Section F

FRONT AXLE

(C-8-A, C-15A, C-30, C-60S, C-60L, C-GT)

The front axle assembly is a front wheel driving unit, consisting of a banjo type housing, which makes provision for mounting specially designed steering knuckles and a conventional type differential.

Both front and rear axles are equipped with a differential to provide for the differences in rolling radii between either the two front or the two rear wheels. There is no differential between the front and the rear axles, since, if the vehicle became bogged or grounded, the loss of traction on one wheel would prevent the other three wheels from having any driving power.

The front wheels are driven by axle shafts equipped with constant velocity type universal joints which are enclosed in steering knuckle support housings.

With this design axle shaft, the power can be equally distributed from the engine to all four wheels, regardless of the angle at which the front wheels may be turned.

See Figs. 1 and 2 for an exploded view of the Front Axles and parts identification for 5″ and 6″ joints.

Differential Carrier

The differential carrier assembly is mounted to the banjo housing in the same manner as in the rear axle, except that the pinion shaft points toward the rear instead of the front. The differential third member assembly in the front axle, is identical and interchangeable with the one on the rear axle. Therefore, the instructions given for the repair of the rear axle, with the exception of where right and left are referred to in connection with ring gear and pinion adjustment, will also apply to the front axle. This being the case, all reference to right and left should be reversed when adjusting the ring gear and pinion on the front axle.

To replace the third member assembly on front axles it will be necessary to remove the axle shafts by disconnecting the steering ends according to the instructions given under the heading "Steering Ends—Removal". The differential assembly may then be removed in the usual manner. (See section "H".

Axle Housing Cover

The axle housings of these vehicles have removable covers with the exception of the C-8A. They can only be installed in one position, that is with the oil filler hole below the centre line of the axle housing.

NOTE:—The rear cover, or the housing on C-8A is painted white to act as a screen for the axle lamp.

Front Axle Identification

There have been a number of different designs used on front axles of army vehicles previously built. It is therefore important that when mechanical work is being done to the front axles of these vehicles, only service information applying to this particular design of axle be used.

The front axle steering ends, (front axle universal joints), are 5″ and 6″ constant velocity, Bendix universal joint drive type. Refer to Fig. 1 for general layout of the 5″ type and to Fig. 2 for the 6″ type.

The 5″ joint is used on C-8A, C-15A, C-30, and on some special equipped C-60L vehicles. The 6″ joint is used on C-60S, C-60L and C-GT vehicles.

The two steering ends are similar but can be distinguished by design and method of attaching steering arms. On the 5″ joint the steering arm is part of the steering knuckle retainer flange. See (19) Fig. 1.

On the 6″ joint the steering arm is a separate part and attached to the lower part of the knuckle by six cap screws. See (38) Fig. 2.

Axle Removal

Should it become necessary to remove the front axle for repair or replacement, the following is the recommended procedure.

1. Using a chain hoist, lift the front end of the vehicle until the springs extend to their normal position.
2. Unfasten the brake line hose at both brake backing plates and place the hose out of the way.
3. Disconnect the front universal joint and allow the drive shaft to drop free of the axle.
4. Remove the four "U" bolts attaching the front springs to the axle and disconnect the shock absorber links at the axle end.
5. Disconnect the steering drag link from the axle, then roll the front axle assembly from under the chassis.
6. Place the axle in a holding fixture for overhaul.

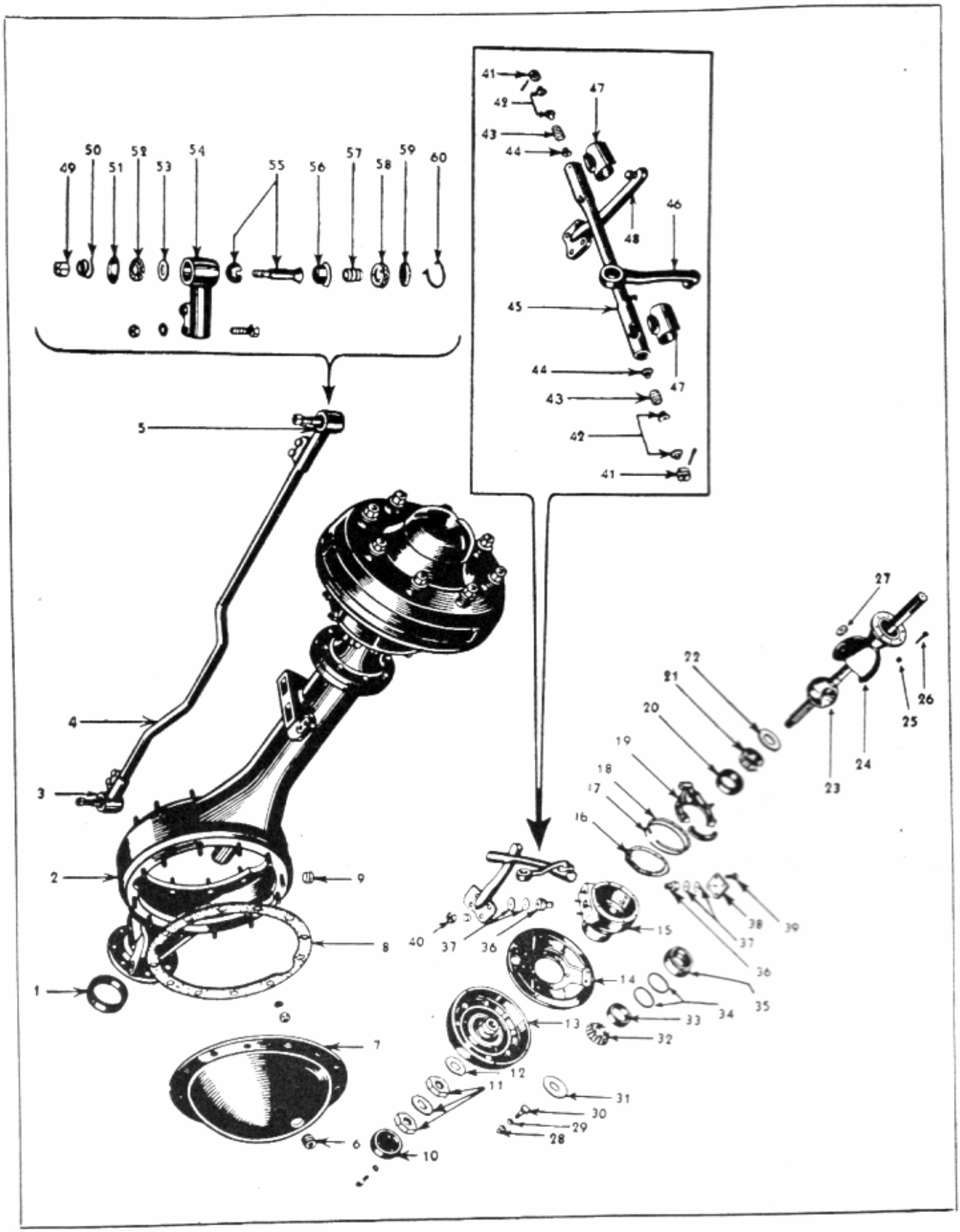

Fig. 1—Exploded View of the Front Axle Assembly, 5" Joint.

CAPTIONS FOR FIGURE 1

1. Axle shaft Inner Oil Seal.
2. Front Axle Housing.
3. Front Axle Tie Rod End Assy.—Right.
4. Front Axle Tie Rod.
5. Front Axle Tie Rod End Assy.—Left.
6. Filler Plug.
7. Front Axle Housing Cover.
8. Axle Housing Cover Gasket.
9. Drain Plug.
10. Front Hub Cap.
11. Front Hub Adjusting Nut, Lock Nut and Washer.
12. Front Hub Adjusting Nut Washer.
13. Front Hub and Drum Assembly.
14. Front Brake Support Plate.
15. Steering Knuckle.
16. Steering Knuckle Gasket.
17. Steering Knuckle Felt Spring.
18. Steering Knuckle Felt.
19. Steering Knuckle Retainer Flange.
20. Front Wheel Inner Bearing Cup.
21. Front Wheel Inner Bearing Cone & Roller.
22. Front Hub Inner Grease Retainer.
23. Front Axle Joint & Drive Shaft.
24. Steering End Ball Socket.
25. Socket to Front Axle Housing Nut.
26. Socket to Front Axle Housing Bolt.
27. Front Wheel Pivot Pin Bearing.
28. Wheel Locking Nut.
29. Front Wheel to Hub Locating Cone.
30. Front Wheel Hub Bolt.
31. Front Hub Outer Bearing Spacer.
32. Front Wheel Outer Bearing Cone & Roller.
33. Front Wheel Outer Bearing Cup.
34. Front Axle Bearing Spacer Shims.
35. Front Axle Bearing Spacer.
36. Steering Knuckle Pivot Pin.
37. Steering Knuckle Pivot Pin Shims.
38. Steering Knuckle Pivot Pin Retaining Plate.
39. Steering Knuckle Pivot Pin Retaining Plate Capscrew.
40. Steering Arm Nut.
41. Steering Connecting Rod Ball Plug.
42. Steering Connecting Rod Ball Seat.
43. Steering Connecting Rod Spring.
44. Steering Connecting Rod Spring Seat.
45. Steering Connecting Rod Assy.
46. Pitman Arm.
47. Steering Connecting Rod Dust Cover.
48. Steering Arm.
49. Ball Stud Nut.
50. Front Axle Tie Rod Spring.
51. Front Axle Tie Rod Ball Stud Cover—Upper Shield.
52. Front Axle Tie Rod Ball Stud Cover.
53. Front Axle Tie Rod Ball Stud Cover—Lower Shield.
54. Front Axle Tie Rod End.
55. Front Axle Tie Rod End Stud and Bearing.
56. Front Axle Tie Rod Ball Seat.
57. Front Axle Tie Rod End Socket Spring.
58. Front Axle Tie Rod End Grease Retainer.
59. Front Axle Tie Rod End Plug.
60. Front Axle Tie Rod Spring Plug Snap Ring.

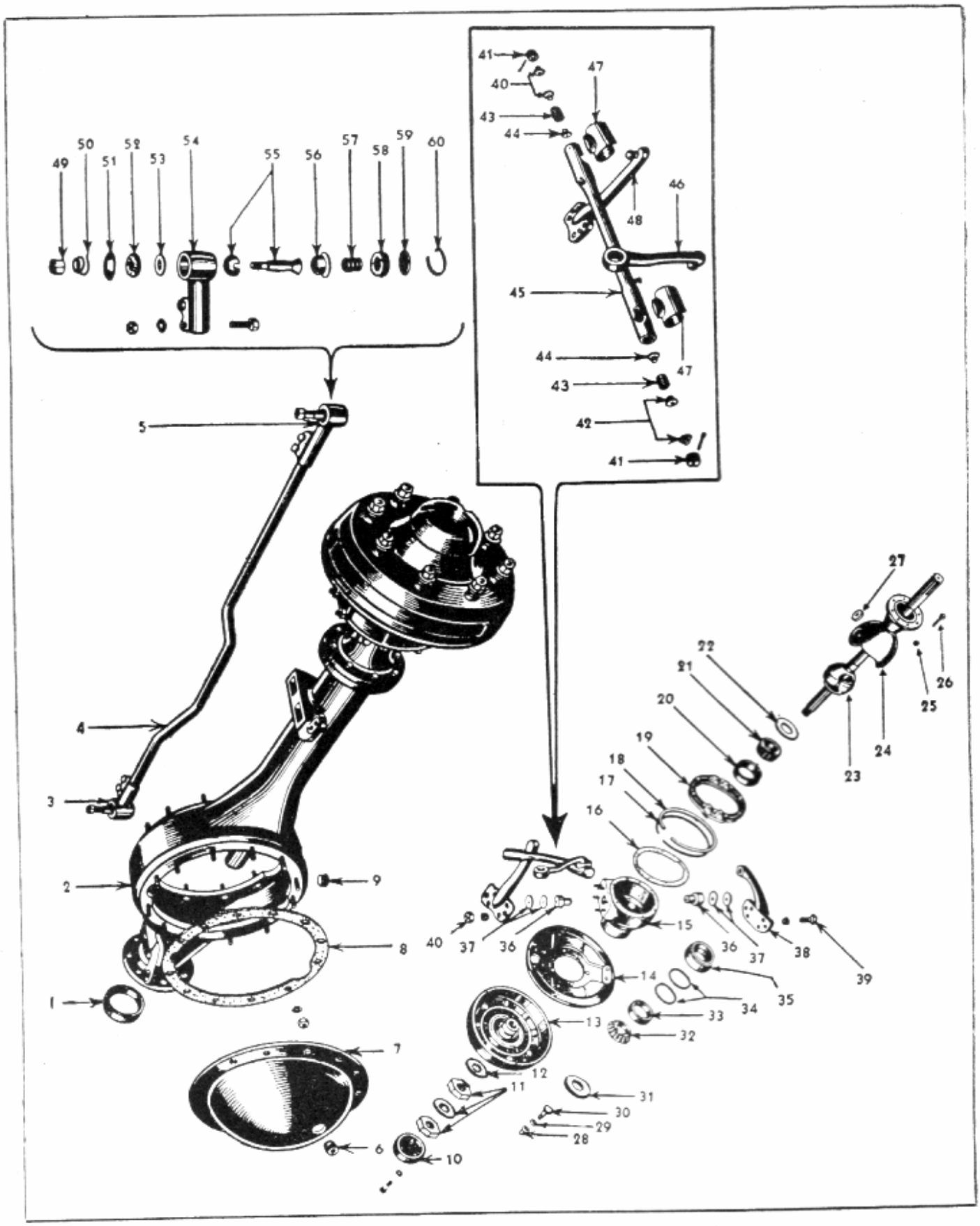

Fig. 2—Exploded View of the Front Axle Assembly, 6" Joint.

CAPTIONS FOR FIGURE 2

1. Axle Shaft Inner Oil Seal.
2. Front Axle Housing.
3. Front Axle Tie Rod End Assy.—Right.
4. Front Axle Tie Rod.
5. Front Axle Tie Rod End Assy.—Left.
6. Filler Plug.
7. Front Axle Housing Cover.
8. Axle Housing Cover Gasket.
9. Drain Plug.
10. Front Hub Cap.
11. Front Hub Adjusting Nut, Lock Nut and Washer.
12. Front Hub Adjusting Nut Washer.
13. Front Hub and Drum Assembly.
14. Front Brake Housing Plate.
15. Steering Knuckle.
16. Steering Knuckle Gasket.
17. Steering Knuckle Felt Spring.
18. Steering Knuckle Felt.
19. Steering Knuckle Retainer Flange.
20. Front Wheel Inner Bearing Cup.
21. Front Wheel Inner Bearing Cone & Roller.
22. Front Hub Inner Grease Retainer.
23. Front Axle Joint & Drive Shaft.
24. Steering End Ball Socket.
25. Socket to Front Axle Housing Nut.
26. Socket to Front Axle Housing Bolt.
27. Front Wheel Pivot Pin Bearing.
28. Wheel Locking Nut.
29. Front Wheel to Hub Locating Cone.
30. Front Wheel Hub Bolt.
31. Front Wheel Outer Bearing Spacer.
32. Front Wheel Outer Bearing Cone & Roller.
33. Front Wheel Outer Bearing Cup.
34. Front Wheel Bearing Spacer Shims.
35. Front Wheel Bearing Spacer.
36. Steering Knuckle Pivot Pin.
37. Steering Knuckle Pivot Pin Shims.
38. Steering Knuckle Pivot Pin Retaining Plate.
39. Steering Knuckle Pivot Pin Retaining Plate Capscrew.
40. Steering Arm Nut.
41. Steering Connecting Rod Ball Plug.
42. Steering Connecting Rod Ball Seat.
43. Steering Connecting Rod Spring.
44. Steering Connecting Rod Spring Seat.
45. Steering Connecting Rod Assy.
46. Pitman Arm.
47. Steering Connecting Rod Dust Cover.
48. Steering Arm.
49. Ball Stud Nut.
50. Front Axle Tie Rod Spring.
51. Front Axle Tie Rod Ball Stud Cover—Upper Shield.
52. Front Axle Tie Rod Ball Stud Cover.
53. Front Axle Tie Rod Ball Stud Cover—Lower Shield.
54. Front Axle Tie Rod End.
55. Front Axle Tie Rod End Stud and Bearing
56. Front Axle Tie Rod Ball Seat.
57. Front Axle Tie Rod End Socket Spring.
58. Front Axle Tie Rod End Grease Retainer.
59. Front Axle Tie Rod End Plug.
60. Front Axle Tie Rod Spring Plug Snap Ring.

SERVICE OPERATIONS

FRONT WHEEL BEARINGS

Adjustment

The front wheel bearings are properly adjusted when the vehicle leaves the Factory and should not require further adjustment unless it becomes necessary to install new parts; such as, hub, steering knuckles or bearings.

When new parts are installed or the bearing adjustment checked, the following procedure is recommended:—

1. Raise the front end of vehicle and place stands under front axle.
2. Remove the front wheels from the hubs.
3. Remove the hub cover, straighten up the tangs on the adjusting nut lock, and remove the lock nut, lock, adjusting nut and washer from the outer shaft.
4. Mark the hub in line with the key way in the shaft, used for the lug type lock washer.

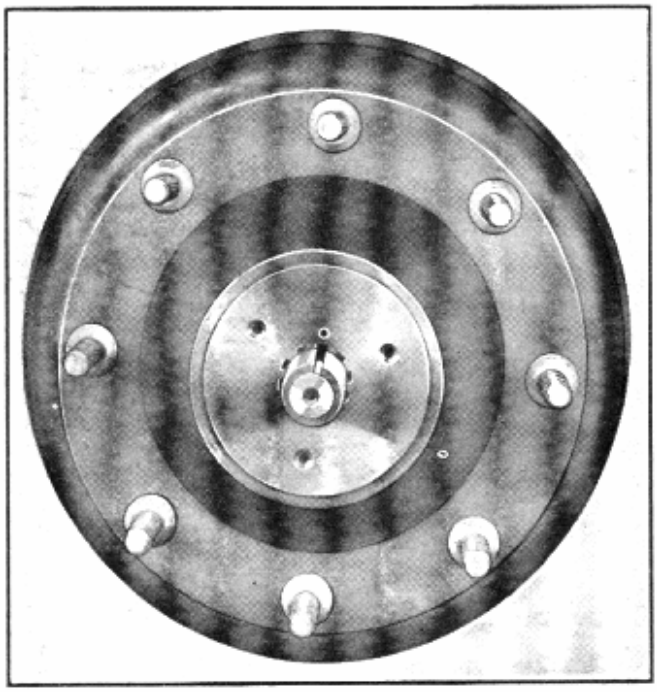

Fig. 3—Markings of Hub for Alignment with Shaft

See Fig. 3. The splines on the shaft may be too hard to mark with a centre punch and the key way will, therefore, serve for this purpose.

5. Remove the hub, spacer and shims.
6. Centre punch mark the inner end of the hub spindle "G", Fig. 4, just above the same spline marked in operation 4. This permits easier indexing of the marked spline on the hub with the identified spline on the shaft, when reassembling.

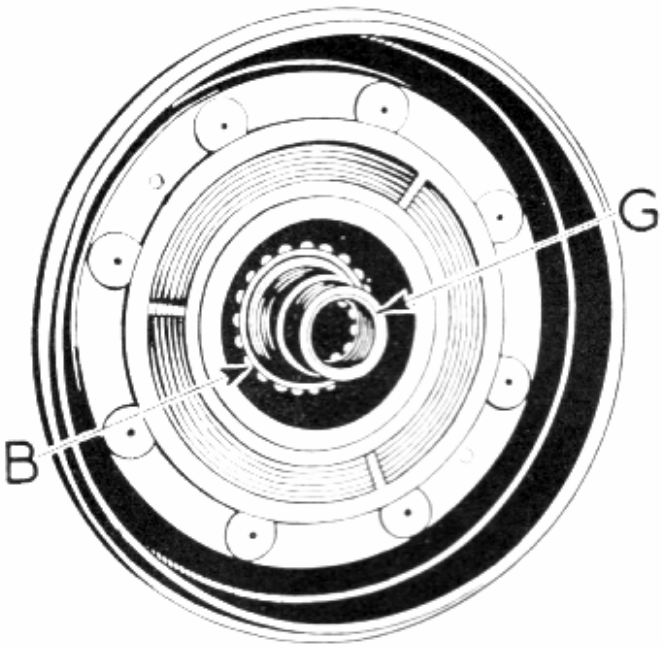

Fig. 4—Inner View of Hub Spindle

Note:—Where it appears necessary, remove, clean and inspect the wheel bearings. If the bearings are badly worn, pitted or damaged, they should be replaced.

7. Re-install the hub on the shaft, making sure that the marks on the hub and shaft are in alignment. Do not install the spacer and shims. Check the fit of the hub on the

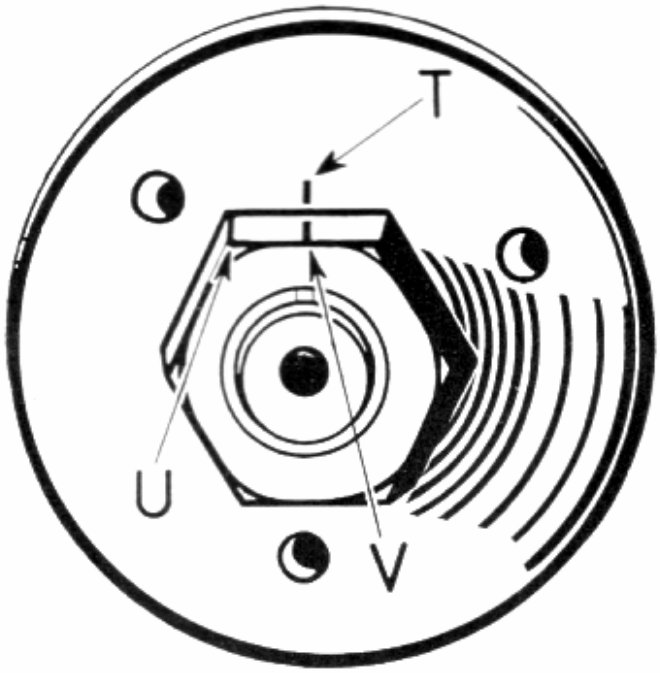

Fig. 5—Markings of Hub and Nut for Bearing Tension

shaft. This should be a hand push fit. Tightness can be caused by tight fitting splines or the inner wheel bearing cone in the steer-

ing end, binding on the end of the hub spindle "G" Fig. 4. Tight splines can be freed up by moving the hub back and forth on the shaft. It may be necessary to use a puller to remove the hub and the adjusting nut to force the hub back on the splines, in order to shear a burr or rough spot. An exceptional rough spot or tight splines may have to be dressed down with a 12" file wrapped in emery cloth.

The inner bearing cone can be freed up on the hub spindle by polishing the spindle with a strip of emery cloth 1½" wide. A rag should be wrapped around the outer wheel bearing "B" Fig. 4, to protect it from emery dust.

8. Install the hub, the washer and the adjusting nut.
9. Tighten the bearing adjusting nut firmly, using a 24" wrench, at the same time turning the hub to seat the bearings.
10. Back off the adjusting nut until it is free, then re-tighten it gradually until the bearings are **just seated.** With a small cold chisel or a piece of chalk, mark the hub as shown at "T" Fig. 5, in line with one corner of the adjusting nut "U" Fig. 5.
11. Make a mark with a chisel in the centre of the flat on the nut as shown at "V" Fig. 5, to the right of the corner "U". When the nut is loosened so that the mark "V" on the nut lines up with the mark "T" on the hub, the bearings will then have approximately .007" end clearance.
12. Remove the adjusting nut, washer and hub.
13. Install .045" thickness of shims, then the spacer, over the hub spindle. The shims and the larger diameter of the spacer should be installed toward hub cap end of the hub.
14. Re-install the hub, making sure that the marked splines are indexed.

NOTE:—It is important that the hub be re-installed on the same spline of the shaft each time it is removed, in order to obtain correct wheel bearing adjustment.

15. Install the washer and the wheel bearing adjusting nut.

NOTE:—Always install the washer next to the hub whenever reassembling the front hub even if only for checking as the marks on the hub and adjusting nut are made with the washer in place and if it is left out an incorrect reading will be obtained.

16. Tighten the adjusting nut securely using a 24" wrench.

If the chisel mark on the nut (see "V" Fig. 5), now comes within ¼ of a flat either way from the chisel or chalk mark "T" on the hub, the bearing end clearance is within specifications (.003"-.010"). If the mark on the adjusting nut is more than ¼ of a flat clockwise of the mark on the hub, more shims should be installed and in cases where the mark on the nut is more than ¼ of a flat counter clockwise of the mark on the hub, it will be necessary to remove shims.

NOTE:—One flat on the adjusting nut is equal to approximately .014". One half flat is equal to .007". One quarter is equal to .0035".

17. Install a new locking washer. Replace the lock nut and tighten securely with a 24" wrench. Bend the edges of the locking washer over both nuts.
18. Install the hub cover and wheel.

STEERING ENDS

Removal

To remove the steering ends sufficiently to withdraw the axle shafts from the differential side gears, in order that the third member assembly may be removed, it is only necessary to remove the bolts "A", Figs. 6 and 7, disconnect the drag link and the tie rod on the right side.

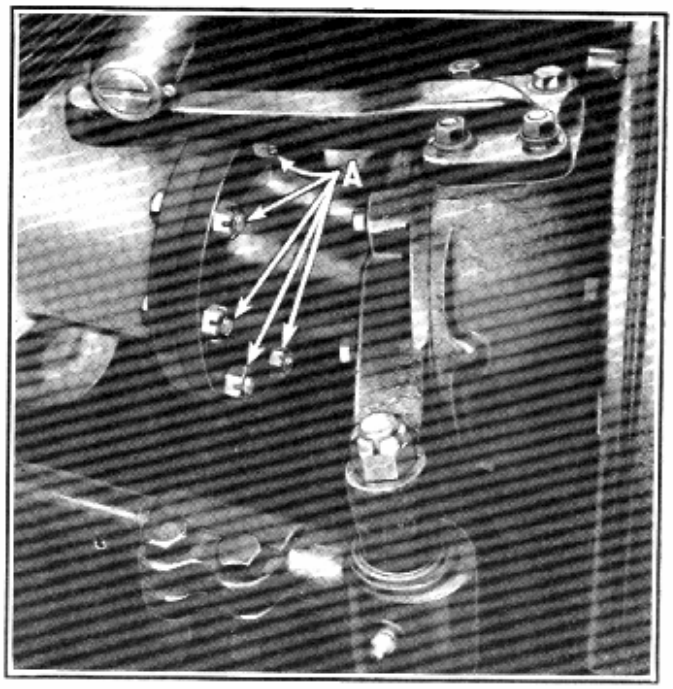

Fig. 6—Steering End Removal, 5" Joint

To remove the steering ends for complete overhaul, proceed as follows:

1. Remove hub cover, straighten up tangs of adjusting nut lock and remove lock nut, lock, adjusting nut, washer and hub.
2. Remove the brake backing plate cap-screws, Fig. 8. The brake backing plate can then be

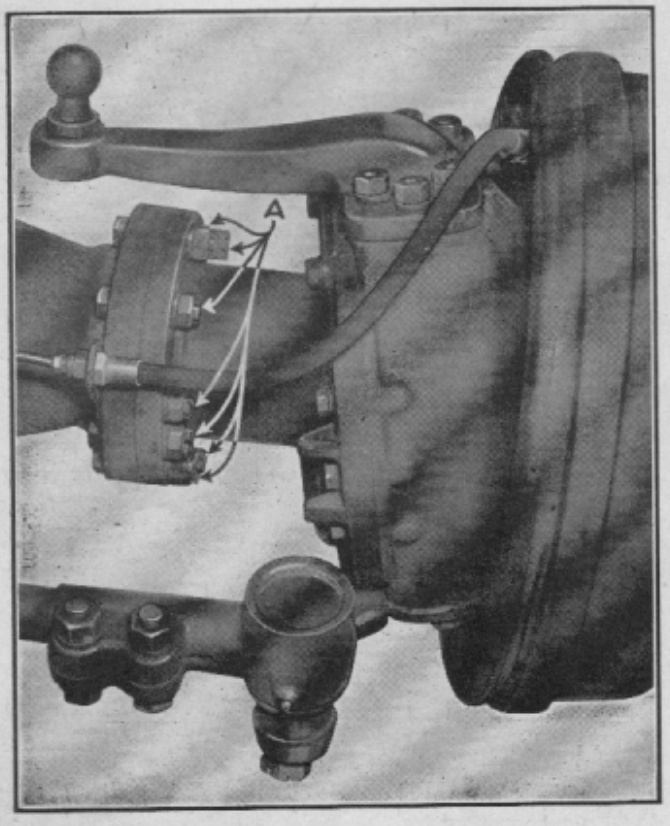

Fig. 7—Steering End Removal, 6" Joint

removed and placed on a box or stand to one side of the axle, eliminating the necessity for disconnecting the brake hose and the consequent necessity of bleeding the brakes.

3. Remove the bolts "A", Figs. 6 and 7. The steering end and axle shaft assembly can then be removed to the bench for further dissassembly.

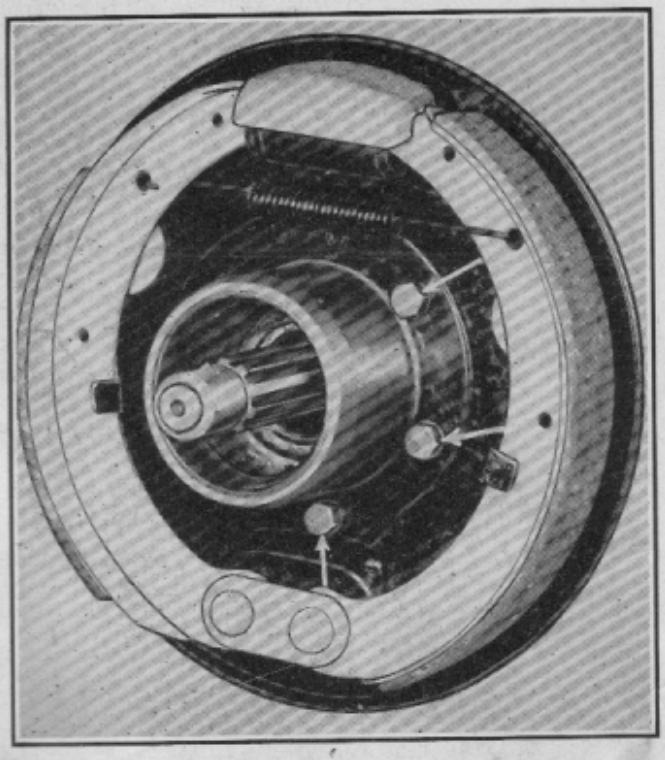

Fig. 8—Brake Backing Plate and Shoe Assembly Removal

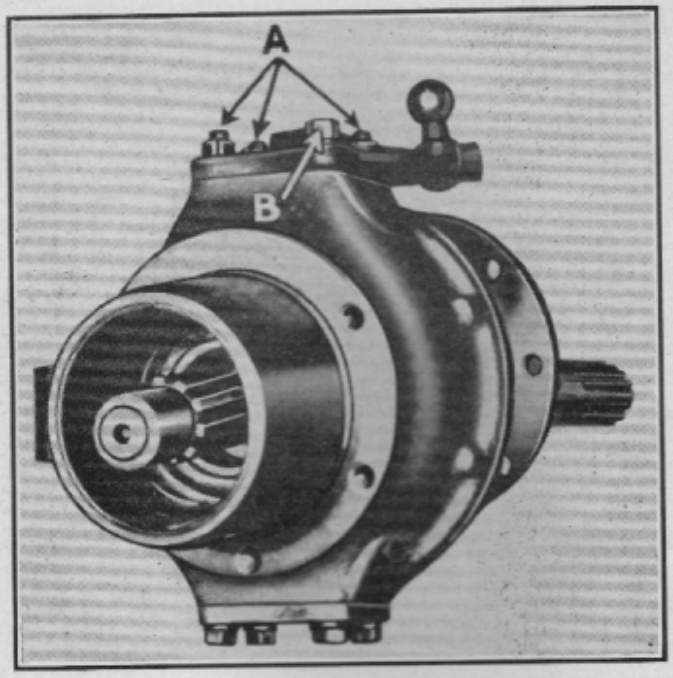

Fig. 9—Pivot Pin Cap Removal 5" Joint

DISASSEMBLY

1. Place the assembly in a vise equipped with brass or copper jaws.
2. Remove the pivot pin caps. Note that on the right side, the steering arm takes the place of the upper pivot pin cap and that three studs with tapered dowels "A" and one cap-

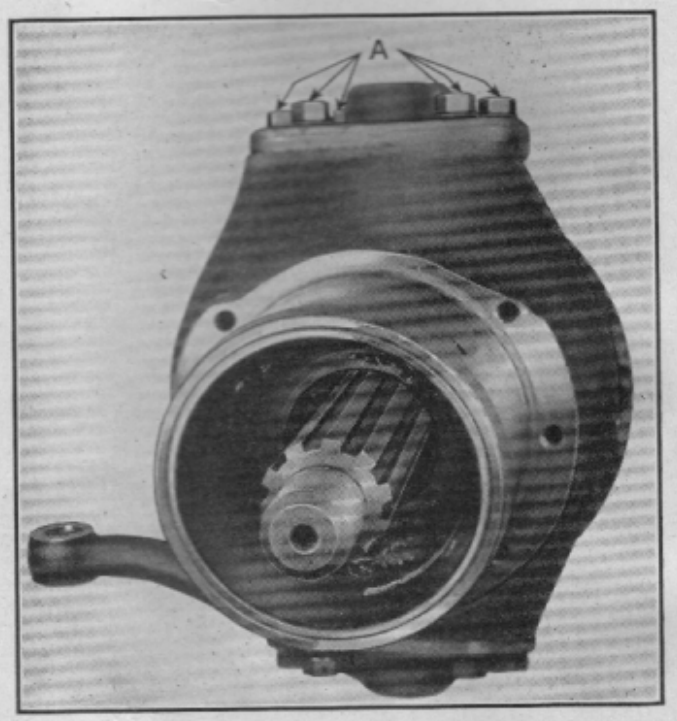

Fig. 10—Pivot Pin Cap Removal 6" Joint

screw "B" with a tapered dowel are used at this point on the 5" joint, (Fig. 9). The 6" joint has six studs with tapered dowels and nuts "A" (Fig. 10)

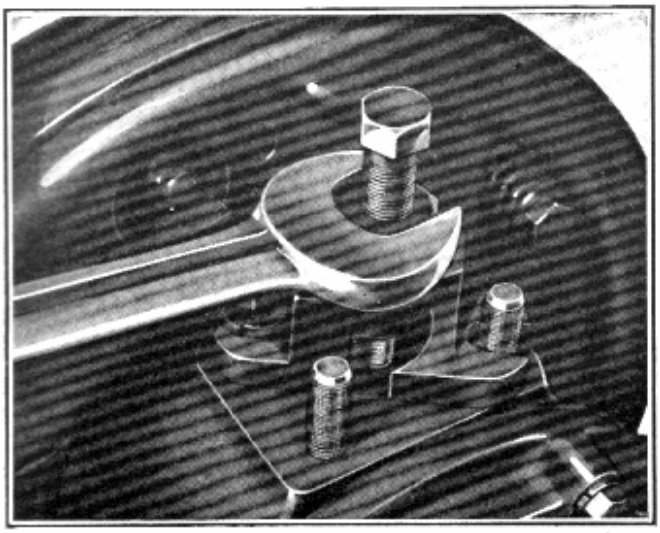

Fig. 11—Pivot Pin Removal Tool No. XA-3363-A

NOTE:—Normally the shim retaining pin in the pivot pin cap is peened over to hold the shims in position. However, where the pin is not peened over, care should be exercised to keep the shims with the caps with which they were used.

3. Remove the pivot pins, using tool No. XA-3363-A as shown in Fig. 11.

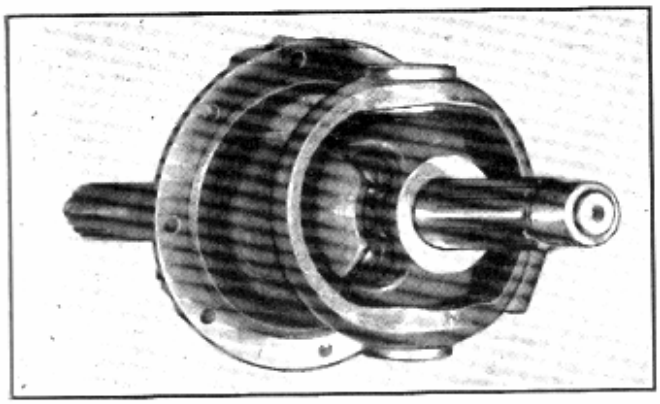

Fig. 12—Steering Knuckle Removed

4. Remove the capscrews from the steering knuckle retainer flange, allowing the steering knuckle to be removed, Fig. 12.

5. The axle shaft and universal joint assembly can then be withdrawn.

6. The steering knuckle retainer flange as used on the 5" joint, (Fig. 13), is in two halves and is removed by taking out the two screws "A", allowing the two halves to separate. The retainer flange as used in production on the 6" joint is of one piece construction. (Fig. 14). To facilitate installation service replacement retainer flanges are of two piece construction similar to that used on 5" joint.

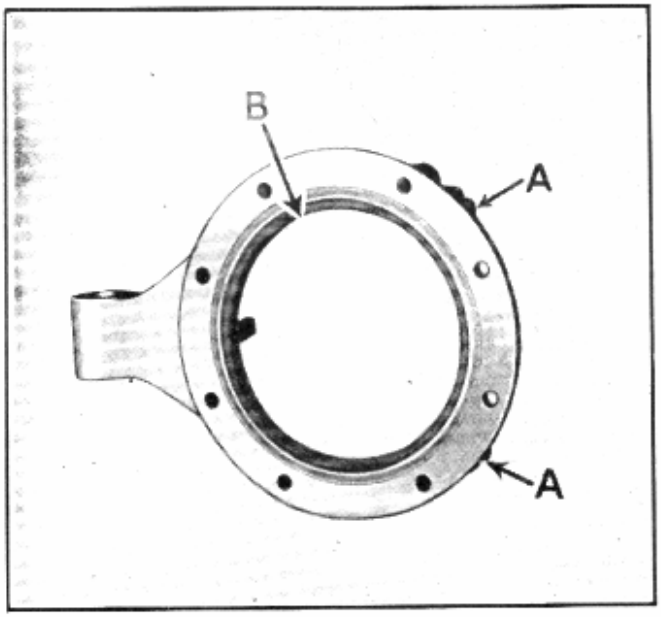

Fig. 13—Steering Knuckle Retainer Flange 5" Joint

7. The felt seal shown at "B" Figs. 13 and 14 is used on the retainers of the 5" and 6" joints and should be replaced at any time the retainer is removed. A waved spring is located under the felt seal. When replacing these parts follow the instructions covered under, "Steering Knuckle Retainer Flange Felt Seal and Spring Replacement 5" and 6" Joints."

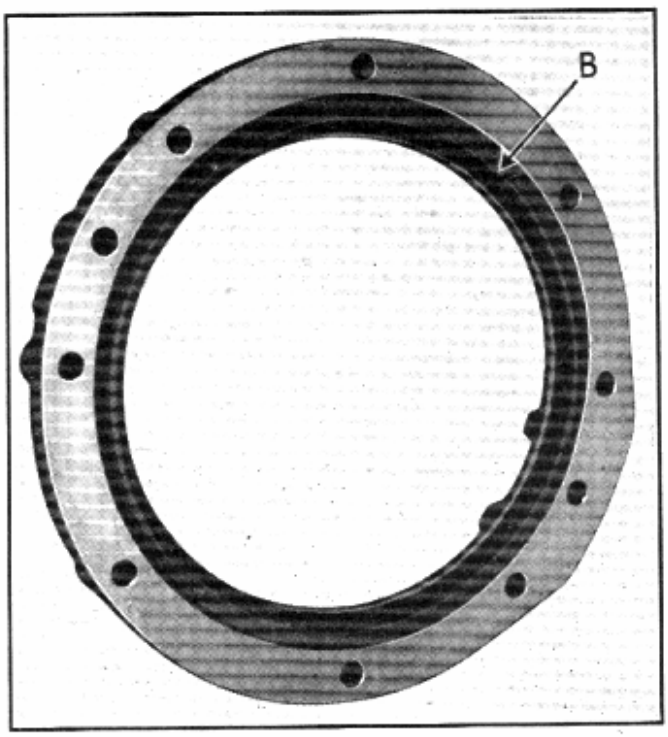

Fig. 14—Steering Knuckle Retainer Flange 6" Joint

STEERING KNUCKLE RETAINER FLANGE REPLACEMENT 6″ JOINT

Should it become necessary to replace the original one-piece retainer as used in production, Fig. 14, this can be performed without completely disassembling the steering end. The following is the recommended procedure.

1. Raise the front end of the vehicle and place stands under front axle.
2. Remove the cap screws holding retainer to the steering knuckle.
3. Place a bar between the retainer and the axle housing, apply pressure on the bar to hold the retainer while the following operation is performed. Using a hammer strike the machined surface of the retainer sharp blows with the objective of cracking it. Break the retainer sufficiently to permit removal. Alternative removal procedure would be to remove a 6″ section of the retainer, using a hacksaw.
4. Procure a new two-piece retainer and inspect same, removing all burrs found at the sides of the grooves and on the machined surface, using a small flat file.
5. Remove any pieces of the old gasket found adhering to the steering knuckle and make certain that all dirt is removed from this surface. Any burrs should be dressed off, using a fine flat mill file.
6. Assemble the two halves of retainer over housing and install the two retaining cap screws shown at "A", Fig. 13. Tighten the cap screws just sufficiently to compress the lock-washers slightly.
7. Bolt the retainer to the knuckle with the lug at the rear, drawing the bolts up evenly until the lockwashers are under light tension.
8. Tighten the two bolts which hold the two halves of the retainer together, thereby obtaining perfect alignment of the two sections as related to the machined surface on the knuckle.
9. Back off the retainer to knuckle bolts, ½ turn at a time until free, then remove all bolts holding the retainer assembly to the steering knuckle.
10. Install new oil seal spring and oil seal as outlined in instructions covering, "Retainer Felt Seal and Spring Replacement".
11. Cut the new gasket to be installed between the retainer and steering knuckle, diagonally across the top section. Smear a light coating of grease on the machine surface of the knuckle to hold the gasket in position.
12. Holding the retainer approximately ½″ away from the knuckle start the bolts into the knuckle. Run up all bolts evenly until contacting the lockwashers.
13. Tighten bolts diagonally opposite to each other ½ turn at a time until securely tightened, using a 6″ box socket wrench (recommended torque 30 foot pounds).

Inner and Outer Bearing Race Removal 5″ and 6″ Joints

To remove the inner and outer bearing outer races, use a drift punch 12″ long and a hammer as shown in Figs. 15 and 16. When performing this operation move the punch around the race so

Fig. 15—Removing Inner Bearing Outer Race

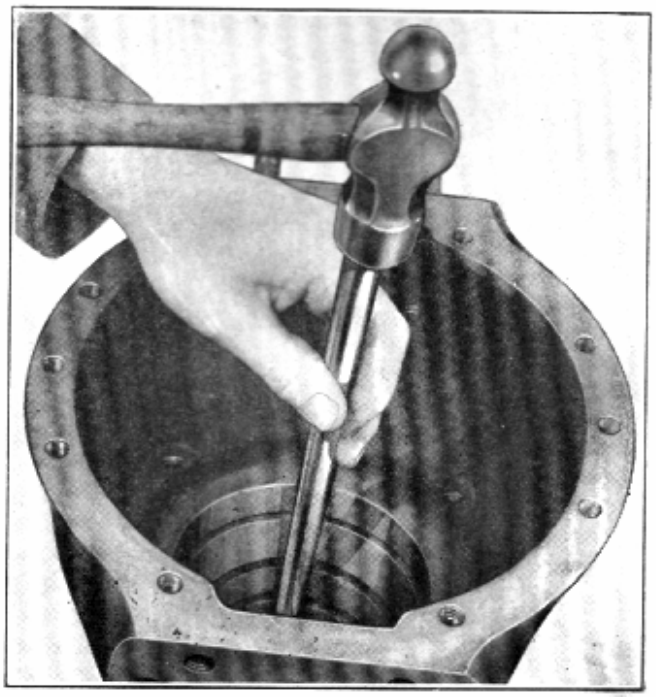

Fig. 16—Removing Outer Bearing Outer Race

that cocking will not take place which may damage the race and bearing area in the steering knuckle.

Front Wheel Outer Bearing Removal

With the hub removed, insert a long thin punch through the three hub cover screw holes and carefully drive the cone assembly and spacer washer

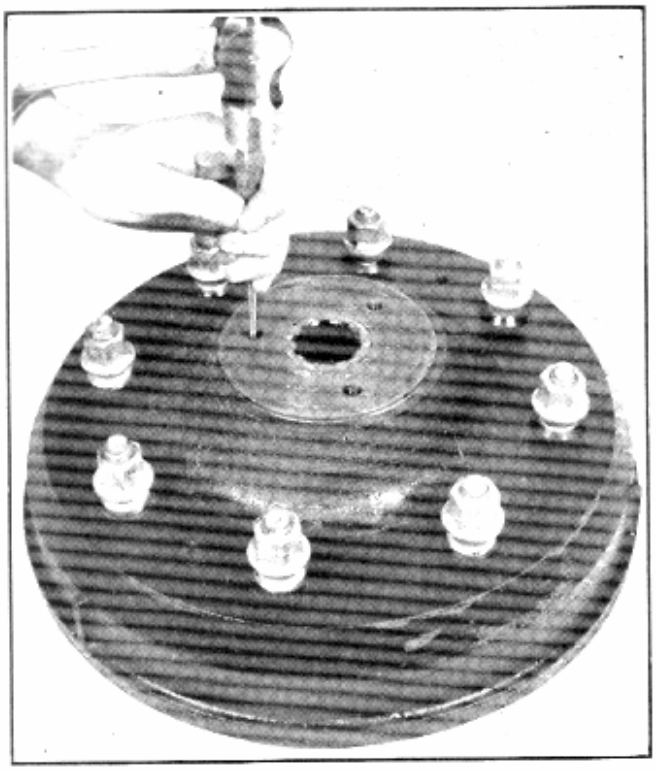

Fig. 17—Removing Front Hub Outer Bearing Cone & Roller Assembly

out, by alternately using the punch in each screw hole, as shown in Fig. 17.

Axle Shaft Universal Joint Disassembly

After the axle shaft has been removed, the

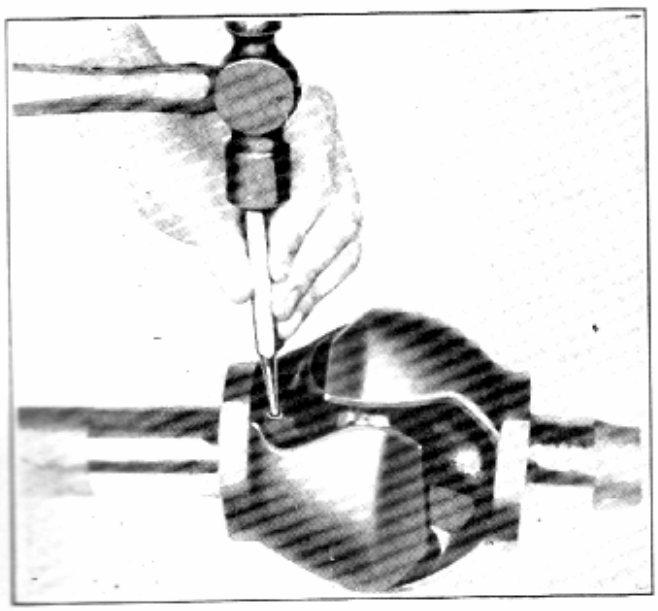

Fig. 18—Driving Out Retainer Pin

universal joint may be disassembled as follows:

1. Wash the axle shaft and universal joint thoroughly in a suitable cleaning fluid.
2. Using a drift punch and hammer, drive out the retainer pin which locks the centre ball retainer pin as shown in Fig. 18.
3. Bounce the wheel end of the shaft on a block of wood to cause the retainer pin to move into the drilled passage in the wheel end of the shaft. See Fig. 25.
4. Pull the two halves of the joint apart and with the finger, turn the centre ball so that the groove in it lines up with the race, to permit the adjacent driving ball to be moved past the centre ball, when the joint is swung at an angle. The remaining three driving balls and the centre ball will then drop out. See Fig. 20.

INSPECTION

After complete disassembly of the Steering end, all parts, excepting the pivot pin bearings, should be thoroughly cleaned in a suitable cleaning fluid.

Clean the face of the flange on the axle housing and the face of the flange on the steering end, making sure that all trace of sealing compound is removed.

Pivot Pin Bearings

Inspect the pivot pin bearings by rotating them by hand. If they feel rough, they should be replaced. As they are pre-lubricated they should not be cleaned in any solvent as this would make them unfit for further use.

Front Axle Shaft Thrust Washer

The front axle shaft thrust washer is incorporated in the steering end ball socket, as shown at "A", Fig. 19. If inspection indicates that its replacement is necessary, due to being badly scored, it can be cut out with a cold chisel and

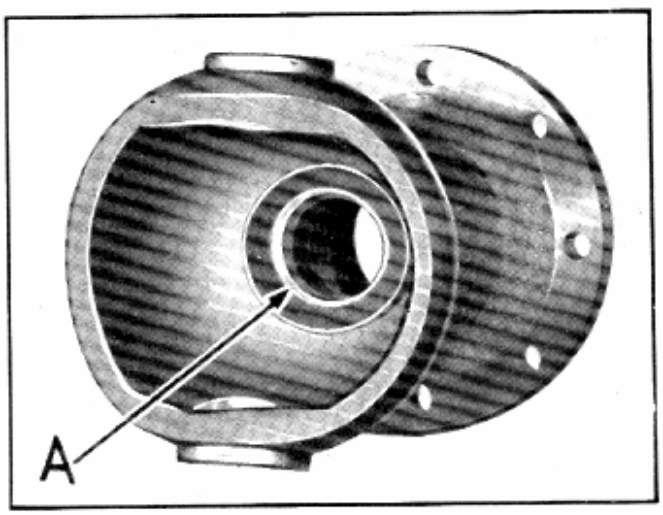

Fig. 19—Ball Socket Showing Thrust Washer

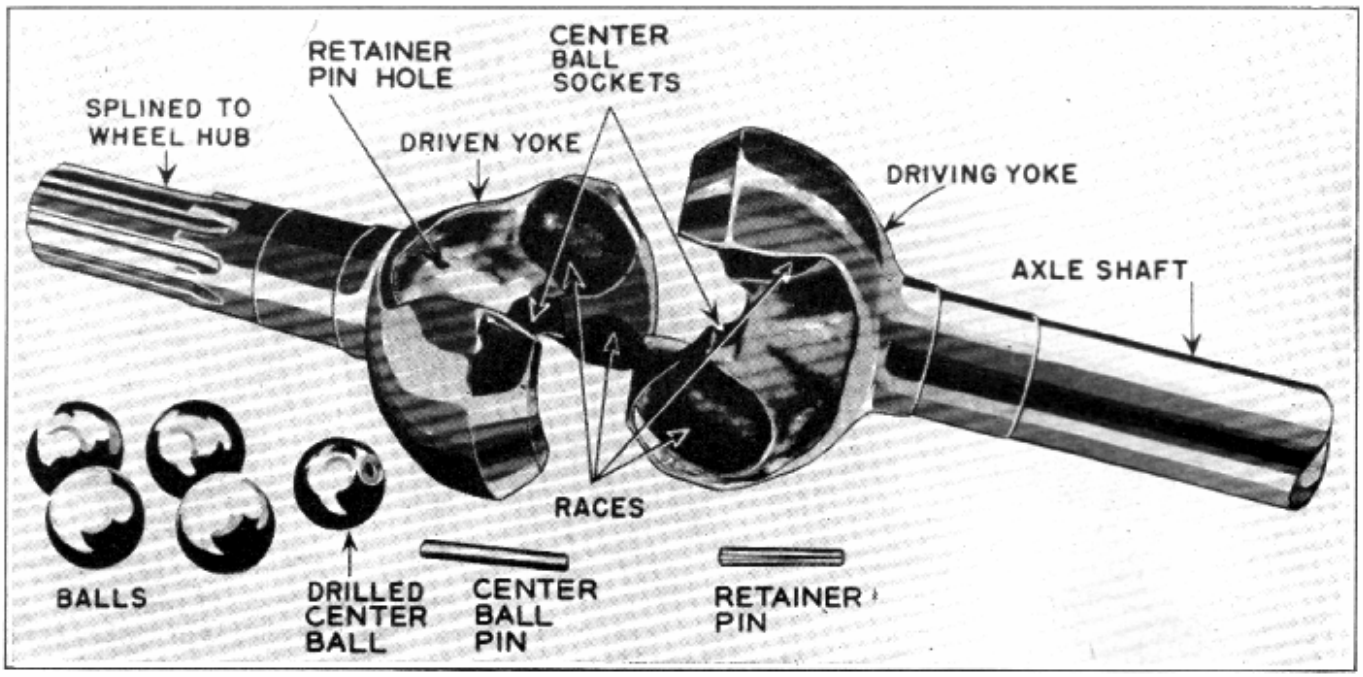

Fig. 20—Exploded View of Universal Joint

a new one pressed into position using an arbor press.

Replacement should not be made because of a small amount of end play in axle shaft.

Front Wheel Bearings

Both inner and outer front wheel bearings and their outer races should be inspected for wear and pitted rollers or races. Damaged parts should be replaced as outlined in this section.

Front Hub Oil Seal

Inspect the hub oil seal for possible damage or wear. If there is any doubt as to its condition it should be replaced as outlined under, "Front Hub Oil Seal Replacement".

Steering Knuckle Retainer Flange Felt Seal

Any time the Steering Knuckle retainer flange is removed, a new felt seal should be installed as outlined later in this section.

Axle Shaft Universal Joint

Inspect the balls and race-ways. If a race-way is scored, or the balls cracked or flattened, the complete axle shaft and universal joint assembly should be replaced. An illustration of a disassembled axle shaft and universal joint assembly is shown in Fig. 20.

Axle Shaft Oil Seal

Inspect the axle shaft oil seal and, if necessary replace according to instructions under "Axle Shaft Oil Seal Replacement".

REASSEMBLY

When a thorough inspection has been completed, the steering ends should be reassembled as follows, using new parts where necessary.

Inner Bearing Outer Race Replacement 5″ and 6″ Joints

1. Remove any burrs from the bearing surface in the steering knuckle.

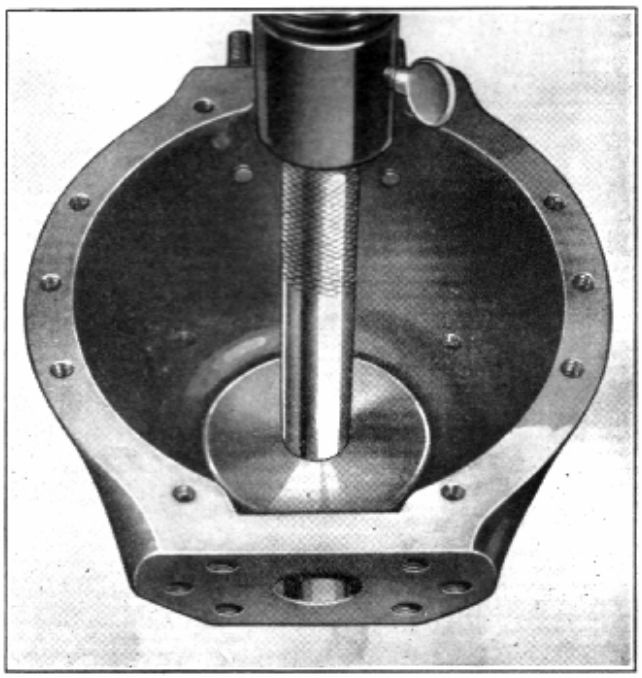

Fig. 21—Installing Inner Bearing Outer Race

2. Place the bearing race in position on the knuckle with the thick side down and with a soft faced hammer start the race squarely.
3. Use Tool No. XG-19850 and Handle No. XG-19854 for the 5″ joint and Tool No. XG-19848 and Handle No. XG-19854 for the 6″ joint. Press the race into its seat in the knuckle as shown in Fig. 21.

Outer Bearing Race Replacement 5″ and 6″ Joints

1. Remove any burrs from the bearing surface in the steering knuckle.
2. Place the bearing race in position on the knuckle with the thick side down and with a soft faced hammer start the race squarely.
3. Use Tool No. XG-19851 and Handle No. XG-19854 for the 5″ joint and Tool No. XG-19849 and Handle No. XG-19854 for the 6″ joint. Press the race into its seat in the knuckle as shown in Fig. 22.

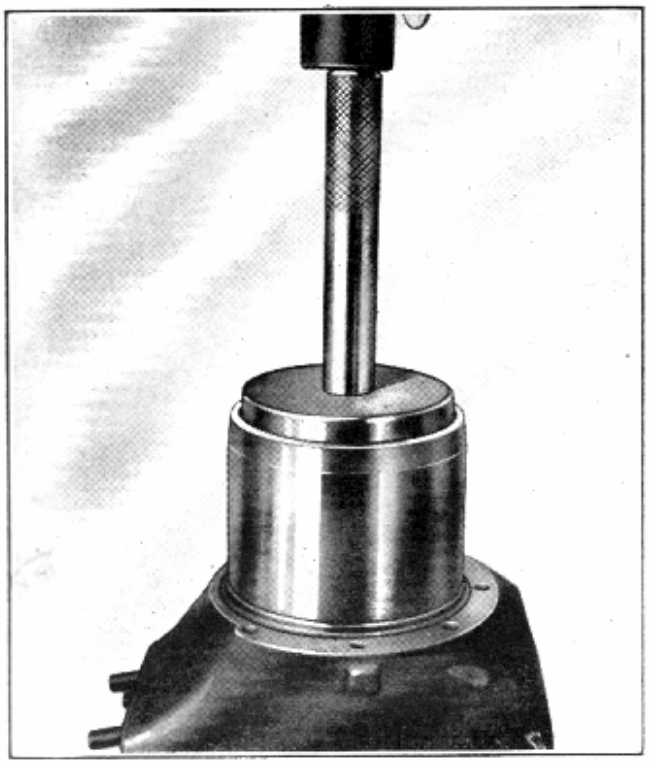

Fig. 22—Installing Outer Bearing Outer Race

Front Wheel Outer Bearing Replacement, 5″ and 6″ Joints

To install the outer bearing cone and roller assembly, first place the spacer washer on the hub spindle, with the bevel side down, or away from the bearing, and then place the cone assembly on with the thick side toward the outer end of the hub. Using Tool No. XG-19852 for the 5″ joint and tool No. XG-19853 for the 6″ joint, press the bearing firmly against its seat as shown in Fig. 23.

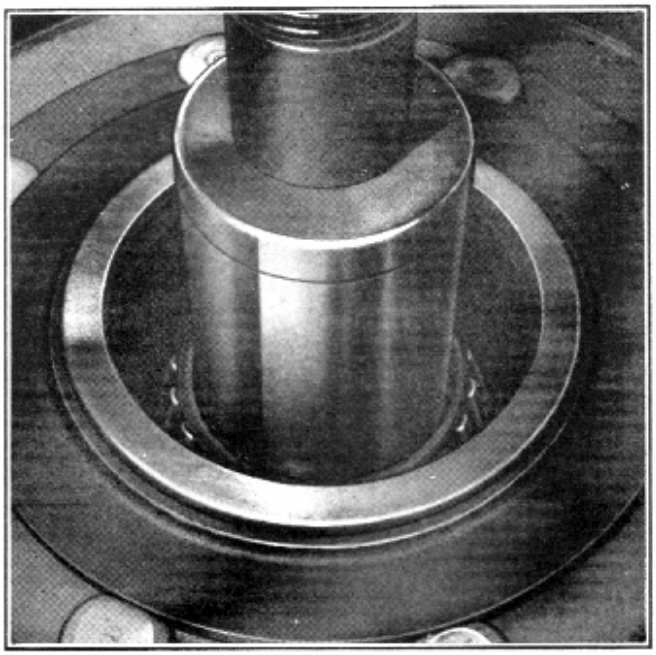

Fig. 23—Installing Front Wheel Outer Bearing

Front Hub Oil Seal Replacement 5″ and 6″ Joints

The following is the recommended procedure for replacing front hub oil seal.

1. Remove the old seal from the hub, by prying it out with a screw driver.
2. Start a new seal squarely into the end of the hub. Install Tool No. XG-19847, making sure the step on the tool fits into the inner diameter of the seal. Press into place as shown in Fig. 24.

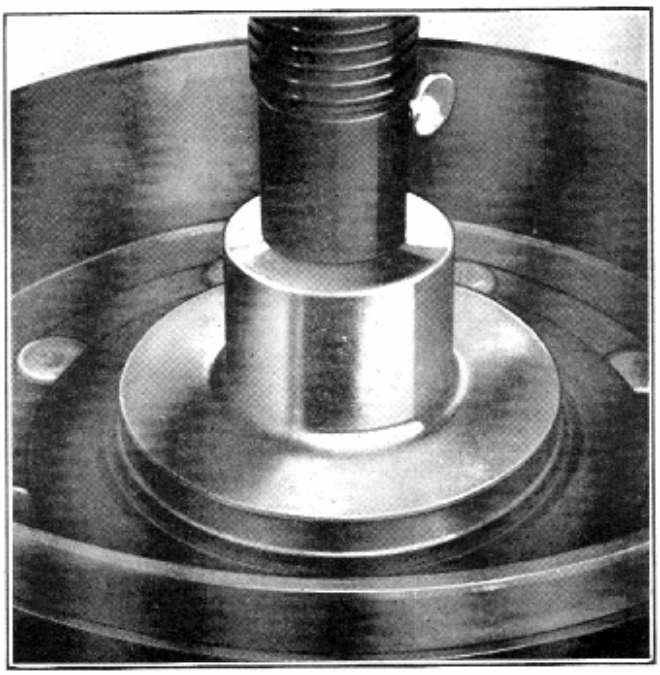

Fig. 24—Installing Front Hub Oil Seal Tool No. XG-19847

NOTE:—The leather lips of the seal must face toward the outer end of the hub.

3. Pack a little wheel bearing lubricant around the race and roller assembly in the hub. Smear a thin layer of this lubricant on the leather of the oil seal.

CAUTION:—Be careful that no surplus grease is left on the face of the seal, as it might throw out on to the brake drum and effect brake operation.

Universal Joint Reassembly

1. Drop the centre ball pin into the drilled passage in the wheel half of the shaft, Fig. 25.
2. Place the differential half of the axle shaft vertically in a bench vise.

NOTE:—Ground portion of shaft should be above vise jaws.

3. Install the centre ball (one with hole and groove drilled in it) into its socket in the shaft.
4. Place the wheel half of the shaft on the differential half, tipping it at as great an angle as possible. Then slip three balls into the raceways.

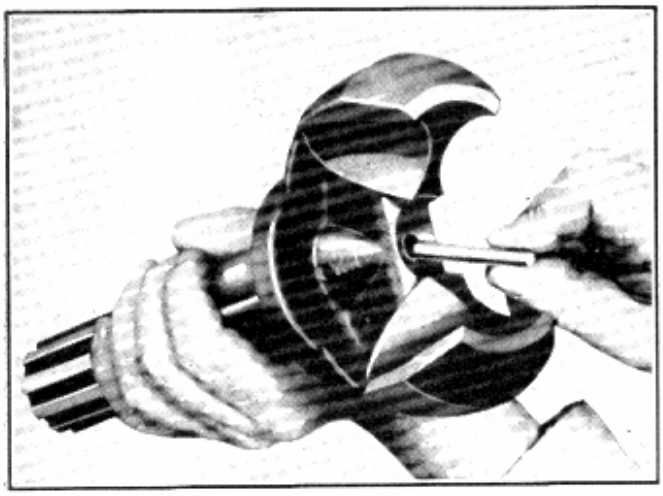

Fig. 25—Installing Center Ball Pin

5. Turn the centre ball until the groove in it lines up with the raceway for the remaining ball as shown in Fig. 26. Slip the ball into the raceway and straighten up the wheel end of the shaft.
6. Reach in with the fingers and turn the centre ball until the centre ball pin drops into the hole drilled in the ball.
7. Install the retainer pin and prick punch its ends to securely lock it in place. Use a new retainer pin.

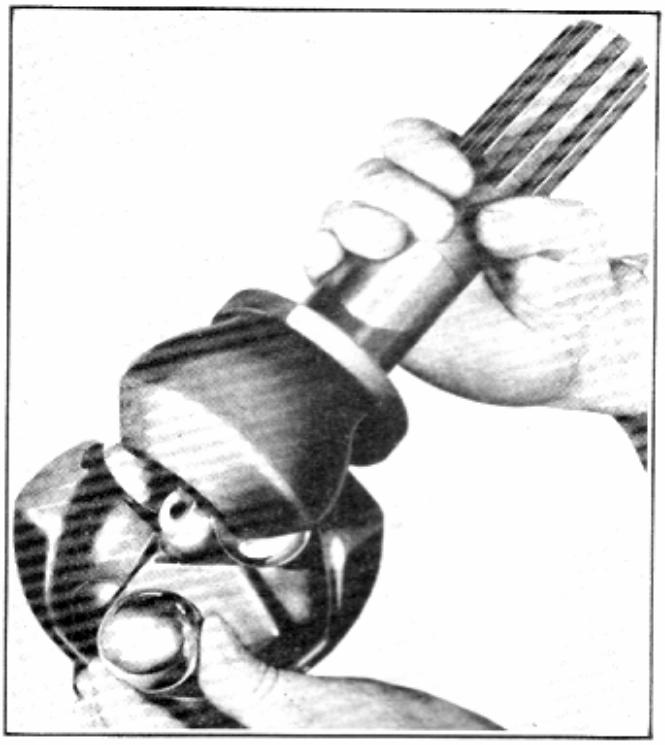

Fig. 26—Installing "U" Joint Balls

Steering Knuckle to Ball Socket Reassembly

Reassembly operations are the reverse of "Disassembly", with the following additions which require special attention:

1. Install the pivot pin bearings, Fig. 27, using an arbor press.
2. Pack the steering end ball socket with wheel bearing lubricant and install axle shaft and universal joint assembly.
3. Make sure that inner grease retainer is in place on the axle shaft and is installed with the flange at the inner radius of the inside diameter towards the universal joint.
4. Install the inner bearing cone and roller assembly in the steering knuckle, packing same with wheel bearing lubricant.
5. Check the steering end ball socket for marks indicating whether or not it is standard in relation to upper pivot pin shimming. If the ball socket is not standard, the numbers 10, 15 or 20, will be stamped on the outside of the socket, between the upper pivot pin bearing and the open end of the socket. These marks indicate that the upper pivot pin requires .010", .015" or .020" thickness of shims in addition to the standard of .030". For example, if the number 10 appears on the ball socket, the thickness of shims required under the upper pivot pin cap is .030" – .010" or a total of .040". When the ball

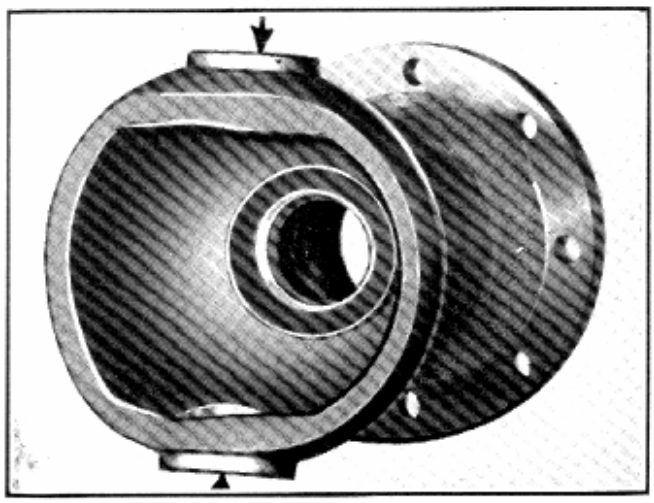

Fig. 27—Pivot Pin Bearings

sockets are not marked the total thickness of shims used under the upper pivot pin cap is .030".

6. After determining the thickness of shims for the upper pivot pin cap, install the steering end ball socket with axle shaft and universal joint assembly into the steering knuckle.
7. Install the upper and lower pivot pins.
8. Install the correct thickness of shims previously determined in paragraph 5, over the shim retaining pin in the upper pivot pin cap. Peen over the shim retaining pin. Install the upper pivot pin cap.
9. Place the assembly in an arbor press and press on the lower pivot pin which will force the upper pivot pin into contact with the shims previously installed.
10. Place a scale across the pivot pin hole and with a feeler gauge measure the distance between the scale and the end of the pivot pin as shown in Fig. 28.

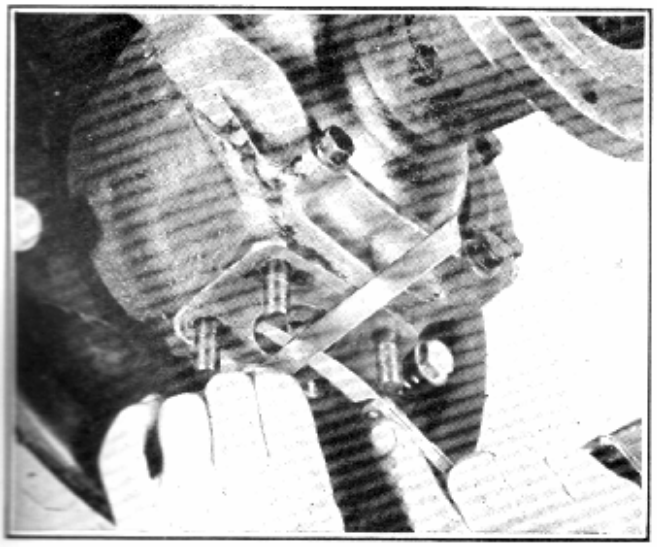

Fig. 28—Checking Pivot Pin Shimming

11. Increase the thickness of shims determined in paragraph 10, by .005" to give the pivot pin bearings the required tension. Place the shims over the shim retaining pin in the lower pivot pin cap and peen over the retaining pin. Install the lower pivot pin cap.
12. Place a new steering knuckle retainer flange gasket in position on steering knuckle. Install a new felt in the retainer flange as covered under, "Steering Knuckle Retainer Flange Felt Seal and Spring Replacement."
13. Locate the knuckle retainer flange in its proper position on the steering knuckle and install capscrews, tightening evenly and securely.
14. If necessary, replace the axle shaft oil seal in the end of the axle housing as outlined under, "Axle Shaft Oil Seal Replacement."

Steering Knuckle Retainer Flange Felt Seal and Spring Replacement 5" and 6" Joints

The following instructions cover only the recommended procedure for installing felt seal "B", Figs. 13 and 14, and spring in knuckle retainer after the retainer has been removed from the steering knuckle.

1. Whether a new or the original retainer is being used make certain that all particles of the old gasket and any burrs are removed from the machined surface of the knuckle and retainer, also from the oil seal groove in the retainer.
2. Assemble the two halves of the retainer over the housing and install cap screws "A", Fig. 13, and tighten until there is a slight pressure on the lockwashers.
3. Assemble the retainer to the steering knuckle and tighten retaining bolts until the lockwashers are under light tension.
4. Tighten the two cap screws which hold the two halves of the retainer together, thereby obtaining perfect alignment of the two sections as related to the machined surface on the knuckle.
5. Back off the retainer to knuckle bolts, ⅛ turn at a time until free, then remove all bolts holding the retainer assembly to the steering knuckle.
6. Install new oil seal spring in the retainer oil seal groove. The spring should be placed in the groove in the same relative position that it will normally take when placed on the bench. This will result in having the short compression bends in the spring against the bottom of the groove in the retainer, and the longer compression sections of the spring against the felt oil seal.

   The free length of the spring for the 5" joint should be approximately 20". The free length of the spring for the 6" joint should be 25".

If the spring does not lie evenly in the groove or has a tendency to coil up, form a circle with the spring in the opposite direction to effect enlarging the circle normally formed when placed on the bench.

7. Place the felt oil seal lengthwise on the bench and cut to 19¾" for the 5" joint and 24½" for the 6" joint. Coat all four sides of the felt with water pump grease, or as an alternative method soak the felt for a short period in light engine oil.

8. The ends of the felt are to be installed towards the front of the vehicle. Turn the spring, if necessary, so that the ends are 90° or ¼ turn away from the ends of the felt. The felt is to be installed in the groove so that the reinforcing rubber section will bear against the spring and spherical surface of the knuckle ball.

9. Hold the retainer in such position to provide accessibility for installation of the felt, start both ends into the groove and work toward the centre section of the felt. As the felt is being installed into the groove, compress it towards the ends. After approximately 6" at each end is fitted into the groove, grasp the centre section and pull it towards the axle housing, thereby forming a reverse arc at the centre section. Continue to work it into the groove until only a 5" arc remains at the centre section. This remaining section can then be pressed into the groove. The felt will remain in correct alignment with the groove as the result of tension being exerted lengthwise in the felt.

10. Check to make certain that the felt will move in the groove freely at all points by applying pressure to the outer face of the seal against the tension of the spring. A feeler blade ½" by .010" may be used to run along the sides of the felt at points found to be binding in the groove.

11. Reinstall the retainer to the steering knuckle as outlined in instructions covering, "Steering Knuckle Retainer Flange Replacement."

STEERING END REPLACEMENT

The steering ends are assembled to the differential housing in the following manner:—

1. Coat the surfaces of the flanges fastened together by the bolts "A", Figs. 6 and 7, with shellac and install the steering end on the axle housing, being careful not to damage the differential seal when threading the axle shaft through it, and tighten the bolts securely.

2. Install the brake backing plate, being careful not to damage the hydraulic brake hose.

3. Pack the hub with lubricant as outlined in section "C", smearing a thin coating of this lubricant on the seal.

CAUTION:—Be careful that no surplus grease is left on the surface of the seal as it might throw out onto the brake drum and affect brake operation.

4. Replace the hub and drum assembly and adjust the bearings according to the instructions given under, "Front Wheel Bearing Adjustment".

5. Connect the steering tie rod and drag link.

6. Adjust the "Toe-in".

AXLE SHAFT OIL SEAL REPLACEMENT

1. To replace an axle shaft oil seal, disconnect the brake hose, tie rod and on the right side, the drag link. Then disconnect the steering end assembly and withdraw the axle shaft from the banjo housing.

2. Insert the oil seal puller J-943 through the opening and in behind the seal at the end of the housing. Tapping the tool with a hammer will remove the seal from the housing.

3. Before installing a new seal, it should be soaked in engine oil to make the leather pliable and also to prevent burning the leather before the regular axle lubricant would reach it.

4. Place the new seal on tool XA-4702A for 5" joints and XA-4702-B for 6" joints with the free end of the leather pointing away from the tool, then drive the seal in place.

5. Prick punch the end of the housing to hold the seal in place.

6. Reassemble the axle and steering end to the banjo housing, according to the foregoing instructions.

NOTE:—Care should be taken not to damage the oil seal when installing the axle shaft in the axle housing.

7. After connecting the brake hose, bleed both front brakes according to instructions under heading "Bleeding Hydraulic Brake System," Section "E".

STEERING TIE ROD

The tie rod is made of solid stock, offset to clear the differential. The right end of the rod is threaded with a right hand thread and the left end with a left hand thread.

The construction of the tie rod ends is shown in Fig. 29 and is so designed that any wear of the balls or sockets is automatically adjusted by the tension springs acting on the balls.

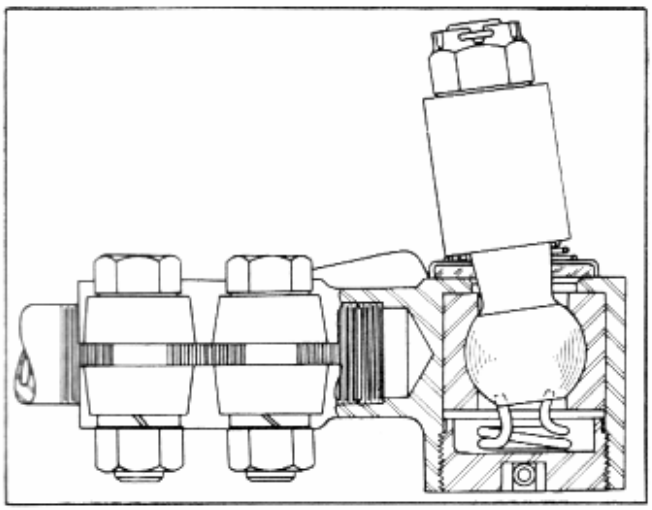

Fig. 29—Tie Rod End

TOE-IN ADJUSTMENT

Toe-in, as the title implies, is the amount in inches that the front wheels toe-in, that is, the distance between the wheels at the front "B" is less than it is at the rear "A". See Fig. 30.

Toe-in is necessary to offset the affect of "camber" or the outward tilt of the front wheels. Just as the purpose of camber is to give the wheel a setting so it will be in as nearly a balanced, free-running position as possible, so with toe-in, the purpose is to set the wheel in a position to reduce to a minimum the road friction on the tire.

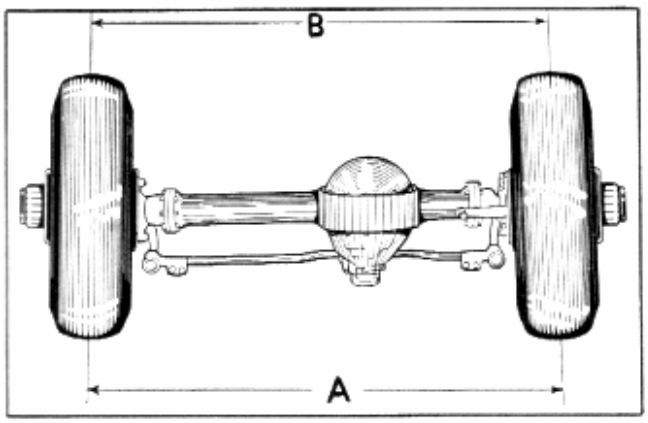

Fig. 30—Toe-in Adjustment

In order to adjust the toe-in, one of the tie rod ends must be driven from the spindle arm and turned in the required direction. Care should be taken to see that there is an equal length of thread showing at both ends of the tie rod.

When installing the tie rod to the steering arm, the nut should be drawn up tight and locked in place with a new cotter pin.

TURNING RADIUS

In the event that a banjo housing or steering end must be replaced it is necessary to adjust the turning radius stops after the front axle has been completely assembled. Place the front wheels on turning radius plates or a front end aligning machine which will measure the angle at which the wheels may be turned from the straight ahead position. The correct setting will allow each front wheel to turn outward, in relation to the frame when viewed from the front, through an angle of 26° for the 5″ joint and 30° for the 6″ joint. The following is the recommended procedure for adjustment.

1. Place the vehicle with the front wheels on the turntable in the straight ahead position.
2. Turn the wheels hard to the left until the steering knuckle contracts the stop.
3. Check the angle of the left wheel.
4. If the angle is not correct, the stop can be adjusted, by either filing the end of the stop if the angle is less than that required, or by brazing metal on the end of the stop if the angle is more than that required.
5. Proceed similarly on the right front wheel.

The purpose of these stops is to prevent damage to the front axle universal joints, and to the steering gear.

With the correct setting of the stops, and with the wheels turned hard over against the stops, the steering wheel may be forced a slight amount past the extreme turning radius right and left without bottoming the gear.

STEERING CONNECTING ROD (Drag Link)

The steering connecting rod shown in Fig. 31 is a ball and socket type. All ball seats, spring

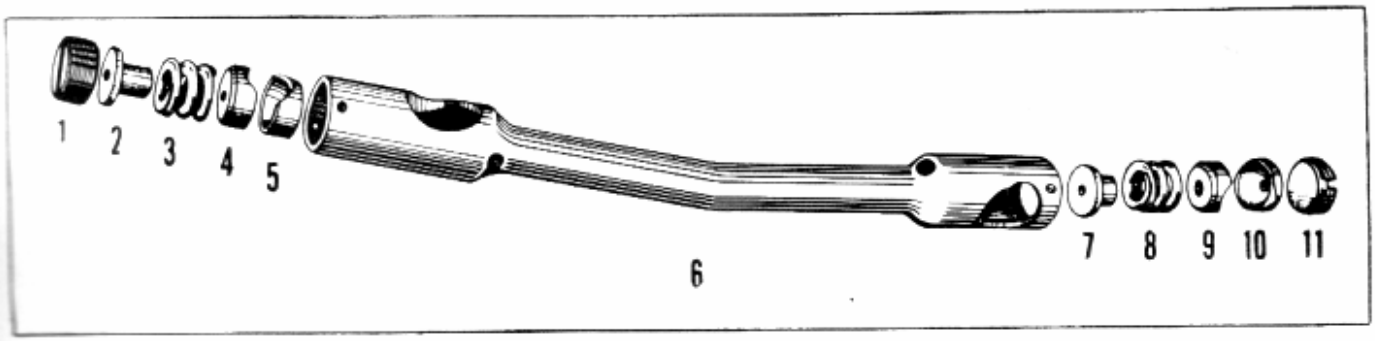

Fig. 31—Steering Connecting Rod Parts

1—End Plug
2—Safety Plug
3—Spring
4—Ball Seat
5—Ball Seat
6—Connecting Rod
7—Safety Plug
8—Spring
9—Ball Seat
10—Ball Seat
11—End Plug

and adjusting plugs are identical, the only difference between the front and rear ends being the relative location of the springs.

At the steering gear end, the spring and spacer are assembled between the rod end (bottom of socket) and the ball seat, while at the axle end the spring and spacer are between the ball seat and the end plug.

When removing the springs and seats for any reason, make sure they are reassembled as above, as this method of assembly relieves road shock from the steering gear in both directions.

To adjust the ball joints, screw the end plugs in tight, then back off one-half turn and lock with a new cotter pin inserted through the hole in the tube and the slot of the adjusting plug.

Ball joints must be tight enough to prevent end play, and yet loose enough to allow free movement of the shock springs.

Specifications for springs used in the steering connecting rod end are given in the "Specifications" at the end of the steering section.

FRONT AXLE (C-15)

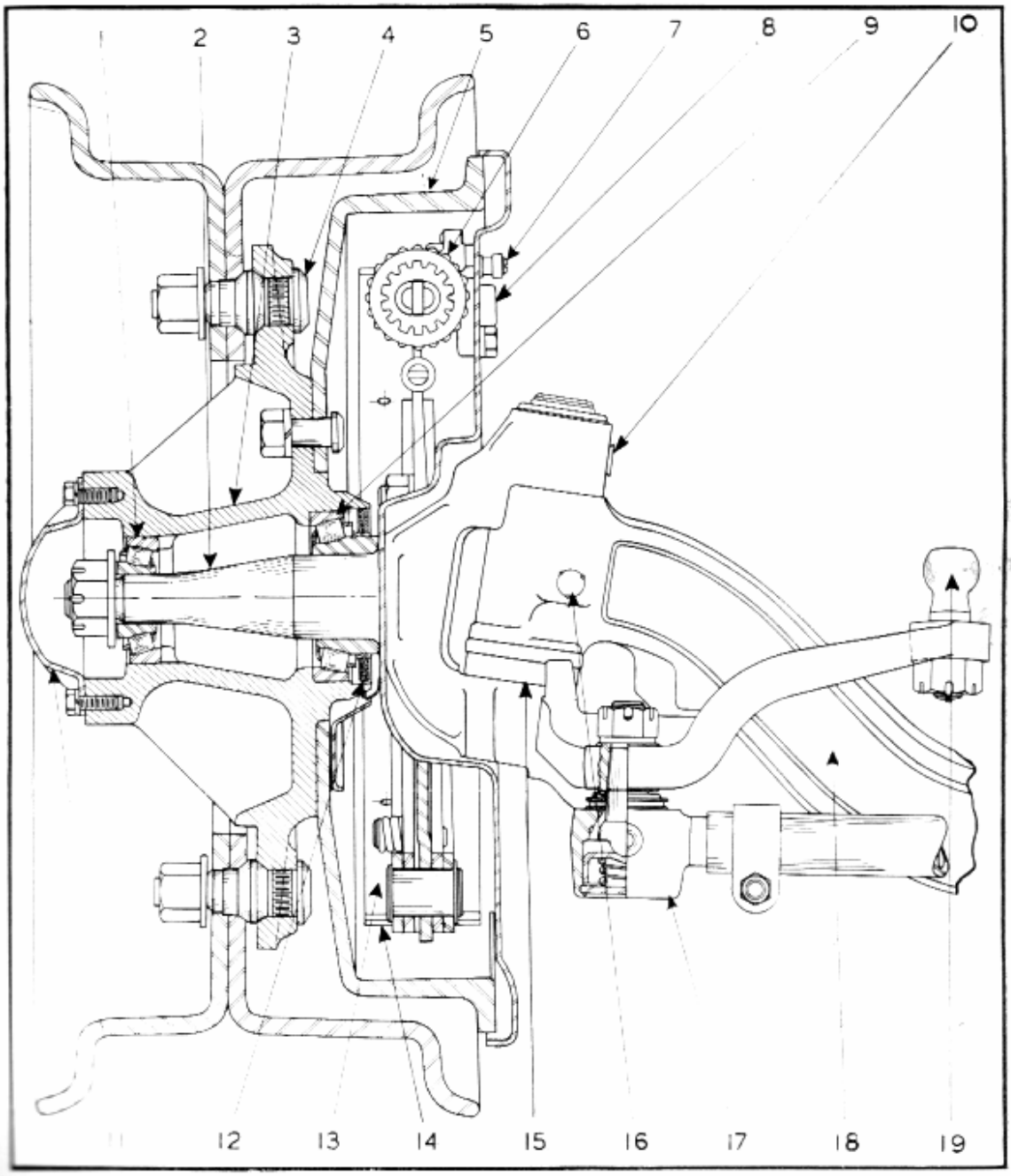

Fig. 32—Front Axle Assembly (C-15)

1—Outer Wheel Bearing
2—Wheel Spindle
3—Wheel Hub
4—Wheel Hub Bolt
5—Brake Drum
6—Brake Wheel Cylinder
7—Brake Bleeder Valve and Screw
8—Brake Wheel Cylinder Hose Connection
9—Inner Wheel Bearing
10—Lubrication Fitting
11—Hub Cap
12—Inner Bearing Oil Seal
13—Brake Shoe
14—Brake Lining
15—King Pin Thrust Bearing
16—King Pin Lock Pin
17—Tie Rod End
18—Axle I Beam
19—Steering and Third Arm

Construction

The front axle used in this vehicle is known as the, "Reverse Elliott", type. It is a steel drop forging with the spring seats forged integral with the "I" beam. The "I" beam is heat-treated for extreme toughness and is machined to very close limits.

The king pin is slotted and held in position in the axle "I" beam by a tapered lock pin. The king pin holes in each end of the axle "I" beam are bored at an angle so that the top end of the king pins are inclined toward the centre line of the vehicle. This is known as, "King Pin Inclination".

The steering knuckles are mounted on each end of the axle "I" beam and are held in position by the king pins. A thrust bearing is located between the lower side of the "I" beam and the knuckle, which permits easy steering under load.

The brake backing or support plates carry the brake shoes and wheel cylinders and are bolted to the steering knuckles. The steering arms are mounted to the lower side of the steering knuckles. The arms have tapered ends which fit into tapered holes in the knuckles, a woodruff key seated in the steering arm fits into a keyway in the knuckle which properly positions the steering arm. The arms are held securely to the knuckle by a castellated nut and cotter pin. The right and left steering arms are connected with each other by the tie rod, which is adjustable and controls the amount of toe-in of the front wheels.

The third arm is forged integral with the left steering arm and is connected to the Pitman arm through the steering connecting rod.

A caster shim or "I" beam spacer is inserted between the front springs and the front axle. The installation of this shim controls the amount the top of the axle inclines backward. This backward tilt of the axle gives the front wheels their caster.

The front wheel spindles, which are forged integral with the steering knuckles, are tilted downward at their outer ends, thus causing the front wheels to be farther apart at the top than they are at the bottom. This slight angular position of the front wheels is called camber.

The steering knuckle arms are installed on the knuckles at an angle, permitting the front wheels to toe-out when making turns. This is necessary so that when turning curves, each wheel may travel in a different arc. This toe-out on curves is known as steering geometry.

These five front end factors are built into the axle and must be in proper relation to each other to prevent steering faults and excessive tire wear.

FRONT END ALIGNMENT

Caster

Caster is the amount in degrees of the backward tilt of the axle and king pin. See Fig. 33.

A vehicle without caster would lack steering stability, would tend to wander over the road and would be difficult to straighten out at the end of a curve.

Unequal caster shows itself in the tendency of the vehicle to pull to the right or left. This condition comes about through the axle having been twisted so that there is a greater amount of caster in one king pin than in the other. The direction in which the vehicle will tend to pull is towards the side with less caster. Suppose that an accident has put a twist into the front axle so that

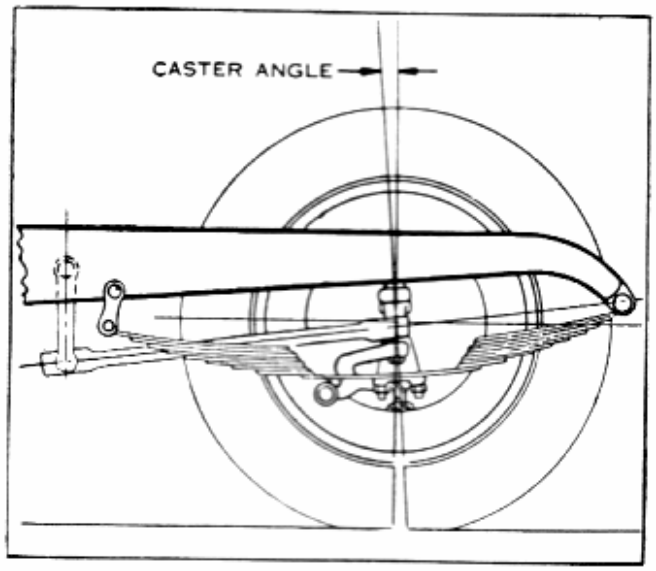

Fig. 33—Caster Angle

the left side is zero caster, while the right side is castered backward five or six degrees, the right wheel will have a strong tendency to turn inward, pulling the vehicle to the left.

Camber

Camber is the amount in inches or degrees that

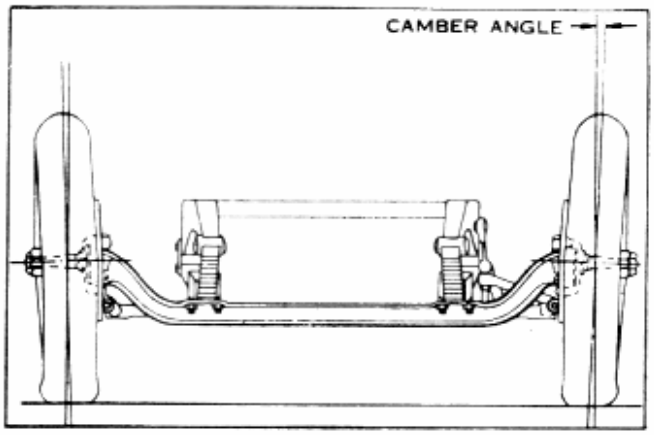

Fig. 34—Camber Angle

the front wheels are tilted outward at the top. See Fig. 34.

When a wheel has too much camber, that is the wheel is tilted too far out at the top, the tire is forced by road contact into a conical shape, on its under side. The result would be excessive tire wear on the outer edges of the tread.

Reverse camber, or a wheel that is tilted too far in at the top, would result in excessive tire wear on the inner edges of the tread. The center of the tread would remain comparatively unworn.

The rule is that if wheels have the maximum of allowable camber they must have the maximum amount of allowable toe-in. If wheels have the minimum amount of allowable camber they must have the minimum amount of allowable toe-in.

King Pin Inclination

King pin inclination is the amount in degrees that the tops of the king pins are inclined toward the center of the vehicle. See Fig. 35.

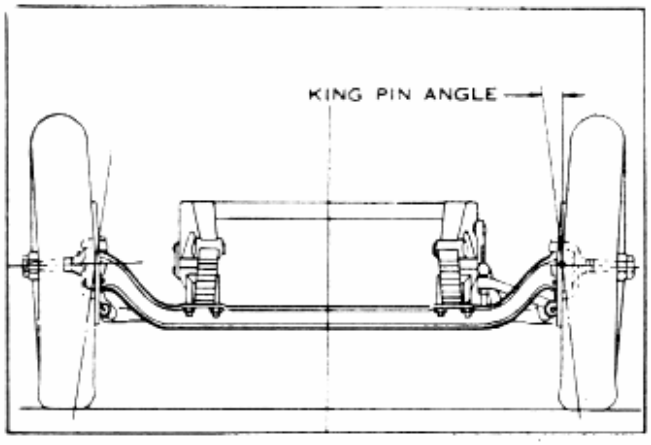

Fig. 35—Kingpin Inclination

King pin inclination tends to keep the wheel spindles pointed outward, in line with the axle, just as caster tends to keep the wheels of a vehicle pointed straight ahead. The effect is the same, since if the spindles are kept pointing out at right angles to the vehicle, the wheels will, as a result be kept pointing ahead. It makes the vehicle steer easier.

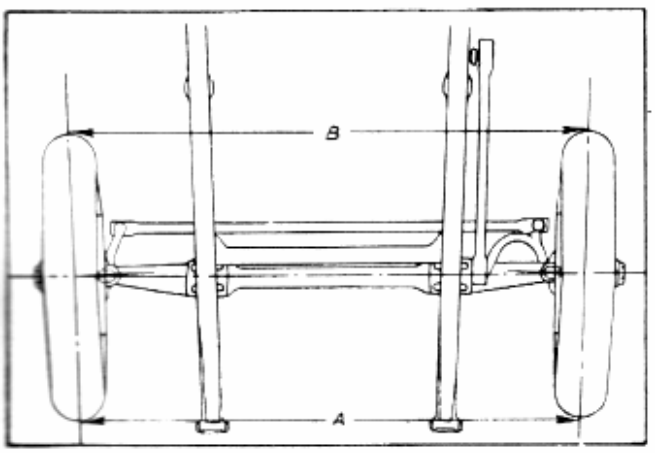

Fig. 36—Toe-In

We have already referred to the close relationship between the factors that enter into the front axle assembly. It is a point that cannot be overstressed. One must keep this close inter-relation constantly in mind to gain a full and true understanding of this cleverly designed mechanism. And especially in order to correct any wrong adjustment, it is necessary to realize what effect a change in one element of the mechanism may have on the operation of the other parts.

Toe-In

Toe-in is the amount in inches that the wheels toe-in, that is, the distance between the wheels at the front, "A," is less than it is at the rear "B." See Fig. 36.

Cambering the wheels out at the top makes it necessary to draw them in at the front.

Toe-in is a necessity growing out of camber and directly related to it. It might seem that since the wheels are headed inward toward the center of the road, while actually traveling a parallel course, there must be a constant grinding of their surfaces on the road surface. It would appear that they are being held apart constantly by the axle, against their tendency to roll outward to the same point. As a matter of fact, it is to avoid this tire-wearing surface grind that toe-in is employed.

Just as the purpose of camber is to give the wheel a setting so it will be in nearly a balanced free-running position as possible, so with toe-in, the purpose is to set the wheel in a position to reduce to a minimum the road friction on the tire.

Steering Geometry

Steering geometry is the mechanics of keeping the front wheels in proper relative alignment as the wheels are turned to the left or right. Fig. 37.

The front wheels, when the vehicle is making a turn, are not on the same radius line, drawn from the center around which the vehicle is turning, and because of this, it is necessary for the front wheels to assume a toed-out position when rounding curves. This position is governed by the angle of the steering arms.

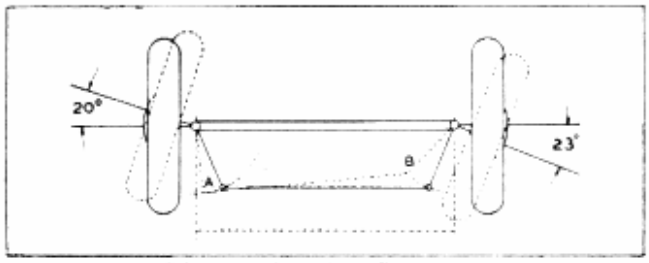

Fig. 37—Steering Geometry

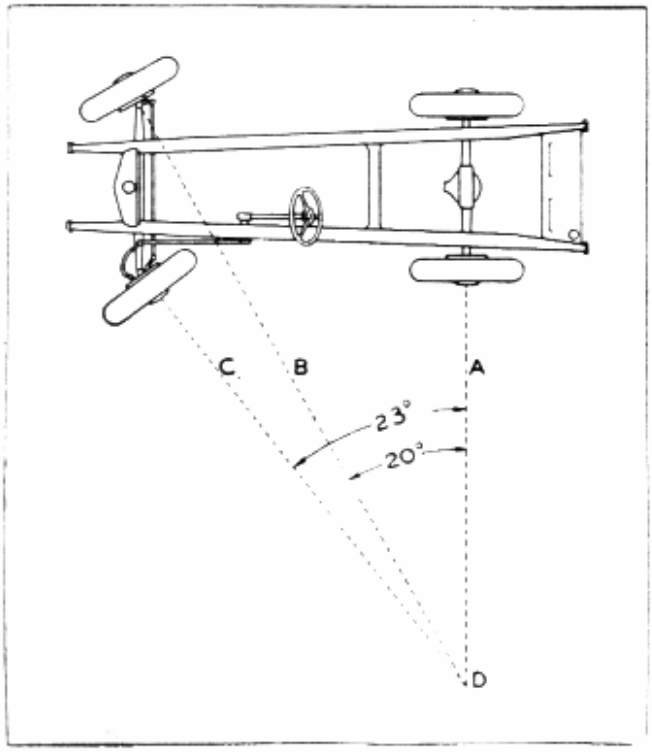

Fig. 38—Toe-Out on Curves

The accuracy of the steering geometry is governed by the condition of the steering arms. For example, suppose a steering arm has been bent by bumping against a curb in such a way to cause the right wheel to toe-in excessively when the vehicle was turned around a corner. This tire would drag, causing rapid wear of the tire. This condition accounts for the vehicle we see once in a while that persists in wearing out one front tire twice as fast as the other, although, it appears to be perfectly set for straight ahead driving.

The wheels of any vehicle, if properly set on the curves, will be at a right angle to the radius line from the center around which the vehicle is turning.

In Fig. 38 is a diagram of a vehicle making a left turn. The right wheel is set at an angle of twenty degrees—the angle being exaggerated to bring out the principles more clearly. A line "A" drawn through the rear axle and a line "B" drawn through the spindle of the right wheel meet at "D," which is the center around which the vehicle is turning. Therefore, the left or inside wheel must be at right angles to the radius line "C" which passes through its spindle and strikes the lines from the other three wheels at "D."

SERVICE OPERATIONS

When mechanics thoroughly understand the foregoing, they will appreciate the accuracy necessary when checking the front end system. There are several different kinds of equipment, by which these operations can be performed.

It must be remembered that no matter what kind of equipment is used, that all of these checks must be made with the vehicle level and with the weight of the vehicle on the wheels and with no load in the vehicle.

Bad steering performance may be due to some cause not connected with front wheel alignment. Therefore, check to see that none of the following conditions are present.

1. Loose steering.
2. Steering housing loose on frame.
3. Excessive clearance between king pins and bushings or king pins loose in axle "I" beam.
4. Steering gear improperly adjusted.
5. Loose tie rod or drag link connections.
6. Loose spring shackles.
7. Front spring shifted on axle due to sheered centre bolt.
8. Sagged or broken front springs.
9. Under inflated tires.
10. Unbalanced or mis-mounted tires.
11. Engine mountings broken or improperly adjusted.
12. Engine improperly tuned.
13. Brakes dragging.
14. Wheel bearing or hub bolts loose.
15. Shock absorbers not operating properly.
16. Cab mounting bolts loose.

After this inspection is completed and the conditions corrected, the vehicle should be placed on a front end machine and checked.

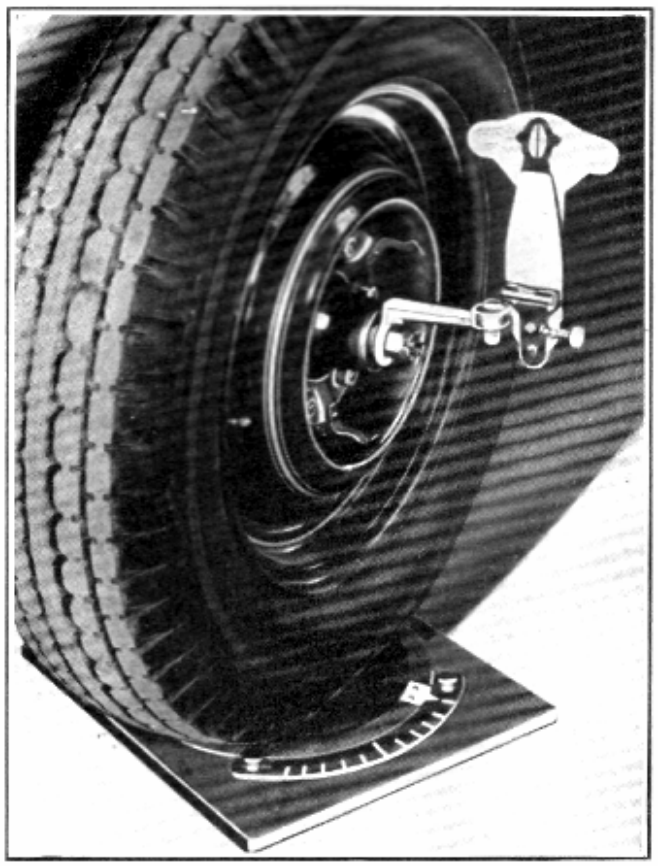

Fig. 39—Checking Kingpin Caster

There are several types of front end machines on the market using different mechanical means for locating and correcting front end troubles. The instructions furnished by each manufacturer for the operation of his particular machine should be followed. However, for the benefit of those who do not have access to any of the various front end machines, we shall explain the checking and correcting of front end alignment with the use of the "Jiffy" wheel aligning system.

Checking Front End Alignment

Before any front end alignment checks are made, the first thing that should be done is to make sure that the vehicle is on a level floor and that all tires are inflated to the proper pressure. Then, after making the above preliminary inspections, proceed to check the front end alignment.

Caster Check

1. Set the front wheels in a straight ahead position on the turntables with the turntable scale set at zero. Install the "Jiffy" gauge, J-800, parallel with the spindle.
2. Turn the wheel on which the check is being made OUT 25°, center the bubble on the gauge and note the reading on the caster scale, Fig. 39.
3. Now turn the wheel IN 25°, center the bubble and note the reading on the caster scale. The caster of the wheel is the amount in degrees of pointer travel from left to right from the first reading. Should the pointer travel from right to left, reverse caster is indicated.

Camber Check

1. Set the wheels in a straight ahead position and install the "Jiffy" gauge parallel with the spindle as shown in Fig. 40.

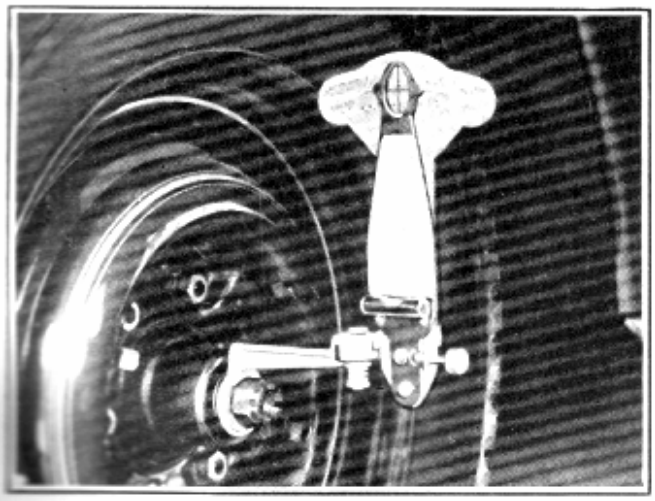

Fig. 40—Checking Camber

2. Adjust the gauge until the bubble in the level is centered and read the amount of camber on the scale. Camber is shown to the left of zero on the scale, reverse camber being indicated if the pointer is to the right of the zero mark.

King Pin Inclination Check

1. Lock the wheels with a brake pedal depressor.
2. Turn the wheel on which the check is being made OUT 25°.
3. Set the gauge on the spindle with the scale turned parallel to the wheel.

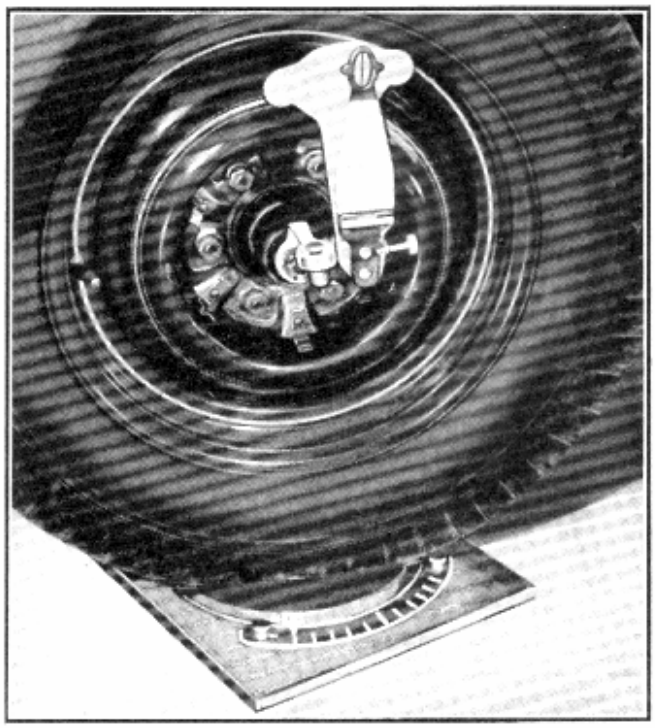

Fig. 41—Checking Kingpin Inclination

4. With the pointer on the gauge set at zero, turn the gauge on the spindle until the bubble in the level is centered.
5. Now turn the wheel IN 25° and adjust the gauge until the bubble in the level is centered and read the amount of king pin inclination on the scale, Fig. 41.

Toe-In Check

Before checking toe-in, the wheels and tires should be checked for run out at centre diameter of tire and at rim of wheel. This run out should not exceed 1/8".

Toe-in should be checked with a front wheel tramming gauge from the centre of each tire at approximately hub height, (when using portable equipment). The following is the recommended procedure.

1. Set the wheels in a straight ahead position. It is also advisable to roll the vehicle ahead some distance when doing this.

2. Place the gauge at the rear of tires and adjust so that the pointers will be approximately hub height, then adjust the pointers so that they will be approximately centre of each tire. After this adjustment is made, make a note of the reading on the scale of gauge.
3. Chalk the pointers of gauge and slide gauge up to tires, so that the pointers will chalk mark tires in approximate centre, and then remove the gauge.
4. Roll vehicle ahead so that chalk marks on the tires will be at the front of vehicle.
5. Place the gauge in position at front of tires, and roll vehicle ahead or back until chalk marks line up with pointers of gauge.
6. Adjust pointers so that they will coincide with the marks on the tire, then note reading on the scale of gauge. The difference in the two readings, front and rear, will indicate the toe-in. The rear measurement should be 1/8″ + or — 1/16″ longer than the front.

Setting Toe-In

Toe-in can be adjusted by loosening the clamp bolts which lock the tie rod ends to the tie rod and turning the rod to the right to decrease its length or to the left to increase it until the correct adjustment has been obtained. Make sure that the tie rod ends are in correct alignment with their ball studs, Fig. 42, before the tie rod ends are locked with the clamp bolt. If the ball seats are not in alignment with the studs, binding will result.

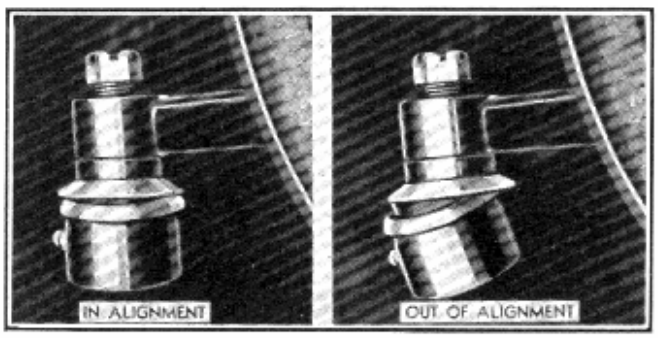

Fig. 42—Alignment of Tie Rod Ends

NOTE:—The threads on the right end of the tie rod are right hand and on the left end they are left hand, so that the tie rod adjustment is made by simply turning the tie rod as necessary, without disconnecting the tie rod end from the steering arm.

Steering Geometry or Toe-Out on Turns

Steering geometry or toe-out on turns is controlled by the steering arm angles. Therefore, the steering geometry check determines whether or not the steering arms are bent. This can be carried out as follows:—

Place turntable scales under each front wheel. To check the right steering arm, turn the steering wheel to the right until the turn-table under the left front wheel shows 20 degrees. Now check the reading of the turntable under the right front wheel, which should be 23 degrees plus or minus 2 degrees.

To check the left steering arm, turn the steering wheel to the left until the turntable under the right front wheel shows 20 degrees and repeat the operations described above.

Replace steering arms if found bent, as their metal structure and shape makes it difficult to straighten them satisfactorily.

CORRECTING FRONT END ALIGNMENT

Caster Correction

Caster corrections in ordinary amounts may be made with the use of caster shims. To increase caster, place the thick side of the shim toward the back between the spring seat and the spring. To decrease caster, place the thick side of the shim toward the front. The maximum amount of caster correction that should be made with the use of shims is 2° and anything over this amount should be corrected with the use of Correcting

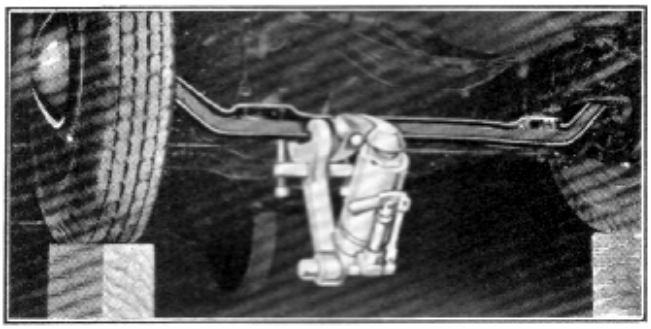

Fig. 43—Decreasing Caster on Right Side

Tools, providing the front springs have not sagged to a point which would seriously affect caster.

Changing caster with the use of correcting tools is an operation of leveling the spring seats in those cases when the use of caster shims is not advisable. Figure 43 shows the proper installation of the tools for decreasing the caster on the right side or for increasing caster on the left side. To increase caster on the right side or to decrease caster on the left side, connect the toggle link to the lower part of the jack on the right hand side of the jack. In other words, the tool installation will be made as shown to either increase or decrease caster, the setup being made at the front of the I-beam to decrease and at the rear of the I-beam to increase caster. As there is a certain amount of "spring" in the I-beam, the valve on the jack should be released before checking the correction with the caster gauge.

Relation Between Camber and King Pin Inclination

From the definitions of king pin inclination and

camber—one being the inward tilt of the king pins and the other the outward tilt of the wheels —it is evident that one can not be corrected with the use of correcting tools without changing the other. For this reason these two factors of front end alignment must be considered together.

Camber and King Pin Inclination Correction

The only instance in which a camber correction may be made at the I-beam, is where both camber and king pin inclination are off by the same amount. Then a correction at the I-beam will take care of both conditions at the same time. Figure 44 shows the installation of the correcting tools for this operation.

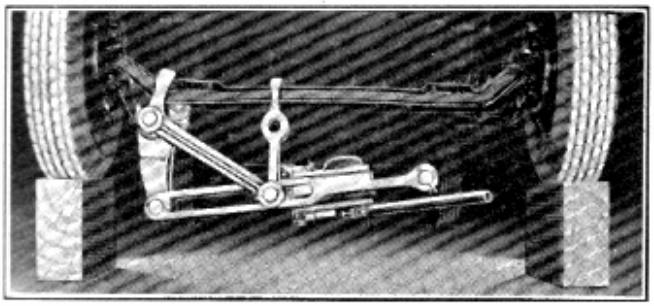

Fig. 44—Correcting Camber and King Pin Inclination

If a check shows that both camber and king pin inclination are out, but not by the same amount, it means not only that the wheel spindle is bent and will have to be replaced, but also that a correction will have to be made at the I-beam to correct the king pin inclination. The same thing is true if the camber is all right and the king pin inclination is out.

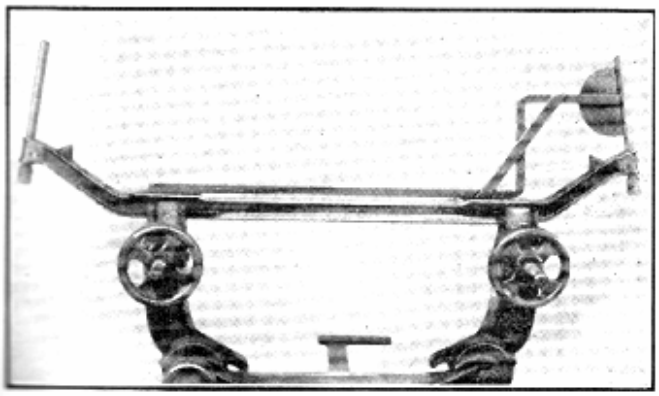

Fig. 45—Front Axle "I" Beam Gauge—Tool J-1185

If a check shows that the camber is out but the king pin inclination is all right, it indicates a bent wheel spindle which will have to be replaced.

Straightening Front Axle "I" Beam

When it is necessary to straighten the front axle "I" beam out of the vehicle, the gauge, J-1185, illustrated in Fig. 45, should be used. The gauge consists of two pins that fit in the king pin holes. These pins are tapered so that they properly fit and center in the axle.

The first operation in straightening "I" beams, is to properly level the spring seats either on an arbor press or with a bending bar. Assemble the king pin pins into the holes in the end of the beam. Place a cord on each pin and slide a square on the spring seat until it touches the cord. Check from the square to center of the spring centre bolt hole. When the axle is in proper alignment the king pin holes and the hole for the spring centre bolt in the spring seats, are all in line.

Place the gauge on the spring seats and check the angle of the pins against the face of the gauge. When the king pin angle is correct, the pins will be parallel with the face of the gauge.

CAUTION—Do not heat front axle "I" beams to straighten. Straighten them cold—heating will change the metal strength and weaken the axle.

FRONT WHEEL BEARINGS

Removal

1. Jack the vehicle up by placing the jack under the front axle "I" beam.
2. Remove the wheel from the hub.
3. Remove the cotter pin from the hub retaining nut, and remove the nut, washer and hub.
4. Remove the inner bearing assembly and oil seal by driving on a long soft punch through the wheel hub; make sure the punch rests on the shoulder of the bearing outer race through the slots cut away on the inside of the hub for this purpose.
5. Use the same procedure to remove the outer bearing outer race.

Inspection

1. Wash all parts in gasoline or other suitable cleaning fluid.
2. Examine all bearings, races, cones and rollers carefully to make sure there is no cracking, chipping or wear present.
3. Check the fit of the inner and outer bearing cones and roller assemblies on the knuckle spindle; these should be free to turn, but not loose enough to permit excessive movement between the bearing cone and spindle.
4. Examine the wheel hub to be sure there are no burrs or dirt present that would prevent the bearing races from being pressed tightly against their seats inside of the wheel hub.

Replacement

1. Press the inner and outer bearing outer races into the hub with an arbor press, making sure

that they are started evenly and are pressed tightly against the shoulder inside of the hub.

2. Pack the inner bearing cone and roller assembly with grease as outlined in, "Lubrication Section".
3. Install a new inner bearing oil seal in the hub.
4. Install the oil deflector on the knuckle spindle behind the inner bearing cone and replace the hub.
5. Pack the outer bearing cone and roller assembly with grease as outlined in, "lubrication section" and place it over the spindle and push it into position in the hub.

   CAUTION:—Do not pack the front hubs with grease between the bearings, as this increases the possibility of grease leaking out onto the brake linings.
6. Install the spindle washer and retaining nut and adjust front hub bearings as outlined under, "Bearing Adjustment."

Bearing Adjustment

1. Remove cotter pin from hub retaining nut and using a tension wrench tighten retaining nut to 33½ foot pounds, at the same time turning hub to make sure that the bearings are seated.
2. Back off the nut 1/6 turn.
3. If at this point a slot in the nut lines up with a cotter pin hole, insert the cotter pin. If it does not line up with the cotter pin hole, tighten nut until the cotter pin can be inserted in the nearest cotter pin hole.

NOTE:—In order to proved for closer bearing adjustment on these models, the cotter pin hole in the spindle is drilled in both the vertical and horizontal plane.

With the bearing inner cup an easy-push fit on the spindle and the nut a free-running fit on the spindle threads, this will give an adjustment toward the tight side, which will allow for settling and working-in of the parts in service.

Front wheel bearings should never be set up on the loose side, as such an adjustment does not bring the rollers and races into proper contact.

It is well to note that the slight friction of a new snugly fitting felt retainer assembly will temporarily produce a slight drag on the wheel, but this is easily recognized and need not be confused with adjustment of the bearing. Spin the wheel, making sure that all parts are in correct position, then clinch cotter pin securely.

STEERING CONNECTING ROD

The steering connection rod used on these vehicles is adjustable at both ends. The adjustment is to screw the plugs in tight then back off ¼ to ½ turn plus the amount necessary to insert the cotter pin in the hole.

FRONT AXLE TIE ROD ENDS

The tie rod end used on C-15 is illustrated in Fig. 46.

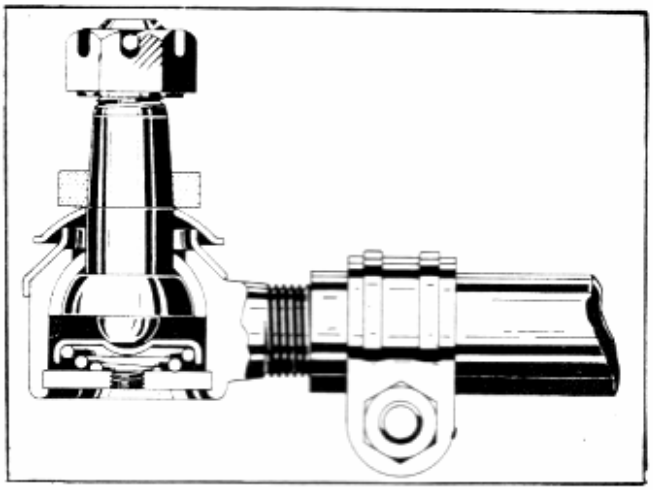

Fig. 46—Front Axle Tie Rod Ends

With this type of tie rod end the adjustment is automatic. Normal wear is taken up by the stud moving on a spherical seat and loosening or rattling are prevented by the tension spring, which bears against the ball.

STEERING KNUCKLE

King Pin Removal

1. Jack up the front of the vehicle and remove the front wheel.
2. Remove the hub cap by taking out the six cap screws holding cap in place.
3. Remove the cotter pin from the outer bearing retaining nut.
4. Remove bearing retaining nut, washer and bearing. This will allow the wheel hub to be lifted off the steering knuckle.
5. Remove the brake backing plate retaining nuts from the inner side of the steering knuckle, and remove the brake backing plate.

   NOTE:—In order to prevent any strain being put on brake hose while performing this operation, the brake backing plate should be wired up to the frame.
6. Remove the steering arm nut located on the front of the steering knuckle and drive the steering arm out of the steering knuckle. Always use a proper threaded knock out tool or a soft faced hammer to prevent damage to the threads.
7. Remove the lock ring, retainer and oil seal

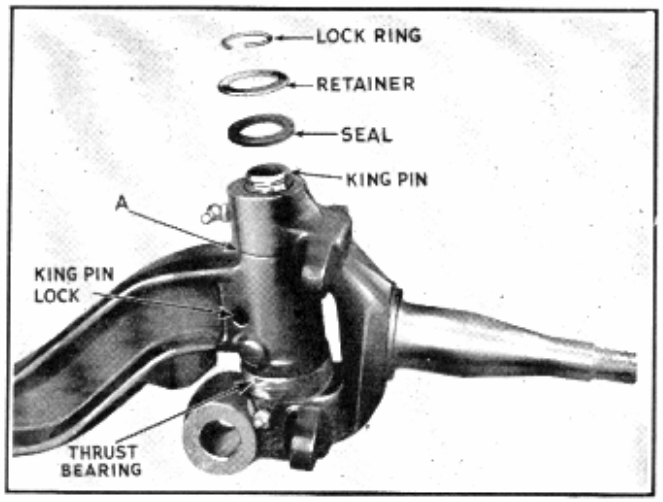

Fig. 47—Steering Knuckle and King Pin

felt from the top of the king pin as shown in Fig. 47.

8. Drive out the king pin lock pin, Fig. 47, which is located in the end of the "I" beam just below the center of the king pin. This pin is tapered and must be driven out from the rear to the front.
9. Drive the king pin out from the top, using a brass drift slightly smaller than the king pin. This will remove the lower expansion plug as well as the king pin and allow the steering knuckle to be removed from the "I" beam.

Inspection

1. Wash all the parts in a suitable cleaning fluid, allowing them to stand long enough to remove all hardened grease, oil or dirt.

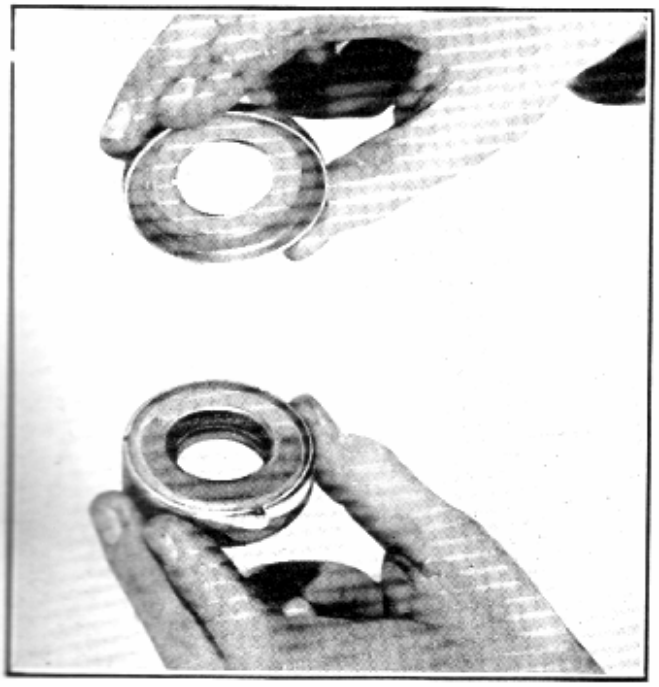

Fig. 48—King Pin Thrust Bearing and Shield

2. Examine all parts thoroughly for wear or damage.
3. Remove the shield from the thrust bearing, Fig. 48, and blow out the bearing, being careful not to rotate with air pressure as this is not only dangerous, but is detrimental to the bearing. If necessary tap the open side of the bearing on a block of wood to remove any particles of dirt remaining in the bearing.
4. Check the king pin hole in the end of the axle "I"beam with a new king pin. If it is worn it should be reamed out and oversize king pins installed.

King Pin Bushing Removal and Replacement

1. If necessary to fit an oversize king pin, ream out the king pin hole in the "I" beam to the correct oversize before installing new bushings in the steering knuckle, as the oversize may be sufficient to allow the old bushings to be reamed to the new oversize, providing they are not chipped or cracked. Oversize king pins can be obtained in .001", .010", .020".
2. If it is found necessary to remove the old bushings a proper bushing puller should be used. If this is not obtainable a steel drift slightly larger than the king pin, but smaller than the hole in the steering knuckle may be used to drive out the old bushings.

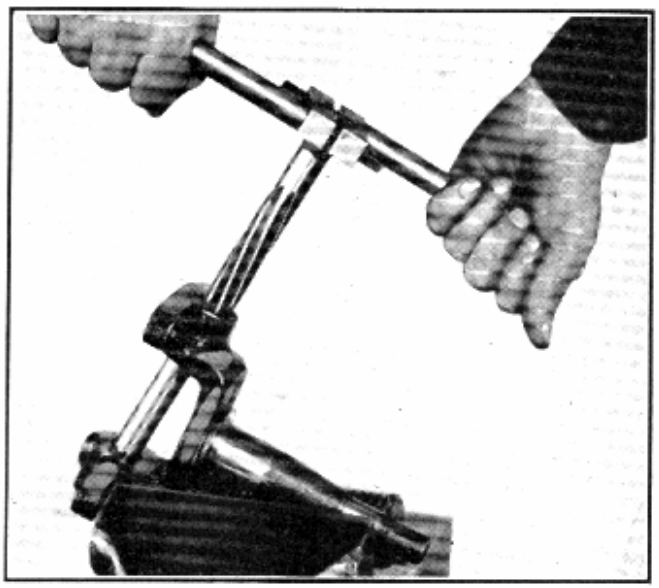

Fig. 49—Reaming Steering Knuckle Bushings

3. Before installing the new bushings, the outer edges should be filed lightly. This will allow the bushing to be entered in the steering knuckle freely and square.
4. Line up the holes in the bushings with the lubrication fitting holes in the steering knuckle body, noting that the holes in the bushings are nearer one end than the other.

5. Press the bushings into place with an arbor press, do not use a hammer as this will distort the bushing.
6. To ream or hone the king pin bushing use either an extra long tool, or one with a long pilot, Fig. 49, so that the operation will keep both bushings in correct alignment and will not cause a binding when the king pin is installed.

Kin Pin Replacement

1. Place the steering knuckle over the end of the "I" beam.
2. Lubricate the steering knuckle thrust bearing, and install it with the shielded side up between the lower edge of the "I" beam and the steering knuckle yoke.
3. Hold the weight of the steering knuckle up off the top of the axle "I" beam and with a feeler gauge check the clearance between the top of the "I" beam and the steering knuckle yoke as shown at "A" Fig. 47. The clearance at this point should not exceed .006". If the clearance is greater than .006" install steel shims which are available in .005" and .015" thickness.

NOTE:—These shims should be installed between the upper side of "I" beam and the steering knuckle.

4. Lubricate the king pin and bushings; install the king pin making sure that the cut away slot is lined up with the lock pin hole in the end of the axle "I" beam.
5. Install the tapered king pin lock from the front of the "I" beam and center punch around the head to hold the pin in place.
6. Install a new expansion plug at the lower end of the king pin.
7. Replace the oil seal felt, retainer and lock ring on the top of the king pin, Fig. 47.
8. Replace the brake backing plate using new lock washers and tighten securely.
9. Replace the steering arm in the steering knuckle. Tighten securely and install a new cotter pin.
10. Replace the hub and drum assembly; install the outer bearing, spindle washer and retaining nut. Adjust bearings as outlined under "Bearing Adjustment".

SERVICE DIAGNOSIS AND CORRECTIVE METHODS

SYMPTOM AND PROBABLE CAUSE	REMEDY
Hard Steering	
1. Front Axle shifted. (C-15).	1. Re-locate and tighten "U" bolts to 110 ft. lbs.
2. Lack of lubrication.	2. Lubricate at following points:— Tie rod ends. Steering gear. Steering connecting rods. Steering knuckles.
3. Excessive caster. (C-15).	3. Adjust caster to specifications.
4. Improper Toe-in.	4. Adjust Toe-in to specifications.
5. Bent Frame.	5. Straighten or replace.
6. Steering Gear improperly adjusted.	6. Re-adjust.
7. Tires under inflated.	7. Inflate tires according to specifications.
Shimmy	
1. Knuckle bearings loose or worn. (C-15).	1. Replace bearings.
2. Tie rod loose.	2. Tighten or replace worn parts.
3. Front axle shifted. (C-15).	3. Re-locate and tighten "U" bolts to 110 ft. lbs.
4. Insufficient toe-in.	4. Re-adjust.
5. Excessive or insufficient caster. (C-15).	5. Adjust to proper caster.
6. Improper load distribution.	6. Equalize load.
7. Steering gear loose.	7. Adjust steering gear.
8. Tires unevenly inflated.	8. Inflate tires according to specifications.

SYMPTOM AND PROBABLE CAUSE	REMEDY
Steering Wander	
1. Excessive or insufficient caster. (C-15).	1. Adjust to proper caster.
2. Bent Axle parts.	2. Replace bent parts.
3. Axle shifted. (C-15).	3. Re-locate and tighten "U" bolts to 110 ft. lbs.
4. Front Wheel Bearings out of adjustment.	4. Adjust wheel bearings.
5. Tight Steering Gear.	5. Adjust and lubricate steering gear and linkage.
6. Improper Toe-in.	6. Adjust Toe-in to Specifications.
Lubricant Leaks (4x4 Vehicles)	
1. Leak at Housing Outer End Gasket or Oil Seal	1. Replace gasket or seal according to instructions.
2. Leak at Differential.	2. Replace Differential or Axle Housing Cover Gasket.
3. Leak at Pinion Shaft.	3. Make sure axle housing vent is not plugged. Replace Seal if necessary.

For symptom and probable cause and remedy for Front Axle noises, refer to "Rear Axle", Section "H" of this Manual.

SPECIFICATIONS

C-15

Make ..... G.M.
Type ..... Reverse Elliott
Caster—Degrees ..... $2\frac{3}{4} \pm \frac{1}{2}$
Camber—Degrees ..... 1 ± 1
Kingpin Inclination—Degrees ..... $7°10' \pm 1°$
Toe-In—Inches ..... $\frac{1}{8}'' \pm \frac{1}{16}''$
Steering Geometry (Toe-Out on Turns)
Outside Wheel—Degrees 20
Inside Wheel—Degrees ..... 23 ± 2
Turning Angle ..... 33°

4 x 4 VEHICLES

Housing ..... Banjo Type
Drive ..... Through Springs

Differential (See "Rear Axle Section")
Drive ..... Spiral Bevel
Gear Ratio ..... See "Rear Axle" Section
Bearings ..... Tapered Roller

Pinion Shaft
Bearings
Inner ..... Straight Roller
Outer ..... Double Tapered Roller

Universal Joint
Type—Bendix Weiss .... 5" Constant Velocity
6" Constant Velocity

Pivot Pins
Adjustment ..... Shim to obtain .005" load on the pivot pin bearings
Shim Thickness ..... .005", .031"
Bearing ..... Single Row Thrust Ball Bearing

Wheel Bearings
Inner and Outer ..... Tapered Roller
Adjustment .... Shim to obtain .003" to .010" Clearance

Turning Angle
Maximum Angle of Front Wheel
(5" joint) 26 degrees
(6" joint) 30 degrees

Steering Geometry
Front Wheel Camber ..... $\frac{3}{4}°$
Front Wheel Caster (except C-8A) ..... $2\frac{1}{4}°$
(C-8A) ..... $2\frac{3}{4}°$
Front Wheel Toe-In ..... $\frac{1}{8}'' \pm \frac{1}{16}''$