

Fig. 154 Checking gear backlash with dial indicator

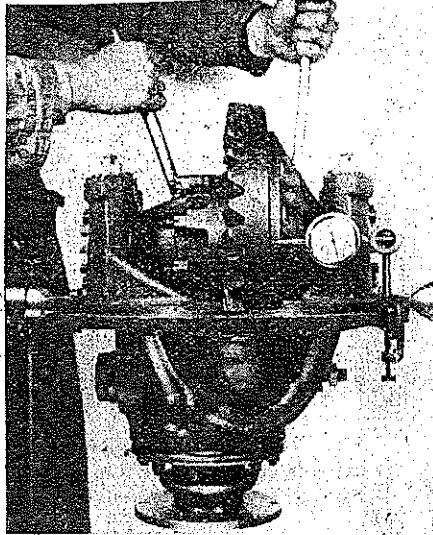


Fig. 155 Using dial indicator to establish zero end play in differential bearings

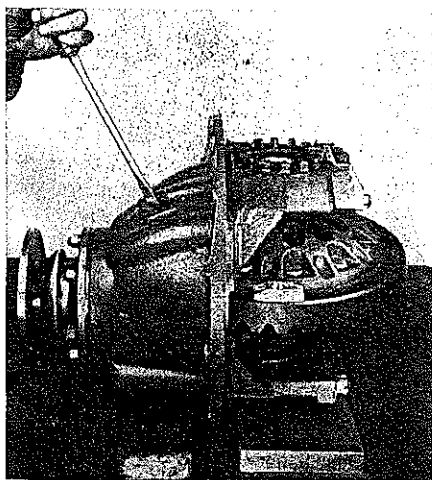


Fig. 156 Removing thrust block adjusting screw

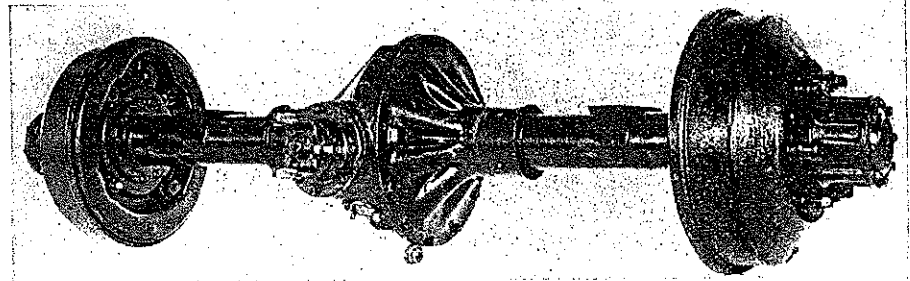


Fig. 158 Timken Unit Housing Type Axle, Model H-150

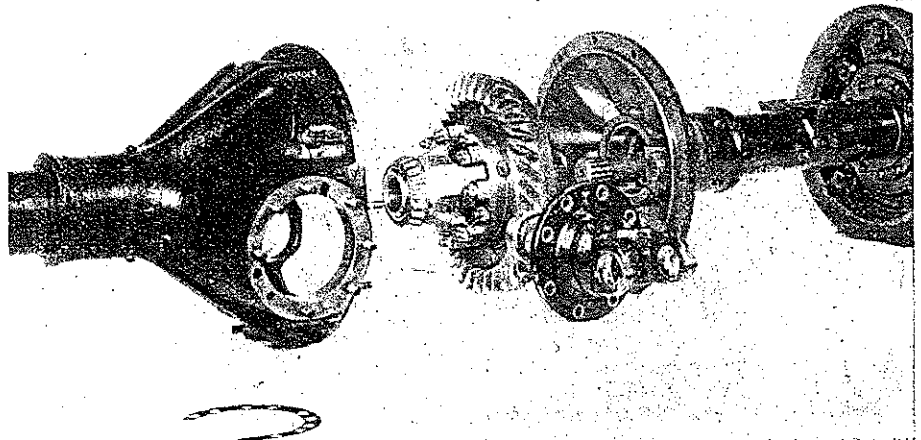


Fig. 159 Timken Unit Housing Type Axle

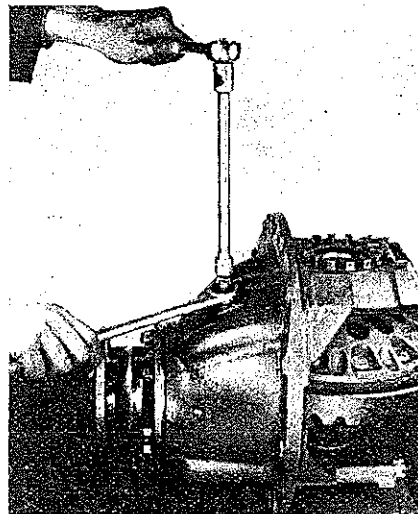


Fig. 157 Adjusting thrust block clearance by means of adjusting screw

thrust block is aligned with adjusting screw hole.

4. Install adjusting screw and lock nut, Fig. 157, and tighten adjusting screw enough to locate thrust block firmly against back face of bevel gear.
5. To secure the correct adjustment of .010-.015" clearance, loosen adjusting screw $\frac{1}{4}$ turn and lock securely with nut.

6. Recheck to assure minimum clearance of .010" during full rotation of bevel gear.

INSTALL CARRIER IN HOUSING—

1. Install new gasket on axle housing flange.
2. Roll carrier into position on roller jack. Start carrier into housing with four flat washers and nuts equally spaced and tighten alternately to draw carrier squarely into the axle housing. Driving carrier into housing with a steel hammer will damage carrier stud flange, which will cause oil leaks.
3. Remove flat washers and install lock washers and nuts, tightening them to the correct torque.
4. Connect universal at pinion shaft and install axle shafts.

LUBRICATION—

1. Fill axle housing to the correct level with specified lubricant.
2. Lubricate universal joint.
3. Jack up both rear wheels and operate vehicle in high transmission gear at approximately 25-30 mph for five minutes to assure satisfactory lubrication of all parts of the carrier assembly. Do not operate with one wheel jacked up as this will result in overheating the differential spider with resultant galling or shearing of spider pins.

TORQUE LIMITS—See the listing in the two-speed, double-reduction axle section

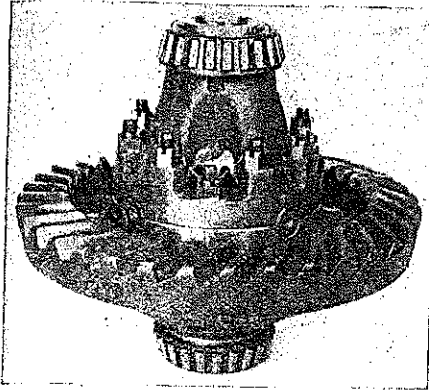


Fig. 160 If original identification marks are not clear, mark differential case halves with a punch before disassembling for correct alignment when reassembling

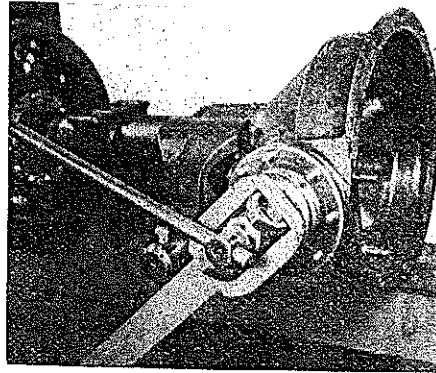


Fig. 162 Secure yoke with holding tool and remove pinion shaft nut and washer

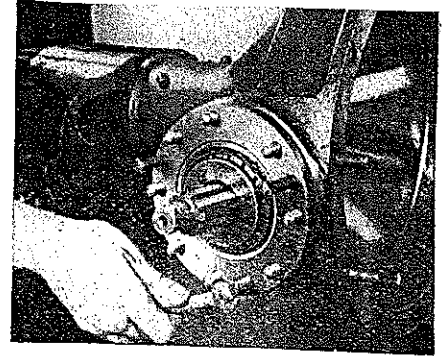


Fig. 164 Remove pinion and cage, using puller screws in holes provided

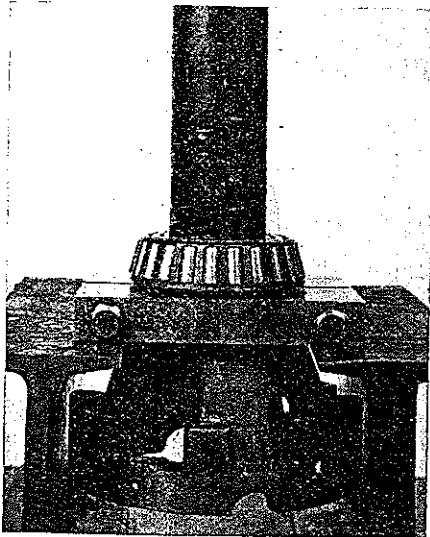


Fig. 161 Remove differential bearings with bearing puller

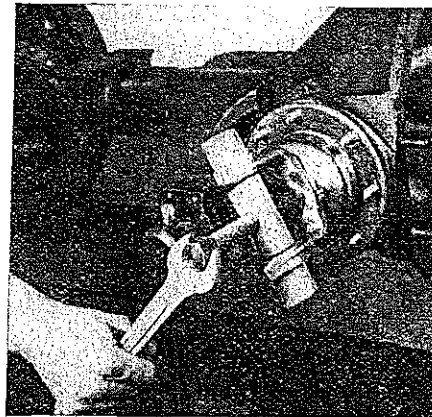


Fig. 163 Insert puller through yoke and remove

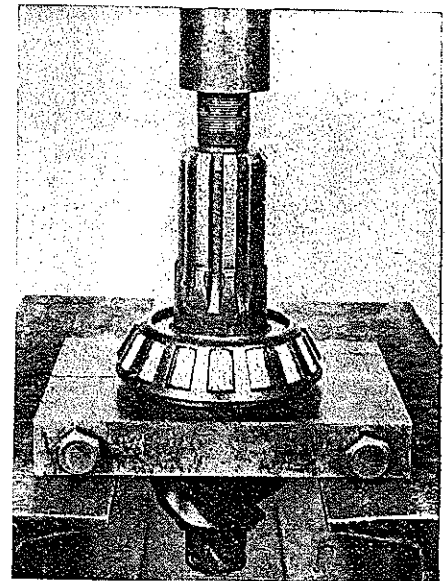


Fig. 165 Remove pinion shaft bearings with bearing puller

for these recommendations, disregarding, of course, any item that does not apply to single reduction units.

TIMKEN SPLIT HOUSING TYPE AXLE

The Timken split housing type, Fig. 158, is a single reduction, hypoid geared axle. The differential and gear assembly is mounted on tapered roller bearings with the cups assembled in the case and cover halves of the unit. The straddle-mounted pinion has two tapered roller bearings and a radial thrust bearing. The tapered roller bearings are located forward of the pinion teeth and the radial bearing at the inner end of the pinion.

REMOVING AXLE—

1. Remove plug from bottom of axle housing and drain lubricant.
2. Disconnect universal at pinion shaft.
3. Disconnect brakes.

4. Remove spring clips.
5. Remove axle from under vehicle.
6. Remove axle shaft stud nuts and washers.
7. Rap axle shafts sharply in center of flange with a heavy steel hammer to free dowels. Remove taper dowels and axle shafts, and carefully remove outer oil seal assemblies.
8. Remove wheels.
9. Place axle assembly in vise, holding by the tube on the case half.

DISASSEMBLE AXLE—

1. Before proceeding, place length of pipe or suitable support slightly smaller than the axle shaft splines approximately two-thirds through the axle from the case side to prevent dropping the differential assembly.
2. Remove bolts, nuts and washers from case and cover and remove cover half, Fig. 159.
3. Remove differential and gear assembly.
4. Remove support pipe.

DISASSEMBLE DIFFERENTIAL & GEAR—

1. If original identification marks are not clear, mark differential case halves, Fig. 160, with a punch before disassembling

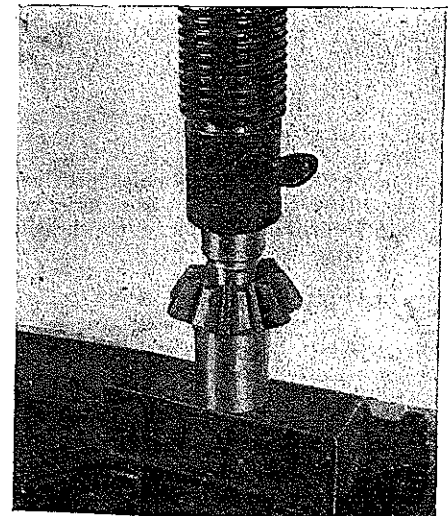


Fig. 166 Pressing bushing into differential pinion. Use adapter with correct size offset to fit bushing

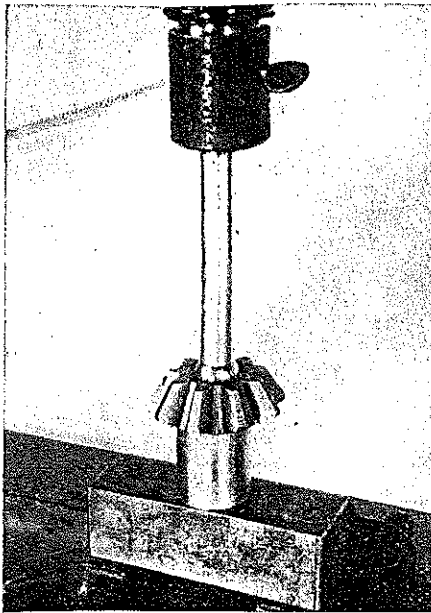


Fig. 167 Using a bar to press burnishing ball through bushing

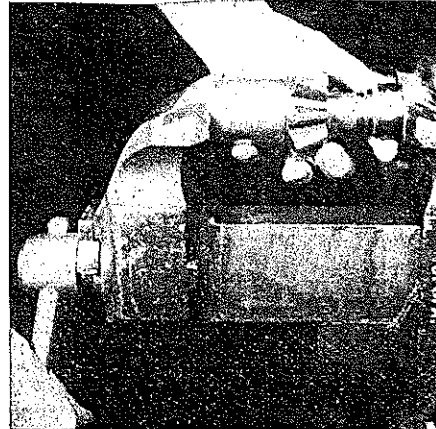


Fig. 168 Using short bar and vise to install bushing in differential pinion

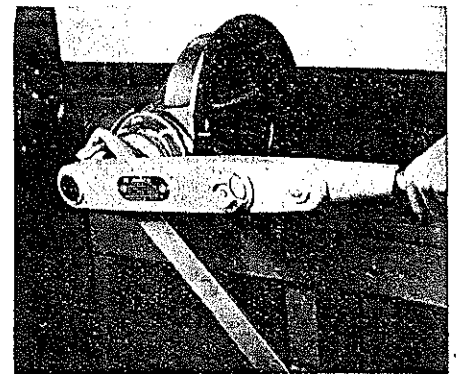


Fig. 171 Removing pinion shaft nut

for correct alignment when reassembling.

2. Cut lock wire, remove bolts and separate case halves.
3. Remove spider, pinions, side gears and thrust washers.
4. Remove rivets and separate gear and case if required. In removing rivets, carefully center punch rivets in center of head. Use drill 1/32" smaller than rivet body to drill through head. Press out rivets.
5. Use bearing puller, Fig. 161, to remove bearings if necessary.

REMOVE PINION & CAGE—

1. Secure yoke with holding tool, Fig. 162, and remove pinion shaft nut and washer.
2. Insert puller through yoke, Fig. 163, and remove.
3. Remove pinion bearing cover and oil seal assembly.
4. Remove pinion and cage assembly, using puller screws in holes provided, Fig. 164. Driving pinion from inner end with a drift will damage the bearing lock ring groove.

DISASSEMBLE PINION & CAGE—

1. Tap shaft from cage with soft mallet or press shaft from cage.
2. Remove outer bearing from cage.
3. Remove spacer or spacer combination from pinion shaft.
4. Remove rear thrust bearing, Fig. 165, and radial bearing with bearing puller if necessary to replace.
5. Remove oil seal from bearing cover.
6. If necessary to remove differential bearing cups, wire the selective spacers which are behind the cups to their respective axle halves.

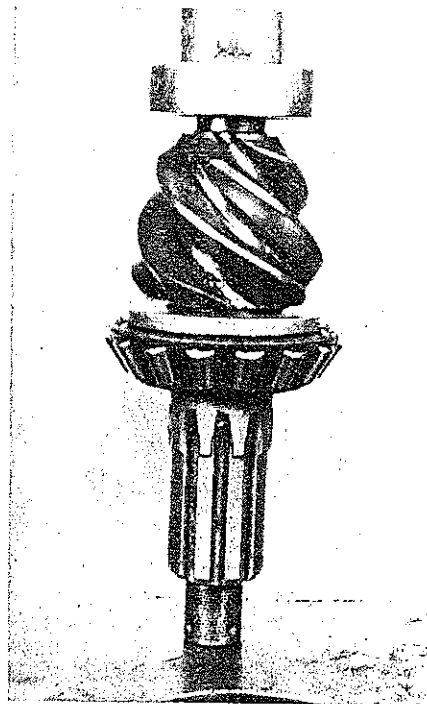


Fig. 169 Pressing pinion shaft radial bearing

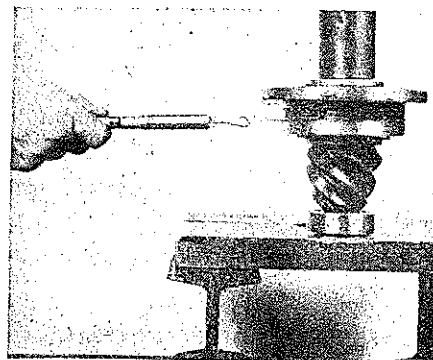


Fig. 170 Checking pinion shaft bearing preload

INSPECTION—Clean and inspect all parts in the manner outlined in the Two-Speed, Double Reduction axle section of this chapter, disregarding, of course, any item that does not apply to this type unit.

DIFFERENTIAL PINION BUSHINGS—If necessary to replace these bushings, proceed as follows:

1. Split the worn bushing with a hacksaw and drive it out.
2. Remove burrs or sharp corners from inner edge of pinion bore to prevent shearing or buckling of bushing on installation.
3. Place pinion on anvil, Fig. 166. Position bushing in inner end of pinion bore and press squarely into position. Use adapter with correct size offset to fit bushing.
4. Use bar to press burnishing ball through bushing, Fig. 167. If desirable, the bar may be shortened to permit the use of a bench vise to install and burnish bushing, Fig. 168.

REASSEMBLE AXLE

REASSEMBLE PINION & CAGE—

When a new pinion is required, the bearing and cage assembly furnished for service purposes should be used. This includes the cage with bearing cups assembled, bearing cones and selective spacer required to obtain the correct bearing preload. The used bearing cones should be removed from the pinion shaft and the new bearings and spacer used in the assembly.

1. Press rear thrust and radial bearings, Fig. 169, firmly and squarely against the pinion shoulders with a suitable sleeve.
2. Install radial bearing lock ring and squeeze ring into pinion shaft groove with pliers.
3. If new cups are to be installed, press firmly against pinion bearing cage shoulders.
4. Lubricate bearings and cups with light machine oil.
5. Insert pinion and bearing assembly in pinion cage and position spacer or



Fig. 172 Installing pinion shaft oil seal with seal driver

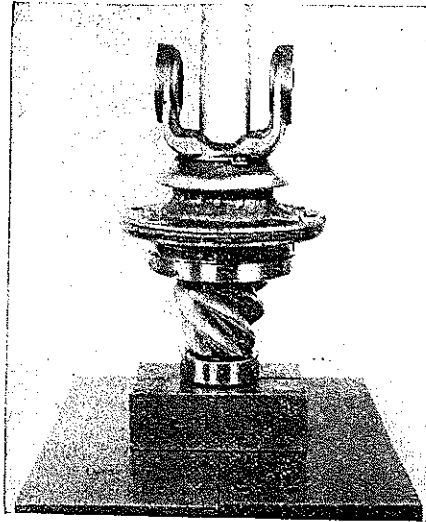


Fig. 173 Pressing on pinion yoke

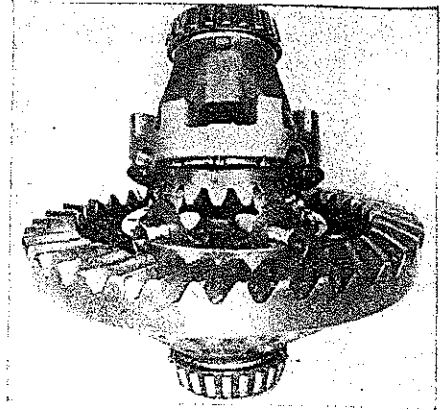


Fig. 175 Align mating marks before assembling differential case halves

spacer combination over pinion shaft.

6. While in a press under 25,000 pounds pressure, check bearing preload torque. Wrap soft wire around cage, Fig. 170, and pull on a horizontal line with a pound scale. If a press is not available, the yoke may be installed and the pinion nut tightened to 300-400 foot pounds torque for checking. If rotating torque is not within 12-18 inch-pounds, use thinner spacer to increase or thicker spacer to decrease preload. As an example, assuming the pinion cage diameter to be 6", the radius would be 3" and with five pounds pull would equal 15 inch-pounds preload torque.
7. Press yoke against forward bearing and install washer and pinion shaft nut.
8. Place pinion and cage over carrier studs. Hold yoke as shown in Fig. 171 and tighten pinion shaft nut to 300-400 foot-pounds torque.
9. Recheck pinion bearing preload torque. If rotating torque is not within 12-18 inch-pounds, repeat foregoing procedure.
10. Hold yoke and remove pinion shaft nut and yoke.
11. Lubricate pinion shaft oil seal and cover outer edge of seal body with a non-hardening sealing compound. Press seal against cover shoulder with seal driver, Fig. 172.
12. Install new gasket and bearing cover.
13. Press yoke against forward bearing, Fig. 173, and install washer and pinion shaft nut.
14. Tighten pinion shaft nut to 300-400 foot-pounds torque and install cotter key. Do not back off nut to align cotter key holes.

ASSEMBLE DIFFERENTIAL & GEAR

1. Rivet bevel gear to case half with new rivets. If a new gear or differential case is to be used, the rivet holes in the gear and case should be checked for alignment and line-reamed if necessary. The gear must be tight on the case

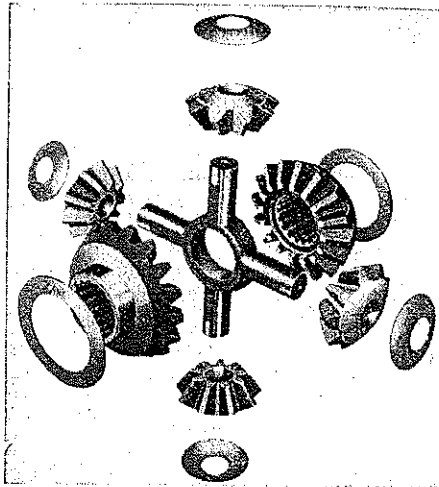


Fig. 174 Layout of differential parts

pilot and riveted flush with the differential case flange. Check with a .002" feeler gauge. Rivets should not be heated but should be upset cold. When the correct rivet and rivet set is used, the head being formed will be at least 1/8" larger in diameter than the rivet hole. The head will then be approximately the same height as the pre-formed head. The formed head should not exceed 1/16" less than the pre-formed head as excessive pressure will cause distortion of the case holes and result in gear eccentricity.

2. Lubricate differential case inner walls and all component parts, Fig. 174, with axle lubricant.
3. Position thrust washer and side gear in bevel gear and case half.
4. Place spider with pinions and thrust washers in position.
5. Install component side gear and thrust washer.
6. Align mating marks, Fig. 175, position component case half and draw assem-

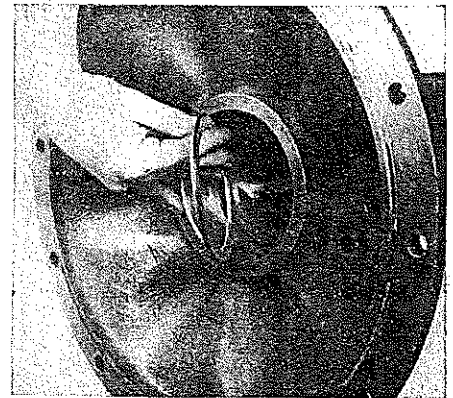


Fig. 176 Installing differential bearing spacer

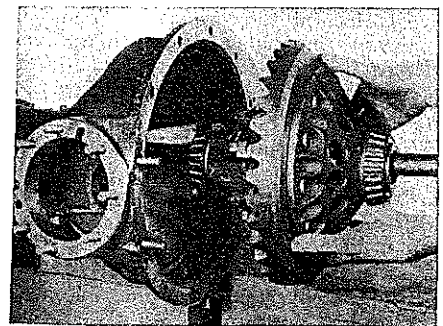


Fig. 177 Installing differential and gear into case

bly together with four bolts equally spaced.

7. Check assembly for free rotation of differential gears and correct if necessary.
8. Install remaining bolts, tighten to 80-110 foot-pounds torque and thread with lock wire.
9. If bearings are to be replaced, press them firmly and squarely on differential case halves.

ADJUST DIFFERENTIAL BEARING PRELOAD—

1. Remove thrust block, using drift to

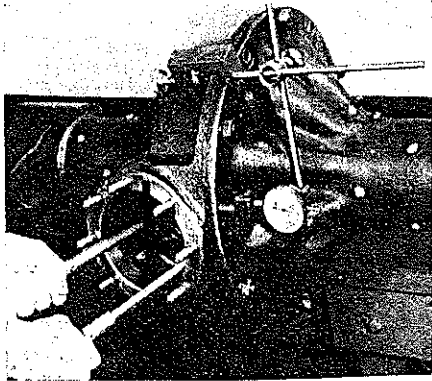


Fig. 178 Checking differential and gear end play with dial indicator through thrust block pin hole

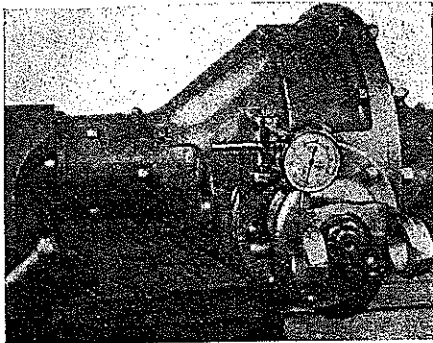


Fig. 179 Checking gear lash with dial indicator

drive pin out of cover.

2. Install differential bearing spacers, Fig. 176, in the original positions if new bearing cups are installed. Spacers must be installed with the chamfered edge toward the machined surfaces in the housing.
3. Insert pipe used for disassembling case half.
4. Position differential and gear over pipe, Fig. 177, with gear facing the case half and slide into position.
5. Install new gasket over case flange.
6. Position cover half over pipe and draw axle halves together with six bolts equally spaced.
7. Check differential and gear assembly end play with dial indicator through thrust block pin hole against gear, Fig. 178. Both differential bearing preload and gear lash are controlled by selective spacers, available in thickness steps of .003", which are installed between the differential bearing cups and the case and cover halves of the axle housing. Bearing preload may be increased or decreased by using a thicker or thinner spacer respectively in the cover half of the assembly. The gear may be moved toward the pinion, decreasing the gear lash, by decreasing the thickness of the spacer in the case half and increasing the thickness of

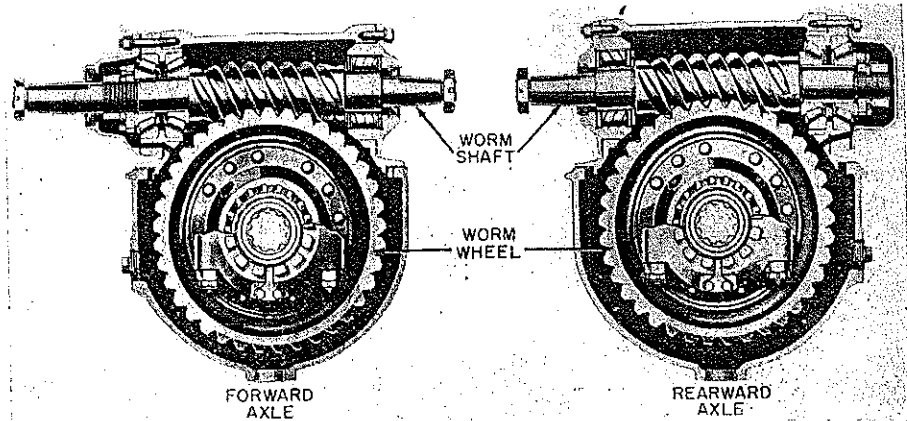


Fig. 180 Timken worm drive tandem axles

the spacer by the same amount in the cover half. Reversing this transposition will move the gear away from the pinion and increase the gear lash. The correct preload of .008" to .013" tight is obtained as follows:

8. Increase or decrease the thickness of the spacer used in the cover half to obtain a freely rotating gear with from .000" to .005" end play.
9. Remove spacer in cover half and install a spacer .008" plus the end play thicker than the spacer used to obtain .008" to .013" preload.
10. If a new gear or case has been installed, check runout at back face of gear. Correct and recheck if runout exceeds .005".
11. When adjustment is satisfactory, remove cover and move differential and gear out on support sufficient to permit installation of pinion and cage assembly.
12. Install thrust block and pin.

INSTALL PINION & CAGE—

1. Coat cage flange contact surface with non-hardening sealing compound and position cage assembly over studs and tap into position with a soft mallet.
2. Install lock washers and stud nuts and tighten to 70-90 foot-pounds torque.

CHECK & ADJUST GEAR LASH—

1. Install differential and gear assembly and assemble cover with six bolts equally spaced and tighten to 85-95 foot-pounds torque.
2. Check gear lash with dial indicator from a position 2" from pinion shaft center, Fig. 179. The amount indicated at this point will be twice the amount of the actual gear lash.
3. Transpose spacers used in both case and cover, decreasing the thickness of the spacer on the side in the direction which the gear is to be moved and increasing the thickness of the opposite spacer exactly the amount as required to obtain the correct gear lash of .006-.012" (.012-.024" on indicator).
4. Install remaining bolts, washers and nuts in housing and tighten all nuts in

bolt circle to 85-95 foot-pounds torque.

INSTALL AXLE IN VEHICLE—

1. Position axle under vehicle and install spring clips.
2. Clean and lubricate hub cavity and wheel bearings if required.
3. Install wheels and adjust wheel bearings.
4. Install new outer oil seal if required.
5. Install axle shafts, using new gaskets. Tighten stud nuts to 85-95 foot-pounds torque.
6. Connect brakes and universal joint.

LUBRICATION—

1. Fill axle with 11 pints of specified lubricant.
2. Lubricate universal joint.
3. Jack up both rear wheels and operate vehicle for five minutes in high transmission gear at approximately 25-30 mph to assure satisfactory lubrication to all parts of the assembly. Do not operate with one wheel jacked up as the differential spider will overheat which could cause galling or shearing of the spider pins.

NOTE—The frequency of wheel bearing lubrication is dependent largely upon the operator's individual requirements. Speedy loads and general operating conditions should be considered but in no event should the intervals exceed 15,000 miles.

TIMKEN WORM DRIVE AXLE

Fig. 180—These axles are heavy duty, four wheel tandem drive, worm gear, single reduction, full floating type. The front and rear axles of this tandem unit are of similar construction. This tandem axle unit is the "through drive" type in which engine torque is directly transmitted from the forward driving axle to the rear driving axle. These are connected with an intermediate propeller shaft.

DISASSEMBLY

The following procedure assumes that the rear axle housings are not going to be re-

moved from the vehicle. However, if either or both housings are to be removed, it will be necessary to disconnect the torque rods, and then proceed as follows:

1. Drain lubricant.
2. Disconnect front propeller shaft at forward rear axle flange.
3. Disassemble universals at each end of intermediate propeller shaft, leaving yokes on worm shafts.
4. Disconnect brake lines.
5. Remove nuts, lock washers and tapered dowels from axle shaft flanges and remove axle shafts by means of puller screws.
6. Remove axle shaft flange gaskets.
7. Remove nuts, lock washers and tapered dowels that hold differential carrier to axle housing.
8. Remove differential carrier and gasket from axle housing.
9. Remove companion flange and yokes with suitable puller.
10. Before removing any parts from carrier assembly, mark one differential carrier leg and bearing cap to identify for proper reassembling.
11. Remove cap screws, lock washers and adjusting ring locks.
12. Remove differential bearing caps and adjusting rings.
13. Remove differential and worm wheel assembly.
14. If necessary, remove differential side bearings with a suitable puller.
15. If worm wheel is to be removed, mark both halves of the differential and then drill rivet heads from one side, using a drill slightly larger in diameter than the rivet, being careful to drill rivet head only. Use a punch to remove remaining portion of rivet.
16. Remove spider, pinions, side gears and thrust washers.
17. Remove bearing cages, covers and gaskets. Remove plain cover from rear unit and front cover from forward unit. Care must be exercised when removing cages and covers to avoid damaging oil seals when passing shaft keyways.
18. Using a soft hammer, tap worm shaft at the straight bearing end until assembly can be removed at opposite end of carrier.
19. Remove spacer washer from straight bearing end of worm shaft.
20. Remove straight bearing. Then, using a brass bar, tap straight bearing cage out of carrier. Remove gasket.
21. If necessary to remove worm shaft or bearings, clamp shaft in vise with soft jaws, straighten locking washer and remove lock nut, locking washer, adjusting locking ring and adjusting nut. Remove shaft from vise. Press worm shaft through bearing and cage. Then press off cone of inner bearing.

REASSEMBLY

1. Press inner taper bearing on worm shaft. Install bearing cage and outer tapered bearing, then clamp shaft in vise. Install adjusting nut and tighten

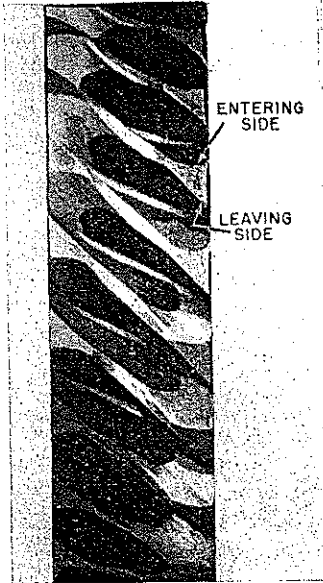


Fig. 181 Tooth contact on worm wheel

to a preload of .000" to .002", which is equivalent to 6-8 lbs. in. of torque. Install adjusting locking ring, locking washer, and outer lock nut. Recheck adjustment. Then bend locking washer over nut securely and remove assembly from vise.

2. Install oil seals in bearing cages and cover of front unit.
3. Attach straight bearing cage and gasket to carrier.
4. Slide spacer washer on worm shaft at straight bearing end.
5. Install worm shaft in carrier, using care to avoid damage to oil seals when passing shaft keyways.
6. Install bearing covers and gaskets. Be sure oil return hole in bottom of taper bearing cage and carrier casting is open. Install lock washers and nuts.
7. Reassemble differential case parts to worm wheel. Use new thrust washers and place marked halves of case together.
8. When attaching a new worm wheel to differential case prior to riveting, install two bolts opposite each other. Install first rivet 90 degrees to bolts. Install second rivet opposite or at 180 degrees to first rivet. Remove bolts and install third rivet at 90 degrees to first two rivets. Then install fourth rivet opposite third rivet and complete riveting in same manner. Sufficient pressure must be applied to rivets to expand and cause them to fill completely the holes in which they are installed. If too much pressure is exerted on rivets, worm wheel may be distorted, making it impossible to obtain correct tooth contact. Riveting should be done cold as hot rivets will shrink when cooling, leaving a space and inviting shearing upon the application of torque.
9. Install differential side bearings on case.

10. Position differential and worm wheel in carrier and install bearing cups and adjusting rings.
11. Check for mating marks and install differential bearing caps. Adjust assembly in proper position and lock stud nuts with new cotter pins. (See Adjustments further on.) If new worm wheel has been assembled to differential, check side of wheel for runout, rotating wheel on differential bearings. Runout should not exceed .004".
12. Install adjusting ring locks.
13. Install differential carrier assembly in axle housing—facing proper direction, Fig. 180. Use new gasket and fasten securely, using tapered dowels, lock washers and nuts.
14. Install axle shafts, gaskets, tapered dowels, lock washers and nuts.
15. Install keys in shaft keyways.
16. Use a suitable flange applier to install companion flange and yokes. Lock in place with nuts and new cotter pins.
17. If either or both axle housings have been removed from vehicle, it will be necessary at this time to mount these axles and connect the torque rods before proceeding with the following:
18. Reassemble universals at each end of intermediate propeller shaft.
19. Connect front propeller shaft at forward rear axle flange.
20. Connect brake lines.
21. Fill axle housing with proper lubricant to level plug.

ADJUSTMENTS

WORM SHAFT BEARINGS—This adjustment is made with the differential carrier removed from the axle housing and differential case and worm wheel removed.

1. Remove bearing cover at tapered roller bearing end.
2. Remove outer locking nut, washer and disc.
3. Tighten inner adjusting nut until all noticeable end play of the worm shaft is eliminated. Test this adjustment which should be .000" to .002" tight, or 6-8 lbs. in. as indicated on torque wrench.
4. Install locking disc, washer and nut. Test adjustment again and bend locking washer over nut securely.

DIFFERENTIAL BEARINGS & WORM GEAR—In adjusting differential bearings a combination adjustment is necessary.

1. All end play must be taken out of bearings by means of the bearing adjusters at sides of differential.
2. The worm and worm wheel must be set in proper alignment by adjusting differential bearings on both sides, end for end, moving the differential and worm wheel assembly to one side or the other as required to obtain correct alignment.

All ordinary adjustment of the differential bearings should be made on the left hand bearing. Do not disturb the right hand bearing except when it is necessary to take down the entire differential assembly. In adjusting the left bearing only, the align-

DRIVING AXLES

ment of the worm and wheel will not be disturbed.

In order to check the contact position on the worm and wheel teeth, paint the wheel teeth with a thin coat of Prussian Blue, and rotate the worm shaft.

When adjusting worm gearing, it must be remembered that each tooth consists of an entering and leaving side, Fig. 181. In other words, when worm shaft revolves, causing rotation of worm wheel, the point where worm threads enter wheel teeth is the entering side; the opposite tooth side is the

leaving side.

The entering side of the tooth is the portion that has the flattest angle—the leaving side being almost straight or vertical.

The proper tooth contact is approximately 80% full, starting at the leaving side—not the entering side.

To obtain this adjustment, proceed as follows:

First set worm wheel to its maximum amount of backlash, then move wheel to right or left with the bearing adjusters until proper contact is obtained as shown in Fig.

181. Use drive sides of teeth when making adjustment as coast sides will automatically show a desirable tooth contact when drive side is correct.

To adjust differential bearings after the proper tooth contact is obtained, adjust the left bearing adjuster only. Tighten the bearings by screwing in the bearing adjuster until all end play in the differential assembly has been removed. Having obtained a good tight adjustment, unscrew the bearing adjuster one notch and lock in this position with the adjuster locks.

STEERING GEARS

Before making an adjustment for play or binding in the steering gear, jack up the front wheels and make sure that the complaint is not due to some other cause. Do not make adjustments in the steering gear to correct any erratic action of the front wheels, as evidenced by wheel shimmy or steering wheel fight. If these conditions exist, check the tires for proper inflation and see that the camber, caster and toe-in are according to specifications. Shock absorber tension or adjustment should be according to the recommended standard. Tie rod and drag link sockets or connections should also be adjusted to the correct tension and freedom. Make sure that the pitman arm is tight on the cross shaft and that its lockwasher and nut are tight also.

End play in the worm (or cam) shows up as play in the steering tube, indicated by up and down movement of the steering wheel. When this adjustment is correct, the steering wheel should turn freely with the thumb and forefinger lightly gripping the steering wheel rim, and without any up and down movement of the column tube. If end play is less than .010", no adjustment is required.

To correct misalignment of the steering column, loosen the frame bracket bolts enough to allow the gear to shift, and to line up at the angle determined by the setting of the steering column bracket at the instrument board. Then tighten the frame bracket bolts. Now, loosen the instrument board bracket and allow it to match the position of the steering column, and then tighten the bracket. If the bracket is of the single-position type, change the bracket to the position of the steering column. Do not spring the column to the bracket.

To locate the steering gear in its central position, turn the steering wheel from one extreme to the other and count the number of turns required. Now, turn the steering wheel just one-half the distance of the

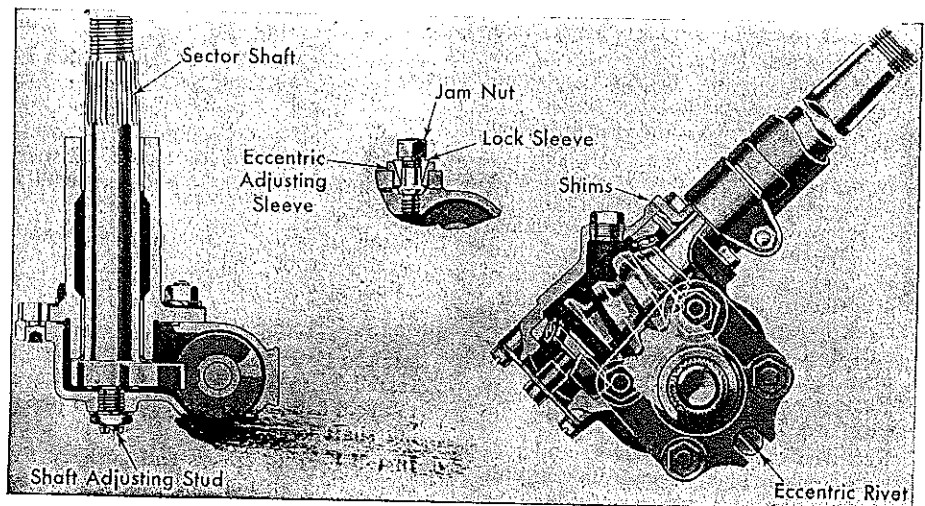


Fig. 1 Gemmer models 120, 140. Worm and sector gear

total movement. Most steering wheels have a trade mark, or depression, on the under side of the spoke that should point directly up or down, whichever location is nearest when the steering gear is in its central position.

While making any adjustment, free the steering gear of any load by disconnecting the drag link from the pitman arm.

When the adjustment is completed, the gear should be free from backlash in its straight-ahead position, and must be free to move throughout its complete travel without binding at any point. Now, turn the steering wheel to its central position and place the front wheels in their straight-ahead position. It should be possible to connect the drag link to the ball end of the pitman arm, without moving the steering gear any appreciable amount. If this cannot be accomplished, remove the pitman arm from the steering gear cross shaft and place it on the splines in

the correct position. If this is not done, the front wheels will not be able to swing equally to the right and left.

GEMMER WORM and SECTOR

MODELS 120, 140, 170

WORM END PLAY—Fig. 1—Loosen the jacket clamp bolt and move the clamp up about $\frac{3}{8}$ " above the lower end of the jacket. Loosen the instrument board bracket clamp from the column jacket. Work the jacket down until its lower end is against the steering gear housing cap. Remove the housing cap screws and work the jacket up, until it is stopped by the bottom of the steering wheel recess. There should now be $\frac{3}{8}$ " clearance between the top of the housing and the housing cap,