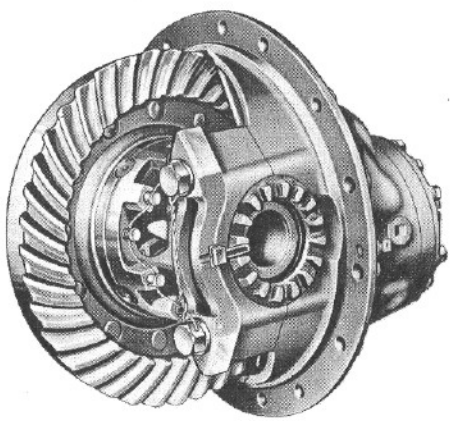
Field Maintenance Manual No. 5

Single-Reduction Drive Unit

Hypoid Gearing



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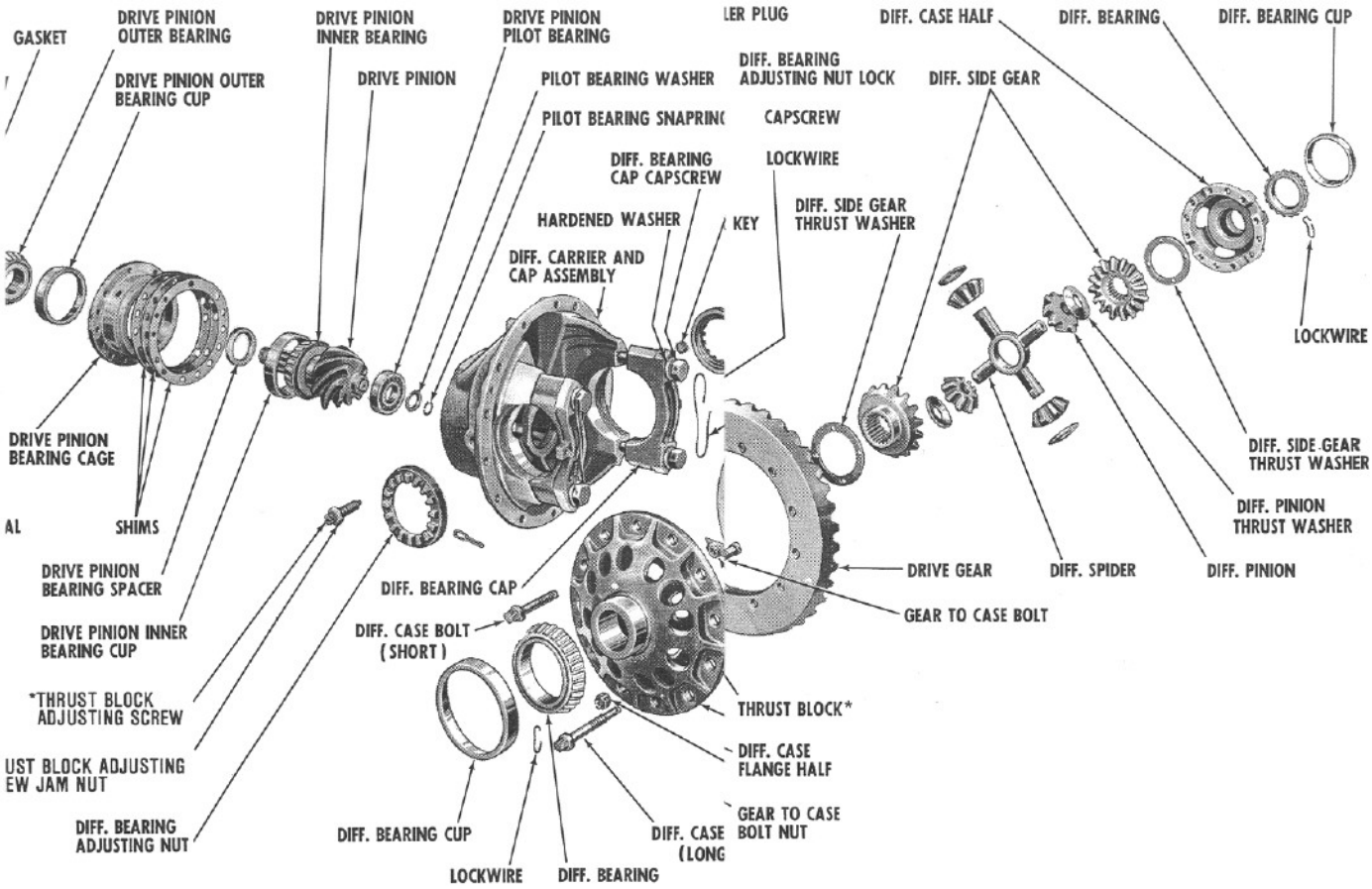

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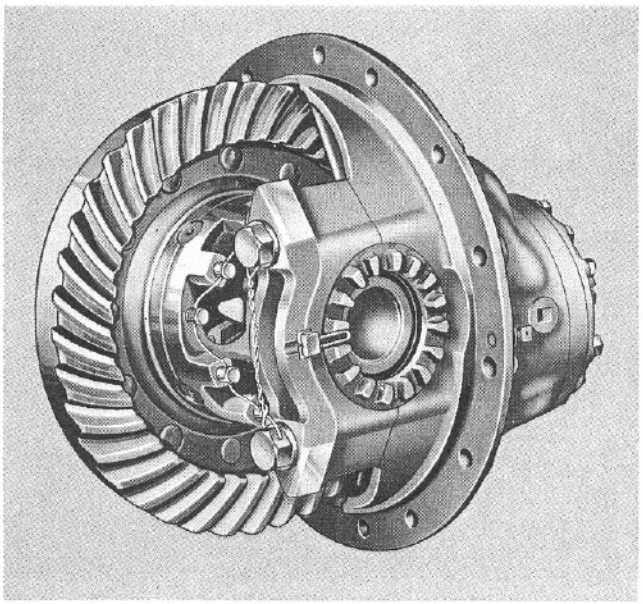
ROCKWELL SINGLE-REDUCTION DRIVE UNITS
CARE AND MAINTENANCE



SINGLE-REDUCTION CARRIER

The Rockwell Single-Reduction Final Drive employs a heavy duty hypoid drive pinion and ring 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.

REMOVE DIFFERENTIAL CARRIER FROM HOUSING

A. Remove plug from bottom of axle housing and drain lubricant.

B. Remove the axle shaft stud nuts, lockwashers and tapered dowels.

IMPORTANT: To loosen the dowels, hold a 1½ inch diameter brass drift against the center of the axle shaft head, INSIDE THE CIRCULAR DRIVING LUGS. Strike the drift a sharp blow with a 5 to 6 pound hammer or sledge. A 1½ inch diameter brass hammer is an excellent and safe drift.

CAUTION: Do not hit the circular driving lugs on the shaft head — this may cause the lugs to shatter and splinter. Do not use chisels or wedges to loosen the shaft or dowels — this will damage the hub, shaft and oil seal.

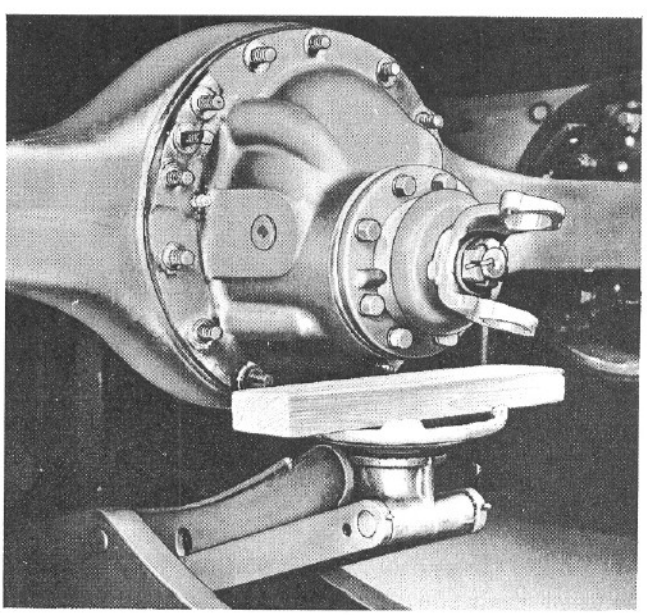
C. Remove the axle shaft from the drive unit and housing.

D. Disconnect universal at pinion shaft.

E. Remove carrier to housing stud nuts and washers. Loosen two top nuts and leave on studs to prevent carrier from falling.

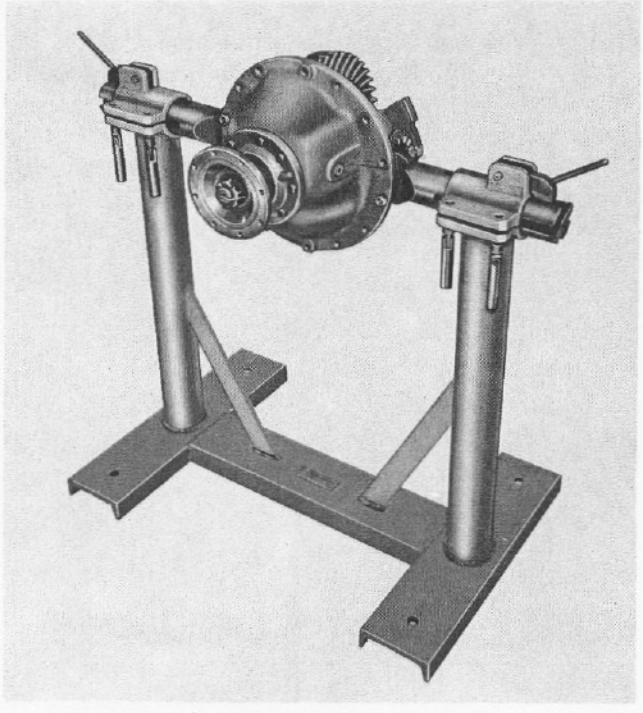
F. Break carrier loose from axle housing with rawhide mallet.

G. Remove top nuts and washers and work carrier free. 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. Use a roller jack to safely remove carrier from housing.



DISASSEMBLE CARRIER

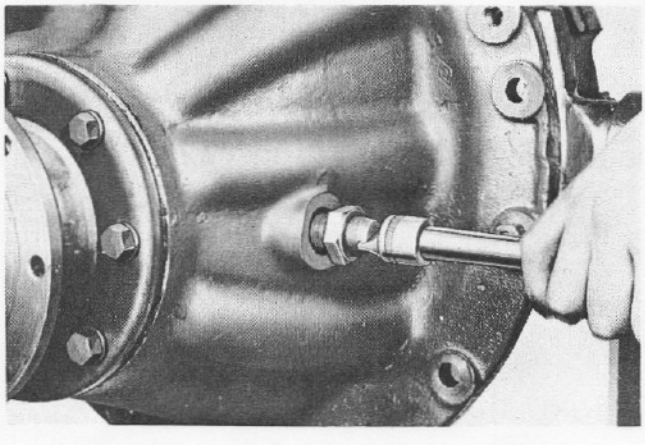
Place carrier in suitable holding fixture as illustrated. Prints of carrier repair stand are available upon request.



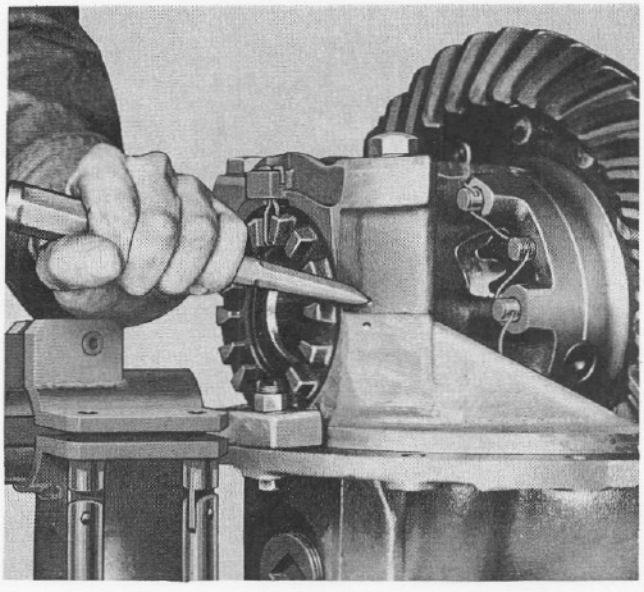
CARRIER IN REPAIR STAND

NOTE: *If the initial inspection indicates that the drive gear is not going to be replaced, we suggest the established backlash be measured and noted for reference and used at reassembly.*

REMOVE DIFFERENTIAL AND GEAR ASSEMBLY



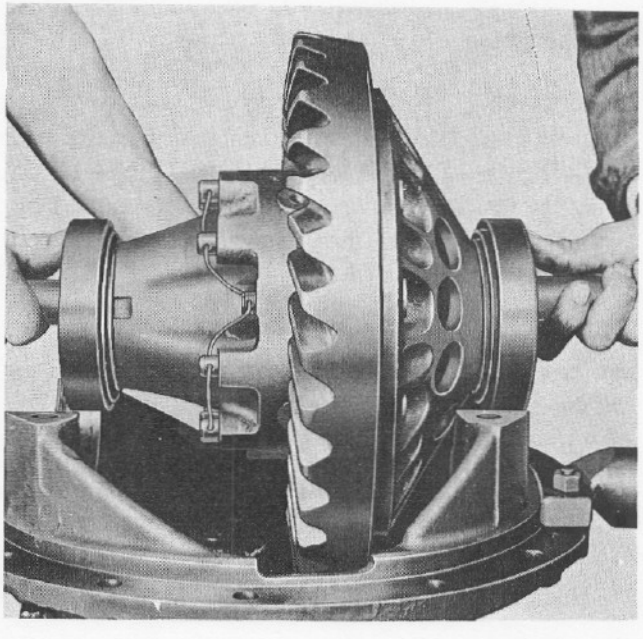
A. Loosen jam nut and back off thrust block adjusting screw.



B. Center punch one differential carrier leg and bearing cap to identify for properly reassembling.

C. Cut lock wire if employed. Remove capscrews and adjusting nut locks.

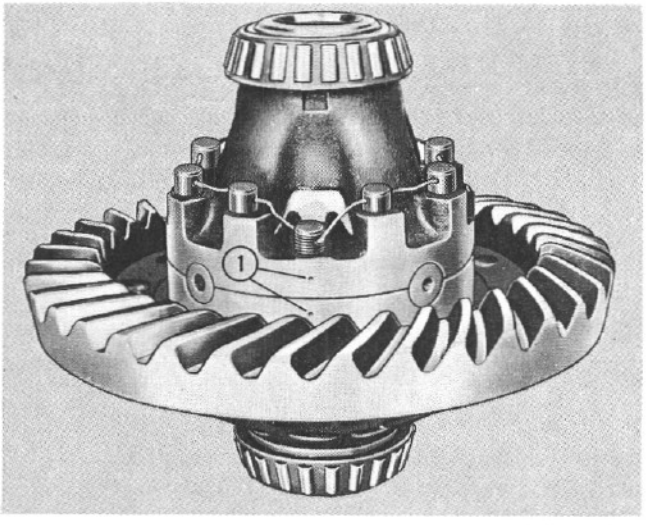
D. Remove bearing cap stud nuts or capscrews, bearing caps and adjusting nuts.



E. Lift out differential and gear assembly.

F. Remove thrust block, if used, from inside of carrier housing.

DISASSEMBLE DIFFERENTIAL CASE AND GEAR ASSEMBLY

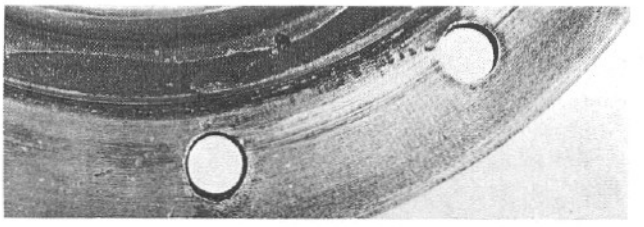


A. If original identification marks are not clear, mark differential case halves with a punch or chisel for correct alignment when reassembling.

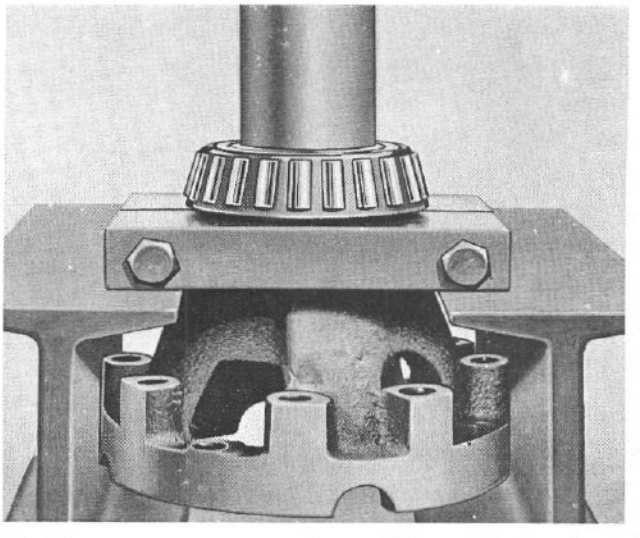
B. Cut lock wire, if used, remove bolts and separate case halves.

C. Remove spider, pinions, side gears and thrust washers.

D. If necessary, remove rivets and separate gear and case.

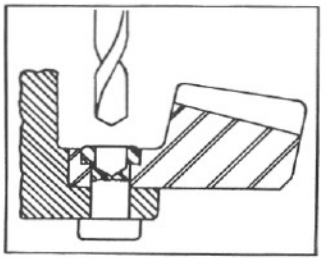


EXAMPLE OF HOW HOLES IN FLANGE WERE ELONGATED WHEN RIVETS WERE CHISELED OUT

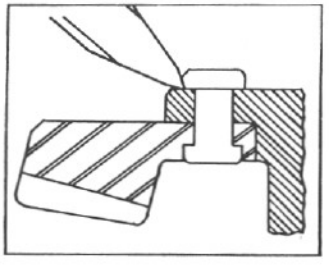


E. If necessary to replace differential bearings, remove with a suitable puller and / or press.

RIGHT



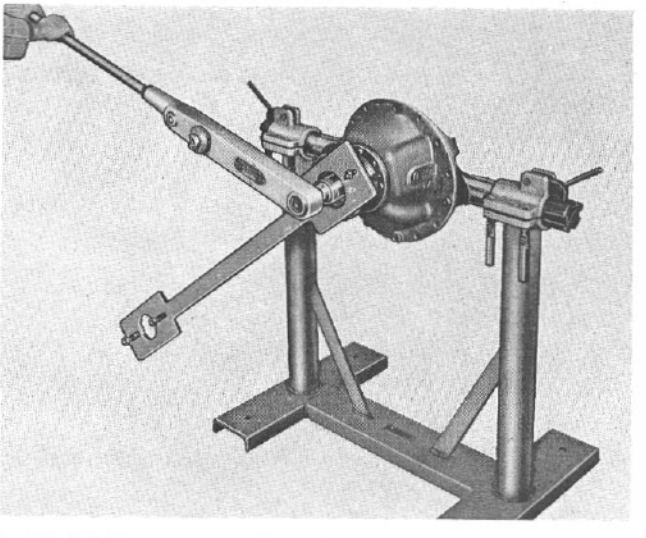
WRONG



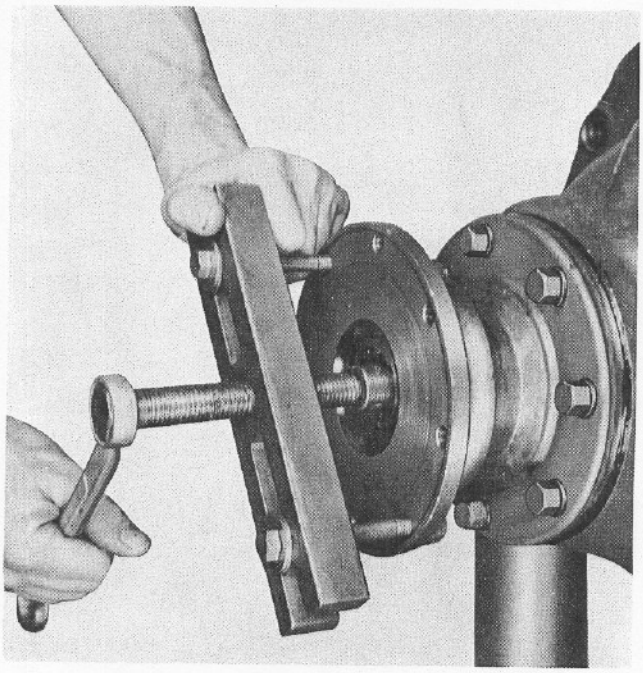
REMOVE GEAR RIVETS

1. Carefully center punch rivets in center of head.
2. Use drill $^{1}/_{32}$" smaller than body of rivet to drill through head.
3. Press out rivets.

REMOVE PINION AND CAGE ASSEMBLY



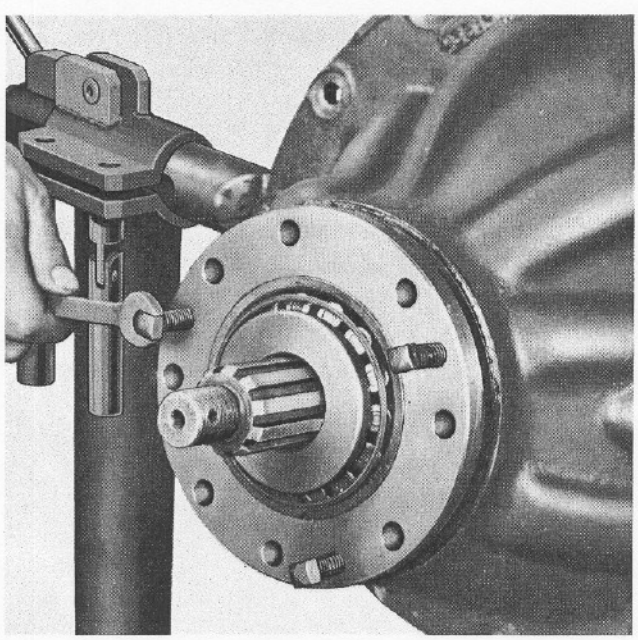
A. Hold flange or yoke with suitable tool and remove pinion shaft nut and washer.



B. Remove flange or yoke with a suitable puller. *Driving the flange off will cause runout.*

C. Remove pinion cage stud nuts or capscrews.

D. Remove bearing cover and oil seal assembly.



E. Remove bearing cage. Original may have puller holes.
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.

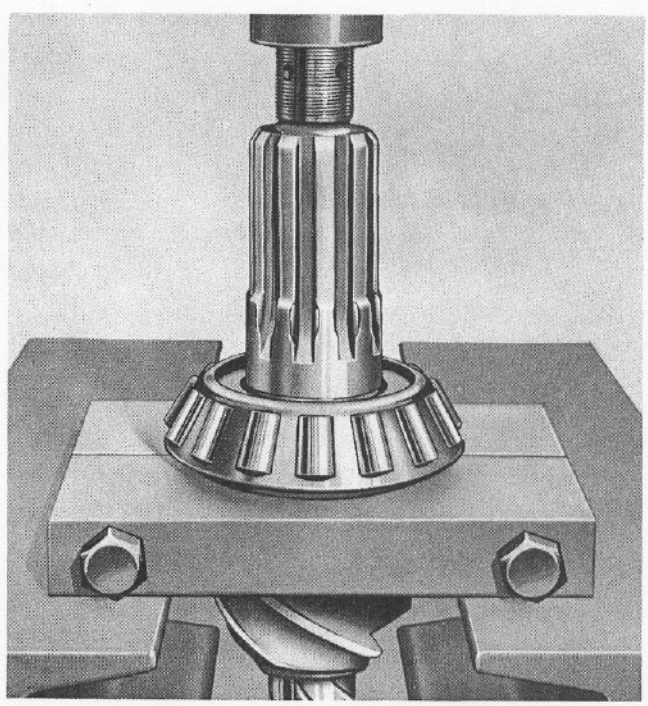
F. Wire shim pack together to facilitate adjustment on reassembling.

DISASSEMBLE PINION AND CAGE ASSEMBLY

A. Tap shaft out of cage with soft mallet or press shaft from cage.

B. Remove outer bearing from cage.

C. Remove spacer or spacer combination from pinion shaft.



D. If necessary to replace rear thrust bearing or radial bearing, remove with suitable puller.

E. Remove oil seal assembly from bearing cover.

PREPARE FOR REASSEMBLY CLEAN, INSPECT AND REPAIR

Parts having ground and polished surfaces such as gears, bearings, shafts and collars, should be cleaned in a suitable solvent such as kerosene or diesel fuel oil.

GASOLINE SHOULD BE AVOIDED.

Do NOT clean these parts in a hot solution tank or with water and alkaline solutions such as sodium hydroxide, orthosilicates or phosphates.

We do NOT recommend steam cleaning assembled drive units after they have been removed from the housing. When this method of cleaning is used, water is trapped in the cored passage of the castings and in the close clearances between parts as well as on the parts. This can lead to corrosion (rust) of critical parts of the assembly and the possibility of circulating rust particles in the lubricant. Premature failure of bearings, gears and other parts can be caused by this practice. Assembled drive units cannot be properly cleaned by steam cleaning, dipping or slushing. Complete drive unit disassembly is a necessary requisite to thorough cleaning.

ROUGH PARTS

Rough parts such as differential carrier castings, cast brackets and some brake parts may be cleaned in hot solution tanks with mild alkali solutions providing these parts are not ground or polished. The parts should remain in the tank long enough to be thoroughly cleaned and heated through. This will aid the evaporation of the rinse water. The parts should be thoroughly rinsed after cleaning to remove all traces of alkali.

CAUTION: *Exercise care to avoid skin rashes and inhalation of vapors when using alkali cleaners.*

COMPLETE ASSEMBLIES

Completely assembled axles, torque dividers and transfer cases may be steam cleaned on the outside only, to facilitate initial removal and disassembly, providing all openings are closed. Breathers, vented shift units, and all other openings should be tightly covered or closed to prevent the possibility of water entering the assembly.

DRYING

Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless absorbent paper towels or wiping rags free of abrasive material, such as lapping compound, metal filings or contaminated oil. Bearings should never be dried by spinning with compressed air.

CORROSION PREVENTION

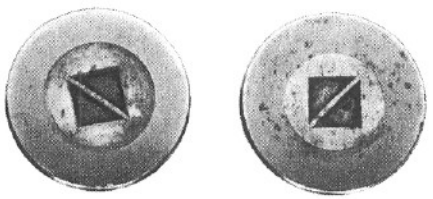
Parts that have been cleaned, dried, inspected and are to be immediately reassembled should be coated with light oil to prevent corrosion. If these parts are to be stored for any length of time, they should be treated with a good RUST PREVENTIVE and wrapped in special paper or other material designed to prevent corrosion.

INSPECT

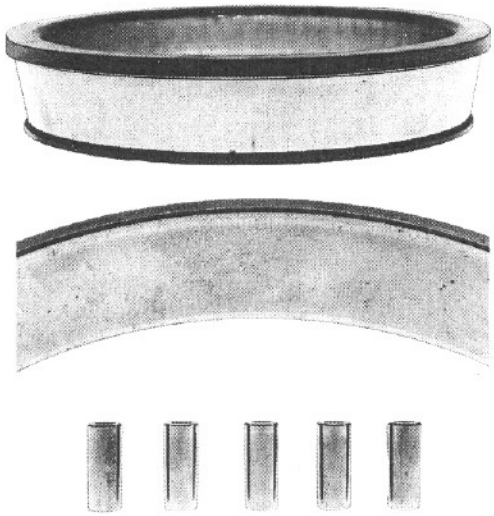
It is impossible to overstress the importance of careful and thorough inspection of drive unit parts prior to reassembly. Thorough visual inspection for indications of wear or stress, and the replacement of such parts as are necessary will eliminate costly and avoidable drive unit failure.

A. Inspect all bearings, cups and cones, including those not removed from parts of the drive unit, and replace if rollers or cups are worn, pitted or damaged in any way. Remove parts needing replacement with a suitable puller or in a press with sleeves. Avoid the use of drifts and hammers. They may easily mutilate or distort component parts.

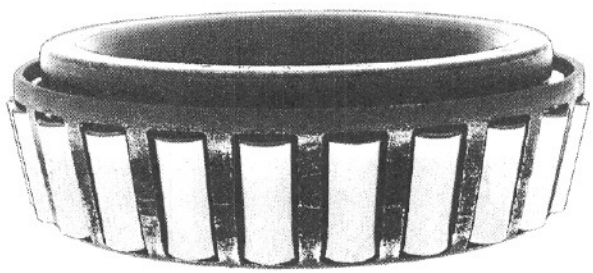
If any of the following bearing conditions exist, bearings must be replaced:



1. Large ends of rollers worn flush to recess or radii at large ends of rollers worn sharp.

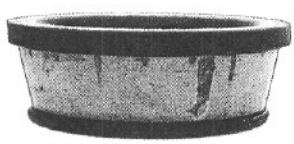


2. (a) Visible step wear, particularly at the small end of the roller track.
   (b) Deep indentations, cracks or brakes in bearing cup and/or cone surfaces.



3. Bright rubbing marks on the dark phosphate surfaces of the bearing cage.

4. Etching or pitting on functioning surfaces.



5. Spalling or flaking on bearing cup and/or cone surfaces.

B. Inspect hypoid gears for wear or damage. Gears which are worn, ridged, pitted or scored, should be replaced. When necessary to replace either the pinion or gear of hypoid set, the entire gear set should be replaced.

C. Inspect the differential assembly for the following:

1. Pitted, scored or worn thrust surfaces 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.

2. Wear or damage to the differential pinion and side gear teeth. Always replace differential pinions and side gears in sets.

D. Inspect axle shafts for signs of torsional fractures or other indication of impending failure.

REPAIR

A. In the interest of safety and preserving the service life of drive axle assemblies, Rockwell recommends that axle assemblies not be repair welded. Repair welding can detract from the structural integrity of a component, particularly as to heat treated parts where the benefit of heat treatment may be nullified by the welding.

Since it can be extremely hazardous and detrimental to repair weld components of any kind, repair welding can be approved only where stringent controls are imposed and equipment, customarily located only at manufacturing facilities, is employed, so as to minimize the potentially detrimental effects of repair welding.

In deciding whether to repair or scrap any damaged part, always keep in mind that we, as manufacturers, never hesitate to scrap any part which is in any way doubtful.

B. Hex nuts with rounded corners, all lock washers, oil seals and gaskets should be replaced at the time of overhaul.

Use only genuine Rockwell replacement parts for satisfactory service. For example, using gaskets of foreign material generally leads to mechanical trouble due to variations in thickness and the inability of certain materials to withstand compression oil, etc.

C. Remove nicks, mars and buffs 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 suitable for this purpose. Studs must be tight prior to reassembling the parts.

D. When assembling component parts use a press where possible.

E. Tighten all the nuts to the specified torque. Where lockwire is employed, use soft iron locking wire to prevent possibility of wire breakage.

F. The burrs, caused by lock washers, at the spot face of stud holes of cages and covers should be removed to assure easy reassembly of these parts.

SILICONE (RTV) GASKET APPLICATION

NOTE: Where silicone RTV gasket material is used, Dow Silastic No. RTV-732 Black and General Electric No. RTV-1473 Black meet our requirements. However, silicone RTV is also available in bulk under Rockwell part number 1199-Q-2981; in 10 oz. tubes, part number 1250-X-388, or in 3 oz. tubes, part number 1199-T-3842.

SERVICE

Removal of all gaskets including silicone RTV is accomplished by peeling or scraping the used gasket off both mating surfaces.

Application of silicione RTV gasket material is as follows:

1. Remove dirt, grease or moisture from both mating surfaces.
2. Dry both surfaces.
3. Apply thin bead, approximately 1/8" diameter completely around one mating surface and all fastener holes to assure complete sealing and prevent leakage.

   CAUTION: Minor concentrations of acetic acid vapor may be produced during application. Adequate ventilation should be provided when silicone RTV is applied in confined areas.

   Further, eye contact with these silicone RTV gasket materials may cause irritation; if eye contact takes place, flush eyes with water for 15 minutes and have eyes examined by a doctor.
4. Assemble the components immediately to permit silicone RTV gasket material to spread evenly.

When rebuilding any assembly, always use torque values on fasteners as specified by either Rockwell or the vehicle manufacturer.

CAUTION: Failure to use appropriate gasket material will cause axle to leak.

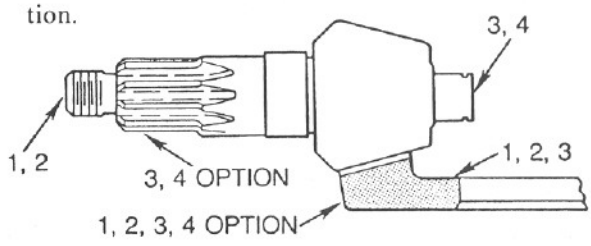
REASSEMBLE CARRIER

IMPORTANT: If a new gear set (drive pinion and ring gear) is being installed into the carrier, refer to the following gear set information before starting reassembly. However, if the original gear set is to be installed start with "Reassemble Pinion and Cage Assembly" on page 11.

GEAR SET IDENTIFICATION

The following information is marked on current drive pinion and gear sets, and will be used for identifying, matching and adjusting procedures.

The items listed are keyed to the following illustration.



STRADDLE MOUNTED PINION
(Shown with parallel sided splines)

1. Part Number
2. Tooth Combination Number

   The Part Number and Tooth Combination Number are found on the shank or threaded end of all pinions. On the ring gears the numbers are normally found on the front face of the gear. However, as an option, they may be located at the gear O.D.

   For any given pinion and gear set the ring gear always has an even part number (i.e. 36786) and the matched pinion has the odd number (i.e. 36787).

   The tooth combinaton number (i.e. 5-37) indicates the gear set has a 5 tooth pinion and a 37-tooth ring gear, the equivalent of a 7.4 to 1 gear ratio.

   Always refer to the Part Number and Tooth Combination Number before starting the reassembly. Check to be certain the pinion and gear match.

3. Gear Set Matching Numbers

   All Rockwell drive pinion and gear sets are manufactured and sold only in matched sets. Both pieces of the set have a matching number such as "M29" or any combination of a letter and number.

On most pinions the number is usually marked on the head end. However, on pinions with parallel-sided splines the number may be marked on the top flat of one of the splines.

On the ring gear the number is usually found on the front face of the gear, although sometimes it may be on the gear O.D.

A gear and pinion which do not have the same matching numbers must *not* be run together. Therefore if either a pinion or a ring gear should require replacement *both* must be replaced in a matched set.

4. Pinion Cone Variation Number

Each pinion has a Pinion Cone (P.C.) Variation Number which indicates variations (in thousandths of an inch) from the nominal mounting distance. This Pinion Cone Variation Number is necessary because pinion and gear sets for a specific series of axles cannot be manufactured exactly alike, and there may be slight differences in the Mounting Distance of the individual gear sets. This P.C. Variation Number must be used to modify the Nominal Pinion Gauging Dimension when using a pinion setting gauge or when calculating pinion cage shim pack thicknesses.

The Pinion Cone Variation Number (i.e. P.C. +3 or P.C. –5) is normally found on the pinion head end; however, it may sometimes be located on a spline of a pinion with the larger parallel-sided-type splines or on the ring gear O.D.

NOTE: The nominal pinion mounting distance and backlash setting is not marked on current gear sets. Refer to the following charts for this information.

NOMINAL PINION MOUNTING DISTANCE

AXLE MODELS	NOMINAL PINION MOUNTING DISTANCE
B-100, B-101	5.250″ (133.35 mm)
C-100	6.125″ (155.58 mm)
D-100 D-140	6.500″ (165.10 mm)
F-106 F-130 F-140, F-142, F-145, F-146, F-147, F-149	6.812″ (173.03 mm)
H-140, H-141, H-145	7.500″ (190.50 mm)
H-150	7.156″ (181.77 mm)
H-162 H-170, H-172	7.625″ (193.68 mm)
L-100 with 3.545 thru 5.833 ratios except 4.875 ratios with 6.166 thru 8.600 ratios including 4.875 ratio	7.562″ (192.08 mm) 7.688″ (195.28 mm)
L-140, L-145, L-148	7.625″ (193.68 mm)
L-155 with 3.545 thru 5.833 ratios except 4.875 ratios with 6.166 thru 8.600 ratios including 4.875 ratio	7.562″ (192.08 mm) 7.688 (195.28 mm)
L-172	7.625″ (193.68 mm)
Q-145, Q-146, Q-148	8.250″ (209.55 mm)
R-100, R-110 R-114, R-115 R-120 R-140, R-141, R-143 R-155, R-158 R-160, R-162, R-164	8.750″ (222.25 mm)
R-170, R-171, R-173 R-180	10.000″ (254.00 mm)
U-140	8.750″ (222.25 mm)
U-170 U-180	10.000″ (254.00 mm)

BACKLASH SETTING

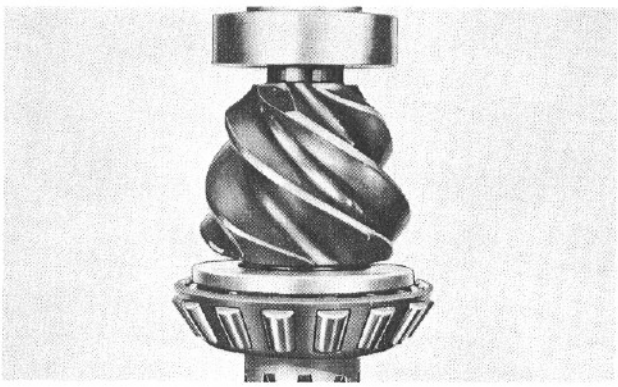
CARRIER TYPE & PITCH DIAMETER	BACKLASH SETTING
Single Reduction Carriers *(Less than 17″ Pitch Dia.)	.005″ - .015″ (.13-.39 mm)
Single Reduction Carriers *(17″ Pitch Dia. & over)	.008″ - .020″ (.21-.51 mm)

***NOTE:** To determine approximate pitch diameter, measure the ring gear outer diameter.

REASSEMBLE PINION AND CAGE ASSEMBLY

A. If new cups are to be installed, press firmly against pinion bearing cage shoulders.

B. Lubricate bearings and cups with the recommended axle lubricant.



C. Press rear thrust and radial bearings firmly against the pinion shoulders with a suitable sleeve that will bear only on bearing inner race.

D. Install radial bearing lock ring and squeeze ring into pinion shaft groove with pliers.

E. Insert pinion and bearing assembly in pinion cage and position spacer or spacer combination over pinion shaft.

F. Press front bearing firmly against spacer.

G. Rotate cage several revolutions to assure normal bearing contact.

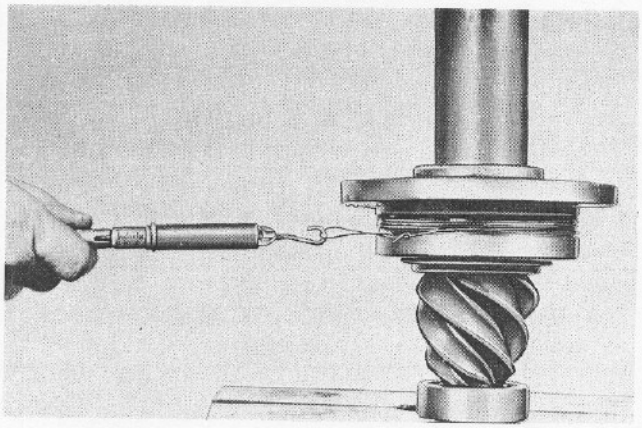
H. While in press under pressure, check bearing preload torque. Wrap soft wire around cage and pull on horizontal line with pound scale.

Use rotating torque, not starting torque.

If a press is not available, the pinion nut may be tightened to the correct torque and preload checked.

The correct pressures and torque for checking pinion bearing preload are as follows:

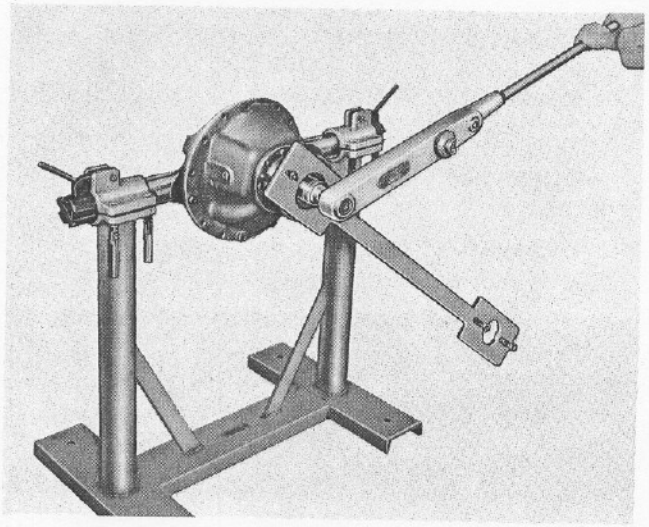
PINION SHAFT THREAD SIZE	PINION NUT TORQUE (required to obtain correct pinion bearing preload)	PRESS LOAD (required to obtain correct pinion bearing preload)
7/8″ — 20	200 — 275 lb. ft.	22,000 lbs. (11 tons)
1″ — 20	300 — 400 lb. ft.	30,000 lbs. (15 tons)
1¼″ — 12	700 — 900 lb. ft.	54,000 lbs. (27 tons)
1¼″ — 18	700 — 900 lb. ft.	54,000 lbs. (27 tons)
1½″ — 12	800 — 1100 lb. ft.	54,000 lbs. (27 tons)
1½″ — 18	800 — 1100 lb. ft.	54,000 lbs. (27 tons)
1¾″ — 12	900 — 1200 lb. ft.	50,000 lbs. (25 tons)
2″ — 12	1200 — 1500 lb. ft.	50,000 lbs. (25 tons)



If rotating torque is not within 5 to 15 pound inches, use thinner spacer to increase or thicker spacer to decrease preload.

Example: Assuming pinion cage diameter to be 6 inches, the radius would be 3 inches and with 5 pounds pull would equal 15 pound inches preload torque.

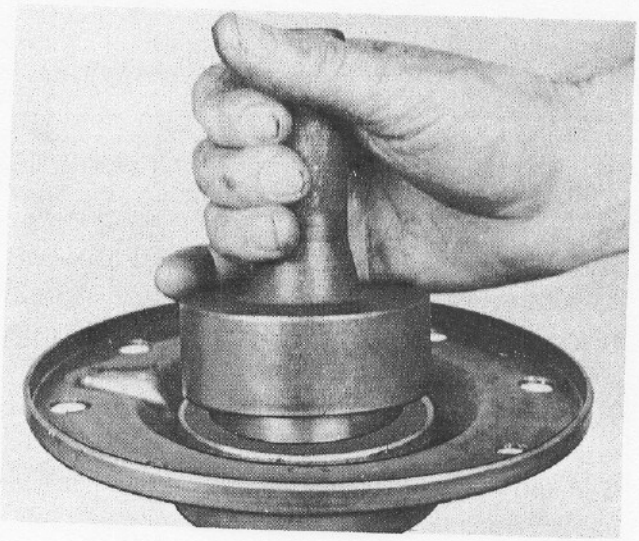
I. Press flange or yoke against forward bearing and install washer and pinion shaft nut.



J. Place pinion and cage assembly over carrier studs, hold flange and tighten pinion shaft nut to the correct torque. The flange must be held with a suitable tool or fixture to tighten nut.

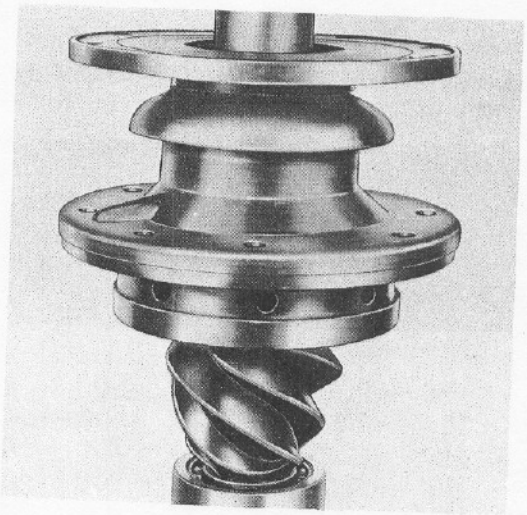
K. Recheck pinion bearing preload torque. If rotating torque is not within 5 to 15 pound inches, repeat the foregoing procedure.

L. Hold flange and remove pinion shaft nut and flange.



M. 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.

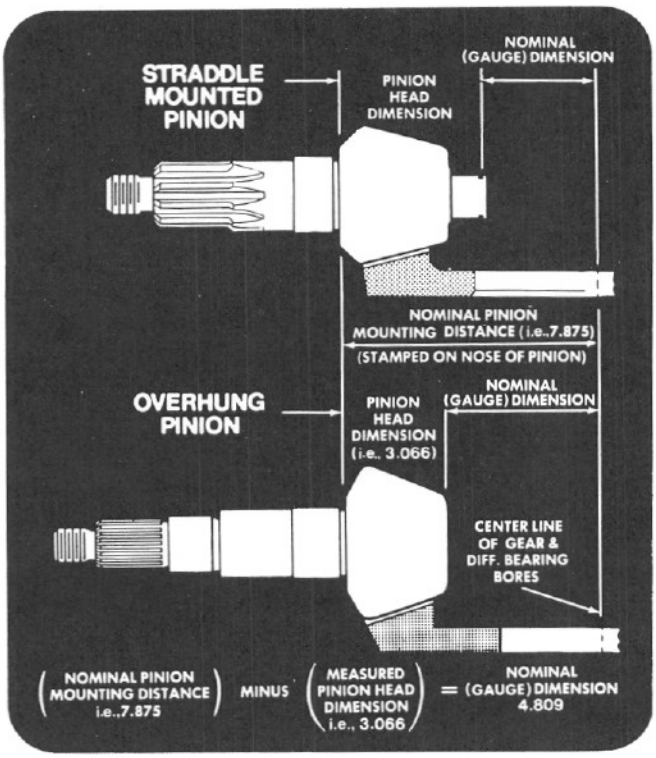
N. Install new gasket and bearing cover.



O. Press flange against forward bearing and install washer and pinion shaft nut.

P. Tighten nut to the correct torque value.

ADJUSTING THE PINION CAGE SHIM PACK THICKNESS WITH A PINION SETTING GAUGE.



The correct use of a pinion setting gauge will simplify the accurate installation of the pinion and cage assembly into the carrier. When using the pinion setting gauge, never use the nominal pinion mounting dimension without first modifying it to a workable value. The Nominal Pinion Mounting Dimension (i.E. 7.875) indicates the proper distance from the center of the ring gear to the bearing shoulder on the pinion.

However, because the pinion setting gauge measures the distance from the ring gear center to the nose of the pinion rather than the bearing shoulder, it becomes necessary to subtract the length of the pinion head from the Nominal Pinion Mounting Dimension in order to establish the correct nominal or gauge dimensions to work with.

To accurately install and adjust the pinion and cage assembly in a typical single reduction carrier using a pinion setting gauge, follow these procedures:

1. Record the Nominal Pinion Mounting Dimension and the original shim pack thickness for future reference.

2. With a micrometer or vernier scale, measure the length of the pinion head from its nose to its bearing shoulder. Mark the spot on the pinion nose from which this measurement was taken. Later, when using the pinion setting gauge, measure to or clamp step plate to this same spot for consistency in the calculations.

3. Substract the measured pinion head length from the Nominal Pinion Mounting Dimension to establish the pinion nominal gauge dimension. Repeating the example in the illustration this would be 7.875 - 3.066 = 4.809. The remainder 4.809 is the basic value or Nominal Gauge Dimension used for calculations when using the pinion setting gauge.

4. Modify the nominal gauge dimension (4.809) by the Pinion Cone Variation Number etched on the pinion (i.e. P.C. +3 or P.C. -5). This P.C. number indicates the variation in thousandths of an inch from the nominal mounting distance of that specific gear set. Add or subtract this value as indicated by its sign from the nominal gauge dimension established in Step 3. This will give the corrected pinion gauge dimension.

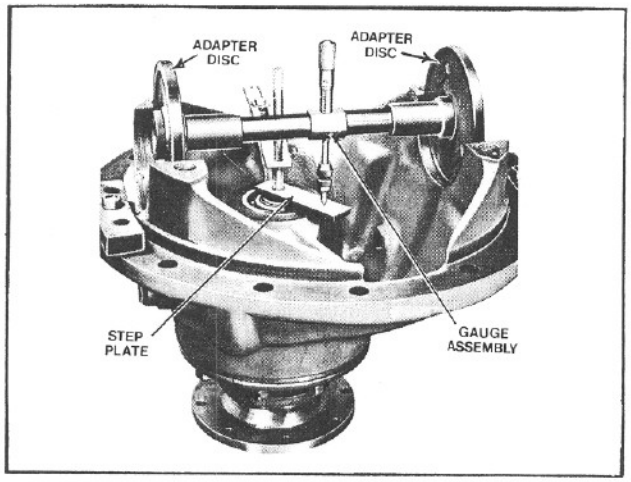
Example: P.C. = +3
4.809 + .003 = 4.812"

Example: P.C. = -5
4.809 - .005 = 4.804"

5. Install the pinion and cage assembly into carrier, using the original shim pack that was removed when the unit was disassembled. Tighten all pinion cage cap screws or stud nuts to the specified torque.

was removed when the unit was disassembled. Tighten all pinion cage cap screws or stud nuts to the specified torque.

6. Assemble the pinion setting gauge and step plate (if required) into the differential bearing bores using proper adapter discs. Refer to Technic Aid Section 8, Aid #19 for specifics on adapter discs. Adjust the micrometer arbor so it is directly over and at a 90° angle to the pinion nose or step plate.



7. Run the micrometer down to measure the distance to the pinion or step plate. Make note of this measurement and use the following procedures to calculate for correct shim pack thickness.

   If a step plate is required, subtract its thickness (.400″) from the corrected pinion gauge dimension calculated in Step 4.

Example:

Corrected Nominal Gauge Distance (4.809″-.005″)	4.804″

Example:

Corrected Nominal Gauge Distance (4.809″-.005″)	4.804″
Step Plate Thickness	-.400″
Corrected Micrometer Distance (Final measurement to be obtained)	4.404″
Initial Micrometer Reading (Using original shim pack)	-4.384″
Shim Pack Correction (To be added)	.020″

8. After making the necessary corrections to the shim pack and tightening the cap screws or nuts to the specified torque, recheck the micrometer measurement again to be certain of the correct pinion adjustment.

C. ADJUSTING THE PINION CAGE SHIM PACK THICKNESS WITHOUT A PINION SETTING GAUGE.

A second means of accurately installing a new pinion and cage assembly into the carrier is to mathematically calculate the proper pinion cage shim pack thickness.

The following are the procedures to use:

1. Measure the thickness of the original shim pack used with the gear set being replaced. Use a micrometer or vernier gauge. Record this measurement for future use.

2. Observe the "PC" or variation number on the original pinion being replaced. If this number is a plus (+) value subtract it from the original shim pack measurement taken in item "1". If the variation number is a minus (-) value add it to the measurement from item "1". Make a note of this value.
   NOTE: *The value calculated in item "2" will establish a "standard shim pack thickness", without a variation. This value will be used in calculating the shim pack thickness used with a new pinion and gear set.*

3. Observe the "PC" or variation number on the new pinion, (locations of the "PC" number are shown above). Add or subtract this Number as indicated by the variation sign (+ add or - subtract) from the calculated "standard shim pack thickness" determined in item "2".

   The resulting answer indicates the thickness (in thousandths) of the new shim pack to be used. Refer to the following examples which cover all the possible combinations of + or - original and new "PC" variations.

EXAMPLES OF CALCULATION:

EXAMPLE NO. 1

Original Pack Thickness		.030″
Original Variation (PC +2)	-	.002
Standard Pack Thickness		.028″
New Variation (PC +5)	+	.005
New Pack Thickness		.033″

EXAMPLE NO. 2

Original Pack Thickness		.030"
Original Variation (PC -2)	+	.002
Standard Pack Thickness		.032"
New Variation (PC +5)	+	.005
New Pack Thickness		.037"

EXAMPLE NO. 3

Original Pack Thickness		.030"
Original Variation (PC +2)	-	.002
Standard Pack Thickness		.028"
New Variation (PC -5)	-	.005
New Pack Thickness		.023"

EXAMPLE NO. 4

Original Pack Thickness		.030"
Original Variation (PC -2)	+	.002
Standard Pack Thickness		.032"
New Variation (PC -5)	-	.005
New Pack Thickness		.027"

After calculating the shim pack thickness, assemble the new pinion and cage assembly with the correct shim pack into the carrier as follows:

IMPORTANT: *Remember, that all Rockwell drive pinion and gear sets are manufactured and sold only in matching sets. Therefore, if either a pinion or a ring gear should require replacement both must be replaced in a matching set.*

INSTALL PINION & CAGE ASSEMBLY

A. Position the correct shim pack between the pinion cage and carrier.

IMPORTANT: *Use a minimum of three (3) shims per pack. If the pack is made up from various thicknesses of shims locate thinnest shims on both sides of the pack for maximum sealing ability.*

B. Install the pinion and cage assembly with shims into carrier and tap into position with soft mallet.

C. Install pinion cage capscrews. Tighten capscrews to the correct torque.

D. After the differential and gear assembly is installed into carrier make a gear tooth contact check.

ASSEMBLE DIFFERENTIAL AND GEAR

IMPORTANT: The ring gear must be heated before assembling onto the case half, otherwise damage to the case half will result.

Proper service replacement of the differential ring gear onto the differential case half is necessary for correct gear adjustment and longer drive unit service life. For correct installation, Rockwell recommends heating the ring gear in water to approximately 160° — 180°F for about ten minutes before assembly. This will allow an easier fit of the gear over the differential case pilot, without the use of a press, and without damaging the case and ring gear mating surfaces.

The gear should not be pressed or driven on the case, as this would cause excessive metal particles to lodge between the gear and case, thus resulting in gear runout. Proper installation should, therefore, incorporate preheating the gear as described above to assure correct interference fit and to eliminate metal pick-up.

A. Rivet the hypoid gear to the case half with new Rockwell rivets. Rivets should not be heated, but always upset cold. When the correct rivet 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. Excessive pressure will cause distortion of the case holes and result in gear eccentricity.

Tonnage required for squeezing cold rivets. These pressures are approximate for annealed steel rivets and pressure can be adjusted to suit individual working conditions.

DIAMETER OF RIVET	TONNAGE REQUIRED
7/16"	22
1/2"	30
9/16"	36
5/8"	45

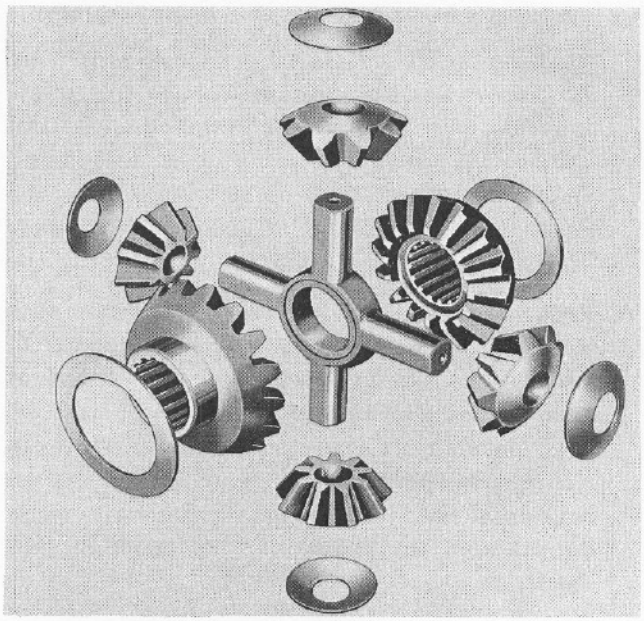
Final pressure should be held for approximately one minute to make sure the rivet has filled the hole.

After installing rivets, check for proper fit between gear and case half. Using a feeler gauge .003" maximum thickness check for gap between back face of gear and case flange. Check at four equally spaced locations around the assembly. If gauge can be inserted more than one half the distance between the flange O.D. and gear pilot diameter, the gear must be removed. Check for cause, correct and reassemble gear onto case half.

Differential case and gear bolts are available for service replacement of rivets. The use of bolts greatly facilitates servicing these units

in the field and eliminates the need for special equipment necessary to correctly cold upset rivets. Consult chart for service bolt instruction shown with the torque chart on last page of manual.

B. Lubricate differential case inner walls and all component parts with axle lubricant.

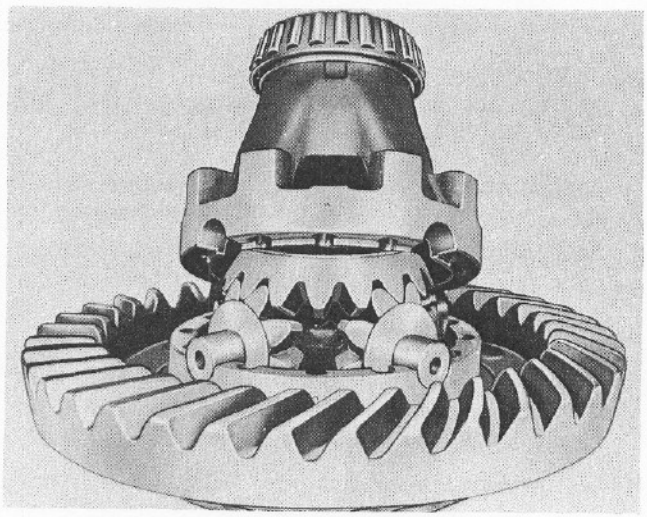


DIFFERENTIAL PINION AND SIDE GEAR ASSEMBLY

C. Postion thrust washer and side gear in ring gear and case half assembly.

D. Place spider with pinions and thrust washers in position.

E. Install component side gear and thrust washer.



F. Align mating marks, position component case half and draw assembly together with four bolts or capscrews equally spaced.

NOTE:If "DRI-LOC" bolts are used, refer to procedures on pages 21 and 22.

G. Check assembly for free rotation of differential gears and correct if necessary.

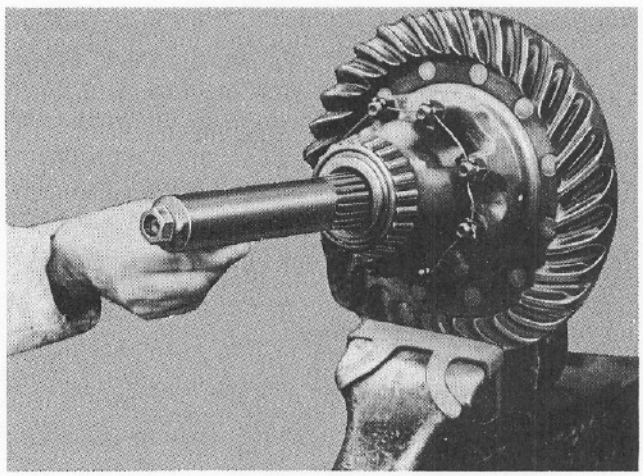
H. Install remaining bolts and capscrews, tighten to the correct torque and lock wire.

I. If bearings are to be replaced, press squarely and firmly on differential case halves.

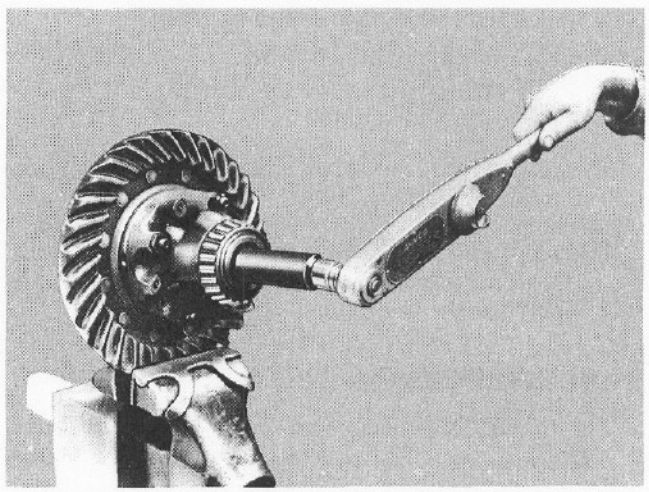
ROLLING RESISTANCE CHECK OF DIFFERENTIAL NEST

A. Place differential and ring gear assembly in a vise.

IMPORTANT: Use soft metal covers over vise jaw to protect ring gear.

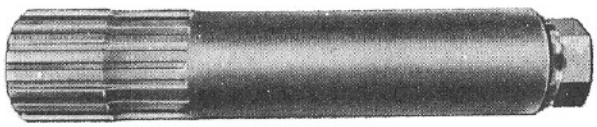


B. Insert checking tool (made from splined axle shaft end) into differential nest. Allow splines of tool to engage with spline of one side gear only.



C. Using a suitable socket and torque wrench, rotate differential nest while observing scale on torque wrench.

Correct rolling resistance of differential assembly is 50 lb. ft. torque maximum applied to one side gear. This applies to all differential assemblies.



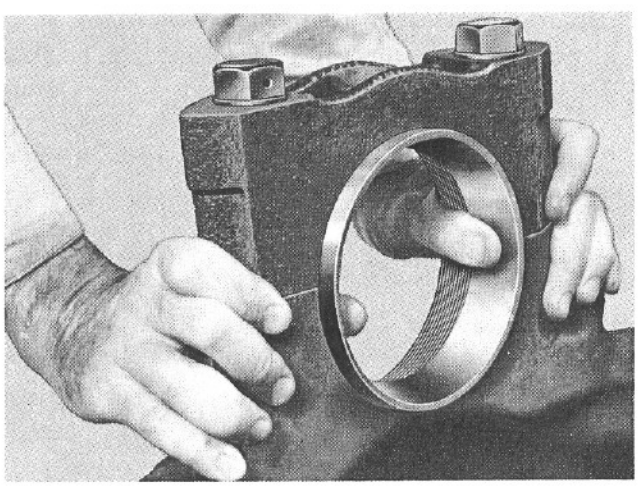
Side View

End View

D. A suitable checking tool can be made by cutting an axle shaft to an appropriate length and welding a nut on the end to accept a wrench socket.

INSTALL BEARING CUPS IN CARRIER LEG BORES

A. Temporarily install the bearing cups, threaded adjusting rings where employed and bearing caps. Tighten the capscrews to the proper torque.



B. The bearing cups must be of a hand push fit in the bores, otherwise the bores must be reworked with a scraper or some emery cloth until a hand push fit is obtained. Use a blued bearing cup as a gauge and check the fits as work progresses. Once the cups fit properly, remove the bearing caps.

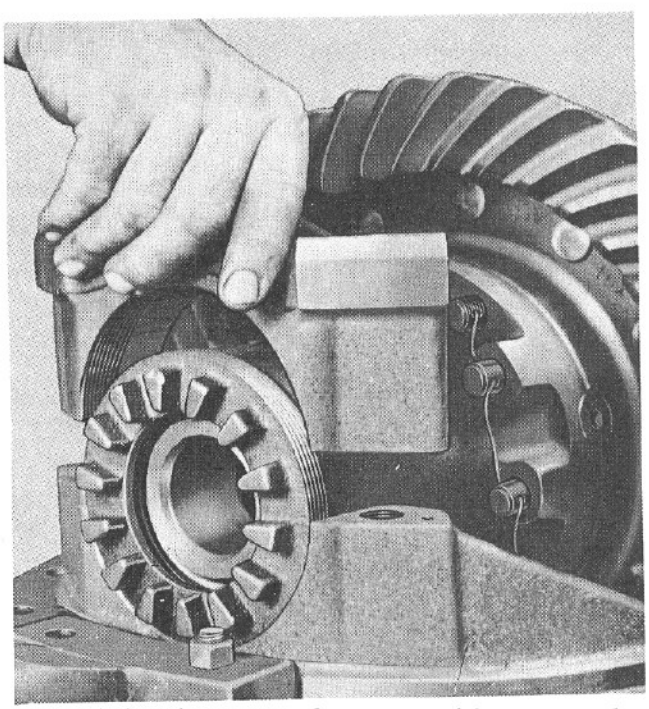
INSTALL DIFFERENTIAL AND GEAR ASSEMBLY

A. After checking related parts, coat the differential bearing cones and cups with specified rear axle lubricant.

B. Place the bearing cups over the assembled differential bearing cones, then position the differential assembly in the carrier.

C. Insert bearing adjusting nuts and turn hand-tight against bearing cups.

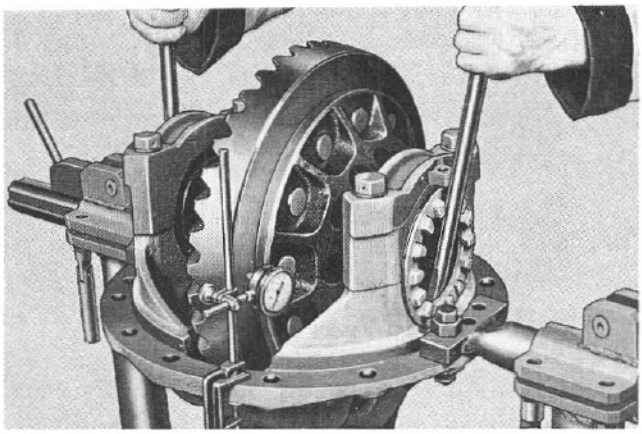
D. Install bearing caps in the correct location as marked and tap lightly into position.



If bearing caps do not position properly, adjusting nuts may be cross threaded. Remove caps and reposition the adjusting nuts. Forcing caps into position will result in irreparable damage to the carrier housing or bearing caps.

E. Install flat washers where used and stud nuts or capscrews. Tighten stud nuts or capscrews to correct torque.

ADJUST DIFFERENTIAL BEARING PRELOAD



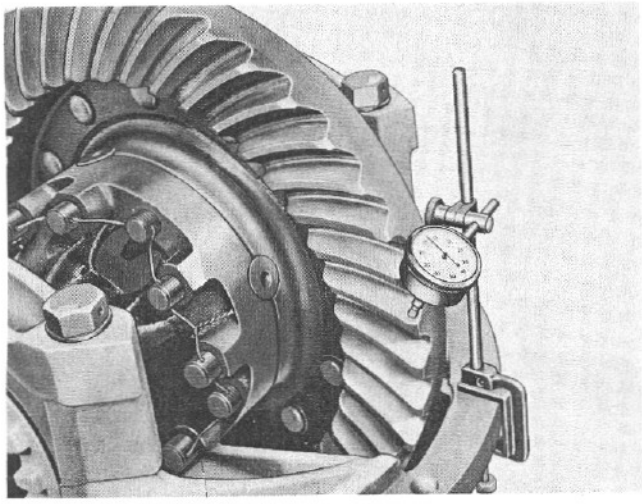
A. Using dial indicator at backface of gear, loosen the bearing adjusting nut on *the side opposite gear only* sufficient to notice end play on the indicator.

B. Tighten the same adjusting nut only sufficient to obtain .000 end play.

C. Check gear for runout. If runout exceeds .008", remove differential and check for cause.

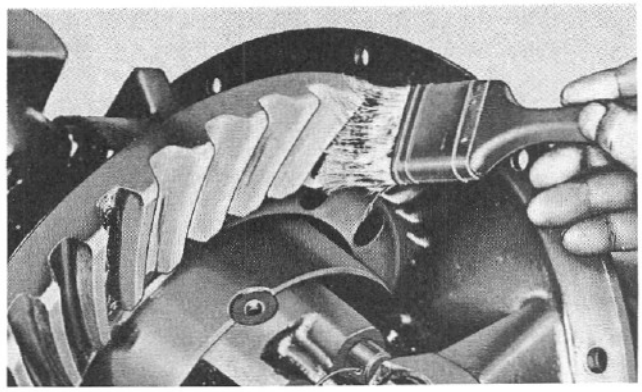
D. Tighten adjusting nuts *one notch each* from .000 end play to preload differential bearings.

CHECK HYPOID GEAR BACKLASH



If the drive gear is not going to be replaced, we suggest the established backlash recorded before disassembly be used. For new gears the new backlash should be initially set at .010". Adjust backlash by moving the gear only. This is done by backing off one adjusting ring and advancing the opposite ring the same amount.

CHECK TOOTH CONTACT



Apply oiled red lead lightly to the hypoid gear teeth. When the pinion 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.

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 gear teeth. Coast side should be automatically correct when drive side is correct. As a rule, coating about twelve teeth is sufficient for checking purposes.

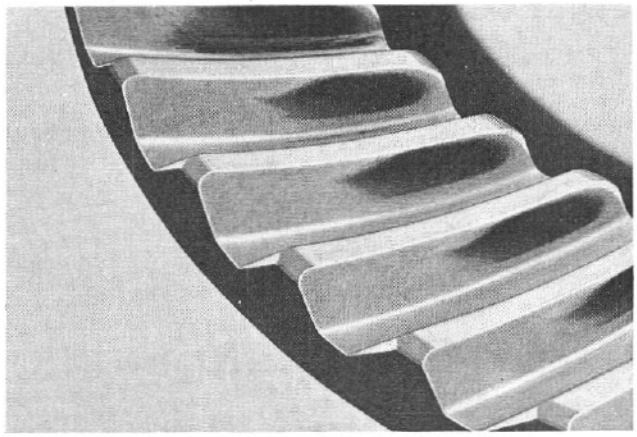
After obtaining a satisfactory tooth contact, especially in relation to the top and bottom of the tooth, the backlash can be altered within the limits of .005"-.015" to obtain a better contact position relative to the length of the tooth.

A high backlash setting can be used to keep the contact from starting too close to the toe, and a low backlash setting can be used to keep the contact from starting too far away from the toe.*

After correct tooth contact has been established, install adjusting nut locks and cap screws. Tighten cap screws and lock wire to bearing cap cap screws.

**For further detailed information refer to SAE Paper SP-228, Section 2, by W. A. Johnson and R. F. Cornish.*

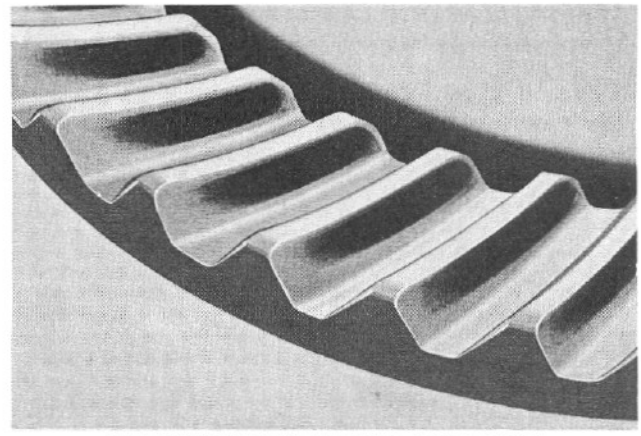
CORRECT TOOTH CONTACT ASSURES LONGER GEAR LIFE



SATISFACTORY TOOTH CONTACT
(GEARS UNLOADED)

With adjustments properly made (pinion at correct depth and backlash set at .010") the above contacts will be procured. The area of contact favors the toe and is centered between the top and bottom of the tooth.

The hand rolled pattern shown above (gears unloaded), will result in a pattern centered in the length of the tooth when the gears are under load shown at right. The loaded pattern will be almost full length and the top of pattern will approach the top of the gear tooth.

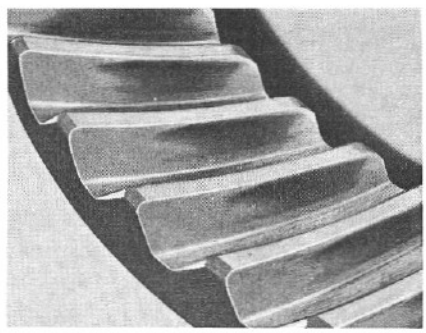


SATISFACTORY TOOTH CONTACT
(GEARS LOADED)

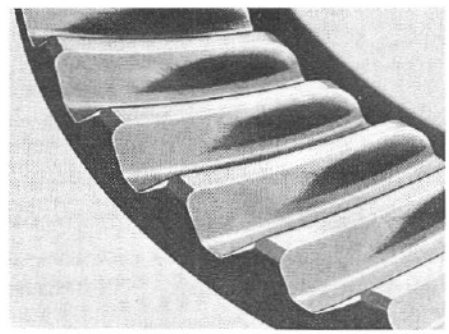
The pattern on the coast side of teeth will appear the same width as the drive side shown above; however, the over-all length will be centered between the toe and heel of gear tooth.

Set used hypoid gear to have the tooth contacts to match wear patterns. Hand rolled patterns of used gears will be smaller in area and should be at the toe end of wear patterns.

INCORRECT TOOTH CONTACT



A high contact indicates pinion is too far out. Set the pinion to the correct depth by removing shims under the pinion cage. Slight outward movement of hypoid gear may be necessary to maintain correct backlash.



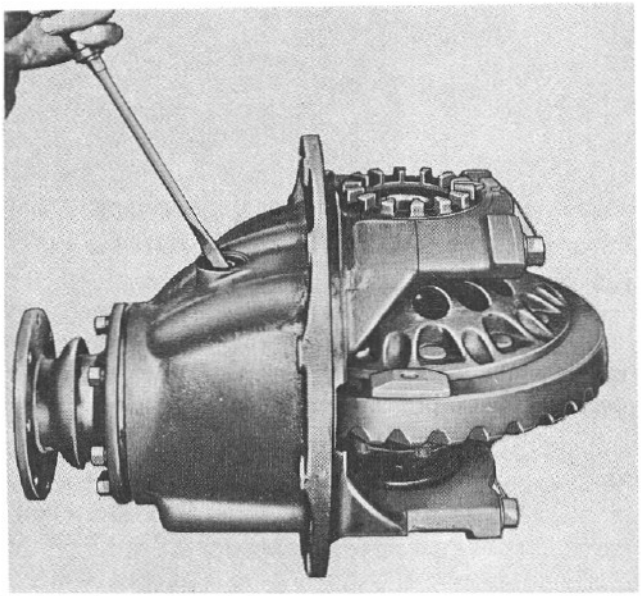
A low contact indicates pinion is too deep. Set the pinion to the correct depth by adding shims under the pinion cage. Slight inward movement of the hypoid gear may be necessary to maintain correct backlash.

INSTALL THRUST SCREW OR BLOCK

A. Remove carrier from stand and position with back face of hypoid or spiral bevel gear upward.

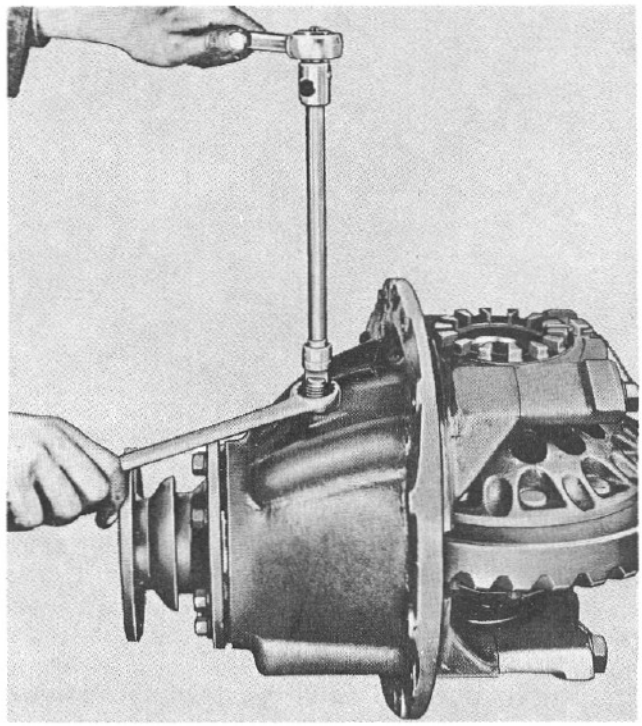
NOTE: Current carrier designs employ only the thrust screw, which may replace the thrust screw and block assembly.

B. Remove adjusting screw and lock nut.



C. If a thrust block is employed, place thrust block on rear face of hypoid gear and rotate gear until the hole in the thrust block is aligned with the adjusting screw hole.

D. Install thrust screw and lock nut and tighten thrust screw sufficient to locate thrust block firmly against back face of hypoid gear.



E. To secure the correct adjustment of .010"-.015" clearance, loosen adjusting screw (or thrust screw) 1/4 turn and lock securely with nut.

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

CLEAN AND INSPECT HOUSING, INSTALL DRIVE UNIT

A. Remove any accumulation of dirt, grit or gum from housing bowl and sleeves. Clean housing thoroughly with solvent and blow dry with compressed air.

B. Inspect housing for cracks, loose studs, nicks, and burrs at machined surfaces. Remove nicks and burrs with stone or file. Make all necessary repairs or parts replacement before installing drive unit in housing.

C. Install new drive unit to housing gasket over housing studs.

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 hammer at the carrier stud flange. The flange may easily be distorted and cause severe oil leakage.

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.

D. Tighten the four nuts over flat washers alternately to draw carrier squarely into axle housing.

E. If necessary, remove nuts and flat washers and install taper dowels, lock washers and stud nuts. Tighten to the correct torque.

F. Connect universal at pinion shaft.

G. Install axle shafts.

PREPARATION FOR STORAGE

In the event the carrier is a spare and may not be immediately installed, all gears and bearings should be thoroughly oiled and the carrier placed in a dustproof container.

LUBRICATION

Proper lubrication of the drive units is extremely important. Our "Standard" recommended lubricant is Rockwell-Standard Specification O-76, O-76-A, O-76-B or O-76-D SAE 140 viscosity, multipurpose gear lubricant. Unusual operating conditions such as extremes in climatic temperatures may require lubricants of "Optional" viscosities. However, experience has shown that the use of an SAE 140 viscosity grade lubricant will result in longer gear life. Refer to Field Maintenance Manual No. 1, "Lubrication," for detailed information.

Since Rockwell lubricant specifications are periodically revised, always refer to Field Maintenance Manual No. 1 for current complete lubricant specifications and applications.

A. Fill axle housing to the correct level with *specified lubricant.*

B. Lubricate universal joint.

C. Drive the vehicle, unloaded, for one to two miles at speeds not to exceed 25 miles per hour to thoroughly circulate the lubricant throughout the assembly.

NEW AND RECONDITIONED AXLE SERVICE

The original rear axle lubricant should be drained at the end of the drive-away or before the maximum of 3,000 miles prior to placing the vehicle in regular service. Drain the lubricant initially used in the assembly following reconditioning at the same interval. Completely drain the lubricant while the unit is warm.

Fill axle housings to bottom of level hole with specified lubricant with the vehicle level.

REGULAR AXLE SERVICE

Refer to Field Maintenance Manual No. 1, "Lubrication," for recommended service interval.

Completely drain the lubricant while the unit is warm.

Some newer model axles have a smaller tapped and plugged hole located near and below the housing lubricant level hole. This smaller hole has been provided for the use of a lubricant temperature indicator only and should not be used as a fill or level hole.

MAGNETIC DRAIN PLUGS

Magnetic drain plugs perform the vital function of trapping small metallic particles that circulate in the lubricant, through the gears and bearings, causing rapid wear and premature failure. The magnet must be strong enough to firmly hold the particles under service conditions. We recommend plugs with elements having a minimum pick-up capacity of 2 pounds of low carbon steel in plate or flat bar form. See Plug section in Field Maintenance Manual No. 1.

Spare clean plugs should be kept on hand for replacement at regular intervals. The change schedule can easily be established by periodic plug examination.

FASTENER TORQUES

Rockwell employs two methods of fastener retention: Original design single reduction carriers employ a lock wire. Current design models employ Dri-Loc bolts or Loctite 277/Rockwell Part No. 2297-C-3747 Liquid Adhesive.

When service is required, rebuild these assemblies with new Dri-Loc bolts or reuse the old bolts by applying liquid adhesive to the threaded holes in the cases. *(NOTE: Dri-Loc bolts or liquid adhesive is not used in nut and bolt constructed cases.)*

When new Dri-Loc bolts are used, identified by a visible patch of adhesive on threads, the locking feature is usable only once. When the same bolt is reused, liquid adhesive must be applied to the threaded hole in the case to achieve the locking feature. Use the following procedures:

New Dri-Loc Bolts

1. Wipe excess oil and any residue from the threaded holes in the case. The holes should be relatively oil free, however, no special cleaning is required.

2. Assemble the differential case components using the new Dri-Loc bolts. DO NOT APPLY LIQUID ADHESIVE OR ANY OTHER TYPE OF FASTENER RETAINER MATERIAL, SEALANT OR ADHESIVE ON NEW DRI-LOC BOLTS OR IN THE THREADED HOLES.

3. Tighten the Dri-Loc case bolts to the specified torque value recommended for the same regular bolt. Dri-Loc will not alter the torque requirement. Refer to Fastener Torque Chart at the end of this manual.

   NOTE: No cure time is required for Dri-Loc bolts prior to rebuilding the axle and returning it to service.

Reuse of Dri-Loc Bolts or Use of Regular Bolts and Liquid Adhesive

1. Wipe excess oil residue from the bolts and threaded holes in the case. The bolts and holes should be relatively oil free, however, no special cleaning is required. When reusing Dri-Loc bolts, it is not necessary to remove the Dri-Loc residue from the threads.

2. Apply liquid adhesive to the threaded holes only, by letting four or five drops run down the side of each hole. Before threading in the bolts, visually check to make sure that the liquid adhesive has contacted the threads.

   IMPORTANT: Do not apply liquid adhesive to the bolt, since trapped air in the hole will create back pressure and "blow out" the liquid adhesive as the bolt advances.

3. Tighten the bolts to the specific torque value recommended for that size bolt. Liquid adhesive will not alter the torque requirement. Refer to the Fastener Torque Chart at the end of this manual.

   NOTE: No cure time is required for liquid adhesive prior to rebuilding the axle and returning it to service.

   Rockwell 2297-C-3747 liquid adhesive is available in ten (10) bottle cartons (10 cc per bottle) from Rockwell International, Florence Distribution Center, Florence, Kentucky 41042. Liquid adhesive is presently available at your local dealer.

IMPORTANT: When servicing drive units assembled with Dri-Loc bolts or liquid adhesive in threaded case holes where the bolts do not require removal —Check each bolt for tightness by applying the minimum amount of torque specified for that size fastener. If the bolt does not rotate, it is satisfactory. If the bolt rotates to any degree, it must be removed from the case halves and liquid adhesive must be applied to the threaded hole. Use the procedures under "Reuse of Dri-Loc Bolts or Use of Regular Bolts and Liquid Adhesive".

Further, if bolt removal becomes difficult due to worn bolt heads or unusually high breakaway torques, the locking strength of either liquid adhesive or Dri-Loc bolts can be reduced by heating. Heat the bolt for only a few seconds at a time while trying to loosen it. DO NOT EXCEED 350°F MAXIMUM. Heating should be done slowly to avoid thermal stresses in the differential case and gears. Application of heat reduces the strength of liquid adhesive and Dri-Loc below recommended installation torque.

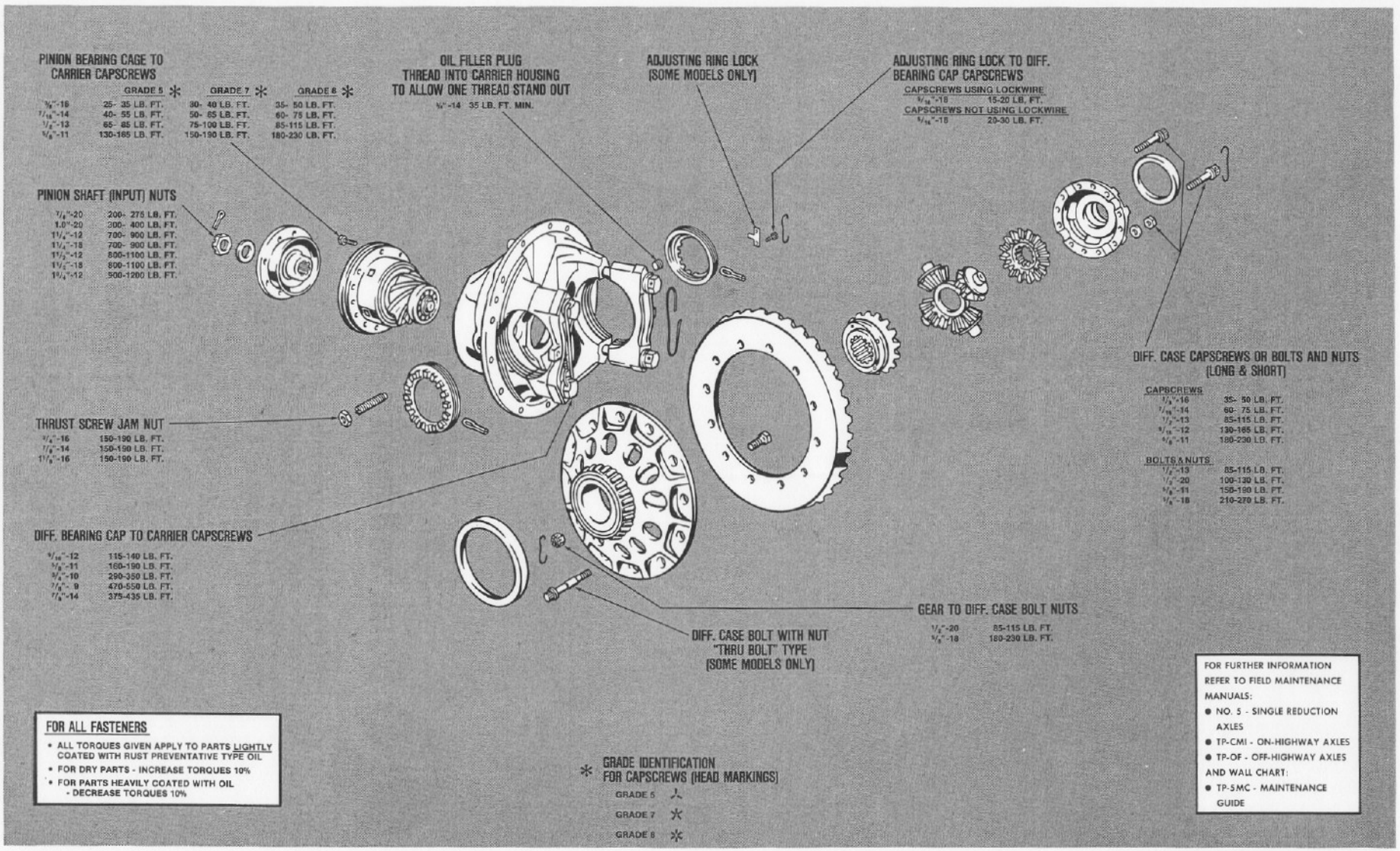
Rockwell does not recommend removing bolts with an impact wrench or by striking with a hammer.

Rockwell

SINGLE REDUCTION DRIVE UNITS

(SINGLE AXLES AND REAR/REAR TANDEM UNITS)

FASTENER TORQUE CHART



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