3. Remove main drive gear bearing snap ring and pull main drive gear and bearing out through front of case far enough to expose bearing snap ring.
4. Apply bearing puller and remove bearing from main drive gear.
5. Tap mainshaft assembly toward rear of case and pull off mainshaft rear bearing.
6. Push mainshaft through rear bore of case to clear main drive gear. Then tilt front end upward and lift out of case. Be sure to catch mainshaft pilot bearing rollers when removing assembly.
7. Lift main drive gear out through top of case.
8. To disassemble mainshaft, remove snap ring holding 3rd and 4th speed synchronizer and 3rd speed gear and slide these parts from mainshaft.
9. Remove 1st and 2nd speed hub retainer snap ring and slide off synchronizer.
10. Remove 2nd speed gear snap ring, and strip the mainshaft of the 2nd speed gear thrust washer, 34 needle bearings, 2nd speed gear and spacer.
11. To disassemble the countershaft, remove lock plate which holds countershaft and reverse idler gear shaft in position.
12. Using a brass drift, drive countershaft out through rear of case and lift gear cluster out through top. The countershaft gear cluster turns on four sets of roller bearings which are loose in the bore of the countershaft gear. There are 22 rollers in each bearing set, totalling 88 bearings, separated by spacer washers and spacer. In the event that these rollers become mixed with the main drive gear pilot bearing rollers, they may be identified by the fact that the countershaft rollers are slightly smaller than the pilot bearing rollers.
13. Be sure to pick up the front thrust washer, rear thrust washer and spacer washer from the bottom of the case.
14. To disassemble the reverse idler gear, remove reverse shifting arm and drive idler shaft out through rear of case and lift idler gear out through top.
15. To disassemble 3rd and 4th speed synchronizer, remove the two retaining springs located on each side of the clutch hub. The clutch sleeve can be removed from the hub by supporting the outside diameter of the sleeve and pressing on the hub. Use care not to lose the three shifting plates. The blocker rings are supported by the main drive gear hub and 3rd speed gear hub and are disassembled with the removel of the mainshaft.
16. To disassemble 1st and 2nd speed synchronizer, support the outside diameter of the clutch sleeve and press out the hub. Use care when disassembling as poppet springs and balls are under spring tension and may fly out when sleeve is removed. Wrap a cloth around the assembly to guard against this.

Reassembly

Reverse the order of the above procedure to assemble the transmission.

In reassembling the synchronizer, be sure to place end of each retaining spring in the same shifting plate with the loose ends located in the same position on both sides to equalize the tension on all three shifting plates, and also index etched marking on hub and sleeve.

REAR AXLES

AXLE SERVICE INDEX

Axle Lubricant Capacities

Lubricant capacities are given as a guide only. The lubricant capacities of two similar axles in the same series may vary considerably due to design changes and the vehicle manufacturer's installation. The actual service capacity may be accurately determined by carefully measuring the amount of lubricant necessary to fill the assembly to the correct level and measuring the lubricant again as it is drained from the unit. The vehicle should be on a level floor when this inspection is made.

EATON AXLES

Single Reduction Axles

Model	Oil, Pts.
1350	13
1614	17
1615	17
1715	22
1716	22
1790	22
1791	22
1795	24
1796	24
1862	22
1863	22
1890	21
1891	21
1892	21
1893	21
1895	24
1896	24
1900	20
1901	20
1911	24

Two Speed Axles

Model	Oil, Pts.
13600	13
16500	20
16501	20
16600	20
16601	20
17500	22
17501	22
17700	24
17701	24
17800	22
17801	22
18500	22
18501	22
18502	22
18503	22
18700	24
18701	24
18800	22
18801	22
18802	22
18803	22
19500	24
19501	24
19503	24
20500	20
20501	20
22500	32

Double Reduction Axles

Model	Oil, Pts.
2613	22
2614	22
2615	22
2616	22
2695	22
2696	22
2750	31

Tandem Axles

Model	Oil, Pts.
22M	27 (5)
22MF	12
22M-P.D.U.	9
22MR	12
22R	11
28M	43 (6)
28MF	17
28M-P.D.U.	9

Model	Oil, Pts.
28MR	17
28R	14
32M	49⑦
32MF	23
32M-P.D.U.	3
32MR	23
32R	③
34M	49⑦
36MF	24
36M-P.D.U.	3
36MR	24
36R	④
38M	51⑧
42MF①	20
42MF②	2
42M-P.D.U.	6
42MR①	20
42MR②	2
42M	22
56MF	24
56MR	24

①In rear filler hole.
②In front filler hole.
③Forward axle 21, rearward axle 23.
④Forward axle 20, rearward axle 21.
⑤Each axle 10 pints and 7 pints in power divider.
⑥Each axle 17 pints and 9 pints in power divider.
⑦Each axle 23 pints and 3 pints in power divider.
⑧Each axle 24 pints and 3 pints in power divider.

TIMKEN AXLES

Single Reduction Axles

Model①	Oil, Pts.
B-100	10
B-100-N	8
C-100	12½
C-100-N	15
D-100-N	15
E-100	15
H-100	20
L-100	23
Q-100	31②
R-100	30
F-104	15
E-105	12½
F-106	15
H-140	20
QT-140	24
R-140	30
A-150	5½
B-150	3½
E-150	9
H-150	11
L-161	24
51500	3½
51524	3
53521	9
53547	9
53625	5
55400	20
56410	20
58300	21
58415	26

Double Reduction Axles

Model①	Oil, Pts.
H-200	28②
L-200	31②
LT-200	31②
Q-200	34②
QT-200	31②
R-200	36②
S-200	38②
U-200	38②
QT-230	44②
R-230	36②
R-230③	45②
RT-240	36
79721	24②
79740	20②
79746	24②

Two Speed Axles

Model①	Oil, Pts.
E-300	12②
H-300	26②
L-300	29②
LT-300	29②
Q-300	32②
QT-300	29②
R-300	34②
S-300	39②
U-300	39②
R-330	35②
R-330③	44②
H-340	22
QT-340	32
RT-340	36
F-341	20
G-341	20
E-350	22
H-350	24
L-351	29
L-361	22
E-370	22
H-370	24
L-371	29
Q-390	30
R-390	60

Tandem Single Reduction Axles

Model①	Oil, Pts.
SBD-700	7
SBD-760	5
SBD-1000	8
SBD-1055	19
SBD-1500	12
SBD-1555	26

Tandem Double Reduction Axles

Model①	Oil, Pts.
SLD	28
SLDD	28④
SQD	22
SQDD	22④
SFD-75	16
SFD-157	9
SD-353	24
SFD-375	23
SFD-450	36
SD-454	26
SFD-460	29
SD-472	28
SD-473	28
SD-3000	19
SD-3010	19
SD-3020	31
SFD-3020	31
SFDD-3020	31
SFD-4600	28
SFDD-4600	28④
SFD-4700	28

Tandem Worm Drive Axles

Model①	Oil, Pts.
SQW	33
SQW③	40
SW-456	28
SW-457	28
SW-460	28
SW-3000	19
SW-3002	17
SW-3010	14
SW-3013	23
SW-3020	28
SW-3022	27
SW-3456	24
SW-3458	33

①Model number embossed on carrier housing.

②Add one pint of lubricant to pinion cage when new or reconditioned drive unit is installed.

③Housing cover 6½" deep overall.

④Add two pints of lubricant to inter-axle differential housing when new or reconditioned drive unit is installed.

Eaton Axle Section

EATON TWO-SPEED AXLES

In the Eaton Two-Speed Axle, Figs. 1 and 2, two axles, a single reduction and a double reduction, combined into one unit is the basic principle. In the high speed ratio, the axle functions as a standard single reduction unit, the ratio being obtained through a bevel pinion and a matched ring gear.

When shifted into the low speed ratio, planetary gears come into operation and through them a secondary reduction is obtained. The Two-Speed Axle now functions as a double reduction unit—first reduction through bevel gears and second reduction through planetary gears —giving two selective axle ratios to be used as working conditions demand.

As pictured in Fig. 3, the axle is in high speed ratio. The Sliding Clutch Gear has been shifted to mesh with the Planetary Pinions and the High Speed Clutch Plate. With this action, the planetary pinions are held stationary and the unit is now a conventional single reduction axle.

Referring to Fig. 4, here the axle is in Low Speed Ratio. The sliding clutch gear has been shifted from the position shown in Fig. 3. It is now in mesh with the Low Speed Clutch Plate and the Planetary Pinions. The pinions are free to rotate about the sliding clutch gear which is held stationary. The secondary reduction, between the ring gear and differential, is introduced and the axle is a double reduction unit.

An oiling system is provided to supply lubricant within a half turn of the vehicle wheels to the essential places during conditions when splash and dip alone would be insufficient. A heavy coating of oil is picked up by the oil collector drum and transmitted to the oil scoop. The scoop scrapes the oil from the drum and splits it into two courses. One half of this oil goes to the pinion bearings; the other half to the right-hand differential bearing, then through the differential and planetary unit to the left differential bearing and down to the reservoir.

Disassembly

Figs. 5 through 40 is a pictorial service procedure for disassembling these axles.

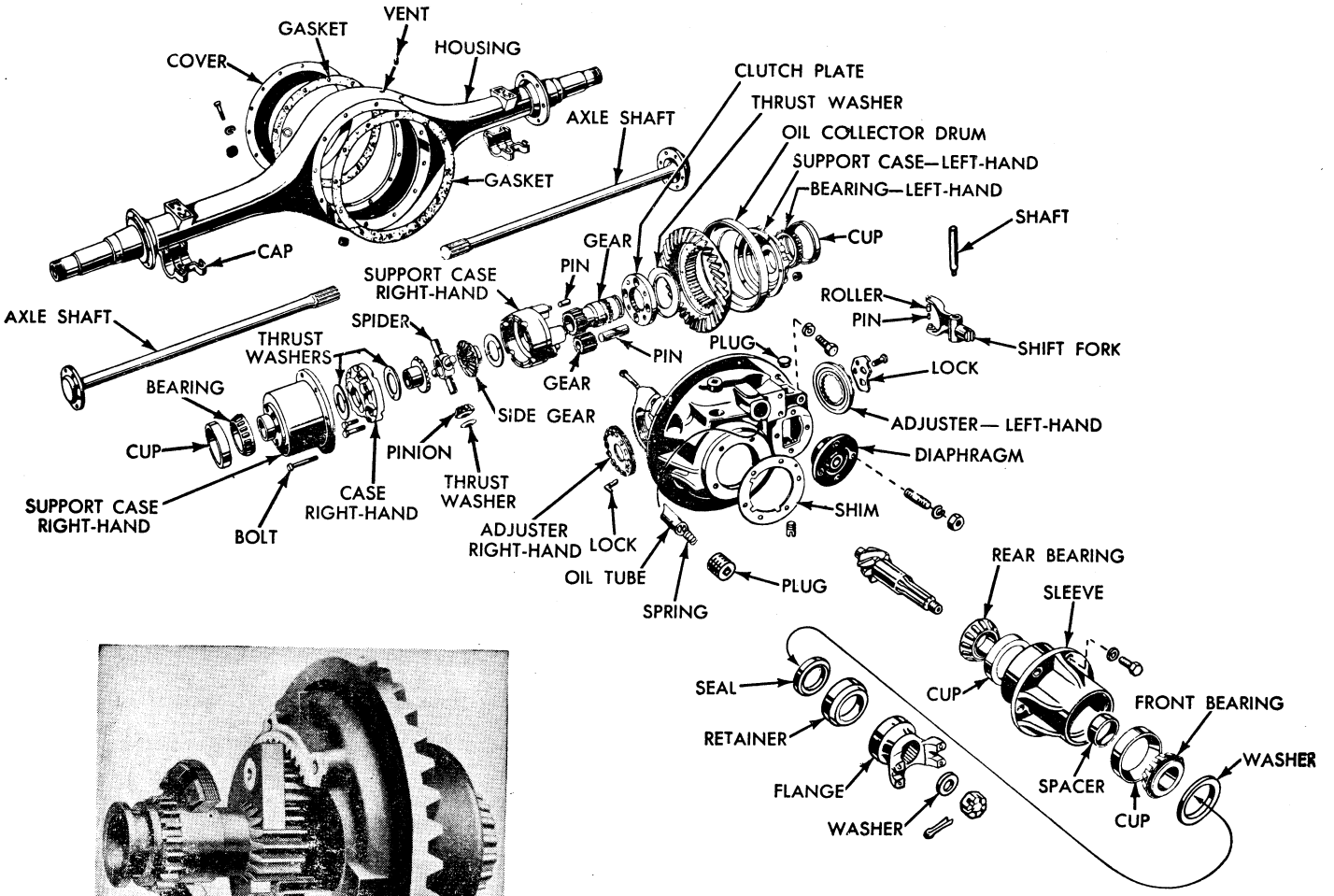


Fig. 1 Eaton two-speed axle—hypoid type

Fig. 3 Showing Eaton Two-Speed Axle in high speed ratio (single reduction)

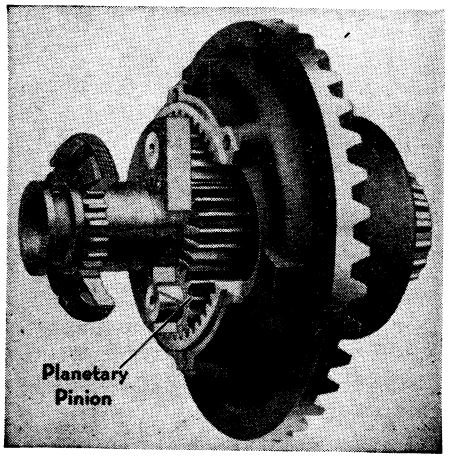


Fig. 4 Showing Eaton Two-Speed Axle in low speed ratio (double reduction)

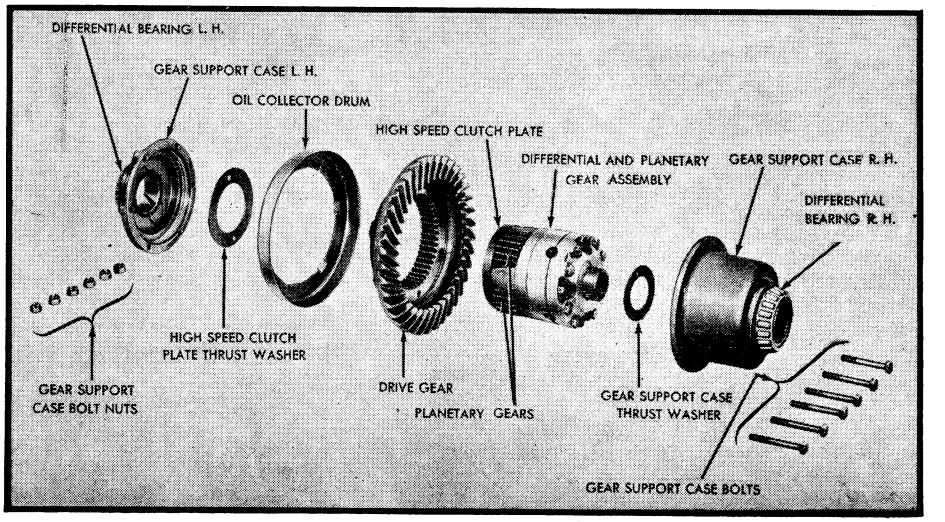


Fig. 5 Eaton two-speed rear axle

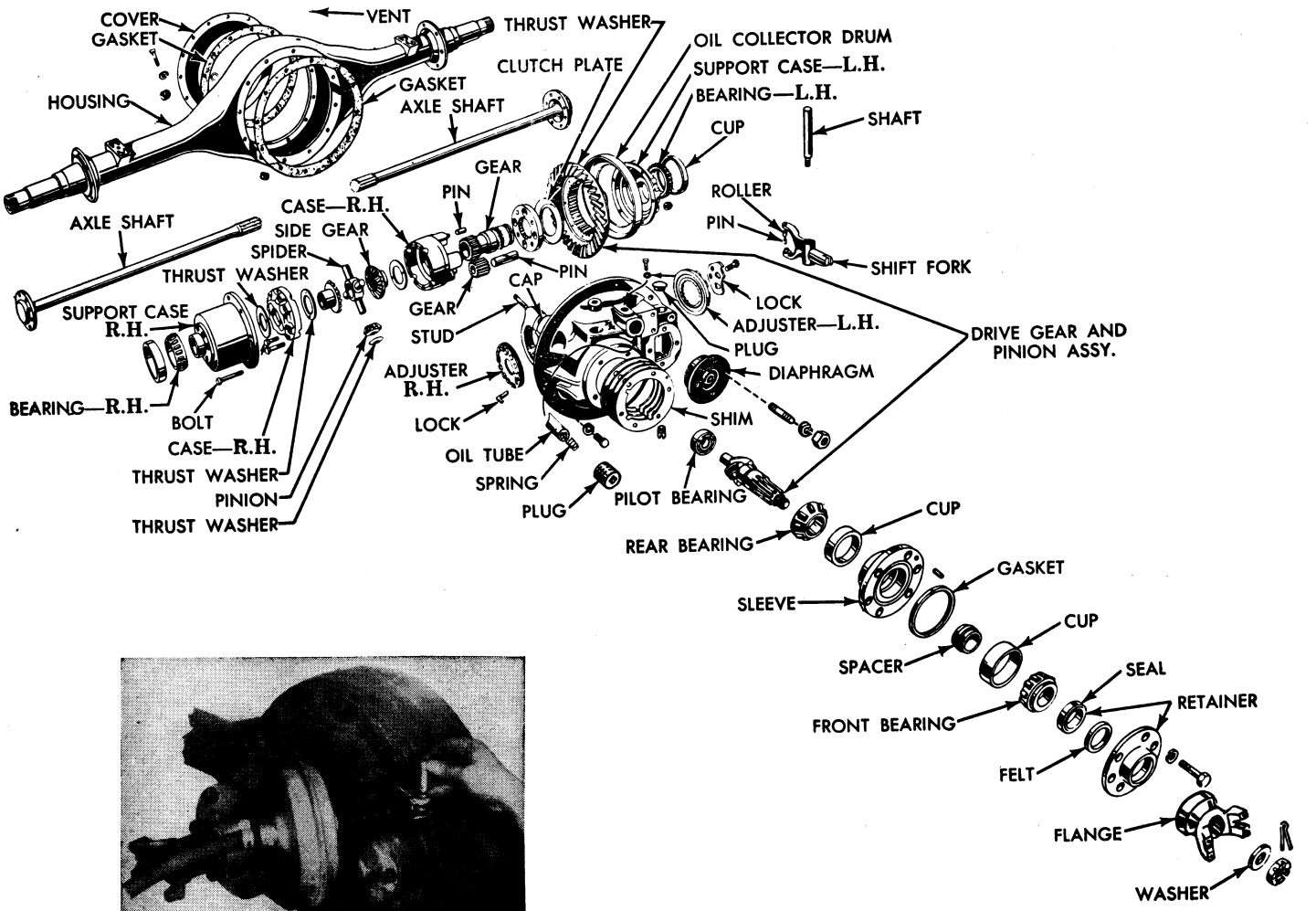


Fig. 2 Eaton two-speed axle—spiral bevel type

Fig. 7 With axle in low range, remove clevis pin from diaphragm clevis

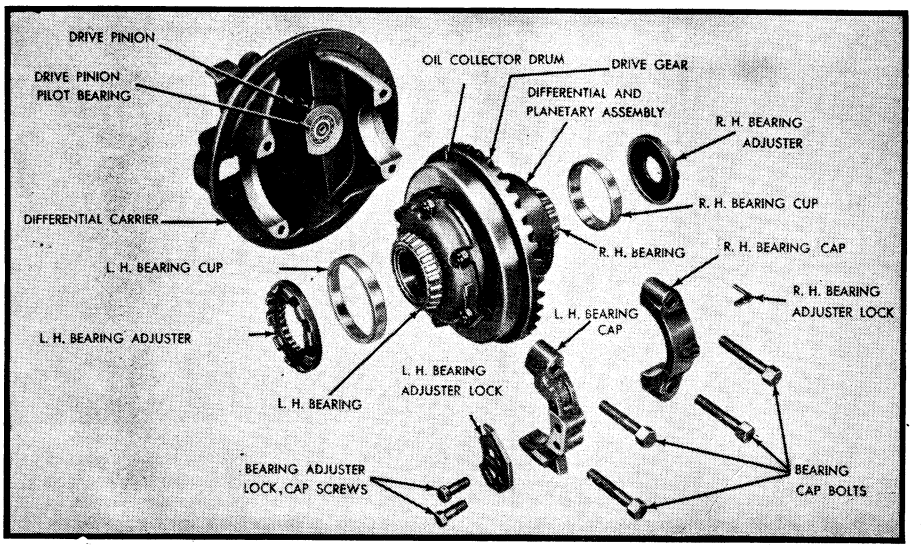


Fig. 6 Eaton two-speed rear axle

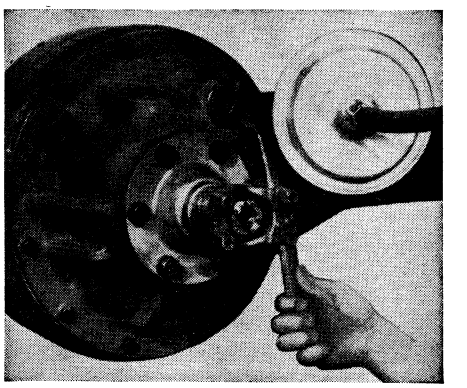


Fig. 8 Remove shift diaphragm and bracket assembly. This diaphragm assembly need not be disconnected from the base, but should be fastened up to the frame out of the way

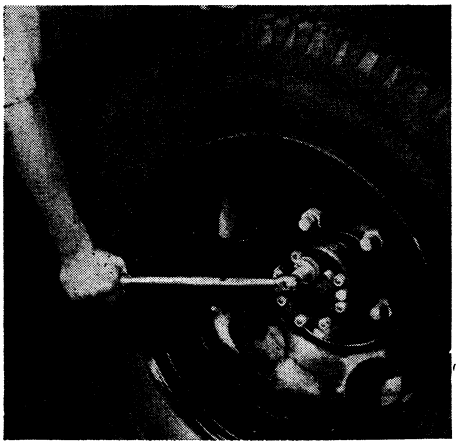


Fig. 9 Remove axle shafts

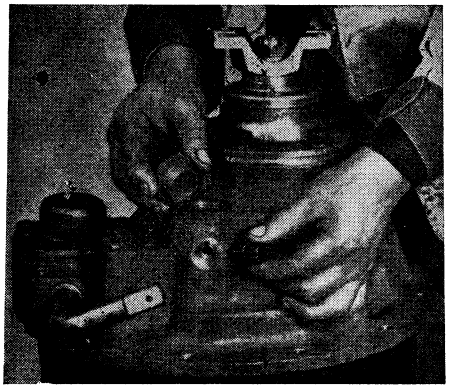


Fig. 12 Remove plug, washer, spring, capscrew, lockwasher and oil distributor

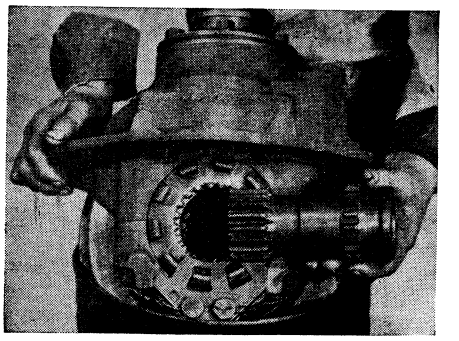


Fig. 15 Slip out sliding clutch gear

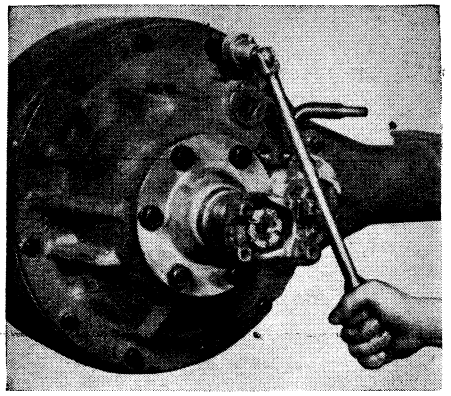


Fig. 10 Remove carrier-to-housing cap screws and washers

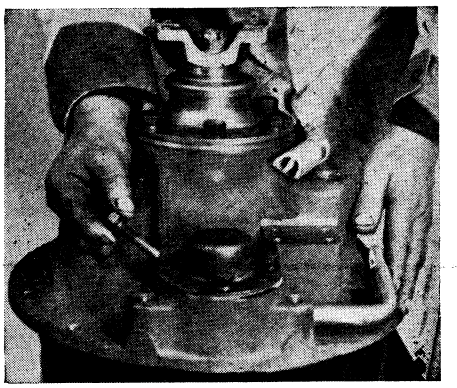


Fig. 13 Remove capscrews in shift fork cover, *noting special screw* in off-center hole. Lift off shift fork cover and gasket

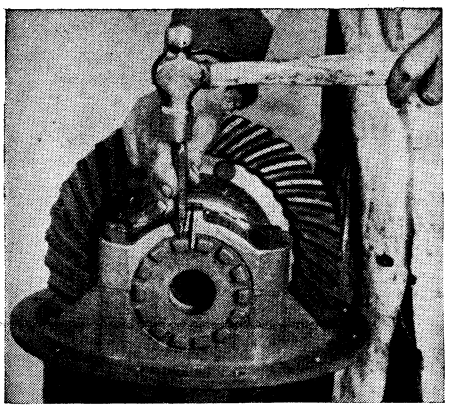


Fig. 16 Mark right-hand differential bearing adjuster with punch. (This is for relocating when reassembling)

Fig. 11 Remove carrier from housing. It is not necessary to hold carrier in any fixture. For convenience in handling, the head may be placed in the end of a clean small keg or drum

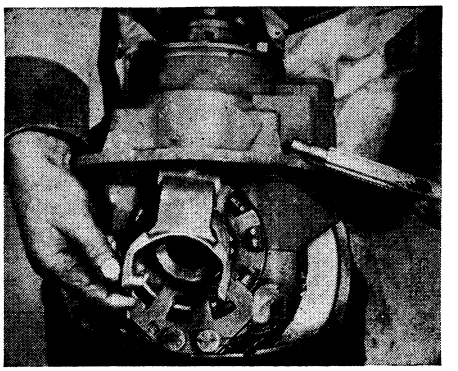


Fig. 14 Pull out shift fork shaft. The shift fork may then be slipped from the sliding clutch gear and removed through the back of the differential carrier

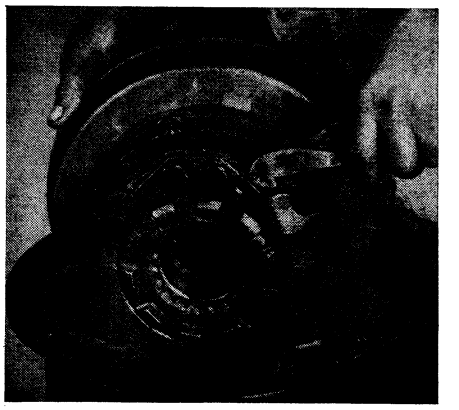


Fig. 17 Remove differential carrier bearing cap bolt lock wires on both right and left hand sides. *Loosen cap bolts only.* Take off right-hand bearing adjuster, lock and cotter pin

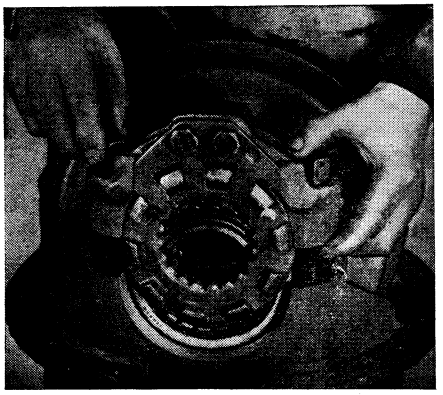


Fig. 18 Remove left-hand differential bearing cap adjuster and lock *as an assembly* to assure correct positioning of gear on reassembly

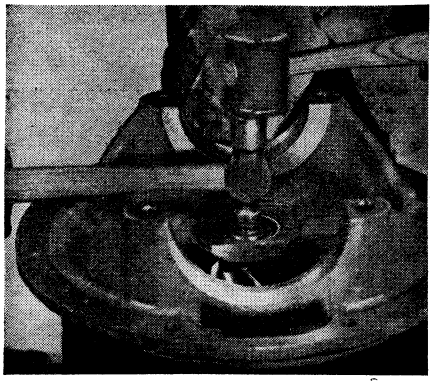


Fig. 21 Use ball peen hammer to drive out bevel pinion assembly, noting shims under pinion bearing cage

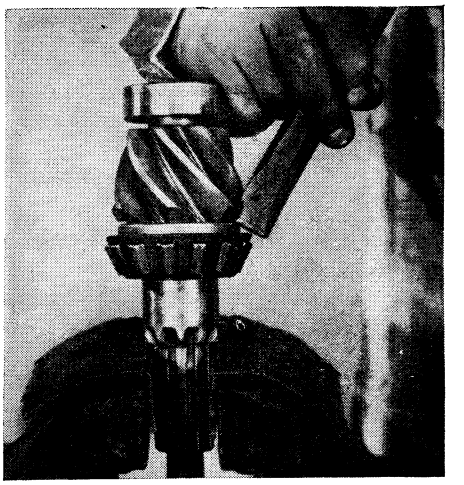


Fig. 24 Drive off pinion bearing cage by tapping between teeth of pinion alternately on opposite sides of inner race

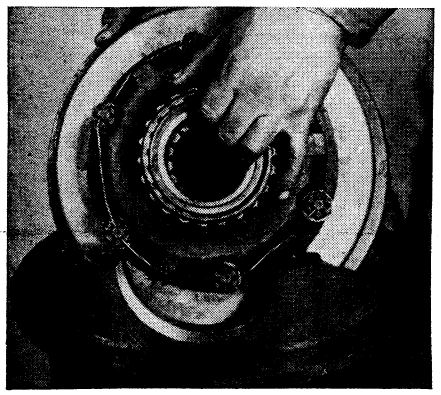


Fig. 19 After removing bearing caps, tip up left hand end of planetary unit and lift out

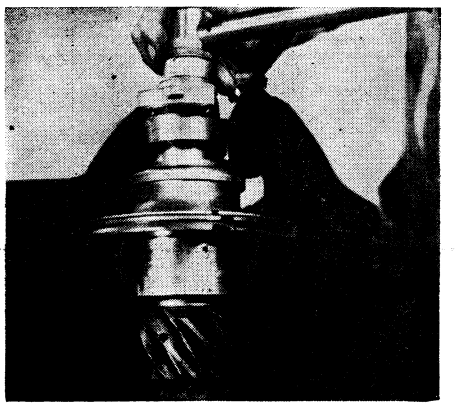


Fig. 22 Take out cotter pin, loosen pinion shaft nut and slide off companion flange

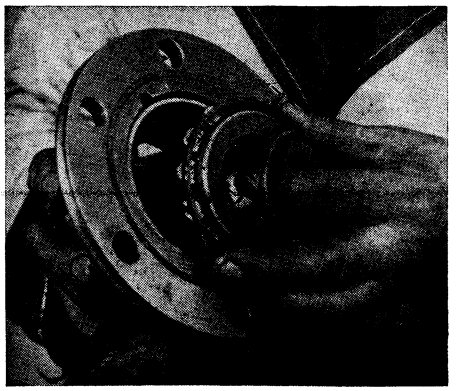


Fig. 25 Remove pinion bearing cone and washer from cage assembly

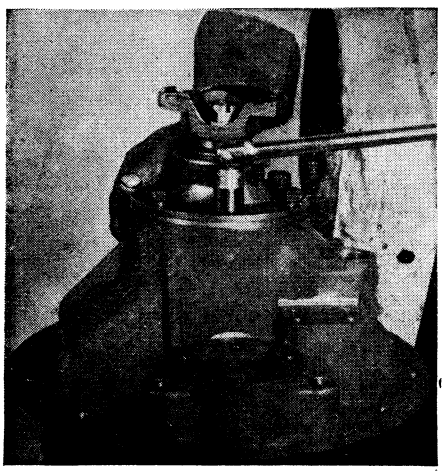


Fig. 20 Remove pinion bearing cage capscrews

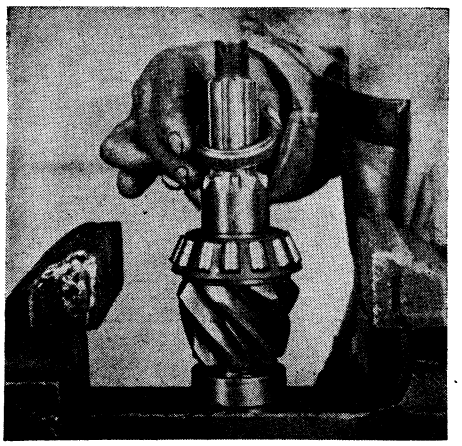


Fig. 23 Lift off pinion bearing cage, bearing and washer. Slip off pinion bearing spacer

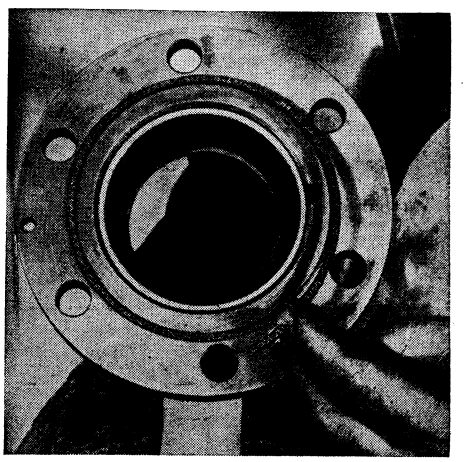


Fig. 26 Take out pinion bearing cage cork (discard)

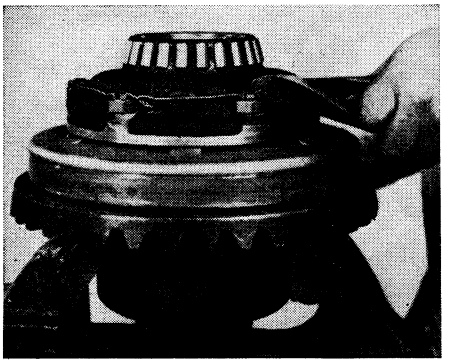


Fig. 27 Remove lock wire from support case bolts

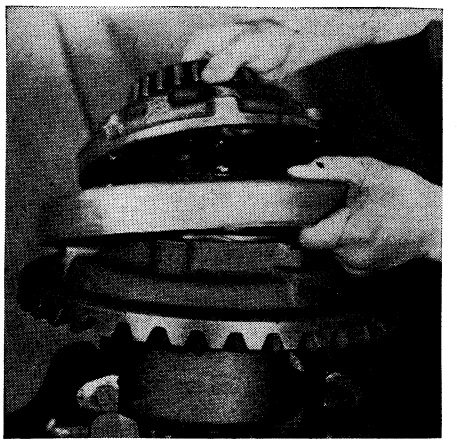


Fig. 30 Lift off left-hand support case and oil drum

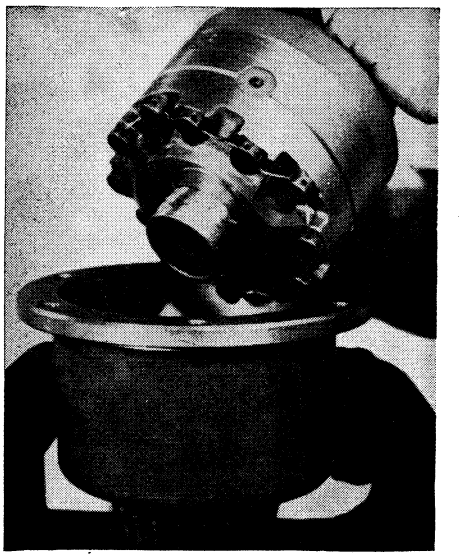


Fig. 33 Lift out differential assembly

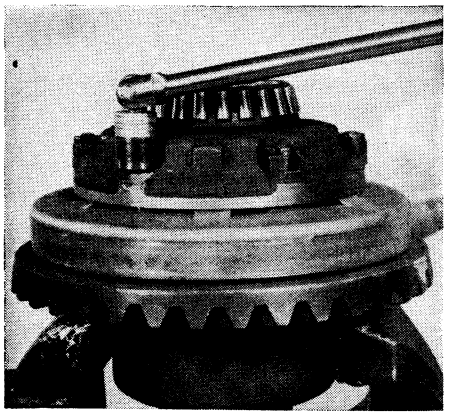


Fig. 28 Unscrew support case bolts and nuts

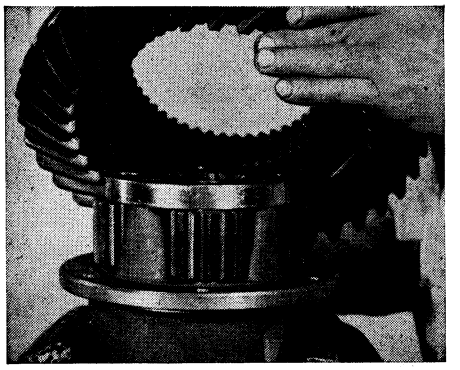


Fig. 31 Lift off thrust washer and bevel drive gear

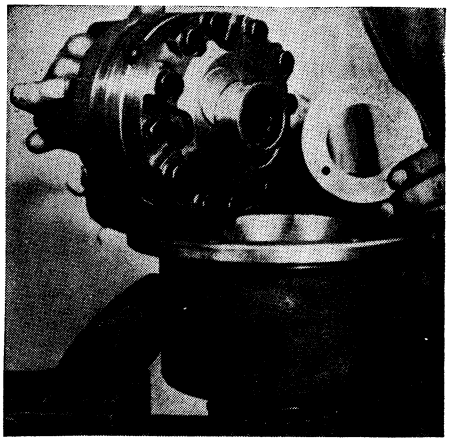


Fig. 34 Remove support case thrust washer

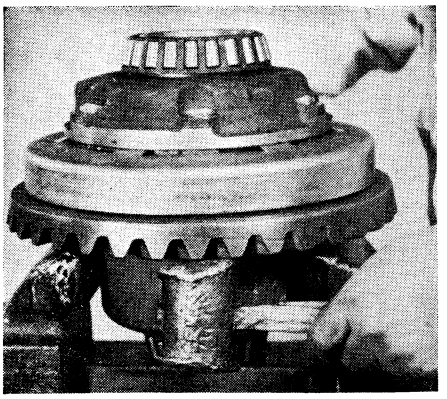


Fig. 29 Tap alternately on opposite sides of ring gear with head of rawhide hammer until gear is free of flange on support case. (When reassembling use two bolts to assure proper line up of bolt holes.)

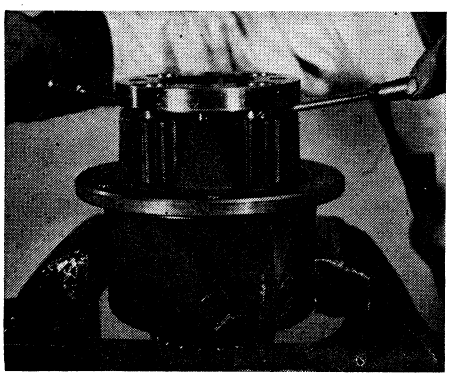


Fig. 32 Pry off high speed clutch plate; take out idler pinions and pins

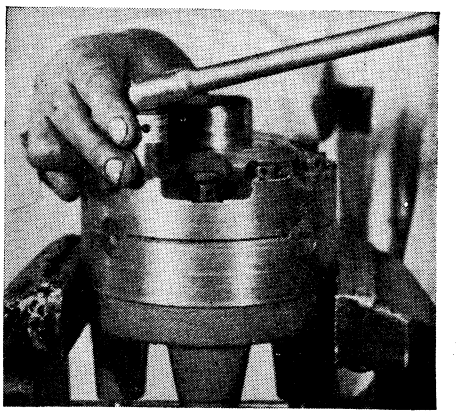


Fig. 35 Take out differential case bolt lockwire and remove bolts, noting the short bolts between spider arms

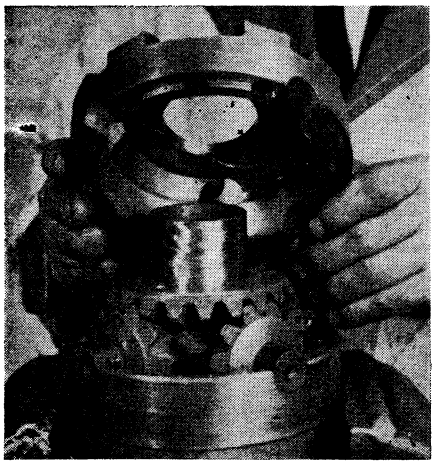


Fig. 36 Lift off right-hand differential case

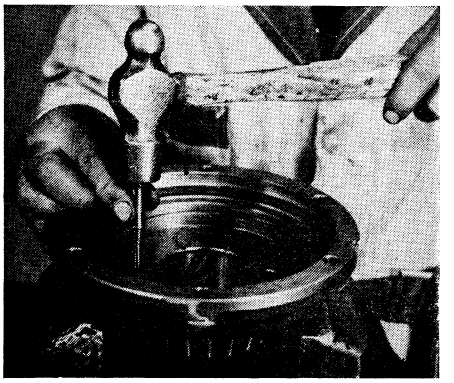


Fig. 40 Remove differential bearing cones by striking inner race on alternate sides through holes provided in support case

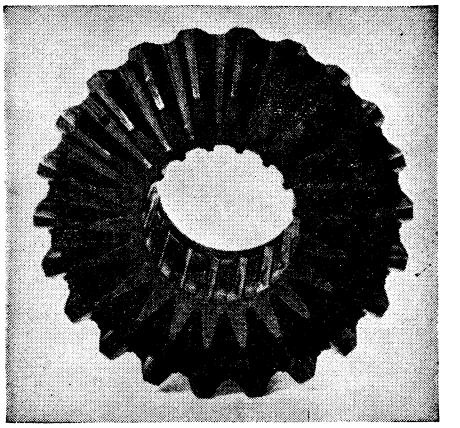


Fig. 41 Example of worn side gear splines

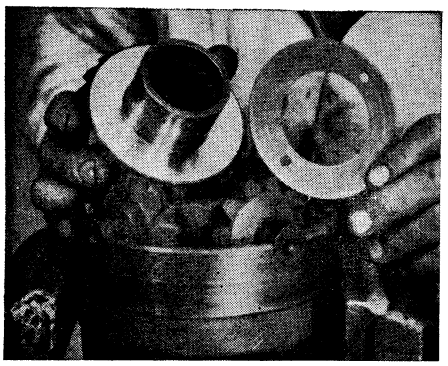


Fig. 37 Pick up long hub side gear (right hand) and slip off thrust washer

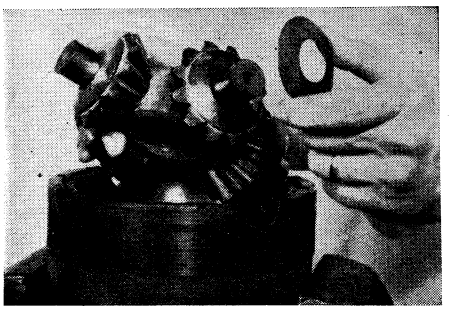


Fig. 38 Pull out spider and slip thrust washers off spider arms

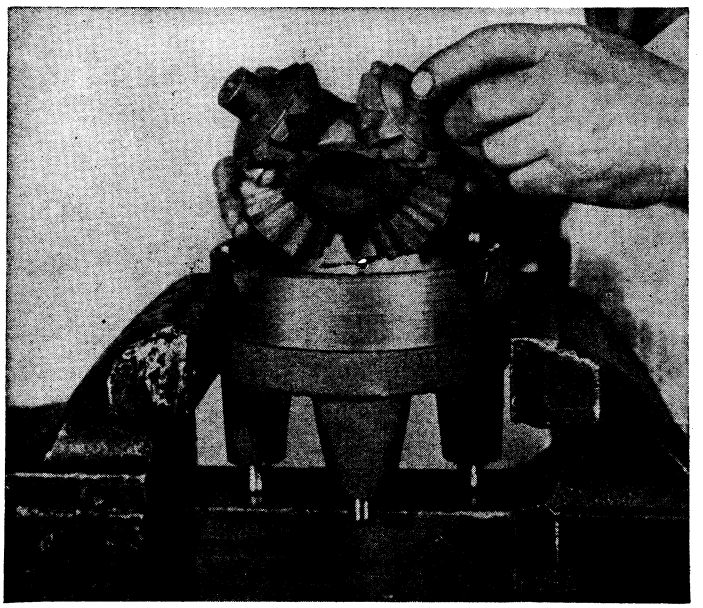


Fig. 39 Slip differential side pinions off spider arms. Take out short hub side gear (left hand) and remove thrust washer

Inspection of Parts

After the unit has been completely disassembled, the parts should be cleaned and a very careful examination of each should be made for excess wear. In some cases this wear will not be harmful, and in other cases the wear will result in early failure if the parts are used again. Listed below are the most important parts where wear may be evident.

Side Gears—The specimen shown in Fig. 41, should be replaced. Wear on the splines of the side gear will allow excessive backlash on reversal of torque and cause shock throughout the entire assembly.

Companion Flange — Wear on the companion flange splines, Fig. 42, will cause shock to the axle and the drive shaft. Such a flange should be replaced.

Pinions—Wear on the pinion splines, Fig. 43, like worn companion flange splines, will shock not only the axle but the drive shaft on sudden reversal of torque. Such wear is sometimes mistaken as excessive backlash. Specimens like that shown in Fig. 43 should be replaced.

Excessive wear in the keyway of a pinion, Fig. 44, will have the same effect as worn splines in the previous example. In addition, the worn condition as shown may even cause the key to be sheared in half, allowing the drive shaft to rotate freely. This pinion is not satisfactory for use.

Bearings—All bearings should be carefully checked to be sure they contain no pitted or scuffed areas. Do not overlook the ends of the taper bearing rolls. In Fig. 45, the left hand bearing is new. Close examination will reveal the raised ground and polished shoulder on the roll ends. The dark center area is considerably lower than the roll end shoulder.

At the right in Fig. 45, is a bearing removed from an axle after an extended period of heavy service. Comparing the roll ends of this bearing with those of the new one, the difference is immediately apparent. Here the shoulder has worn completely away and below the original height of the center recessed area. Readjustment of bearings in this condition

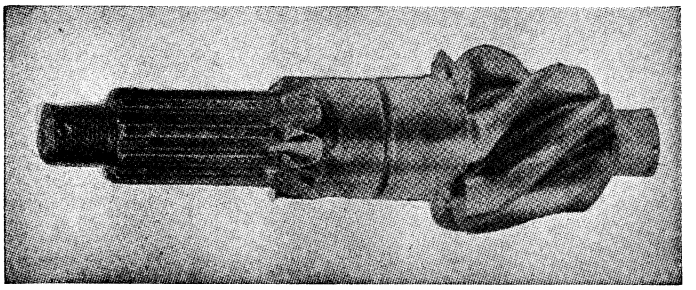


Fig. 43 Example of worn pinion shaft splines

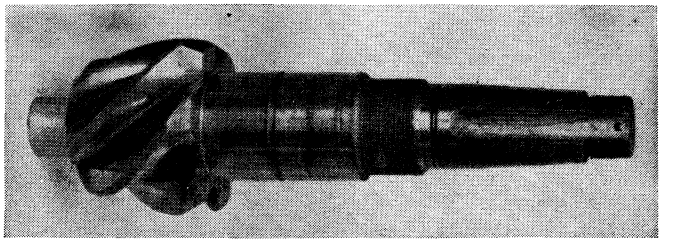


Fig. 44 Example of excessive wear on pinion shaft keyway

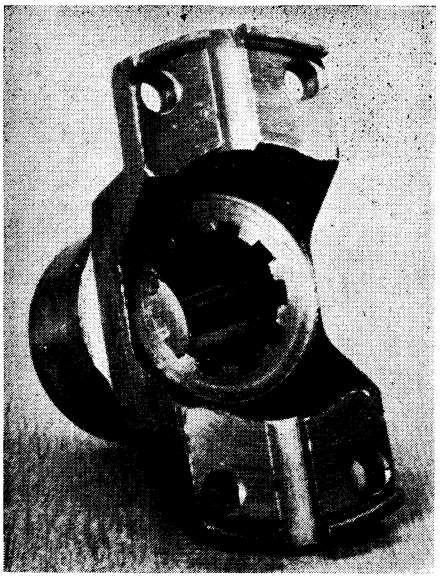


Fig. 42 Example of worn companion flange splines

will not give a satisfactory repair job as they will continue to wear rapidly. They should be replaced to prevent damage to bevel gears.

Idler Pinion Pins—These pins, Fig. 46, are made of bearing material to prevent the possibility of seizure to either the high speed clutch plate or idler pinions, should the lubrication be inadequate. The surfaces are quite readily scratched by dirt or foreign matter in the lubricant, but slight surface scratches in no way impair the usability of these parts.

Idler pins need not be replaced unless they are actually loose more than $\frac{1}{64}$" when tried into high speed clutch plate, differential case or idler pinions, provided all pins in a single unit are worn by approximately the same amount.

Bevel Gears—Scuffed or pitted gears and pinions must be replaced, Fig. 47. Small particles or flakes of steel from pitted areas will drop into the lubricating oil and will thus be carried to all parts of the axle, causing rapid failure of all moving parts.

Pitted bevel gears will tend to be noisy, and scuffed gear teeth will cause excessive backlash in the system. It is imperative that all damaged bevel gears and pinions be replaced, not individually, but as a matched set, otherwise the life of the axle will be greatly reduced.

Clutch Plate—Worn or burred teeth on the clutch plate, Fig. 48, will cause a rough shift into the high range, and if worn badly enough, will cause the axle to slip into the low range under high torque loads. A badly worn clutch plate cannot be repaired.

If the outside diameter of the clutch plate is marred, the plate will not be able to rotate freely in the left hand differential support case and thus may cause damage to the case. The clutch plate should not be used unless the outside diameter is smooth.

Thrust Washers—The axle contains four thrust washers, one between each of the side gears and the differential case, Fig. 49, one between the differential case and right-hand differential support case, and one between the clutch plate and the left-hand differential support case. In addition, there is a spherical thrust washer in back of each differential pinion on the spider. The maximum allowable wear on all thrust washers is .005" under the original size. The original size may be obtained by measuring unused washers.

Differential Bearing Hubs—Differential bearing hubs in axles which have been in severe service are apt to be worn undersize. Pressures are exceedingly high between the inner race of the differential bearing and the case hub when subjected to excessive torque. Under such circumstances, differential bearings are forced to carry a load greater than the capacity for which they were designed. Consequently, the hub is compressed and the race turns, wearing away the metal of the hub with increasing rapidity. There is no way that the hub can be repaired once the inner race of the bearing starts to turn on it.

Reassembly

The following illustrations and descriptive information cover important points that must be observed in correctly reassembling the two-speed axle. Note this information carefully, then, by starting with Fig. 40 and reversing the disassembly operations, you will have the correct procedure for completely rebuilding the Eaton Two-Speed Axle.

Assembling Inner Pinion Bearing—The pinion shaft must be staked over in four spots after inner bearing is pressed on. Fig. 50 shows the recommended method, using a bearing ball.

Assembling Planetary Unit—Before replacing thrust washers, lubricate both sides well and cover idler pinion pins

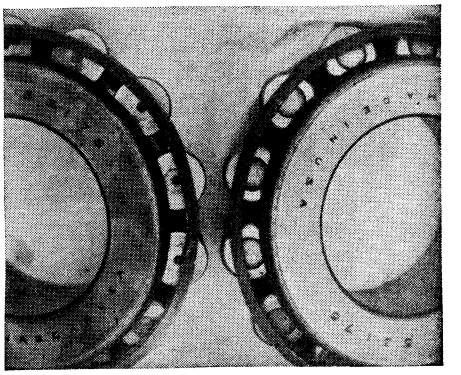


Fig. 45 Comparison of new (left) and worn ends of taper bearing rolls (right)

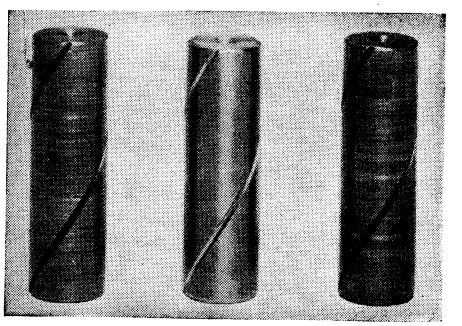


Fig. 46 Idler pinion pins

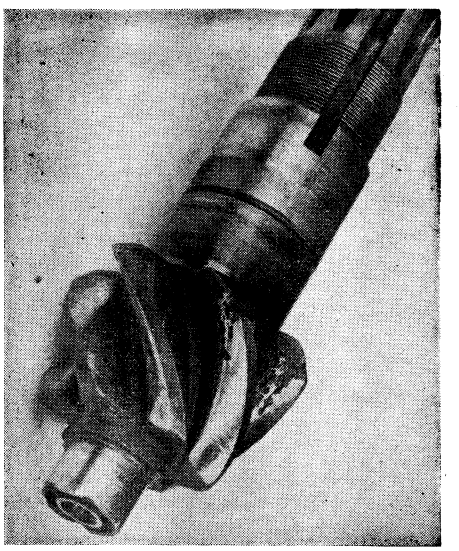


Fig. 47 Example of scuffed and pitted pinion gear

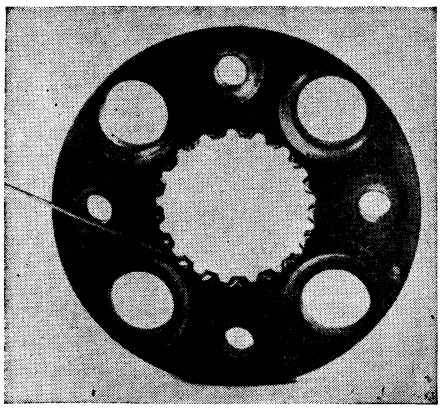


Fig. 48 Example of worn clutch plate teeth

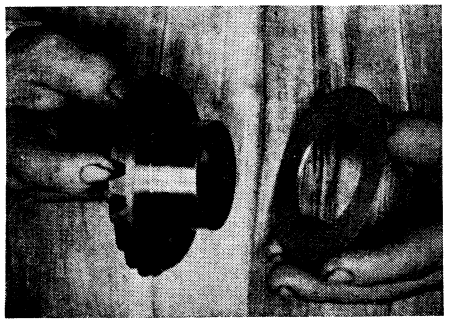


Fig. 49 Replace thrust washers if they are .005" under original size

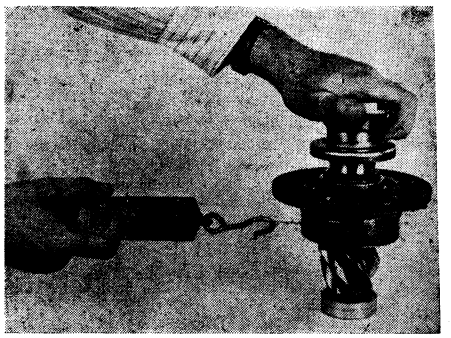


Fig. 53 Method of determining preload on pinion shaft bearing

with lubricant. Chamfered teeth on high speed clutch plate must face pinions, Fig. 51. Place the notches in the oil collector drum between the bolt holes in the bevel gear. Draw the bolts tight with a long-handled wrench and securely fasten with lockwire.

Assembling Differential Carrier Unit—Lubricate all bearings as they are assembled in carrier. See that dowel in pinion bearing cage is inserted in dowel hole in carrier. When reassembling adjusters, be sure threads mesh freely. Start cap bolts before dropping bearing caps in place. After adjusting gears, be sure cap bolts are very tight. Wire bolts securely, including cap screws in adjuster lock.

Pinion Shaft Bearing Adjustment—To determine the proper preload on the pinion bearings, reassemble the pinion, using bearings, bearing cage, spacer, companion flange and nut (omit oil seal and retainer). The companion flange must be held in a vise to tighten the nut. Nuts should be drawn up tight equal to a torque wrench reading of 300-350 lbs. ft. where the thread is one inch or smaller, 500-600 lbs. ft. for 1¼" thread, and 600-900 lbs. ft. for 1½" or larger. The cage should be rotated by hand while tightening the nut, Fig. 52.

With the pinion held stationary, a noticeable drag should be obtained when turning the cage by gripping the cage flange. It is desirable to hold this drag to a range of 8-15 lbs. in. of torque on models 1350 and 16500 axles; while on models 17500, 18500, 20500 and 22500, 12-25 lbs. in. of torque is desired.

To check the torque, proceed as follows: Wrap a soft wire around the cage and pull on a line tangent to the outside diameter with a spring scale attached to the wire, as shown in Fig. 53. For example, if the cage radius is 2½", and the scale pull is 6 pounds, the lbs. in. of torque would be 6 x 2½ or 15. The cage should be turning when the reading is taken as the starting torque will be higher. If the torque is not within the required limits, the flange should be removed and the spacer or shim between the tapered bearings should be changed. The above operation should be repeated until the correct torque is obtained.

Assembling Companion Flange — Press the companion flange on the pinion with an arbor press. If a press is not available, tap flange lightly on pinion until nut picks up threads. Then by tightening the nut, pull flange down on pinion. Do not hammer the flange. A fixture can be made for holding the flange while the nut is being tightened.

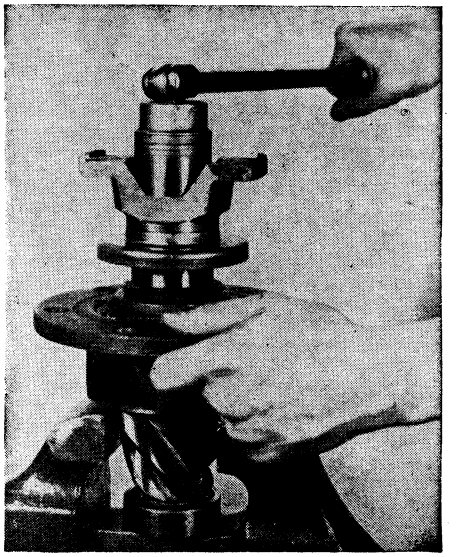
Bevel Drive Gear Adjustment—There are two distinct considerations in obtaining proper tooth contact: One is the bearing along the tooth, or lengthwise, the other is the bearing up and down the tooth, or profile bearing. It is essential that the two be considered separately to obtain the proper results in combination. To make the adjustment proceed as follows:

1. The pinion shaft, bearing and cage assembly should first be made on the bench and adjusted.
2. Bevel drive pinion is adjusted for tooth contact by means of shims placed between bearing cage flange and carrier. Install pinion and bearing cage assembly, using the same thickness of shims as with original setting for first trial. Tighten only two bolts until correct settings are obtained.
3. With pinion in position, assemble differential and bevel gear unit and bring gear up to position to secure about .006" to .016" backlash, as measured with a dial indicator. Check for proper tooth contact by painting at least ten gear teeth with

Fig. 52 Assembling companion flange on pinion

Fig. 50 Method of staking pinion shaft, using a bearing ball under a press ram

Fig. 51 Assembling planetary unit



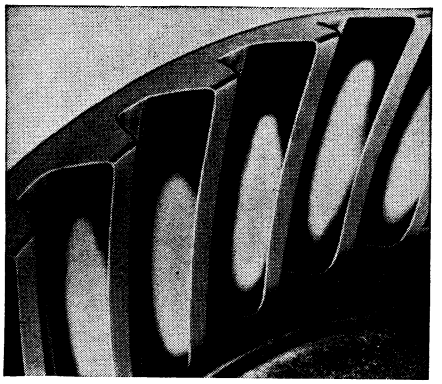


Fig. 54 Proper tooth contact. The tooth bearing, both lengthwise and profile should appear as shown

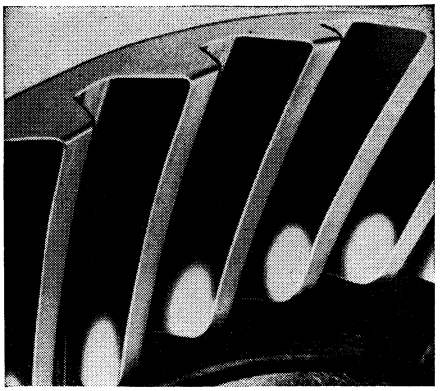


Fig. 55 Not enough backlash; move gear away from pinion

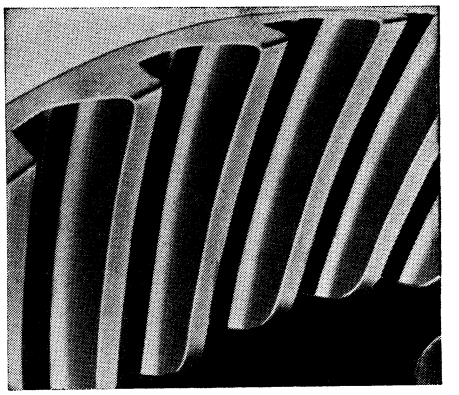


Fig. 57 Pinion in too far; add shims

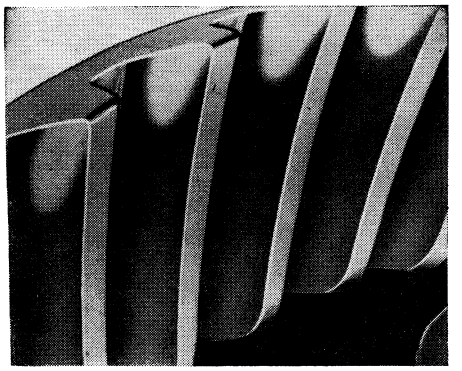


Fig. 56 Too much backlash; move ring gear up to pinion

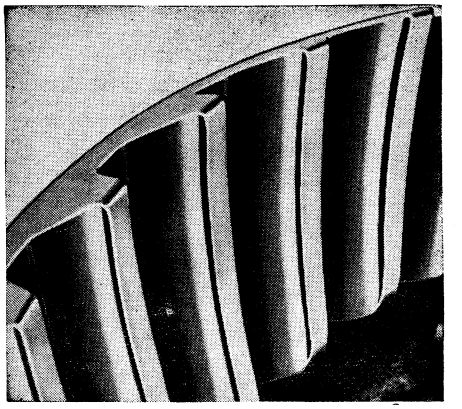


Fig. 58 Pinion out too far; remove shims

red lead or prussian blue. Turn the gear by hand a few revolutions in both directions to secure impressions of tooth contact. This should approximate contact shown in Fig. 54. Aim to get proper contact on drive side of teeth, and when this is secured, the coast side will ordinarily be satisfactory. If contact is not as illustrated, compare tooth contact with Figs. 55, 56, 57, 58, and determine directions and approximate distance that gear and pinion should be moved. Bear in mind that gear movements affect lengthwise contact, and pinion movements affect profile contacts, that is, depth of contact from face towards root. After settings are completed, be sure differential bearings are tight. A light preload of 1½ to 2 notches on the right-hand adjuster is desirable.

4. After the carrier is assembled in the chassis, make a final check. Jack up one wheel and paint gear teeth all round. Place axle in high speed range and apply light brake load with engine for a few revolutions with transmission in low and reverse. See if contact still checks fairly well with bench settings. It is to be expected that the lengthwise bearing will lengthen out a little, particularly towards the heel.

Lubrication

Use nothing but the best Extreme Pressure (EP) lubricant, with a viscosity suitable for the anticipated temperature. With outside temperatures up to 100° F., use SAE-90; above 100° F. consistently use SAE-140.

If the vehicle is operating in heavy work, or at high speed, renew oil every 5,000 miles. If used for light work, renew every 10,000 miles. Never add lubricant to the axle unless it is the same make and grade as that which is already in the axle. If the same lubricant is not available, drain, flush and refill with the available EP lubricant.

Filling—Fill the axle through the back filler plug until oil flows from overflow plug.

Insert the plug. Then add one additional pint of oil, using the filler hole at the top front of the carrier. This will supply the extra oil required to fill differential and planetary unit. At initial running of the axle in the chassis, see that axle is in the low speed range and run without load for about one mile. This will circulate the oil through the differential unit. At 1,000 mile intervals, check the oil level and add as required.

Draining—Draining should preferably be done when the vehicle has come in from a run in order that the oil may be well agitated and warmed up. This is particularly desirable in cold weather.

To drain, unscrew the plug at bottom of housing and allow sufficient time for all the old oil to drain out. Before refilling, a thorough flushing with light engine oil or flushing oil is desirable. When flushing oil is completely drained, it will remove any thickened material within the housing.

EATON ELECTRIC SHIFT

For Two Speed Axles

This device consists of three parts: (1) Control switch, (2) speedometer adapter and (3) wiring system or harness.

Control Switch—The control switch, which is located on the transmission gearshift lever, has two positions—up and down. Three wires are connected to the switch, Fig. 59. When the selector button of the switch is up, the battery wire "A" is connected to wire "B" leading to one field of the motor in the axle shift unit proper.

When the button is down, the battery wire is connected to wire "C" leading to the other field of the axle shift unit motor and also to the speedometer adapter.

The control switch is connected to the wiring system by plugging into the three-pronged connector which is part of the harness. The switch is removable by moving the rubber boot up to the knob and pulling apart.

Speedometer Adapter—The speedometer adapter compensates for variations in the speed of the drive shaft between high and low speed range of the axle. The adapter is held in the high range by a spring and in the low range by an electro magnet. The inner mechanism is lubricated for life but the two shaft ends should occasionally receive a small amount of light oil at the oil wick cups which are provided.

Wiring System—As shown in Fig. 59, the wiring harness has four terminals. Two of them (B and C) in a double line run to the axle shift unit on the axle. Of these the longer (red) one is connected to the bottom terminal, and the shorter (black) one is connected to the top terminal. The short single black wire (C) is connected to the speedometer adapter and the green wire (A) is connected to the circuit breaker. Wire (D) connects

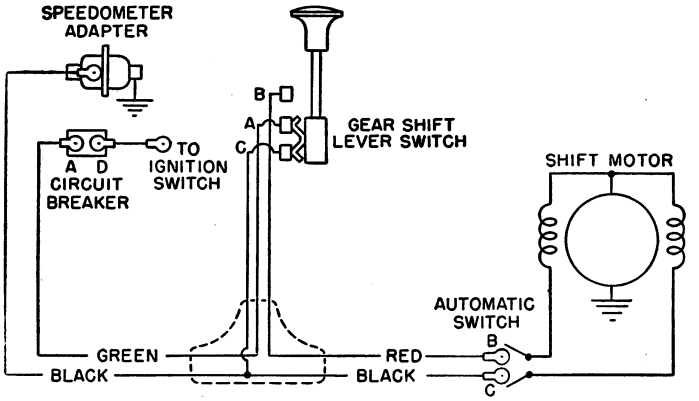


Fig. 59 Eaton electric shift wiring diagram

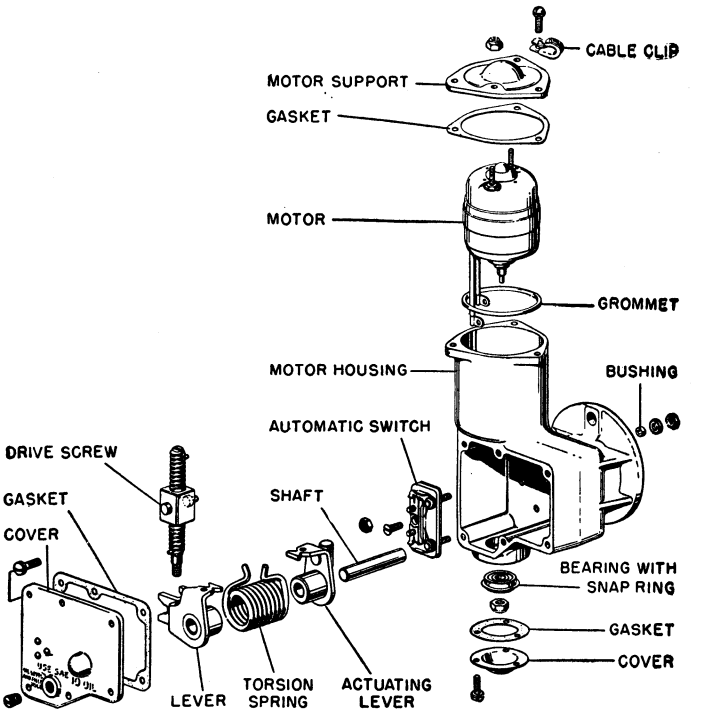


Fig. 60 Eaton electric shift parts layout

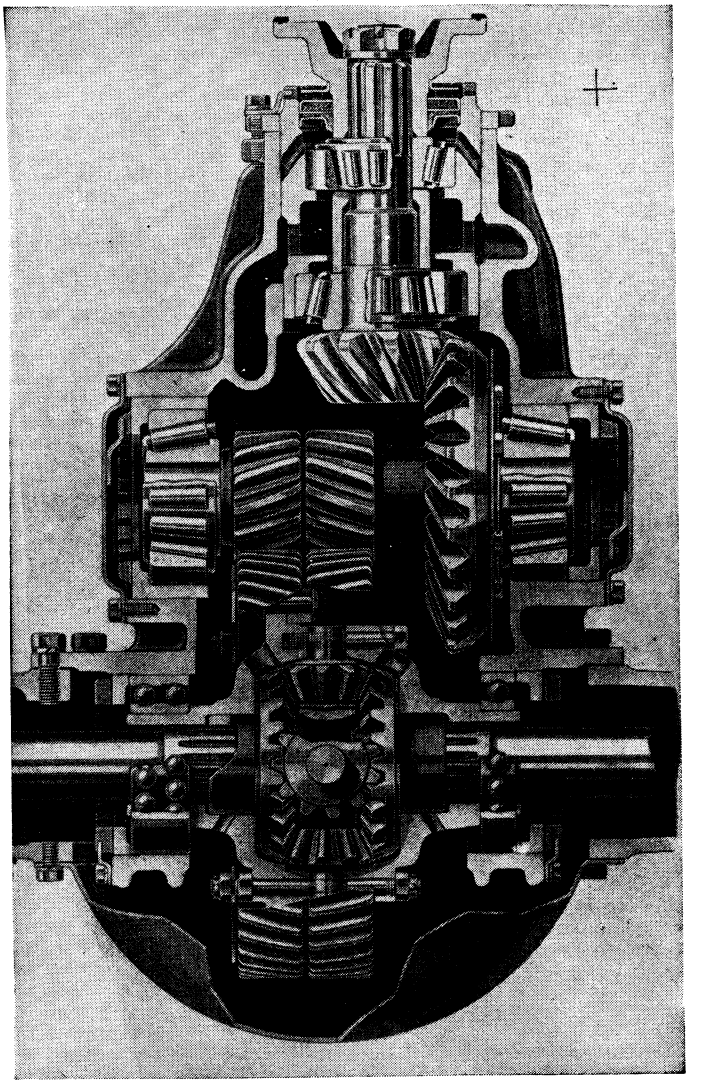


Fig. 61 Eaton double-reduction axle

the copper stud of the circuit breaker to the cold side of the ignition switch. The circuit breaker protects the system in the event of a short circuit. Should a short circuit occur, it will open the circuit until the trouble has been corrected.

Electric Shift Service

In disassembling and assembling the unit, see Fig. 60 and proceed as follows:

1. Remove two shift housing-to-carrier stud nuts and washers.
2. Pull off shift unit. In reassembling, the swivel block must fit into the shift fork.
3. Remove lock nuts and two wires. In reassembling, the long (red) wire goes to the bottom terminal.
4. Remove front cover and drain lubricant.
5. After removing front cover, nut will be at either top or bottom, depending upon the position in which the shift button was last left.
6. By turning drive screw, run nut from either top or bottom position to center of screw. This is essential to prevent damage to drive nut contact bumper and is also necessary in assembly.
7. Remove lever assemblies and spring by pulling out pin. In reassembling, care must be taken that contact bumper on nut is *toward switch.*
8. Remove drive screw bearing cover on bottom and push down on screw assembly until bearing is free from housing. Insert screw driver in drive slot of screw and remove bearing retainer nut and bearing.
9. Remove two lock nuts from switch terminals and pull off motor wires.
10. Remove motor cover screws and pull out motor with cover.
11. Remove jam nuts and fibre washers from back side of housing and unscrew switch center screw. Pull out automatic switch assembly.
12. Fasten actuating lever end of switch in vise. Turn spring winding lever clockwise and pull. Do not disassemble this assembly until necessary to replace one of the parts.
13. When assembling, the spring winding lever should be turned clockwise until end of spring is past shift fork actuating lever and push; this will preload the spring.

Service Notes—The automatic switch should have clean, free moving points which close firmly under spring tension.

The drive screw should turn freely by rotating the screw while holding the nut. When the nut gets to the end of the screw, the screw can continue to turn but the nut should not jam or run off the end. By turning the screw in the opposite direction, the nut will go to the other end and stop as before while the screw can continue to be turned.

The fibre bumper in the nut should be a tight press fit. Be sure that this bumper is in toward the switch.

The motor is reversible so that with the motor housing connected to one battery terminal and either one of the two motor wires connected to the other battery terminal the motor will run in one direction. With the other motor wire connected to the battery the motor will run in the opposite direction.

The rubber diaphragm between the shift unit and carrier assembly should be in good condition and a tight fit over the shift fork. This diaphragm seals off axle lubricant from the shift unit. For correct positioning of diaphragm, refer to the lettering printed on its face.

Lubrication—The speedometer adapter requires no more attention than would be required by the speedometer or cable. Several drops of light engine oil should be applied to the oil wick cups.

On the axle shift unit, there is an oil filler plug—so marked—provided in the front cover near the bottom. Upon installation the unit should be filled to the level indicated and should be checked every 3 months or 10,000 miles, whichever comes first.

Use SAE 10 motor oil except where temperatures below 0° F. will be encountered, in which case use SAE 5W oil. This cold weather oil can be safely used in temperatures up to 32° F.

EATON DOUBLE-REDUCTION AXLE

Fig. 61 is a sectional view of this design. It is a full-floating, double-reduction drive axle with a banjo type housing. Tapered roller bearings are used throughout with the exception of ball bearings used on each side of the differential case.

Disassemble

1. Drain differential and remove cover.
2. Remove carrier from axle housing.
3. Remove oil distributor.
4. Remove differential bearing caps.
5. Remove drive pinion cage and pinion from carrier.
6. Remove cover at left-hand end of shaft and remove adjusting ring from carrier.
7. Herring-bone pinion shaft can now be moved to left so that bevel gear will clear case as shaft is taken out of housing.
8. To disassemble pinion cage, remove nut and washer. Press pinion out of flange and cage. Permit pinion to drop out of cage. Do not lose shims between spacer and front bearing cone. These shims or others of equal thickness must be used at reassembly. Remove oil seal from cage.
9. To disassemble cross shaft, remove bearings from both ends of shaft. If replacement of bevel gear is found necessary, it can be removed from cross shaft by taking out bolts, remove disc and press gear off shaft.
10. Before disassembling differential case, make sure both halves are marked plainly so that they may be reassembled in the same relative positions. Halves of differential case may be taken apart after removing bolts and nuts. Side bearings should be removed from case with puller or arbor press.

Reassembly

Before assembling all bearings, thrust washers and gears, make certain that parts are clean and lubricated. This must be done to prevent scoring of parts when vehicle is first placed in service.

Cross Shaft, Assemble

1. If bevel gear has been removed, replace in reverse order of removal, making sure bolts are drawn up firmly.
2. Install oil collector disc under heads of bolts, making sure that outside of depressions are against cross shaft flange. Oil collector disc bolts are locked in place by lock wire threaded through holes in bolt heads.
3. Dip bearings in lubricant and install on shaft.
4. When installing herring-bone pinion shaft, dip bearings in differential lubricant and put assembly in position in carrier.
5. Replace bearing adjusting cages and draw up temporarily until pinion cage is installed.

Pinion Cage, Assemble

1. Dip bearings in differential lubricant. Brush a thin coating of same lubricant on bearing cups.
2. Install rear bearing on pinion, using a suitable piece of tubing to force it in place.
3. Install spacer over end of pinion.
4. Place original thickness of shims (which were removed at disassembly) on top of spacer, then insert pinion, bearing, spacer and shims as an assembly in the cage.
5. Install bearing, washer, and universal joint flange over end of pinion. Install nut and tighten firmly.
6. Check pinion end play. This should be from .002" to .004". Remove or add shims of required thickness to secure correct adjustment. There should be no perceptible end play and cage should spin freely on shaft. After correct adjustment has been made, remove nut, washer and flange from pinion.
7. Install bearing felt which has been dipped in differential lubricant in retainer. Then install oil seal on top of felt. Coat exterior diameter of retainer with sealing compound, then install seal and retainer assembly in cage. Wipe surplus sealing compound off retainer and cage.
8. After oil seal and retainer assembly is in place, reinstall flange, washer and nut. Tighten nut securely and check bearing adjustment, which was previously made. Make certain that adjustment has not changed. When adjustment check is completed, secure nut with cotter pin.
9. When flange nut is finally tightened and locked, check adjustment again. There should be no perceptible end play, and cage should spin freely on shaft. Bearings must not bind.
10. Place pinion cage assembly in position in carrier and turn cage until bevel gear meshes with bevel pinion and heels of teeth are flush. When heel of teeth are flush, there should be .003" to .005" end play in cross shaft.
11. Paint ring gear teeth and check tooth contact in a manner described in the Two-Speed Axle section and make any adjustments necessary to secure satisfactory tooth contact.
12. When satisfactory tooth contact has been secured, check end play in cross shaft again to be sure it is within correct limits.
13. Apply a thin film of gasket sealer on face of shaft bores on carrier and on face of covers. Install bearing covers, using new gaskets and make certain that locks engage slots in adjusting rings. Total backlash between pinion and bevel gear should be .005" to .010". Backlash in herring-bone gear, .010" to .012".

Differential, Assemble

1. Reassemble case, using new thrust washers, and being sure that halves are put together according to marks on edges.
2. Bolt halves of case together securely and install lock wire in such a manner that wire will be drawn together if bolts work loose.
3. Reinstall oil collector disc on ends of differential bolts, and install differential side bearings.
4. Install differential and herring-bone gear assembly with end of teeth on pinion and gear flush. Tighten side bearing adjusting nuts to seat bearings without disturbing relative position of gear and pinion.
5. It is very important that all bevel gear adjustments be made before attempting to adjust differential herring-bone gears. And if it should be necessary to readjust bevel gears, herring-bone gears must also be readjusted.
6. Check clearance at both sides between herring-bone gear teeth, readjusting as necessary to make this clearance as nearly equal on both sides as possible.
7. Paint a few teeth on gear with red lead and turn gears by hand, noting tooth contact shown on both sides of each gear. Make whatever changes are necessary to secure equal contact on both sides. All herring-bone gear adjustments must be made at differential side bearing adjusters. Never change adjustment of cross shaft bearings when adjusting for herring-bone tooth contact.
8. After proper tooth contact has been secured with adjusting rings drawn up firmly, back off two or three notches on each ring, and lock securely. Be sure that side bearing cap bolts are tight and securely locked.

Oil Distributor, Install

See that oil distributors are clean and contact surface is not scored. Install double-passage distributor at shaft collector disc with machined surface toward disc, and single passage at herring-bone drive gear collector disc. See that distributors are seated against discs so that set screws can be properly installed.

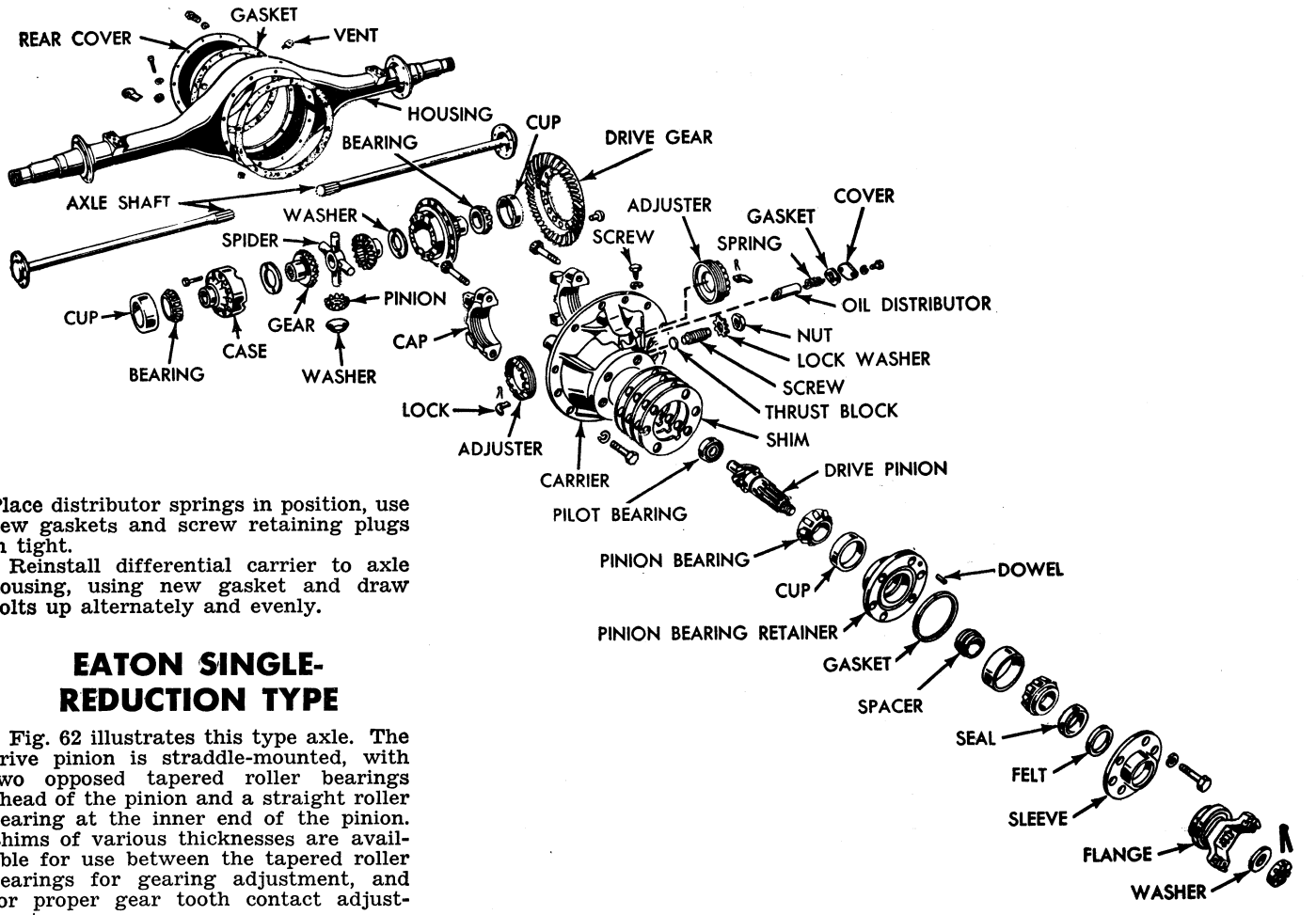


Fig. 62 Eaton single reduction axle

Place distributor springs in position, use new gaskets and screw retaining plugs in tight.

Reinstall differential carrier to axle housing, using new gasket and draw bolts up alternately and evenly.

EATON SINGLE-REDUCTION TYPE

Fig. 62 illustrates this type axle. The drive pinion is straddle-mounted, with two opposed tapered roller bearings ahead of the pinion and a straight roller bearing at the inner end of the pinion. Shims of various thicknesses are available for use between the tapered roller bearings for gearing adjustment, and for proper gear tooth contact adjustments.

The differential is a four-pinion type with spiral bevel drive gear attached to the flanged part of the differential case. The differential case is the two-piece type, machined as a complete assembly and must be replaced as such whenever necessary.

Thrust washers are used between differential side gears and between differential pinions and case. Adjusters are provided at each end of the differential case for ring gear and pinion backlash, and gear tooth contact adjustments.

Disassembly

1. Remove oil distributor bolt and cover and extract the spring and oil distributor from carrier.
2. Loosen ring gear thrust screw so that ring gear and differential case will clear drive pinion when case is removed from carrier.
3. If it is desired to retain original side bearing adjustment, do not disturb right-hand side bearing cap, but remove only the left-hand cap. The differential case can be moved to the left side sufficiently to clear right-hand cap. Otherwise, remove both caps.
4. Mark right-hand bearing cap and differential carrier to insure installation of bearing caps in the original position on reassembly.
5. Remove differential bearing adjuster rings.
6. Remove drive pinion, bearing and cage assembly from carrier.
7. To disassemble differential, first make certain that both differential case halves are marked so that the same relative position may be obtained on reassembly. Then separate the differential case and remove its parts.
8. To disassemble the drive pinion, remove nut and washer and drive or press pinion shaft out of flange. Remove tapered bearing and bearing from cage. Remove tapered bearing from pinion. Remove rear bearing. Remove flange from oil seal cover.

Reassembly

Reverse the order of the above procedure to assemble the unit. Make certain that all parts have been thoroughly cleaned. Apply a coating of differential lubricant to all bearing surfaces and thrust washers to prevent scoring of parts when vehicle is first placed in service.

Drive pinion bearings should turn freely without perceptible end play. If correction is necessary, select the proper size bearing spacer to obtain correct adjustment.

Drive pinion is adjusted for tooth contact by means of shims placed between pinion cage and differential carrier.

Ring gear is adjusted for tooth contact by adjusting rings. To adjust for proper tooth contact, follow procedure given in the Two-Speed axle section. Pinion adjustment should never be altered unless new gears have been installed.

EATON TANDEM REAR AXLES

Rear axles are full floating, hypoid, tandem drive type with a single speed power divider, having an inter-axle differential, mounted on the forward rear axle unit, Fig. 63. The drive is transmitted from the transmission to the power divider.

Power Divider

The power divider assembly, Fig. 64, is mounted on the front side of the forward axle differential carrier. The assembly consists of an input shaft assembly, an output shaft assembly, a power divider differential lockout mechanism, a power divider differential, and a power divider case. The forward rear axle drive pinion assembly is also installed in the power divider case.

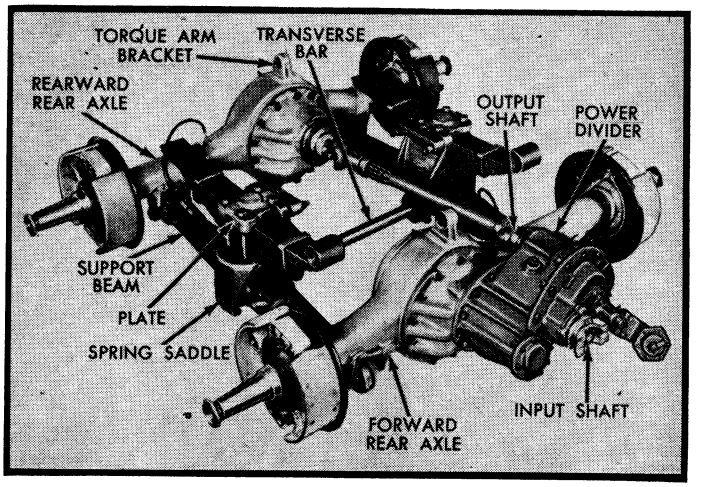


Fig. 63 Eaton tandem rear axles with power divider

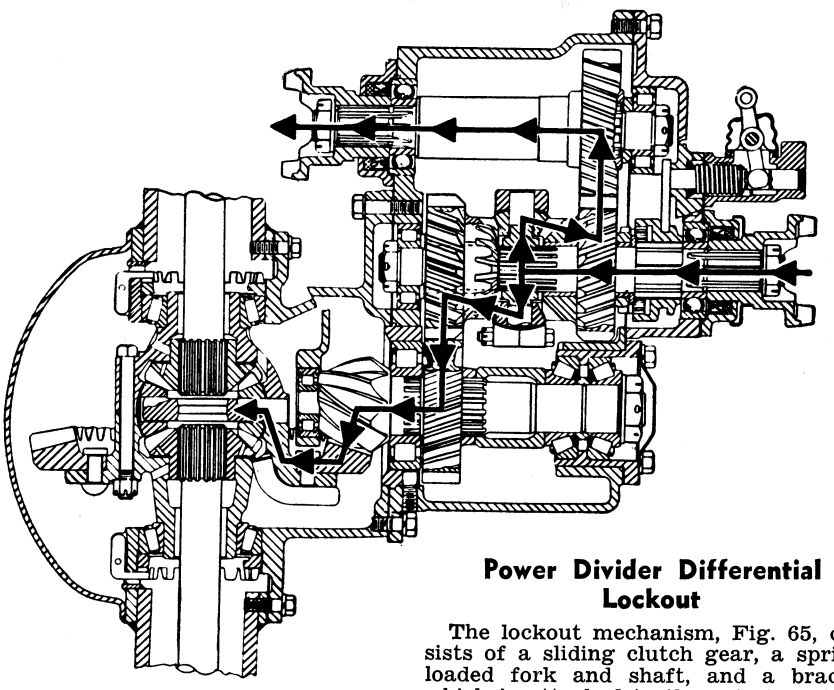


Fig. 64 Power divider power flow

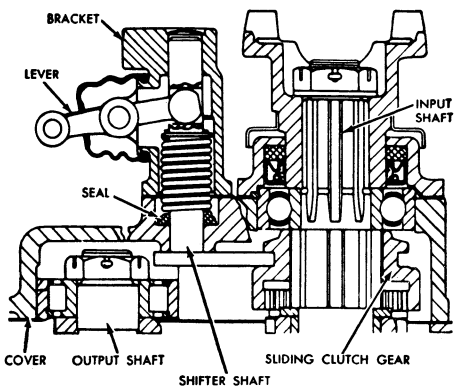


Fig. 65 Power divider lockout mechanism

Power Divider Differential Lockout

The lockout mechanism, Fig. 65, consists of a sliding clutch gear, a spring-loaded fork and shaft, and a bracket which is attached to the exterior of the power divider case cover.

The sliding clutch gear is mounted on the power divider input shaft and is secured in a disengaged position by the spring-loaded fork. The fork shaft, spring, and spring retainer are mounted in a bracket.

The mechanism to shift the lockout mechanism consists of a control knob, control valve and check valve assembly, a warning light and switch, interconnecting vacuum tight connections, and a lockout cylinder assembly.

Rearward Rear Axle, Remove

1. Raise chassis enough to remove truck weight from rear springs.
2. Support chassis in front of forward rear axle.
3. Disconnect rearward rear axle drive shaft at rear universal joint.
4. Disconnect hydraulic brake lines from brake carrier plates. *If truck is equipped with air brakes, bleed the air from the system, then disconnect the air brake hoses from the brake chambers.*
5. Drain lubricant from housing.
6. Remove left-hand axle shaft stud nuts and strike the center of the flange with a hammer to loosen and remove the dowels.
7. Remove axle shaft from housing.
8. Support the axle with a suitable jack.
9. Back off the brake adjustment slightly and remove the left dual wheels and brake drum as an assembly.
10. On axles equipped with hydraulic brakes, remove the brake carrier plate and brake shoes as a unit.
11. On trucks equipped with air brakes, remove the roto chamber, dust shield and brake spider assembly.
12. Loosen the nut on the rear torque arm stud. Free the stud with a puller or soft hammer. Do not remove the stud from the bracket.
13. Remove the nuts which secure the left-hand support beam end shaft in the axle housing bracket. Drive or pull the shaft toward the outer end of the axle housing until it is removed from the bracket and insulator bushing.
14. Drive out the shaft. The right-hand support beam may be removed in the same manner.
15. Remove the right-hand axle shaft, wheels, hub and drum from the axle housing in the same manner as the left-hand side. Then remove the nut from the torque arm stud and pry the stud out of the housing bracket.
16. Free the support beam ends from their respective hanger brackets by raising the axle and carefully pulling the assembly out from under the chassis.

Rearward Rear Axle, Install

1. Balance the axle on a roller jack and position the assembly under the chassis. Attach the drive shaft U-joint trunnion to the U-joint flange.
2. Raise the axle at the same time, align the support beam ends in their respective hanger brackets.
3. Clean the outside diameter of each support beam end shaft body so that the shaft retaining nuts will thread onto the shafts easily by hand.
4. Apply a thin film of graphite grease or its equivalent on the body of each shaft.
5. With the support beam and insulator bushing properly aligned in the hanger brackets, insert the shafts so that their outer ends are equidistant from the outer faces of the hanger brackets.
6. *Install each nut by hand and spin it down until it seats against the face of the hanger bracket.* This must be done to make certain that the nut is properly threaded on the shaft. Do not use a wrench until the nut is properly threaded on the shaft.
7. After each nut is seated, tighten to 350-400 lb. ft. torque. Install the torque arm stud into its bracket and tighten the stud nut to 175-225 lb. ft.

8. Install the brake assemblies.
9. Install the brake drums, wheels and axle shafts. Adjust brakes and bleed hydraulic system (if so equipped).

Forward Rear Axle, Remove

1. Raise and support the chassis.
2. Disconnect the lockout shift cylinder hose from the cylinder.
3. Disconnect the drive shaft at the front of the power divider.
4. Disconnect hydraulic brake hose at chassis and brake carrier plate. If equipped with air brakes, bleed the air from the brake system and disconnect the air brake hoses from the brake chambers.
5. Remove the right-hand axle shaft.
6. Raise the right-hand side of the forward rear axle until the wheel clears the floor. Remove the wheels, hub and drum as a unit.
7. Remove the brake assemblies.
8. Loosen torque arm stud nut, loosen the stud from the bracket but do not remove the stud.
9. Remove the nuts and drive the support beam shaft toward the outer end of the axle housing and out of the hanger and bushing.
10. Disconnect the drive shaft from the power divider output shaft at the U-joint flange.
11. Remove the parts from the left-hand side of the forward rear axle in the same manner as for the right-hand side. *Do not remove the brake assemblies from this side.* The left-hand axle must be driven through, or pulled out of, the hanger bracket toward the center of the axle housing.
12. Remove the nut from the torque arm stud and drive the stud out of the bracket.
13. With the axle and power divider securely positioned on a jack, raise the assembly to free the hanger brackets from the support beams and withdraw it from under the truck.

Forward Rear Axle, Install

Reverse the foregoing procedure to install the axle, following the same precautionary measures outlined for the rearward rear axle.

If either drive shaft slip joint has been separated, be sure the arrow on the drive shaft and U-joint are aligned upon assembly or an out-of-balance condition may result.

Power Divider & Differential Carrier, Replace

1. Block rear wheels to prevent truck from rolling.
2. Disconnect vacuum hose from lockout cylinder.
3. Disconnect lockout cylinder push rod from bracket lever.
4. Remove lockout cylinder.
5. Drain lubricant from power divider and axle housing.
6. Disconnect input shaft U-joint at power divider and the U-joint knuckle at the front of the input drive shaft.
7. Remove drive shaft assembly.
8. Disconnect rearward rear axle drive shaft at the power divider output shaft U-joint.
9. Remove both axle shafts.
10. Remove differential carrier-to-axle housing capscrews or stud nuts. Support the assembly on a roller jack and remove the assembly from the axle housing.
11. Reverse the foregoing procedure to install the assembly.

Rear Axles, Overhaul

The procedure for overhauling both the rearward and forward rear axles is essentially the same as outlined for the Eaton Single Reduction axle.

Power Divider, Overhaul

After removing the differential case from the forward rear axle carrier, remove the power divider from the carrier and service the power divider, referring to Figs. 66 to 88.

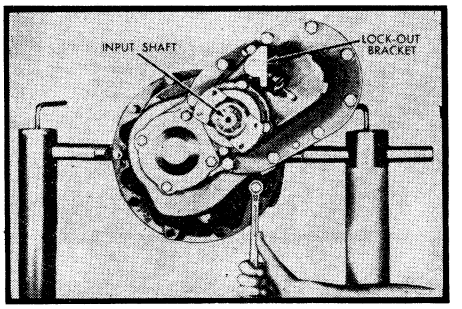


Fig. 66 Removing power divider from carrier

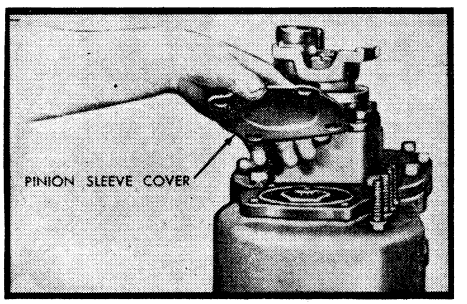


Fig. 67 Removing drive pinion sleeve cover

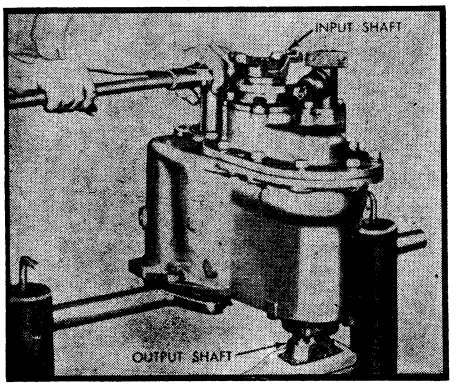


Fig. 68 Removing drive pinion nut

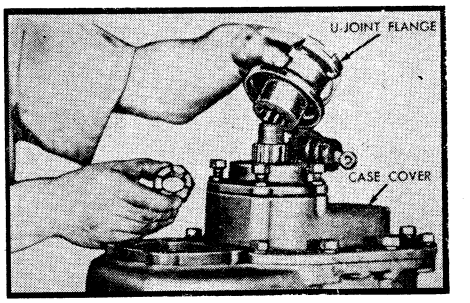


Fig. 69 Removing input shaft nut and flange

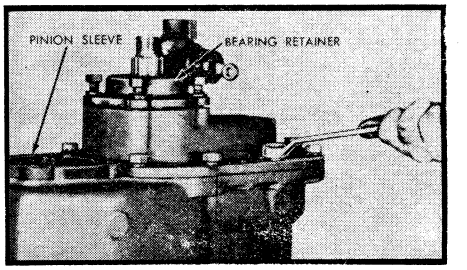


Fig. 70 Removing case cover bolts

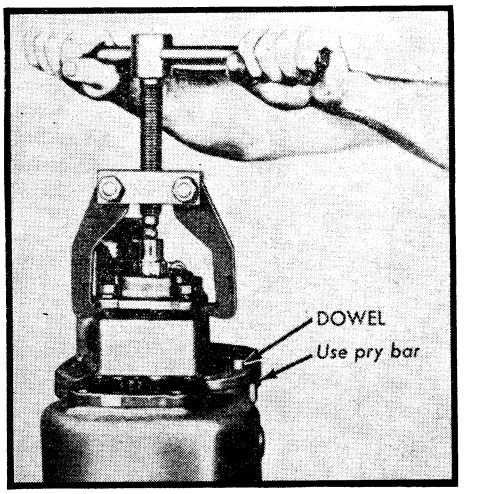


Fig. 71 Removing case cover (typical)

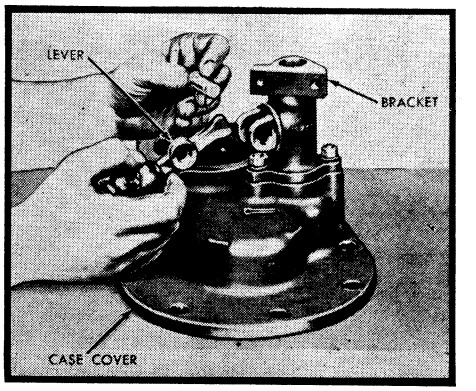


Fig. 72 Removing lockout lever (typical)

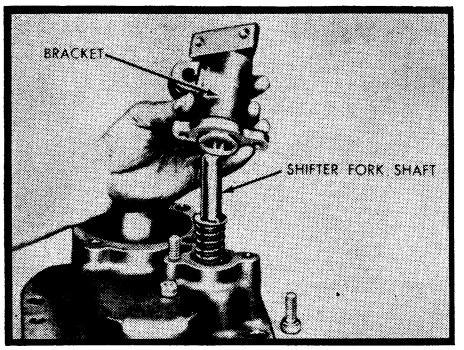


Fig. 73 Removing shift fork bracket (typical)

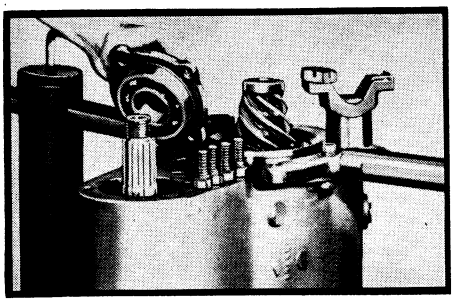


Fig. 74 Removing output shaft bearing cover

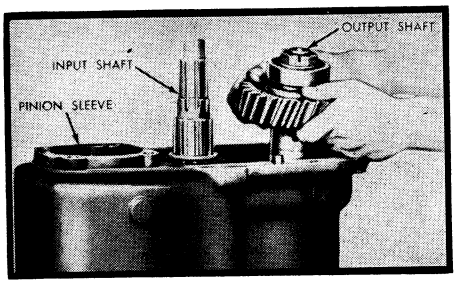


Fig. 75 Removing output shaft assembly

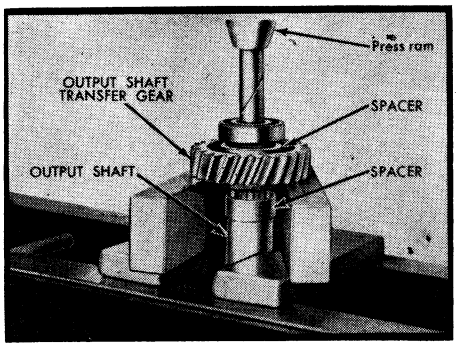


Fig. 76 Disassembly of output shaft

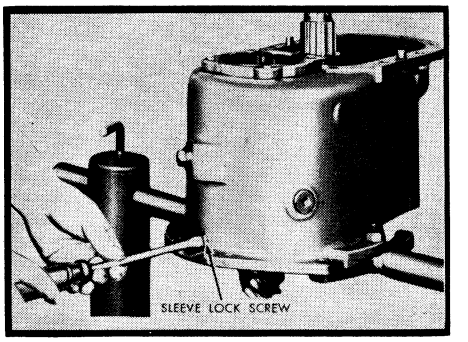


Fig. 77 Removing bearing sleeve lock screw

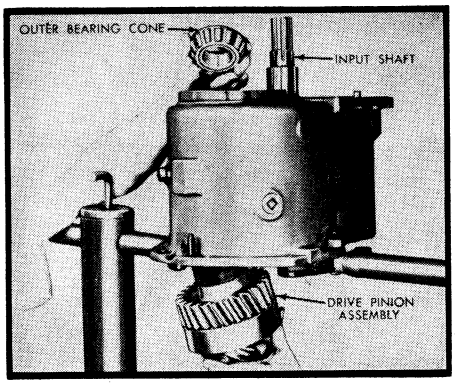


Fig. 78 Removing drive pinion

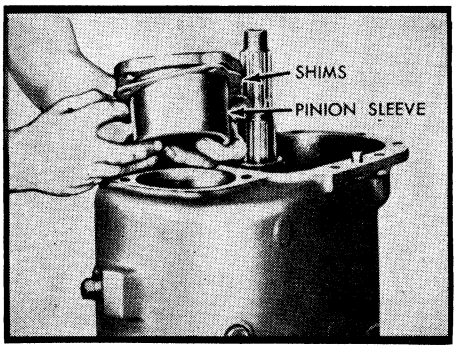


Fig. 79 Removing pinion sleeve

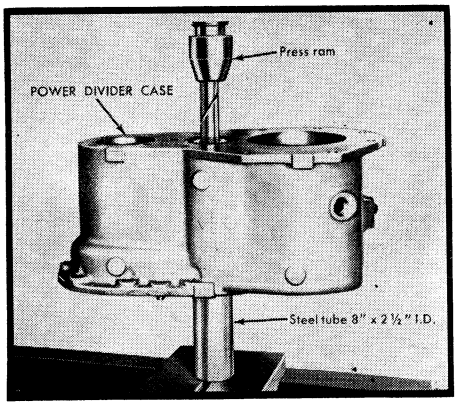


Fig. 80 Removing input shaft

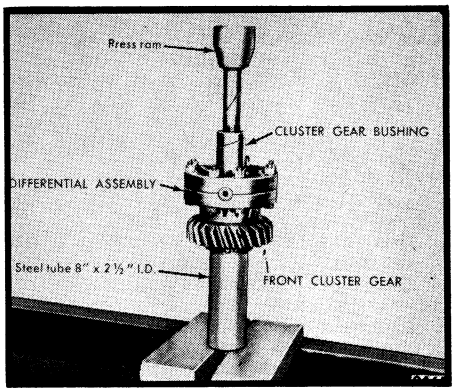


Fig. 81 Disassembly of input shaft

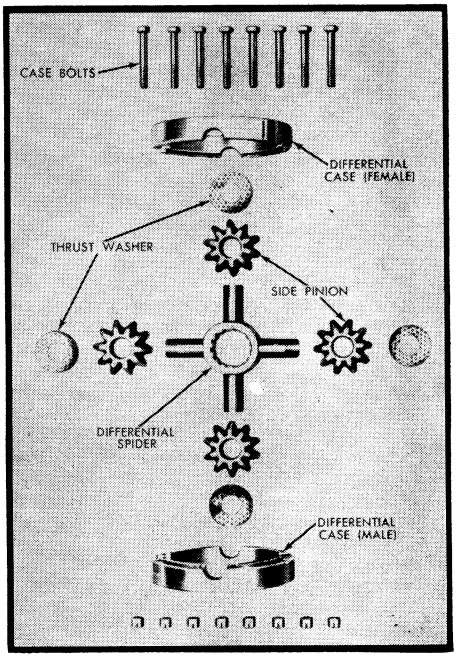


Fig. 82 Layout of power divider differential parts

Lockout Vacuum System

Fig. 89 shows the power divider differential lockout vacuum cylinder. To test the system for leaks, position the truck on level ground with the parking brake released and transmission in neutral. Start the engine with the valve control knob pulled out. Accelerate the engine for a few seconds, release the accelerator and turn off the ignition.

Immediately measure the distance between the face of the cylinder mounting bracket and the center of the push rod yoke to the lever pin and note the dimension. At the end of 10 minutes, again measure the distance. If the dimension has not increased, the system may be considered vacuum tight. However, if the distance has increased, a vacuum leak exists in the system.

To localize leaks, first check all the connections. After all hoses and connections have been checked and tightened, test the system again. If leaks are still evident, check the control valve and check valve assembly and then check the power divider lockout cylinder.

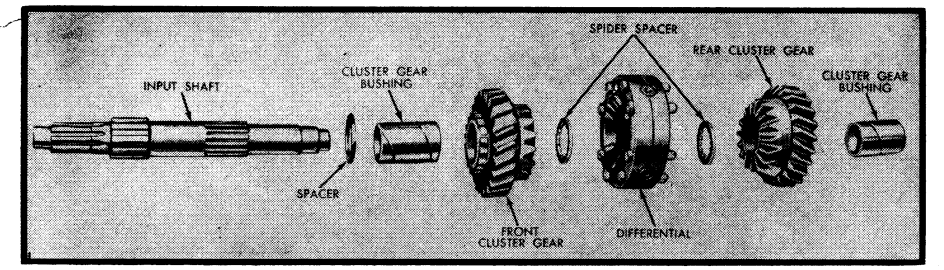


Fig. 83 Layout of input shaft parts

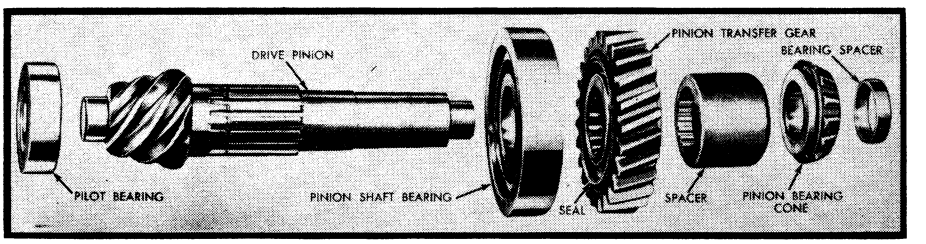


Fig. 84 Layout of drive pinion parts (typical)

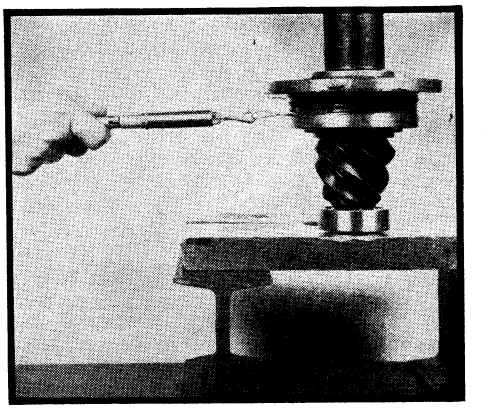


Fig. 85 Checking pinion bearing pre-load (typical)

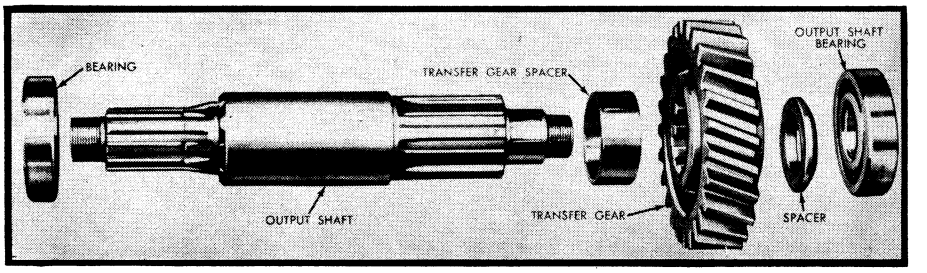


Fig. 86 Layout of ouput shaft parts

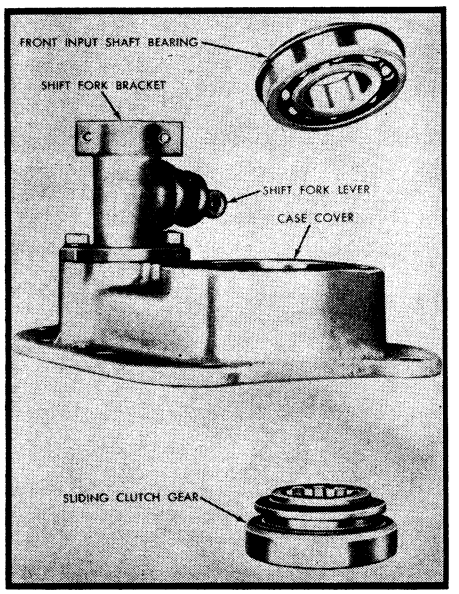


Fig. 87 Case cover components

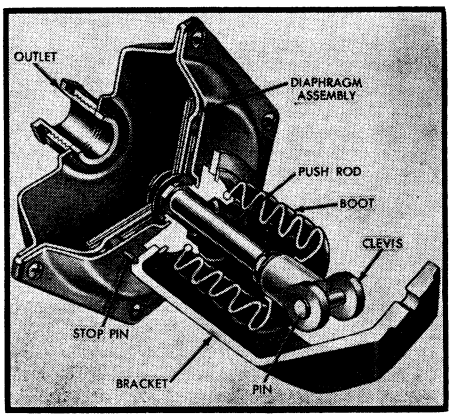


Fig. 89 Cutaway view of lockout cylinder

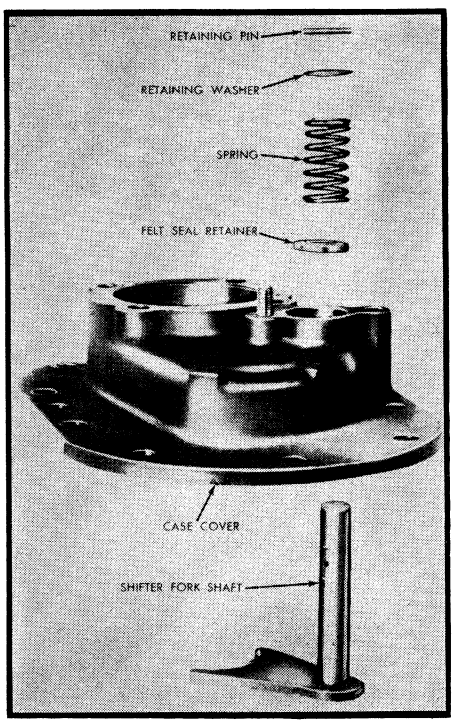


Fig. 88 Shift fork shaft parts (typical)

Timken Axle Section

TIMKEN TWO-SPEED DOUBLE-REDUCTION AXLE

The Timken Two-Speed Double-Reduction drive unit, Fig. 1, provides two gear ratios—actually two full size final drives in one unit—a "fast" ratio for maximum speed and a "slow" ratio for maximum pulling power. This feature enables the vehicle operator to use the proper axle gear combination required for speed, load and road conditions.

Operation

The first reduction is through a heavy duty spiral or hypoid bevel pinion and gear. The bevel pinion and gear set operates in conjunction with either of two sets of wide-face helical spur gears and pinions of different ratios. The second reduction is selective between a fast or slow ratio.

The bevel pinion is mounted on two tapered roller bearings in a pinion cage. The bevel gear is locked on the cross shaft by either splines or a key. The cross shaft is mounted on tapered roller bearings and carries two free-rolling helical spur pinions. Both spur pinions engage helical spur gears attached to the tapered roller bearing mounted differential.

On the inner side of each of the spur pinions are integral splines. On the cross shaft are two rows of splined teeth. A shift fork, actuated either by manual mechanism or a power actuated shift unit, moves the shift collar on the splined portion of the cross shaft to engage the splines on the fast or slow speed spur pinion.

When the fast axle speed is selected and torque released, the shift collar is moved toward the fast speed spur pinion, Fig. 2, and at the same time disengages the splines on the slow speed spur pinion. The fast speed spur pinion now revolves as part of the cross shaft to drive the fast speed spur gear. During this operation, the slow speed spur pinion is disengaged so as to rotate freely on the cross shaft. Power is transmitted through the bevel pinion and gear, cross shaft, clutch collar, fast idle spur pinion and gear, differential and axle shafts.

When the slow speed is selected and torque released, the shift collar moves in the opposite direction, Fig. 3, disengaging the fast speed spur pinion and locking the slow speed spur pinion as part of the cross shaft. Power is then transmitted through the slow speed spur pinion and gear, differential and axle shafts.

The design of the shift collar prevents disengagement until the opposite gear ratio is selected and torque released.

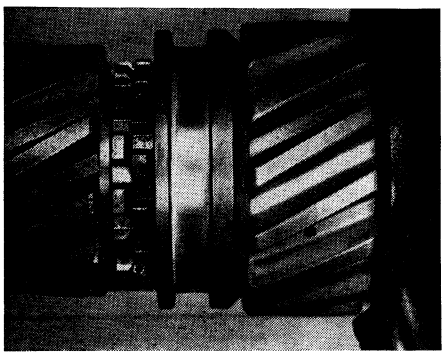


Fig. 2 Fast speed pinion engaged

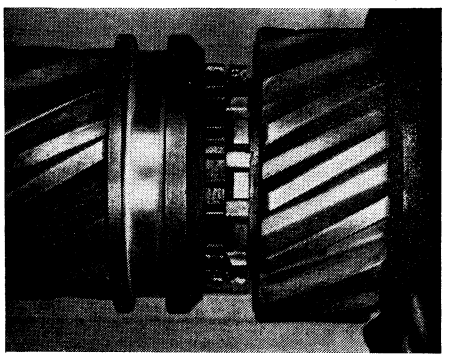


Fig. 3 Slow speed pinion engaged

Removing Carrier

1. Remove the plug from bottom of axle housing and drain lubricant.
2. Remove axle shaft drive stud nuts and lock washers.
3. Rap axle shafts sharply in center of flange to free dowels.
4. Remove taper dowels and axle shafts. To avoid damage to hubs and oil seals, do not pry shafts loose.
5. Disconnect vacuum or air lines from power actuated shift unit, or clevis from shift lever on top of housing if manually operated.
6. Disconnect universal at pinion shaft.
7. Remove carrier-to-axle stud nuts and washers. Leave two top nuts partially loose to prevent carrier from falling.
8. Break carrier loose from axle housing with rawhide mallet, and remove taper dowels.
9. Place roller jack under carrier, remove top nuts and work carrier free, using puller screws in holes provided. A small pinch bar may be used to straighten the carrier in the housing bore. However, the end must be rounded to prevent indenting the the carrier flange.
10. Place carrier in suitable holding fixture, such as a keg or drum or equipment shown in Fig. 4.

Disassemble Carrier

1. Clip lock wire, remove cap screws and adjusting nut locks.
2. Center-punch one differential carrier leg and bearing cap, Fig. 5, to

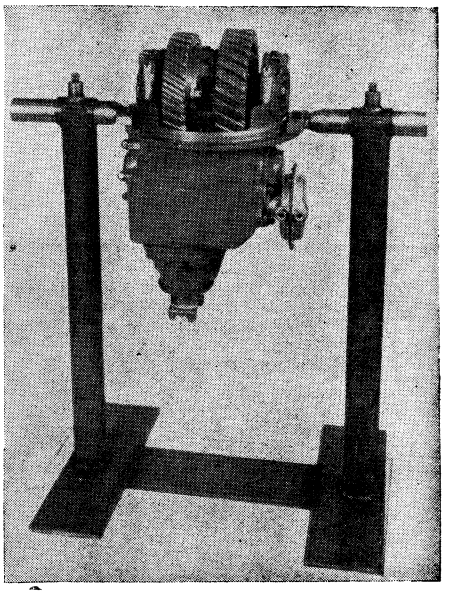


Fig. 4 Carrier mounted in repair stand

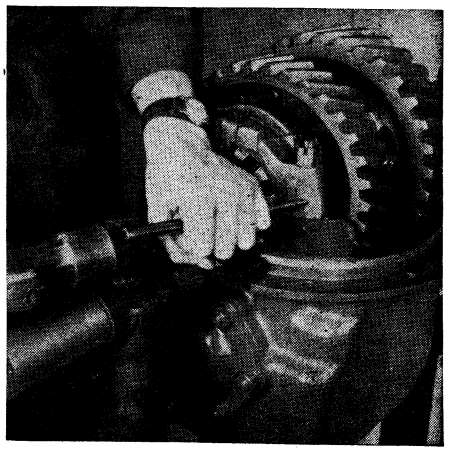


Fig. 5 Marking differential bearing cap and carrier leg to identify for proper reassembly

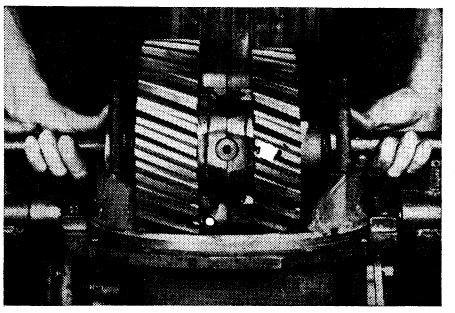


Fig. 6 Lifting out differential and gear assembly

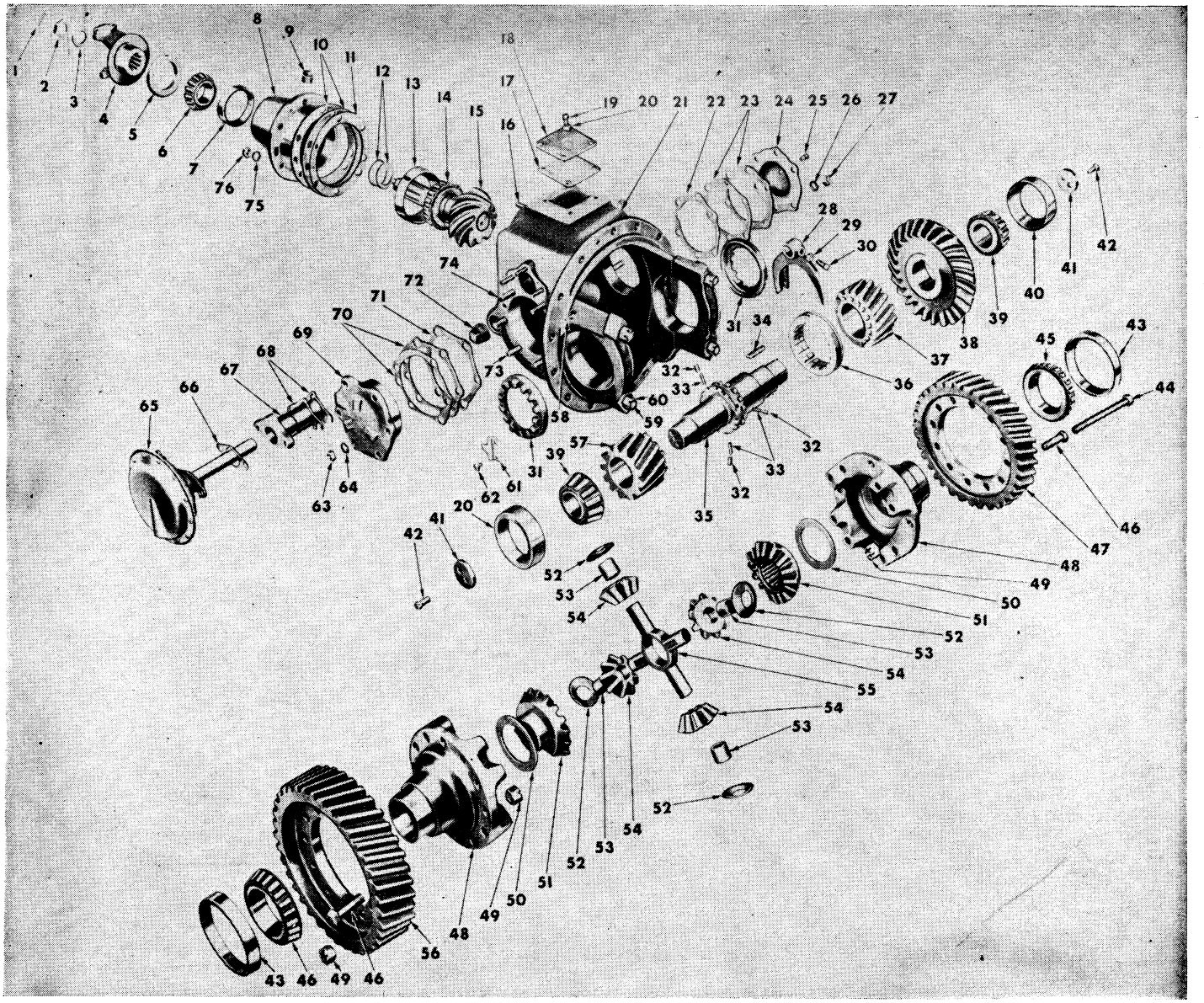


Fig. 1 Timken two-speed, double-reduction axle

1. Cotter pin
2. Nut
3. Washer
4. Companion yoke
5. Pinion front bearing oil seal
6. Pinion front bearing cone
7. Pinion front bearing cup
8. Drive pinion carrier
9. Plug
10. Carrier shims
11. Carrier gasket
12. Drive pinion bearing spacer
13. Pinion rear bearing cup
14. Pinion rear bearing cone
15. Drive pinion
16. Pinion carrier stud
17. Inspection cover plate
18. Inspection cover
19. Screw
21. Differential carrier
22. Gasket
23. Shims
24. Bearing retainer
25. Differential carrier breather
26. Washer
27. Nut
28. Shift fork
29. Nut
30. Screw
31. Differential bearing adjusting nut
32. Shift collar lock plunger
33. Plunger spring
34. Gear key
35. Differential spiral pinion shaft
36. Spiral pinion shift collar
37. High speed spiral pinion
38. Spiral pinion drive gear
39. Spiral pinion bearing cone
40. Spiral pinion bearing cup
41. Washer
42. Screw
43. Differential bearing cup
44. Bolt
45. Differential bearing cone
47. Differential drive gear (high speed)
48. Differential case
49. Nut
50. Differential side gear thrust washer
51. Differential side gear
52. Differential pinion thrust washer
53. Differential pinion bushing
54. Differential pinion
55. Differential spider
56. Differential drive gear (low speed)
57. Low speed spiral pinion
58. Pin
59. Stud
60. Nut
61. Nut lock
62. Lock screw
63. Nut
64. Washer
65. Shift diaphragm
66. Gasket
67. Diaphragm sleeve
68. Spacer
69. Spiral pinion bearing cage
70. Shims
71. Gasket
72. Plug
73. Stud
74. Stud
75. Washer
76. Nut

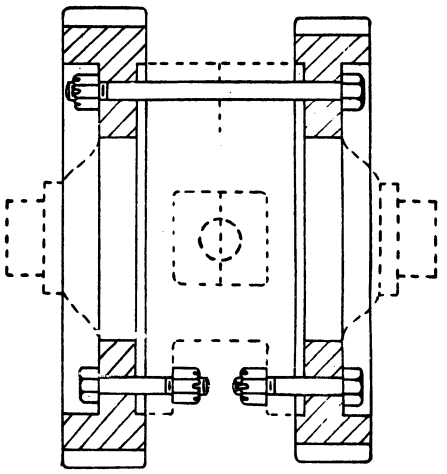


Fig. 7 Spur gear mounting of type joined by long and short bolts

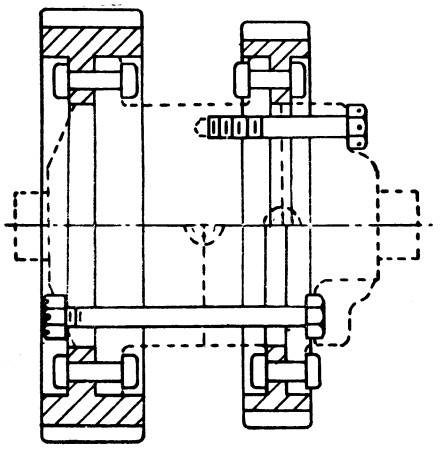


Fig. 8 Spur gear mounting of type joined by rivets and cap screws or long bolts

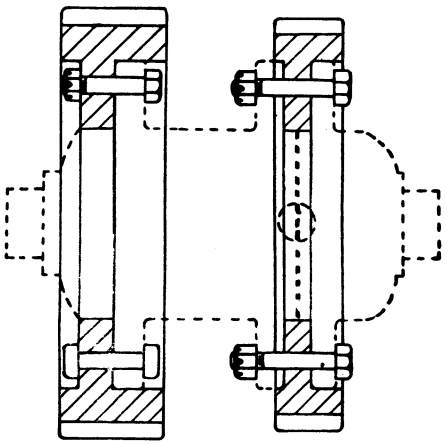


Fig. 9 Spur gear mounting of type joined by rivets or bolts

identify for proper reassembly.

3. Remove bearing cap stud nuts or cap screws, bearing caps and adjusting nuts.
4. Lift out differential and gear assembly, Fig. 6.

NOTE—Three types of spur gear mountings are used in these drive units. In type 1, Fig. 7, the spur gears and differential assembly are joined by long and short bolts. In type 2, Fig. 8, the fast and slow speed spur gears are riveted to the case halves and the assembly joined by cap screws or long bolts. In type 3, Fig. 9, the slow speed spur gear is riveted or bolted to one differential case half. The fast speed spur gear is located between the case halves and attached by the same bolts which join the case halves.

5. If original identification marks are not clear, center-punch case halves for correct alignment on reassembling.
6. Clip lock wire, remove long bolts or cap screws and separate case halves.
7. Remove spider, pinions, side gears and thrust washers.
8. Remove short bolts or rivets and separate gears from case. In removing rivets, do not chisel them off as this will elongate the holes in the flange. To remove rivets properly, carefully center-punch rivet in the center of the head. Use a drill $\frac{1}{32}$" smaller than the body of the rivet to drill through the head, Fig. 10. Press out rivets.
9. Remove differential bearings, using a suitable puller if necessary.
10. Remove pinion cage stud nuts and lock washers and lift out cage assembly. If cage is not free, tap it loose, using a soft drift on inner face of pinion or use puller screws in holes provided.
11. Wire shim pack together to keep intact to facilitate adjustment on reassembling.
12. Place pinion cage over carrier studs, Fig. 11. Hold flange and remove pinion shaft nut. (Flange or yoke may be locked in a suitable fixture.)
13. Press pinion shaft out of flange and cage, Fig. 12.
14. Remove adjusting spacers or shims.
15. If necessary to renew the pinion or rear bearing, remove bearing with suitable puller.
16. Press front bearing and pinion shaft oil seal from cage.

NOTE—Power and manually operated shifts are used on two-speed carriers. The power operated shift units are either side or front mounted.

17. To remove the side mounted power unit, Fig. 13, loosen lock nut on shift fork lock screw and remove screw and nut, Fig. 14. Remove two shift unit stud nuts and lock washers. Remove shift unit and shaft and lift out shift fork. Remove third nut and lock washer. Tap sleeve and bushing assembly from carrier with a soft mallet. Wire shim pack to keep intact to facilitate adjustment on reassembling.
18. To remove the front mounted type power unit, Fig. 15, remove four cap screws and lock washers. Re-

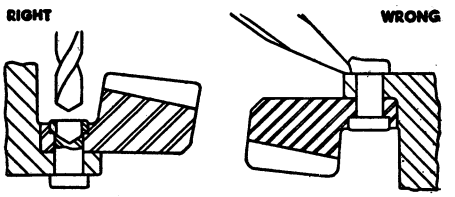


Fig. 10 Removing gear rivets

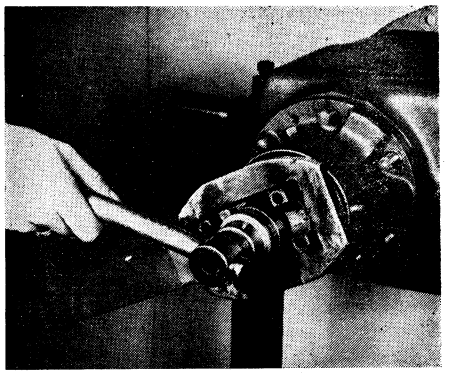


Fig. 11 Removing pinion shaft nut

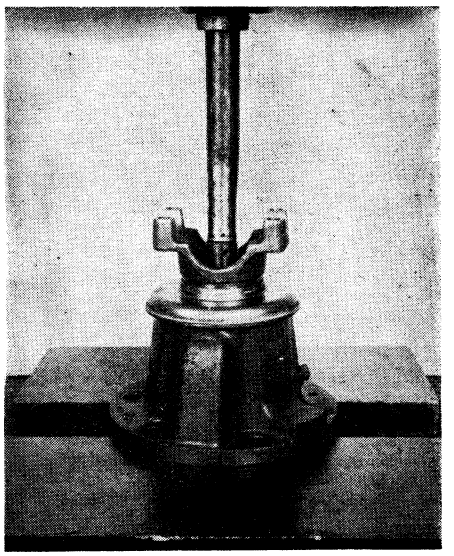


Fig. 12 Pressing pinion shaft out of flange and cage

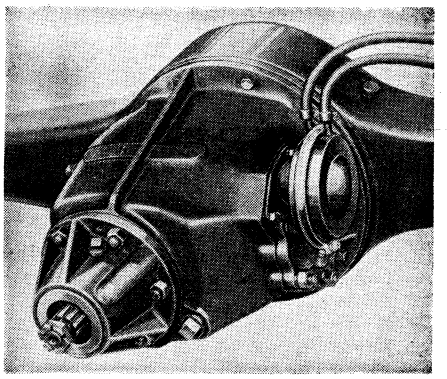


Fig. 13 Side mounted power actuated shift unit

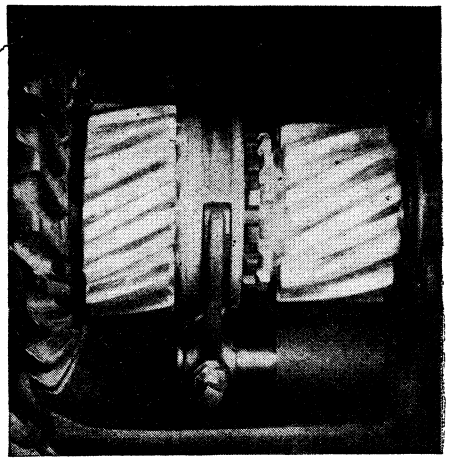


Fig. 14 Showing shift fork lock screw and nut

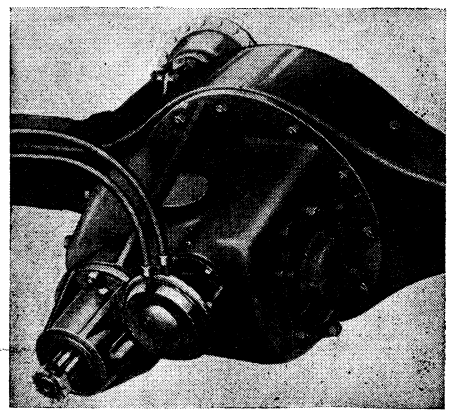


Fig. 15 Front mounted power actuated shift unit

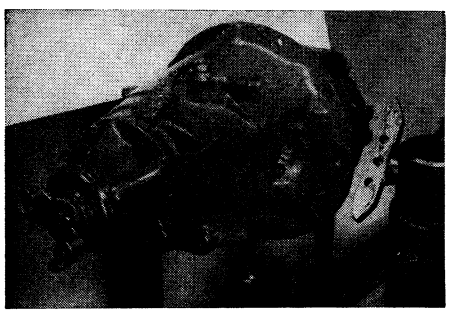


Fig. 16 Manually operated shift

move shift unit and guard assembly.

19. To remove the manually operated shift, Fig. 16, remove shift lever retaining nut and shake proof washer. Remove lever, poppet, spring and Woodruff key from shift fork shaft.
20. To remove the cross shaft assembly, force off bearing cage with a small pinch bar, Fig. 17, between the back of the bevel gear and carrier housing. (Puller screws are also provided.)
21. Wire shim pack together to keep intact to facilitate adjustment on reassembling.
22. Thread out cross shaft, Fig. 18.
23. On power actuated shaft (front mounting), remove set screw holding shift fork on shift shaft. Slide out shift shaft and remove shift fork from inside of housing.
24. On manually operated shift, remove bushing with screw driver through slot provided in carrier housing. If the bushing has seized, force it out using a split bushing around the shaft inside the carrier housing and a small pinch bar for pry. Remove shift fork from inside housing.
25. Cross shaft bearings are retained either by nuts and lock rings or plates and cap screws which are lock wired, Fig. 19. Clip the lock wire and remove cap screws and retaining plates or clamp slow speed spur pinion in vise with soft jaws. Engage shift collar to lock cross shaft and remove lock rings and nuts from both ends of cross shaft.
26. Press cross shaft from bevel gear and bearing, Fig. 20.
27. Lift off fast speed spur pinion and remove shift collar poppets and springs.
28. Replace shift collar and press cross shaft from slow speed spur pinion and bearing, Fig. 21. On some assemblies, a snap ring is used on the slow speed spur pinion. Where used, it should remain intact with the pinion or transferred to the new pinion if the gears are to be replaced.
29. If necessary to replace the cross shaft bearing cups, remove cross shaft bearing cover (bevel gear side). Wire shim pack together to facilitate adjustment on reassembling. Remove cups with suitable puller.

Inspection

Clean bearings and cups in a suitable solvent, such as kerosene or diesel fuel oil (avoid using gasoline). Bearings should never be placed in a hot solution tank for cleaning. Clean all other carrier parts in a solution tank or with suitable solvent.

Inspect all bearings, cups and cones, including those not removed from parts of the carrier. Replace if rollers or cups are pitted or damaged in any way. Re-

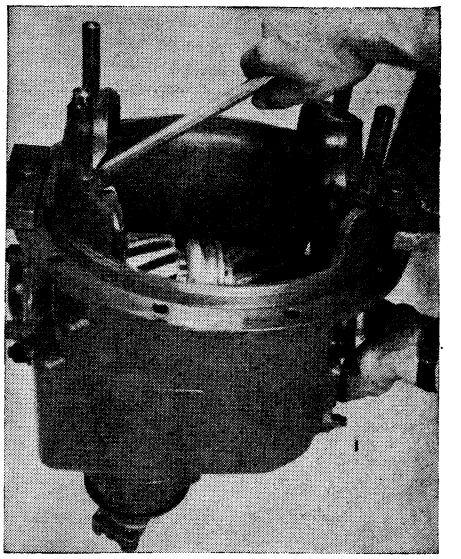


Fig. 17 Forcing bearing cage off with pinch bar

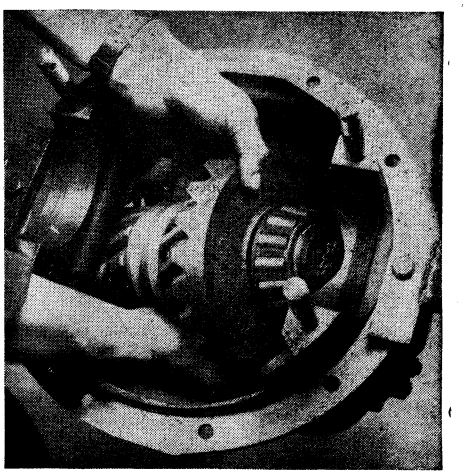
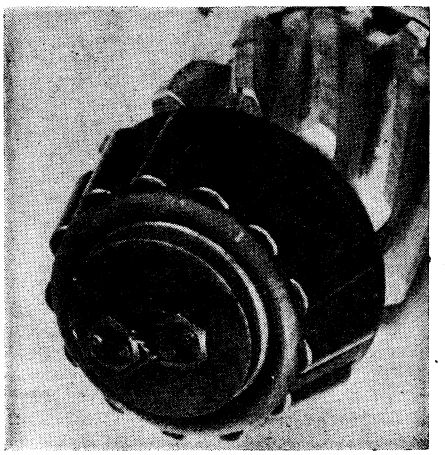


Fig. 18 Lifting out cross shaft assembly



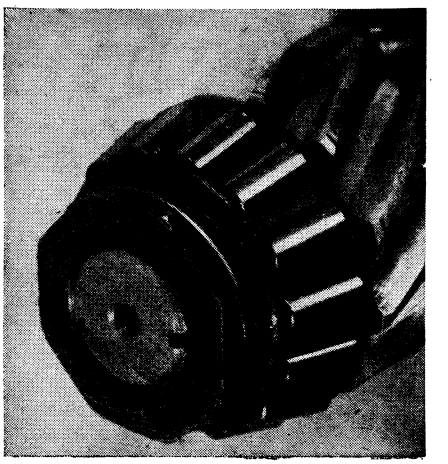


Fig. 19 Cross shaft bearing retainers; Left, plate and cap screws. Right, nuts and lock rings

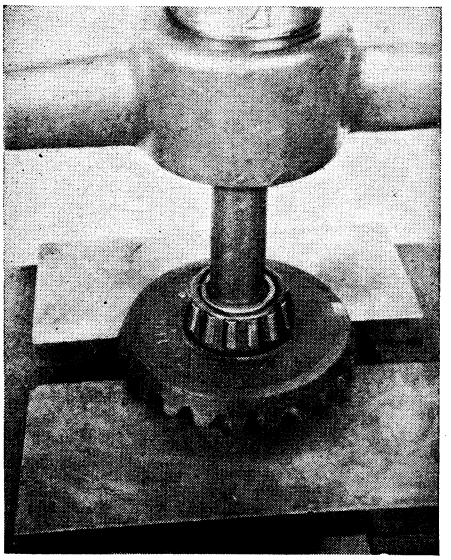


Fig. 20 Pressing cross shaft out of bevel gear and bearing

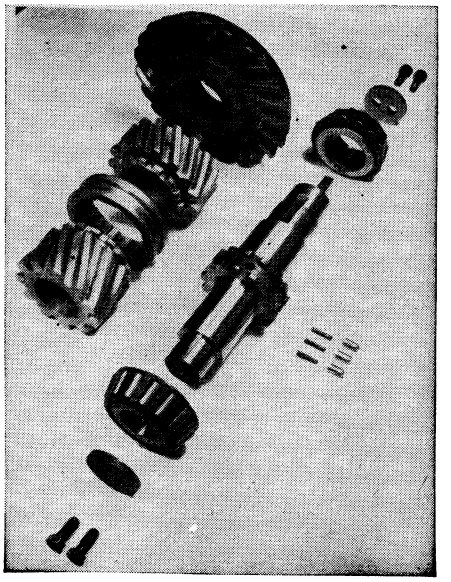


Fig. 22 Cross shaft assembly using bearing retainer plates

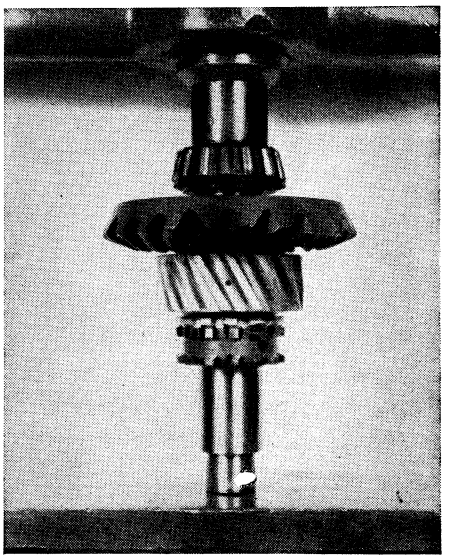


Fig. 24 Pressing bearing on cross shaft

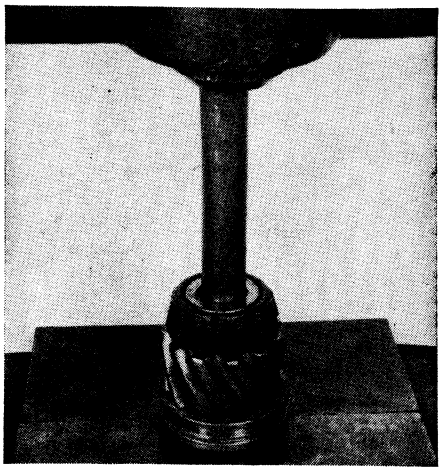


Fig. 21 Pressing cross shaft from slow speed pinion and bearing

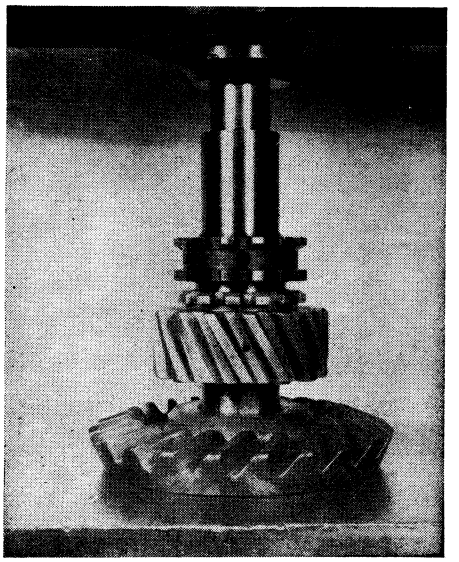


Fig. 23 Pressing cross shaft into bevel gear

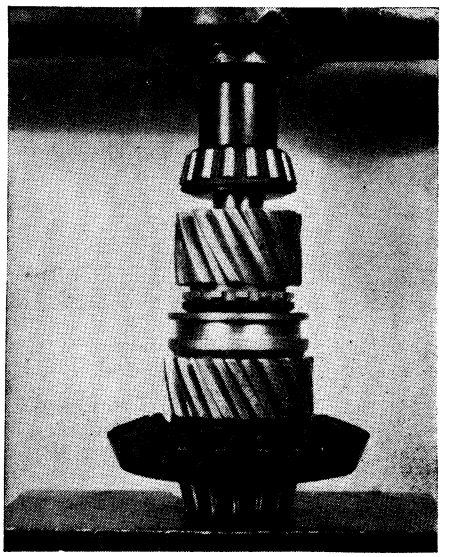


Fig. 25 Pressing bearing on cross shaft

move parts needing replacement with suitable puller. Avoid use of drifts or hammers as they may easily mutilate or distort component parts.

Inspect bevel and spur gears for wear or damage. Gears which are pitted, galled, worn or broken through case hardening should be replaced. When necessary to replace either the bevel pinion or bevel gear, the gear set must be replaced. These gears are matched to assure quietness and satisfactory service.

Inspect the differential assembly for pitted, scored or worn thrust faces of differential case halves, thrust washers, spider trunnions and differential gears. Thrust washers must be replaced in sets. The use of a combination of old and new washers will result in premature failure. Examine for wear or damage to the differential pinion and side gear teeth. Inspect for looseness of spider trunnions in differential case bores. Examine spur pinion and cross shaft for wear or damage to teeth. Look for indications of torsional fractures on axle shafts.

Replace all worn or damaged parts. Hex nuts with rounded corners, all lock washers, oil seals and gaskets should be replaced.

Remove nicks, mars, and burrs from machined or ground surfaces. Threads must be clean and free to obtain accurate adjustment and correct torque. A fine mill file or india stone is suited for this purpose. Studs must be tight prior to reassembling.

When assembling component parts, use a press where necessary; avoid hammering. Tighten all nuts to correct torque (torque limits are given further on). Lock wire must not be brittle; use soft iron wire to prevent breakage.

Reassemble Carrier

Assemble Cross Shaft—Type using bearing retaining plates, Fig. 22.

1. Lubricate inner bearing surfaces on the fast and slow speed spur pinions with axle lubricant.
2. Position fast speed spur pinion on the cross shaft with splined teeth toward cross shaft splines.
3. Install key and start cross shaft and pinion in bevel gear in line with keyway.
4. Press cross shaft squarely into bevel gear, Fig. 23. Gear must be firmly against cross shaft shoulder. To make installation easier, bevel gear may be heated in oil to 200-250° F.
5. Press bearing firmly against bevel gear, using a suitable sleeve, Fig. 24.
6. Check pinion end play with feeler gauge to assure a clearance of at least .010″. Normal end play will be .015″ minimum to .030″ maximum.

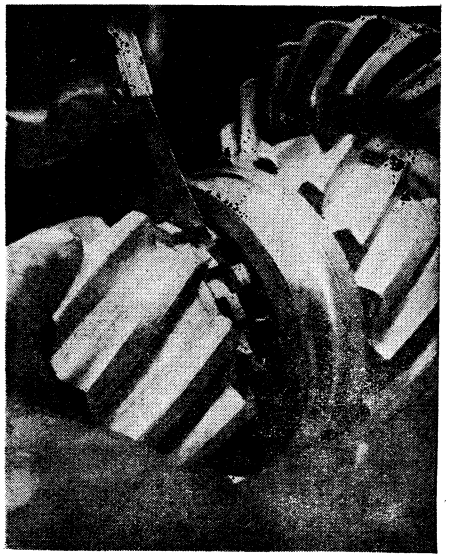


Fig. 26 Checking end play of slow speed pinion

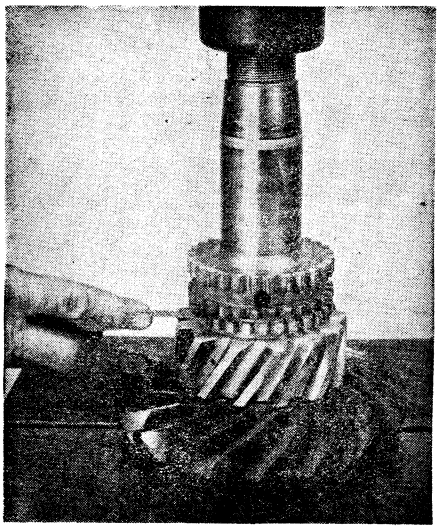


Fig. 27 Press cross shaft and pinion into bevel gear until slight drag is felt on .015" feeler when inserted as shown

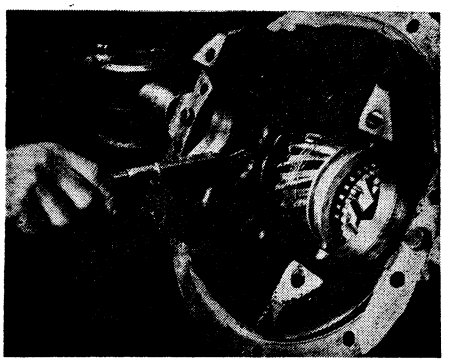


Fig. 28 Checking cross shaft bearing preload torque

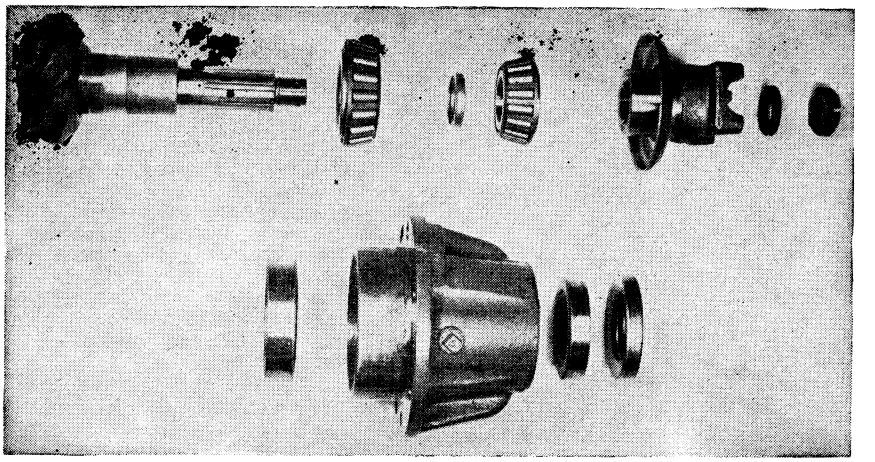


Fig. 29 Layout of bevel pinion and cage assembly

7. Install poppets and springs and coat with axle lubricant.
8. Align three tapered shift collar splines with poppets and position with wide shift collar splines toward bevel gear. Due to tooth spacing some shift collars can be assembled in one position only.
9. Install slow speed spur pinion on cross shaft with splines toward cross shaft splines.
10. Press cross shaft bearing squarely and firmly against the cross shaft shoulder, using suitable sleeve, Fig. 25.
11. Check slow speed spur pinion end play, Fig. 26. Must check to minimum of .010".
12. Install bearing retainer plates. Tighten cap screws and install lock wire.
13. If new bearing cups are to be installed, cage and housing must be clean and cups pressed firmly and squarely against their shoulders.

Assemble Cross Shaft—Type using bearing retaining nuts:

1. Lubricate inner bearing surfaces on the fast and slow speed spur pinions with axle lubricant.
2. Press cross shaft and pinion into bevel gear, Fig. 27. Use a .015" feeler gauge between pinion and cross shaft splines, and press shaft into gear until a slight drag is obtained.
3. Press cross shaft bearing against bevel gear.
4. Place splined section of cross shaft in vise with soft jaws. Install bearing retaining nut. Tighten firmly against bearing and align lock ring hole.
5. Recheck clearance between pinion and cross shaft splines for correct end play of .010" minimum and .020" maximum. Install lock ring when correctly adjusted.
6. Install poppets and springs in cross shaft bores and lubricate with axle lubricant.
7. Align the three tapered teeth on the shift collar with the poppets and position with wide shift collar splines toward the level gear. Due to tooth spacing, some shift collars can be assembled in one position only.
8. Install slow speed spur pinion (and snap ring where used) with splined teeth toward cross shaft splines.
9. Hold assembly by fast speed spur pinion in vise with soft jaws. Engage shift collar to lock shaft. Place remaining bearing on taper and install retaining nut. Use a .012" feeler gauge between pinion and cross shaft splines and tighten nut to obtain a clearance between .010" and .020".
10. Install lock ring.
11. Recheck assembly to be sure end play is correct. Less than the minimum clearance of .010" may result in seizure.

Install Cross Shaft—Gaskets at the pinion cage, cross shaft covers and cages are not used in current production drive units. When assembling a drive unit formerly incorporating gaskets, add approximately .015" shim stock to the original pack to maintain correct bearing preload and gear adjustment. Thin shims should be located on both sides of the pack to maintain maximum sealing ability.

1. On manually-operated type, install shift fork in carrier housing. Do not install lever until cross shaft has been installed.
2. Lubricate cross shaft bearings and cups with light machine oil.
3. If the bearing cover or the cage on the bevel gear side has been removed, replace, using the correct shim pack. Tighten stud nuts or cap screws to the correct torque. If cover has not been removed, retighten stud nuts or cap screws to the correct torque.
4. Ease cross shaft assembly past differential bearing supports and position in bearing cup.
5. On power-operated shift (front mounting type), position shift fork. Align lock screw hole and install shift shaft. Tighten lock screw firmly and tighten lock nut.
6. Start bearing cage (side opposite bevel gear) in housing.
7. Tap bearing cage in position with soft mallet. Install lock washers

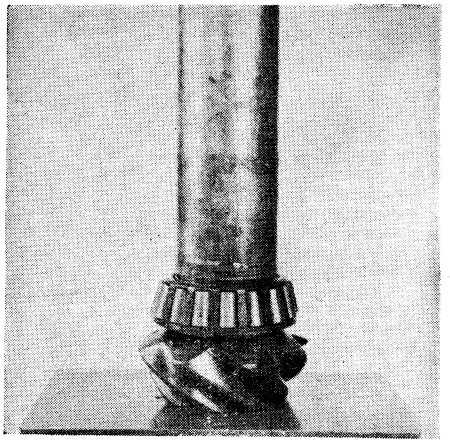


Fig. 30 Pressing on pinion rear bearing

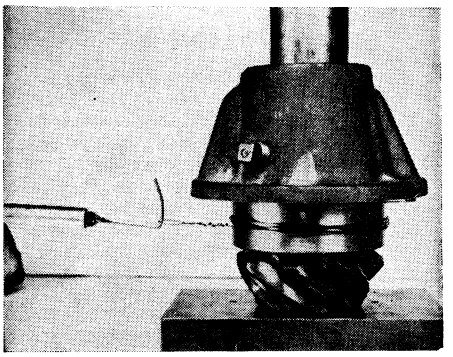


Fig. 31 Checking pinion bearing preload torque

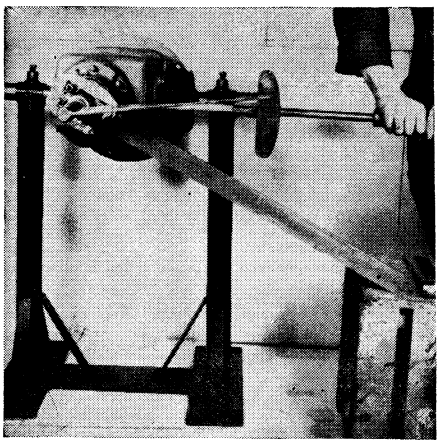


Fig. 32 Tightening pinion shaft nut with torque wrench

and stud nuts and tighten to correct torque. Always rotate cross shaft and gear assembly several revolutions before checking preload to assure normal bearing contact.

8. Check cross shaft bearing preload torque. Lock slow speed spur pinion and cross shaft with shift collar. Wrap soft wire around pinion and pull on a horizontal line with a spring scale, Fig. 28. Example: Assuming spur pinion diameter is 4", the radius would be 2", and with 8 pounds pull on the scale it would equal 16 inch-pounds bearing preload torque. Use rotating torque—not starting torque.
9. To obtain the correct preload torque of from 12 to 18 inch pounds, add or remove shims from pack under bearing cage (side opposite bevel gear).

Assemble Bevel Pinion & Cage—Fig. 29

1. Press rear bearing squarely and firmly against pinion shaft shoulder, Fig. 30.
2. Press bearing cups squarely and firmly against pinion cage shoulder.
3. Lubricate bearing and cups with light machine oil.
4. Insert pinion and bearing assembly in pinion cage.
5. Install selective spacer over pinion shaft with the bevel side toward pinion shaft shoulder.
6. Press front bearing squarely and firmly against the selective spacer, using a suitable sleeve.
7. Rotate cage several revolutions to assure normal bearing contact.
8. While in press under pressure, check pinion bearing preload torque. Wrap soft wire around pinion cage, Fig. 31, and pull on a horizontal line with a spring scale. If a press is not available, the pinion nut may be tightened to the correct torque and the preload checked. The correct pressures or torques for checking pinion bearing preload are as follows:

Pinion Shaft Thread Size	Specified Nut Torque Lbs. Ft.	Equivalent Press Pressure In Tons
1" x 20	300-400	6
1¼" x 18	700-900	11
1½" x 12	800-1100	14
1½" x 18	800-1100	14
1¾" x 12	800-1100	14
2" x 16	800-1100	14
2⅛" x 12	800-1100	14

EXAMPLE: Assuming pinion cage diameter to be 6", the radius would be 3", and with 6 pounds pull on scale would be equal to 18 inch-pounds bearing preload torque. Use rotating torque—not starting torque. If rotating torque is not within 12 to 18 inch pounds, use thinner spacer to increase or thicker spacer to decrease preload torque.

9. Press flange or yoke against pinion forward bearing.
10. Place pinion and cage assembly over carrier studs. Hold flange and tighten pinion shaft nut to the correct torque, Fig. 32.
11. Recheck pinion bearing preload torque. If not within the proper limits, repeat above procedure.
12. Hold flange and remove pinion shaft nut and flange or yoke.
13. Lubricate pinion shaft oil seal. With suitable sleeve press seal firmly against bearing cage shoulder.
14. Reinstall flange or yoke and tighten pinion shaft nut to correct torque.

Install Pinion & Cage—The oil passage holes in the carrier housing, shim pack and pinion bearing cage must be aligned, Fig. 33. See first paragraph under Install Cross Shaft relative to gaskets.

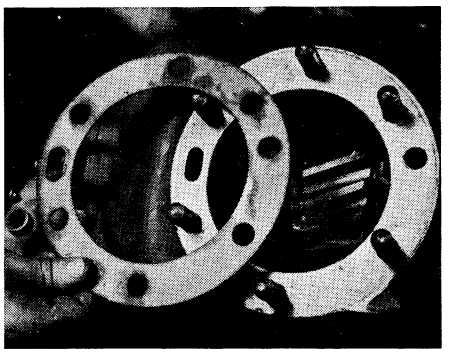


Fig. 33 Line up oil passage holes in carrier housing, gasket, shim pack and pinion bearing cage

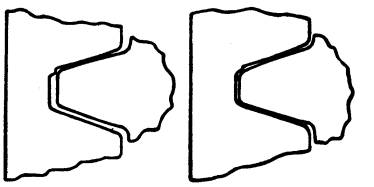


Fig. 34 Worn tooth section

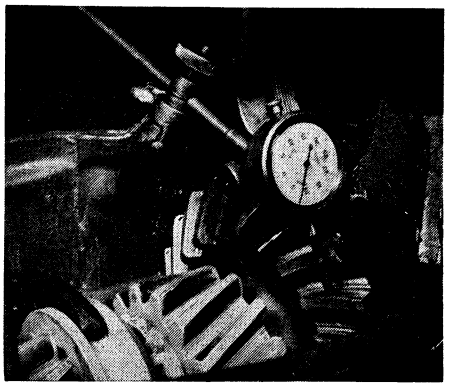


Fig. 35 Checking gear lash with dial indicator

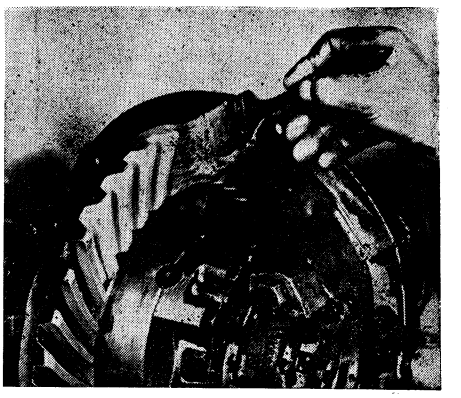


Fig. 36 Painting about 12 gear teeth with oiled red lead to check tooth contact

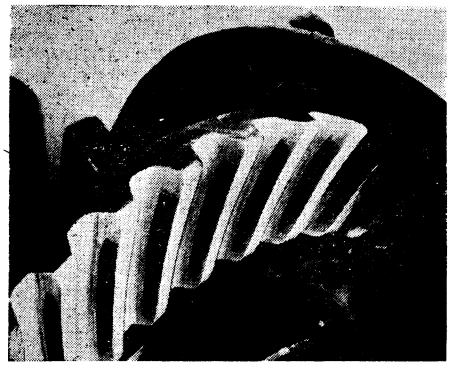


Fig. 37 Correct tooth contact

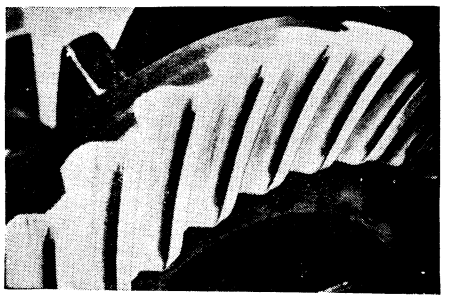


Fig. 38 High narrow contact. To correct, move pinion toward bevel gear

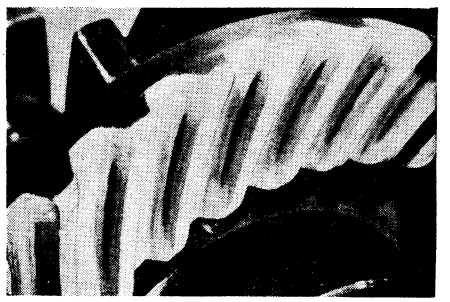


Fig. 39 Low narrow contact. To correct, move pinion away from bevel gear

1. Install original shim pack over studs.
2. Install pinion cage assembly. Lock washers and stud nuts or cap screws. Tighten to correct torque.

NOTE—Generally, if original gears are being reinstalled in assembly, painting gear teeth will not indicate the same contact as new gears and can be misleading. Gears that have been in service for long periods form running contacts due to wear of teeth. Therefore, the original shim pack plus approximately .015" additional shim stock should be maintained to check gear lash. In the event that gear lash is in excess of maximum tolerance, as stated under gear adjustment, reduce gear lash only in the amount that will avoid overlap of the worn tooth section, as shown in Fig. 34. Bevel gear lash can only be reduced to a point of maintaining smooth rotation of bevel gears. Smoothness or roughness can be noted by rotating the bevel gear. If a slight overlap, Fig. 34, takes place at the worn tooth section, rotation will be rough. With the original gears, the gear tone should be satisfactory.

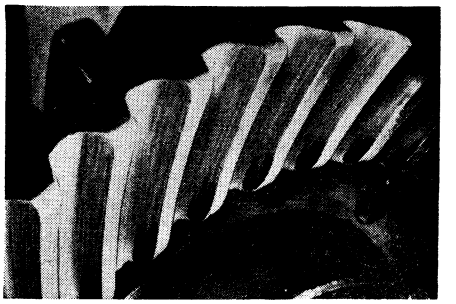


Fig. 40 Short toe contact. To correct, move bevel gear away from pinion

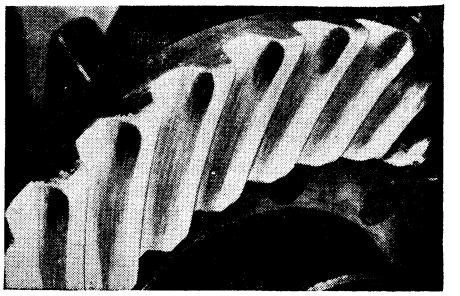


Fig. 41 Short tool contact. To correct, move bevel gear toward pinion

3. If bevel gear set has been renewed, check gear lash with dial indicator, Fig. 35, and adjust to obtain .006" to .012" lash. (a) To move pinion toward bevel gear, remove shims from pack under bearing cage. (b) To move pinion away from bevel gear, add shims to pack under pinion cage. (c) To move bevel gear away from pinion, remove shims from pack under cross shaft bearing cage (side opposite bevel gear), and add shims of equal thickness to pack under cross shaft bearing cover or cage on bevel gear side. Shims should be transposed in this manner to maintain established preload. (d) to move bevel gear toward pinion, reverse procedure (c).
4. When correct gear lash is obtained, check and adjust as necessary to obtain correct tooth contact.

Gear Tooth Contact

Timken recommends the use of oiled red lead applied lightly to the bevel gear teeth as a means of checking gear tooth contact. When the gear is rotated, the red lead is squeezed away by the contact of the teeth, leaving bare areas the exact size, shape and location of the contacts. Paint gear teeth as shown in Fig. 36. As a rule, painting about 12 teeth is sufficient for checking purposes.

Sharper impressions may be obtained by applying a small amount of resistance to the gear with a flat steel bar and using a wrench to rotate the pinion. When making adjustments, check the drive side of the bevel gear teeth. Coast side contact should automatically be correct when drive side contact is correct.

With adjustments properly made, the

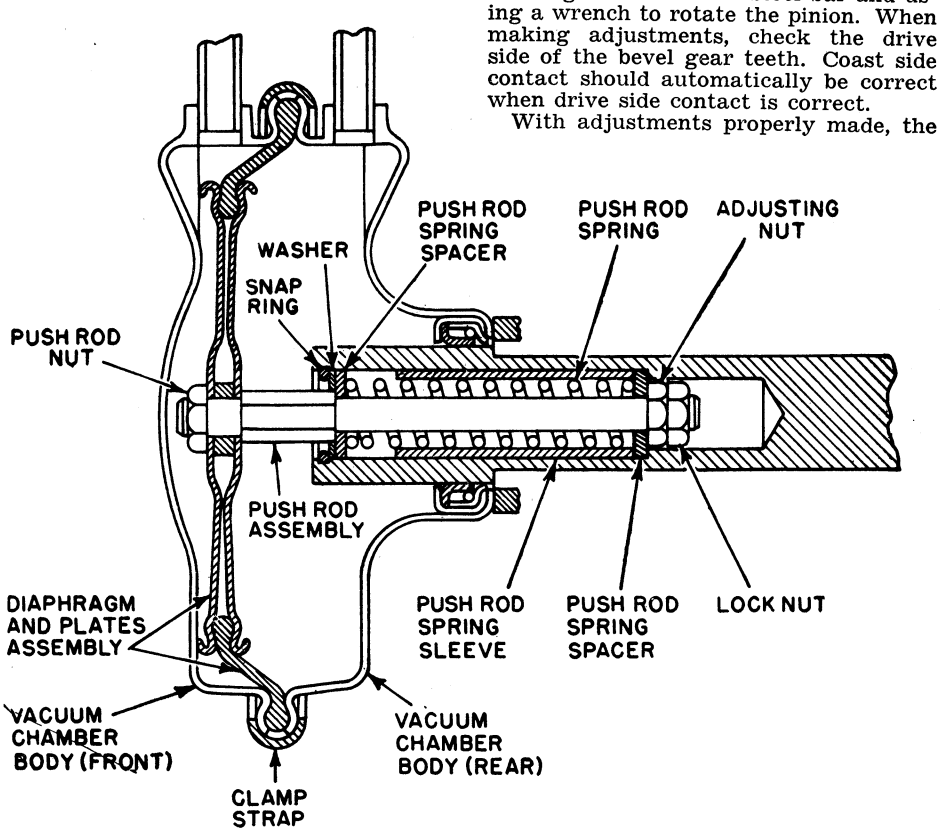


Fig. 42 Typical two-line power shift unit

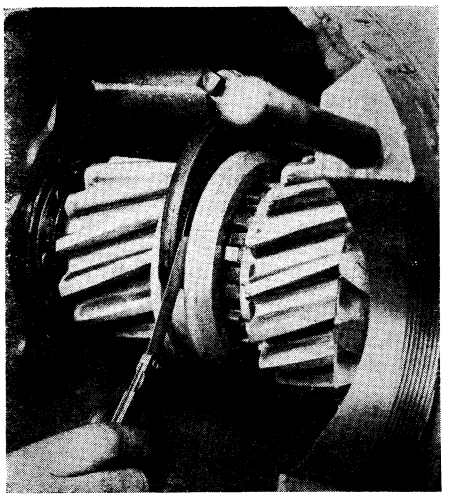


Fig. 43 Checking clearance of shift fork machined pads in shift collar with feeler gauge

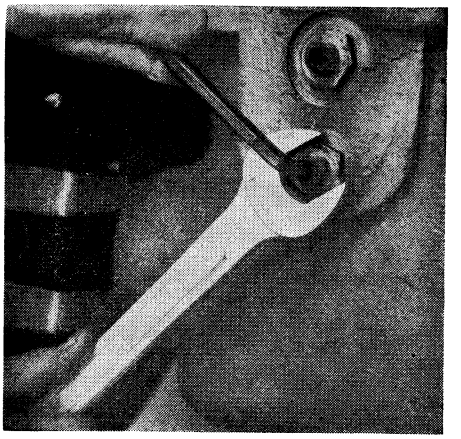


Fig. 45 Adjusting Allen set screws in top of carrier housing to allow shift collar to engage splined teeth on spur pinions

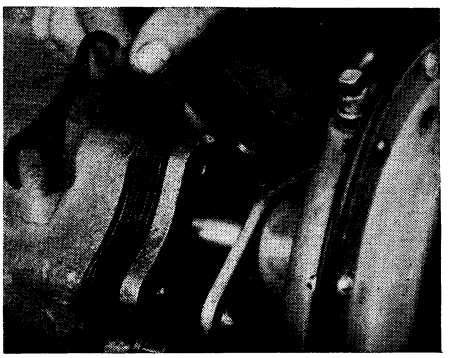


Fig. 44 Add or remove shims from pack under sleeve to obtain correct adjustment of shift fork pads in shift collar

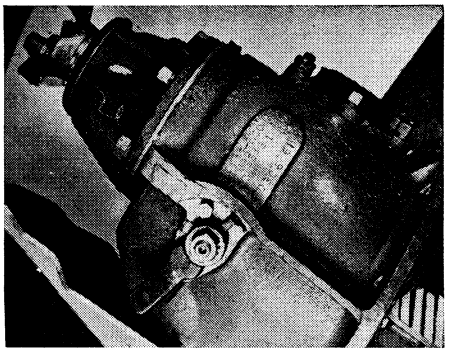


Fig. 46 The round type eccentric stop pin (where used) should be replaced with hex type to simplify lever adjustment for shift fork clearance

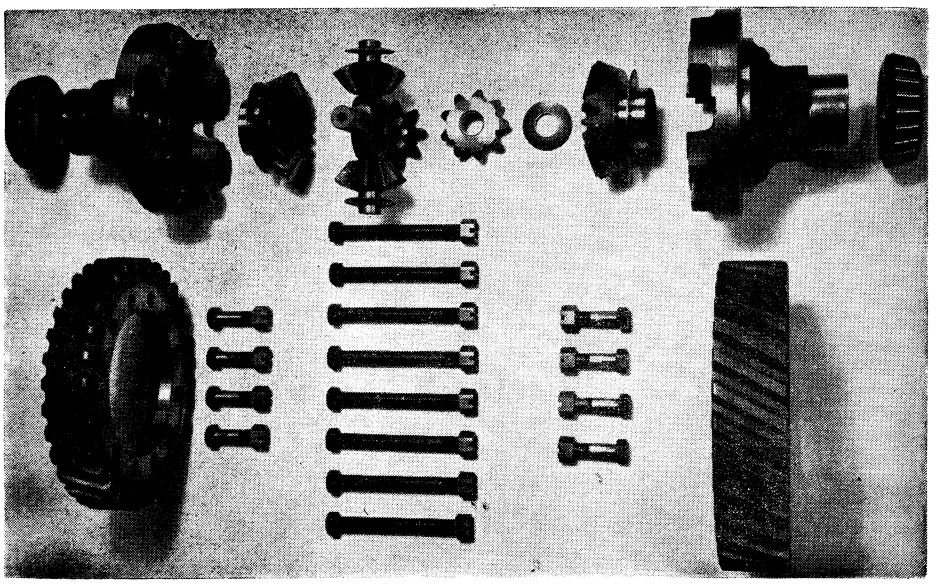


Fig. 47 Layout of differential and gear assembly

correct tooth contact, Fig. 37, will be secured. The area of contact starts near the toe of the gear and extends about 80% of the tooth length. This adjustment results in a quiet running gear set.

A High Narrow Contact, Fig. 38, is not desirable. If gears are allowed to operate with an adjustment of this kind, noise, galling and rolling over of the top edges of the teeth will result. To obtain correct contact, move pinion toward bevel gear to lower the contact area to the proper position. This adjustment will decrease backlash between pinion and bevel gear teeth, which may be corrected by moving bevel gear away from pinion. Backlash of .006″ to .012″ is correct.

A Low Narrow Contact, Fig. 39, is not desirable. If gears are allowed to operate with an adjustment of this kind, galling, noise and grooved teeth will result. To obtain correct contact, move pinion away from bevel gear to raise contact area to proper location. Correct backlash of .006″ to .012″ may be obtained by moving bevel gear toward pinion.

A Short Toe Contact, Fig. 40, will result in chipping at tooth edges and excessive wear due to small contact area. To obtain correct contact, move bevel gear away from pinion. This will increase the lengthwise contact and move contact toward heel of tooth. Correct backlash of .006″ to .012″ may be obtained by moving pinion toward bevel gear.

A Short Heel Contact, Fig. 41, will result in chipping, excessive wear and noise. To obtain correct contact, move bevel gear toward pinion to increase the lengthwise contact and move contact toward toe. Correct backlash of .006″ to .012″ can be obtained by moving pinion away from bevel gear.

Several adjustments of both pinion and gear may be necessary before correct contact and backlash are secured. After establishing the correct tooth contact and backlash, recheck cross shaft bearing preload.

POWER SHIFT

For Two-Speed Axles

NOTE—Different types of shift units are used on Timken two-speed axles depending on axle size and individual vehicle manufacturer's specifications. To service a typical two line type, proceed as follows:

Disassemble

Refer to Fig. 42 to identify parts given in the instructions which follow.

1. Remove nut and bolt from clamp strap. Remove clamp strap and separate front and rear vacuum chamber bodies.
2. Position ⅜″ wrench on hex portion of push rod beneath diaphragm and plate assembly, and with a ½″ wrench, remove diaphragm plate-to-push rod nut. Then remove diaphragm and plate.
3. Remove snap ring which holds push

rod in shift shaft and remove push rod assembly.
4. Remove washer from top of push rod. Remove lock nut and adjusting nut from bottom of push rod. Push rod spring spacer, spring sleeve, spring and spring spacer can now be removed.

Reassemble

1. Assemble spring spacer over bottom of push rod against shoulder.
2. Pack spring with light grease and assemble spring on push rod against spacer.
3. Cover spring sleeve with light grease and install over spring.
4. Install lower spacer on push rod against spring and install adjusting nut. Draw adjusting nut up until there is a slight tension on the spring and install lock nut.
5. Place washer against spring spacer and install push rod assembly in shift shaft. Secure push rod in shift shaft with snap ring against washer.
6. Check push rod for end play in shift shaft. If any end play exists, disassemble and remove some tension on push rod spring by backing off adjusting nut.
7. Assemble diaphragm and plates on push rod and install push rod nut, tightening it securely.
8. Assemble vacuum chamber body, align fittings and install clamp strap.

Install Side-Mounted Shift Unit

1. Tap shift unit sleeve and bushing into carrier housing over original shim pack. Install lock washer and stud nut and tighten to the correct torque.
2. Install new shift unit mounting flange gasket.
3. Hold shift fork in position. Align lock screw holes in shift shaft and slide shift unit and shaft into position.
4. Tighten lock screw securely and set lock nut.
5. Install lock washers and stud nuts and tighten to correct torque.
6. Check clearance of shift fork machined pads in shift collar with feeler gauge, Fig. 43. Clearance should not be less than .010" on each side of the fork in both fast and slow speed positions. When checking clearances, shift collar must be flush with end face of spur pinion in both fast and slow speed positions.
7. Add or remove shims from pack under sleeve, Fig. 44, to obtain correct adjustment.
8. Check operation of shift unit with air or vacuum, depending on type of unit. Ten pounds of air may be used to check vacuum type unit by applying to opposite side of diaphragm, using vent opening on single line shift unit.

Install Front-Mounted Shift Unit

1. Check bellcrank and remove any scores at ball operating end faces.
2. Place both shift fork and collar and shift unit in fast speed position.
3. Install new gasket and position shift unit with bellcrank in slot in shift shaft. Install lock washers and cap screws and tighten to correct torque.
4. Adjust Allen screws in top of carrier housing, Fig. 45, to allow shift collar to engage the splined teeth on both the fast and slow speed spur pinions. If the shift collar will not engage the fast speed pinion, back off the Allen screw on the fast speed side until the correct shift collar travel is obtained. Adjust Allen screw on the slow speed side to obtain the correct engagement of the shift collar and slow speed pinion.
5. Check clearance of shift fork machined pads in the shift collar with a feeler gauge, Fig. 43. The clearance must not be less than .010" on each side of the shift fork in both the fast and slow speed positions. When checking clearances, the shift collar must be flush with the end face of the spur pinion in both fast and slow speed positions.
6. Check operation of shift unit with either air or vacuum, depending on the type of unit. Ten pounds of air may be used to check the vacuum type unit.

Install Manually-Operated Shift Unit

1. Lubricate shift fork shaft bushing with axle lubricant. Insert bushing and tap into carrier housing.
2. Install cork seal on top of carrier housing.
3. Install poppet and spring.
4. The round type eccentric stop pin (where used) should be replaced with the hexagon type, Fig. 46, to simplify lever adjustment for shift fork clearance.
5. Insert Woodruff key and install lever with shakeproof washer and nut.
6. Adjust eccentric stop pins to obtain correct shift collar engagement.
7. Check clearance between both sides of the shift fork shoes and shift collar with a feeler gauge. The clearance must not be less than .010" on each side of the shift fork shoes in both the fast and slow speed positions. When checking clearances, the shift collar must be flush with the end face of the spur pinion in both the fast and slow speed positions.
8. Adjust eccentric stop pins as required to obtain correct clearance.

Assemble Differential & Spur Gears

1. Join fast and slow speed spur gears to their respective case halves with bolts or rivets as required, Fig. 47. When new spur gears or a new differential case is installed, the differential case holes must be line-reamed with the gear in order to assemble, using correct size bolts or rivets. Tighten nuts to the correct torque. Rivets should be upset cold. The formed head of rivets should not exceed $\frac{1}{16}$" less than the preformed head as excessive pressure will result in distortion of the case holes and cause spur gear eccentricity.

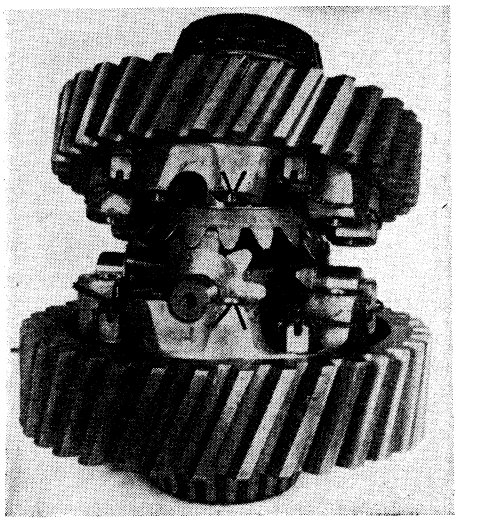


Fig. 48 Install differential and spur gears according to identification marks

2. Lubricate differential case inner walls and all component parts with axle lubricant.
3. Install thrust washer and side gear in one of the case halves. Place spider with pinions and thrust washers in position. Install component side gear and thrust washer.
4. Align mating marks, Fig. 48, position component case half and draw assembly together with four long bolts or cap screws equally spaced.
5. Check assembly for free rotation of differential gears and correct if necessary.
6. Install remaining bolts or cap screws and tighten to the correct torque.
7. Install lock wire.
8. Press differential bearings squarely and firmly on differential case.

Install Differential & Spur Gears

1. Lubricate differential bearings and cups with axle lubricant.
2. Place cups over bearings and position assembly in carrier housing.
3. Insert bearing adjusting nuts and turn hand tight against bearing cups, Fig. 49.
4. Start bearing caps in the correct location as marked and tap lightly into position. If bearing caps do not position properly, adjusting nuts are cross threaded. Remove caps and reposition nuts. Forcing caps into position will result in irreparable damage to carrier housing.
5. Install flat washers (where used) and stud nuts.
6. Tighten snugly, then back off nuts just enough to permit turning bearing adjusting nuts.
7. Align spur gears with spur pinions by moving differential assembly with adjusting nuts.
8. Using dial gauge at side of spur gear, Fig. 50, adjust differential assembly to zero end play in the differential bearings.

Fig. 49 Start bearing caps in the correct position as previously marked

9. Rotate assembly several times to assure normal bearing contact.
10. Readjust differential assembly to zero end play.
11. Check fast and slow speed spur gears for runout with dial gauge. If runout exceeds .008", remove differential and check for cause.
12. Tighten adjusting nuts one notch each from zero end play to secure correct differential bearing preload.
13. Check differential and spur gear assembly to be certain there is no interference between spur gears and shift collar faces. When correctly located, there will be approximately $\frac{1}{16}$" clearance between gears and shift collar faces in both fast and slow speed positions. Any interference will result in improper shifting and damage to component parts.
14. Tighten bearing cap stud nuts to the correct torque.
15. Install adjusting nut locks and cap screws. Tighten to the correct torque and install lock wire.

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. Do not drive carrier in housing with the use of a steel hammer at the carrier stud flange as the flange may easily be distorted and cause severe oil leakage.
3. Install lock washers and nuts on any studs under carrier housing offsets. It is impossible to start these nuts after carrier is drawn into housing.
4. Tighten four nuts alternately to draw carrier squarely into axle housing.
5. Remove nuts and flat washers. Install taper dowels, lock washers and stud nuts. Tighten to the correct torque.
6. Connect universal at pinion shaft.
7. Connect air vacuum lines to power actuated shift, or clevis on manual shift.
8. Install axle shafts.

Lubrication

1. Remove pipe plug in pinion cage and add one pint of lubricant.
2. Fill axle housing to correct level with lubricant.
3. Lubricate universal joint.
4. 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 housing. Do not operate with one wheel jacked up as this will overheat the differential spider with resultant galling or shearing of the spider pins.

NOTE—Check every 1,000 miles and drain and refill to top of filler neck or bottom of tapped hole every 12,000 to 25,000 miles. Use SAE-90 gear oil in winter and SAE-140 in summer.

TIMKEN DOUBLE-REDUCTION AXLE

Front-Mounted Type

The Timken Double-Reduction Drive Unit, Figs. 51 and 52, employs a heavy duty spiral bevel or hypoid pinion and gear for the first reduction and a wide-faced helical spur pinion and gear for the second reduction. Both gear sets are mounted on Timken tapered roller bearings.

Removing Carrier

1. Disconnect universal at pinion shaft.
2. Remove plug from bottom of axle housing and drain lubricant.
3. Remove axle shaft drive stud nuts and washers.
4. Rap axle shaft sharply in center of flange to free dowels, remove taper dowels and axle shafts. Prying shafts loose will damage hubs and oil seals.
5. Remove carrier-to-housing nuts. Loosen two top nuts and leave on studs to prevent carrier from falling.
6. Break carrier loose from axle housing with rawhide mallet and remove taper dowels. If necessary, back out studs to remove dowels.
7. Remove carrier from housing. Place roller jack under carrier. Remove top nuts and washers and work carrier free, using puller screws in holes provided. A small pinch bar may be used to straighten the carrier in the housing bore. However, the end must be rounded to prevent indenting the carrier flange.
8. Place carrier in a suitable holding fixture, such as shown in Fig. 53.

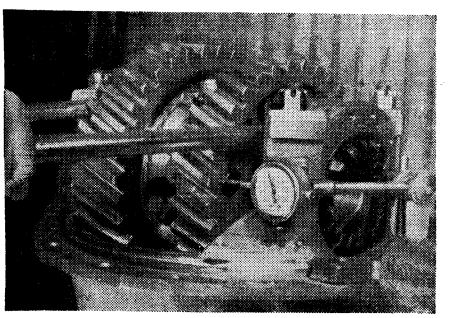


Fig. 50 Using dial indicator at side face of spur gear to check for end play of differential bearing

Disassemble Carrier

1. Cut lock wire and remove cap screws and adjusting nut locks.
2. Center punch one differential carrier leg and bearing cap, Fig. 54, to identify for proper reassembling.
3. Remove bearing cap stud nuts or cap screws, bearing caps and adjusting nuts.
4. Lift out differential and gear assembly, Fig. 55. On the herringbone gear type, remove the leg cap stud nuts, leg caps, bearing retaining ring and differential assembly.

Stud Nut Torque Limits

Location	Size	Lb. Ft. Torque
Shift unit	$\frac{3}{8}$-24	25-35
Pinion cage	$\frac{7}{16}$-20	62-69
	$\frac{1}{2}$-20	85-95
	$\frac{9}{16}$-18	115-126
Cross shaft bearing	$\frac{1}{2}$-20	85-95
Cage cover	$\frac{1}{2}$-20	65-75
	$\frac{9}{16}$-18	115-130
Carrier to housing	$\frac{1}{2}$-20	85-95
	$\frac{5}{8}$-18	140-155
Differential bearing cap.	$\frac{5}{8}$-18	155-200
	$\frac{3}{4}$-16	300-325
	$\frac{7}{8}$-14	450-500
	1-14	450-500
Differential bolts	$\frac{1}{2}$-20	80-110
	$\frac{5}{8}$-18	155-200
	$\frac{3}{4}$-16	295-340
Pinion shaft	1-20	300
	$1\frac{1}{4}$-18	700
	$1\frac{1}{2}$-12	800
	$1\frac{1}{2}$-18	800
	$1\frac{3}{4}$-12	800

Cap Screw Torque Limits

Adjusting nut lock	$\frac{5}{16}$-18	15-20
Inspection cover	$\frac{3}{8}$-16	25-35
Cross shaft bearing lock.	$\frac{7}{16}$-14	35-44
	$\frac{9}{16}$-12	87-97
Shift unit	$\frac{3}{8}$-16	25-35
Pinion and cross shaft cages and covers	$\frac{1}{2}$-13	78-88
	$\frac{9}{16}$-12	116-126
	$\frac{5}{8}$-11	160-175

NOTE—Spur gear mounting in Timken Double-Reduction axles is of two types: In one type the spur gear and differential assembly are joined by long and short bolts. In the other type, these parts are joined by rivets or short bolts. With either type, if the original identification marks are not clear, center punch the case halves, Fig. 56, for correct alignment on reassembling.

5. To disassemble the first type, remove the long bolts and separate the case halves. Take out differential parts. Remove short bolts and separate gear from case half. Remove differential bearings, using a suitable puller if necessary.
6. To disassemble the second type, remove the rivets or bolts and separate gear and case halves. Carefully cen-

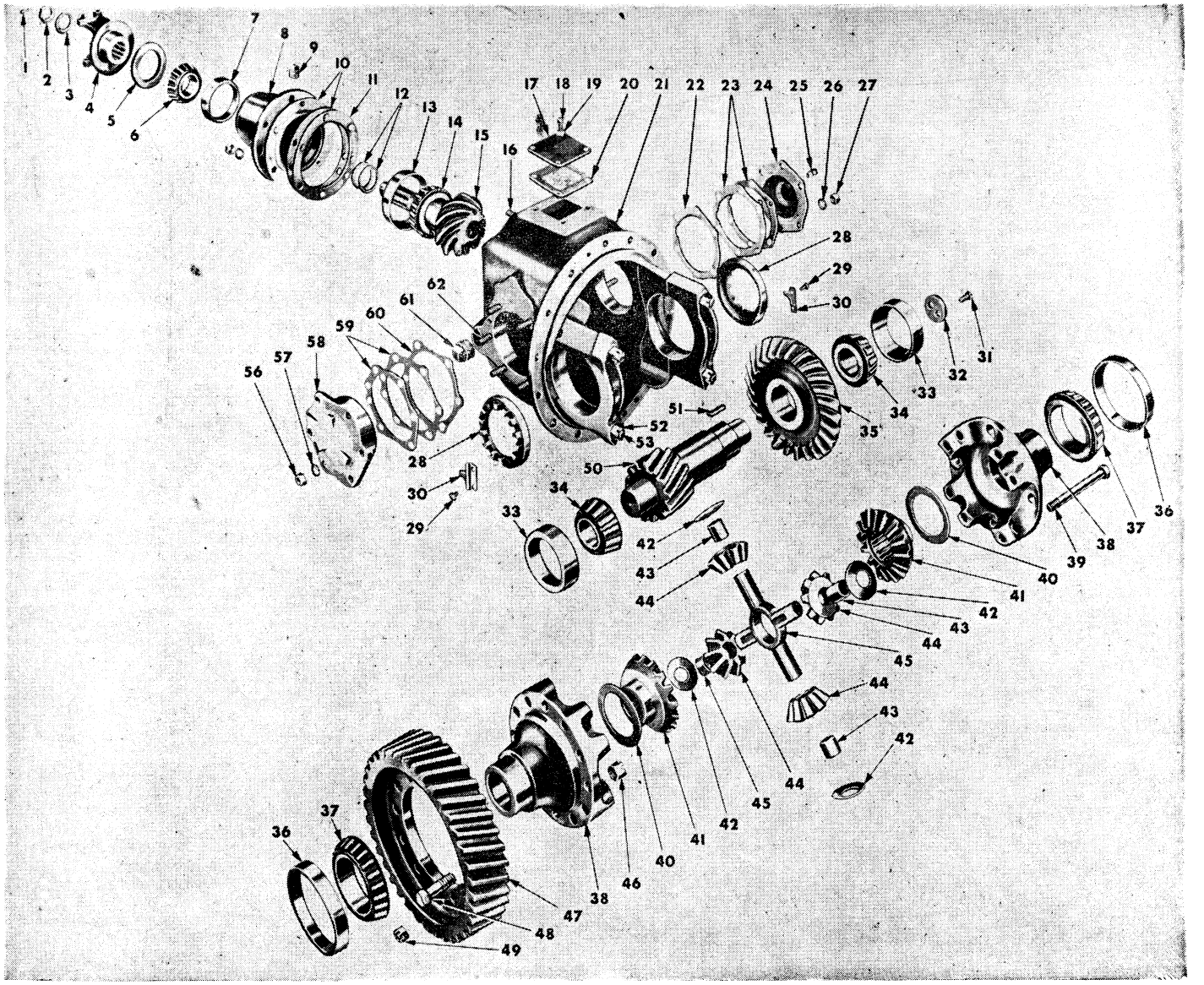


Fig. 51 Timken single-speed, double-reduction axle

1. Yoke nut cotter pin
2. Yoke nut
3. Yoke nut washer
4. Companion yoke
5. Pinion front bearing oil seal
6. Pinion front bearing cone
7. Pinion front bearing cup
8. Drive pinion carrier
9. Carrier plug
10. Pinion carrier shims
11. Pinion carrier gasket
12. Pinion carrier spacer
13. Pinion rear bearing cup
14. Pinion rear bearing cone
15. Drive pinion (first reduction)
16. Pinion carrier stud
17. Inspection hole cover
18. Cover bolt
19. Washer
20. Cover gasket
21. Differential carrier
22. Spiral pinion bearing retainer gasket
23. Spiral pinion bearing retainer shims
24. Spiral pinion bearing retainer
25. Differential carrier breather
26. Washer
27. Nut
28. Differential bearing adjusting nut
29. Lock screw
30. Nut lock
31. Screw
32. Washer
33. Spiral pinion bearing cup
34. Spiral pinion bearing cone
35. Spiral pinion drive gear (first reduction)
36. Differential bearing cup
37. Differential bearing cone
38. Differential case
39. Bolt
40. Differential side gear thrust washer
41. Differential side gear
42. Differential pinion thrust washer
43. Differential pinion bushing
44. Differential pinion
45. Differential spider
46. Nut
47. Differential drive gear (second reduction)
48. Bolt
49. Nut
50. Spiral pinion (second reduction)
51. Key
52. Nut
53. Stud
56. Nut
57. Washer
58. Spiral pinion bearing cage
59. Cage shims
60. Cage gasket
61. Plug
62. Cage stud

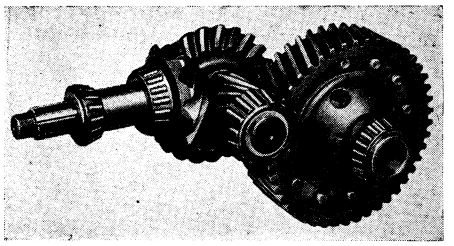


Fig. 52 Timken Double-Reduction gear train

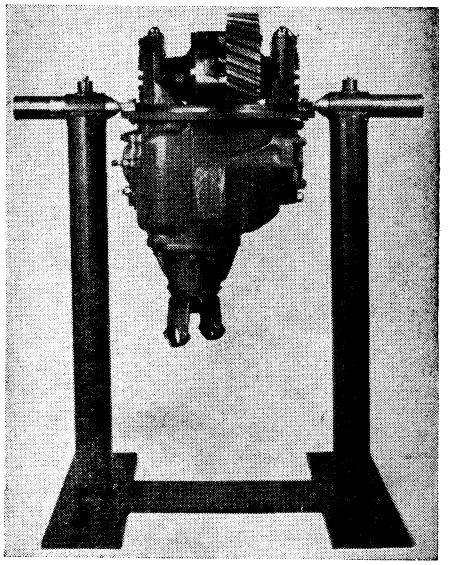


Fig. 53 Showing carrier in repair stand

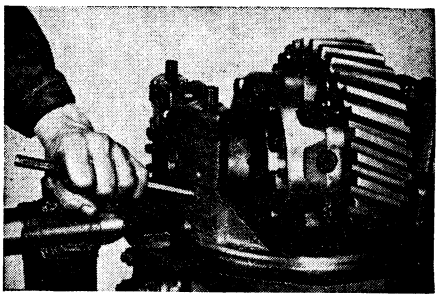


Fig. 54 Center punch one differential carrier leg and bearing cap to identify for proper reassembling

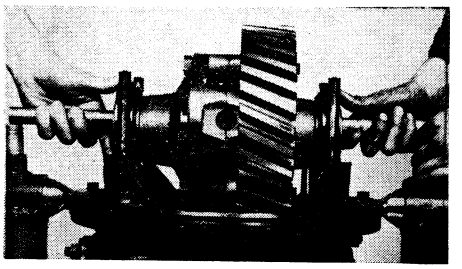


Fig. 55 Lifting out differential and gear assembly

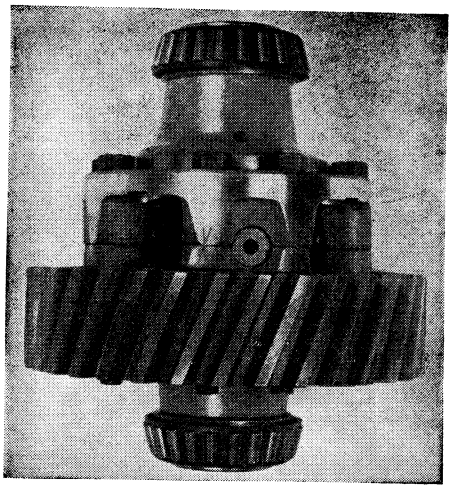


Fig. 56 If original identification marks are not clear, center punch differential halves for correct alignment on reassembling

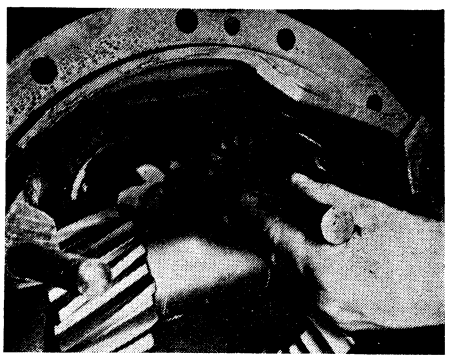


Fig. 57 If pinion cage is not free, tap it loose, using soft drift on inner face of pinion or use puller screws in holes provided

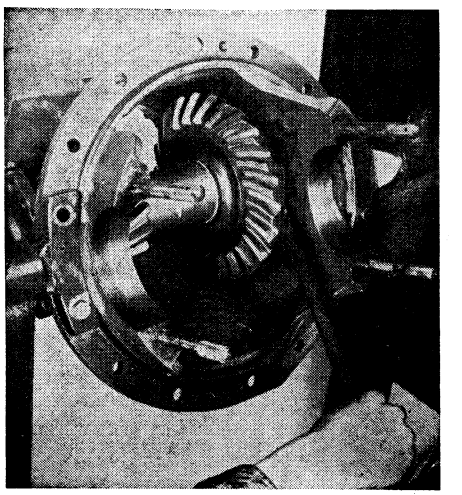


Fig. 58 Force off bearing cage with small pinch bar between back of gear and carrier housing (puller screw holes are also provided)

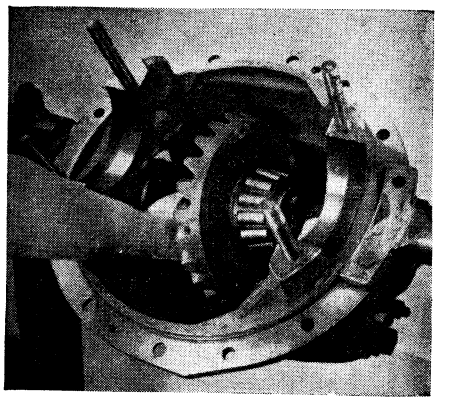


Fig. 59 Removing cross shaft assembly

ter punch rivets in center of head. Use a drill $\frac{1}{32}$" smaller than body of rivet to drill through head. Press out rivets. (Rivets should not be chiseled off as this will elongate the holes in the flange.) Take out differential parts.

7. Remove pinion cage nuts and lift out cage assembly. If cage is not free, tap it loose, Fig. 57, using a soft drift on the inner face of the pinion or use puller screws in holes provided.
8. Wire the pinion cage shim pack together to keep intact to facilitate adjustment on reassembly.
9. Place pinion cage over carrier studs. Hold flange and remove pinion shaft nut.
10. Press pinion shaft out of flange or yoke and cage.
11. Remove adjusting spacers or shims.
12. If necessary to renew the pinion or rear bearing, remove bearing with suitable puller.
13. Press front bearing and pinion shaft oil seal from cage. (On units having a bearing cover, remove the seal from the cover.)
14. Remove nuts from cross shaft bearing cage (side opposite bevel gear).
15. Force off bearing cage with small pinch bar, Fig. 58, between back of gear and carrier housing (puller screw holes are also provided).
16. Wire shim pack together to keep intact to facilitate adjustment on reassembling.
17. Thread out cross shaft assembly, Fig. 59.
18. To disassemble the cross shaft, remove cap screws and bearing plate from gear end of cross shaft.
19. Press shaft from gear and bearing, Fig. 60.
20. If necessary to replace bearing, remove bearing from opposite end of cross shaft, using suitable puller.
21. If necessary to replace bearing cups, remove cross shaft bearing cover (bevel gear side). Wire shim pack together to keep intact to facilitate adjustment on reassembling.

Inspection

The procedure for cleaning and inspection of parts should be conducted in the same manner outlined previously for Timken Two-Speed Double-Reduction Drive Units.

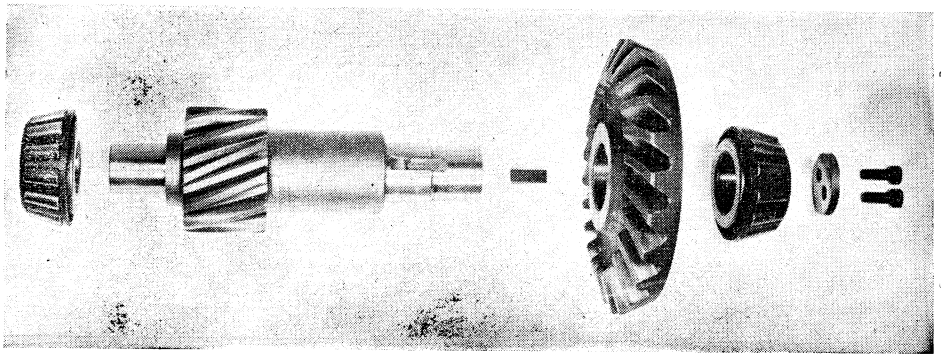


Fig. 61 Layout of cross shaft assembly

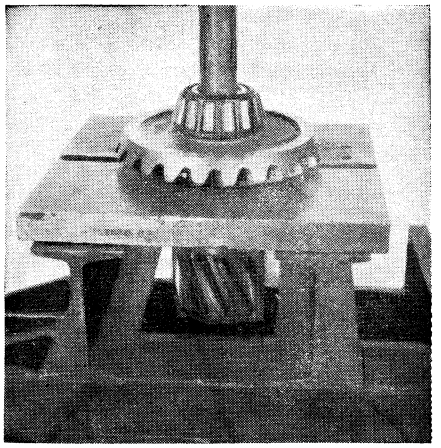


Fig. 60 Press cross shaft from gear and bearing

Assemble Cross Shaft

1. Insert key and start shaft into bevel gear in line with keyway or splines, Fig. 61.
2. Press shaft squarely into bevel gear and firmly against cross shaft shoulder. To facilitate installation, bevel gear may be heated in oil to 200-250° F. Install cap screws where used.
3. Press bearing firmly against cross shaft shoulder on spur gear end, Fig. 62.
4. Press bearing firmly against bevel gear, using a suitable sleeve, Fig. 63.
5. Install bearing retaining plate and cap screws on bevel gear end. Tighten to correct torque and lock with soft wire.

Install Cross Shaft

1. Lubricate cross shaft bearings and cups with light machine oil.
2. If bearing cover (bevel gear side) has been removed, install new gasket under original shim pack. Tighten stud nuts to correct torque.
3. Ease cross shaft past differential bearing supports and position in bearing cup.
4. Install new gasket under original shim pack and start cross shaft bearing cage into carrier housing.
5. Tap cage into position with soft mallet. Install lock washers and stud nuts and tighten to the correct torque.
6. Rotate assembly several revolutions before checking bearing preload to assure full bearing contact.
7. To check cross shaft bearing preload torque, wrap soft wire around pinion and pull on a horizontal line with a pound scale, Fig. 64. Example: Assuming spur gear diameter to be 4", the radius would equal 2". With 8 pounds pull on scale, it would equal 16 inch-pounds bearing preload torque. Use rotating, not starting torque.
8. To obtain the correct preload torque of 12-18 inch-pounds, add or remove shims from under bearing cage (side opposite bevel gear).

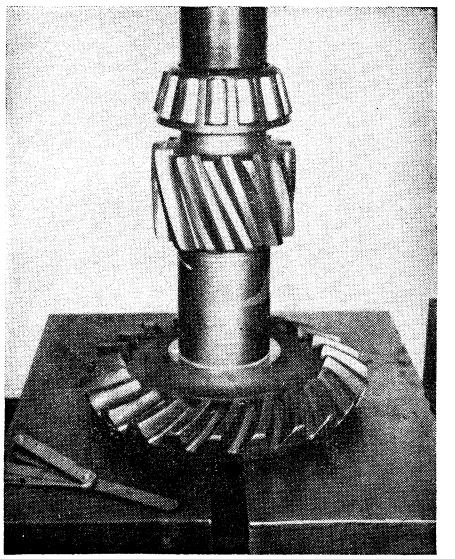


Fig. 62 Press bearing firmly against cross shaft shoulder on spur gear end

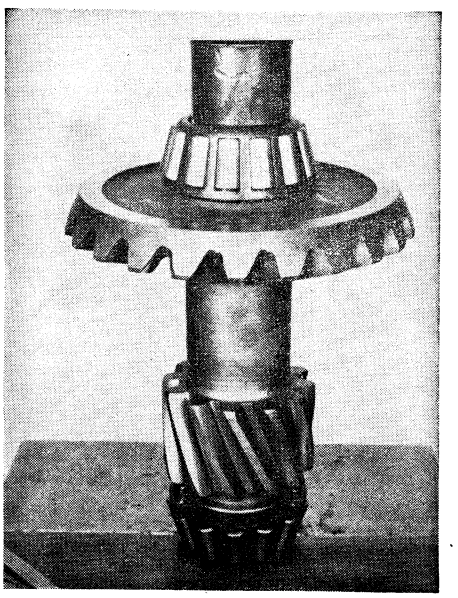


Fig. 63 Press bearing firmly against bevel gear, using a suitable sleeve

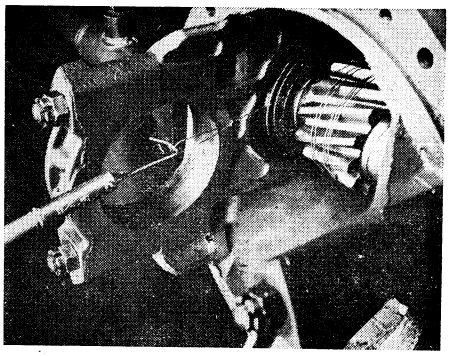


Fig. 64 Checking cross shaft bearing preload with wire and pound scale

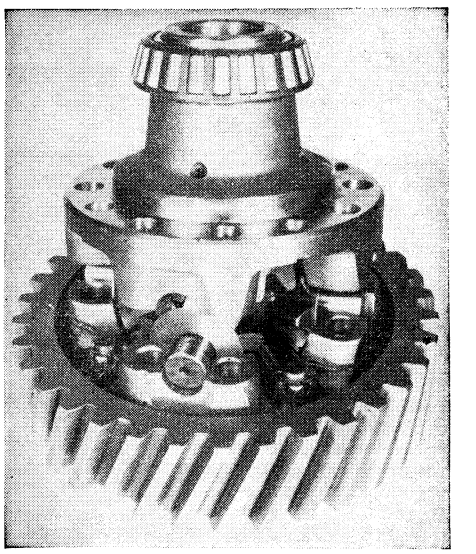


Fig. 66 Align mating marks of differential case halves before assembling

Assemble Pinion & Cage

1. Press rear bearing squarely and firmly against pinion cage shoulder.
2. Press bearing cups squarely and firmly against pinion cage shoulder.
3. Lubricate bearing and cups with light machine oil.
4. Insert pinion and bearing assembly in pinion cage.
5. Install selective spacer over pinion

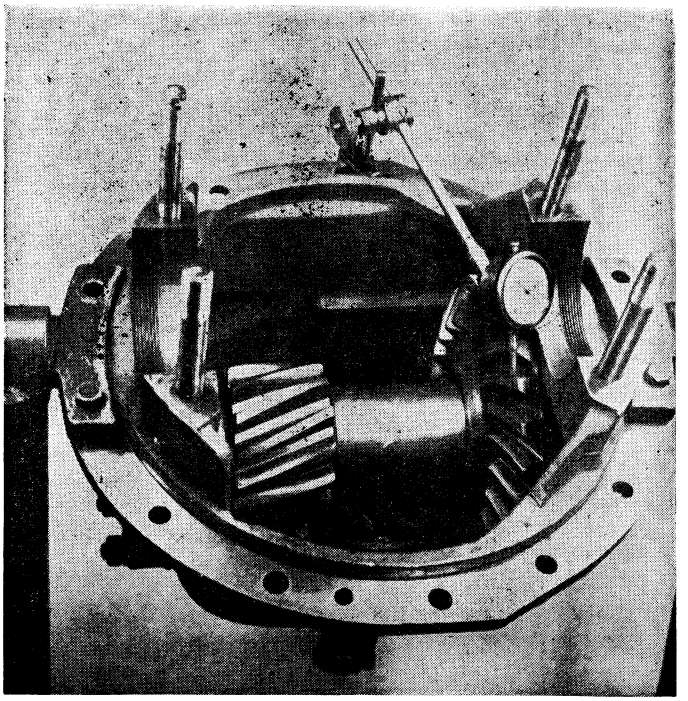


Fig. 65 Checking gear lash with dial indicator

shaft with the bevel side toward the pinion shaft shoulder.

6. Press front bearing squarely and firmly against the selective spacer with a suitable sleeve.
7. Rotate cage several revolutions to assure normal bearing contact.
8. While in the press under pressure, check pinion bearing preload torque by wrapping soft wire around the pinion cage and pull on a horizontal line with a pound scale. If a press is not available, the preload may be checked with the flange or yoke installed and the nut tightened to the correct torque.

NOTE—The correct pressures or torques for checking pinion bearing preload are given in the Two-Speed Double-Reduction axle section. As an example, however, assuming the pinion cage diameter to be 6", the radius would be 3". Thus with six pounds pull on the scale the bearing preload torque would be 18 inch-pounds. Use rotating torque, not starting torque. If rotating torque is not within 12 to 18 inch-pounds, use a thinner spacer to increase or thicker spacer to decrease bearing preload.

9. Press flange or yoke firmly against forward pinion bearing.
10. Place pinion and bearing cage over carrier studs. Hold flange and tighten pinion shaft nut to correct torque.
11. Recheck pinion bearing preload torque. If rotating torque is not within 12-18 inch-pounds, repeat foregoing procedure.
12. Hold flange and remove pinion shaft nut and yoke or flange.
13. Lubricate pinion shaft oil seal. Coat outer edge of seal body with non-hardening sealing compound and press seal firmly against cage or cover shoulder. Install bearing cover where used.
14. Reinstall flange or yoke. Tighten pinion shaft nut to the correct torque.

Install Pinion & Cage

The oil passage holes in the carrier housing, gasket, shim pack and pinion bearing cage must be aligned.

1. Install new gasket over housing-to-cage studs.
2. Install original shim pack over gasket.
3. Install pinion cage assembly, lock washers and stud nuts. Tighten to correct torque.

NOTE—Generally, if original gears are being reinstalled, painting of gear teeth will not indicate the same contact as new gears and can be misleading. Gears that have been in service for long periods form running contacts due to wear of teeth. Therefore, the original shim pack plus a new gasket should be maintained to check gear lash. In the event that gear lash is in excess of maximum tolerance, Fig. 65, as stated under gear adjustment, reduce gear lash only in the amount that will avoid overlap of the worn tooth section. For details on tooth contact and gear lash adjustments, see the text and illustrations outlined under Timken Two-Speed Double-Reduction Drive Units. After establishing the correct tooth contact and gear lash, recheck the cross shaft bearing preload as previously described, and when this is done, complete the job as follows:

Assemble Differential & Spur Gear

When new spur gears or a new differential case is installed, the differential case holes must be line-reamed with the gear in order to assemble these parts with the correct size bolts or rivets.

Type Assembly Using Long and Short Bolts—

1. Join spur gear to differential case halves with short bolts.
2. Lubricate differential case inner walls and all component parts with axle lubricant.
3. Install thrust washer and side gear in one of the case halves. Place spider with pinions and thrust washers in position. Install component side gear and thrust washer.
4. Align mating marks, Fig. 66, position component case half and draw assembly together with four long bolts equally spaced.
5. Check assembly for free rotation of differential gears and correct if necessary.
6. Install remaining bolts and tighten to the correct torque.
7. Install lock wire.
8. Press differential bearings squarely and firmly on differential case.

Type Assembly Using Rivets or Short Bolts—

1. Lubricate differential case inner walls and all component parts with axle lubricant.
2. Install thrust washer and side gear in one of the differential case halves.
3. Position spur gear on case half.
4. Place spider with pinions and thrust washers in position and install component side gear and thrust washer.
5. Align mating marks, Fig. 66, and position component case half.
6. Draw either bolted or riveted assemblies together with four bolts equally spaced and check for free rotation of differential gears.
7. Install remaining bolts or rivet the assembly together as required. (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 $\frac{1}{8}$" 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 $\frac{1}{16}$" less than the pre-formed head as excessive pressure will result in distortion of the case holes and spur gear eccentricity.)

Install Differential Assembly Taper Roller Bearing Type

1. Lubricate differential bearings and cups with axle lubricant.
2. Place cups over bearings and position assembly in carrier housing.
3. Insert bearing adjusting nuts and turn hand tight against bearing cups.
4. Start bearing caps in correct location as marked and tap lightly into position, Fig. 67. If bearing caps do not position properly, adjusting nuts are cross-threaded. Remove caps and reposition them. Forcing caps into position will result in serious damage to carrier housing.
5. Install flat washers (where used) and stud nuts.
6. Tighten snugly, then back off nuts enough to turn bearing adjusting nuts.
7. Align spur gear with spur pinion by

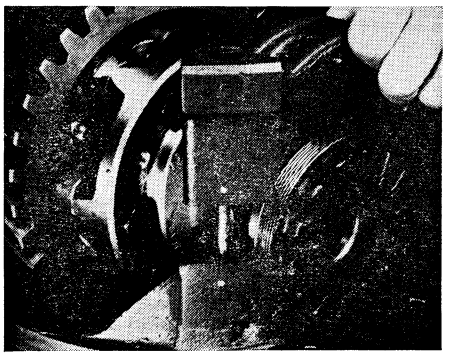


Fig. 67 Start bearing caps in correct location as marked and tap lightly into position

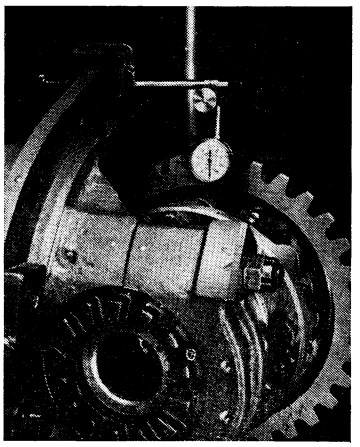


Fig. 68 Adjust differential assembly to .000" (zero) end play, using dial indicator against side face of spur gear

moving differential assembly with adjusting nuts.

8. Using dial indicator at side of spur gear, Fig. 68, adjust differential assembly to zero end play in differential bearings.
9. Rotate assembly several revolutions to assure normal bearing contact.
10. Recheck differential end play and readjust to zero if necessary.
11. Check spur gear for runout with dial indicator. If runout exceeds .008", remove differential assembly and check for cause.
12. Tighten adjusting nuts one notch each from .000" end play to secure the correct differential bearing preload.
13. Tighten bearing cap stud nuts to the correct torque.
14. Install adjusting nut locks and cap screws. Tighten to the correct torque and install lock wire.

Radial Thrust Bearing Type

Position differential assembly and install bearing retaining rings and carrier leg caps.

As this type gearing is self-aligning, no gear or bearing adjustment is required. However, the radial thrust bearings must be a "creeping fit" in the carrier legs after the stud nuts are tightened to the correct torque.

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. Do not drive carrier into housing with a steel hammer at the carrier stud flange as the flange may easily be distorted and cause severe oil leakage.
3. Install lock washers and stud nuts on any studs under carrier housing offsets. It is impossible to start these nuts after carrier is drawn into housing.
4. Tighten the four nuts over the flat washers alternately to draw carrier squarely into axle housing.
5. Remove nuts and flat washers. Install taper dowels, lock washers and stud nuts. Tighten to the correct torque.
6. Connect universal at pinion shaft, and install axle shafts.

Lubrication

1. Remove pipe plug in pinion cage and add one pint of specified lubricant.
2. Fill axle housing to correct level with specified lubricant.
3. Lubricate universal joint.
4. Jack up both rear wheels and operate vehicle in high transmission gear at about 25-30 mph for five minutes to assure satisfactory lubrication of the carrier assembly.

NOTE—Do not operate with one wheel jacked up as this will result in overheating the differential spider with resultant galling or shearing of the spider pins.

Check every 1,000 miles and drain and refill to top filler neck or bottom of tapped hole every 12,000 to 25,000 miles. Use SAE-90 gear oil in winter and SAE-140 in summer.

Torque Limits

See the listing in the Two-Speed Double-Reduction axle section for these recommendations, disregarding, of course, any item that does not apply to Double-Reduction Units.

TIMKEN DOUBLE-REDUCTION AXLE

Top-Mounted Type

Timken top-mounted double reduction drive units are of both conventional and "thru-shaft" design, the latter being generally used in tandem axles. The servicing of the conventional design is accomplished identically the same as the front-mounted type previously covered.

Except for the instructions which follow, the "thru-shaft" design is also serviced in the same manner as the front-mounted type.

Disassemble Drive Unit

1. Remove differential from drive unit.
2. Remove cover enclosing tapered end of thru-shaft (where used).
3. Hold flange or yoke with suitable tool and remove nuts from both ends of thru-shaft.
4. Remove flange or yoke from end of shaft with suitable puller. Do not drive flanges or yokes from thru-shaft as this may result in serious damage to these components.
5. Remove stamped inspection cover and threaded inspection hole plug from drive unit. (A small spanner wrench for removing and installing the threaded inspection hole plug can be easily made of a piece of two-inch pipe about 8" long. Cut right-angle slots approximately $\frac{3}{8}$" wide and $\frac{1}{2}$" deep in one end of the pipe. Drill a $\frac{9}{16}$" hole through the opposite end to insert a "T" handle.)
6. Remove stud nuts or capscrews, lock-washers and bearing covers from both ends of thru-shaft. Attach shim packs to their respective covers to facilitate bearing preload adjustment when reassembling drive unit.
7. Carefully tap bearing from tapered end of thru-shaft with brass drift. Drift should fit against bearing inner race. Cup will come out with bearing cone.
8. Tap on tapered end of thru-shaft with soft mallet to remove opposite bearing, thru-shaft and pinion assembly. Cup will come out with bearing cone.
9. Remove seal assemblies, when incorporated in bearing covers, with suitable tool.

Cross Shaft

NOTE—There are three methods of attaching the bevel gear to the cross shaft:

In Type 1, the radial bearing journal is ground on the gear. The gear and bearing assembly is pressed on the cross shaft and locked with a key.

In Type 2, the radial bearing journal is ground on an externally splined hub that is pressed on the cross shaft and locked with a key. The gear is pressed over the hub splines and held to the hub with capscrews.

In Type 3, the radial bearing journal is ground on the splined cross shaft. The gear is pressed over cross shaft splines and held in place by capscrews.

Disassemble Type 1—Gear Journal Fit to Cross Shaft

1. Remove cross shaft cover stud nuts, lockwashers and cover. Attach shim pack, which controls cross shaft bearing preload, to cover. This will facilitate preload adjustment when reassembling drive unit.
2. Cut lock wire from bearing retainer plate capscrews and remove screws and plate.
3. Insert hard wood block between end of cross shaft and outer thru-shaft chamber wall. Remove bearing cage and tapered bearings with suitable puller, using $\frac{3}{8}$"-16 puller screws in cage flange tapped holes. Attach shim pack, which controls gear backlash, to cage. This will facilitate adjustment when reassembling drive unit.
4. Remove six studs from cross shaft chamber to facilitate positioning drive unit in press for further disassembly.

5. Two pieces of ¾" steel square bar stock, approximately 10" long, bent to form segments of an 18" diameter circle will facilitate cross shaft removal.
6. Tap cross shaft and gear assembly toward thru-shaft chamber, so semi-circular blocks can be inserted between back of gear and inner thru-shaft chamber wall.
7. Position drive unit in press, thru-shaft chamber up, with blocks under gear, and press cross shaft from gear.

NOTE—Provide a rigid support on the press bed for the drive unit during this operation. A sleeve with a ¾" or 1" wall and I.D. approximately the size of the cross shaft cage O.D. is suitable, or the drive unit may be supported by a horizontal flat plate 10" x 10" x 1" with a bored hole about the same size as the cross shaft cage O.D. Support the horizontal plate on heavy vertical plates of a convenient size.

8. Lift or tap out radial bearing and gear assembly from drive unit. Do not lose gear spacer. Remove bearing from gear with pry bars or suitable puller.
9. Do not remove radial bearing sleeve from drive unit unless replacement of sleeve is necessary.
10. Remove cross shaft tapered bearing inner and outer cones and outer cup from cage with suitable puller or with sleeve in press.
11. Remove cage inner cup with suitable puller or with sleeve in press.
12. Remove pinion and bearing assembly from thru-shaft by supporting gear with plate having a bored hole which will slip over largest O.D. of thru-shaft, or use a sleeve of convenient size. Press against splined end of shaft.
13. Remove pinion bearing from pinion with suitable puller or in press, as is most convenient.

Disassemble Type 2—Gear Splined to Hub

1. Remove thru-shaft in usual manner.
2. Remove threaded inspection hole plug.
3. Straighten gear capscrew cover locks and remove three cover capscrews, cover and spacers. Do not lose spacers under cover. Remove lock wire from six gear and hub capscrews.
4. Remove cross shaft bearing cage cover with suitable puller.
5. Lock gear in place with piece of brass or hard wood and straighten thin lockwasher. Remove jam nut, thin washer, nut lock and bearing adjusting nut.
6. Insert hard wood block between gear and outer thru-shaft chamber wall. Remove cross shaft bearing cage with suitable puller, using ⅜"-16 puller screws in cage flange tapped holes. Attach shim pack, which controls backlash adjustment, to cage.
7. Remove six cross shaft bearing cage studs to facilitate mounting drive unit on press bed.
8. Tap cross shaft toward thru-shaft chamber so two semi-circular steel blocks can be inserted between back of gear and inner thru-shaft chamber wall.
9. Position drive unit in press, thru-shaft chamber up, with blocks under gear, and press cross shaft from gear. Provide a rigid support on the press bed for the drive unit during this operation. (See instructions under Type 1.)
10. Remove drive unit from press and lift or tap out gear, hub and radial bearing assembly from drive unit.
11. Pull or press cross shaft inner tapered bearing from shaft with suitable puller, or mount in press and remove.
12. Remove radial bearing from gear and hub assembly, using pry bars or suitable puller.
13. Mount gear and hub assembly in vise with soft jaws and remove six gear and hub capscrews.
14. Pull gear from hub, using three ½"-13 puller screws approximately 2" long in puller screw holes in gear.
15. Remove cross shaft tapered bearing cup from cage, if necessary, with suitable puller, or in press, using bearing cone, pulling or pressing toward cage flange. Do not remove radial bearing sleeve from drive unit unless replacement is necessary.

Disassemble Type 3—Gear Splined to Cross Shaft

1. Remove thru-shaft in usual manner.
2. Remove threaded inspection hole plug.
3. Remove cross shaft bearing cage cover.
4. Lock gear in place with piece of brass or hard wood and straighten thin lockwasher. Remove jam nut, thin washer, nut lock and bearing adjusting nut.
5. Straighten gear capscrew cover locks and remove three cover capscrews, cover and spacers. Do not lose spacers under cover.
6. Cut lock wire and remove six gear and cross shaft retaining screws.
7. Pull gear from cross shaft, using three ½"-13 puller screws approximately 2" long in puller screw holes in gear.
8. Insert hard wood block between end of cross shaft and outer thru-shaft chamber wall. Pull cross shaft bearing cage with suitable puller, using ⅜"-16 puller screws in cage flange tapped holes. Attach shim pack, which controls backlash, to cage.
9. Position drive unit in press, thru-shaft chamber down. Block up outer race of bearing and press cross shaft out through threaded inspection hole.
10. Continue pressing operation to remove inner tapered bearing from cross shaft.
11. Lift or tap radial bearing from drive unit.
12. Remove cross shaft tapered bearing cup from cage, if necessary, with suitable puller, pulling toward cage flange. Do not remove radial bearing sleeve from drive unit unless replacement is necessary.

Reassemble Drive Unit—Thru-Shaft

1. Lubricate all bearing journals only with a few drops of engine oil and press tapered bearing on pinion, using suitable sleeve.
2. Heat pinion in oil to 250°F. maximum, apply white lead to thru-shaft O.D. and press pinion on thru-shaft. Begin the assembly operation on the press, making sure the parts are properly aligned. Press the parts together about ¼" to ⅜", then relieve the press pressure to permit them to realign themselves to prevent distortion and damage. Continue the pressing operation until the parts are correctly assembled.
3. Install pinion, bearing and thru-shaft assembly in drive unit. Install pinion bearing cup with suitable sleeve.
4. Install spacer (if used) over splined end of thru-shaft and tighten nut on sleeve end of thru-shaft to specified torque.
5. Install bearing cover and oil seal assembly (where used) and original shim pack over splined end of thru-shaft. Tighten cover nuts to specified torque.
6. Install bearing opposite pinion firmly against shaft shoulder with suitable sleeve.
7. Install bearing cup in drive unit with suitable sleeve, rotating shaft to position all bearing rollers.
8. Install bearing cover and seal assembly over original shim pack and tighten stud nuts to specified torque.
9. Measure thru-shaft bearing preload by wrapping a wire around the shaft and attaching it to a spring scale. Add or remove shims under cover at tapered end of thru-shaft to obtain desired preload. When new bearing cups and cones are used, bearing preload should be 12" to 18" pounds maximum. When the original (used) bearings are reassembled into a rebuilt drive unit, the preload should be 4" to 8" pounds maximum.
10. Complete all bearing preload adjustments before installing flanges or yokes.
11. Remove thru-shaft assembly as previously described. Keep both shim packs with their respective covers to maintain established bearing preload.

Assemble & Install Cross Shaft—Gear Journal Fit to Cross Shaft

1. Check sleeve I.D. and radial bearing O.D. Replace sleeve and/or bearing if the parts are damaged or if there is more than .006" clearance between sleeve and bearing. When these parts are new, the sleeve I.D. should be .004" to .0024" larger than the bearing O.D. The radial bearing must be free to float in the sleeve.

NOTE—Carefully check the I.D. of the bearing bore of older drive units that do not have replaceable sleeves. If the I.D. is more than .006" larger than the bearing O.D., replace the carrier and cap assembly with the newer type carrier and cap assembly that incorporates replaceable sleeves.

2. If radial bearing sleeve is to be re-

placed, press new sleeve firmly against housing shoulder. Drill hole for lock screw and remove burrs from sleeve I.D. Install lock screw and tighten securely. Install six studs (which were removed to facilitate drive unit disassembly) at cross shaft cage.

3. Assemble radial bearing on gear hub with large radius of bearing inner race toward back of gear.
4. Install bearing spacer on gear hub over bearing, with chamfer of spacer toward tapered roller bearing cross shaft cage.
5. Coat I.D. of gear with white lead. Install gear, bearing and spacer assembly in drive unit sleeve and block up to hold in place.
6. Inspect entering end of cross shaft and remove any nicks or burrs. Coat O.D. of shaft with white lead.
7. Position housing in press, thru-shaft chamber down, with gear supported on suitable sleeve.
8. Align key in cross shaft with keyway in gear hub and press shaft firmly against gear, bearing and spacer. Continue pressing operation to exert 10 to 20 tons pressure in excess of that required for secure assembly. Begin the pressing operation in the press, making sure the parts are properly aligned. Press the parts together about ¼" to ⅜", then relieve the press pressure to permit them to realign themselves to prevent distortion and damage. Continue the pressing operation until the parts are correctly assembled.
9. Install tapered bearing cage original shim pack (which controls gear backlash) over cross shaft cage studs.
10. Assemble cross shaft bearing cage inner and outer tapered bearings, using suitable sleeves to assemble cups and cones.
11. Install cage and bearing assembly in drive unit, pressing against outer bearing cone with suitable sleeve. Be sure oil holes in cage are properly aligned with oil holes in drive unit.
12. Assemble bearing retainer plate with two capscrews. Tighten capscrews to specified torque and lock with wire.
13. Install bearing cage over original shim pack (which controls tapered bearing preload) over studs next to cage flange.
14. Check cross shaft bearing preload, which should be 12" to 18" pounds. Add shims to decrease or remove shims to increase the preload.

NOTE—When new bearing cups and cones are used, bearing preload should be 12" to 18" pounds maximum. When the original used bearings are reassembled in the rebuilt drive unit, the bearing preload should be 4" to 8" pounds maximum.

15. Install pinion and thru-shaft assembly as previously described.
16. Adjust pinion and gear to secure proper gear tooth contact and backlash.

NOTE—To move pinion toward gear, add to shim pack under bearing cover at tapered end of thru-shaft and remove shims of equal thickness from pack under bearing cover at splined end of thru-shaft. To remove pinion from gear, add to shim pack under bearing cover at splined end of shaft and remove shims of equal thickness from pack under bearing cover at tapered end of thru-shaft.

It is essential that shims of required thickness are first added to the proper shim pack before shims of opposite pack are removed. This will prevent excessive bearing preload which may result in bearing damage. Accurately measure shims removed and shims added with micrometer to avoid changing preload on thru-shaft tapered bearings. Shims must be transposed in this manner to maintain established thru-shaft bearing preload.

Adjust gear backlash to .006" minimum, .012" maximum by adding shims to increase or removing shims to decrease backlash. Shims to be added or removed from under cross shaft bearing cage.

Most double-reduction drive units incorporate spiral bevel gears. The ratio of backlash decrease or increase is approximately .007" for each .010" removal of shims from, or addition of shims to the shim pack at the cross shaft bearing cage.

Type 2 Cross Shaft—Gear Splined to Hub, Hub Keyed to Cross Shaft

1. Check sleeve I.D. and radial bearing O.D. Replace sleeve and/or bearing if the parts are damaged, or if there is more than .006" clearance between the sleeve and bearing. When these parts are new the slevee I.D. should be .004" to .0024" larger than the bearing O.D. The radial bearing must be free to float in the sleeve. Carefully check the bearing bore of older drive units that do not have replaceable sleeves. If the I.D. is more than .006" larger than the bearing O.D. replace the carrier and cap assembly with the newer type carrier and cap assembly that incorporates replaceable sleeves.
2. If sleeve is to be replaced, press new sleeve firmly against housing shoulder. Drill hole for lockscrew and remove burrs from sleeve. Install lockscrew and tighten securely.
3. Press cross shaft inner tapered bearing on shaft firmly against shaft shoulder.
4. Assemble bevel gear to hub, correctly aligning six gear and hub capscrew holes. Tighten screws to 69-77 lbs. ft. torque.
5. Position drive unit on press bed, thru-shaft chamber up, and install radial bearing in drive unit sleeve. Large radius of bearing inner race must be towards bevel gear.
6. Support inner race of radial bearing with sleeve, and press gear and hub assembly into bearing.
7. Turn drive unit over in press, thru-shaft chamber down, and support gear, hub and bearing assembly on sleeve with notches in end that will fit over capscrew heads. Align keyway in hub with key in cross shaft and press cross shaft and inner tapered bearing assembly firmly against hub. Perform this operation in the same manner outlined for Type 1.
8. Remove drive unit from press and install six cross shaft cage studs.
9. If tapered bearing cup has been removed from cross shaft cage, reassemble in press, using sleeve or other suitable installation tool. Install cup firmly against cage shoulder.
10. Install original shim pack (which controls gear backlash) over studs and cross shaft cage over pack, carefully aligning oil holes in cage with oil holes in drive unit.
11. Install four cross shaft cage stud nuts over thick flat washers to hold assembly in place. Tighten nuts securely.
12. Install cross shaft outer tapered bearing, using suitable sleeve.
13. Install cross shaft bearing adjusting nut. Tighten nut as cross shaft assembly is revolved to correctly position all bearing rollers. Establish cross shaft tapered bearing preload in the same manner as outlined for Type 1 assembly.
14. Install nut lock, flat washer and jam nut. Tighten jam nut to 500 lbs. ft. torque.
15. Recheck bearing preload, after which bend flat washer over jam nut.
16. Install six gear and hub capscrews and lock with soft iron wire. Install capscrew cover spacers, cover and three capscrews. Bend up cover tang to lock screws in place.
17. Install thru-shaft assembly.
18. Refer to Item 16 under "Assemble & Install Cross Shaft, Type 1" and perform that operation.
19. Remove stud nuts and flat washers. Install bearing cage cover gasket, cover, stud nuts and lockwashers. Tighten nuts to specified torque.

Type 3 Cross Shaft—Gear Splined to Cross Shaft

After performing Items 1 and 2 outlined under Type 2 Cross Shaft, proceed as follows:

1. Install radial bearing in drive unit. Large radius of bearing inner race must be toward bevel gear.
2. Position drive unit in press, thru-shaft chamber up. Support inner race of bearing on sleeve in press and press cross shaft firmly against bearing. Begin the assembly operation in the press, making sure the parts are properly aligned. Press the parts together about ¼" to ⅜", then relieve the press pressure to permit them to realign themselves to prevent distortion and damage. Continue the pressing operation until the parts are correctly assembled.
3. Align gear and cross shaft capscrew holes and assemble gear to shaft.
4. Install and tighten six gear and cross shaft capscrews to 69-77 lbs. ft. torque and lock them with wire.
5. Block up gear with piece of hard wood and install cross shaft inner tapered bearing firmly against shaft shoulder with suitable sleeve.
6. If tapered bearing cup has been re-

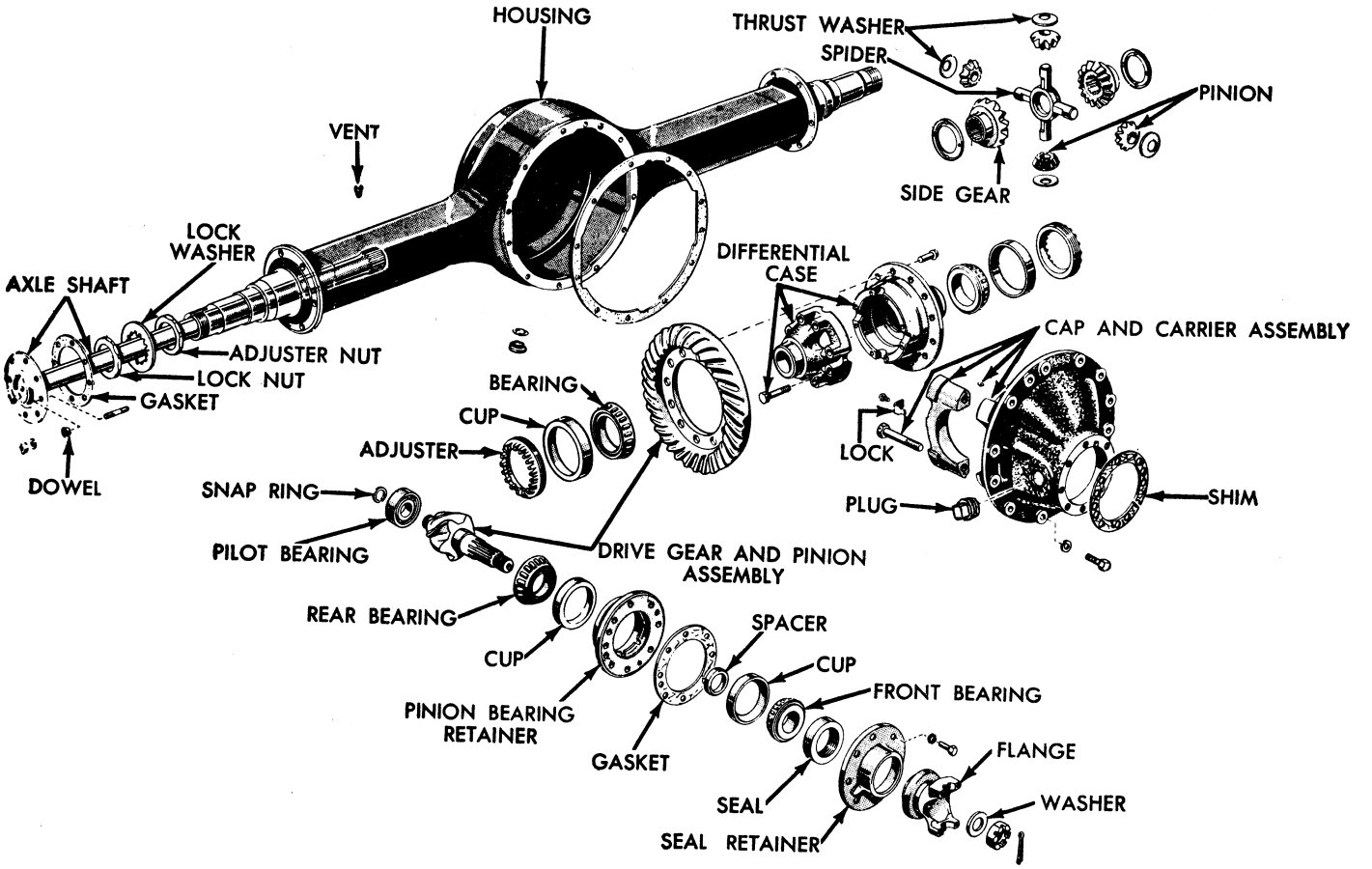


Fig. 69 Timken single-reduction, single-speed axle

moved from cross shaft cage, reassemble in press using sleeve or other suitable installation tool. Press cup firmly against cage shoulder.

7. Install original shim pack (which controls gear backlash) over cross shaft cage studs and cage over shim pack, carefully aligning oil holes in cage with oil holes in drive unit. Install four stud nuts over thick flat washers to hold assembly in place and tighten nuts securely.
8. Install outer cross shaft tapered bearing with suitable sleeve.
9. Install cross shaft bearing adjusting nut. Tighten nut as cross shaft is revolved to correctly position all bearing rollers. Then establish preload to the same limits and in the same manner outlined for Type 1 Cross Shaft.
10. Install nut lock, lock washer and jam nut, tightening jam nut to 500 lbs. ft. torque.
11. Install gear cover spacers, cover and three capscrews, tightening screws to specified torque. Bend up cover tang to lock screws in place.
12. Install thru-shaft assembly.
13. Refer to backlash adjustment outlined under Type 1 Cross Shaft and perform this operation. Then complete the assembly.

TIMKEN SINGLE-REDUCTION AXLE

Banjo Type

The Timken Single-Reduction Final Drive, Fig. 69, employs a heavy duty spiral bevel or hypoid pinion and gear. The differential and gear assembly is mounted on tapered roller bearings. The straddle-mounted pinion has two tapered roller bearings in front of the pinion teeth which take the forward and reverse thrust, and a third bearing behind the pinion teeth to carry the radial load.

Removing Carrier

1. To remove the carrier from the housing, first remove the plug from the bottom of the axle housing and drain the lubricant.
2. Remove axle drive stud nuts.
3. Rap axle shafts sharply in center of flange with heavy steel hammer to free dowels. Remove taper dowels and axle shafts. Prying shafts loose will damage hubs and oil seals.
4. Disconnect universal at pinion shaft.
5. Remove carrier-to-housing stud nuts and washers. Loosen two top nuts and leave on studs to prevent carrier from falling.
6. Break carrier loose from axle housing with rawhide mallet.
7. Remove top nuts and washers and work carrier free, using puller screws in holes provided. A small pinch bar may be used to straighten the carrier in the housing bore. However, the end must be rounded to prevent indenting the carrier flange. A roller jack may be used to facilitate removal of the carrier, Fig. 70.
8. Place carrier in fixture, Fig. 71.

Disassemble Carrier

1. Cut lock wire. Remove cap screws and adjusting nut locks.
2. Center punch one differential carrier leg and bearing cap, Fig. 72, to identify for proper reassembling.
3. Remove bearing cap stud nuts or cap screws, bearing caps and adjusting nuts.
4. Loosen jam nut and back off thrust block adjusting screw, Fig. 73.
5. Lift out carrier and gear assembly, Fig. 74.
6. Remove thrust block from inside of carrier housing.
7. If original identification marks are not clear, Fig. 75, mark differential case halves with a punch for correct alignment on reassembling.
8. Cut lock wire, remove bolts and separate case halves.

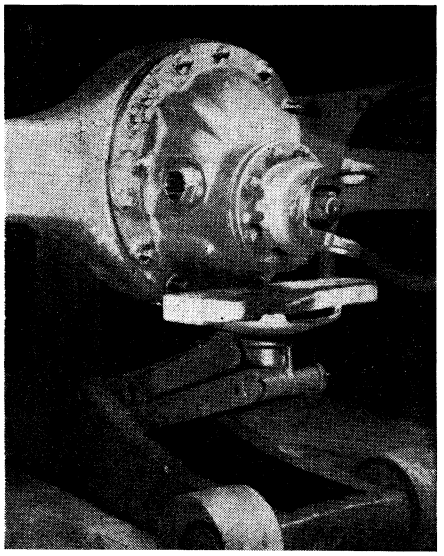


Fig. 70 Using roller jack to support carrier while being removed from housing

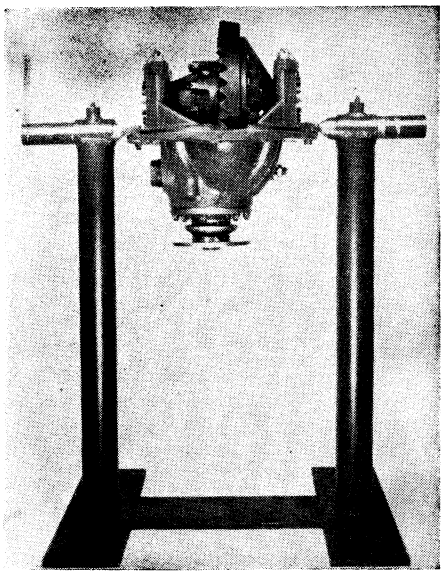


Fig. 71 Carrier mounted in repair stand

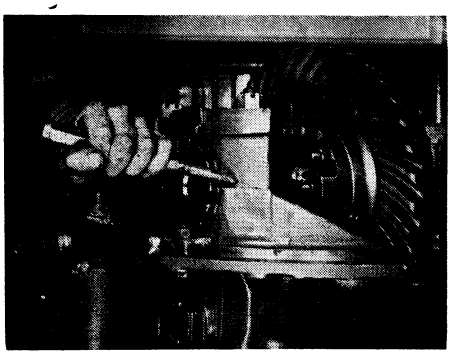


Fig. 72 Center punch one differential carrier leg and bearing cap to identify for proper reassembly

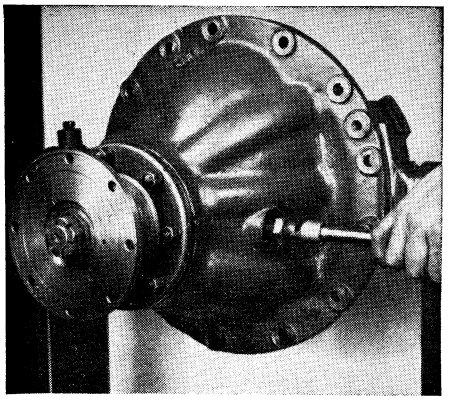


Fig. 73 Lossen jam nut and back off thrust block adjusting screw

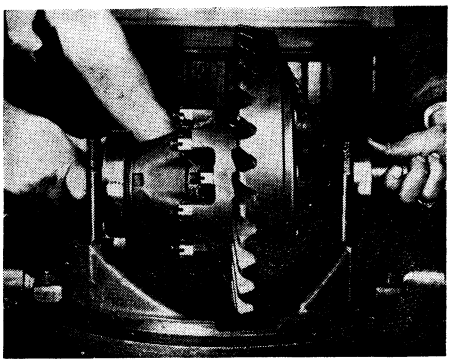


Fig. 74 Lifting out differential and gear assembly

9. Remove spider, pinions, side gears and thrust washers.
10. Remove rivets and separate gear and case.
11. If necessary to replace differential bearings, remove with suitable puller, Fig. 76.
12. Hold flange or yoke with suitable tool, Fig. 77, and remove pinion shaft nut and washer.
13. Remove flange or yoke with suitable puller, Fig. 78. Driving the flange off will cause runout.
14. Remove bearing cover and oil seal assembly.
15. Remove bearing cage, using puller screws in holes provided, Fig. 79. The use of a pinch bar will damage the shims. Driving pinion from inner end with a drift will damage the bearing lock ring groove.
16. Wire shim pack together to facilitate adjustment on reassembling.

NOTE—Both splined and tapered pinion shafts are used in Single-Reduction carriers. Where the tapered shaft is used, the thrust bearings are adjusted by means of adjusting and lock nuts. On the splined shaft, this adjustment is secured with a selective spacer or spacer combination.

17. On units with splined shaft, tap shaft out of cage with soft mallet or press shaft from cage. Remove outer bearing from cage. Remove spacer or spacer combination from pinion shaft. If necessary to replace rear thrust bearing or radial bearing, remove with suitable puller, Fig. 80. Remove oil seal from bearing cover.
18. On units with tapered shaft, remove lock nut, adjusting nut and thrust washer. Tap pinion out of cage with soft mallet or press shaft from cage. Remove bearings from cage. Remove bearings from shaft with suitable puller if necessary. Remove oil seal from bearing cover.

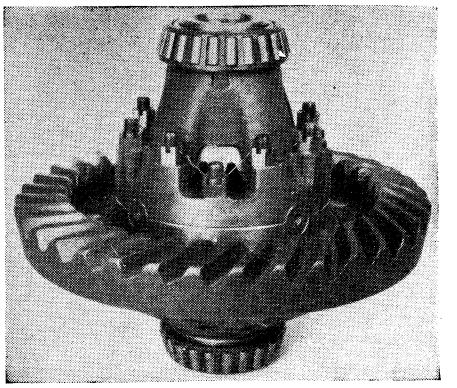


Fig. 75 If original identification marks are not clear, mark differential case halves with punch for correct alignment on reassembling

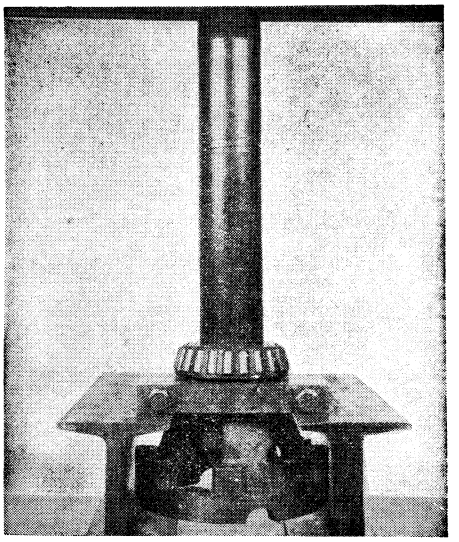


Fig. 76 Removing differential bearing

Inspection

The procedure for cleaning and inspection of parts should be conducted in the same manner outlined previously for Timken Two-Speed, Double-Reduction Drive Units.

Assemble Pinion & Cage—Splined Type Shaft

1. Press rear thrust and radial bearings firmly against pinion shoulders with a suitable sleeve, Fig. 81.
2. Install radial bearing lock ring and

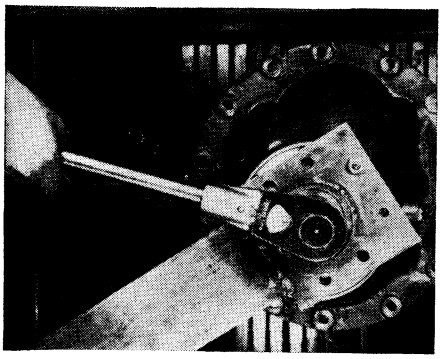


Fig. 77 Removing pinion nut

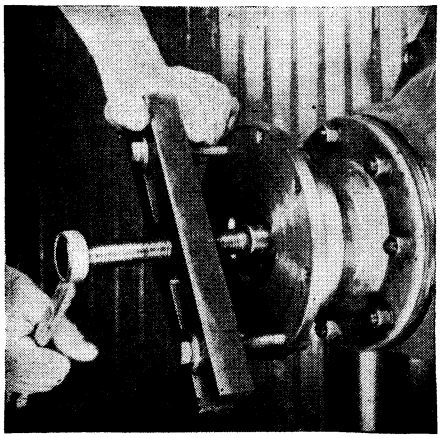


Fig. 78 Removing flange or yoke with puller

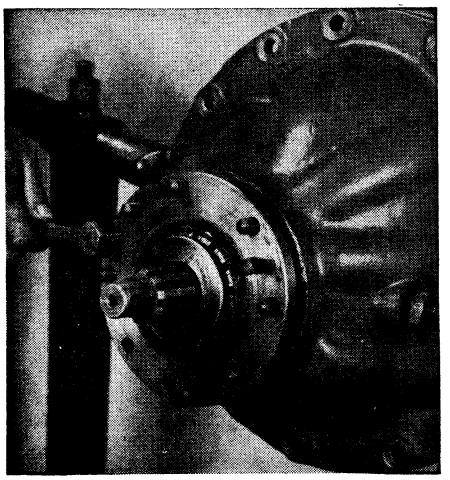


Fig. 79 Removing bearing cage, using puller screws in holes provided

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 spacer combination over pinion shaft.
6. Press front bearing firmly against spacer.
7. Rotate cage several revolutions to assure normal bearing contact.
8. While in a press under pressure, check bearing preload torque by wrapping soft wire around cage and pulling on a horizontal line with a pound scale, Fig. 82. If a press is not available, the pinion nut may be tightened to the correct torque and preload checked.

NOTE—The correct pressures or torques for checking pinion bearing preload are given in the Two-Speed, Double-Reduction Drive Unit section of this chapter. As an example, however, assuming pinion cage diameter to be 6" the radius would be 3" and with 5 pound pull of the scale would equal 15 inch-pounds preload torque. If the rotating torque is not within 12 to 18 inch-pounds, use thinner spacer to increase or thicker spacer to decrease preload. Use rotating torque, not starting torque.

9. Press flange or yoke against forward bearing and install washer and pinion shaft nut.
10. Place pinion and cage over carrier studs, hold flange and tighten pinion shaft nut to correct torque, Fig. 83.
11. Recheck pinion bearing preload torque. If rotating torque is not within 12 to 18 inch-pounds, repeat foregoing procedure.
12. Hold flange and remove pinion shaft nut and flange.
13. Lubricate pinion shaft oil seal and cover outer edge of seal body with non-hardening sealing compound. Press seal against cover shoulder with seal driver, Fig. 84.
14. Install new gasket and bearing cover.
15. Press flange against forward bearing, Fig. 85, and install washer and pinion shaft nut.
16. Tighten to correct torque and install cotter key. Do not back off nut to align cotter key holes.

Assemble Pinion & Cage—Tapered Type Shaft

1. Press rear thrust and radial bearings firmly against pinion shaft shoulder.
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 cage shoulders.
4. Lubricate bearings and cups with light machine oil.
5. Install forward bearing, thrust washer and adjusting nut.
6. Install new lock washer and the lock nut.
7. Adjust pinion bearing preload to 12 to 18 inch-pounds with lock nut tightened securely against washer.
8. Bend lock washer when correct adjustment has been secured.
9. Lubricate pinion shaft oil seal and cover edge of oil seal with non-hardening sealing compound. Press seal against cover shoulder with seal driver, Fig. 84.
10. Install new cork gasket and bearing cover. Cover should be carefully installed to prevent cutting seal on keyway.
11. Install key, press flange on taper and install washer and pinion shaft nut, Fig. 85.
12. Tighten to the correct torque and install cotter key. Do not back off nut to align cotter key holes.

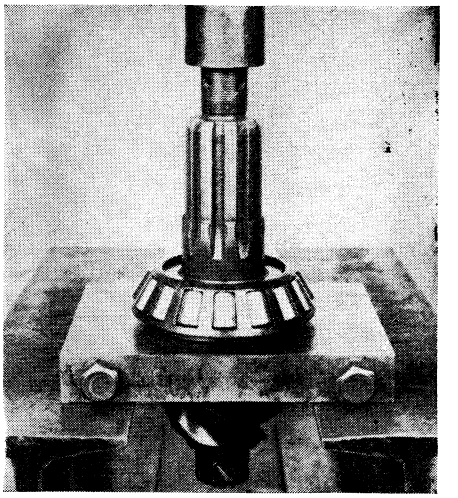


Fig. 80 Removing pinion bearing

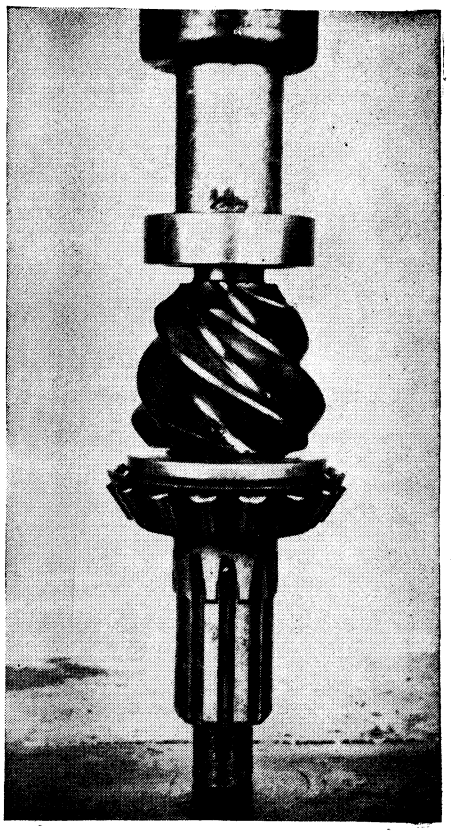


Fig. 81 Installing radial bearing on pinion shaft

Install Pinion & Cage

1. Install new gasket over housing-to-cage studs.

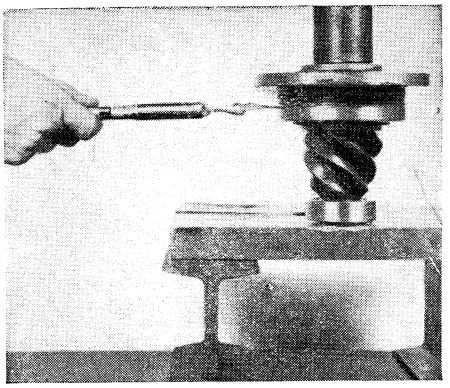


Fig. 82 Checking pinion bearing preload torque with wire and pound scale

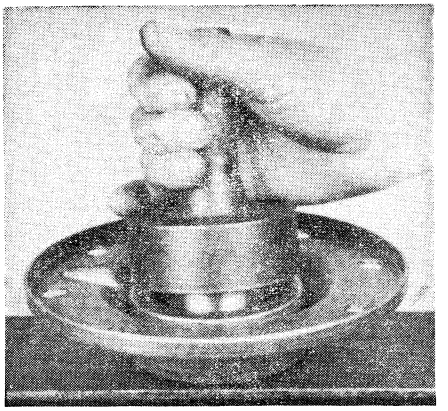


Fig. 84 Using seal driver to install pinion shaft oil seal

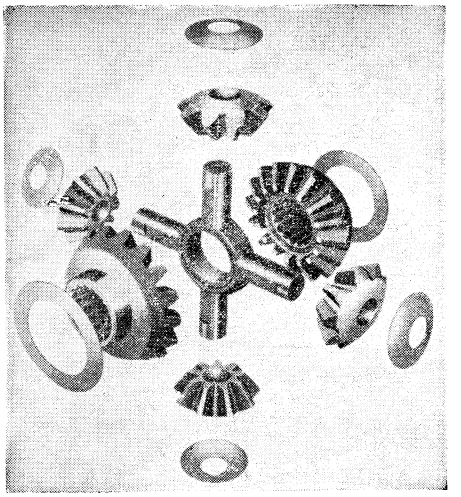


Fig. 86 Layout of differential parts

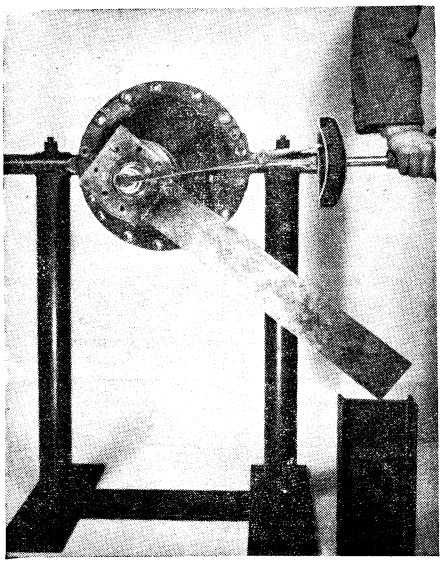


Fig. 83 Tightening pinion shaft nut

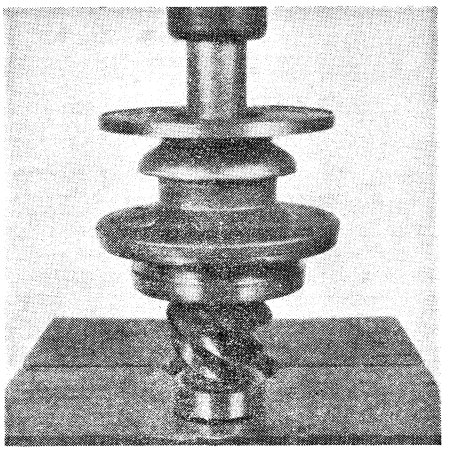


Fig. 85 Pressing flange on pinion shaft

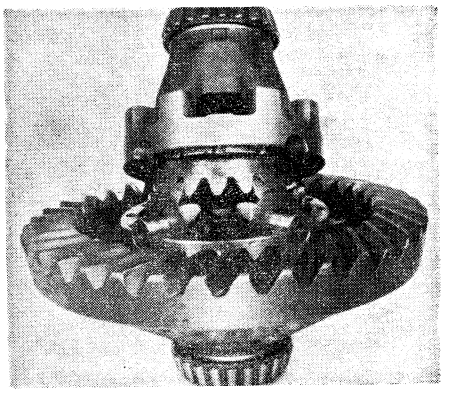


Fig. 87 Align mating marks on differential case halves before assembly

2. Install original shim pack over gasket.
3. Position pinion and cage over studs and tap into position with soft mallet.
4. Install lock washers and stud nuts. Tighten to the correct torque.

Assemble Differential & Gear

1. Rivet bevel gear to case half with new rivets. 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 ⅛" larger in diameter than the rivet hole. The head will then be approximately the same height as the preformed head. The formed head should not exceed $\frac{1}{16}$" less than the preformed 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 with axle lubricant, Fig. 86.
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. 87, position component case half and draw assembly together with four bolts or cap screws equally spaced.
7. Check assembly for free rotation of differential gears and correct if necessary.
8. Install remaining bolts or cap screws, tighten to the correct torque and lock with wire.
9. If bearings are to be replaced, press them firmly and squarely on differential case halves.

Install Differential & Gear

1. Lubricate differential bearings and cups with axle lubricant.
2. Place cups over bearings and position assembly in carrier housing.
3. Insert bearing adjusting nuts and turn hand tight against bearing cups.
4. Install bearing caps in the correct location as marked, Fig. 88, and tap lightly into position.
5. Install flat washers (where used) and stud nuts. Tighten snugly, then back off sufficiently to turn bearing adjusting nuts.

NOTE—Generally, if original gears are being reinstalled, painting of gear teeth will not indicate the same contact as new gears and can be misleading. Gears that have been in service for long periods form running contacts due to wear of teeth. Therefore, the original shim pack plus a new gasket should be maintained to check gear lash. In the event that gear lash is in excess of the maximum tolerance, as stated under gear adjustment, reduce gear lash only in the amount that will avoid overlap of the worn tooth section. For details on tooth contact and gear lash adjustments, see the text and illustrations outlined under Timken Two-Speed, Double-Reduction Drive Units. After establishing the correct tooth contact and gear lash, Fig. 89, complete the job as follows:

Adjust Differential Bearing Preload

1. Using dial indicator on back face of gear, Fig. 90, loosen the bearing adjusting nut on the side opposite the gear just enough to notice end play on the indicator.
2. Tighten the same adjusting nut only enough to obtain .000" end play.
3. Check gear for runout and if it exceeds .008", remove differential and check for cause.

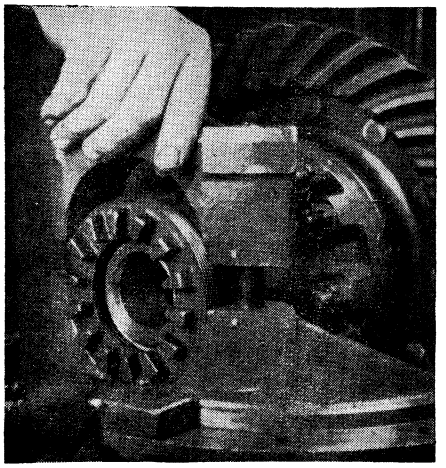


Fig. 88 Install bearing caps in correct position as marked and tap into position

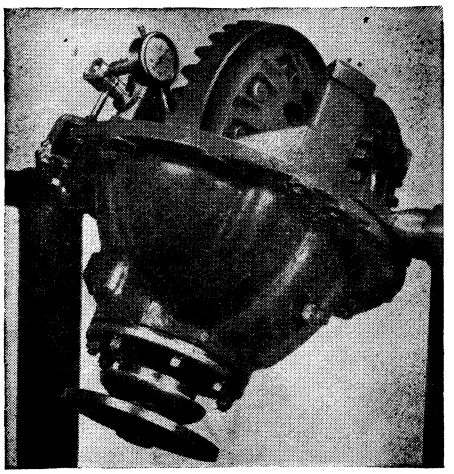


Fig. 89 Checking gear backlash with dial indicator

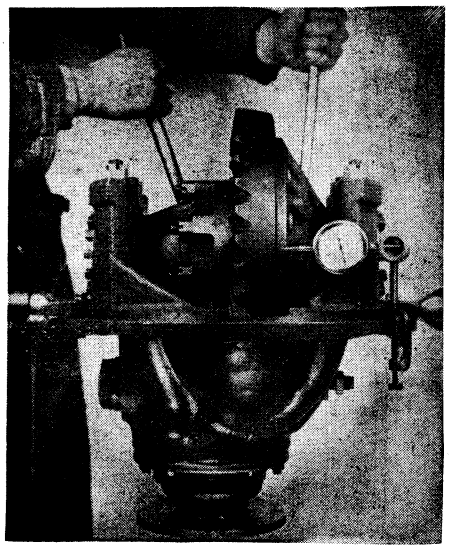


Fig. 90 Using dial indicator to establish zero end play in differential bearings

4. Tighten adjusting nuts one notch each from .000" (zero) end play to preload differential bearings.
5. Tighten bearing cap stud nuts or cap screws to the correct torque.
6. Install adjusting ring locks and cap screws. Tighten to the correct torque and lock with wire.

Install Thrust Block

1. Remove carrier from holding fixture and position with back face of bevel gear upward.
2. Remove adjusting screw and lock nut, Fig. 91.
3. Place thrust block on rear face of bevel gear and rotate gear until hole in thrust block is aligned with adjusting screw hole.
4. Install adjusting screw and lock nut, Fig. 92, 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 ¼ 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 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. 93, is a single reduction, hypoid geared

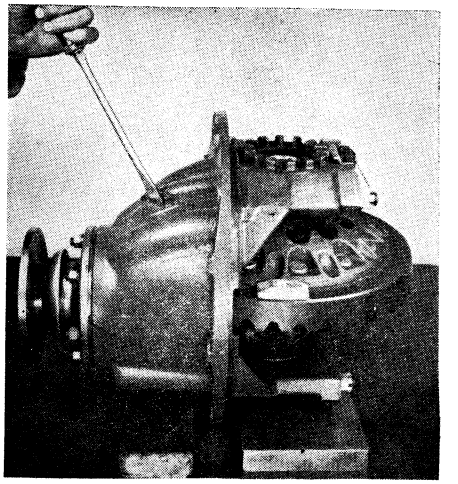


Fig. 91 Removing thrust block adjusting screw

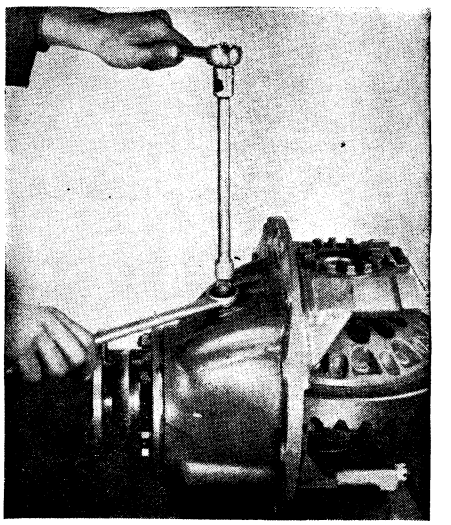


Fig. 92 Adjusting thrust block clearance by means of adjusting screw

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

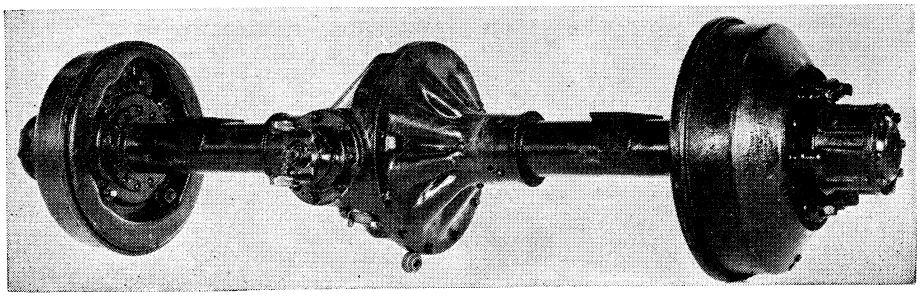


Fig. 93 Timken Unit Housing Type Axle, Model H-150

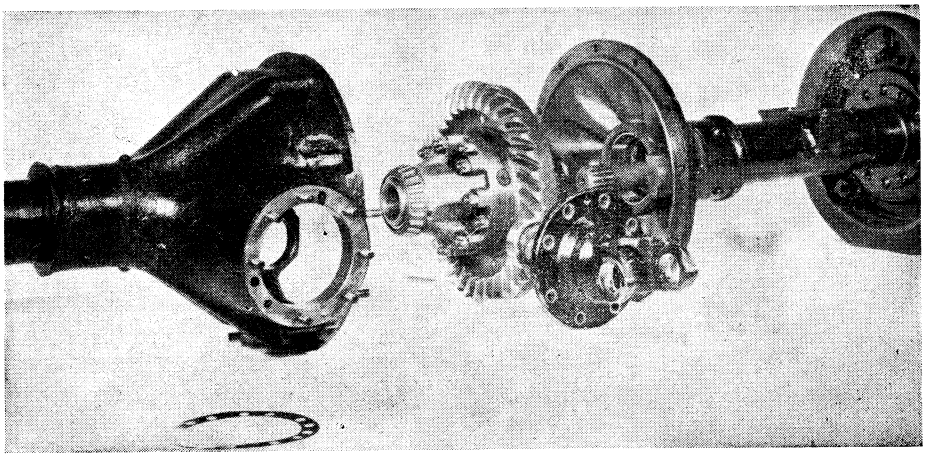


Fig. 94 Timken Unit Housing Type Axle

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. 94.
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. 95, with a punch before disassembling 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 $\frac{1}{32}$" smaller than rivet body to drill through head. Press out rivets.
5. Use bearing puller, Fig. 96, to remove bearings if necessary.

Remove Pinion & Cage

1. Secure yoke with holding tool, Fig. 97, and remove pinion shaft nut and washer.
2. Insert puller through yoke, Fig. 98, and remove.
3. Remove pinion bearing cover and oil seal assembly.
4. Remove pinion and cage assembly, using puller screws in holes provided, Fig. 99. 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.

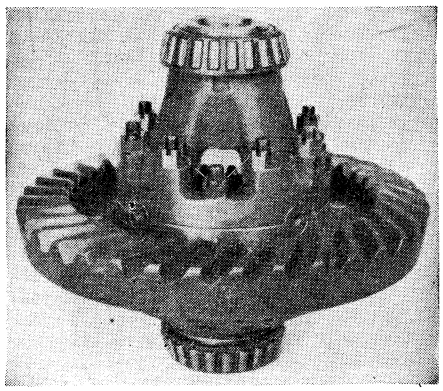


Fig. 95 If original identification marks are not clear, mark differential case halves with a punch before disassembling for correct alignment when reassembling

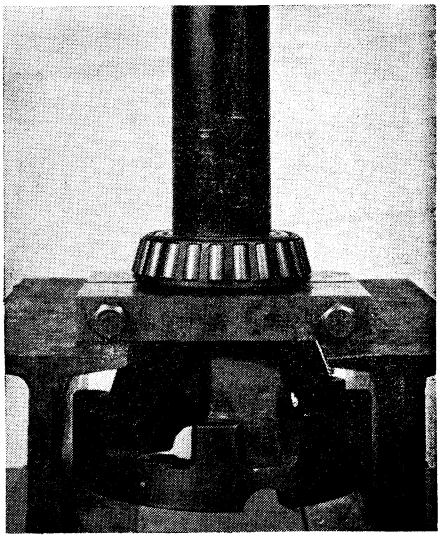


Fig. 96 Remove differential bearings with bearing puller

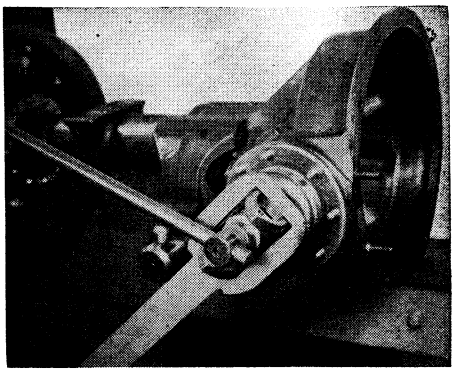


Fig. 97 Secure yoke with holding tool and remove pinion shaft nut and washer

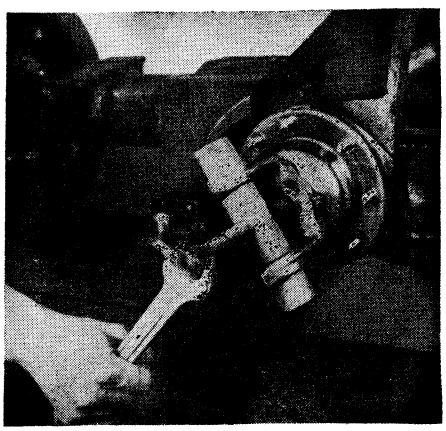


Fig. 98 Insert puller through yoke and remove

2. Remove outer bearing from cage.
3. Remove spacer or spacer combination from pinion shaft.
4. Remove rear thrust bearing, Fig. 100, and radial bearing with bearing puller if necessary to replace.
5. Remove oil seal from bearing cover.
6. If necessary to remove differential

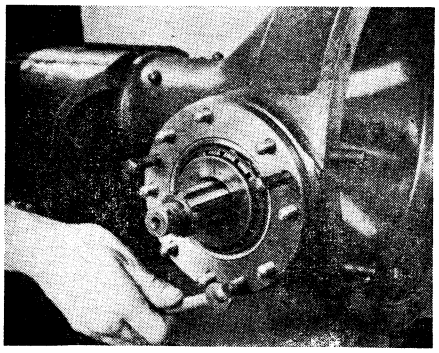


Fig. 99 Remove pinion and cage, using puller screws in holes provided

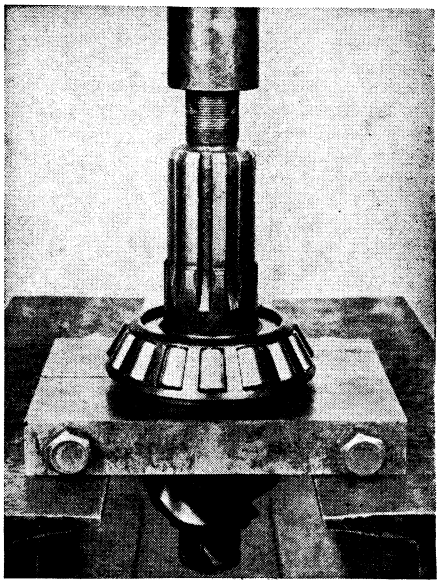


Fig. 100 Remove pinion shaft bearings with bearing puller

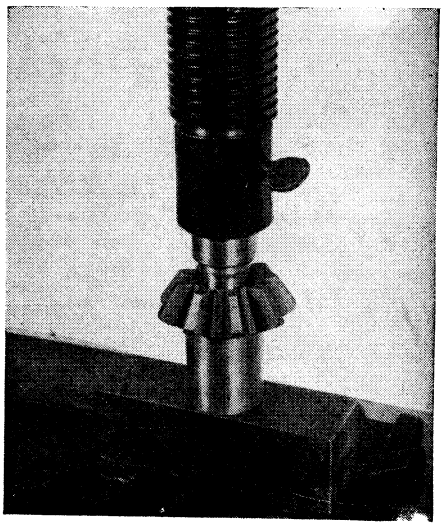


Fig. 101 Pressing bushing into differential pinion. Use adapter with correct size offset to fit bushing

bearing cups, wire the selective spacers which are behind the cups to their respective axle halves.

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. 101. 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. 102. If desirable, the bar may be shortened to permit the use of a bench vise to install and burnish bushing, Fig. 103.

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. 104, 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 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. 105, 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.

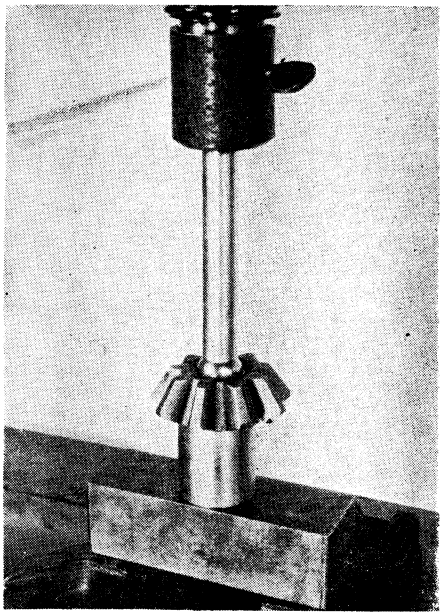


Fig. 102 Using a bar to press burnishing ball through bushing

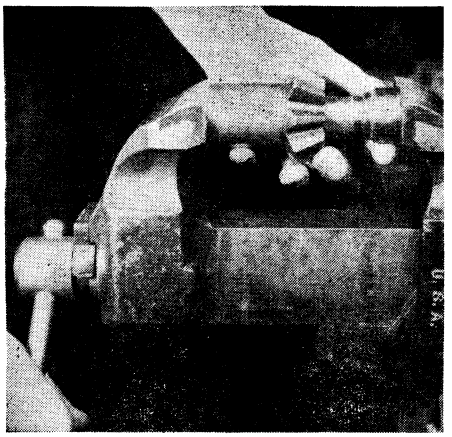


Fig. 103 Using short bar and vise to install bushing in differential pinion

8. Place pinion and cage over carrier studs. Hold yoke as shown in Fig. 106 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. 107.
12. Install new gasket and bearing cover.
13. Press yoke against forward bearing, Fig. 108, 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.

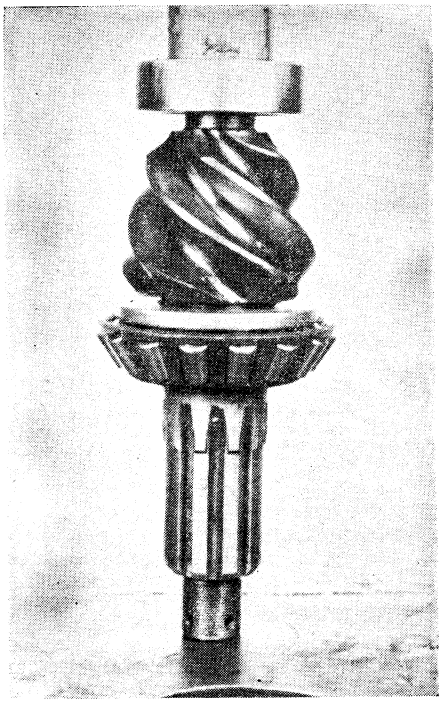


Fig. 104 Pressing pinion shaft radial bearing

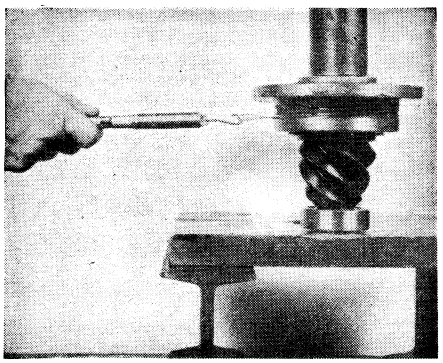


Fig. 105 Checking pinion shaft bearing preload

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 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 $\frac{1}{8}$" larger in diameter than the rivet hole. The head will then be approximately the same height as the preformed head. The formed head should not exceed $\frac{1}{16}$" less than the preformed head as excessive pressure will cause distortion of the case holes and result in gear eccentricity.

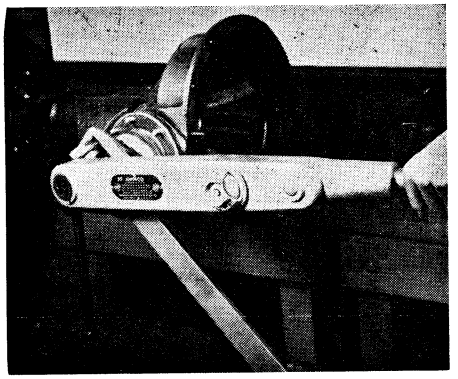


Fig. 106 Removing pinion shaft nut

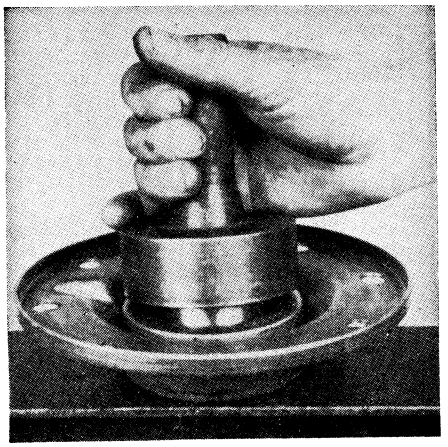


Fig. 107 Installing pinion shaft oil seal with seal driver

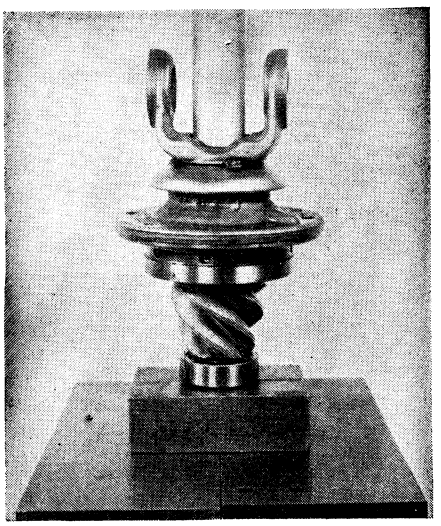


Fig. 108 Pressing on pinion yoke

2. Lubricate differential case inner walls and all component parts, Fig. 109, 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.

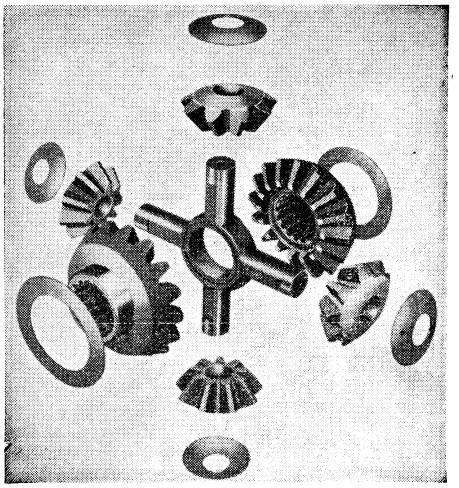


Fig. 109 Layout of differential parts

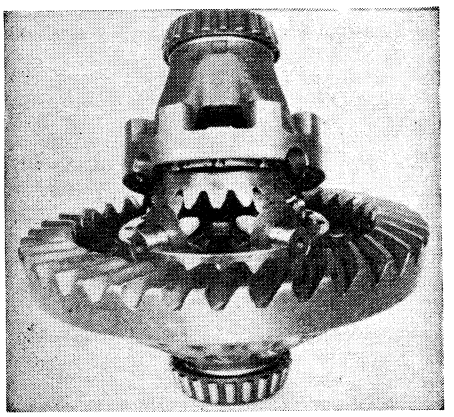


Fig. 110 Align mating marks before assembling differential case halves

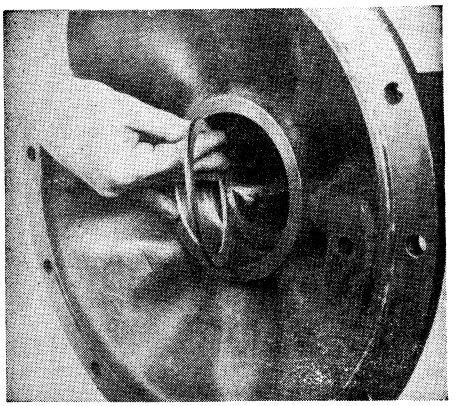


Fig. 111 Installing differential bearing spacer

6. Align mating marks, Fig. 110, position component case half and draw assembly 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.

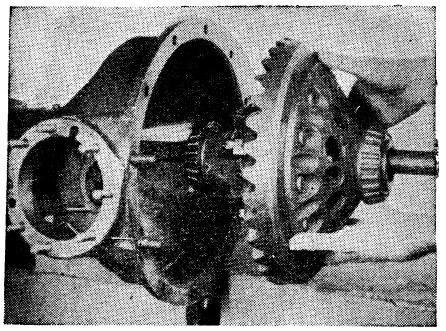


Fig. 112 Installing differential and gear into case

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 drive pin out of cover.
2. Install differential bearing spacers, Fig. 111, in the original position 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. 112, 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. 113. 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 thicknes of the spacer in the case half and increasing the thickness of 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. 114. 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.

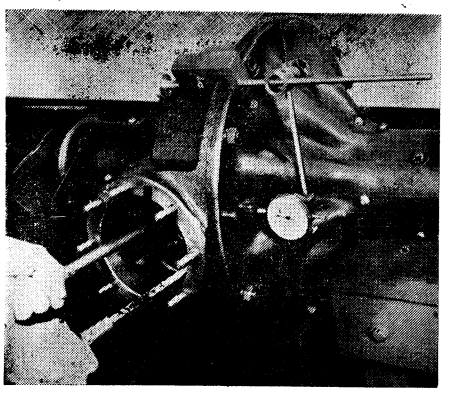


Fig. 113 Checking differential and gear end play with dial indicator through thrust block pin hole

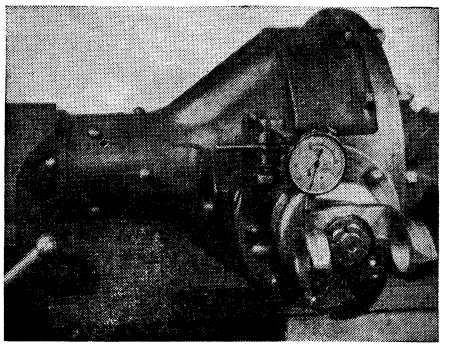


Fig. 114 Checking gear lash with dial indicator

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

TIMKEN SINGLE REDUCTION AXLE THROUGH DRIVE TYPE

With Inter-Axle Differential

This unit, Fig. 115, incorporates hypoid reduction gears and bevel-type inter-axle differential gears. The through shaft and inter-axle differential assembly are supported by four ball bearings with the rearmost one located in the cage at the rear of the axle housing.

The drive pinion and the differential and gear assembly are supported by tapered bearings. The pinion bearing preload is adjusted and maintained by a hardened precision spacer between the inner and outer tapered bearings. The differential bearing preload is adjusted and maintained by threaded adjusting rings located in the carrier legs and caps.

The inter-axle differential may be either engaged or disengaged by a power actuated shift unit which moves a sliding dog clutch on the through-shaft splines, Fig. 116.

The shift unit is controlled by a selector switch or lever within the cab of the vehicle and may be engaged or disengaged under any normal operating conditions. The inter-axle differential when engaged (unlocked) divides the engine torque between the forward and rear axles, when disengaged (locked) converts the two axles to a through drive type tandem.

To service the unit, refer to Fig. 117.

Remove Drive Unit From Housing

1. Disconnect forward propeller shaft universal at inter-axle differential input shaft.
2. Disconnect rear propeller shaft at through shaft yoke or flange.
3. Drain lubricant by removing plug from bottom of axle housing and bottom plug from inter-axle differential cover.
4. Remove axle flange nuts and washers.
5. Hold a short drift against center of axle shaft flange and strike a sharp blow to loosen shaft.
6. Remove axle shafts.
7. Remove shift shaft housing assembly.
8. Disassemble and remove shift lever attaching parts. Body fit bolt should not be removed.
9. Remove through-shaft, cage and yoke assembly. To free cage from case bore it may be necessary to tap yoke with a soft mallet. *While through-shaft assembly is being threaded out, the sliding clutch must be eased along the shaft at shift lever opening. When through-shaft clears opening, clutch may be lifted out.*
10. After removing attaching nuts, break carrier loose from housing with a soft mallet.
11. Place jack under carrier and remove it from housing. A small pinch bar may be used to straighten carrier in housing bore. However, the end must be rounded to prevent indenting the carrier flange.

Disassemble Through Shaft

1. Remove through-shaft yoke with puller.
2. Press through-shaft from cage, using a suitable sleeve against bearing inner race.

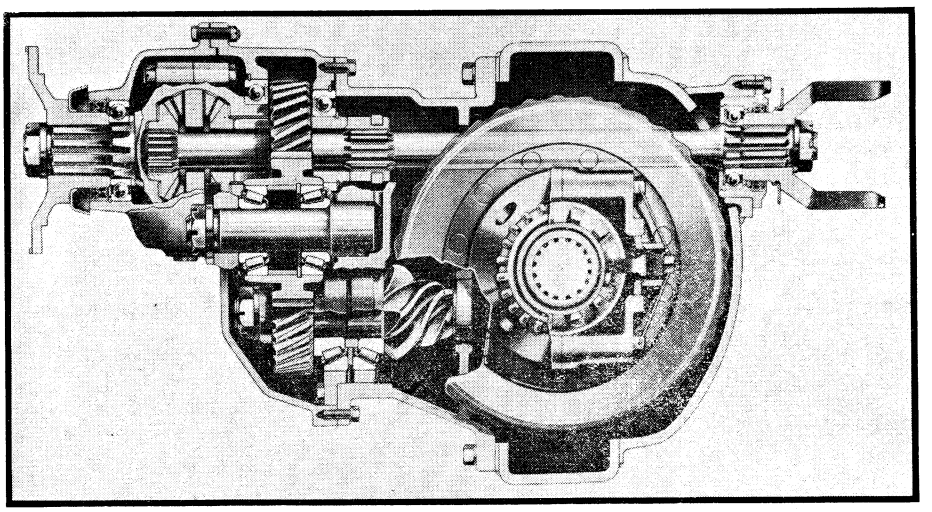


Fig. 115 Timken single reduction axle with inter-axle differential and through drive

3. Remove cage snap ring.
4. Tap radial bearing out of bore from seal end. *If oil seal is in good condition, do not disturb.*

Disassemble Inter-Axle Differential

1. Separate inter-axle differential adapter case from carrier case.
2. Separate cover containing inter-axle differential. This will leave the through-shaft drive gear, idler gear and shaft in adapter case.
3. Remove yoke or flange with puller.
4. Press inter-axle differential from cover.
5. If original identification marks are not clear, mark differential case halves with a punch for correct alignment on reassembly.
6. Separate case halves and remove differential parts.
7. Remove radial bearings from case halves with puller. Puller must press against inner race.
8. Remove snap ring from cover and press out oil seal.
9. Tap through-shaft drive gear back until gear touches case.
10. Remove snap ring on outer race of rear bearing.
11. Remove through-shaft drive gear and bearing by tapping end of gear hub with mallet.
12. Do not remove radial bearing from gear hub unless replacement is necessary. If necessary, fold back tab locks and remove hub snap ring. Then remove bearing with puller.
13. Remove idler gear and bearing.
14. Remove tapered bearings from idler gear.

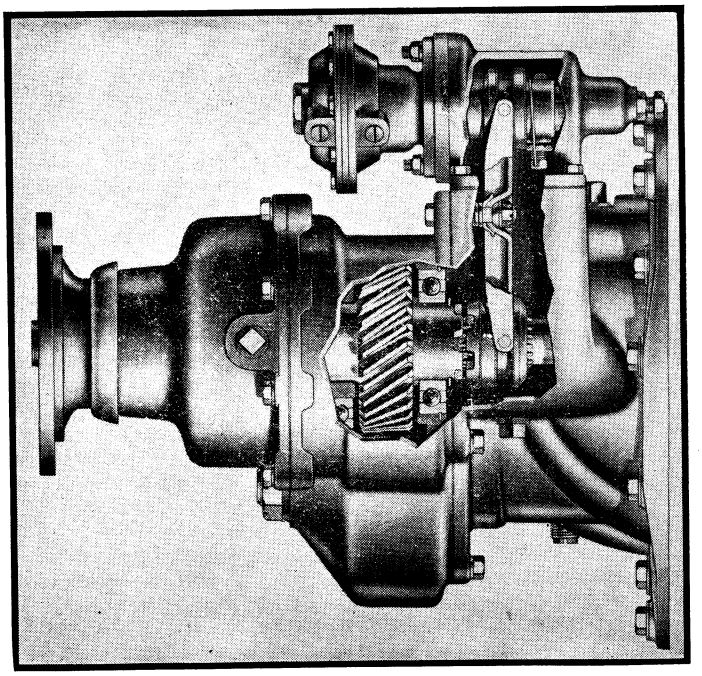


Fig. 116 Drive unit for axle shown in Fig. 115

Differential & Gear

1. Back off thrust block adjusting screw, allowing thrust block to drop out.
2. Check backlash. Backlash setting at this time may be required for reassembly.
3. If original identification marks are not clear, mark differential case halves with a punch for correct alignment on reassembly.
4. Remove leg cap screws and adjusting ring locks.
5. Remove leg caps and adjusting rings.
6. Lift out differential and gear.
7. *Disassemble and assemble the differential and gear in the same manner outlined for the Timken Single Reduction Banjo Type Axle.*

Pinion & Cage Assembly

Service on this assembly is accomplished in the same manner outlined for the *Timken Single Reduction Banjo Type Axle.*

Adapter Case, Assemble

1. Install snap ring in idler gear hub groove.

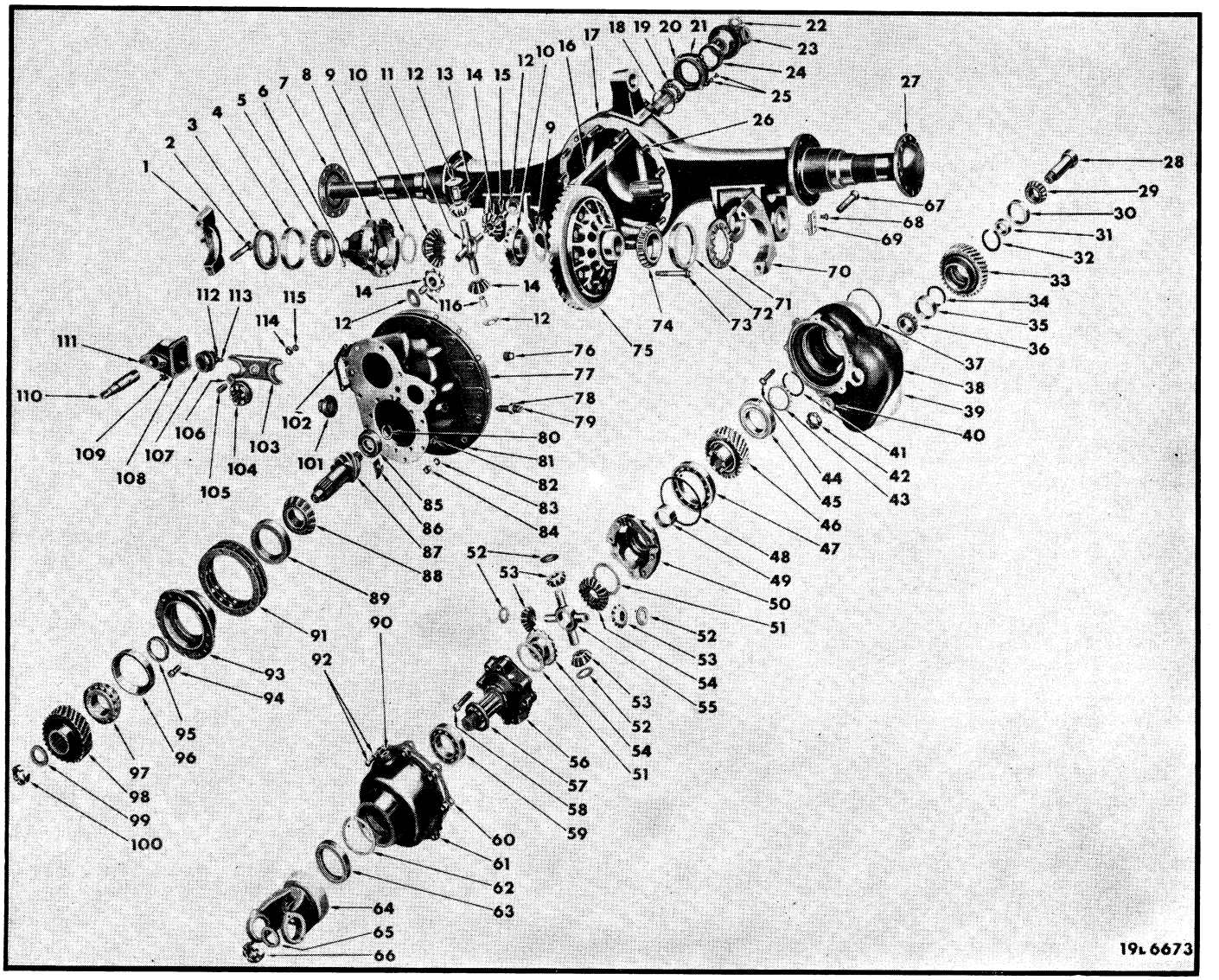


Fig. 117 Timken single reduction light weight tandem forward axle

1. Differential bearing cap
2. Cap screw
3. Threaded adjusting ring
4. Bearing cup
5. Bearing
6. Case bolt nut
7. Axle shaft
8. Differential case half
9. Side gear thrust washer
10. Differential side gear
11. Differential spider
12. Pinion thrust washer
13. Pinion bushing
14. Differential pinion
15. Pinion bushing
16. Through-shaft
17. Axle housing
18. Snap ring
19. Bearing
20. Cage gasket
21. Through-shaft cage
22. Yoke nut
23. Yoke
24. Cage oil seal
25. Cap screw
26. Stud
27. Axle shaft
28. Idler gear shaft
29. Rear bearing
30. Rear bearing cup
31. Spacing sleeve
32. Snap ring
33. Idler gear
34. Snap ring (early models only)
35. Bearing cup
36. Front bearing
37. Snap ring
38. Adapter case
39. Gasket
40. Washer
41. Snap ring
42. Nut
43. Hub lock
44. Cap screw
45. Bearing
46. Through-shaft drive gear
47. Bearing
48. Snap ring
49. Bushing
50. Differential case half
51. Thrust washer
52. Thrust washer
53. Pinion
54. Side gear
55. Spider
56. Front case half
57. Spacing washer
58. Bolt
59. Bearing
60. Gasket
61. Differential cover
62. Snap ring
63. Oil seal
64. Input shaft yoke
65. Washer
66. Nut
67. Cap screws
68. Cap screws
69. Adjusting ring lock
70. Bearing cap
71. Bearing adjusting ring
72. Bearing cup
73. Bolt
74. Differential bearing
75. Differential gear and case
76. Inspection hole plug
77. Gasket
78. Lock nut
79. Bolt
80. Snap ring
81. Carrier case
82. Dowel stud (older models only)
83. Dowel washer (older models only)
84. Dowel (older models only)
85. Bearing
86. Thrust block
87. Drive pinion
88. Inner bearing
89. Bearing cup
90. Oil fill plug
91. Shim pack
92. Cap screw

2. Press idler gear inner bearing cup squarely against snap ring.
3. Insert idler gear cup spacing sleeve in hub against opposite side of snap ring.
4. Press idler gear idler gear bearing cup squarely against spacing sleeve.
5. Position idler gear inner and outer bearing into cups and slide complete assembly through adapter case drive pinion opening.
6. Position assembly so that bearings are aligned with adapter case shaft hole.
7. Tap idler shaft through adapter case and idler gear so that inner bearing is squarely against idler shaft shoulder.
8. Install idler shaft washer and nut.
9. To adjust idler gear bearings, tighten idler shaft nut to 25 lb. ft. torque and back off 1/6 to ¼ turn. *The nut when backed off the 1/6 to ¼ turn and cotter key installed will be finger loose. After folding over the cotter key, tap the nut end of the shaft with a soft mallet to position nut and washer against case. This procedure will assure a bearing adjustment of zero end play to .005" loose.*

Through-Shaft Drive Gear, Assemble

1. If rear bearing has been removed for replacement, press new bearing on hub, using a suitable sleeve against bearing inner race.
2. Install tab lock ring and hub snap ring.
3. Fold back tab locks to secure snap ring.
4. With radial bearing outer snap ring removed, position through-shaft drive gear and bearing into adapter case bore.
5. Tap assembly through bore until gear touches case wall.
6. Install radial bearing outer race snap ring in groove and tap assembly back so that lock ring rests in recess in adapter case.

93. Drive pinion cage
94. Cap screws
95. Bearing spacer
96. Bearing cup
97. Bearing
98. Drive pinion gear
99. Spacing washer
100. Nut
101. Oil fill plug
102. Gasket
103. Shift yoke
104. Dog clutch
105. Yoke spring
106. Yoke button
107. Clutch collar
108. Shift shaft housing
109. Cap screw
110. Shift shaft
111. Stud
112. Lock nut
113. Set screw
114. Washer
115. Nut
116. Differential spider pinion bushing

Inter-Axle Differential, Assemble

1. Lubricate differential case walls and all component parts with axle lubricant.
2. Position thrust washer and rear side gear into rear case half.
3. Place spider with pinions and thrust washers in position.
4. Install forward side gear and thrust washer.
5. Align mating marks, position forward case half and draw together with case cap screws.
6. Check for free rotation of gears and correct if necessary.
7. Press on forward and rear case half radial bearings.

Final Assembly

1. Install inter-axle assembly rear case half hub over through-shaft drive gear hub and tap into position so that rear radial bearing snap ring mates in adapter case recess. It may be necessary to rotate the assembly slightly to allow the dog clutch teeth to line up.
2. Install snap ring in nose of inter-axle differential case cover.
3. Install cover and draw together the cover and adapter case with cap screws.
4. After tightening cover, install outer oil seal with suitable driver.
5. Install adapter case-to-carrier gasket.
6. With carrier assembly mounted in stand in an upright position, lower by use of chain falls the inter-axle differential and adapter case assembly. Care should be taken to rotate the idler gear shaft so that one shaft flat mates with the cast flat in the carrier.
7. Install cap screws and lock washers and tighten.
8. 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 axle housing.
9. Remove nuts and flat washers and install lock washers and stud nuts.
10. Install through-shaft rear radial bearing into cage and lock in place with snap ring.
11. Press cage and bearing on rear splined end of through-shaft so that inner race of radial bearing is firmly against through-shaft shoulder. *For this operation a sleeve that will slip over the shaft and bear against the inner race of the radial bearing must be employed.*
12. Install through-shaft cage oil seal with suitable driver.
13. Enter through-shaft and cage, with new gasket, into cage bore in rear of axle housing until forward end of shaft is even with shift lever opening.
14. Slide splined clutch collar over forward end of shaft through shift housing opening and ease shaft through and into forward side gear of inter-axle differential, while at the same time passing the splined clutch collar through and onto through-shaft clutch splines.
15. Install and tighten through-shaft cage cap screws.
16. Install over the shift lever bolt the shift lever spring, cup and lever. Lever inner yoke must be properly located in clutch groove at this time. Install shift lever button, nut and cotter key.
17. Insert shift shaft into housing with shift collar in place so that shaft will pass through collar at the same time.
18. Position collar and tighten set screw into locating indent.
19. Position shift shaft housing to drive unit, making sure that the shift lever outer yoke is properly located in shift shaft collar groove.
20. Install shift housing cap screws and tighten.

Shift Shaft, Adjust

Adjust the positioning screw at the rear of the shift shaft housing as follows:

With the shift shaft moved back to its full travel (unlocking the inter-axle differential) turn the adjusting screw in until the end of the screw touches the end of the shift shaft.

From this point proceed ¼ turn more and lock adjusting screw with jam nut. This will allow approximately .012" clearance between yoke and groove of collar and thus eliminate yoke and collar wear. The shift collar provides a definite stop against housing wall when shifted in the opposite direction.

Through-Shaft Yoke, Install

Install through-shaft yoke on splines with a suitable sleeve. Install washer and nut. By use of a holder on the yoke, tighten the yoke nut and install cotter key.

Check Flange & Yoke Angles

After the drive units are secured to the housings and the axle assemblies installed in the vehicle, the through-shaft universal flanges and yokes should be inspected for correct angularity. Flange and yoke angles must be within 1 degree of the main transmission flange or yoke angle, and runout should not exceed .005" total indicator reading.

TIMKEN WORM DRIVE AXLE

Fig. 118—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 removed 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:

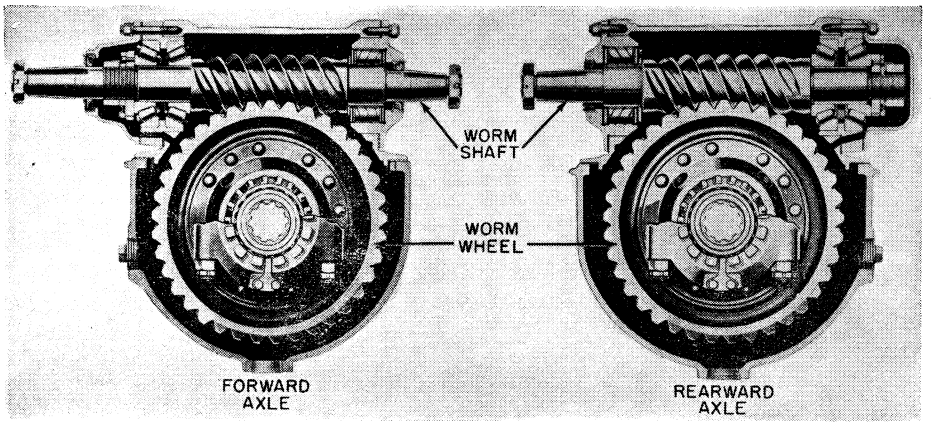


Fig. 118 Timken worm drive tandem axles

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 worn 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 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. 118. 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.

Worm Bearings, Adjust

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

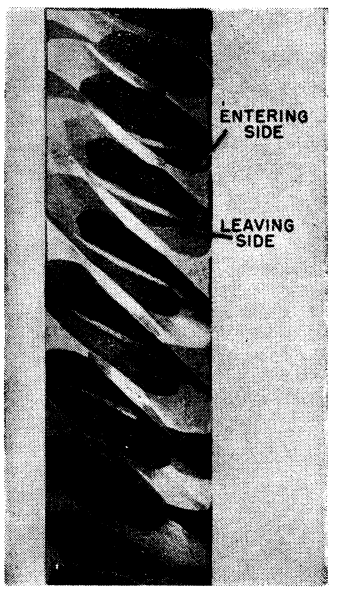


Fig. 119 Tooth contact on worm wheel

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, Adjust

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 alignment 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. 119. 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 flatest 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. 119. 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.

HYDRAULIC BRAKE SYSTEM

Fluid Level

Before checking the fluid level, examine the master cylinder and reservoir, Fig. 1, for evidence of fluid leaks, especially at the brake fluid pipe connection. Examine the rubber boot located at the end of the cylinder. A fluid leak at this point indicates that the master cylinder cup washer is leaking, in which case the cylinder must be removed and disassembled for correction.

Before removing the reservoir filler cap, clean away all dirt so none will fall into the reservoir when the cap is removed. After removing the cap, if the fluid level is more than ⅜" below the bottom of the filler neck, add sufficient fluid to bring the level to this point. Install the filler cap and tighten it firmly so that dirt and water will not enter the cylinder.

Use only approved brake fluid; never use engine oil or other mineral oils as to do so will ruin the rubber parts of the hydraulic system.

Brake Pedal Free Play

Check the amount of free pedal travel by applying a light finger pressure to the pedal. A slight resistance will be felt when the pedal travel has reached the point where it operates the master cylinder piston. This free travel should be approximately ½", Fig. 2. Adjustment is made by loosening the push rod lock nut and adjusting the travel of the push rod the necessary amount to obtain the desired pedal free play.

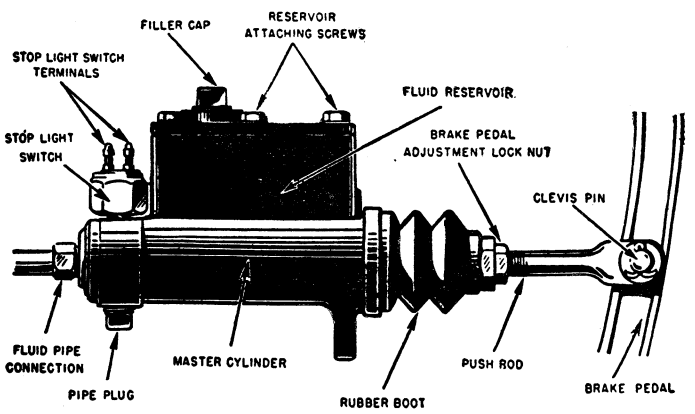


Fig. 1 Exterior view of a typical master cylinder

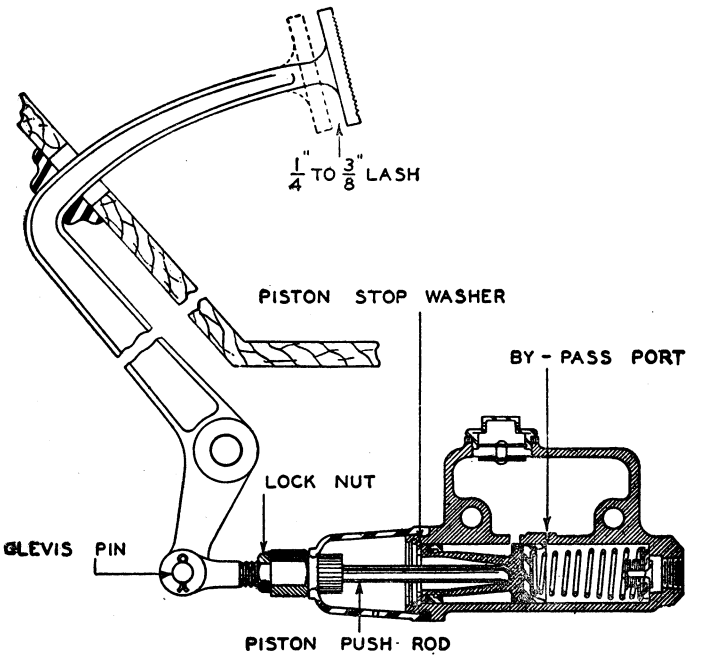


Fig. 2 Brake pedal adjustment for free play. This free play is required to prevent hydraulic pressure being applied to the master cylinder piston when brakes are released