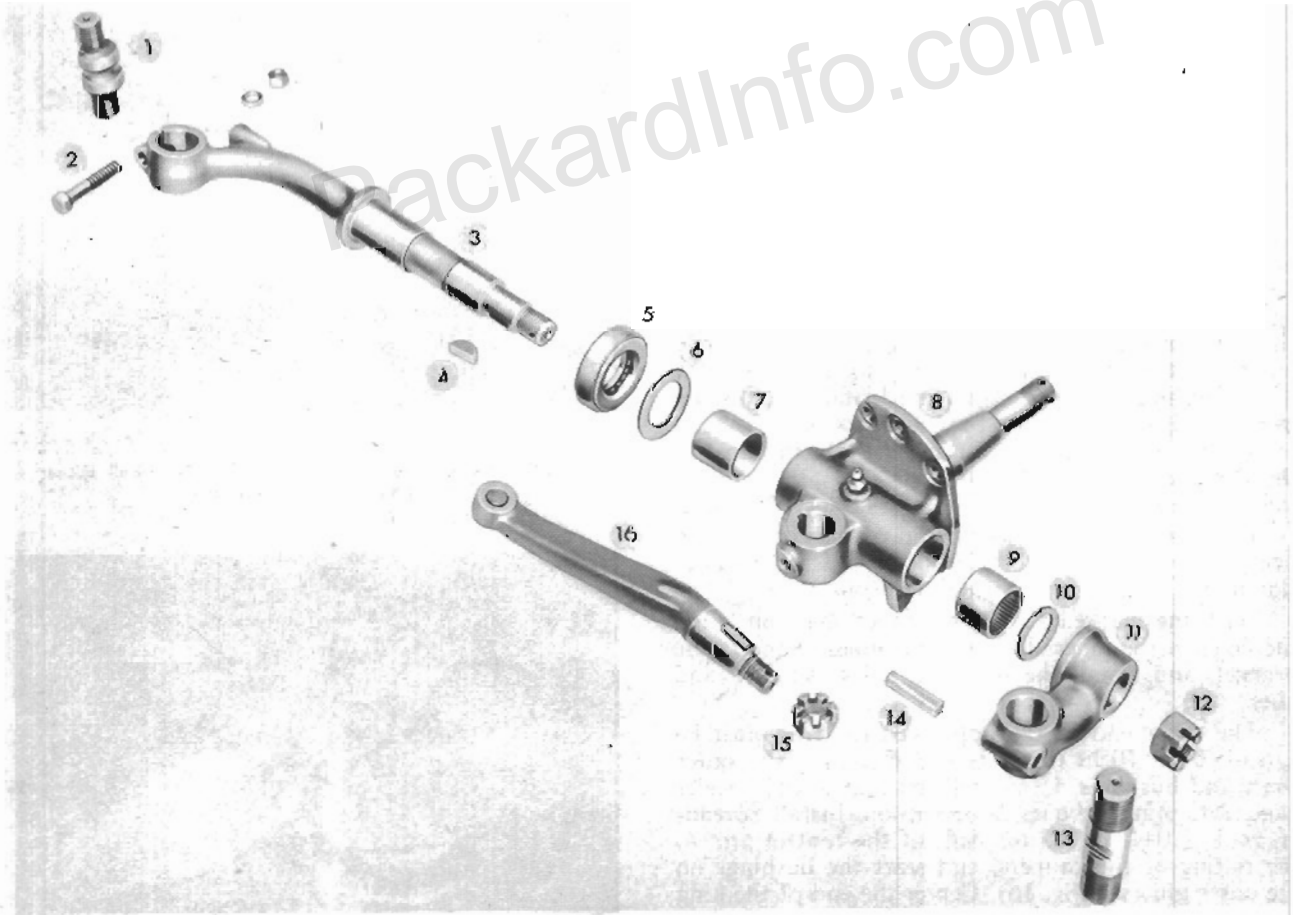

FIG. 18

1. Upper outer pin
2. Pinch bolt
3. King pin
4. Key
5. Thrust bearing
6. Shim
7. Bushing
8. Steering knuckle
9. Bearing
10. Gasket
11. Lower support
12. King pin nut
13. Lower outer pin
14. Lock pin
15. Knuckle arm nut
16. Knuckle arm

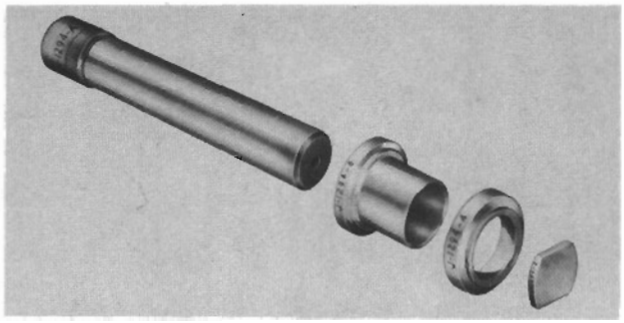

FIG. 19
J-1294-A Arbor J-1294-6 Pilot J-1294-4 Pilot
J-1294-9 Removal adapter

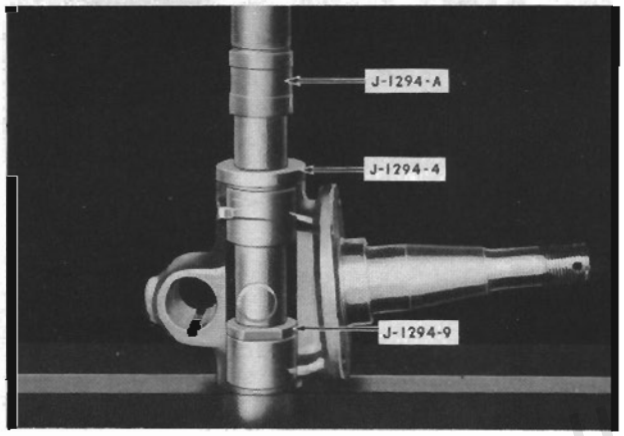

FIG. 20
J-1294-A Arbor J-1294-4 Pilot J-1294-9 Removal adapter

Bushing and Bearing Remover and Replacer Set J-4477-A is used for the steering knuckle. The parts of this set which are needed for this operation are the J-1294-A Arbor, J-1294-6 Pilot, J-1294-4 Pilot, and J-1294-9 Removal Adapter (see Fig. 19).

To remove the steering knuckle bushing (see Fig. 20), invert the steering knuckle and place the Removal Adapter J-1294-9 on the inner end of the bushing. Insert the Pilot J-1294-4 in the bearing end of the knuckle and, using the Arbor J-1294-A, press the bushing out of the knuckle.

To remove the needle bearing, turn the steering knuckle over, place the Removal Adapter J-1294-9 on the inner end of the bearing, and place the Pilot J-1294-4 in the bushing end. Using the Arbor J-1294-A, press the needle bearing out of the knuckle (see Fig. 21).

To remove the king pin lower support from the lower control arm outer end, follow the procedure for removal of the outer pin and bushing as outlined in Lower Control Arm Assembly—Disassembly.

Reassembly and Installation—All Models

To install the bushing, place the Pilot J-1294-6 over the arbor with the wide shoulder of the pilot against the shoulder of the arbor. Place the new bushing on

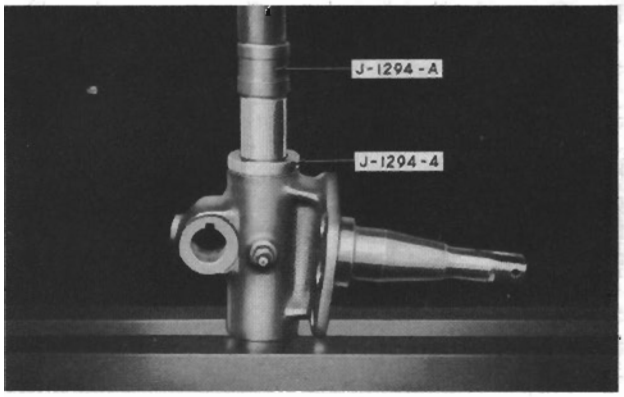

FIG. 21
J-1294-A Arbor J-1294-4 Pilot

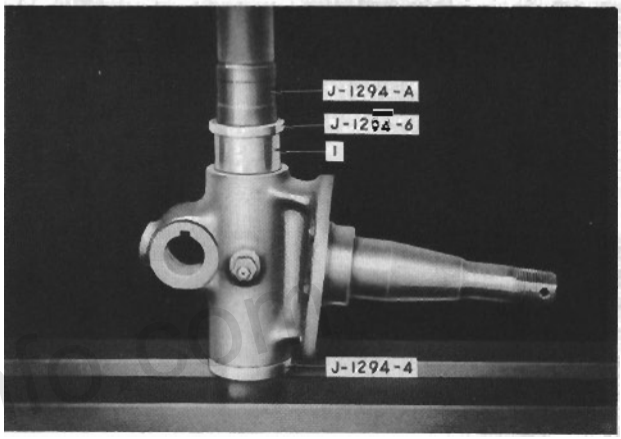

FIG. 22
J-1294-A Arbor J-1294-6 Pilot J-1294-4 Pilot
1. Bushing

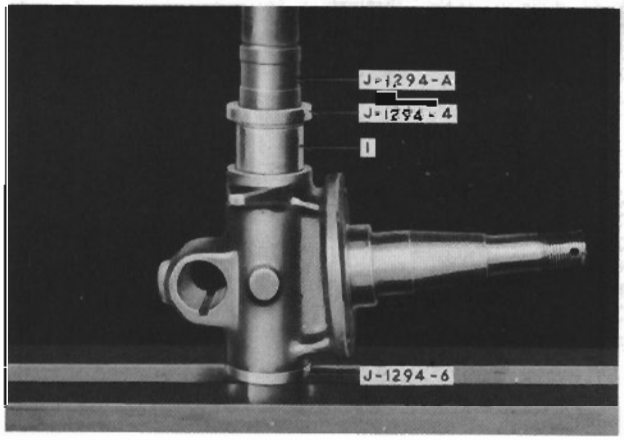

FIG. 23
J-1294-A Arbor J-1294-4 Pilot J-1294-6 Pilot
1. Bearing

the pilot. Insert Pilot J-1294-4 in the bearing end of the knuckle. Press the bushing (1, Fig. 22) in until the Pilot J-1294-6 stops against the knuckle. The bushing will be exposed approximately 1/16" (1,58 mm.) above the knuckle. Remove the Arbor J-1294-A, reverse the Pilot J-1294-6, and press the bushing in until the pilot stops against the knuckle.

To install the needle bearing (1, Fig. 23) in the

knuckle, place the Pilot J-1294-4 on the Arbor J-1294-A so that the wide shoulder of the pilot is against the shoulder of the arbor. Place the bearing on the Pilot J-1294-4 so that the lettered end of the bearing is against the shoulder of the Pilot J-1294-4. Insert Pilot J-1294-6 in the bushing bore. Insert the arbor in the bearing end of the knuckle, and press the bearing in until the Pilot J-1294-4 stops against the knuckle. The bearing will then be recessed in the knuckle, leaving a space for the cork gasket.

Then to determine the steering knuckle end play on the king pin, first place the king pin in a vice and place the steering knuckle (4, Fig. 24) on the king pin (6) *without the cork gasket* which is normally installed in the bottom of the knuckle. Place the thrust bearing (2) and shims (3) on the king pin. Insert a .003" to .006" (0,076 mm. to 0,15 mm.) feeler gage (5) between the shoulder of the king pin and the steering knuckle. Place a straight edge or small scale (1) across the top surface of the thrust bearing and lower shoulder of the king pin, and press down on the thrust bearing. If the surface of the thrust bearing is not flush with the shoulder of the king pin, remove or add shims as required. After proper end play is obtained, remove the steering knuckle, thrust bearing, and shims from the king pin.

To install the assembly, install the upper control arm outer pin in the king pin with the hex opening to the rear. Install the grease seals on the outer pin. Center the outer pin in the king pin by aligning the groove of the outer pin with the hole in the king pin. Install the king pin retaining bolt and nut. (Turn the nut finger tight). Place one end of the outer pin in one member of the upper control arm, push in, swing the opposite end of the outer pin into position, and insert it in the outer member of the arm.

Spread the outer end of the upper control arm and install the bushings as described in Upper Control Arm Assembly—Installation. Place the thrust bearing, shim, and then the steering knuckle on the king pin. Be sure the shim is between the knuckle and the bearing. Install the Woodruff key in the king pin. Then, start the lower end of the king pin in the lower support. Use a lead mallet, if necessary, to drive the king pin in through the support far enough to allow installation of the king pin retaining nut. Tighten the nut, drawing the king pin through the support. Install a cotter pin.

Install the brake backing plate assembly. Install the wheel, hub and drum assembly. Check and adjust camber and caster as necessary, and tighten the king ping upper retaining bolt.

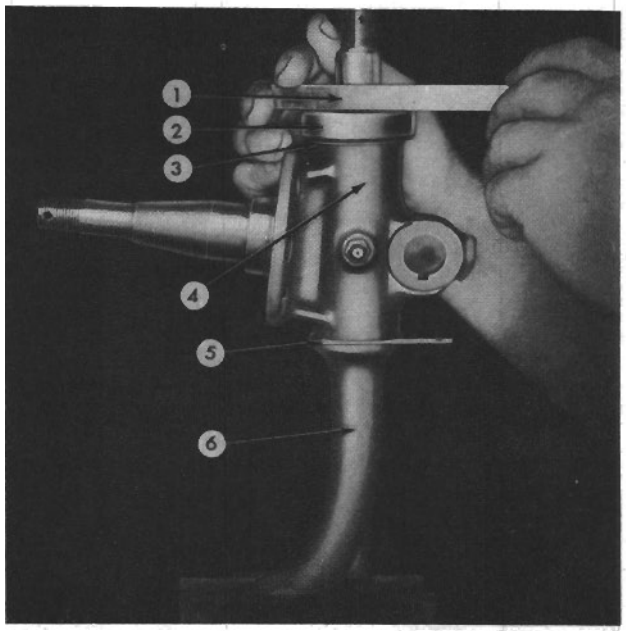

FIG. 24

1. Straight edge
2. Thrust bearing
3. Shim
4. Steering knuckle
5. Feeler gage
6. King pin

Steering System

Two types of steering gears are used. The Ross variable ratio and the Saginaw. On both of these steering gears the cam lever is serrated for attachment to the steering pitman arm.

The make of steering gear installed on the car can be identified by location of the filler hole plug. On the Ross, it is at the upper end of the housing; on the Saginaw, it is on a boss located near the center of the housing. The Saginaw steering gear can also be identified by the presence of a large bearing adjuster lock nut located at the lower end of the housing. Both of these steering gears are interchangeable. However, if the steering gear assemblies are interchanged, the pitman arm must also be changed.

Hydraulic type power steering is available as optional equipment on all models. The unit operates only if the engine is running and when force is applied to the steering wheel, and will supply about 80 per cent of the effort required to turn the front wheels.

SPECIFICATIONS

	ALL MODELS
Steering gear—type	Cam & Twin Lever or worm & roller
—make	Ross or Saginaw
—ratio (gear)	Ross 18.5-16.5-18.5 Saginaw 19-1
—ratio (overall)	Ross 33.8-24-33.8 Saginaw 20-1
Power steering (optional at extra cost)	
—type	Hydraulic
—make	Saginaw
—ratio	20-1

STEERING WHEEL AND POST JACKET ASSEMBLY

STEERING WHEEL

Removal—Champion, Commander, Flighthawk and Powerhawk Models

Remove the horn button assembly by pushing down on the button and at the same time turning the button one-third of a turn. Remove the wheel retaining nut and lock plate.

Place the puller center adapter (2, Fig. 25) in the end of the steering post over the end of the horn wire terminal. Install the steering wheel Puller J-5473 by installing screws in the holes provided in the wheel hub, and remove the wheel.

Installation—Champion, Commander, Flighthawk and Powerhawk Models

Align the mark on the top of the wheel with the mark on the end of the steering post and install the wheel over the splines. Install the lock plate and retaining nut. Tighten the nut to 23 to 27 ft-lbs (3,18 to 3,73 kg-m) torque and bend the lock plate to hold the nut. Then install the horn button assembly.

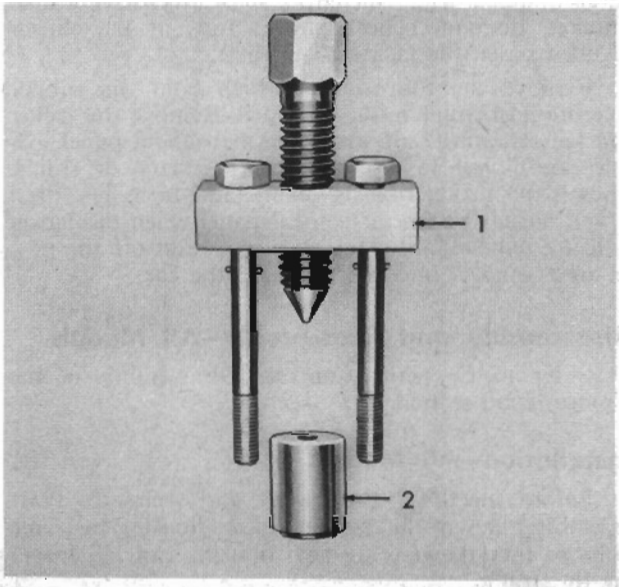

FIG. 25

1. Puller J-5473 2. Center adapter

Removal—President, Skyhawk and Goldenhawk Models

Remove the button from the steering wheel by inserting a knife blade under the edge of the button and forcing the button up and out. Remove the horn ring retaining screws and remove the ring and rubber shock pad. Remove the steering wheel retaining nut and lock plate.

Place the puller center adapter (2, Fig. 25) in the end of the steering post over the end of the horn wire terminal. Remove the steering wheel.

Installation—President, Skyhawk and Goldenhawk Models

Align the mark on top of the steering wheel hub and the mark on the end of the steering post and install the wheel. Install the lock plate and retaining nut, and tighten to 23 to 27 ft-lbs (3,18 to 3,73 kg-m) torque. Bend the lock plate to hold the nut and install the rubber shock pad and horn ring.

When installing the plastic button in the horn ring, make sure that the rubber "O" ring is not distorted or stretched. If it is damaged, use a new one. Put the "O" ring in the groove of the plastic button and snap the "O" ring a few times to make sure that it is not twisted. Place the button squarely over the hole and strike it sharply with the palm of the hand to seat it.

STEERING POST JACKET ASSEMBLY

Removal—All Models

Disconnect the battery cable at the battery. Remove the horn button assembly and remove the steering wheel. Take out the jacket spring and spring seat. On cars equipped with power steering, remove the horn wire brush and retaining bracket at the lower end of the steering post jacket. On cars equipped with Flightomatic, disconnect the quadrant light cable and the two wires at the starter cutout switch, and disconnect the transmission control rod at the shifter lever. On cars equipped with conventional or overdrive transmission, disconnect both shifter rods at the shifter levers. Loosen the jacket clamp bolt.

Remove the four screws which hold the rubber steering post collar to the toeboard. Remove the jacket bracket retaining bolts from the instrument panel, being careful not to lose the nuts, washers, or shims. Loosen the jacket bracket clamp and turn it so that it will not strike the instrument panel when the jacket is being removed. Slip the steering jacket off the post as an assembly, into the inside of the car.

Disassembly and Reassembly—All Models

Refer to Gearshift Control—Disassembly in the Transmission section.

Installation—All Models

Before installing the jacket and gearshift shaft assembly, loosen the steering gear housing-to-frame bolts so that the steering gear housing can be shifted on the frame.

From the inside of the car, install the steering post jacket assembly over the steering post. Turn the jacket bracket and align it with the holes in the instrument panel. Install any shims which were removed during the jacket removal, and install and tighten the jacket bracket-to-instrument panel bolts and nuts. Position the jacket and gearshift shaft assembly on the steering gear housing, and tighten the jacket clamp bolt. On cars equipped with power steering, the alignment boss on the steering gear housing must engage the mating slot in the steering post jacket. Connect the shift lever rods or transmission control rod.

Tighten the steering gear housing-to-frame bolts and jacket bracket clamp bolt securely. On cars equipped with Flightomatic, connect the quadrant light cable and the starter cutout switch. On cars equipped with power steering, install the horn wire brush and bracket. Align the marks on the steering wheel and the steering post and install the steering wheel, nut lock, and nut. Tighten the nut and bend the lock. Install the horn button assembly and connect the battery.

HORN WIRE

Replacement—All Models Except With Power Steering

Disconnect the horn wire at the Douglas connector below the steering gear housing and attach a pilot wire to the lower end of the old horn wire.

Note.—A good pilot wire can be made by soldering the inner sleeve of an old Douglas connector to an old horn wire cable. The connector provides a small-diameter, quick, but positive means of attachment.

On Custom and Deluxe models, remove the horn button by pressing in on it and turning it one-third turn counterclockwise. On all other models, carefully pry the ornamental plastic insert out of the center of the horn ring, and remove the horn ring and attaching parts. Pull the old horn wire up through the steering post, leaving the pilot wire in the post.

Fasten the lower end of the new horn wire to the pilot wire and pull it down through the steering post, being careful not to displace the rubber antirattler washers on the wire. On Custom and Deluxe models, install the horn button. On all other models, install the horn ring and attaching parts. When installing the plastic button in the horn ring, make sure that the rubber "O" ring has not been distorted or stretched. If it is damaged, use a new one. Put the "O" ring in the groove of the plastic button, and snap the "O" ring a few times to make sure it is free of any twist. Place the insert squarely over the hole and strike it sharply with the palm of the hand.

Remove the pilot wire and connect the horn wire at the Douglas connector. Check the horn for proper operation.

Replacement—All Models With Power Steering

Disconnect and remove the battery. Turn the steering wheel so that the spokes are horizontal and the front wheels are in the straight-ahead position. Remove the horn button or horn ring and attaching parts, and remove the steering wheel using Puller J-5473. Remove the steering jacket bracket bolts and shims.

if any. Loosen the steering post rubber collar (Duffy plate) and slide it up the jacket. If the car has directional signals, disconnect the wires at the multiple connector. If the car has an automatic transmission, disconnect the quadrant lamp wire and starter cutout switch. Remove the horn wire brush bracket retaining screws and move the bracket aside, without disconnecting the horn wire. Disconnect the gearshift rods or hand selector rod, loosen the lower jacket clamp, and slide the steering jacket up out of the way. Remove the four nuts from the worm shaft flange studs and slide the steering post up to expose the horn wire contact ring plate. Remove the plate from the horn wire by pulling down on the wire against the spring tension, holding the wire terminal with pliers, and unscrewing the plate with the other hand. Remove the horn switch wire, antirattlers, spring, and ferrule from the top of the steering post. Carefully examine the steering post flange insulators and replace them if they are damaged or distorted.

Install the new cable assembly from the top end of the steering post, being careful not to displace any of the antirattlers. Position the flat of the brass ferrule so that the "O" mark at the top of the steering post is visible. Arrange the three insulators at the lower end of the post so that the two thick ones with the locating bosses will be on either side of the post flange, and the thin one will be inside the contact ring plate. The three insulators and the contact ring must be placed so that the "T" marks on all four pieces are aligned with the "T" mark on the steering post flange. Note also that the locating bosses on the lower insulator protrude through both the holes in the contact ring and the holes in the thin insulator. While holding the contact ring, thin insulator, and lower thick insulator in alignment, pull down on the contact wire with a pair of pliers and screw the contact ring firmly onto the terminal. Press the bosses of the upper thick insulator through the holes in the steering post flange and press the flat washer down on the insulator to hold it in position while installing the insulators and flange over the worm shaft flange studs. Note that the bosses on the lower thick insulator, which protrude through the contact plate and thin insulator, also engage the holes in the steering post flange. Liquid soap map be used on these insulators to provide easier engagement. Make sure that the "T" marks on the worm shaft flange, steering post flange, and retaining washer are in alignment, and install new self-locking nuts on the worm shaft flange studs.

Slide the jacket assembly down over the steering post, align the slot in the jacket with the locating pin on the valve body cover, and slide the jacket over the valve body cover. Align the marks on the steering post and the steering wheel, and install the steering wheel. Use a new steering wheel nut lock. Tighten the nut securely and bend the lock to retain it. Position the jacket so that there is about ⅛" (3,16 mm.) clearance between the steering wheel hub and the upper end of the jacket, then tighten the clamp at the lower end of the jacket. Install the jacket bracket-to-instrument board shims (if shims were used), bolts, and nuts, and tighten securely. Turn the steering wheel through the entire range to check for a possible bind caused by misalignment of the jacket. If such a bind exists, loosen the steering gear-to-frame bolts and shift the steering gear to eliminate it.

Connect the shift lever rods or selector rod. Install the horn wire brush bracket. Connect the automatic transmission quadrant light, starter lockout switch, and directional lights if so equipped. Install the jacket collar (Duffy plate). Install the horn button or horn ring, and install and connect the battery. Check the horn, shift linkage, and steering for proper operation.

STEERING GEAR

Removal—All Models

Disconnect the battery and disconnect the horn switch wire at the connector. On all Commander and President models, also disconnect the battery cable at the starter switch. On Goldenhawk, Powerhawk and Skyhawk models, remove the battery and the battery box.

Remove the steering wheel and steering post jacket assembly. NOTE.—The steering gear housing, steering post jacket, and steering wheel can be removed as an assembly. However, on the Goldenhawk, Powerhawk and Skyhawk models, it will be necessary to remove the left front engine support cushion and raise the left front corner of the engine approximately 2" (50,8 mm.).

Remove the pitman arm, using Puller J-5664. Remove the steering gear housing-to-frame bolts and remove the steering gear through the hole in the dash and into the car. Wrap a cloth around the steering gear housing top cover to prevent spilling the lubricant during removal.

Installation—All Models

Insert the steering gear through the opening in the dash from the inside of the car and position the steering gear housing on the frame. Before installing the jacket and gearshift shaft assembly, install the housing-to-frame bolts but do not tighten until the jacket and jacket-to-instrument panel bracket bolts have been installed.

From inside the car, install the steering jacket on the steering post as an assembly. Turn the jacket bracket to line up with the holes in the instrument panel and install the jacket bracket-to-instrument panel bolts.

Position the jacket and gearshift shaft assembly on the post so that the shift rods are aligned with the hole of the shift levers. Tighten the steering post jacket clamp. Connect the shift lever rod or rods.

Check the alignment of the housing mounting flange face with the frame side rail. Insert spacing washers as necessary to secure proper alignment and high spot adjustment. Misalignment will cause a bind in the assembly.

Tighten the jacket bracket-to-instrument panel bolts, steering gear housing-to-frame bolts, and the jacket clamp bolt securely. Align the mark on the pitman arm with the cam lever shaft mark and install the pitman arm. Tighten the retaining nut securely.

Install and connect the battery. If the car is equipped with an automatic transmission, connect the cutout switch cables and the quadrant light cable.

Align the marks of the steering wheel and steering post, and install the steering wheel. The steering wheel spoke should be straight across when the steering gear is on the high spot.

Fill the steering gear housing with approved lubricant and check for binding or misalignment.

STEERING GEAR REPAIR—ROSS

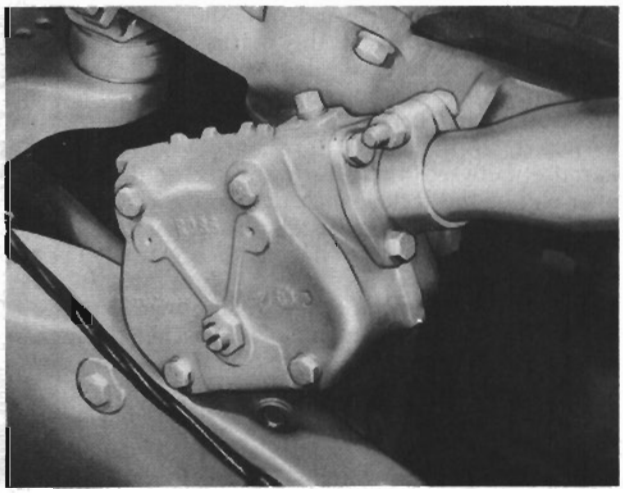

FIG. 26 ROSS STEERING GEAR

Disassembly—All Models

Loosen the cam lever adjusting screw lock nut and back off the adjusting screw. Remove the steering gear housing side cover and gasket, and drain the lubricant from the housing. Withdraw the cam lever shaft from the housing. Take out the three steering gear top cover bolts and remove the top cover, lower oil seal, and adjusting shims. Then withdraw the post and cam assembly from the housing. Remove the ring from the lower end of the cam, which allows the removal of the lower cup and ball bearings. Remove the upper bearing cup ring, bearing cup, and ball bearings.

Remove the oil seal and gasket from the cam lever shaft bore and, using a suitable arbor, press the inner and outer bushings out of the housing.

If necessary to remove the housing end cover-and-horn wire housing assembly, use a suitable pipe to fit over the horn wire housing and drive the assembly out of the steering gear housing. It is necessary to remove the end cover only when leakage occurs.

Reassembly—All Models

Inspect and thoroughly wash all parts before reassembly.

With a suitable arbor, press the bushings into place in the cam lever shaft bore of the housing. The bushings should be line-reamed to fit the cam lever shaft. If the housing end cover-and-horn wire housing assembly has been removed, install the assembly in the housing. Assemble the cam bearings, cups, and rings on the cam and post assembly and install the assembly in the steering gear housing. Assemble the housing top cover and shims on the housing. Check the worm bearing adjustment, and remove or add shims as required. Install the cam lever shaft, housing cover gasket, and cover, tightening the cover screws securely. Install the lever shaft gasket and oil seal.

Adjustment—All Models

Two adjustments are provided for the steering gear assembly: the steering post end play and the cam lever shaft stud clearance. Before making the adjustment, disconnect the steering gear from the steering linkage by removing the reach rod from the pitman arm.

Check the steering post end play first. Loosen the cam lever shaft adjusting screw lock nut and back off the adjusting screw. Using a spring scale that is calibrated in ounces, measure the amount of pull required to turn the steering wheel. The scale should be hooked to a light tag wire or string which is wrapped around the rim of the steering wheel at the spoke (see Fig. 27). A steady pull of 4 to 7 ounces (113,4 to 198,45 grams) tangent to the rim of the wheel should turn the steering gear smoothly. If the pull is not within the limits, adjust the end play. To adjust the end play, loosen the steering post jacket clamp, remove the top cover cap screws, lift the top cover, and add or remove shims to secure the proper scale reading.

With the steering gear end play adjusted correctly, locate the center of travel (high spot) of the steering gear. While turning the steering wheel back and forth

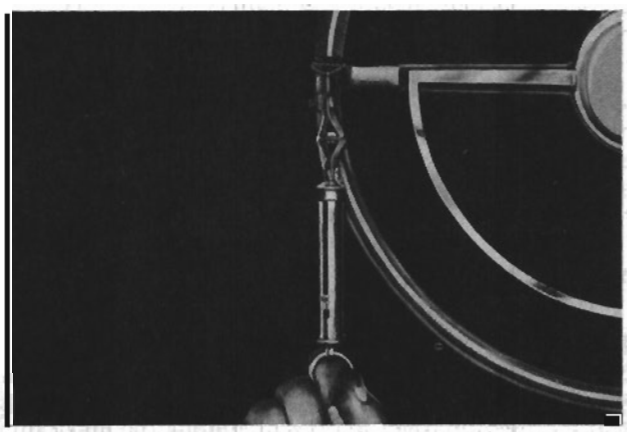

FIG. 27

over the high spot, turn the lever shaft adjusting screw. Keep the lock nut snug until a slight drag is felt. Then tighten the lock nut (see Fig. 28). To check the adjustment, hook a spring scale to the rim of the steering wheel as outlined in the preceding paragraph and check the amount of effort required to turn the wheel either direction through the high spot. The scale readings should be 16 to 24 ounces (453,6 to 480,4 grams). Install the reach rod on the pitman arm.

With the steering gear on the center of the high spot, the left front wheel should be in a straight-ahead position with respect to the rest of the car. If it is not, adjust the left and right tie rods as outlined under Wheel Alignment– Toe-In.

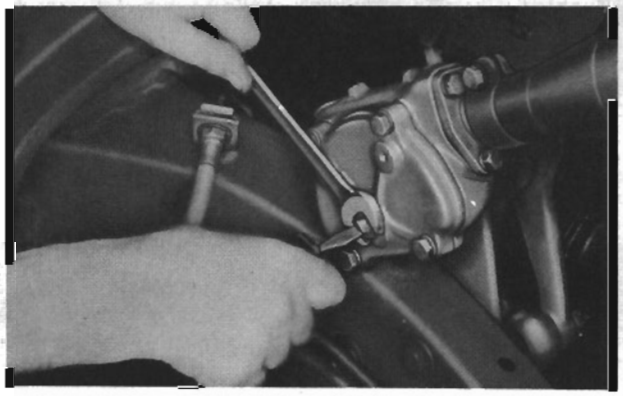

FIG. 28

CAM LEVER SHAFT

Removal and Installation—All Models

Disconnect the battery and raise the front end of the car. Remove the left front wheel. Cut the staples holding the rubber splash shield to the fender skirt and move the shield aside to expose the steering gear housing. Remove the pitman arm, using Puller J-5664. Remove the housing side cover and scrape off the old gasket. Withdraw the cam lever shaft from the housing.

Inspect the cam and the cam lever shaft bushings and pins for wear. Drive out the cam lever shaft oil seal. Adjust the post and cam assembly end play as outlined under Adjustment.

Install a new cam lever shaft oil seal. Insert the cam lever shaft into the housing, and install the housing side cover, using a new gasket. Adjust the cam lever shaft as outlined under Adjustment—High Spot. Install the pitman arm. Install the splash shield on the fender skirt with sheet metal screws, and install the left front wheel, and lower the car.

Fill the steering gear housing to the proper level with recommended lubricant.

CAM LEVER SHAFT OIL SEAL

Removal and Disassembly—All Models

Disconnect the battery and raise the front end of the car. Using Puller J-5664, remove the pitman arm. Remove the old oil seal with an awl or sharp punch. Clean the bore in the housing.

Install a new oil seal. Align the pitman arm with the cam lever shaft splines, and install the pitman arm. Lower the car, connect the battery, and fill the gear housing with correct lubricant.

Check for leakage at new seal.

STEERING GEAR REPAIR—SAGINAW

The Saginaw steering gear, with a gear ratio of 19 to 1, is being used on some models. The Saginaw gear can be readily identified by the presence of the large bearing adjuster lock nut located at the lower front end of the housing. The complete steering gear assembly is interchangeable with the Ross steering gear assembly. If the steering gear assemblies are interchanged, the pitman arm must also be changed.

The main parts of the Saginaw steering gear are the worm shaft and the roller and cross shaft assembly. The worm shaft is supported by roller bearings, end play adjustment of the worm shaft being made at the lower bearing. The roller rotates on a double row of ball bearings and is mounted on the cross shaft. A bronze bushing in the gear housing side cover supports one end of the shaft and the serrated end is supported by a bronze bushing in the housing.

The worm shaft teeth are cut so that when the cross shaft is adjusted to give minimum clearance between roller and worm at the center of travel, or straight-ahead position, there will be a slightly greater clearance at each end of travel to prevent binding at the extreme right or left position.

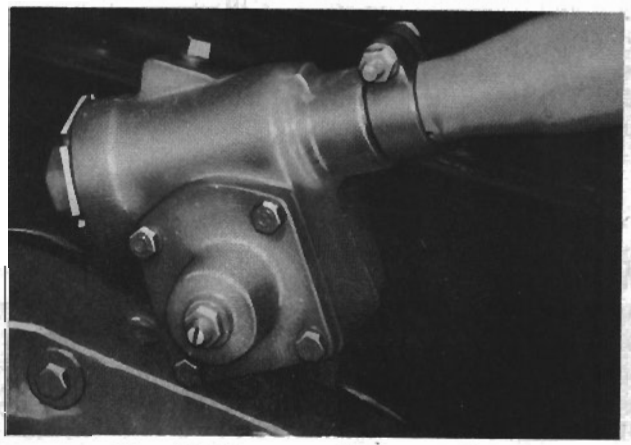

FIG. 29 SAGINAW STEERING GEAR

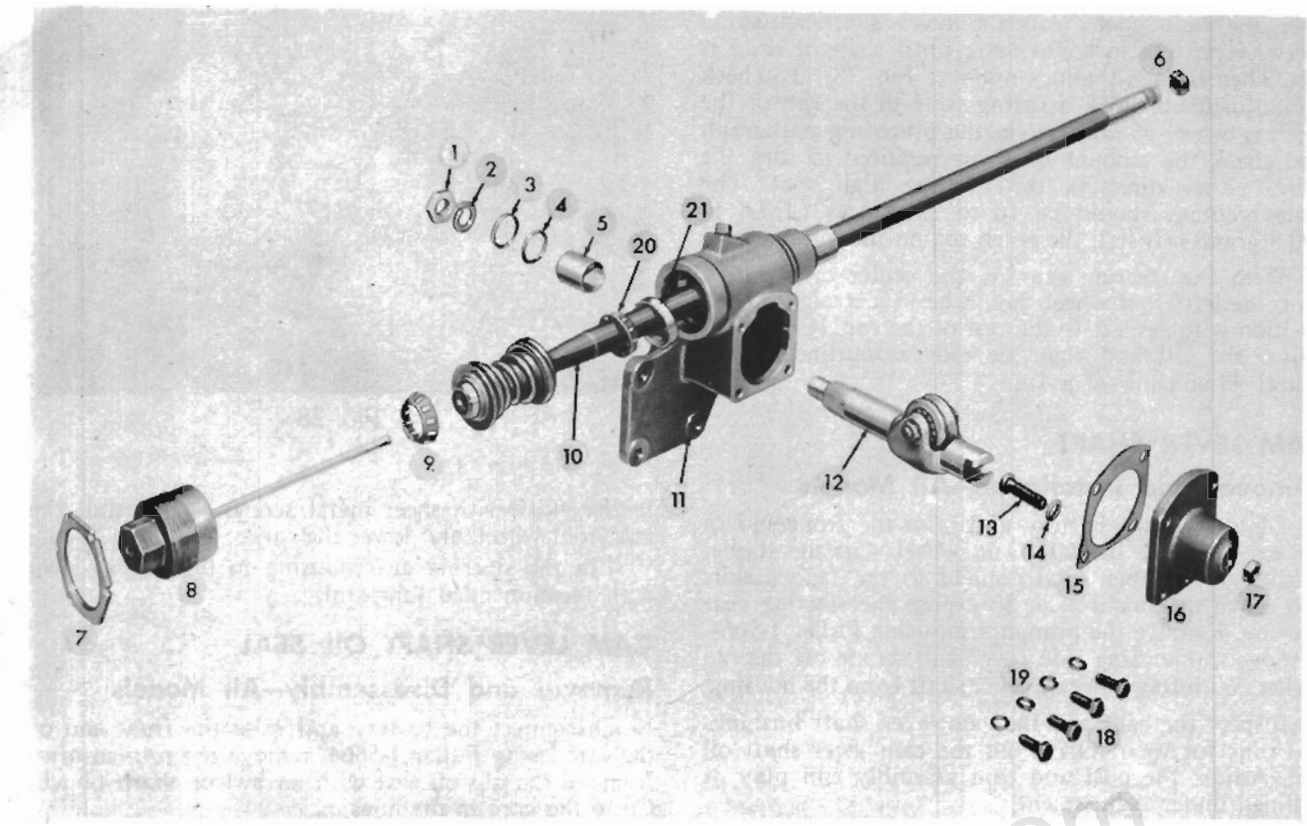

FIG. 30

1. Pitman arm nut
2. Lock washer
3. Grease washer retainer
4. Grease washer
5. Cross shaft bushing
6. Directional signal cam
7. Adjuster lock nut
8. Adjuster assembly
9. Worm shaft lower bearing
10. Worm shaft assembly
11. Housing
12. Cross shaft assembly
13. Adjusting screw
14. Shim
15. Side cover gasket
16. Side cover
17. Adjusting screw lock nut
18. Side cover screw
19. Lock washer
20. Worm shaft upper bearing
21. Upper bearing cup

Disassembly—All Models

Remove the pitman arm retaining nut (1, Fig. 30) and lock washer (2) from the cross shaft (12). Punch locating marks on the pitman arm and the end of the cross shaft and remove the pitman arm.

Remove the adjusting screw lock nut (17), then turn the adjusting screw (13) out one or two turns to relieve the bushings and bearings of the load caused by the close meshing of the worm and roller. Remove the four side cover retaining screws (18) and lock washers (19) and pull the side cover (16) and cross shaft assembly (12) from the housing. If there is interference between the housing and the cross shaft roller, turn the cross shaft slightly so that the roller will clear the housing.

Remove the cross shaft assembly from the side cover by screwing the adjusting screw (13) through the cover. Slide the adjusting screw out of the slot in the end of the cross shaft and remove the shim (14) from the adjusting screw.

Remove the worm shaft bearing adjuster lock nut (7). Remove the worm shaft bearing adjuster assembly (8) and the worm shaft lower bearing (9). Mark the directional signal cam (6) and the worm shaft so that the cam can be correctly positioned on the shaft at reassembly. Then loosen the two set screws which hold the directional signal cam to the upper end of the worm shaft and remove the cam. Pull the worm shaft (10) out of the housing (11). Remove the worm shaft upper bearing (20).

A hammer and a suitable brass drift may be used to remove the worm shaft upper bearing cup (21). Being careful to avoid tilting the cup in the housing bore, drive first against one side of the upper edge of the cup, then against the other side, and remove the cup.

Pry the grease washer retainer (3) out of the housing and remove the grease washer (4).

Using a suitable arbor, press the cross shaft bushing (5) out of the housing.

Reassembly—All Models

Using a suitable arbor, press the cross shaft bushing into the housing until the outer end of the bushing is 1/32" (0,79 mm.) below the shoulder of the housing bore.

The worm shaft upper bearing cup can be installed with a hard wood block and a lead mallet. Being careful to avoid tilting the cup in the housing bore, drive the cup in until it bottoms against the shoulder of the bore.

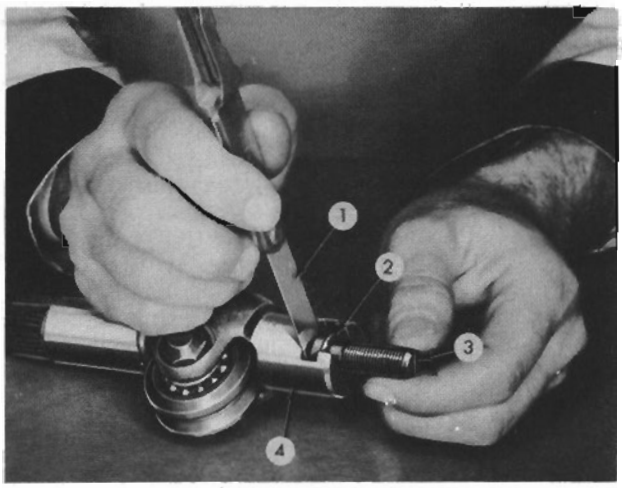

FIG. 31

1. Feeler gage
2. Shim
3. Adjusting screw
4. Cross shaft

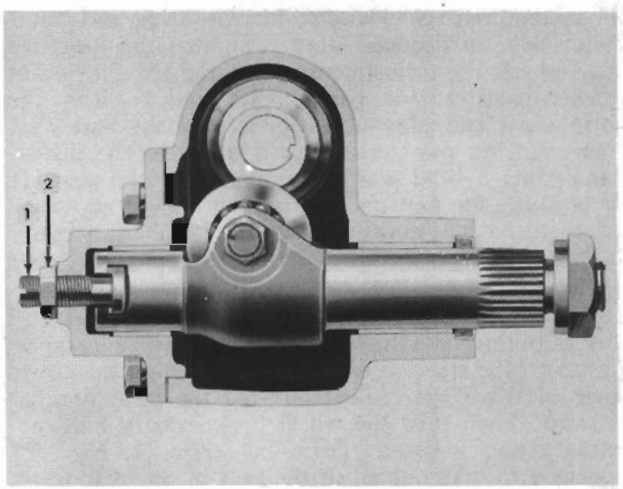

FIG. 32

1. Adjusting screw
2. Lock nut

Soak a new grease washer in engine oil, then install it in a new grease washer retainer. Press the retainer and washer into the housing until the retainer bottoms on the shoulder of the bore.

Place the worm shaft upper bearing on the worm shaft and slide the worm shaft assembly into the housing. The upper and lower bearings are interchangeable when new, but when old bearings are reinstalled they should not be interchanged. Install the worm shaft lower bearings and the bearing adjuster assembly. Adjust the bearings so that there is no end play of the shaft. Install the bearing adjuster lock nut.

Place the adjusting screw shim (2, Fig. 31) on the adjusting screw (3) and slide the head of the screw into the slot in the end of the cross shaft (4). Check the clearance between the head of the screw and the bottom of the slot with a feeler gage (1). The clearance should not exceed .002" (0,051 mm.). If the clearance is too great, replace the shim with the next thickest shim and check the clearance again. Adjusting screw shims are available in four thicknesses: .063" (1,60 mm.)—marked "3"; .065" (1,65 mm)—marked "5"; .067" (1,70 mm.)—marked "7"; and .069" (1,75 mm.)—marked "9." When the clearance has been adjusted, start the cross shaft into the side cover. Then insert a screw driver through the adjusting screw hole in the side cover and screw the adjusting screw through the side cover as far as the cross shaft will go. Place a new gasket on the side cover and assemble the cross shaft and side cover to the housing. Make sure there is clearance between the worm and the roller, then install and tighten the side cover retaining screw and lock washers. Adjust the cross shaft so that there is no clearance between the roller and worm when the roller is on the high spot, then install the adjusting screw lock nut.

Install the pitman arm on the cross shaft according to the locating marks made at disassembly. Install the pitman arm retaining nut and lock washer and tighten the nut to 90 to 100 ft-lbs (12,4 to 13,8 kg-m) torque. Install the directional signal cam on the upper end of the worm shaft according to the locating marks made at disassembly, and tighten the set screws.

Adjustment—All Models

Although two adjustments are provided on the Saginaw gear, both must be adjusted if either is changed. The complete adjusting procedure given below should be followed. Disconnect the steering reach rod from the pitman arm. Loosen the steering post jacket bracket-to-instrument panel bolts.

Loosen the lock nut (2, Fig. 32) and turn the adjusting screw (1) a few turns in the counterclockwise direction. This releases the worm shaft bearings from the load caused by close meshing of the worm and roller. Turn the steering wheel gently in one direction until stopped by the gear, then back away one turn.

Wrap a piece of cord around the rim of the wheel at one of the spokes (see Fig. 25), attach a spring scale, and measure the pull required to turn the wheel. A steady pull, tangent to the rim of the wheel, should give a scale reading between 6 and 10 ounces (160 and 280 grams). If the reading is not within limits, adjustment of the worm shaft bearings is necessary.

To adjust the worm shaft bearings, loosen the lock nut (2, Fig. 33) and turn the bearing adjuster

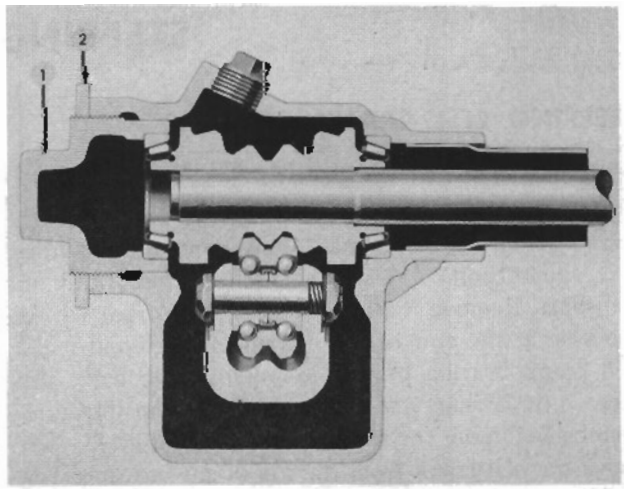

FIG. 33

1. Bearing adjuster
2. Lock nut

(1) as required (clockwise to increase drag and counterclockwise to decrease drag.) Tighten the lock nut and recheck the adjustment. Then tighten the jacket bracket-to-instrument panel bolts and recheck the worm shaft end play adjustment to make sure that when securing the steering gear jacket to the instrument panel a bind was not imposed on the gear. If the readings are now out of limits, it will be necessary to loosen the gear housing mounting bolts and slightly shift or shim the assembly to correct the binding condition.

After proper adjustment of the worm shaft end play is obtained, adjust the roller-to-worm clearance. First turn the steering wheel gently through the entire range of travel, carefully counting the total number of turns. Then turn the wheel back exactly halfway, to the center position. Turn the screw (1, Fig. 32) clockwise to take out all of the lash in the gear teeth, and tighten the lock nut (2). Then check the pull at the wheel as in the first adjustment, taking the highest reading of the scale as the wheel is pulled through the center position. This should be 14 to 30 ounces (390 to 840 grams). Readjust the screw (1), if necessary, to obtain proper pull. After setting the lock nut (2), recheck the adjustment. After making the adjustment, connect the steering reach rod to the pitman arm.

CROSS SHAFT ASSEMBLY

Removal and Installation

It is not necessary to remove the steering gear housing from the car to remove the cross shaft and roller assembly.

Disconnect the battery, raise the front end of the car, and remove the left front wheel. Cut the staples holding the rubber splash shield to the fender apron and pull the shield back to gain working space. Punch locating marks on the pitman arm and on the end of the cross shaft, and using Puller J-5664, remove the pitman arm. Remove the adjusting screw lock nut and turn the adjusting screw out one or two turns to relieve the load on the worm and roller. Take out the four cover screws and remove the cover plate and cross shaft assembly, turning the cross shaft slightly so that the roller will clear the housing.

Remove the cross shaft and roller assembly from the side cover plate by screwing the adjusting screw through the cover. Scrape the old gasket off the cover plate and housing. Thoroughly clean and inspect all parts for wear. Remove the grease washer retainer and grease washer. Check the clearance between the head of the adjusting screw and the slot in the end of the cross shaft as illustrated in Fig. 31. If necessary, adjust this clearance as described under Saginaw Steering Gear—Reassembly. Install the adjusting screw and cross shaft assembly in the side cover, screwing the adjusting screw into the cover as far as it will go. Assemble the cross shaft assembly and side cover in the gear housing, using a new cover gasket. Install the cover retaining screws and tighten them. Install the pitman arm and tighten the retaining nut to 90 to 100 ft-lbs (12,4 to 13,8 kg-m) torque. Adjust the worm shaft end play and the clearance between the worm shaft and roller as described under Saginaw Steering Gear—Adjustment.

With the steering gear on the center of the high spot, the left front wheel should be in a straight-ahead position with respect to the rest of the car. If not, adjust the left tie rod as outlined under Wheel Alignment– Toe-In.

Replace the rubber splash shield, using metal screws to hold it to the fender apron. Install the left front wheel, lower the car, and fill the steering gear with recommended lubricant. Check for leaks.

CROSS SHAFT GREASE SEAL

Removal and Installation—All Models

Disconnect the battery and raise the front end of the car. Using Puller J-5664, remove the pitman arm. Remove the old grease seal and seal retainer with a sharp awl or punch. Clean the bore in the housing.

Install the new grease seal and seal retainer. Install the pitman arm and tighten the retaining nut to 90 to 100 ft-lbs (12,4 to 13,8 kg-m) torque. Lower the car, connect the battery, and fill the gear housing with correct lubricant. Check for leakage at new seal.

STEERING LINKAGE

STEERING BELL CRANK ASSEMBLY

Removal and Disassembly—All Models

Disconnect the tie rods (1 and 2, Fig. 34) and reach rod (3) from the bell crank (4). Remove the retaining bolt (pinch bolt) (5) which holds the bell crank to the shaft. Remove the lubrication fitting from within the hole at the rear of the crossmember. Remove the bell crank bearing bracket-to-crossmember bolts and remove the bracket and shaft assembly from the crossmember, slipping the shaft out of the bell crank. Remove the bell crank from the top of the crossmember.

Remove the cotter pin, nut, lower thrust washer, and shims, and push the shaft out of the bracket. Then

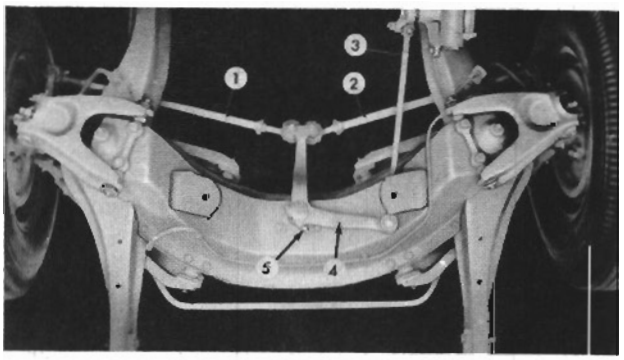

FIG. 34

1. Right tie rod
2. Left tie rod
3. Reach rod
4. Bell crank
5. Bell crank shaft pinch bolt

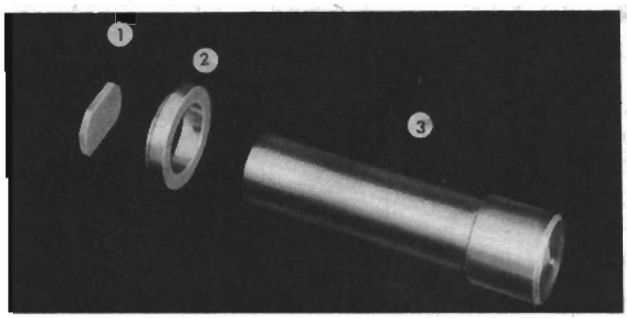

FIG. 35

1. Removal adapter 2. Pilot 3. Arbor

remove the cork gasket from the lower section of the bracket.

The bell crank shaft and upper thrust washer are serviced as an assembly. The thrust washer is pressed on the shaft and then machined to correct tolerances. Therefore, do not press the thrust washer off the shaft. If either the washer or the shaft is to be replaced, the assembly must be replaced.

Bearing Remover and Replacer Set J-4147-A (see Fig. 35) is used for the steering bell crank bearings.

To remove the lower bell crank shaft bearing, insert removal adapter (1) in the bracket and place it on the upper surface of the bearing. Using the upper bearing as a pilot, insert the Arbor J-4147-4 (3) and press the lower bearing out of the bracket; place the removal adapter on the inner end of the bearing. Insert the pilot (2) in the lower bearing recess and, using the arbor (3), press out the upper bearing.

Reassembly and Installation—All Models

To install the upper bearing (3, Fig. 36), insert the pilot in the lower end of the bracket (4), place the upper bearing on the arbor, and press the bearing into the bracket until the bearing is approximately 1/32" (0,79 mm.) below the surface of the bracket. To install the lower bearing, place the pilot (2, Fig. 37) and the lower bearing (3) on the arbor (1) and, using the upper bearing as a pilot, press the bearing into the bracket (4) until the shoulder of the pilot is flush with the bracket.

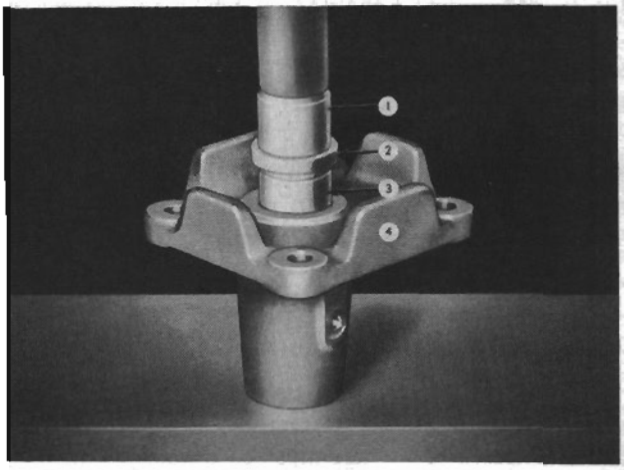

FIG. 37

1. Arbor
2. Pilot
3. Lower bearing
4. Bracket

Install the shaft and thrust washer assembly in the bracket. Install the cork seal (6, Fig. 36) in the shaft bracket. Install the thrust washer (8) and nut (9), then adjust by inserting shims between the lower thrust washer and the shaft until there is no end play. The shaft should, however, turn freely in the bearings. After obtaining the proper end play, lock the nut securely with the cotter pin.

Install the bracket and shaft assembly in the crossmember. Align the retaining bolt (pinch bolt) slot of the shaft with the bell crank and install the bell crank on the shaft. Install the retaining bolt and tighten nut securely. Install the lubrication fitting. Connect the reach rod and tie rods to the bell crank.

TIE ROD

Removal and Disassembly—All Models

Use Ball Bolt Puller J-2200 to disconnect either end of the tie rod. Remove the castellated nut, invert, and reinstall so the nut is flush with the end of the ball stud to act as a seat for the puller screw. If the J-2200 puller is not available, loosen the tie rod ball stud nut and insert a pry bar or similar tool between

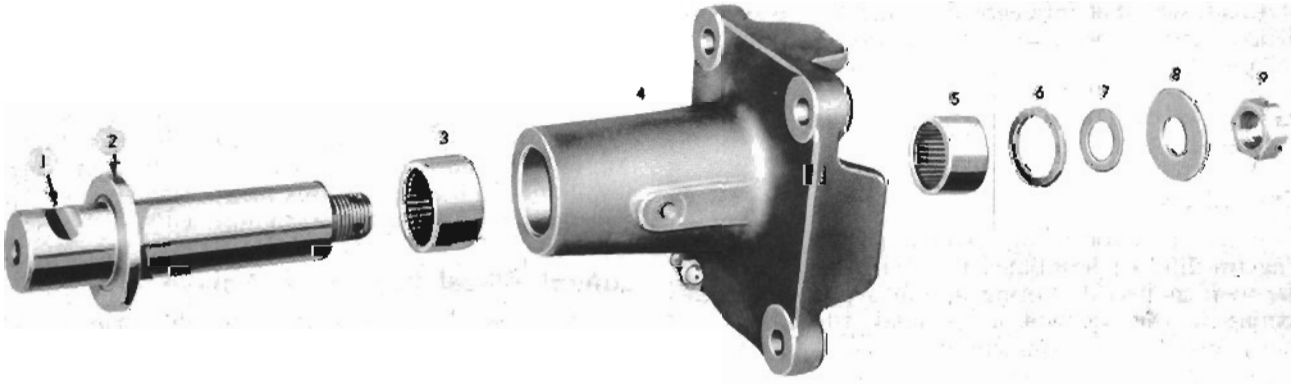

FIG. 36

1. Bell crank shaft
2. Upper thrust washer
3. Upper bearing
4. Bracket
5. Lower bearing
6. Cork seal
7. Shim
8. Thrust washer
9. Nut

the tie rod end and the part to which the tie rod is connected. Apply pressure to the pry bar and at the same time strike the side of the connecting part with a hammer to loosen the stud.

To remove the tie rod end, loosen the clamp bolts and unscrew the assembly from the rod. Note the number of turns required to remove the rod end so that on installation the approximate original tie rod length can be maintained.

Reassembly and Installation—All Models

Install the tie rod end on the tie rod the same number of turns that were required for removal. The ball stud and nut threads must be clean and smooth, otherwise the stud may turn in the rod end when tightening the nut and will not be drawn securely into the connecting part.

Install the tie rod, making sure the ball stud is well seated, then install and tighten the stud nuts to 23 to 28 ft-lbs (3,18 to 3,87 kg-m) on the Champion and Flighthawk and 50 to 55 ft-lbs (6,9 to 7,6 kg-m) on all other models. Adjust the toe-in as outlined under Toe-in—Adjustment.

REACH ROD (DRAG LINK)

The removal and installation procedures of the reach rod are the same as outlined for the tie rod. The reach rod ball stud nut should be tightened to 50 to 55 ft-lbs (6,9 to 7,6 kg-m).

The reach rod cannot be disassembled and must be replaced as a complete assembly.

PITMAN ARM

Removal—All Models

Disconnect the reach rod from the pitman arm. Remove the nut and lock washer, and punch locating marks on the pitman arm and the end of the shaft. Then, using Puller J-5664, remove the pitman arm from the cam lever shaft (cross shaft on Saginaw gear). To facilitate removal of the arm, remove the starter.

Installation—All Models

Place the pitman arm on the cam lever shaft (cross shaft on Saginaw gear). Be sure to align the punch marks on the arm and shaft. Then install the lock washer and nut, and tighten the nut securely to 90 to 150 ft-lbs (12,4 to 20,7 kg-m) torque. Connect the reach rod and install the starter.

WHEEL ALIGNMENT

Proper alignment of the front wheels must be maintained to insure ease of steering, long tire life, and minimum wear of front suspension and steering parts. The factors of wheel alignment are caster, camber, king pin inclination, toe-in, and wheel alignment on turns. All steering factors are very closely related and interdependent. Because of this interdependency, any specific steering difficulty may be caused by a number of different factors and all must be checked and corrected before satisfactory steering can be obtained.

Conditions that influence these factors are tire inflation, wheel bearing adjustment, steering gear and linkage, lateral and radial wheel and tire runout, wheel balance, and shock absorbers. These conditions must be checked before making any alignment corrections.

Tire Inflation

Proper inflation is important to good steering and long tire life. Underinflated tires will cause excessive tire wear and hard steering due to a greater surface coming in contact with the ground, which in turn causes excessive friction and will also cause added stress in the tire side wall. Overinflated tires cause excessive wear in the front axle parts due to the inability of the tires to absorb road shock. Before checking the wheel alignment, inflate the tires to the recommended pressures; on the Champion and Flighthawk 26 lbs. (1,82 kgs.) in the front and 24 lbs. (1,68 kgs.) in the rear. On all other models, inflate the tires to 26 lbs. (1,82 kgs.) in the front and 22 lbs. (1,54 kgs.) in the rear.

Wheel Bearing Adjustment

Rotate the wheel to make sure all bearing surfaces are in contact, and at the same time tighten the wheel bearing nut until the wheel binds on the bearings. Then back off the nut to the next castellation of the nut, or as necessary to permit the wheel to turn freely.

Steering Gear and Linkage

With the front wheels of the car off the ground, check all linkage for excessive looseness or binding at the connections. Check the movement in the steering knuckle by grasping the wheel at the top and bottom. An inward and outward movement would indicate worn king pin bushings. Check the steering gear operation and make the necessary adjustments.

Lateral Wheel Runout or Wobble

Excessive lateral runout or wobble will cause spotty tire wear and also has its effect on wheel alignment in that it can cause an incorrect reading when checking wheel alignment. Check the runout with a dial test indicator. The maximum allowable lateral runout is .125" (3,175 mm.) on the Champion and Flighthawk and .100" (2,54 mm.) on all other models. If the wobble is excessive, repair or replace the wheel.

When checking camber, set the wheel so that the spot of greatest runout is to the front. During the caster check, the point of greatest runout should be placed at the top.

Radial Wheel Runout or Eccentricity

Excessive radial runout will cause tire wear and will set up a vertical motion resulting in shimmy and wheel tramp. Using a dial test indicator, check at the center of the tire the radial runout of the wheel and tire assembly. The maximum allowable runout is .093" (2,36 mm.). If the assembly runout is not within limits, check the runout of the wheel. The maximum wheel radial runout limits are: .062" (1,57 mm.) on the front and .078" (1,98 mm.) on the rear of all models except Champion and Flighthawk; and .078" (1,98 mm.) on the front or rear of the Champion and Flighthawk. Excessive runout in the wheel necessitates the repair or replacement of the wheel.

If the radial runout of the wheel is within limits but the radial runout of the wheel and tire assembly is above .093" (2,36 mm.), reposition the tire on the wheel by placing the point of greatest tire runout at the point of least wheel runout. In this way the lowest possible total runout of the assembly is secured.

If repositioning fails to bring the total radial runout within the limits, the tires should be replaced.

Wheel—Balance

Wheel balance plays an important part in satisfactory steering. Properly balanced wheel, tire and drum assemblies will prevent shimmy and prolong the life of the tire.

Shock Absorbers

Shock absorbers which are inoperative, unevenly adjusted, or lack fluid often permit front wheel disturbances.

CASTER AND CAMBER

The caster and camber adjustments are both made at the upper control arm outer pin (3, Fig. 38). The pin is threaded into the bushing (1) of the control arm (5) and is held in the king pin (6) by the pinch bolt (4). When the outer pin is turned, the pinch bolt slides in the groove around the center of the pin, keeping the king pin centralized on the outer pin. Therefore, turning the outer pin in either direction causes a change in the position of the king pin, and consequently a change in caster. The center portion of the pin is eccentric, which provides inward and outward movement of the king pin for a camber change.

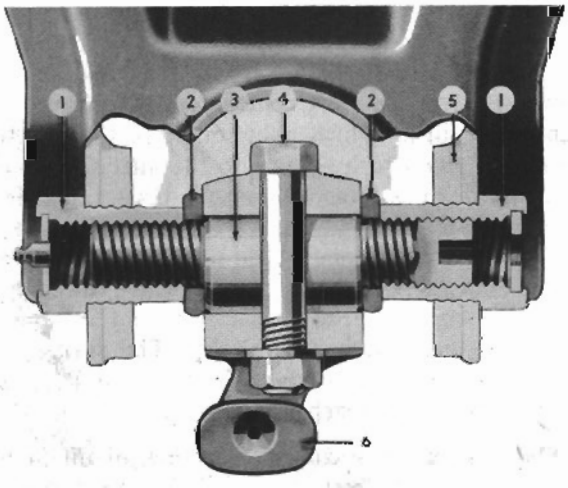

FIG. 38

1. Bushing
2. Grease seal
3. Outer pin
4. Pinch bolt
5. Control arm
6. King pin

FIG. 39

The caster adjustment should be made first. Loosen the king pin pinch bolt. Remove the lubrication fitting from the rear bushing at the upper control arm outer pin. Then insert an Allen wrench into the opening provided in the pin (see Fig. 39) and turn the pin until the proper caster is obtained. A full turn of the pin will change the caster ½°. The caster specifications are —1° to —2½°. There should not be more than ¾° variation between wheels.

To make the camber adjustment, turn the outer pin with the Allen wrench until the desired setting is obtained. The camber specification is 0° to +1° for all models, with ½° more camber favored on the driver's side. One-half turn of the pin covers the entire range of camber adjustment; therefore, it should not be necessary to turn the pin more than one-half turn to obtain the correct camber setting. Adjusting the camber will make only a very slight change in the caster setting, but recheck the caster to make sure it is still within specifications.

After making the caster and camber adjustments, be sure to tighten the pinch bolt securely. Install the lubrication fitting.

KING PIN INCLINATION

The specified king pin inclination is 5¼° for all models. Before checking the king pin inclination, check the camber and adjust if necessary.

TOE-IN

Set the steering gear so that the cam lever shaft is on the center of the high spot of the cam. Reposition the steering wheel, if necessary, so the spoke is straight across. With the steering gear on the high spot, the left front wheel (right wheel on right-hand control cars) should be in the straight-ahead position. To

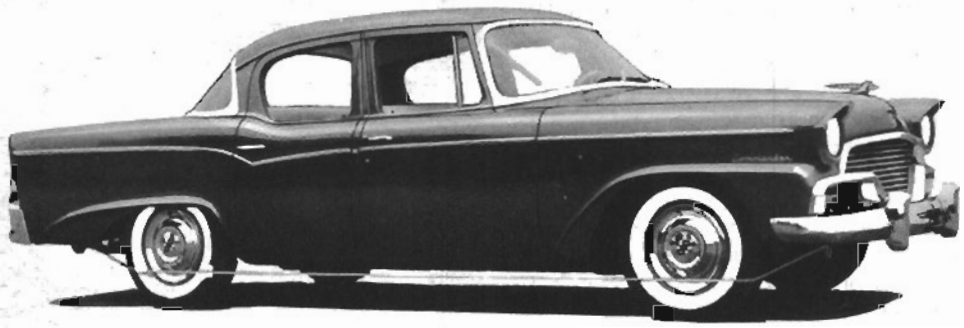

FIG. 40

check the straight-ahead position of the wheel, attach a string to the rear bumper and draw it tightly across the outside of the front and rear tires. Insert a block of wood, ½" (12,7 mm.) thick, between the string and the front sidewall of the rear tire to compensate for the difference in the tread of the front and rear wheels (see Fig. 40). If the wheel is not in the straight-ahead position, adjust the left tie rod (right tie rod on the right-hand control cars).

Set the toe-in by adjusting the right tie rod (left tie rod on right-hand control cars). The toe-in specifications are 1/16" to ⅛" (1,58 mm. to 3,17 mm.). Tighten the tie rod clamps securely. The inner tie rod clamp bolts should be at the bottom and horizontal, with the head of the bolt toward the engine oil pan.

WHEEL ALIGNMENT ON TURNS

Wheel alignment on turns is the mechanics of keeping the front wheels in proper relative alignment as they are turned to the right or left. Because the wheels do not have a common pivot, they do not run on the same radius of the curve or turn. Therefore, to run smoothly and with a minimum of scuffing, both wheels must be at right angles to radii of the circle formed by the vehicle as the turn is made. To obtain this condition, the inside wheel on the curve must turn an angle of a greater number of degrees than the outside wheel, hence the toe-out condition of the turns. The condition is controlled by the angle of the steering knuckle arm. The sharper the turn, the greater the amount of toe-out. On the right turn, with the left wheel set at 20°, the right wheel should have turned 22½° to 23½°. On the left turn, with the right wheel set at 20°, the left wheel should have turned 22½° to 23½°.

If correct turning angles are not obtained, the steering knuckle arms should be replaced.

HYDRAULIC POWER STEERING

Studebaker hydraulic power steering is composed of a hydraulic booster system and a recirculating ball type steering gear. The hydraulic booster system consists primarily of an oil pump, double acting piston, and a control valve. The piston is enclosed in a cylinder which is mounted on the steering gear housing. The control valve, also mounted on the housing, is concentric with the steering gear worm shaft.

Figure 41 illustrates the cross section of the pump and steering gear. Figures 42 and 43 are external views of the steering gear and pump respectively.

The pump is a constant flow 12-vaned pump. The pump impeller rotates within an oblong chamber in the cam ring and the pumping action takes place at each end of the chamber. The pump contains a dual valve to control the volume of oil flow and the maximum pressure. The flow control valve consists of a poppet and spring which allow oil from the pressure side of the pump to by-pass into the inlet side of the pump when an output volume of about 1.8 gallons per minute is reached. The pressure relief valve is mounted at the back and inside the poppet. Oil under pressure enters behind the poppet valve through a drilled passage from the outlet port and is applied against the ball check relief valve. The spring will allow the valve to open when 750 p.s.i. (52,7 kg. per sq. cm.) pressure is reached.

The control valve controls the flow of oil in the hydraulic system by means of precisely placed grooves in the valve body and valve spool. The valve spool is a cylinder having two annular grooves around the outer circumference which connect three annular

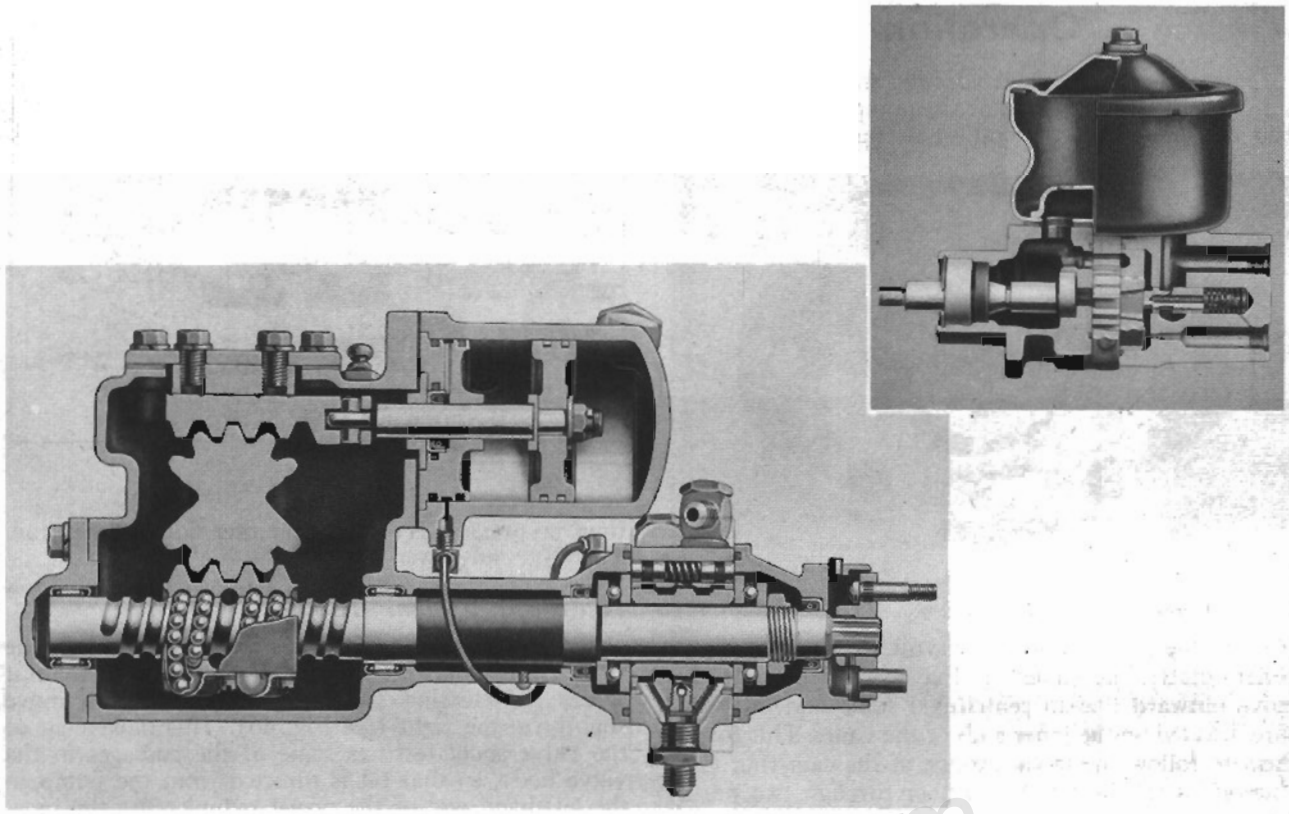

FIG. 41

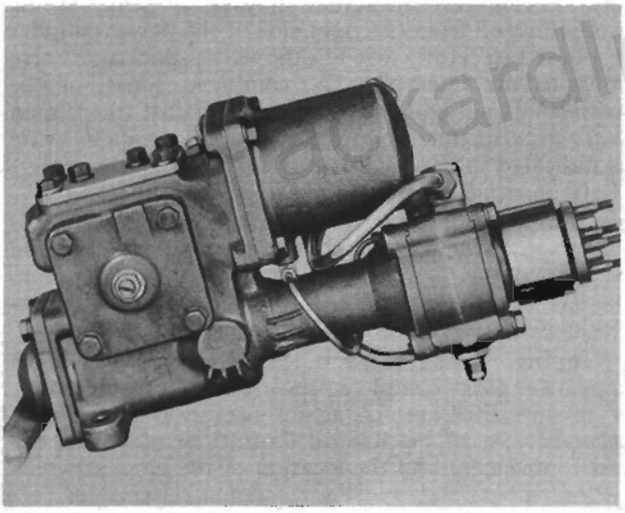

FIG. 42

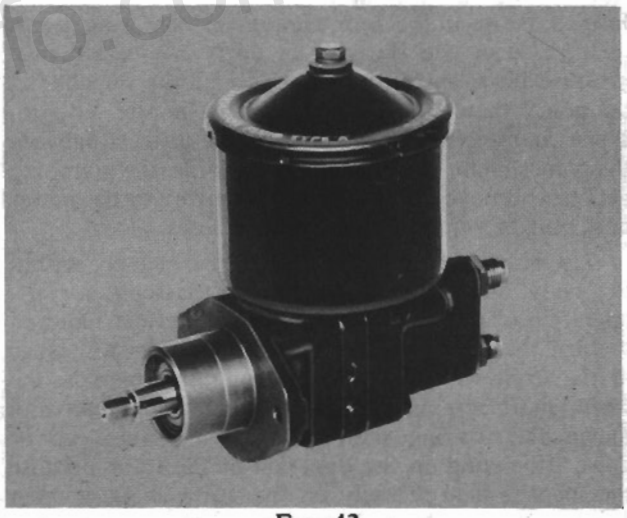

FIG. 43

grooves in the inside of the valve body. The spool is mounted securely on the steering gear worm shaft. The position of the valve spool directs hydraulic pressure against the proper side of the double acting piston. Power is transferred from the piston to the steering system by a rack gear which is in mesh with a gear sector on the steering gear pitman shaft.

The steering gear pitman shaft has a second gear sector which is in mesh with the ball nut of the steering gear. The ball nut is connected to the worm shaft through ball bearings. Helical grooves in the ball nut match helical grooves in the worm shaft. The ball bearings within the grooves form a thread between the ball nut and the shaft. As the worm shaft is turned, the nut moves along on the balls as it would on an ordinary screw thread.

The balls are set up in two separate closed circuits. Each circuit includes 1½ turns on the worm shaft, the passages in the ball nut, and the ball guide. As the balls complete the turn around the worm shaft, they are deflected into the guide. The guide then carries the balls diagonally across the back of the nut and returns them to the worm shaft groove. In this way the balls recirculate through the circuit, thus providing virtually frictionless contact between the balls, the worm shaft, and the ball nut.

Operation

Power to operate the hydraulic steering booster is supplied by the engine. The oil pump is driven by a belt and pulley off the crankshaft pulley. Oil is supplied to the pump from a reservoir. As the pump impeller rotates, the vanes (1, Fig. 44) in the hub (3) move outward due to centrifugal force and oil pressure directed on the inner ends of the vanes. This forces them to follow the inner surface of the cam ring (2). The oil enters the pump chamber through two ports. The ports are located in the pump cover on opposite sides of the chamber at the point where the pockets formed between the hub vanes and cam ring begin to increase in size. Two outlet ports are located in a pressure plate on the pressure side of the impeller at the point where vane pockets decrease in size. This increase and decrease in the size of the pockets between the vanes, hub, and cam ring provide the pumping action. Oil moved by the pump is carried to the power unit control valve through flexible hoses.

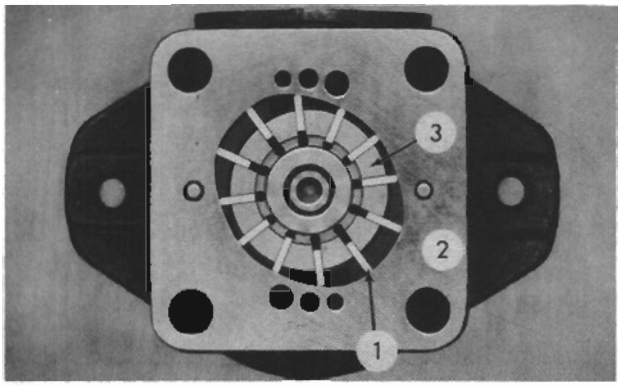

FIG. 44

1. Vanes 2. Cam ring 3. Hub

Up and down movement of the valve spool within the body directs oil to the proper passages for the operation of the power unit. When the effort required to turn the steering wheel to overcome the resistance at the front wheels is greater than three pounds, the worm shaft acts as a screw jack in the ball nut and moves the steering shaft and steering wheel up or down depending on the direction of the turn. Because the spool is held securely on the worm shaft, it must move with the worm shaft. The total up and down movement over the entire range is approximately .060" (1,5 mm.). The shaft and spool move down on left turns and up on right turns.

Figs. 45, 46, and 47 show the result the valve spool movement has on the hydraulic booster system.

Hydraulic System at Rest

In Fig. 45 the valve spool is in a centered position. In this position the oil displaced by the pump circulates freely from the reservoir to the valve, through the grooves in both ends of the valve spool and body, back to the reservoir. Since no resistance is provided, except for restrictions in lines and passages, the oil circulates at practically zero pressure and the pump requires a minimum amount of power. At the same time, no pressure is exerted on either side of the piston. Therefore, no power is applied to the steering gear.

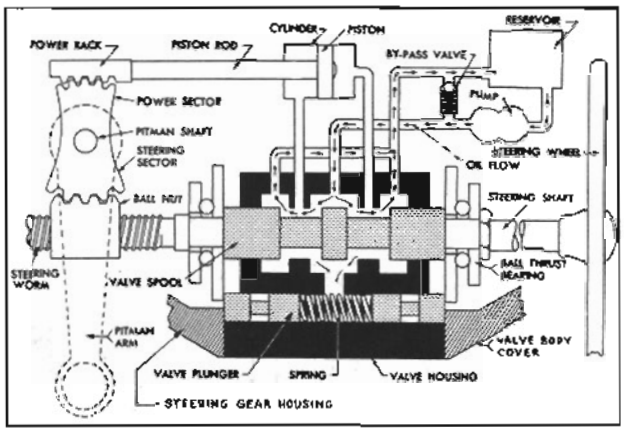

FIG. 45

Hydraulic System Applied

When the steering wheel is turned to the left, the first effect is that the reaction of the worm in the nut causes the steering shaft and valve spool to move slightly to the right (see Fig. 46). This movement of the valve spool restricts some of the passages in the valve body, so that oil is directed from the pump to the left-hand end of the power cylinder. As the pressure increases, the piston is moved to the right against any steering resistance that may be present. At the same time, oil from the right side of the power cylinder is allowed to return through the valve spool and valve body to the reservoir. The combined action of the worm shaft nut and the power rack against the pitman shaft gear sectors, rotates the pitman arm clockwise as indicated in Fig. 47.

If the steering wheel is turned to the right, the conditions would be reversed. The steering shaft and valve spool would move slightly to the left, oil would be sent to the right side of the piston, moving it to the left, and the pitman arm would be turned counterclockwise.

In Fig. 46 the valve is shown fully closed. This appears to allow complete pressure output of the booster in one direction. In actual operation this cannot occur because of mechanical limitations placed on the spool movement and the location of the grooves which

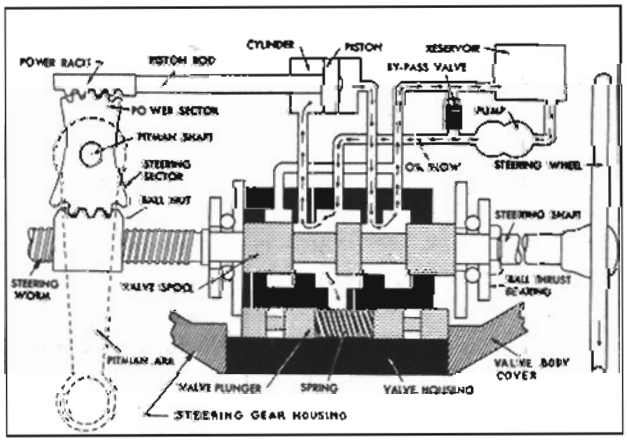

FIG. 46

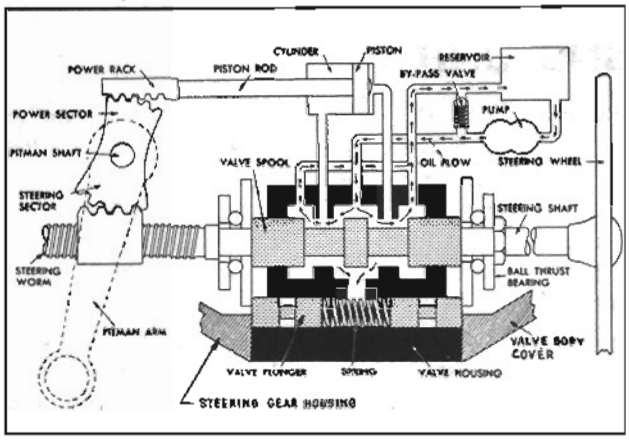

FIG. 47

provide for controlled leakage past the valve to the reservoir. Therefore, variable assisting pressures are provided to "feather" the booster power into the driver's effort, maintaining steering feel for the driver and preventing the hydraulic booster from over-steering.

Position of the valve spool is controlled by two factors: steering wheel movement and self-centering spring-and-plunger assemblies. There are five sets of springs and plungers in the valve body arranged around the circumference of the valve. For clarity, only one of these spring and plunger sets is shown in the schematic diagrams (Figs. 45, 46, and 47). The plungers contact the inner races of the thrust bearing on the valve housing. The plungers cannot move outward but can move inward against the spring. Therefore, the valve spool and thrust bearing assembly can be moved to the right or left against these plungers and springs.

The plungers, in combination with the springs, perform three functions:

1. Automatically center the valve spool when less than three pounds of pull is exerted on the rim of the steering wheel.
2. Determine the minimum pull required on the steering wheel to actuate the hydraulic booster system by relating the spring compression rate to the effort necessary to steer the car.
3. Provide proportional steering feel to the driver, i.e., slightly increased steering wheel pull when more steering effort is needed. To accomplish this, oil pressure, proportional to the steering effort, is directed on the inner ends of the plungers and adds to the springs' resistance to movement of the valve.

Transmitting Power Assistance to the Steering Gear

The pitman shaft which actuates the pitman arm has two sets of gear teeth, one of which engages the worm driven ball nut for the regular mechanical control, and the other, directly opposite, which engages a rack gear connected to the end of the piston rod. Movement of the pitman shaft must therefore result in movement of the pitman arm and the booster piston, providing positive mechanical control and booster assistance.

Since oil circulates freely in the system at zero pressure until its flow is directed to one side of the piston, the piston regulates the oil pressure by moving when a sufficient force is built up behind it to overcome steering resistance. Thus, decrease or increase in steering resistance automatically decreases or increases the assisting power so that the booster system is always completely responsive to the driver and proportionate to the demand placed upon it.

When holding steady on a left turn and less than three pounds pull is exerted on the steering wheel, oil pressure and the springs between the plungers will return the valve spool to a centered position, as shown in Fig. 47. Oil pressure in the system drops to zero. Under these conditions, all of the holding effort is provided by the driver through the mechanical gear. When effort on the steering wheel is released completely, the centering forces built into the steering geometry will return the wheels to a straight-ahead position as in regular mechanical steering.

Shock and Blow-out Resistance

If the wheel is held and a sudden force is exerted against the steering by road shock, a sequence opposite those previously described is set up. If the pitman arm attempts to move back and rotate the pitman shaft, the steering shaft and valve would move to the right, as in Fig. 46. Sufficient oil pressure would be exerted on the left-hand side of the piston to counteract the force of the road shock and it would not be transmitted to the steering wheel. Similarly, in the event of a tire blow-out, the extra steering effort required would be counteracted by added power from the booster when the driver exerts the normal effort of three to seven pounds pull on the steering wheel. If the wheel were merely held, the extra steering resistance would open the valve, and hydraulic assistance equal to the steering effort required would hold the wheels on their course.

Power Failure

In the event the oil pump should fail to supply oil pressure because of belt breakage, engine failure, or other cause, a one-way ball check valve, placed in the outlet port of the valve body, will provide a by-pass for oil around the pump to the reservoir. Therefore, oil may be displaced from either side of the piston and the piston may be moved mechanically without resistance. Under these circumstances, steering control is mechanical and no additional effort is required to turn the wheels except the negligible friction of the power piston.

POWER STEERING UNIT

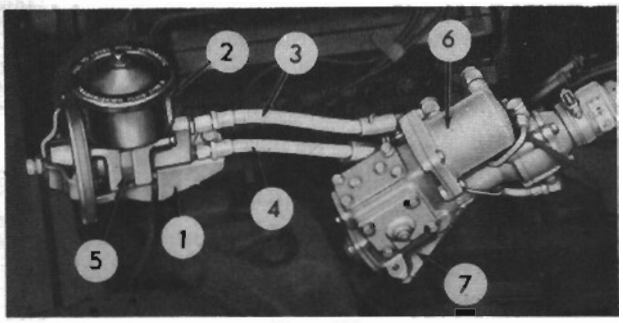

FIG. 48

1. Support bracket
2. Oil reservoir
3. Fluid return hose
4. Fluid pressure hose
5. Pump
6. Power unit
7. Mounting bracket

Disassembly and reassembly of the unit or the subassemblies must be made on a clean metal bench or a bench covered with clean paper. As in repairing any hydraulically operated unit, cleanliness is of utmost importance. Therefore, the bench, tools, and parts must be kept clean at all times.

Before disassembly of the unit, thoroughly clean the exterior of the unit. Drain as much as possible of the oil from the power cylinder and the control valve by turning the worm shaft two or three times through the entire range.

Except where noted in the procedure, do not remove the universal elbows or line fittings unless leakage at the fittings is apparent and the O-ring seals (2, 5, and 7, Fig. 49) should be replaced. Leaving the universal elbows tight will aid in reassembling and lessen the chance of leakage later.

Removal

Disconnect and remove the battery. On C and K models, remove the battery box. Remove the steering post collar (Duffy plate) screws and slip the collar up out of the way. Remove the horn wire brush terminal and bracket. If the car is equipped with automatic transmission, disconnect the quadrant light and starter cutout switch cables. If equipped with directional signals, disconnect the cables. Disconnect the shift lever rod or rods. Loosen the jacket clamp bolt at the lower end of the jacket. Remove the steering wheel, using Puller J-5473. Remove the jacket spring. Loosen the jacket-to-instrument board bracket clamp screw and remove the jacket-to-instrument board bracket screws and shims (if shims are used). Slip the steering jacket assembly off the steering post.

Remove the four steering post coupling nuts, separate the coupling, keeping the collector ring and insulators intact, and remove the post assembly. Tape the coupling studs to prevent damaging the threads when removing the unit.

On the President and Commander models, remove the left rocker arm cover. Disconnect the reach rod from the pitman arm. Loosen and remove the pitman arm pinch bolt. Move the fender gravel deflector out of the way and remove the three steering gear housing-to-mounting bracket bolts. On the President and Commander models, it may be necessary to shift the unit against the fender apron to gain clearance to remove the pitman arm. Then remove the pitman arm.

Disconnect the flexible hoses from the pump. Tape the openings of the pump fittings and hoses or install the plastic caps and plugs.

Shift the unit rearward, inserting the top end of the unit through the opening in the firewall. Lift the lower end of the unit, turn it as necessary to gain clearance past the fender apron and the battery box on the W, F, D, and Y models, and lift the unit out of the car.

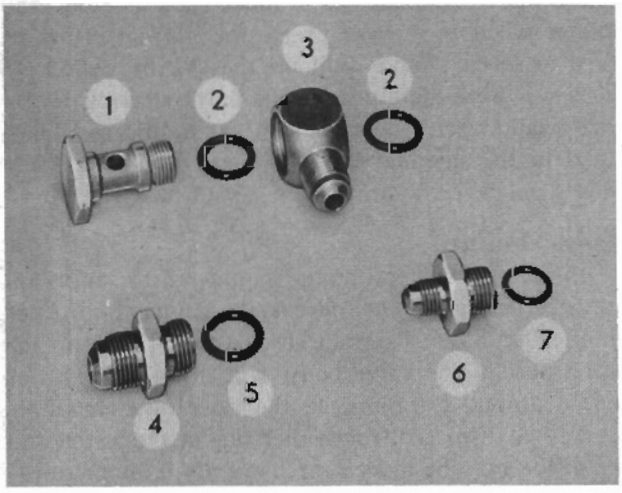

FIG. 49

1. Elbow bolt
2. O-ring seals
3. Universal elbow
4. Return line fitting
5. O-ring seal
6. Pressure line fitting
7. O-ring seal

Installation

Lower the unit into the engine compartment with the upper end of the unit down. Move it rearward and insert the upper end through the opening in the firewall. Turn the unit as necessary and lower the front end of the unit. Then move the unit forward and place it on the mounting bracket. Install the pitman arm on the shaft. Position the unit on the mounting bracket and install the retaining bolts. Then install and tighten the pitman arm pinch bolt.

Remove the tape or plugs and caps and connect the flexible hoses to the pump.

Check the installation of the coupling on the worm shaft. With the gear in mid-position (on the high spot), the punch mark on the end of the worm shaft should be at the top and the "T" stamped on the coupling should also be at the top. Properly position the collector ring and insulators on the end of the

steering post, align the holes with the coupling studs, and slip the assembly down over the studs. Make sure that the boss at each stud hole on the insulator is properly seated in the collector ring. Install the coupling stud nuts.

Slide the jacket assembly down over the post, being sure to hold the horn brush away from the collector ring when starting the jacket on the steering gear. Align the locating pin on the valve body cover with the slot in the jacket and slip the jacket into position. Place the jacket spring on the post. Align the marks of the steering wheel and the post, and install the wheel and retaining nut. Position the jacket in relation to the steering wheel so that there is approximately 1/8" (3,16 mm.) clearance between the hub of the wheel and the end of the jacket assembly. If the steering wheel-to-jacket clearance is too small, the power unit may not operate on right turns. Then, tighten the jacket clamp bolt at the lower end of the jacket. Install the jacket-to-instrument board bracket screws and shims (if shims were used). Tighten the bracket clamp bolt. Turn the wheel through the entire range to check for possible bind in the system caused by misalignment when the retaining bolts and screws were tightened. The wheel must turn freely through the entire range. If a bind exists, loosen the entire assembly and shift it as necessary to eliminate the bind.

Connect the shift lever rods. Connect the horn wire. If the car is equipped with automatic transmission, connect the quadrant light and starter cutout switch cables. Connect the directional signal cables, if so equipped. Connect the reach rod to the pitman arm. Install the jacket collar (Duffy plate). On the President and Commander models, install the left rocker arm cover. On the C and K models, install the battery box. Install and connect the battery.

Check the fluid level in the gear housing and in the pump reservoir. Bleed the hydraulic system as outlined under Bleeding the System.

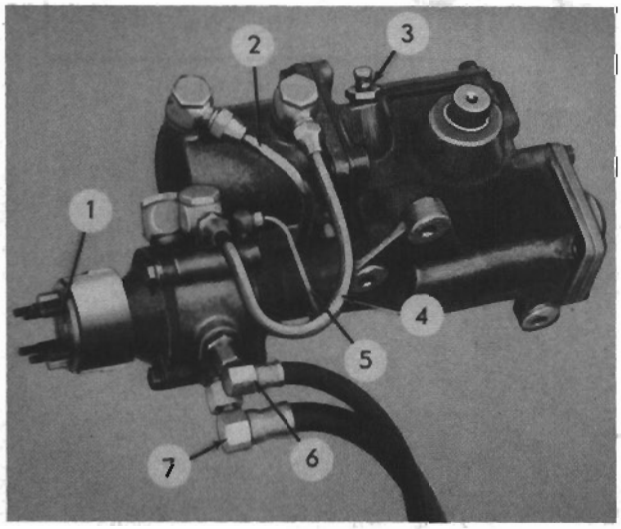

FIG. 50

1. Coupling
2. Pressure line
3. Gear housing filler plug
4. Pressure line
5. Bleeder line
6. Flexible hose (Pressure)
7. Flexible hose (Return)

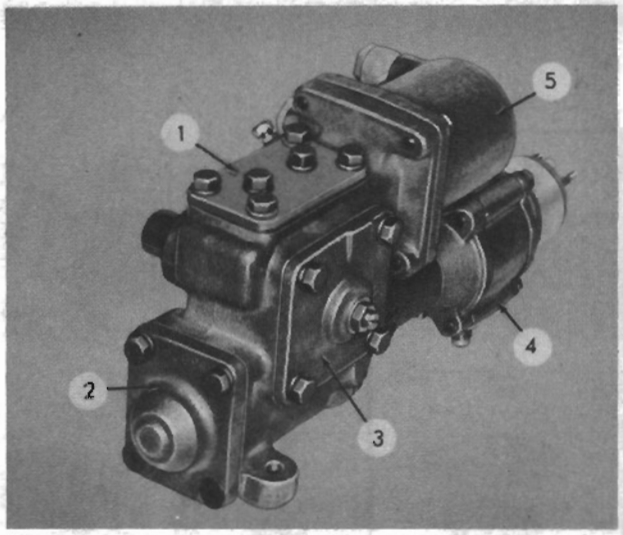

FIG. 51

1. Power rack cover
2. Worm shaft end cover
3. Pitman shaft cover
4. Valve body
5. Power cylinder

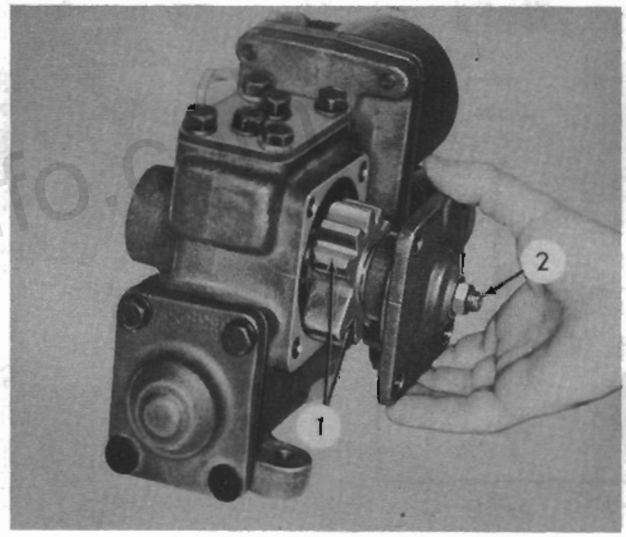

FIG. 52

1. Pitman shaft sector gears
2. Pitman shaft adjusting screw

PITMAN SHAFT ASSEMBLY

Removal

Mark the cover (3, Fig. 51) and gear housing for proper reassembly and remove the cover retaining screws. Then, by tapping with a soft mallet on the end of the pitman shaft, slip the pitman shaft out of the housing and remove the shaft, cover, and gasket as an assembly (see Fig. 52).

Disassembly

Remove the gasket from the cover. Hold the pitman shaft adjusting screw with a screw driver, and remove the adjusting screw lock nut. Turn the screw out of the cover and remove the cover. Then slip the adjusting screw and shim out of the slot of the pitman shaft.

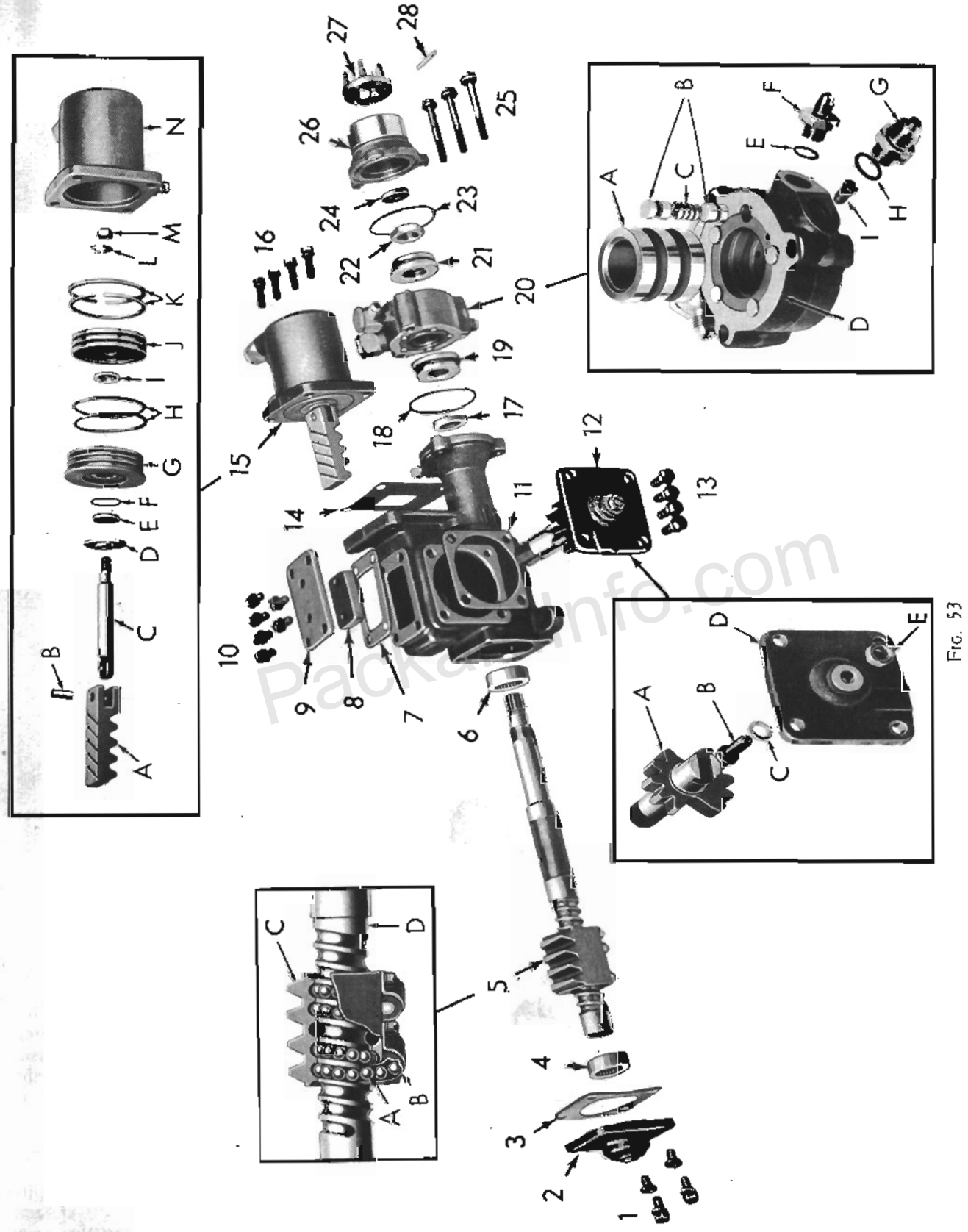

FIG. 53

KEY TO PARTS IN FIG. 53

1. Worm shaft cover screws
2. Worm shaft cover
3. Cover gasket
4. Worm shaft lower bearing
5. Ball nut and shaft assembly
   a. Bearings
   b. Guide
   c. Nut
   d. Shaft
6. Worm shaft upper bearing
7. Guide cover shims
8. Guide
9. Cover
10. Cover screws
11. Pitman shaft cover gasket
12. Pitman shaft assembly
   a. Pitman shaft
   b. Adjusting screw
   c. Adjusting shim
   d. Cover
   e. Lock nut
13. Pitman shaft cover screws
14. Power cylinder gasket
15. Power cylinder assembly
   a. Power rack
   b. Rack pin
   c. Piston rod
   d. Stop plate
   e. Oil seal
   f. O-ring seal
   g. Adapter
   h. O-ring seal
   i. Thrust washer
   j. Piston
   k. Piston rings
   l. Thrust washer
   m. Nut
   n. Power cylinder
16. Power cylinder screws
17. Oil seal
18. O-Ring seal
19. Thrust bearing assembly
20. Valve body assembly
   a. Valve spool
   b. Plungers
   c. Spring
   d. Valve body
   e. O-ring seal
   f. Pressure line fitting
   g. Return line fitting
   h. O-ring seal
   i. Check valve
21. Thrust bearing assembly
22. Nut
23. O-Ring seal
24. Oil seal
25. Valve body cover screws
26. Valve body cover
27. Coupling
28. Coupling pin

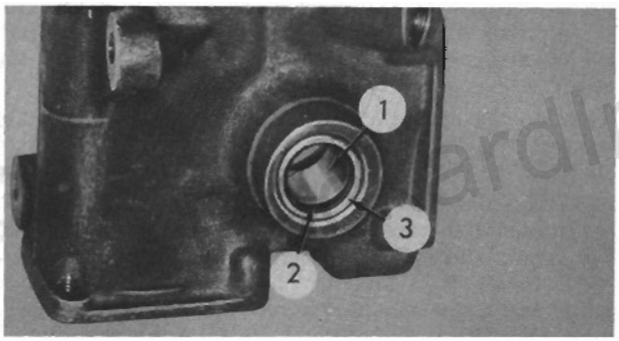

FIG. 54

1. Bushing 2. Shaft packing 3. Packing retainer

Use a sharp punch to pry the pitman shaft packing (2, Fig. 54) and retainer (3) out of the housing. This seal should be replaced whenever the pitman shaft is removed. Be careful when removing the seal not to damage the bushing (1).

Inspection

Inspect the bushing (1, Fig. 55) in the cover for excessive wear. If worn, replace the cover and bushing as an assembly.

Check the pitman shaft sector teeth. If the teeth are worn, pitted, or scored, replace the shaft.

Check the pitman shaft bushing in the housing for wear. If worn, replace the bushing using Bushing Remover and Replacer J-5562 to remove and install the bushing.

Reassembly

Check the end play of the adjusting screw in the slot of the shaft by inserting a feeler gage between the head of the screw and the bottom of the slot (see Fig. 56). The end play should not exceed .002" (0,051 mm.). If the end play exceeds .002" (0,051 mm.), select the proper shim to give the desired end play. The shims are available in four different thicknesses: .063" (1,60 mm.), .065" (1,65 mm.), .067" (1,70 mm.), and .069" (1,75 mm.).

Installation

Turn the worm shaft as necessary until the center groove of the ball nut is aligned with the center of the pitman shaft bushing. Then, position the power rack so that the center groove of the rack (third groove from piston end) is also aligned with the center of the bushing (see Fig. 57). Install the pitman shaft

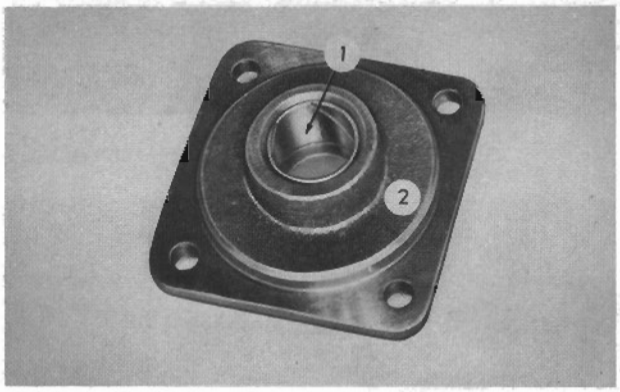

FIG. 55

1. Bushing 2. Pitman shaft and cover

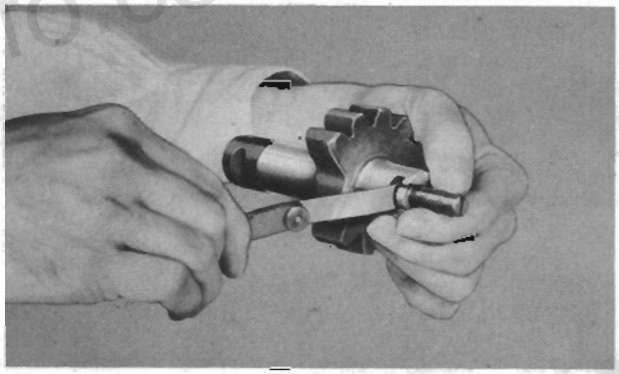

FIG. 56

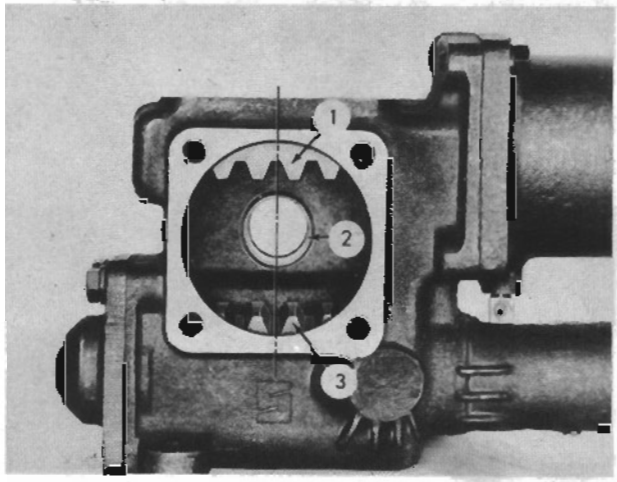

FIG. 57

1. Power rack 2. Bushing 3. Ball nut

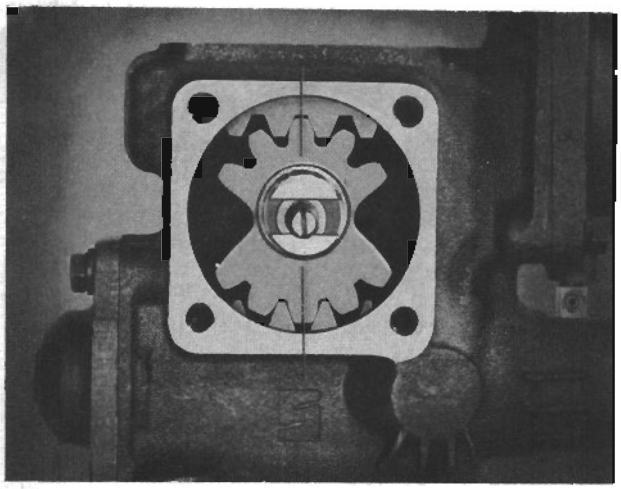

FIG. 58

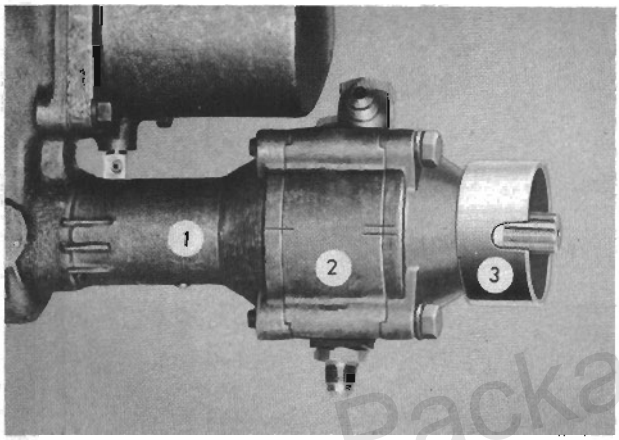

FIG. 59

1. Gear housing 2. Valve body 3. Valve body cover

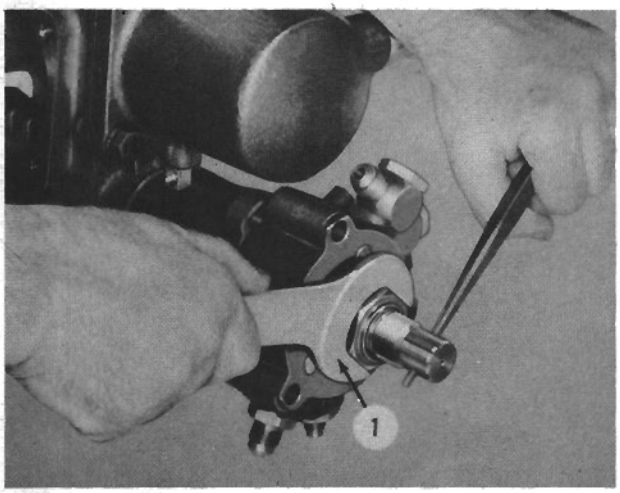

FIG. 60

1. Worm bearing adjusting wrench J-5259

so that the center tooth in each sector meshes with the center grooves of the ball nut and the power rack (see Fig. 58). The tapered teeth should mesh with the

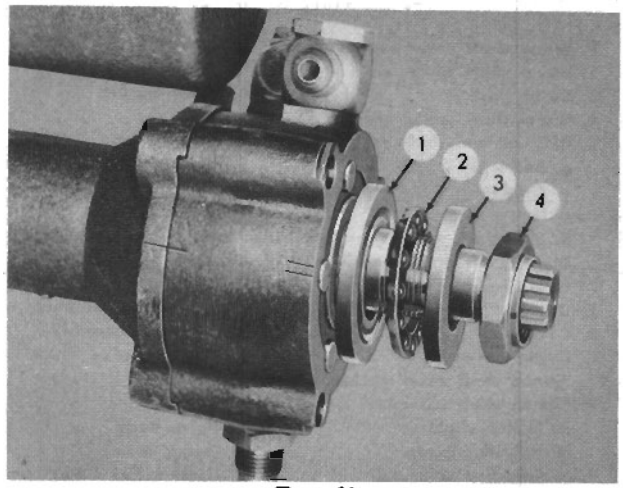

FIG. 61

1. Inner race 3. Outer race
2. Bearing 4. Nut

ball nut and the straight teeth with the power rack. It may be necessary to lift the power rack slightly to permit meshing of the rack and sector teeth.

Position a new gasket on the housing. Hold the cover over the adjusting screw and align the marks made at disassembly. Insert a screw driver in the hole of the cover and turn the screw into the cover to pull the cover against the housing. Install and tighten the cover screws securely.

Soak the new shaft packing in engine oil and slip the packing and retainer over the end of the pitman shaft. Use a 1¼" (31,75 mm.) pipe to press the assembly into the housing.

Loosen the power rack guide and cover (1, Fig. 51) screws and make the high spot adjustment as outlined under Adjustments. Tighten the power rack guide and cover assembly screws and check the power rack adjustment as outlined under Adjustments.

CONTROL VALVE ASSEMBLY

Removal

Remove the pressure lines (2 and 4, Fig. 50), bleeder line (5), and flexible hoses (6 and 7).

Using a suitable drift, drive out the coupling retaining pin and slip the coupling off the splines of the worm shaft. Mark the valve body cover (3, Fig. 59), valve body (2), and housing (1). Make a double mark at the cover end of the valve body to assure proper reassembly. Remove the valve cover retaining screws and remove the valve cover and O-ring seal. Discard the seal.

Place the unit so that the worm shaft is in a horizontal position. Push the staked portion of the valve spool retaining nut up out of the groove in the shaft, being careful not to damage the shaft or thread. Then, using a drift inserted in the hole of the worm shaft to hold the shaft, remove the nut using the Worm Bearing Adjusting Wrench J-5259. See Fig. 60.

Remove the thrust bearing assembly. The assembly consists of the outer race (3, Fig. 61), bearing (2), and inner race (1). It should be noted that the outer race is of smaller diameter than the inner race.

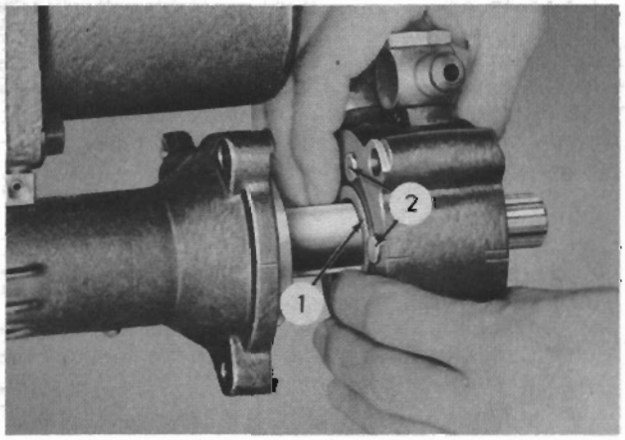

FIG. 62

1. Valve spool 2. Plungers

Slide the control valve assembly from the shaft, (see Fig. 62), being careful not to allow the spool (1) and plungers (2) to fall out. If the control valve assembly is not to be disassembled, wrap the unit in a clean lint-free rag. Take all precautions to keep the assembly clean.

Remove the O-ring seal from the face of the gear housing and discard the seal.

Disassembly

Before removing the valve spool, note which end of the spool is at the cover end of the valve body. One end of the spool is grooved while the other end is machined smooth. It must be installed in its original position at reassembly. Carefully slide the spool (20A, Fig. 53 out of the control valve body. Then push the plungers (20B) and springs (20C) out of the body.

Remove the pump return fitting from the valve body and remove the check valve (20I).

Inspection

Inspect the lands inside the body; the spool and the plungers for scores, nicks, or burred edges. If the spool or lands in the body are damaged, both parts must be replaced. The spool and the valve body are available only in matched sets and are not serviced separately.

If necessary to replace the valve cover seal, remove the seal by carefully tapping an offset screw driver in between the seal and the shoulder of the cover and then pry the seal out of the cover. To install the seal in the valve cover, place the seal on the Valve Cover Seal Installer J-5188 with the lip and spring side of the seal against the shoulder of the tool and press the seal into the cover (see Fig. 63).

Reassembly

Make sure all parts are clean and lubricated with engine oil.

Install the check valve in the valve body. Install the line fitting.

Hold the valve body so the end which has the double marks is up, and very carefully slip the spool into the valve body so that it will be in the same position as it was at disassembly. The fit of the spool in the valve body is a selective fit and only if properly started can the spool be installed. To facilitate the installation, rotate the spool, do not attempt to force it into the valve body.

Insert the centering springs in the valve body. Insert a plunger on each side of the spring. The rough or unmachined end of the plunger must contact the spring.

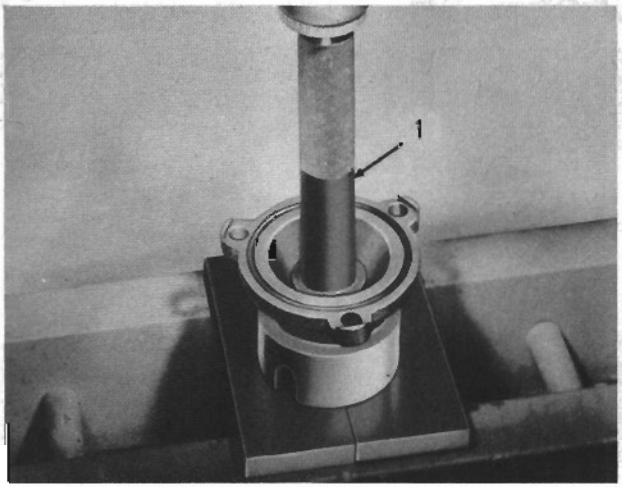

FIG. 63

1. Valve Cover Seal Installer J-5188

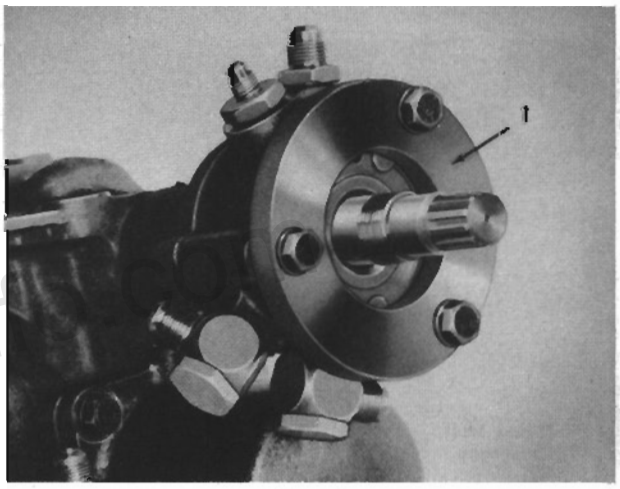

FIG. 64

1. Worm Shaft Retainer Collar J-5182

Installation

Install a new O-ring seal in the groove in the face of the gear housing. Make sure that the lower thrust bearing assembly is properly in place at the housing. Then, carefully slip the control valve assembly on the shaft. Align the marks made at disassembly and install the valve assembly against the face of the gear housing.

Install the Worm Shaft Retainer Collar J-5182 and install the valve cover screws securely and evenly. See Fig. 64. Install the upper thrust bearing assembly on the shaft, placing the large race against the valve spool. Install a new retaining nut.

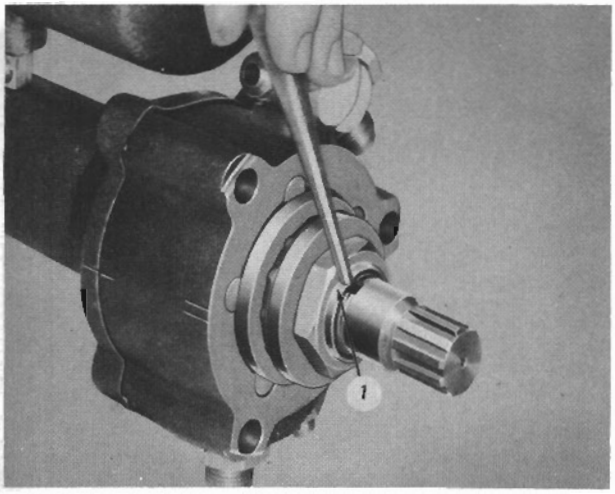

FIG. 65
1. Flange of nut

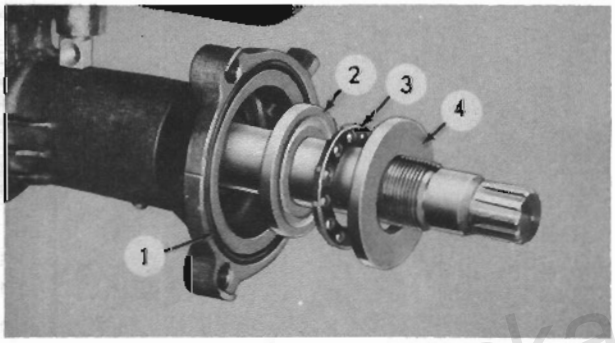

FIG. 66
1. O-ring seal
2. Outer race
3. Bearing
4. Inner race

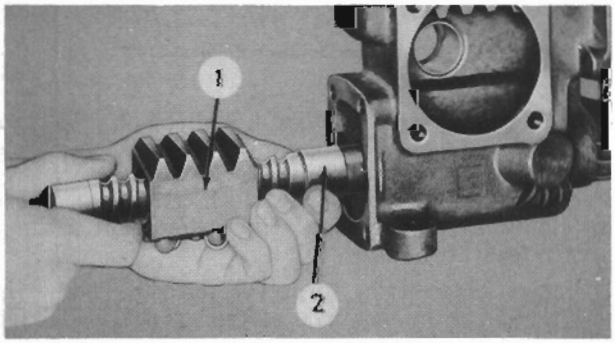

FIG. 67
1. Ball nut
2. Worm shaft

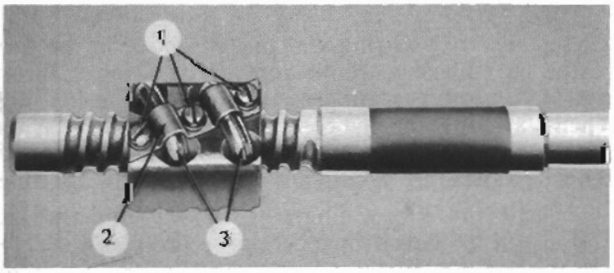

FIG. 68
1. Clamp screws
2. Clamp
3. Ball guides

To make the bearing adjustment, use a small drift inserted in the hole of the worm shaft and turn the shaft counterclockwise or to the left to the end of its travel. Continue to turn approximately another ⅛ of a turn to compress the centering springs. As the springs are compressed, the shaft will move downward. Hold the shaft in this position and tighten the retaining nut to remove all end play. Turn the shaft back to relieve the pressure of the springs. Then, while holding the shaft, back off the nut until the outer race of the upper thrust bearing assembly can be turned with a heavy drag. This should give the proper preload on the thrust bearing. Stake the nut with a rounded end punch as shown in Fig. 65. Remove the retainer collar.

Place a new O-ring seal in the valve cover flange. Align the marks made at disassembly and install the cover on the valve body. Install the retaining screws and tighten to 15 to 20 ft-lbs (2.07 to 2.76 kg-m) torque. The proper torque is important because if the screws are too tight the valve body may distort and cause the spool to stick. Turn the worm shaft so that the gear is on the high spot or in the middle of its travel. The mark on the end of the shaft should be at the top. Then slip the coupling on the shaft so that the retaining pin holes are aligned and the "T" stamped on the coupling is also at the top. Install the retaining pin.

Install the pressure lines, bleeder line, and flexible hoses.

WORM SHAFT AND BALL NUT ASSEMBLY

Removal

Remove the pitman shaft assembly as outlined under Pitman Shaft Assembly—Removal.

Remove the control valve assembly as outlined under Control Valve Assembly—Removal.

Remove the lower thrust bearing assembly. The assembly consists of three parts: the inner race (4, Fig. 66), bearing (3), and outer race (2). The outer race is of smaller diameter than the inner race. Remove the worm shaft lower end cover screws (2, Fig. 51). Then remove the cover and gasket from the housing. Carefully slide the worm shaft and ball nut assembly out of the housing (see Fig. 67).

Disassembly

Remove the screws (1, Fig. 68) and clamp (2) which retain the guides (3). Turn the nut upside down and rotate the shaft back and forth until all of the balls have dropped out of the nut. Catch the balls in a clean pan. Then remove the nut from the shaft.

Inspection

Wash all parts in cleaning solvent and dry with a lint-free rag.

Inspect the worm and ball nut grooves and all of the balls for wear or scoring. Inspect the ball guides, making sure that the ends where the balls enter and leave the guides are not damaged. Inspect the ball nut teeth for pitting, wear, and scoring. If either the ball nut or the worm shaft is damaged and requires replacement, both the nut and the shaft will have to be replaced. The ball nut and shaft are serviced only

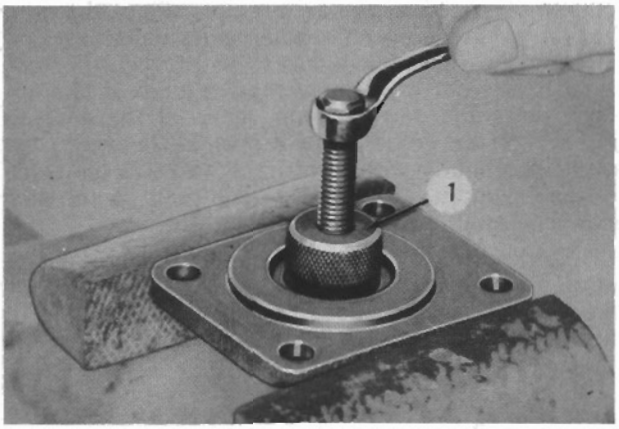

FIG. 69

1. Lower Worm Shaft Bearing Remover J-5190

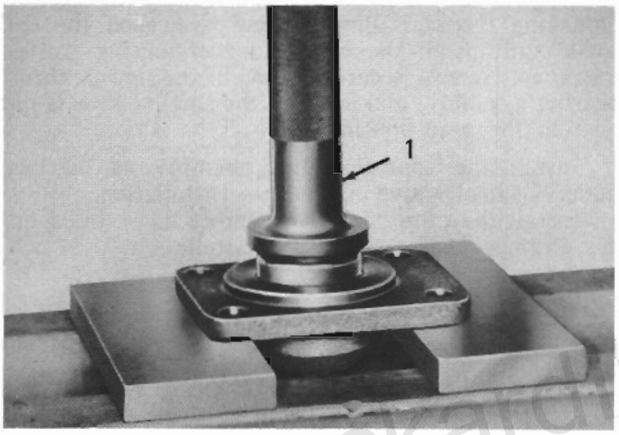

FIG. 70

1. Lower Worm Shaft Installer J-5191

as an assembly in a matched set. The balls are available only in sets of thirty.

Check the bearing in the end cover. If it requires replacement, use the Lower Worm Shaft Bearing Remover J-5190 to remove the bearing (see Fig. 69). To install the bearing, use Bearing Installer J-5191 and press the bearing into the cover (see Fig. 70).

Check the worm shaft upper seal in the housing. If necessary to replace the seal (1, Fig. 71), remove the seal by carefully tapping an offset screw driver in between the seal and the shoulder in the housing. Then, pry the seal out of the housing. To install the seal, use Worm Shaft Bearing and Seal Installer J-5189. The lip and spring of the seal should be up when installed.

Inspect the bearing, do not remove unless replacement is necessary as removal will damage the bearing. To remove the bearing, use a punch at the end of the bearing, and tap it out of the housing. To install a new bearing, use the Bearing and Seal Installer J-5189 (see Fig. 72).

Reassembly

Make sure all parts are clean and lubricate with engine oil.

Assemble the nut on the shaft as shown in Fig. 73. Then turn the nut over so that the ball guide holes are up. Align the grooves in the worm and nut

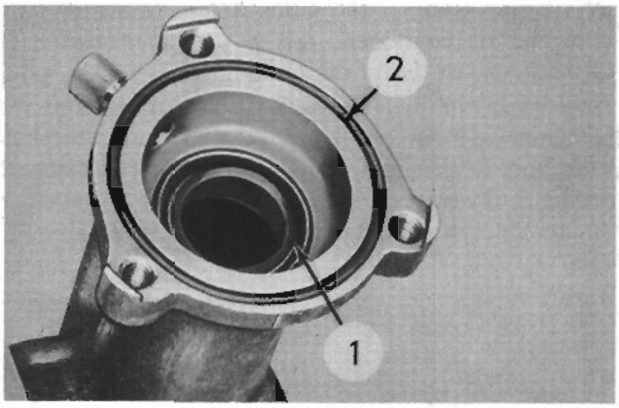

FIG. 71

1. Seal 2. O-ring seal

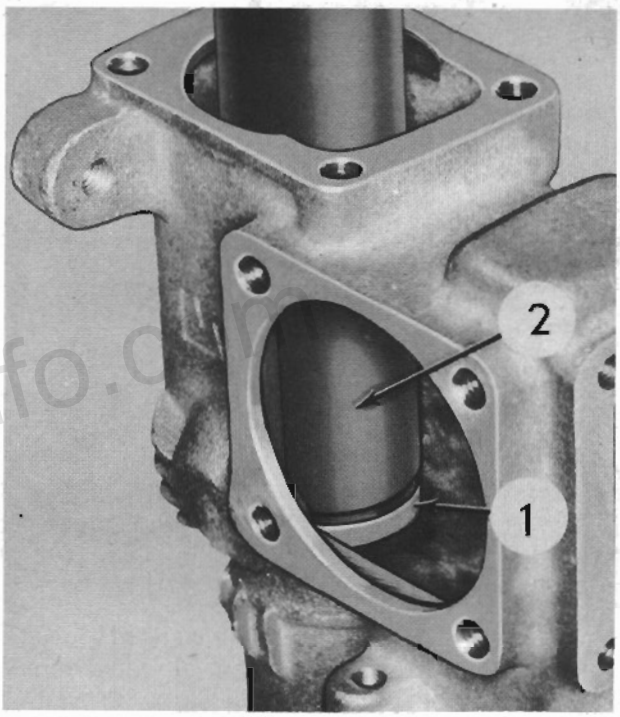

FIG. 72

1. Bearing 2. Bearing and Seat Installer J-5189

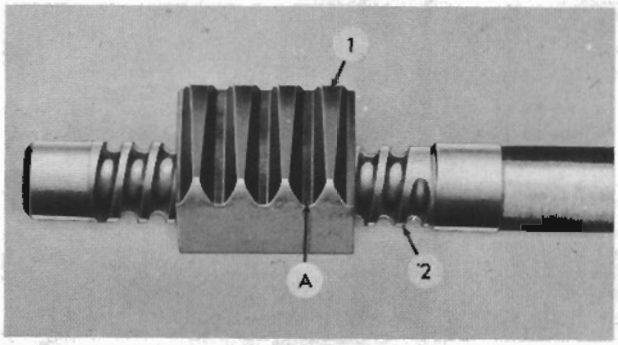

FIG. 73

1. Ball nut 2. Worm shaft

a. Deep side of tooth

by sighting through the guide holes. Count 30 balls into separate containers, this is the number of balls for each circuit. Drop the balls into one of the guide holes. Push the balls in with a punch or a blunt rod (see Fig. 74) and at the same time turn the shaft back and forth slightly to close the spaces between the balls. Twenty of the balls should be installed in the nut in each circuit. Fill one-half of the guide with the remaining 10 balls (see Fig. 74). Place the other half of the guide over the balls and plug each end of the guide with a heavy grease to prevent the balls from falling out when installing the guide in the nut. Push the guide into the guide holes of the nut (see Fig. 75). If the guide does not push all the way down easily, tap lightly with a soft mallet to seat the guide. Assemble and install the other set of balls in the same manner. Install the guide clamp and screws.

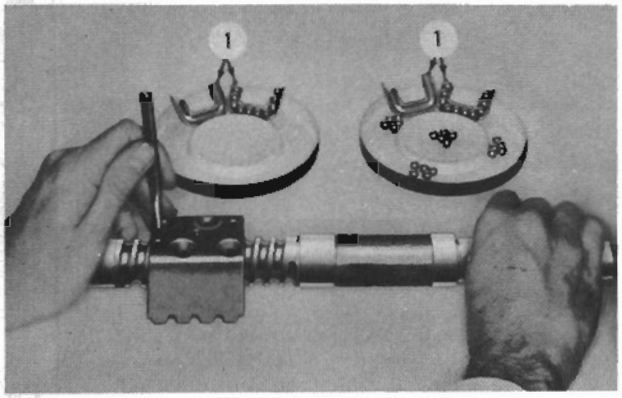

FIG. 74
1. Ball guides

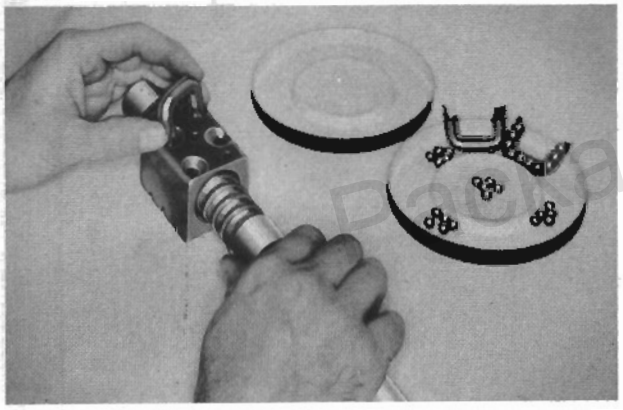

FIG. 75

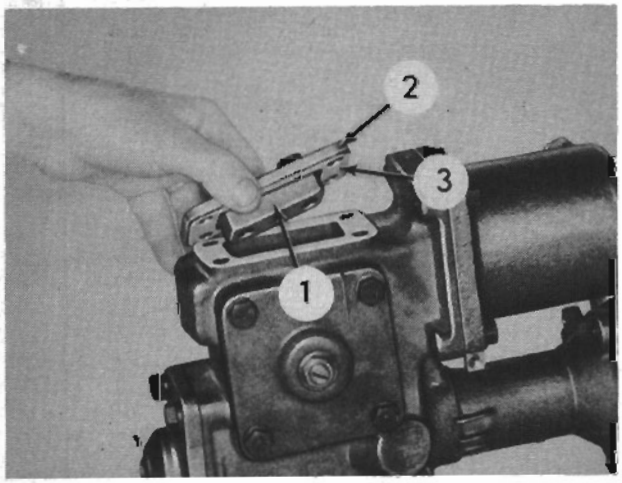

FIG. 76
1. Guide 2. Cover 3. Shims

Check the assembly by rotating the nut on the worm to make sure that it rotates freely. Do not allow the nut to rotate of its own weight until it strikes either end of the worm. Allowing it to do so will damage the ball guides.

Installation

Slide the worm shaft and ball nut assembly into the housing, carefully guiding the upper end of the shaft through the seal of the housing to prevent damaging the seal. Place a new gasket on the end cover and install the cover on the housing. Install the cover screws securely. Install the lower thrust bearing assembly, making sure the smaller race is put next to the gear housing.

Install the control valve assembly as outlined under Control Valve Assembly—Installation.

Install the pitman shaft assembly as outlined under Pitman Shaft Assembly—Installation.

POWER CYLINDER ASSEMBLY

Removal

Remove the pressure lines (2 and 4, Fig. 50) and bleeder line (5).

Remove the screws from the power rack guide and cover (1, Fig. 51). Do not remove the screws located in the center of the plate. These screws hold the rack guide to the cover. Lift the cover assembly and shims from the housing (see Fig. 76).

Remove the pitman shaft assembly as outlined under Pitman Shaft Assembly—Removal.

Mark the flange of the power cylinder and the housing for proper reassembly. Remove the top universal elbow from the control valve body to permit moving the power cylinder rearward. Remove the power cylinder retaining screws. Then, slip the assembly from the housing (see Fig. 77).

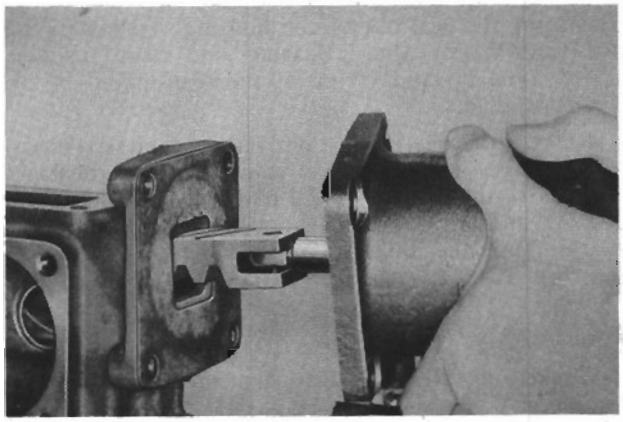

FIG. 77

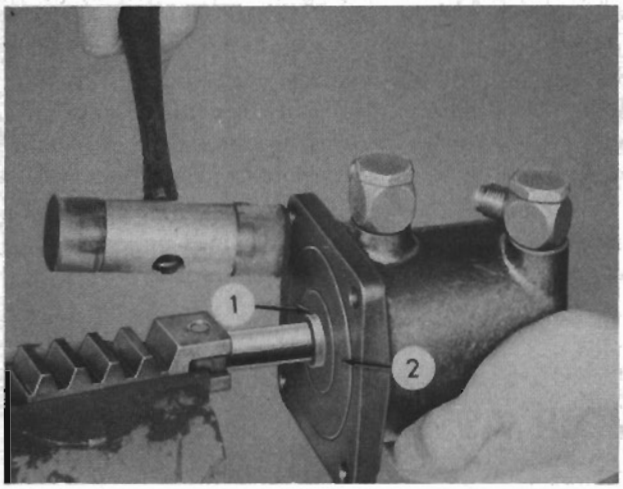

FIG. 78

1. Stop plate
2. Adapter

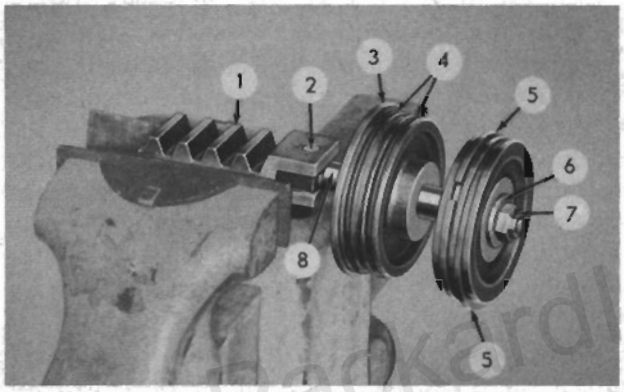

FIG. 79

1. Power
2. Pin
3. Adapter
4. O-ring seals
5. Piston rings
6. Thrust washer
7. Retaining nut
8. Piston rod

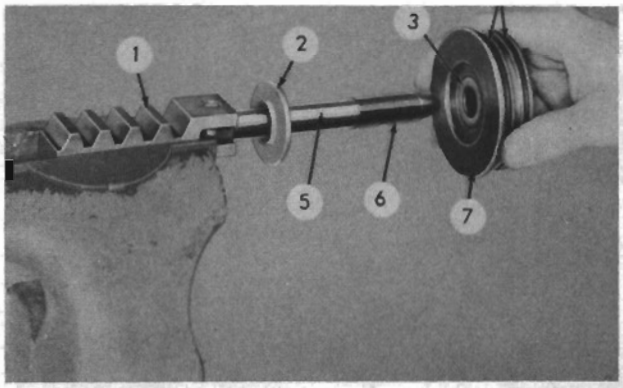

FIG. 80

1. Power rack
2. Stop plate
3. Oil seal
4. O-ring seal
5. Piston rod
6. Piston Rod Inserter J-5193
7. Adapter

Disassembly

Remove the gasket and hold the assembly by clamping the power rack in a vise equipped with brass jaws. Using a soft mallet, tap the cylinder off the adapter as shown in Fig. 78. To remove the piston from the shaft, remove the retaining nut (7, Fig. 79) and thrust washer (6). Slip the piston off the shaft and remove the inner thrust washer. To remove the piston rings, use a standard 3" (76,2 mm.) piston ring expander and remove the rings. Slip the adapter (3) off the shaft and remove the stop plate. Using a pointed tool, remove the large O-ring seals (4) and discard.

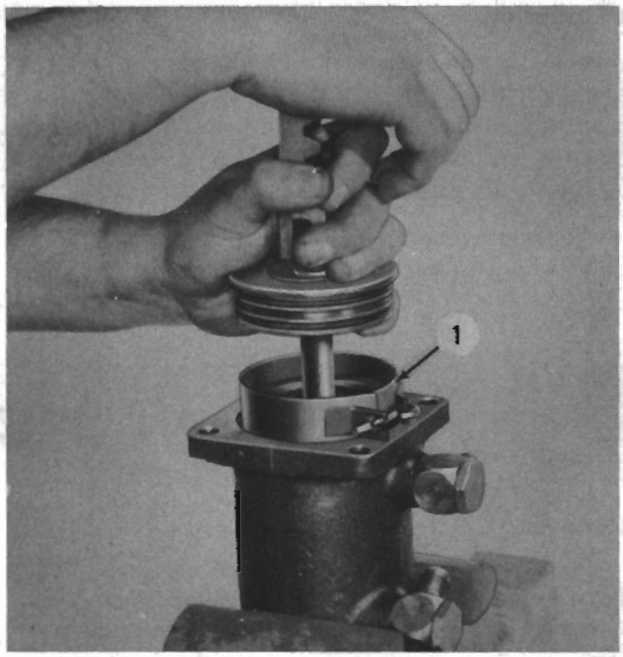

FIG. 81

1. Ring Compressor J-5186-A

Inspection

Inspect the seal in the adapter. If the seal is damaged or worn, pry the seal out of the adapter. To install a new seal, place the seal in the adapter with the lip and spring of the seal down and use a tube or socket of 1⅛" (28,6 mm.) outside diameter to press the seal into the adapter.

Check the power rack teeth for burrs, scores, or excessive wear. If it is necessary to replace the rack, press out the pin and remove the rack from the piston rod. When installing the pin, stake the pin in three places on both sides to retain the pin, then file the burrs raised by the staking.

Inspect the power cylinder and piston for scoring.

Reassembly

Install new O-ring seals on the adapter. Install the piston rings on the piston. Install the stop plate on the piston rod. Install Piston Rod Inserter J-5193 over the threaded portion of the piston rod to protect the adapter seal, and slip the adapter on the piston rod. See Fig. 80. Slip the inner thrust washer, piston, and outer thrust washer on the piston rod and install the retaining nut. Make sure that the inner thrust washer is installed with the flat face of the washer against the piston.

Install the Ring Compressor J-5186-A (1, Fig. 81) on the rings and install the piston in the cylinder. Push the adapter into the cylinder until it is flush with the face of the cylinder.

Installation

Place a new gasket on the housing. Check the aligning marks made at disassembly. Guide the power rack through the opening in the housing and position it on the housing. Install the retaining screws.

Install the pressure lines and bleeder line.

Apply oil to the face of the power rack and the guide, and position the power rack guide and cover assembly on the housing. Use the shims that were removed at disassembly. Install but do not tighten the screws until the high spot adjustment has been made. Install the pitman shaft assembly as outlined under Pitman Shaft Assembly—Installation. Make the high spot adjustment as outlined under Adjustments.

Tighten the power rack cover screws and check the power rack adjustment as outlined under Adjustments..

PUMP AND RESERVOIR ASSEMBLY

Removal

Disconnect the flexible hoses from the pump. Tape the openings of the pump fittings and hoses with masking tape or install the plastic caps and plugs.

On the 56G models, loosen the pulley retaining nut (2, Fig. 82). Then loosen the mounting cap screws (1) and allow the assembly to move downward to take the tension off the belt. Remove the belt from the pulley, remove nut, and slip the pulley off the shaft. Remove the mounting cap screws and remove the assembly from the bracket.

On the 56B and 56H models, loosen the pulley retaining nut (1, Fig. 83). Loosen the support bracket mounting cap screws (3) to allow the assembly to move downward to take the tension off the belt. On the 56J, although a different bracket is used, the mounting screws are at the same location but the upper screw is used as a pivot and only the lower screw moves in a slot. Slip the belt off the pulley, remove pulley retaining nut, and remove the pulley. Remove the pump body mounting screws (2) and remove the pump.

Remove the cover and drain the oil from the reservoir.

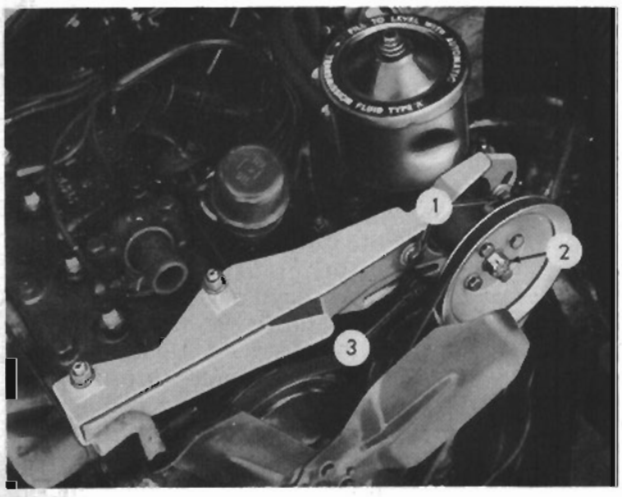

FIG. 82

1. Mounting cap screws 2. Pulley nut 3. Generator bolt

Installation

Insert the forward end of the pump through the bracket and start the mounting cap screws. Install the pulley on the shaft. On all models except the Champion and Flighthawk, tighten the mounting cap screws securely; on the Champion and Flighthawk models tighten the cap screws finger tight. Install the pulley retaining nut. Place the belt on the pulley, making sure it is also properly positioned on the crankshaft pulley. Lift the pump assembly to put tension on the belt, and tighten the retaining cap screws. Then check the belt tension as outlined under Pump Drive Belt—Adjustment.

After securing proper belt tension, make sure that all cap screws and the pulley nut are tight. Remove the tape or plastic caps and plugs, and connect the flexible hoses. Fill the reservoir with Type A (AQ-ATF) fluid and bleed the system as outlined under Bleeding the Hydraulic System.

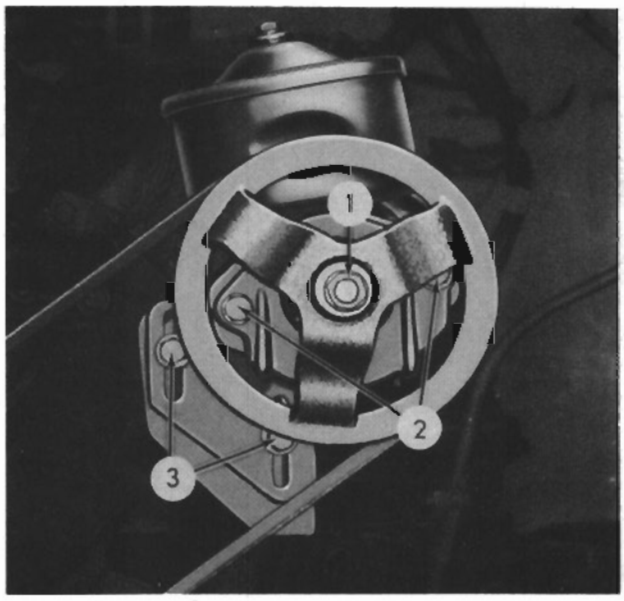

FIG. 83

1. Pulley nut 2. Pump mounting screws 3. Support bracket screws

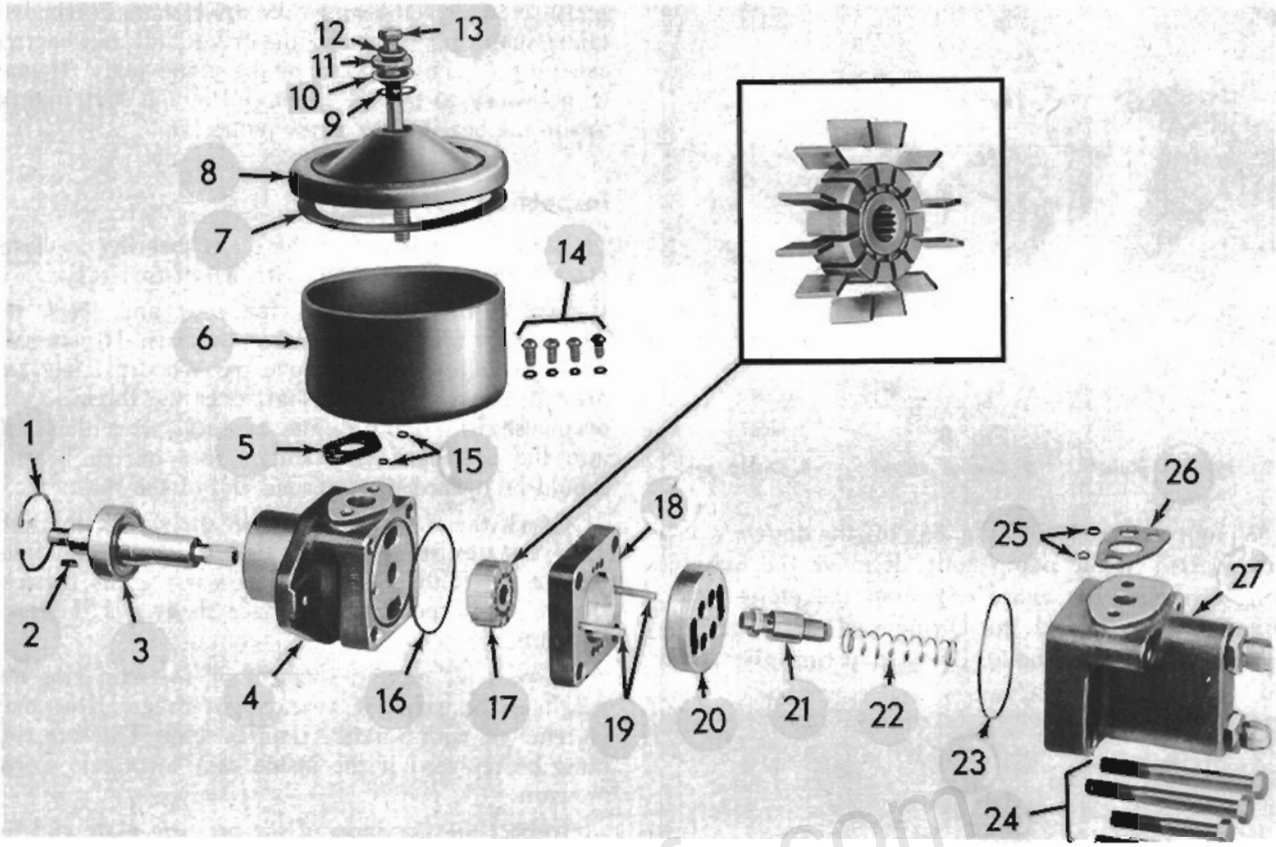

FIG. 84

1. Snap ring
2. Key
3. Shaft and bearing assembly
4. Pump body assembly
5. Gasket
6. Reservoir
7. Cover gasket
8. Cover
9. Gasket
10. Guide
11. Spacer
12. Lock washer
13. Bolt
14. Reservoir screws
15. Gasket spacers
16. O-ring seal
17. Impeller assembly
18. Cam ring
19. Dowels
20. Pressure plate
21. Flow and pressure control valve assembly
22. Spring
23. O-ring seal
24. Pump cover screws
25. Gasket spacers
26. Gasket
27. Pump cover

PUMP AND RESERVOIR ASSEMBLY

Disassembly

Remove the reservoir cover bolt (13, Fig. 84), washer (12), spacer (11), guide (10), and gasket (9), and remove the reservoir cover (8) with the gasket (7). Remove the four reservoir-to-pump mounting screws, indicated by arrows in Fig. 85, and remove the reservoir. Remove the gaskets (5, Fig. 84) and (26) with spacers from the pump assembly.

Remove the four pump cover-to-body bolts (24) and remove the cover (see Fig. 86). Remove the control valve assembly (21, Fig. 84) and spring (22) from the cover. Remove the cover O-ring seal (23) and discard. The control valve assembly should not be disassembled. The unit is serviced only as an assembly. Lift the pressure plate off the dowels which extend through the pump cam ring (see Fig. 87). Lift

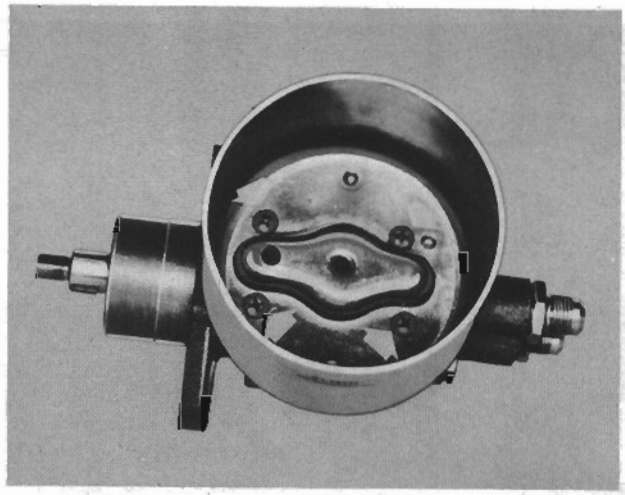

FIG. 85

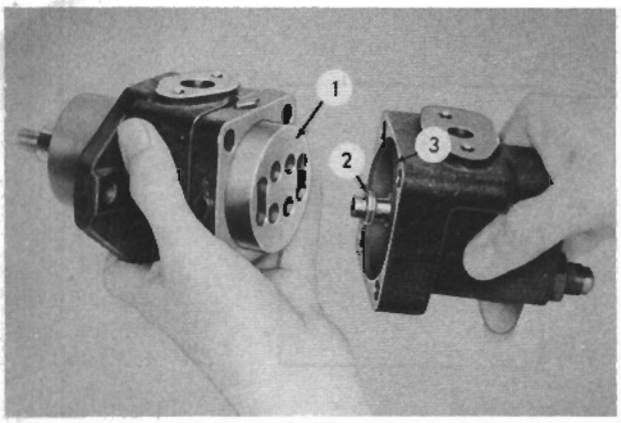

FIG. 86

1. Pressure plate 2. Control valve 3. O-ring seal

the pump cam ring (19, Fig. 84) off the dowels which are located in the pump body. Remove the hub (1, Fig. 88) with the vanes (3) from the pump shaft. Remove and discard the O-ring seal (2) from the groove in the pump body. Using snap ring pliers or a small screw driver, remove the drive shaft bearing retainer snap ring. Then slip the drive shaft and bearing assembly (3, Fig. 84) out of the pump body. It may be necessary to tap the inner end of the shaft lightly to slip the bearing out of the pump body.

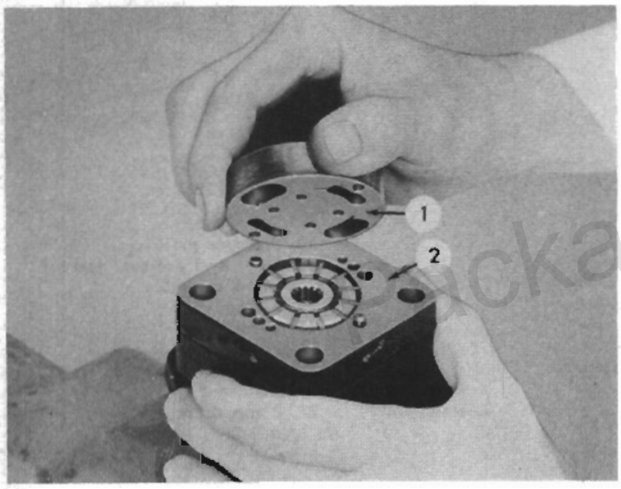

FIG. 87

1. Pressure plate 2. Cam ring

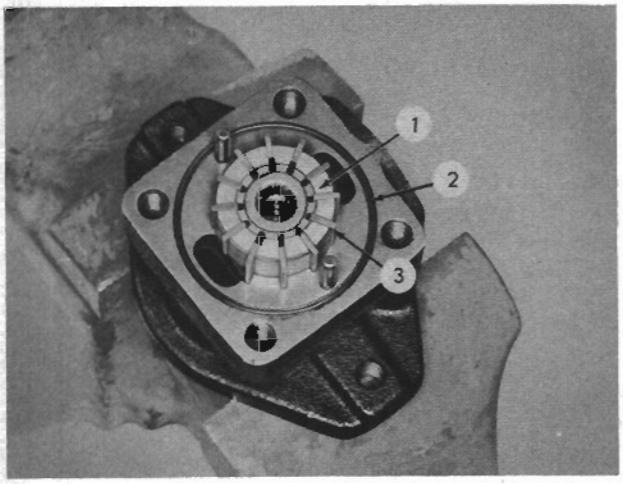

FIG. 88

1. Hub 2. O-ring seal 3. Vane

Inspection

Wash all parts except the sealed bearing in cleaning solvent and wipe dry with a lint-free rag.

Inspect the drive shaft for wear and check the bearings for roughness or noisy operation. If necessary to replace either part, remove the Woodruff key and press the bearing off the shaft over the threaded end of the shaft. To install the bearing, press the shaft into the bearing. The stamped face of the bearing should be toward the threaded end of the shaft.

Check the fit of the vanes in the slot in the hub. The vanes must slide freely but snugly in the slots. Replace the hub if excessive looseness exists between the hub and the vanes. Replace the vanes if scored or worn.

Inspect all ground surfaces of the cam ring for roughness or irregular wear. Slight irregularities may be removed with a hard Arkansas stone. The cam ring must be replaced if the inside cam surface is scored or worn.

Inspect the flat faces of the pressure plate and the body for wear or scoring. These faces may be repaired by lapping until smooth and flat, after which all lapping compound must be thoroughly washed away.

Inspect the cylindrical surface of the control valve and check the fit of the control valve in the pump cover.

Inspect the inner bearing (1, Fig. 89) and seal (2) in the pump body. If necessary to replace the seal or inner bearing, use a punch to drive the seal and bearing out of the pump body. The seal must be removed before the bearing can be removed. Be careful when removing the seal or bearing not to damage the face of the body which mates with the cam ring when the pump is assembled. To install the inner bear-

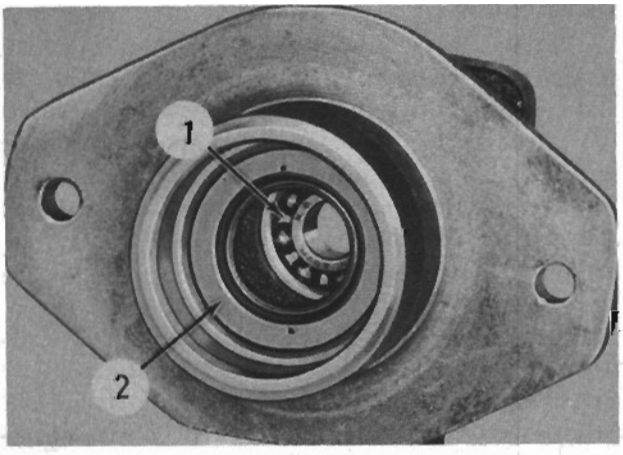

FIG. 89

1. Inner bearing 2. Oil seal

ing, place it in position in the body with the stamped face down. Then tap it lightly into position until it is fully seated. To install the seal, place the seal on the body with the two small oil holes up. Then use a tube or socket of 1⅝" (41,275 mm.) outside diameter and press the seal into the body.

Reassembly

Make sure all parts are clean, then lubricate the parts with engine oil before assembly. Install the shaft and bearing assembly in the body. Install the retaining snap ring. Install the hub with vanes on the pump body over the splined end of the drive shaft. The curved edges of the vanes must be toward the outside of the hub. Install the cam ring over the dowels and hub vanes, being sure that the arrows on the outside of the ring point in the direction of pump rotation. Install the pressure plate over the dowels which extend through the cam ring.

Place a new pump cover O-ring seal in the cover. Install the flow control valve spring in the cover, install the flow control valve, and place the pump cover assembly over the pressure plate and against the cam ring. Install and tighten the four cover-to-body bolts.

When the pump assembly is completed, rotate the pump shaft to make sure of free movement. Then install caps on the fittings to pervent dirt from entering the pump.

Install new cork gaskets and spacers on the pump body and the pump cover reservoir mounting flanges. Install the reservoir on the pump assembly. On the 56J model, after placing the reservoir on the pump, position the pump manifold in the reservoir and install the retaining screws. Slip the spring and spring retainer on the tube and install the strainer. Be careful to properly seat the strainer within the manifold to prevent damage to the strainer. Install the reservoir cover with new gasket. Install the bolt, gasket, guide, spacer, and lock washer.

ADJUSTMENTS

The power steering unit requires three adjustments: the high spot adjustment, power rack adjustment, and the worm shaft thrust bearing adjustment. The high spot adjustment eliminates lash between the sector teeth and the ball nut. The power rack adjustment provides proper preload of the rack on the sector teeth. The thrust bearing adjustment provides proper preload on the worm shaft thrust bearings.

The thrust bearing adjustment is made during reassembly of the unit. The high spot and power rack adjustments should be made while the unit is out of the car, although minor changes in the high spot adjustment may be made with the unit installed.

HIGH SPOT ADJUSTMENT

Loosen the power rack cover and guide assembly screws. Install the Steering Gear Adjusting Tool J-5563 (2, Fig. 90) on the dowels of the coupling. Turn the steering gear slowly through the full range to check for free action, then turn the gear back to the midway position to center the ball nut on the high spot of the sector gear teeth. Turn the pitman shaft adjusting screw clockwise to take out all lash in the gear teeth. Tighten the lock nut. Turn the gear off the high spot. Then, using a spring scale at the end of the adjusting tool, check the highest reading as the gear is turned through the high spot. This should be between ½ and 1 pound (0,22 and 0,45 kg.). If the reading is not within limits, turn the gear off the high spot and either tighten or loosen the adjusting screw as necessary. Then recheck the adjustment by again pulling the gear through the high spot. The final adjustment should be between ½ and 1 pound (0,22 and 0,45 kg.).

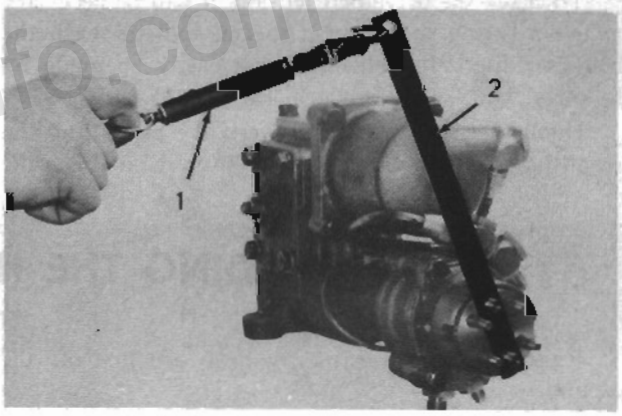

FIG. 90

1. Spring scale 2. Steering gear adjusting tool J-5563

POWER RACK ADJUSTMENT

Tighten the power rack guide cover screws evenly. Place the gear adjusting tool on the coupling. Using a spring scale, check the highest reading as the gear is turned through the center position. If the amount of pull over the high spot remains the same as the final reading in the high spot adjustment, one .003" shim should be removed. The guide cover should be again installed and the pull checked again. If necessary, continue to remove .003" shims, one at a time or a combination that will equal .003" until the pull required increases over the final reading in the high spot adjustment. At the time of increase, if the pull increases more than ⅛ pound, add one .003" shim.

If, when the power rack cover is first tightened down, the pull through the high spot increases over the final reading of the high spot adjustment, then shims of .003" thickness should be added one at a time until the pull required is decreased to within ⅛ pound of the final reading of the high spot adjustment. The pull over the high spot after all adjustments are made must not exceed 1¼ pounds. Guide rack cover shims are available in thicknesses of .003", .005", and .010" (0,076 mm,, 0,127 mm., and 0,254 mm.).

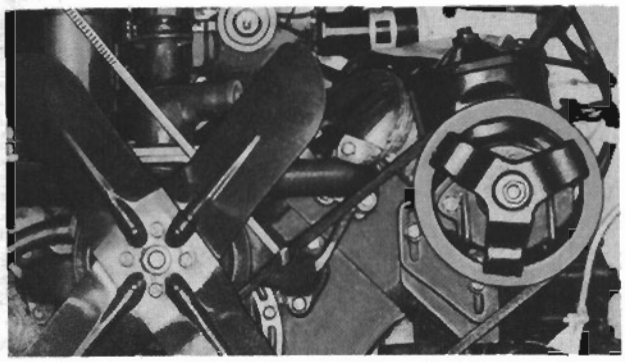

FIG. 91

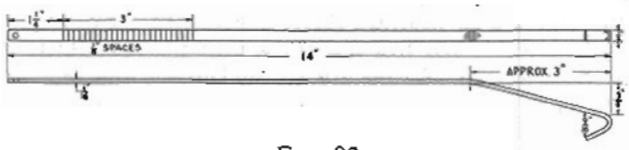

FIG. 92

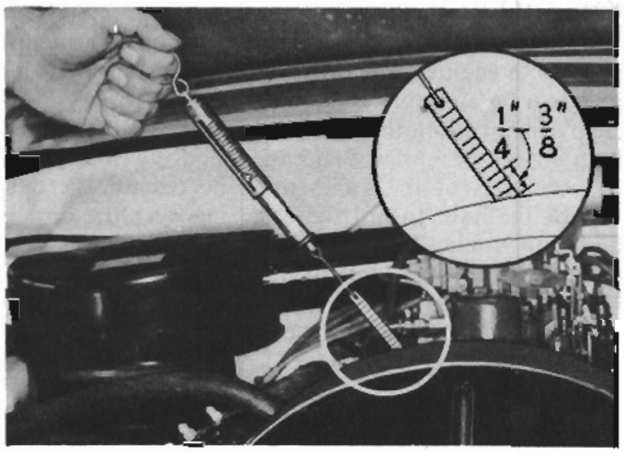

FIG. 93

PUMP DRIVE BELT ADJUSTMENT

To check the drive belt tension, it will be necessary to use a spring scale and a special tool to reach the belt (see Fig. 91). This tool can easily be made by following the sketch shown in Fig. 92.

Hook the belt midway between the pump and the crankshaft pulleys. Then check the pull on the scale. On the C and K models, check by the graduations on the tool the distance the tool is moved in relation to the edge of the fan shroud (see Fig. 93). The scale and tool must be kept at right angles to the belt. The movement (belt deflection) should be ¼" to ⅜" (6,350 mm. to 9,525 mm.) with a four-pound pull. Slots are provided at the mounting screws in the bracket to permit shifting the pump body to secure the proper belt tension.

BLEEDING THE HYDRAULIC SYSTEM

Raise the car so that the wheels are just off the ground.

Remove the cover from the reservoir and check the fluid level. If the level is below the level mark, add fluid. If the pump has been removed and the reservoir is dry, fill the reservoir and wait for a few minutes to allow oil to drain into the hoses and gear. Crank the engine with the ignition off and turn the steering wheel through the entire range several times to expel all air from the power cylinder. Add oil as necessary to maintain the proper level.

Start the engine and run it at idle for two minutes. Recheck the fluid level. Check hose connections for leaks. Increase the speed to 1500 rpm and continue to run at this speed while keeping the fluid level at the mark until the air bubbles no longer appear in the reservoir. Turn the steering wheel again through the entire range to make sure all air is removed.

Lower the car. Turn wheels several times on the ground. Then recheck for leaks. Check the fluid level and add fluid if necessary. Install the reservoir cover.

LUBRICATION

The recommended oil for use in the hydraulic system of the power steering unit is Type A (AQ-ATF) Automatic Transmission Fluid (AC-2261).

Check the fluid level at 5000 mile intervals. Maintain the fluid level at the mark indicated on the side of the reservoir.

Use S.A.E. No. 90 multipurpose gear lubricant in the gear housing. Remove the gear housing filler plug with vent and check lubricant level. The level should be up to the filler opening. Check level every 5000 miles.

Do not use a pressure gun to fill the housing because lubricant may be forced through the seals into the hydraulic system.

DIAGNOSIS

Power Steering

Hydraulic power steering diagnosis conditions and causes are listed below. For diagnosis of such abnormal steering conditions as Shimmy or Front Wheel Wobble, Low Speed Shimmy, High Speed Shimmy or Wheel Tramp, Steering Wander or Road Weave, and Steering Kickback, refer to the Steering System Diagnosis section.

CAR STEERS HARD

CAUSES

1. Tires underinflated or unequally inflated.
2. Tires oversize or abnormally worn.
3. Abnormal friction in steering tie rod or reach rod joints due to:
   a) Lack of lubrication or improper type of lubricant.
   b) Dirt accumulation.
   c) Ball seat or ball scored, rough, or galled.
   d) Ball worn out of round (tight on turns).
4. Abnormal friction in steering assembly because of misalignment caused by improper mounting at chassis frame and instrument board bracket.
5. Excessive friction of steering knuckles resulting from:
   a) Lack of lubrication of steering knuckles and knuckle thrust bearings.
   b) Galled, rough, or scored knuckle pins.
   c) Insufficient clearance between steering knuckle roller bearings and knuckle pins.
   d) Insufficient clearance between steering knuckle roller bearings and knuckle pins.
   e) Insufficient end play of steering knuckle.
   f) Thrust bearing races galled, rough, scored, or full of dirt.
6. Steering pitman shaft adjustment too tight.
7. Power rack adjustment too tight.
8. Air in hydraulic system.
9. No oil pressure. See "No Oil Pressure" for causes.
10. Tight steering tube upper bushing.
11. Lack of lubricant in gear housing.
12. Damaged worm shaft upper or lower bearings.
13. Damaged ball nut or worm.
14. Power piston sticking.
15. Unusual causes:
    a) Insufficient knuckle pin inclination (bent part).
    b) Improper front wheel camber (reverse or excessive).
    c) Incorrect front wheel toe-in.

ABNORMAL LOST MOTION IN STEERING SYSTEM

CAUSES

1. Loose or worn steering tie rod and reach rod ends.
2. Loose front wheel bearings.
3. Loose or worn steering knuckle, bearings, bushings, and pins.
4. Steering knuckle arms loose at steering knuckle.
5. Loose steering bell crank.
6. Pitman shaft adjustment too loose.
7. Power rack adjustment too loose.
8. Excessive clearance in pitman shaft bushings.
9. Excessive clearance between worm and ball nut.
10. Worm shaft thrust bearing adjustment too loose.
11. Steering shaft lower flange loose on coupling dowels or worm coupling insulators.
12. Inoperative valve plungers and springs. (All plungers at one or both ends stuck in the IN position or all the centering springs broken or missing.)
13. Unusual causes:
    a) Steering gear housing loose on chassis frame.
    b) Excessive clearance at steering post upper bushing.

STEERING GEAR RATTLES

A slight rattle occurring on turns is normal due to the increase in lash when the steering is turned away from the "high spot" position. The pitman shaft should never be tightened beyond specifications in an effort to eliminate this slight rattle.

CAUSES

1. Insufficient lubricant in steering gear assembly.
2. Incorrect grade of lubricant used in steering gear assembly.
3. Abnormal clearance at steering connections.
4. Steering post jacket clamp loose on jacket or instrument panel.
5. Steering post jacket loose at lower end.
6. Steering gear loose on chassis frame.
7. Excessive looseness in steering linkage.
8. Loose pitman shaft adjustment.
9. Loose power rack adjustment.
10. Pitman shaft loose in bushings.
11. Ball nut loose on worm shaft.
12. Worm shaft thrust bearing adjustment too loose.
13. Steering shaft coupling flange loose or worn.
14. Steering shaft loose in upper bushing.
15. Loose power rack to piston rod pin.
16. Power piston loose on piston rod.
17. Inoperative valve plungers and springs. (ALL

plungers at one or both ends stuck in the IN position or all the centering springs broken or missing.)

POOR RECOVERY ON TURNS

CAUSES

1. Pitman shaft adjusted too tight.
2. Power rack adjusted too tight.
3. Power piston sticking.
4. Valve spool sticking.
5. Tight upper steering post bushing.
6. Lack of or incorrect type of lubricant.
7. Scored or galled worm shaft or ball nut.
8. Bent or damaged ball guides in the ball nut.
9. Scored or galled worm shaft upper or lower bearings.
10. Excessive loose thrust bearings.

NO OIL PRESSURE

CAUSES

1. Loose pump drive belt.
2. Obstructed intake oil lines or passages.
3. Valve spool stuck in neutral position.
4. Excessive internal or external oil leaks.
5. Pump inoperative due to worn, sticking, or scored parts.
6. Volume control valve stuck open.
7. Pressure relief valve stuck open.
8. Weak pressure relief valve spring.
9. By-pass valve stuck open or missing.
10. Low oil level in reservoir.
11. Oil too light.

EXTERNAL OIL LEAKS

CAUSES

1. Pump drive shaft oil seal.
2. Pump body due to loose cap screws or bad O-ring seals.
3. Hose loose at connections.
4. Damaged hose.
5. Damaged O-rings at unions or elbows.
6. Power cylinder gasket.
7. Valve body-to-housing O-ring seals.
8. Valve body-to-cover O-ring seals.
9. Upper worm shaft oil seal (in valve body cover).

INTERNAL OIL LEAKS

CAUSES

1. Lower worm shaft oil seal (evidenced by hydraulic oil in the gear case).
2. Power piston rod seal (hydraulic oil in gear case).
3. Excessive leakage around the power piston.
4. Excessive leakage around valve spool.

CAR PULLS TO ONE SIDE

CAUSES

1. Excessive variation in camber (right to left side).
2. Excessive variation in caster (right to left side).
3. Excessive variation in king pin inclination (right to left side).
4. Weak or broken spring on one side.
5. Uneven tire pressure, size and wear (right to left).
6. Bent frame.
7. Rear wheels not parallel with frame.
8. Brake drag on one side.
9. Valve spool stuck in either the upper or lower position.
10. Worm shaft thrust bearing adjustment excessively loose.
11. Valve plungers stuck in the valve body.
12. Pitman shaft operating off the high spot. (Car steering very free in one direction and very hard in the opposite direction.)

ERRATIC APPLICATION OF POWER ASSISTANCE

CAUSES

1. Valve spool sticking intermittently.
2. Valve plungers sticking intermittently.
3. Pressure relief valve sticking open intermittently.
4. Volume control valve sticking open intermittently.
5. By-pass valve sticking open intermittently.
6. Loose worm shaft thrust bearing adjustment.
7. Intermittent obstruction, to free movement of the ball nut worm shaft, by foreign material in the gear case.
8. Air in hydraulic system (more noticeable on turns).

NOISY OIL PUMP

CAUSES

1. Air in hydraulic system.
2. Relief valve chatter.
3. Low oil level in reservoir.
4. Obstructed intake oil line or passage.
5. Obstructed reservoir vent.
6. Wrong type of fluid.
7. Pump bearings rough.
8. Sticking pump vanes.
9. Loose pump drive pulley.

Steering System

ABNORMAL LOST MOTION IN STEERING SYSTEM

DESCRIPTION

To provide ease of steering, a small amount of backlash of the steering wheel is necessary and the entire steering system must be adjusted so as to eliminate a binding action in any part.

CAUSES

1. Excessive looseness in steering gear assembly due to:
   a) Improper adjustment.
   b) Cam lever shaft bushings oversize or badly worn.
   c) Cam lever pivot pins worn or chipped.
   d) Steering gear cam worn, chipped, rough, distorted, or adjusted off center.
   e) Steering gear cam bearings worn, broken, or incorrectly adjusted.
   f) Steering wheel loose on post.
2. Loose or worn steering tie rod and reach rod ends.
3. Loose front wheel bearings.
4. Loose or worn steering knuckle, bearings, bushings, and pins.
5. Steering knuckle arms loose at steering knuckle.
6. Cam lever shaft end play.
7. Loose auxiliary steering arm.
8. Loose steering bell crank.
9. Unusual causes:
   a) Steering gear housing loose on chassis frame.
   b) Excessive clearance of steering post in upper jacket bushing.

CAR STEERS HARD

CAUSES

1. Tires underinflated or unequally inflated.
2. Tires oversize or abnormally worn.
3. Abnormal friction in steering tie rod or reach rod joints due to:
   a) Lack of lubrication or improper type of lubricant.
   b) Dirt accumulation.
   c) Ball seat or ball scored, rough, or galled.
   d) Ball worn out of round (tight on turns).
4. Abnormal friction in steering gear due to:
   a) Lack of lubrication or improper type of lubricant.
   b) Steering camshaft pivot pins meshed too deeply with steering gear cam (not sufficient end play of cam lever shaft).
   c) Steering gear cam bearings adjusted too tightly.
   d) Steering gear cam lever shaft bearings rough, scored, or otherwise damaged.
   e) Insufficient clearance of cam lever shaft in bushings.
   f) Cam lever shaft bushings not in proper alignment.
   g) Steering gear cam thrust bearings broken, galled, rough, or chipped.
   h) Insufficient clearance of steering post upper bushing on post.
   i) Steering gear cam or tube sprung or distorted.
   j) Misalignment of steering gear assembly due to method of mounting at chassis frame and instrument board bracket.
5. Excessive friction of steering knuckles resulting from:
   a) Lack of lubrication of steering knuckles and knuckle thrust bearings.
   b) Galled, rough, or scored knuckle pins.
   c) Insufficient clearance between steering knuckle bushings and knuckle pins.
   d) Insufficient clearance between steering knuckle roller bearings and knuckle pins.
   e) Insufficient end play of steering knuckle.
   f) Thrust bearing races galled, rough, scored, or full of dirt.
6. Unusual causes:
   a) Insufficient knuckle pin inclination (bent part).
   b) Improper front wheel camber (reverse or excessive).
   c) Incorrect front wheel toe-in.

SHIMMY OR FRONT WHEEL WOBBLE

DESCRIPTION

High and low speed shimmy are often confused by the serviceman. Although many of the causes are identical, the two conditions have absolutely different characteristics.

Many times a vibration or movement in the steering wheel only is termed shimmy; this is, however, an incorrect term and should be avoided. Front wheel shimmy often causes steering movement, but this movement is originated at the front wheels and is transferred to the steering wheel.

Low speed shimmy, or front wheel wobble as the name implies, can be simply described as a rapid series of oscillations of the wheel and tire assembly on the knuckle pin. In other words, the front wheels attempt to point alternately to the right and left.

High speed shimmy, or front wheel tramp, can be described as a gallop. In other words, the condition encountered is very similar to a condition which would be evident if the front wheels were decidedly "egg-shaped." In cases of severe high speed shimmy, the front tires actually leave the pavement; while in mild cases, one front wheel appears deflated and the other appears inflated. This condition alternates rapidly between the front wheels.

LOW SPEED SHIMMY

CAUSES

1. Tires underinflated or unequally inflated.

2. Excessive freedom or looseness of steering knuckle thrust bearings.
3. Worn or loose steering gear parts.
4. Worn or loose steering linkage parts.
5. Front springs too flexible because of:
   a) Weak springs.
   b) Inadequate shock absorber control due to:
      (1) Insufficient or incorrect type of fluid in instrument.
      (2) Abnormal internal clearance.
6. Incorrect front wheel camber resulting from:
   a) Front wheel bearings adjusted too loosely.
   b) Steering knuckle spindle worn by rotation of outer bearing cone.
   c) Steering knuckle bushings or pins worn or loose.
   d) Bent steering knuckle yoke or spindle.
   e) Improper adjustment.
7. Unequal front wheel camber (variation of more than ½°).
8. Irregularities in front wheel tire tread.

HIGH SPEED SHIMMY OR WHEEL TRAMP

CAUSES

1. Items affecting low speed shimmy or wheel wobble.
2. Front wheel, hub, brake drum, and tire assembly out of balance.
3. Excessive lateral runout front tires and wheels (wobble).
4. Excessive radial runout front tires (eccentricity).
5. Rear wheel and tire assemblies out of balance.
6. Rear wheel wobble or eccentricity.
7. Unusual cause:
   a) Dragging front wheel brakes.

STEERING WANDER OR ROAD WEAVE

CAUSES

1. Tires underinflated or unequally inflated (front and rear).
2. Incorrect or unequal front wheel camber.
3. Worn or loose king pins and bushings.
4. Excessively tight king pins and bushings.
5. Improperly adjusted steering gear or linkage.
6. Excessive front wheel toe-in.
7. Rear axle shifted on rear springs.
8. Cross wind.
9. Type of road surface.
10. Tight tie rod ends.
11. Loose rear spring U bolts.
12. Unequal load in car.

STEERING KICKBACK

DESCRIPTION

Steering kickback is registered on the steering wheel as a very rapid movement of the steering wheel and is the result of one front wheel having encountered a bump or obstruction in the road surface. A small amount of steering wheel movement must be expected and is normal when the car is driven over an excessively rough road or when the front wheels strike an unusual obstruction.

CAUSES

1. Tires improperly inflated.
2. Chassis springs sagged.
3. Insufficient shock absorber control.
4. Worn, loose, or improperly adjusted steering gear parts.
5. Worn, loose, or improperly adjusted steering linkage parts.

STEERING GEAR RATTLES

CAUSES

1. Insufficient lubricant in steering gear assembly.
2. Incorrect grade of lubricant used in steering gear assembly.
3. Excessive lash between cam lever pivot pins and cam.
4. Steering gear cam bearings broken, damaged, or incorrectly adjusted.
5. Excessive radial clearance of cam lever shaft in case bushings.
6. Abnormal clearance at steering connections.
7. Steering post jacket clamp loose on jacket or instrument panel.
8. Steering post jacket loose at lower end.
9. Steering gear loose on chassis frame.
10. Steering gear arm loose on cam lever shaft.
11. Excessive looseness in steering linkage.

SERVICE BULLETIN REFERENCE

NUMBER	PAGE	SUBJECT

ADDITIONAL NOTES