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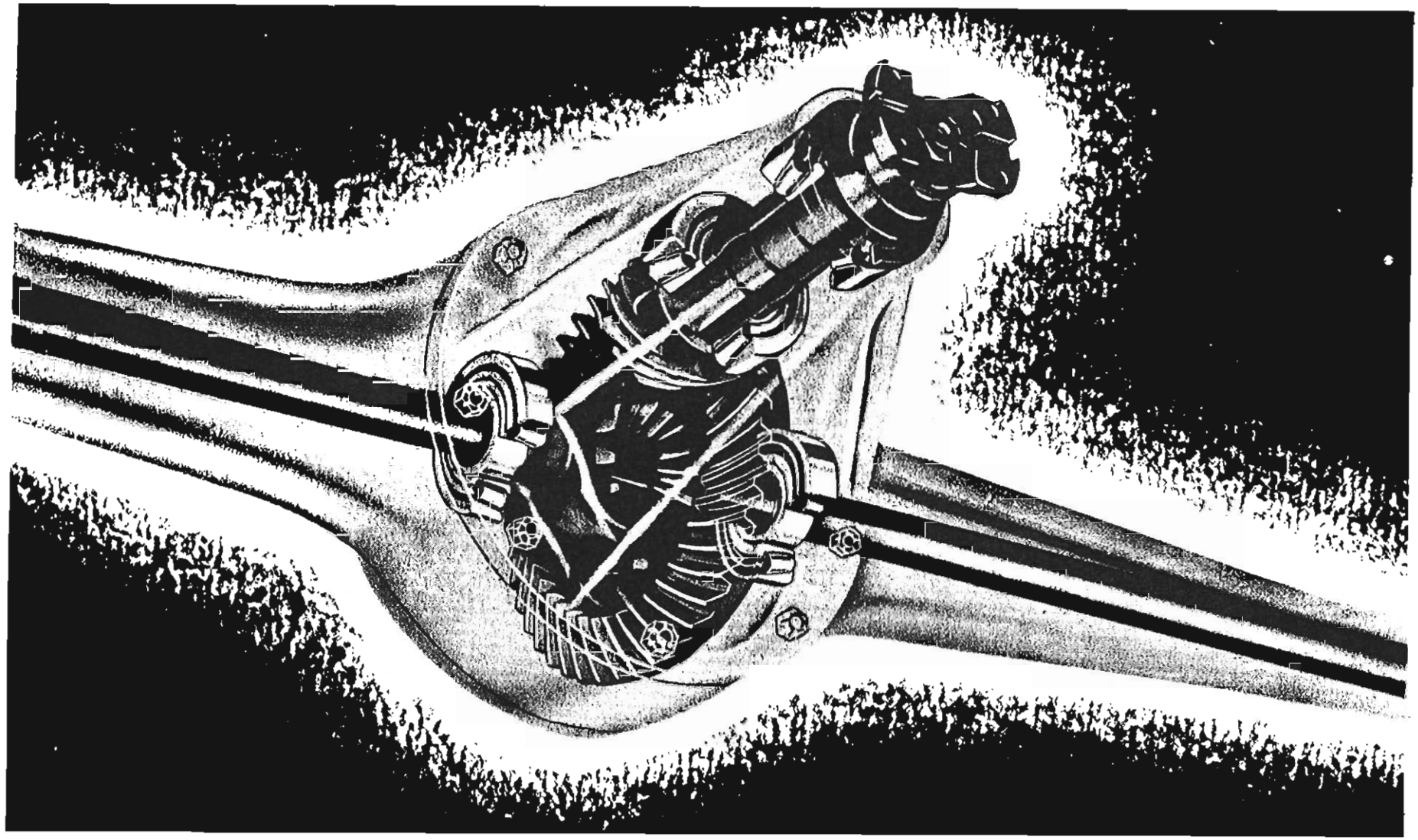

RECONDITIONING THE REAR AXLE

DESCRIPTION AND OPERATION

The rear axle used on all Packard cars makes use of a differential having hypoid type driving gear and pinion.

This type of gear permits lowering the body of the car without the use of a high tunnel in the floor by mounting the pinion below the center of the driving or ring gear. The design of the hypoid gear tooth permits greater tooth contact with the ring gear resulting in longer wear and quieter operation.

The semi-floating axle shafts are carried at their outer ends by tapered roller bearings which absorb the side thrust of the wheels. Thrust from each wheel is transferred to the roller bearing on the opposite side by means of a thrust block between the inner ends of the axle shafts.

A differential unit is necessary to permit each rear wheel to revolve independently of the other. If both wheels were mounted on a solid axle both would rotate at the same speed and, since when going around a curve the outer wheel travels farther than the inner, excessive tire wear would result. The differential permits the outer wheel to turn faster and farther than the inner while still receiving the same power from the ring gear and pinion.

The differential carrier assembly consists of a carrier which houses the differential drive pinion and bearings and acts as a support for the differential case and ring gear and for the differential unit which is housed in the differential case.

The differential drive pinion is carried in two opposed tapered roller bearings pressed into the differential carrier. These bearings have a preload imposed by the adjustment of the universal joint flange retaining nut. This perload prevents all fore and aft movement of the pinion thus assuring correct meshing with the ring gear.

The ring gear is attached to the differential case, which is carried on two opposed tapered roller bearings held in position in the carrier by threaded adjusting nuts, bearing caps, and pedestals. By means of these threaded adjusting nuts the ring gear may be moved toward or away from the pinion to obtain proper backlash. These bearings are also preloaded to assist in maintaining the correct backlash at all times. Some models are equipped with an adjustable idler roller mounted on needle bearings for the purpose of backing up the ring gear to prevent an increase in backlash under extreme loads.

The differential case which carries the ring gear also encloses the differential gears, consisting of two beveled side gears, two differential pinions, and the pin on which the differential pinions rotate.

The two side gears are internally splined to accept the inner ends of the axle shafts. Two beveled differential pinions are mounted on a pinion pin in the differential housing so that both pinions are in constant mesh with both side gears. To transfer thrust from either wheel to the bearing on the opposite side, a thrust block fits over the pinion pin and is held in the center by spacers and the differential pinions. The hole in this thrust block is elongated to permit the transfer of thrust to the wheel bearing without exerting strain on the pinion pin.

In operation, the engine power is conducted from the rear of the transmission to the differential pinion by the drive shaft. The rotation of the pinion causes the driving gear and differential case to turn. As the differential case is turned, the power transmission is through the differential pinion pin and the pinions to the differential side gears and the axle shafts.

DISASSEMBLY

Removing Axle Shafts

1. Remove one wheel and the axle shaft cotter pin and washer. Remove the brake drum and hub assembly, using Puller KMO-476. (See figure 1.) Disconnect the hydraulic brake line from the brake cylinder.

To avoid the possibility of fracturing the thrust block or axle shaft bearing, never use a knock-out type wheel puller or hammer on the end of the regular puller screw to loosen up wheel hubs.

2. Remove the nuts holding the oil seal and the brake support plate to the rear axle housing and then remove the seal guard,

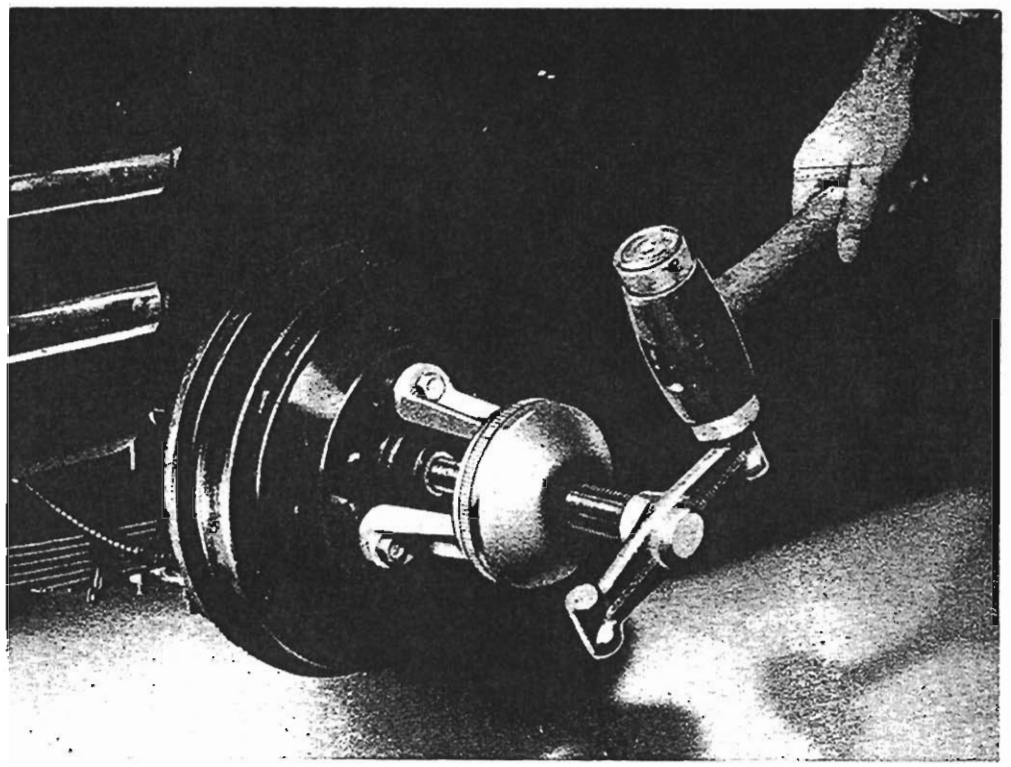

Fig. 1—Removing Brake Drum and Hub Assembly Using Puller KMO-476. Do Not Use Knock-Off Type

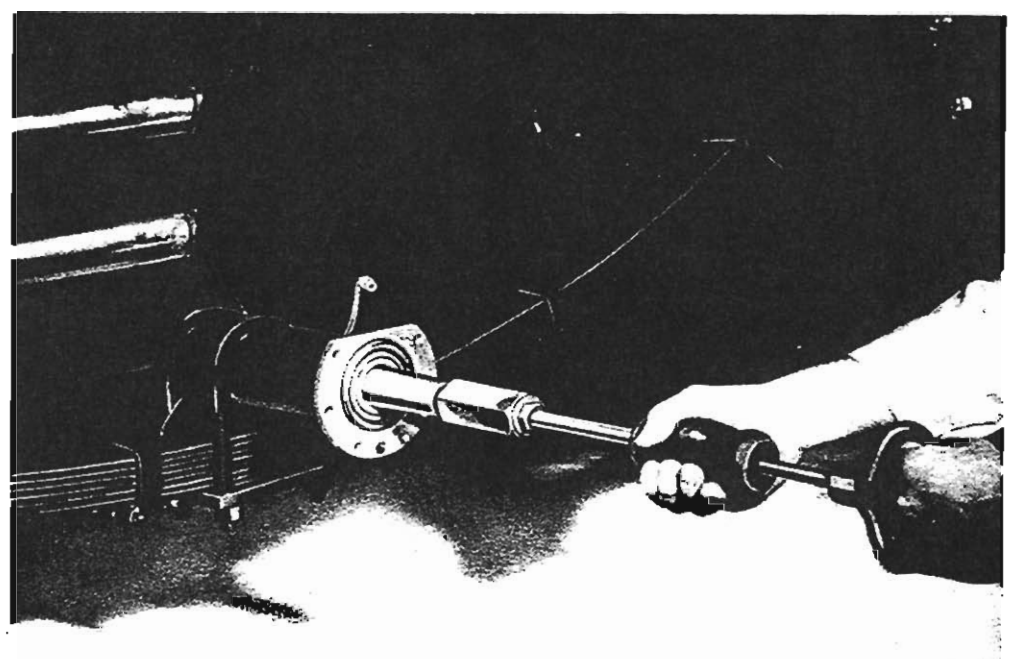

Fig. 2—Using Puller J-2552 To Remove Axle Shaft and Bearing Cup from Housing

gasket, retainer, oil seal, brake support plate, and axle shaft bearing shims.

3. Remove the axle shaft and bearing, using Puller J-2552, as shown in figure 2.

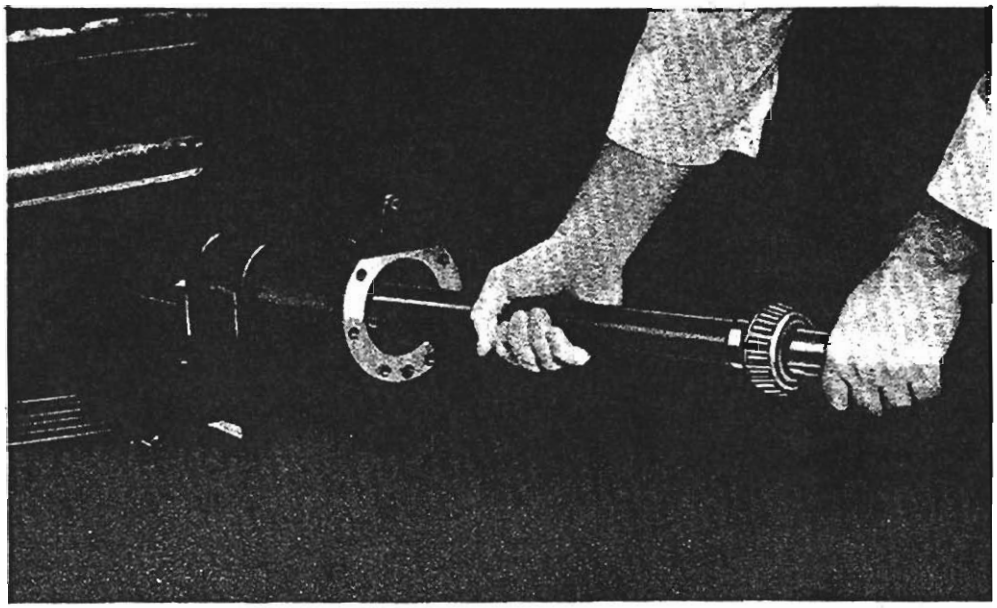

Fig. 3—Lift Axle Shaft Slightly and Slide Out Completely. Do Not Drag Over Seal

In the event that the inner axle shaft seal was renewed recently, and if it is not the intention to renew the oil seal at this reconditioning, care must be exercised to prevent damaging the seal. The axle shaft must be slid out completely by lifting slightly while removing, as shown in figure 3. Be careful not to damage the seal by pulling the rough shaft across the seal.

Do not allow the shaft to remain partially pulled out of the housing as the weight of the shaft on the lower part of the seal will stretch and deform the seal. This will result in oil leaks occurring when the shaft is installed.

Always completely remove axle shafts.

4. Remove the inner axle shaft seal, using tool J-943-B, as shown in figure 4.

5. Perform previously described operations on opposite side of the rear axle.

Removing Carrier

1. Disconnect the propeller shaft at rear universal joint only by removing locks and screws.

When the joint is disconnected, the cross bearings may fall off and allow dirt to enter the bearings. This can be prevented by using either tape or wire to secure the bearing to the joint assembly. Time

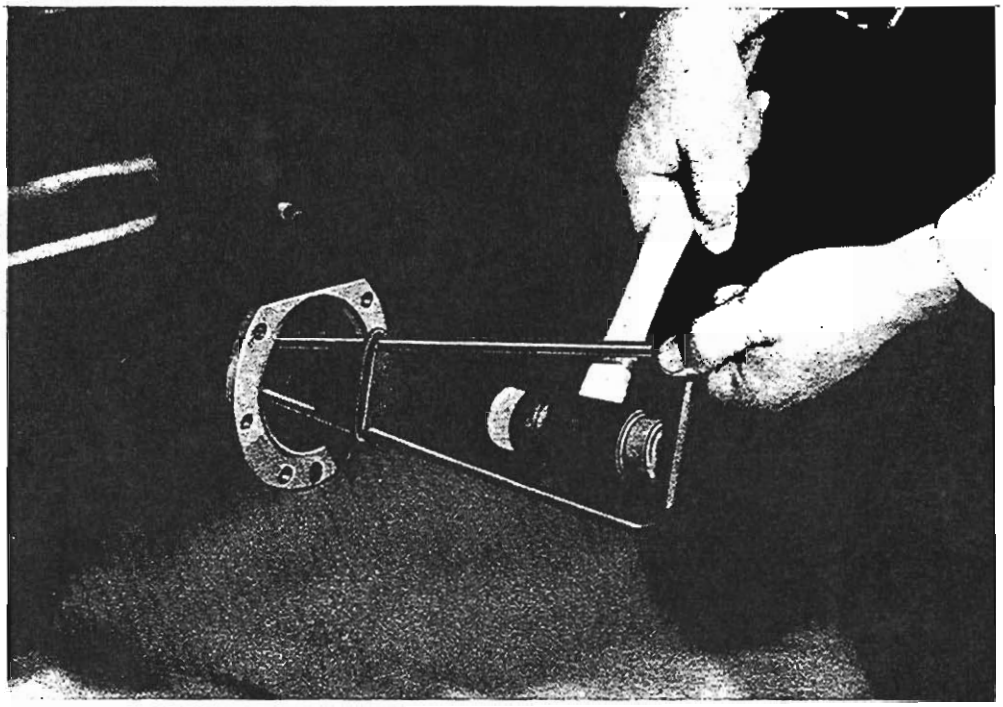

Fig. 4—Removing Inner Axle Shaft Oil Seal from Housing Using Seal Remover J-943-B

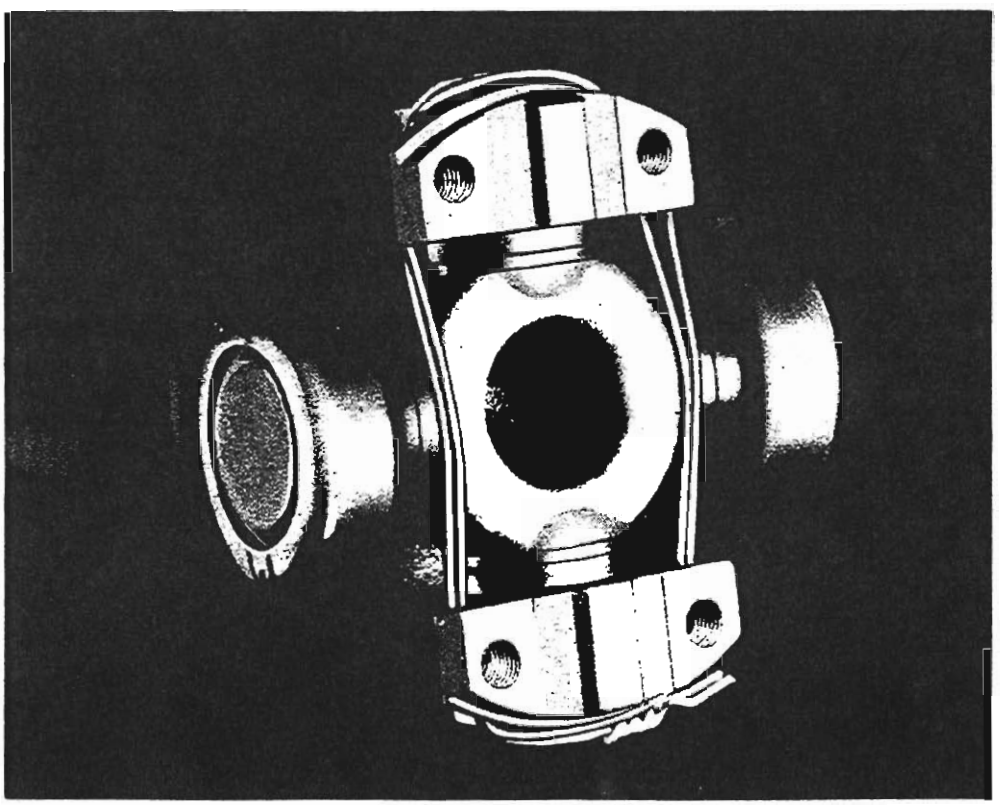

Fig. 5—Showing Universal Joint Bearings Being Held in Place with Wire

will also be saved during reassembly. A wired joint is shown in figure 5.

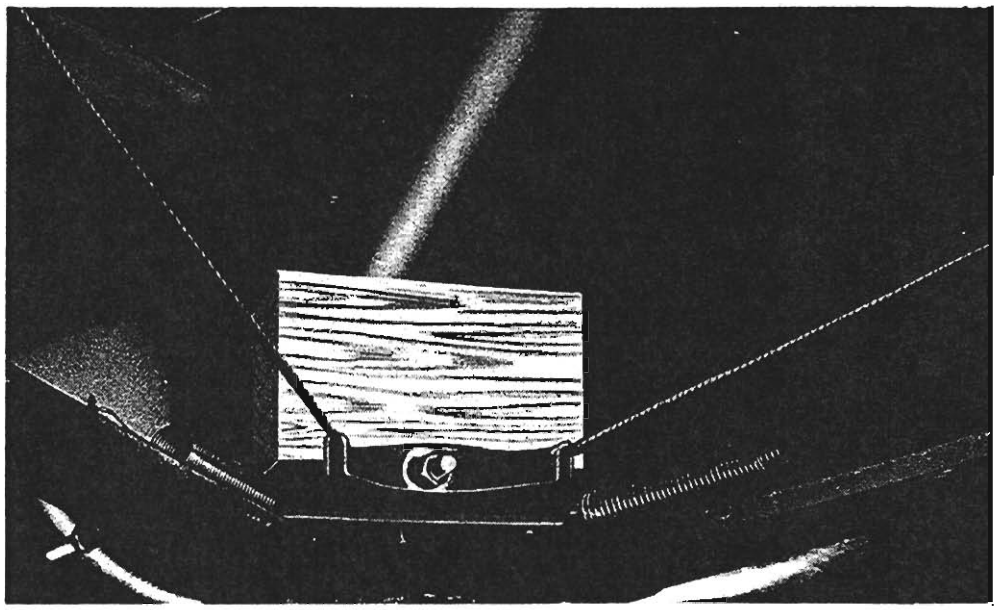

Fig. 6—Do Not Disconnect Transmission End of Propeller Shaft. Block Up as Shown

2. The propeller shaft should not be disconnected at the transmission end but should be held out of the way by a wire or by propping it up against the floor pan with a short piece of two-by-four inserted inside the frame "X" member in the rear of the transmission. (See figure 6.)

3. Remove the drain plug at the bottom of the carrier and drain the oil. Then reinstall the drain plug and tighten securely.

4. Wire brush or wash the differential housing and carrier around the carrier to case gasket. This will prevent dirt and grit from entering the axle housing during removal and installation of the carrier.

5. Lift out the differential carrier after removing all the carrier lock nuts. Now wash interior of carrier with kerosene or cleaning solvent and disassemble before washing outside of carrier. This is to prevent grit from entering bearings, etc.

NOTE

Generally it is a bad practice to wash differential carrier assemblies with hot water or steam. Regardless of the amount of air hose drying that may be applied, there is always the possibility of water being trapped around bearing or rollers and causing rough surfaces due to corroding and acid etching. If hot water or steam is used the unit *must* be completely torn down immediately and all parts blown free of moisture and a liberal coating of light oil applied to all bearings and highly polished parts.

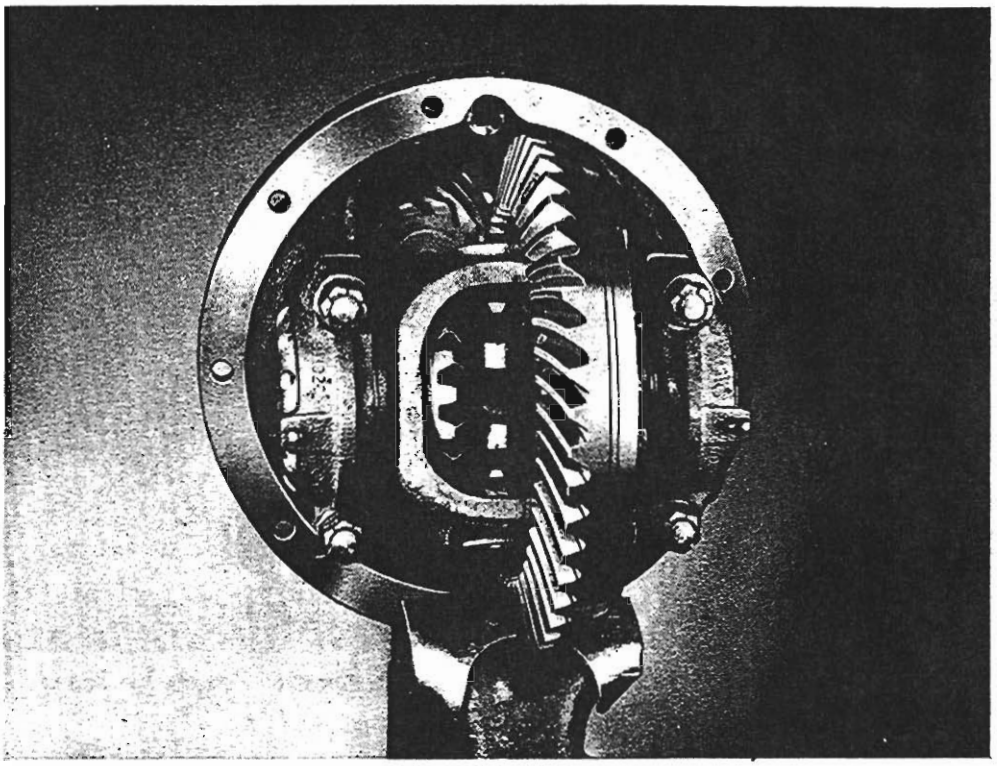

Fig. 7—Use Vise with Copper or Lead Jaw Covers To Avoid Damaging Face of Flange

Carrier Disassembly

1. Place the differential carrier in a suitable bench fixture or securely clamp the carrier mounting flange in a vise, as shown in figure 7. (Avoid damaging gasket face of mounting flange with sharp vise jaws; use copper or lead vise jaw covers.)

If broken teeth are found, or there is evidence of any material having gone through the teeth, indicate back side of ring gear with dial indicator before disassembly. Renew the differential case if the runout is over the limits given in the table of specifications or if indicating equipment is not available.

2. Center punch marks should be placed on the carrier bearing cap, bearing adjusting nut, and pedestal, as shown in figure 8. This will save time during reassembly in indicating right-hand and left-hand parts and also the approximate adjustment.

3. Unlock the carrier bearing cap screw lock plate tabs. Remove screws, back off adjusting nuts, and lift off the bearing caps. Be careful at this point to prevent the differential case assembly from falling when bearing tension is relieved. This may cause personal injury or damage to the differential. The ring gear and case should be held in place with one hand while removing side bearing races

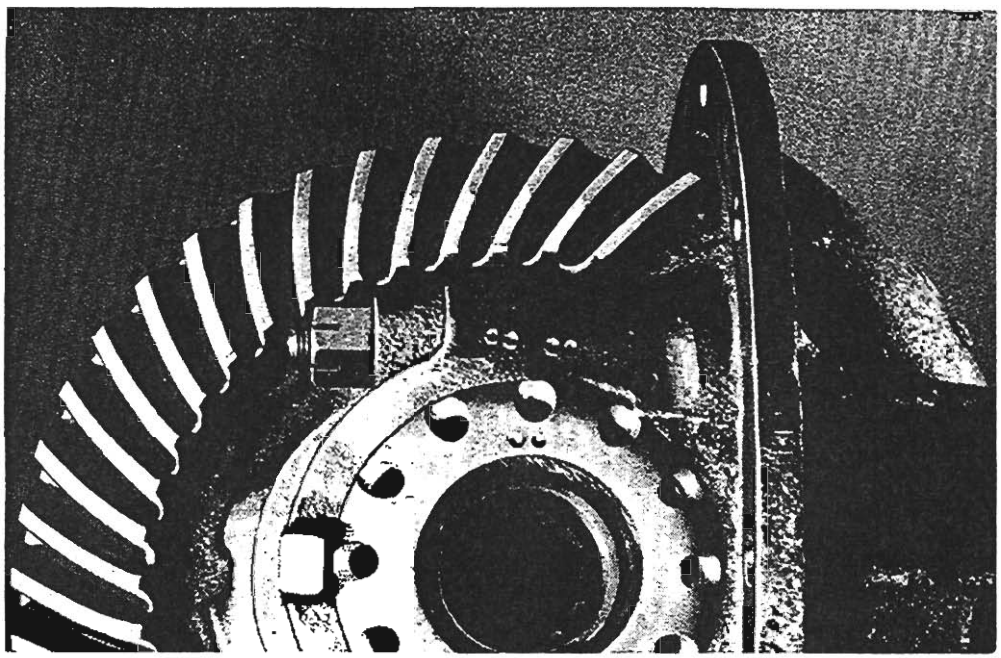

Fig. 8—Mark Cap Nut and Pedestal with Center Punch To Save Time in Assembling

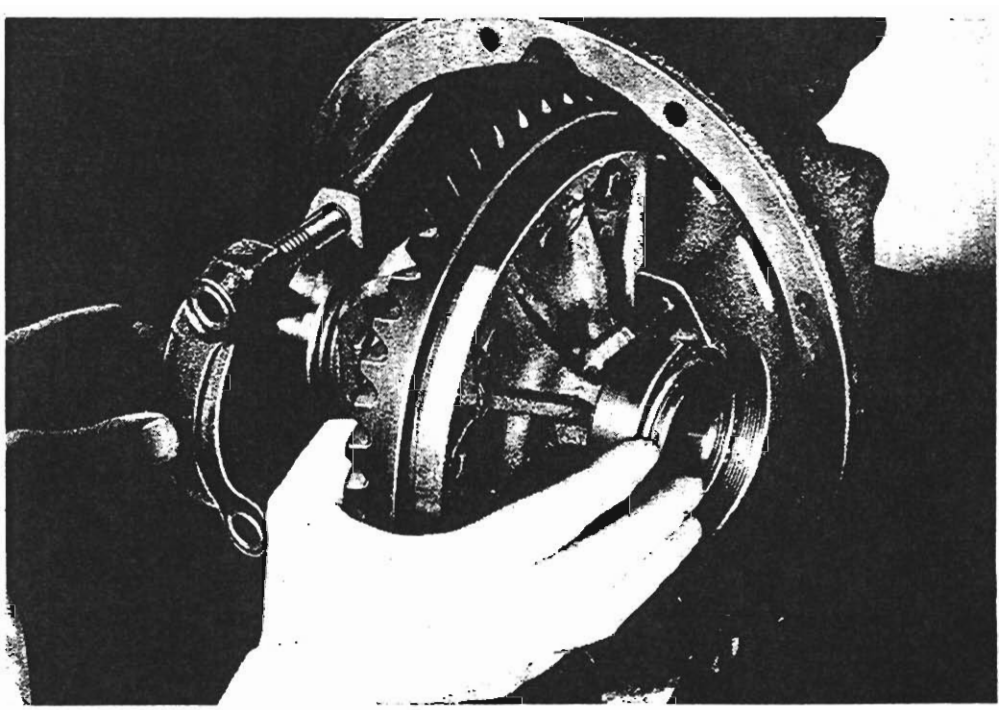

Fig. 9—Hold Ring Gear and Case in Place while Removing Side Bearing Races

as shown in figure 9. Differential assembly can now be lifted out of the carrier.

On the 1951, 2130, 2206-13-20-22-26-33, and all the Super Eight models prior to the 22nd Series, the carrier bearing caps are assembled with studs, castellated nuts and lock wires, or self-locking nuts.

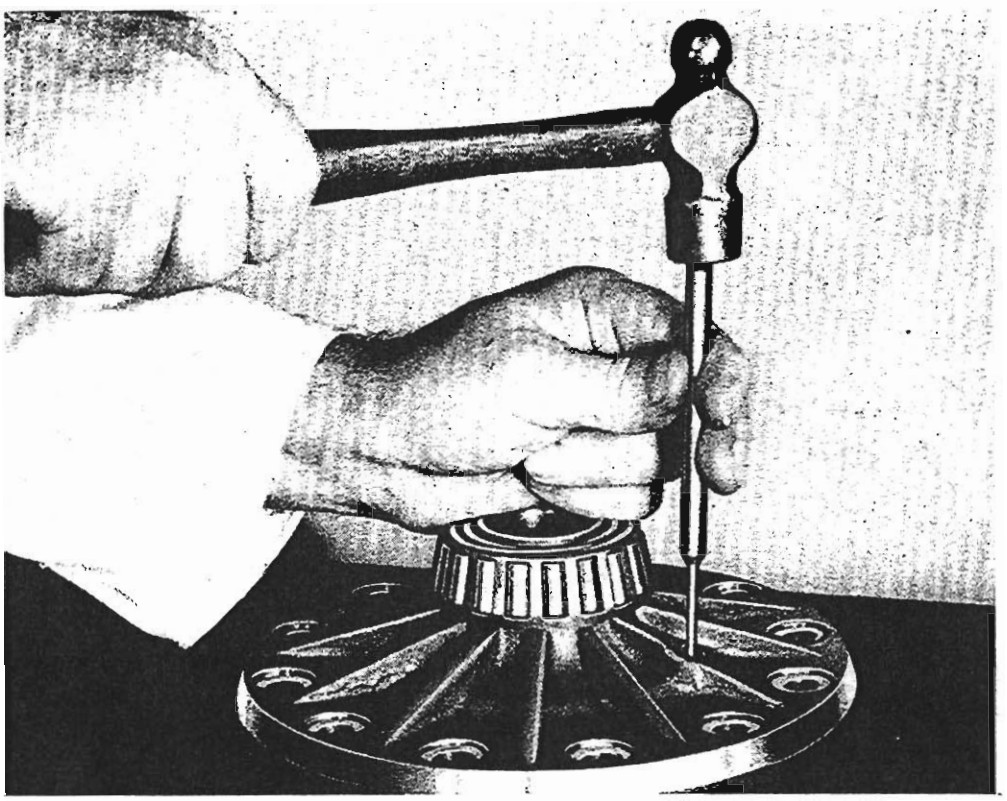

Fig. 10—Driving Out Pinion Shaft Lockpin with Hammer and Pin Punch

4. Remove the ring gear retaining screw lock wires and screws and lift the ring gear from the case. If the gear fails to come off easily, tap the outside of the gear with a soft hammer.

5. Remove the differential pinion shaft lockpin with a hammer and pin punch, as shown in figure 10, and then drive out the pinion shaft.

6. Remove the differential pinions, pinion thrust washers, axle shaft thrust block, and spacers, differential gears, and gear thrust washers.

Drive Pinion Removal

1. Remove the universal joint flange nut with Socket Wrench J-2571-A while holding the joint flange in a vise as shown in figure 11.

2. Attach Flange Puller J-2576 and remove flange as shown in figure 12.

3. Use a soft hammer to drive out the pinion, sleeve, and rear bearing from the differential carrier as shown in figure 13.

4. Remove the pinion shaft oil seal and pinion front bearing from

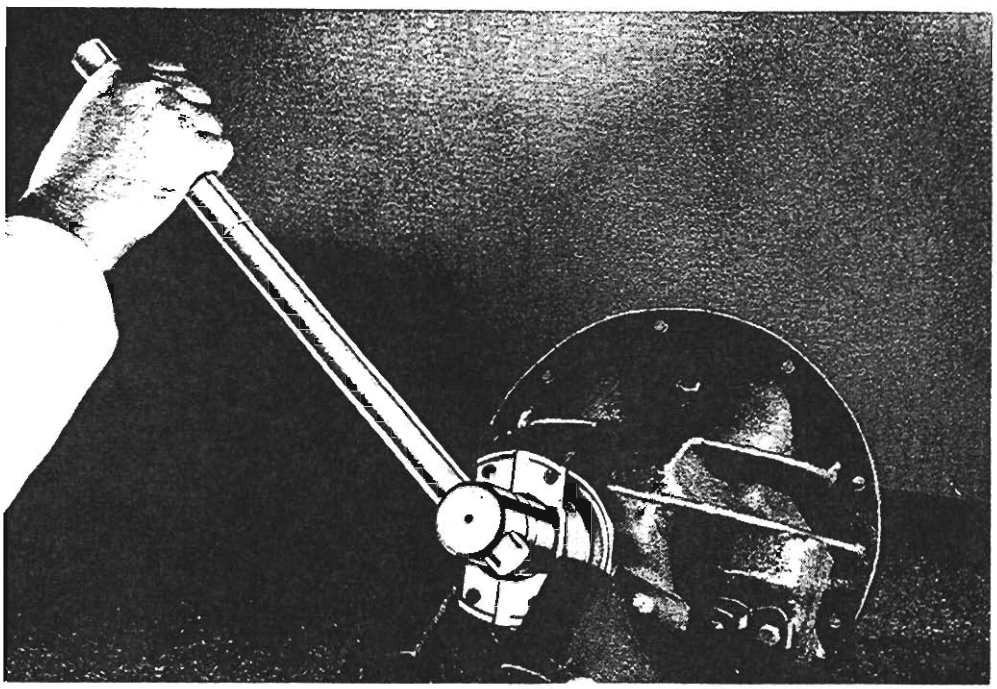

Fig. 11—Hold Flange in the Vise while Removing Flange Nut with Wrench J-2571-A

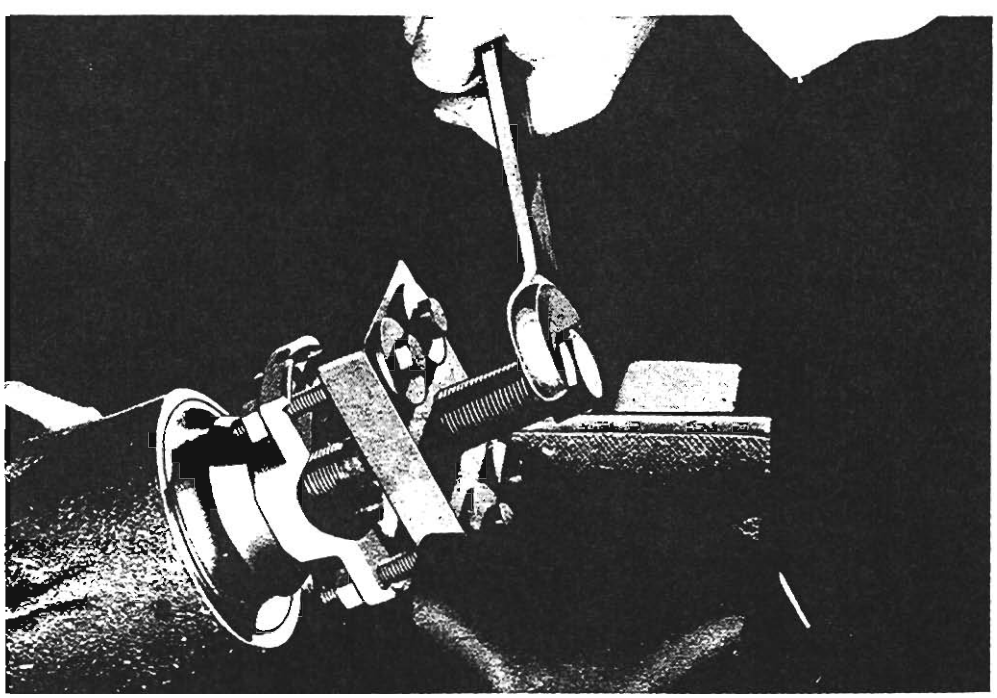

Fig. 12—Place the Carrier Assembly on Bench and Remove Flange with Puller J-2576

the carrier. (On the 1951, 2130, 2206-13-20-22-26-33, and all the Super Eight models prior to the 22nd Series, lift out the universal joint flange spacer.)

Used oil seals should be discarded and new seals installed during

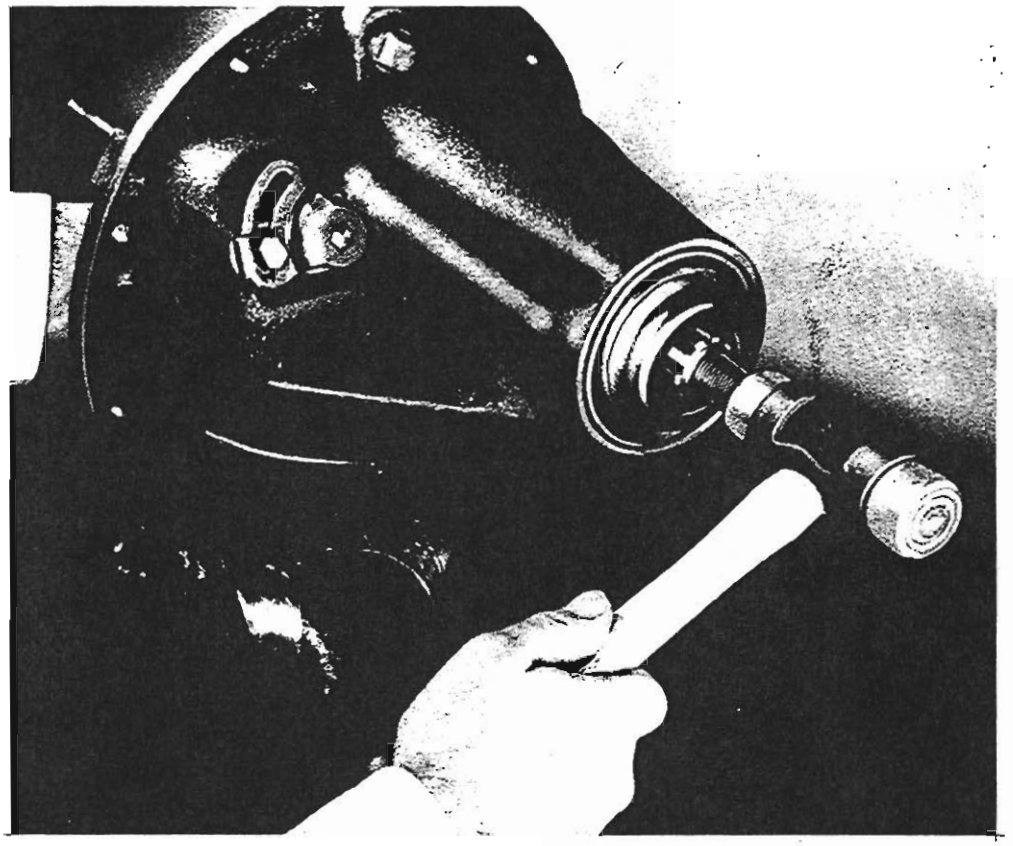

Fig. 13—Drive Out the Pinion, Sleeve, and Rear Bearing from Carrier with Soft Hammer

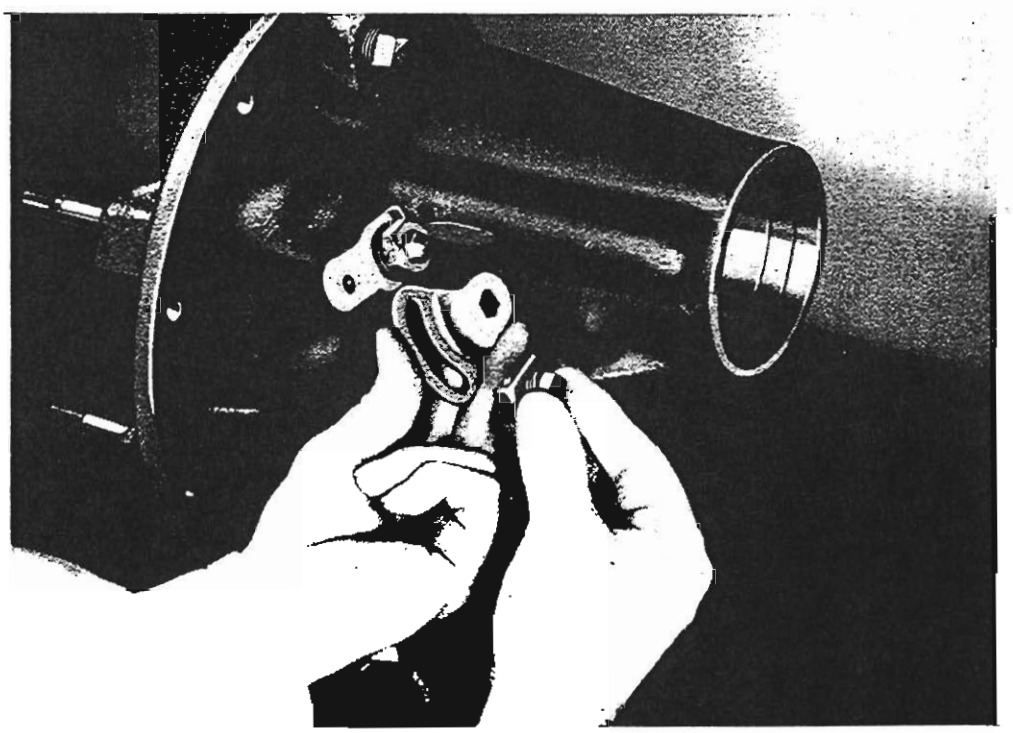

Fig. 14—Remove Idler Gear Locking Plate Screw and Washer. Then Take Off Locking Plate

reassembly.

Ring Gear Idler

(2130, 2206-13-20-22-26-33, and all Super Eights prior to the 22nd Series).

1. Remove the idler gear locking plate screw and washer (figure 14), the plate, and the idler shaft check nut and washer.

2. Remove the idler shaft, idler, and thrust washer, exercising care to prevent the loss of any of the 28 rollers which make up the idler bearing.

INSPECTION

Wash all differential parts in clean kerosene or cleaning solvent.

Gears

Carefully examine the teeth of the ring gear, pinion, differential gear, and differential pinions for chipped, scored, or worn conditions.

If threads on the pinion shaft are damaged by staking of the nut, the threads should be cleaned up with a thread chaser or file and the damaged nut discarded.

Check the pinion flange on splines for backlash or excessive free play. It should be a sliding fit. If too loose, renew the flange.

NOTE

The ring gear and pinion are mated or matched as a pair at the factory through the use of special machines and processes. Then they are run as a set in specially constructed sound-proofed rooms to determine whether gear noise level is up to established standards of quality. If not up to standards, they are returned for additional running-in on lapping machines until the desired patterns and quietness is obtained.

The ring gear and pinion are not identified as being a matched set by serial numbers or letters, making it necessary at all times

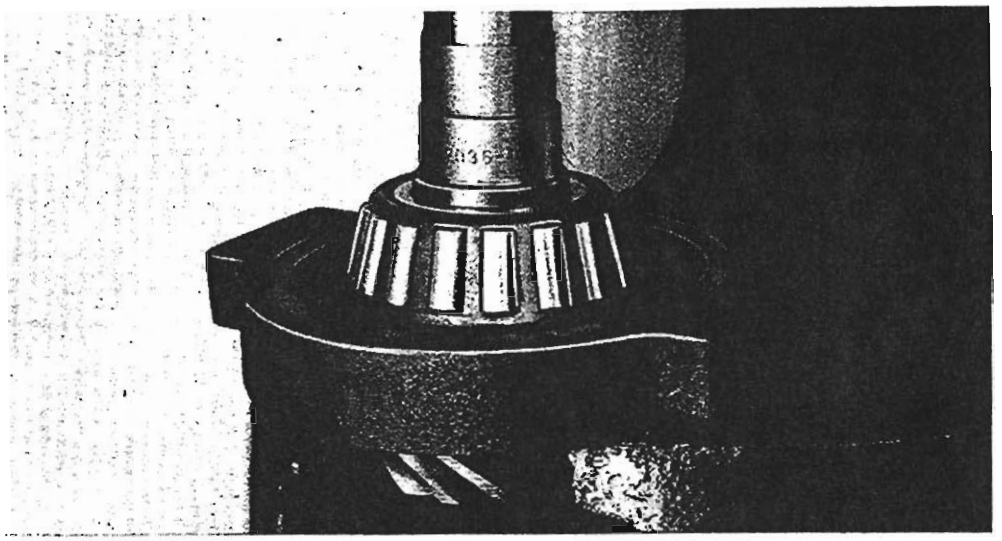

Fig. 15—Use Arbor Press and Adaptor Plate J-2574 To Remove Rear Bearing if Necessary

to keep the two gears together. New gears are wired together and shipped as sets. Do not remove the wire and separate the gears unless they are to be installed in a carrier at once.

Never replace either gear as a separate part, always replace with a matched set.

Bearings and Cups

1. After a thorough cleaning, inspect for scores, flat spots, chipped, fractured, broken or worn conditions. Check bearing inner races for turning on shafts or on hubs and check cups for turning in housings.

2. Particularly examine condition of the front and rear pinion shaft bearing outer cups in the carrier. Check for looseness in the carrier and the condition of bearing surfaces. Cups should be a tight fit in the carrier. Do not remove unless replacement is necessary.

3. Check the condition of front and rear pinion bearings. If replacement of the rear bearing or pinion shaft is required, the rear bearing should be pressed off in an arbor press using Adaptor Plate J-2574 as shown in figure 15. If the bearing is to be replaced, the cup should be removed from the carrier and both parts of the bearing renewed.

4. The differential case side bearings should be checked for tight fit on case hubs by prying the bearing at the case hub shoulder. (See figure 16.) If looseness is evident the bearing should be removed with Puller TR-278R, as shown in figure 17, and replaced with a new bearing and cup. If the bearing is still loose, the case should

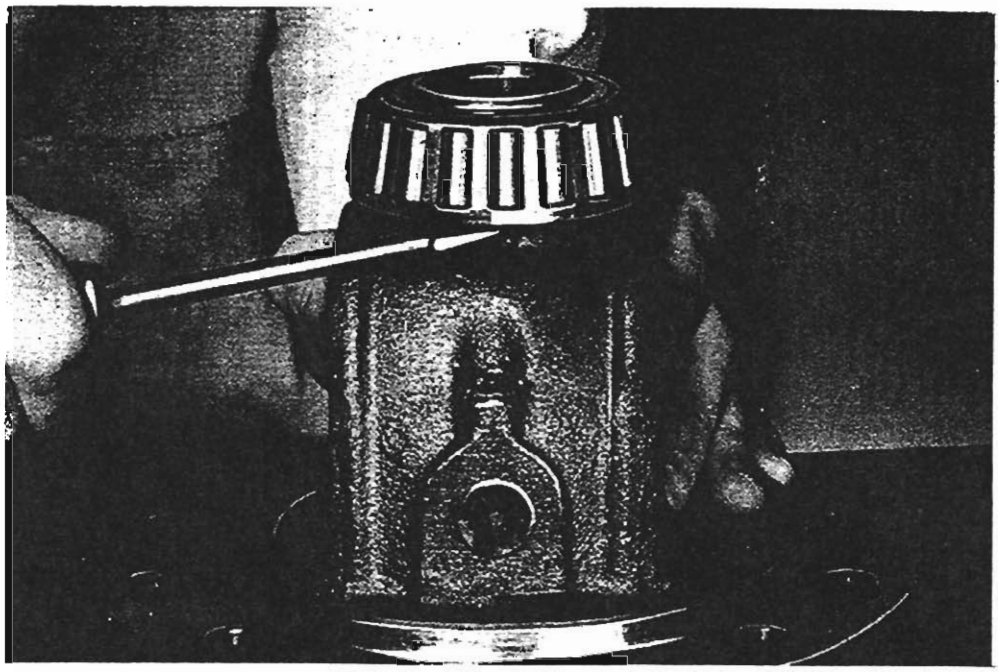

Fig. 16—Check Fit of Differential Case Side Bearings by Prying on Case Hub Shoulder

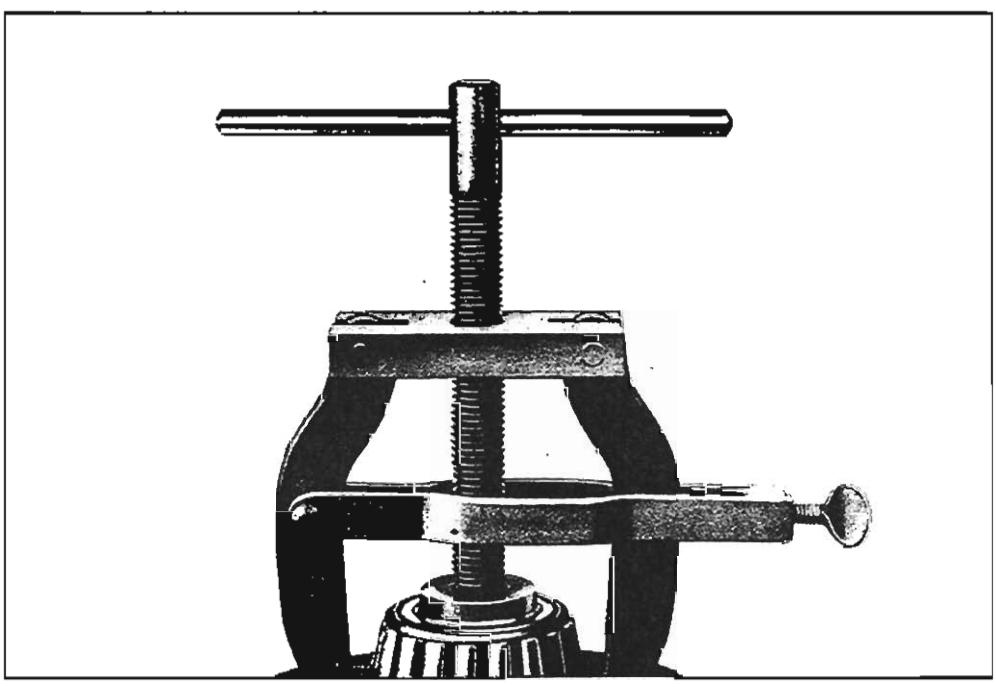

Fig. 17—Use Puller TR-278R to Remove Side Bearing if Bearing Replacement Is Necessary

be renewed.

5. The fit of the side bearing cups should be tight in the carrier when checked with the carrier caps in place and properly tightened.

6. The fit of the axle shaft bearing cup in the differential housing is to be a sliding clearance to a tight tap fit.

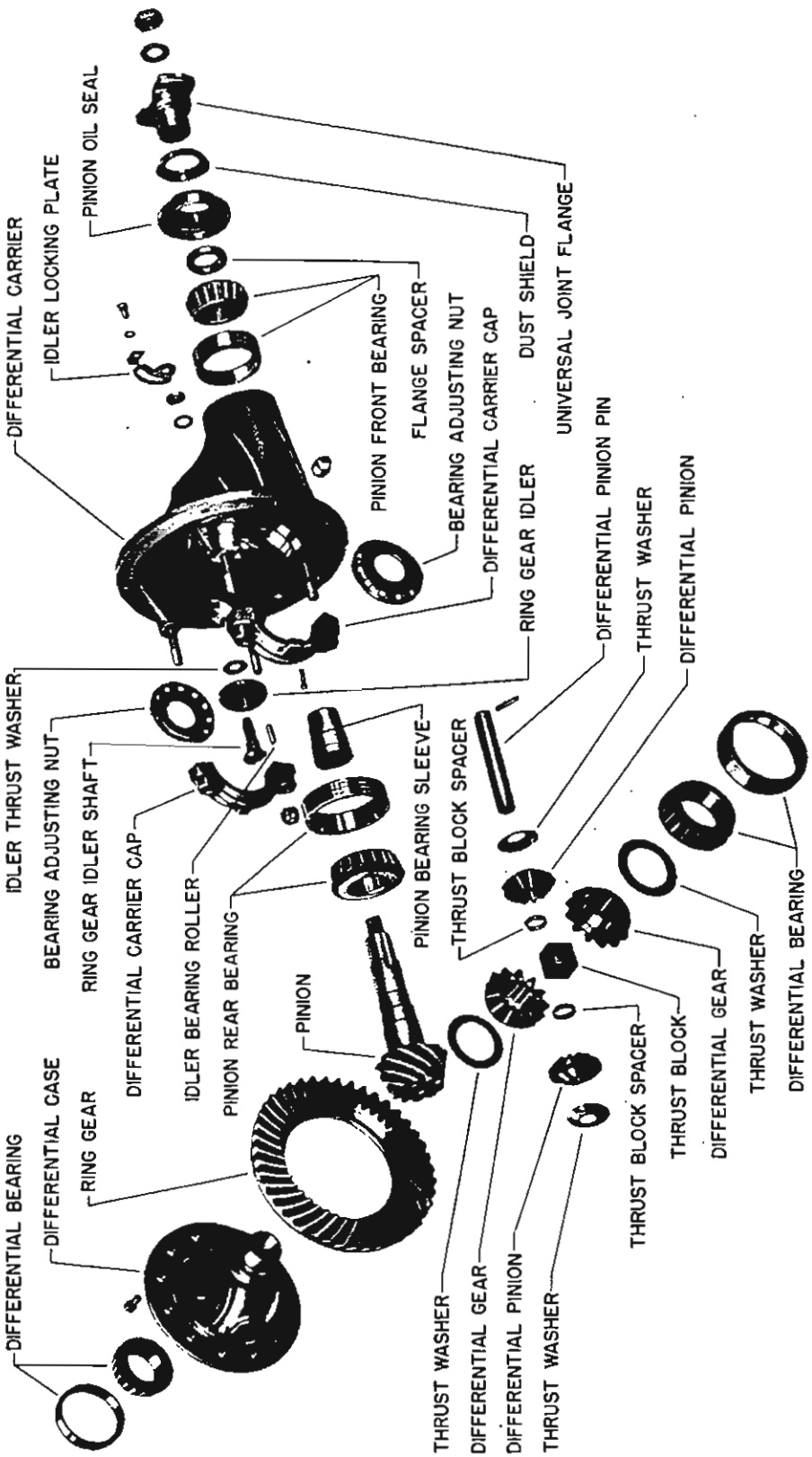

Fig. 18—Exploded View of Differential Carrier

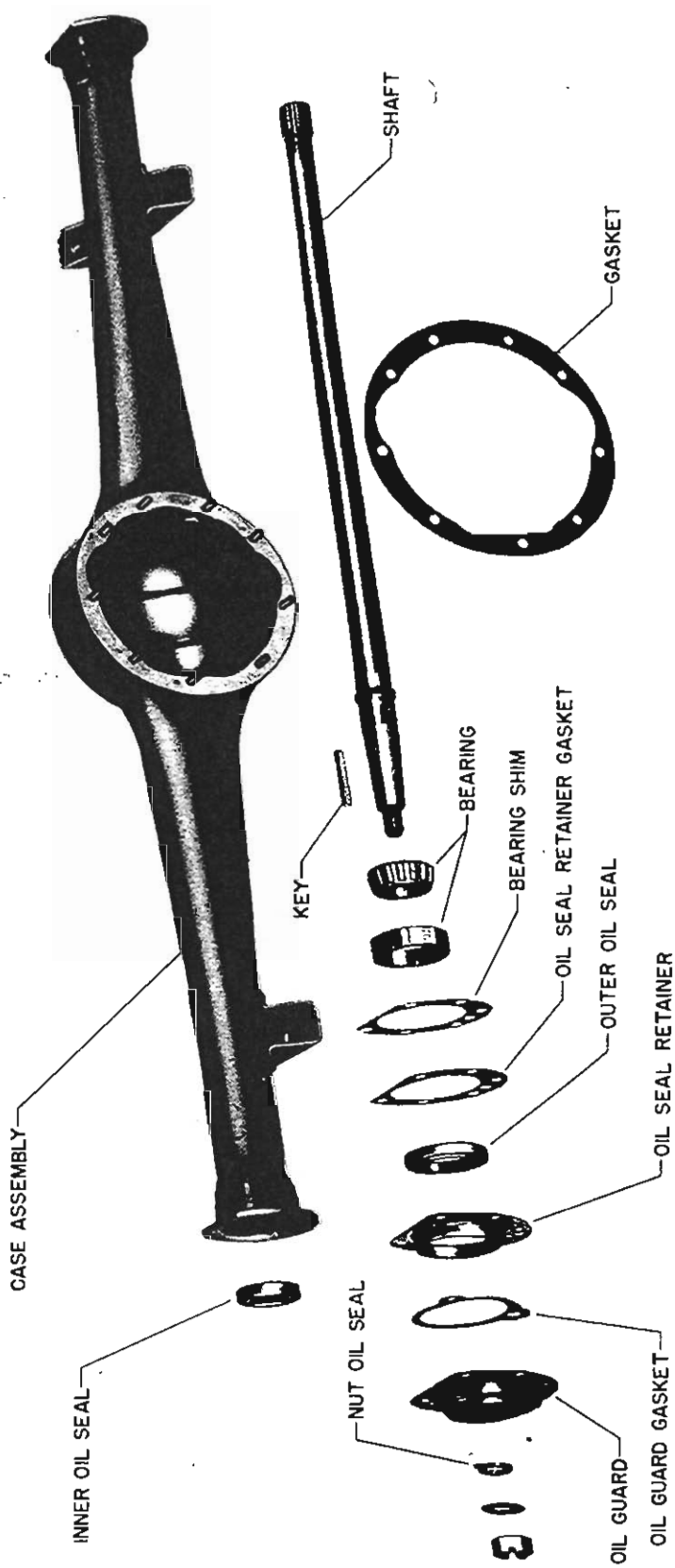

Fig. 19—Exploded View of Rear Axle and Case

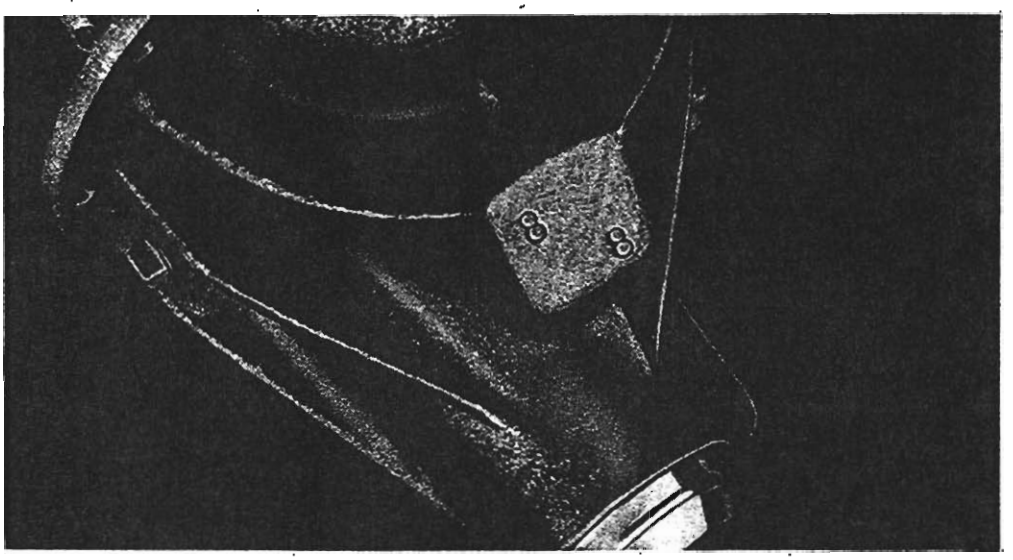

Fig. 20—Two "8's" Stamped in Pad on Carrier Top Identify Units in which 1/16" Spacer Is Used

7. The axle shaft bearing should be checked for evidence of the inner cone being loose on the axle shaft. The bearing should not slide on the shaft when pried or tapped lightly. Install a new bearing where necessary and press onto the shaft, being careful to apply pressure on the end of the inner cone only. If still loose, renew the axle shaft.

Differential Case

Examine the condition of the differential case thrust washer contacting surfaces for excessive wear or scoring and differential case in general for damage or fractures. The ring gear mounting flange face and pilot should be inspected and nicks and foreign matter removed.

ASSEMBLY

Prior to installing gears, bearings, or other moving parts, it is advisable to lubricate all surfaces which are subject to friction with motor oil. This will provide sufficient lubrication until such time as the differential oil reaches these parts after the unit has been installed and the car is driven.

Pinion Shaft and Bearings

1. When reinstalling the pinion front and rear bearing cups in the

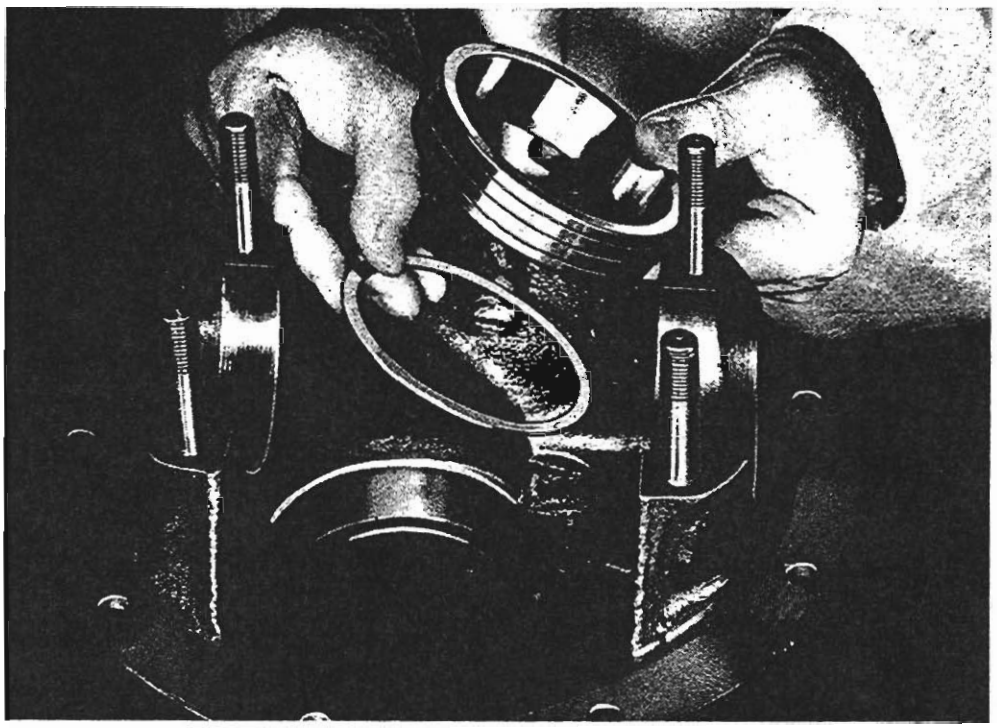

Fig. 21—If 1/16" Spacer Was Used, it Must Be Reinstalled on Assembly or Unit Will Be Noisy

differential carrier, the cups may be tapped into place, although the recommended method is to press them into place using an arbor press.

On some 2103-06 and -26 carriers, a 1/16-inch spacer was used between the rear pinion outer cup and the carrier pinion bore shoulder. These carriers can be identified by two figure "8's", 1/4-inch high, stamped into the 1 1/2-inch square pad on top of the carrier. (See figure 20.) The paint must be removed to make these numerals legible.

CAUTION

Make certain that this spacer is installed in these carriers as shown in figure 21. If it is left out, it will change the alignment of the pinion with the ring gear and result in a noisy unit. *Use this spacer only in the original carrier in which it was found as the bore in these carriers is 1/16-inch deeper.*

2. Press the pinion rear bearing onto the pinion shaft until tight against the shoulder.

3. Install the pinion in the differential carrier. Install the pinion bearing sleeve and pinion front bearing.

4. Lubricate the new pinion bearing oil seal with engine oil and

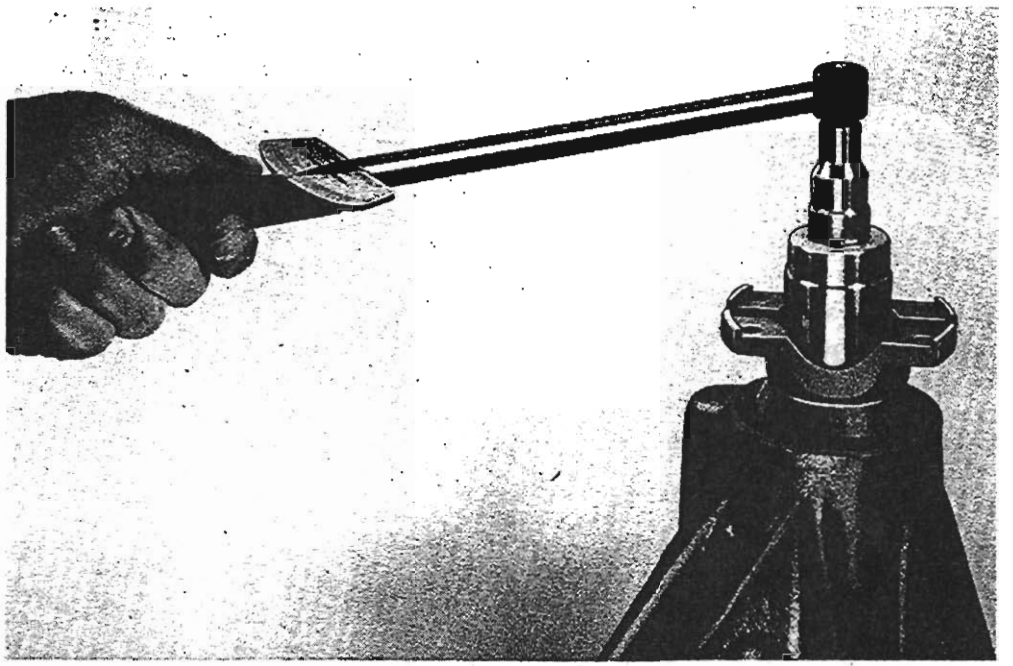

Fig. 22—Check Bearing Preload with Tool J-2571-B and Adjust to 2 to 2½ Foot Pounds Torque

tap into place. (On 1951, 2130, 2206-13-20-22-26-33, and all Super Eight models prior to 22nd Series, install the universal joint flange spacer before installing the oil seal.)

5. Coat the splines of the pinion shaft with Lubriplate and install the universal joint flange and dust shield, flange washer, and nut.

Pinion Bearing Preloading

Lock the universal joint flange in a vise and tighten the retaining nut to obtain the correct pinion bearing preload using Socket and Wrench J-2571-A. If the old pinion bearing sleeve is being re-used, all that is necessary is to tighten the retaining nut until 2 to 2½ foot pounds torque is required to rotate the pinion shaft. If a new pinion bearing sleeve has been installed, it will be necessary to buckle the sleeve to obtain correct preload. This is accomplished by tightening the nut until the effort or torque required to turn the nut suddenly falls off. Check with Preload Indicating Wrench and Adaptor J-2571-B and, if necessary, tighten the nut until 2 to 2½ foot pounds (24 to 30 inch pounds) torque is required to rotate the pinion shaft. (See figure 22). If the flat type (Marsden) nut is used, the nut must be staked in at least two places. If the new type (Hug-Lock) nut is used, no staking is necessary. The new type (Hug-Lock) nut is recommended as replacement whenever the Marsden type nut is removed.

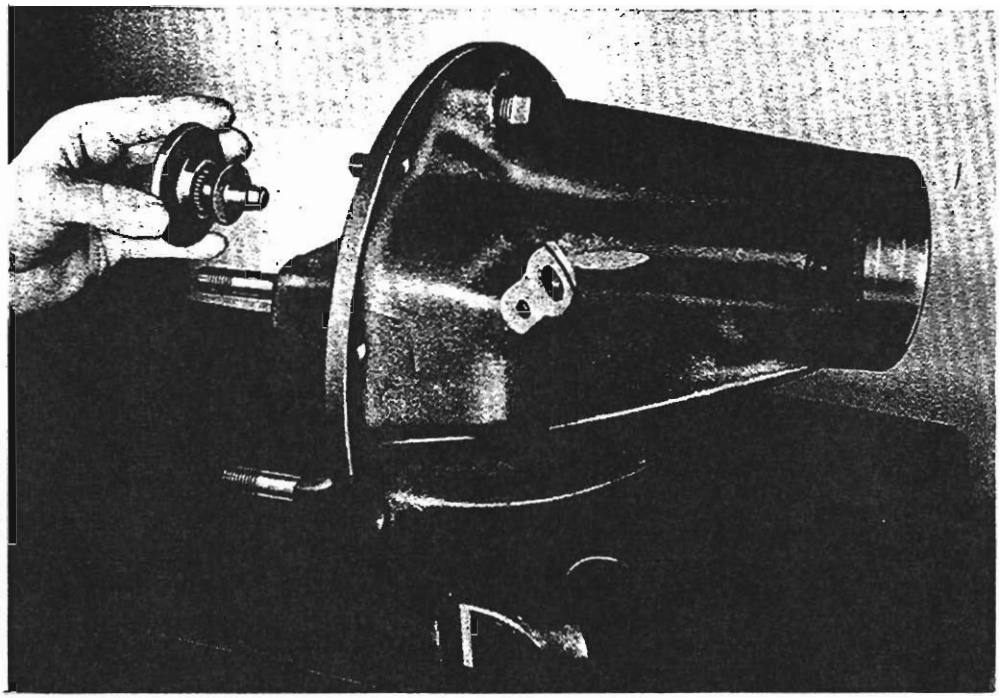

Fig. 23—Place Thrust Washer on Idler Shaft and Install Assembly in Differential Carrier

Ring Gear Idler

(2130, 2206-13-20-22-26-33, and all Super Eight models prior to the 22nd Series).

1. Place the idler on the idler shaft and insert the 28 rollers between the idler and shaft using a heavy grease to hold them in position.

2. Place the thrust washer on the idler shaft and install the assembly in the differential carrier. (See figure 23.)

3. Install the retaining nut and washer and tighten the nut finger tight.

Differential Reassembly

1. Install the two differential gear thrust washers on the gear hubs and place the gears in the differential case.

2. Align the pinion pin lockpin hole with the hole in the case and insert the pinion pin into the case.

3. Tap the pinion pin into the case. As the pin is being tapped into place, install on the pin the following parts in the order given: pinion thrust washer, pinion, thrust block spacer, thrust block, thrust block spacer, pinion, pinion thrust washer. (See figure 24.)

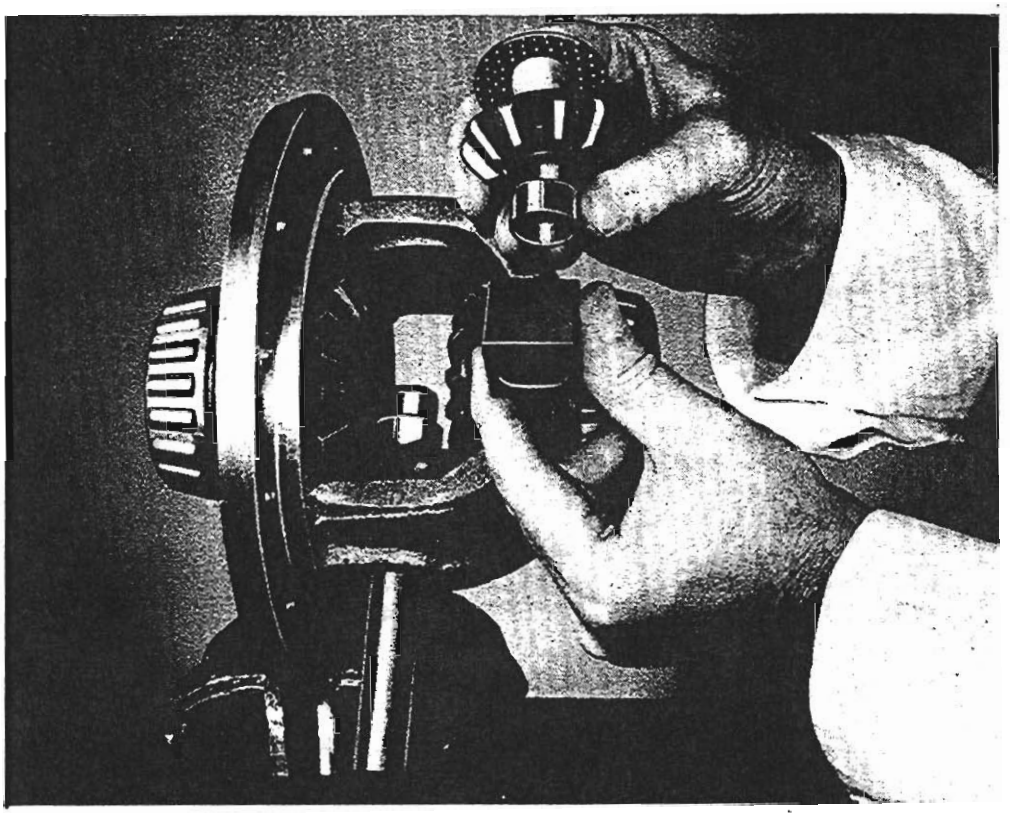

Fig. 24—As Pin Is Tapped into Case, Install Washers, Pinions, Spacers, and Thrust Block on Pin

4. Tap the pinion pin further into the case until the lockpin hole in the pinion pin is in register with the hole in the case.

5. Check each differential gear for proper end play which should be from .002-inch to .005-inch. (See figure 25.) If the end play is not within these limits, it will be necessary to remove the previously installed parts and to install differential gear thrust washers of the proper thickness. Thrust washers of four thicknesses are available: .031-inch, .036-inch, .041-inch, and .046-inch. When proper end play has been obtained, install the pinion pin lockpin and stake the edge of the lockpin hole in the case to secure the lockpin. (See figure 26.)

Ring Gear Installation

1. Install the ring gear on the case after making sure that the back face of the ring gear and mating face on the case are free from dirt and burrs. Install the ring gear screws and gradually tighten all screws equally until snug. Torque up to 65 to 67 foot pounds.

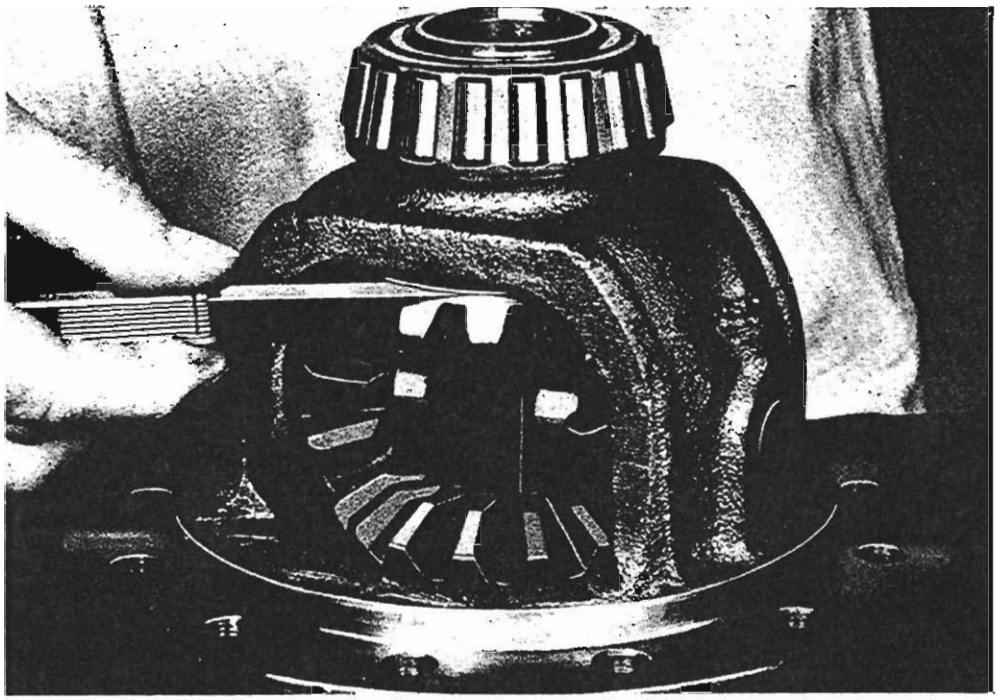

Fig. 25—Differential Gear to Thrust Washer End Play Should Be .002″ to .005″

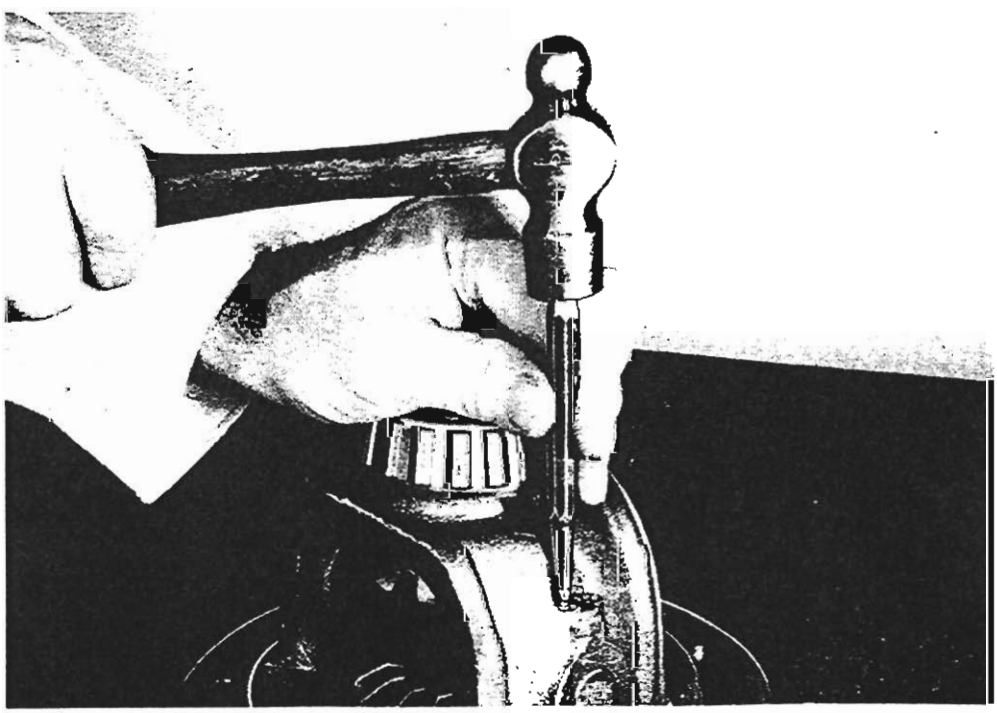

Fig. 26—Stake Lockpin in Place by Using Center Punch To Upset Edge of Pin Hole

NOTE

On 2130, 2206-13-20-22-26-33, and all Super Eight models prior to the 22nd Series, assembly lock wires through screws

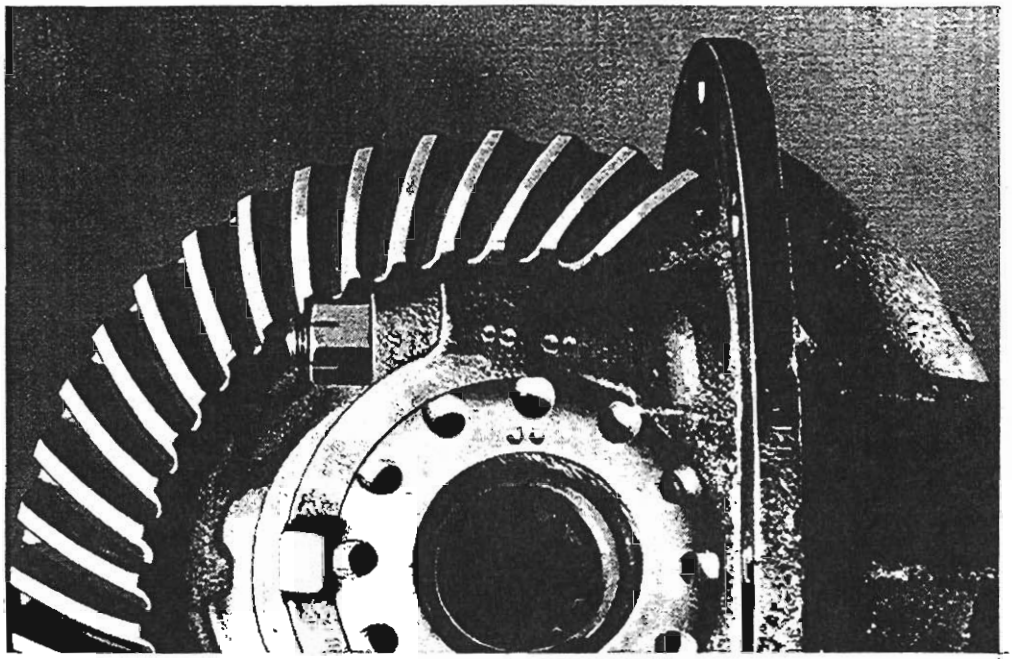

Fig. 27—Use Punch Marks To Identify Positions of Bearing Adjusting Nuts and Carrier Caps

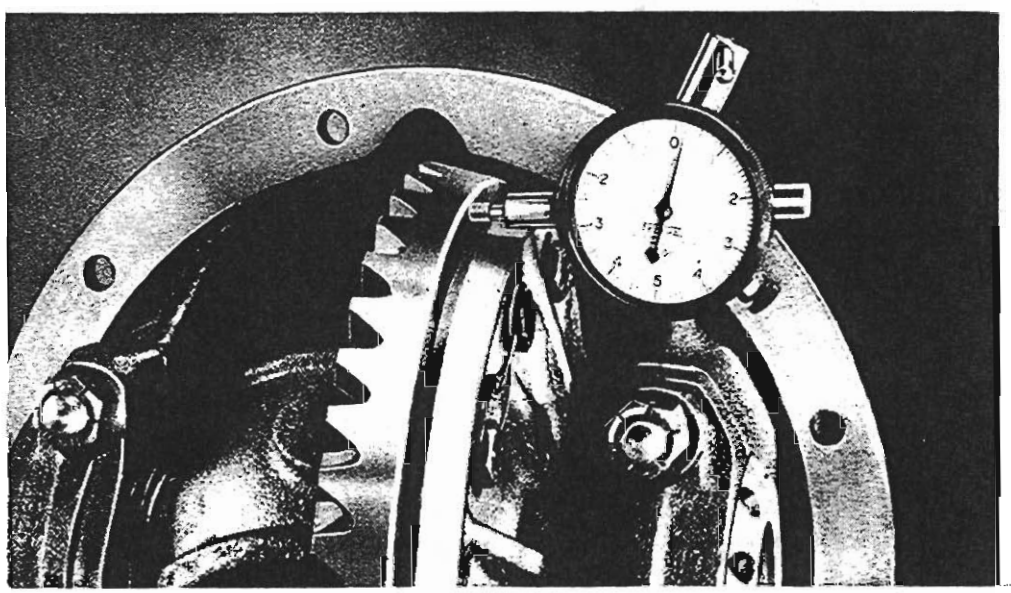

Fig. 28—Check Gear Runout with Indicator. Runout Should Not Exceed .004″

being sure there is no interference with the ring gear idler roller. Otherwise, the lock wire may be torn off by becoming wedged between the roller and screws.

2. Place the outer bearing cups over the differential bearings and set the entire assembly into the differential carrier.

3. Place the punch-marked differential bearing adjusting nuts in their proper position as to right and left sides, and also the punch-marked carrier caps, as shown in figure 27.

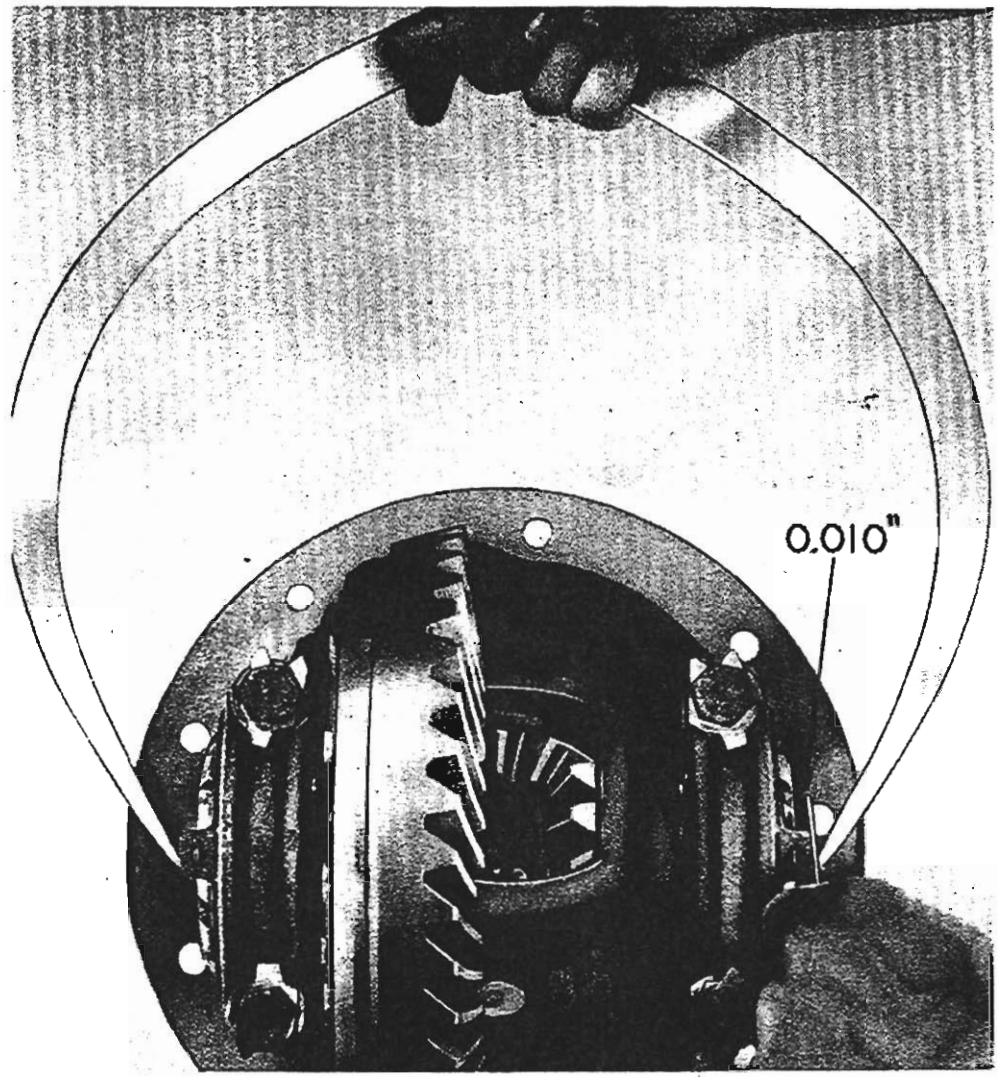

Fig. 29—Prior To Spreading Case, Adjust Caliper with .010" Feeler Gauge

4. Tighten the cap retaining bolts or nuts just enough to hold the adjusting nuts in the threads but still allow them to turn in order that the differential bearing preload may be adjusted.

5. Mount indicator and make ring gear runout check by indicating finished back face of ring gear. (See figure 28.) Runout must not exceed .004 inch. If runout is excessive, check for burrs or foreign matter between the ring gear and differential case flange.

Bearing Preload

The bearing preload, which should be .010 inch to .012 inch, is determined by the spread of the carrier pedestals and is adjusted in the following manner:

1. Back off both adjusting nuts to permit side-to-side movement

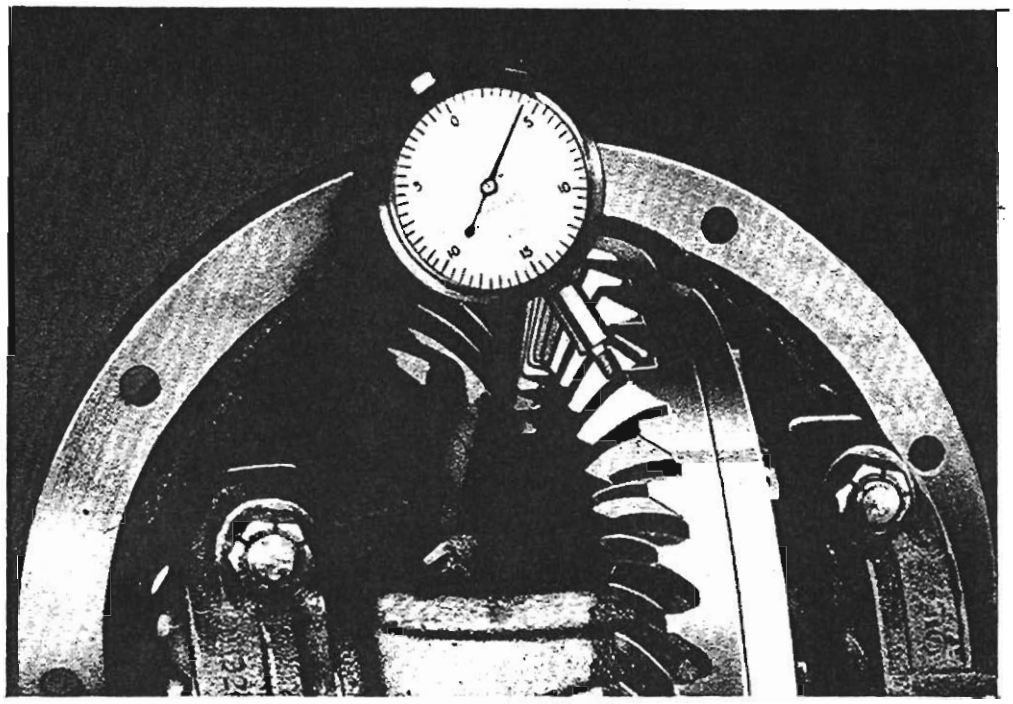

Fig. 30—Measure Ring Gear to Pinion Backlash with Indicator. Backlash Should Be .004" to .006"

of the differential assembly.

2. Tighten the adjusting nut at the left side of the case (the side opposite that to which the ring gear is attached) until approximately .005-inch backlash exists between the ring gear and pinion. Tighten the nut on the opposite side until end play is just taken up.

3. Using a large outside caliper and a .010-inch feeler blade, measure from the finished boss of one carrier cap to the other with the feeler blade held between one of the bosses and the caliper. (See figure 29.) Lock the caliper in this position.

4. Tighten the adjusting nut at the right side of the case (the side to which the ring gear is attached) until the previously adjusted caliper will just pass over both finished bosses without the .010-inch feeler blade.

Ring Gear and Pinion Backlash

1. Check the ring gear to pinion backlash which should be .004 inch to .006 inch. (See figure 30.) Adjustment is accomplished with the bearing adjusting nuts by moving the ring gear away from or toward the pinion shaft.

If it is necessary to tighten one of the adjusting nuts to obtain cor-

rect backlash, it is very important that the opposite nut be loosened the same amount in order to maintain the previously adjusted bearing preload.

NOTE

Tightening one adjusting nut one notch and loosening the other one notch will change the backlash approximately .004 inch.

2. Tighten the carrier cap bolts and secure with lock plates. (Castellated nuts and cotter pins or self-locking nuts are used on some models.)

3. Install the bearing adjusting nut cotter pins.

Adjusting Ring Gear Idler

(2130, 2206-13-20-22-26-33, and all Super Eight models prior to 22nd Series).

1. Adjust the idler to ring gear clearance to .005 inch and tighten the check nut. Rotate the ring gear and check for possible interference between the ring gear to case screw lock wires and the idler roller. Relocate lock wires if they are too close.

2. Install the lock plate, lock plate washer, lock washer, and cap screw.

Installing Carrier

NOTE

To avoid fracturing the thrust block during the axle shaft installation, with the resulting possibility of rear end failure, care must be exercised in positioning the thrust block so that the polished faces of the block are toward the outer ends of the rear axle case. Packing heavy grease around the thrust block will prevent it from turning while the carrier assembly is being installed. (For further details see "Rear Axle Shaft Thrust Blocks" *Service Counselor,* Volume 20, Number 8.)

1. Remove the old carrier to housing gasket, clean and inspect the housing gasket face for damage that would affect the proper sealing of the gasket.

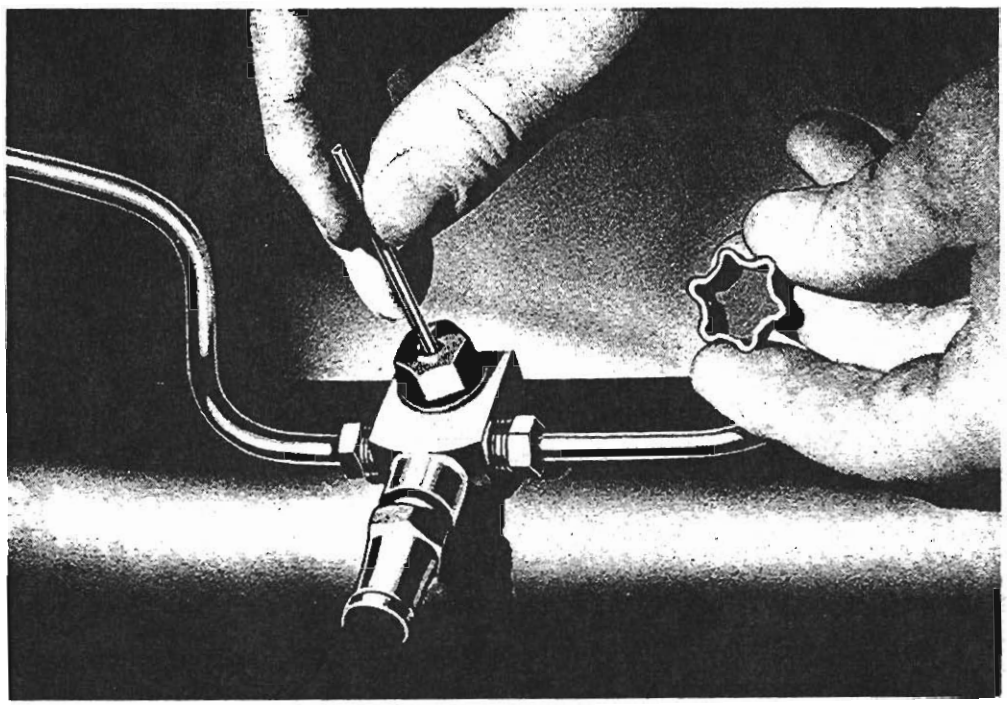

Fig. 31—Use a Wire To Make Sure Breather Hole in Vent Screw on Axle Housing Is Open

2. Remove and clean the vent cap and the $\frac{7}{16}$-inch vent screw, which holds the brake tube junction to the axle housing at the left side of the housing. Many oil leaks at axle shafts and around differential pinion seals have been due to an excessive build-up of pressure in the housing caused by this vent being plugged with road dirt. Always remove the cap and either remove the screw completely and clean; or work a wire through the drilled center hole in the vent screw while it is attached to the housing. (See figure 31.) Reinstall the cap after cleaning.

3. Make certain before installing the carrier in the axle housing that the housing has been thoroughly cleaned internally, especially if the removed carrier has had gears or bearings that failed in operation and caused chips or grindings to settle in the housing. Remove all traces of cleaner and foreign matter with wiping cloths. There have been many otherwise perfect reconditioning jobs or new units totally ruined due to the lack of sufficient attention to this cleaning operation.

4. Install a new carrier to housing gasket and then install a new copper wire ring (not gasket) around each housing stud as shown in figure 32.

5. Install the carrier in the differential housing. Be careful to avoid tearing or injuring the gasket with the ring gear or other protruding parts.

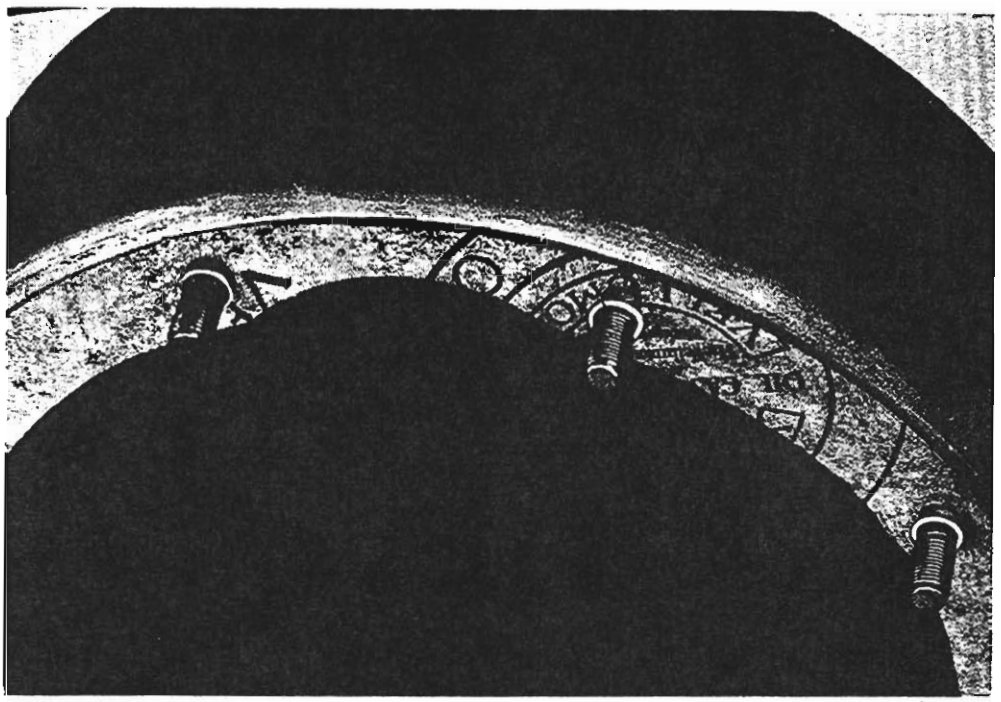

Fig. 32—Install Copper Wire Rings on Each Housing Stud on Top of Gasket

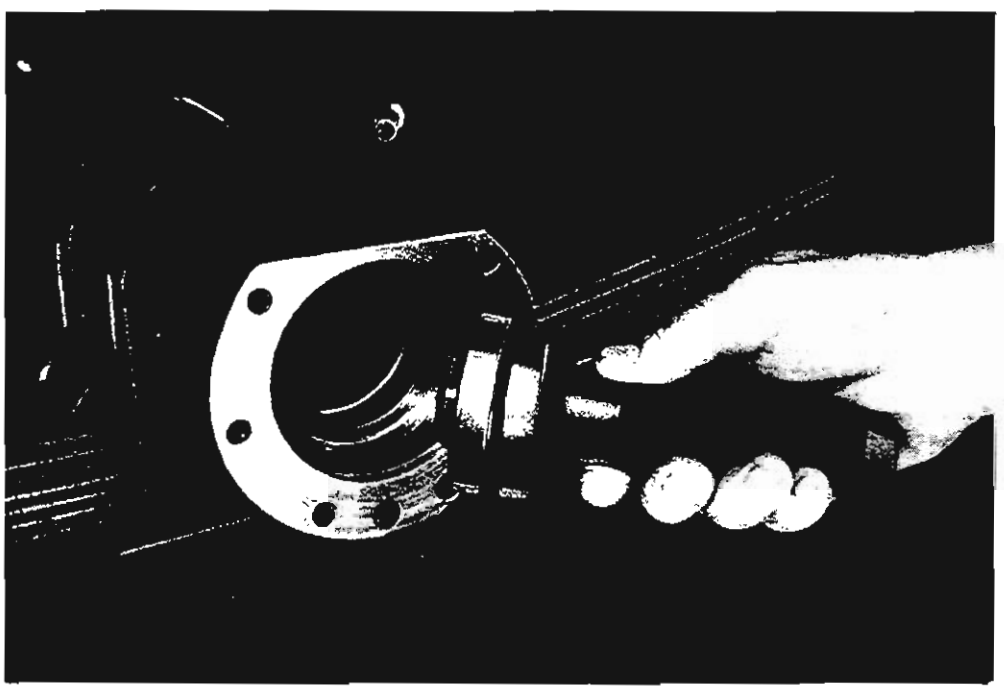

Fig. 33—Install Inner Oil Seal on Pilot End of Tool J-2554 and Drive into Place

6. Install the nine ⅜-inch carrier retaining lock nuts. (Refer to "Rear Axle Oil Leaks" in the *Service Counselor*, Volume 20, Number 9.) Torque to 35 to 40 foot pounds. Do not use lock washers with self-locking nuts.

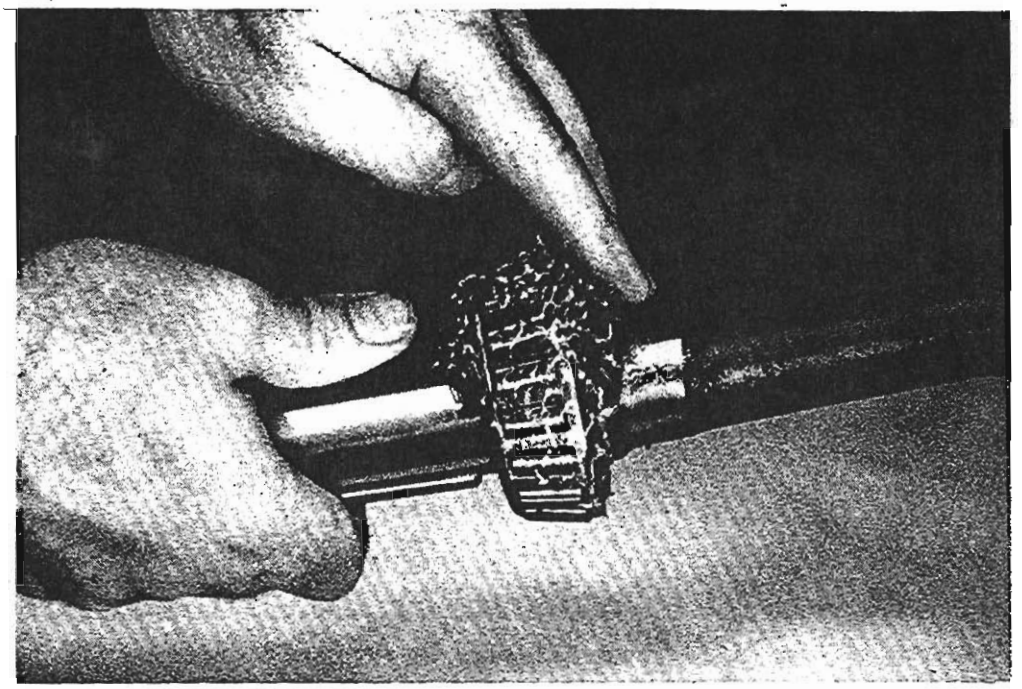

Fig. 34—Pack Axle Shaft Bearing with Two Ounces of No. 3 Fiber Grease

7. Remove the wire or two-by-four propeller shaft prop from the frame "X" member and remove the wire or tape from the rear universal joint bearings.

8. Assemble the rear joint to the differential flange, using new lock tabs under screws; tighten the screws and bend over the locking tabs.

9. Fill the differential to the proper level (level with bottom of filler plug) with recommended grade of hypoid lubricant and reinstall the filler plug.

Installing Axle Shafts

1. Wipe the axle housing axle shaft bearing flange and the brake support plate free of road dirt to prevent any dirt from contacting the axle shaft bearing during installation.

2. Install a new axle shaft inner oil seal using tool J-2554 by placing the seal on the pilot end of driver (figure 33) and driving into position.

3. Pack the axle shaft bearing with 2 ounces of No. 3 fiber grease. Work the grease thoroughly under the roller cage and around the rollers performing the operation the same as on front wheel bearings. (See figure 34.) Do not apply extra grease on the axle shaft or in the housing when installing the shaft.

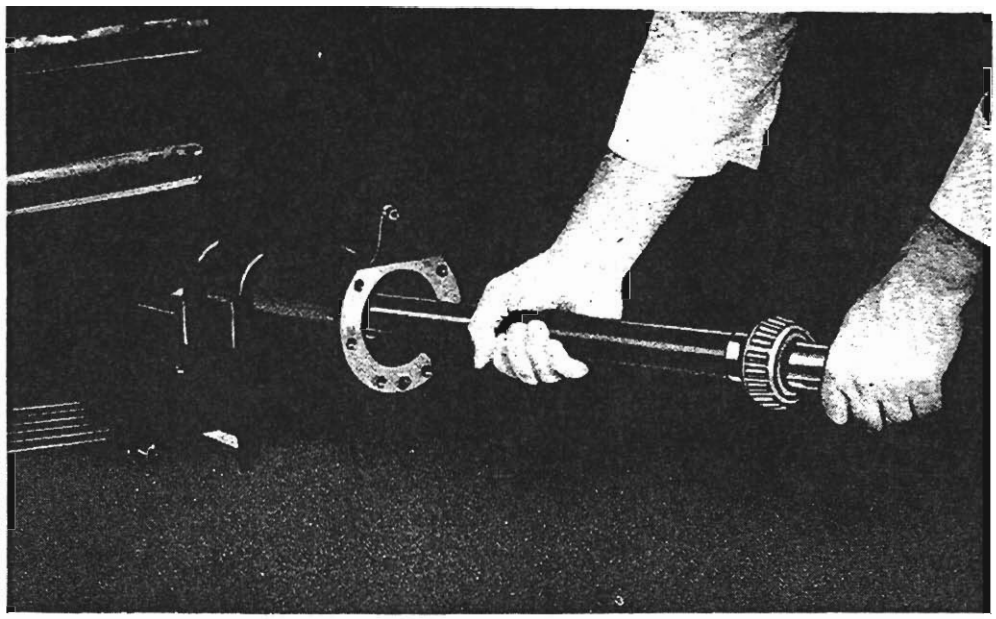

Fig. 35—Keep Axle Shaft Centered To Prevent Damaging Oil Seal During Installation

4. Install the axle shaft in the axle housing and mesh the end splines in the differential gear. Slide the shaft into place. (See figure 35.) Be careful during the axle installation not to drag the shaft across the oil seal.

5. Install the axle shaft bearing cup and shims, having previously wiped the shims free of dirt. Make sure cup does not cock or wedge itself in the housing, or backing plate will become bent when tightened.

6. Install the brake support plate screws, support plate, new oil seal retainer gasket, new oil seal, oil seal retainer, new seal guard gasket, and the seal guard. Install the nuts and lock washers, and gradually snug up all nuts before final tightening. Torque to 35 to 40 foot pounds.

7. Due to the possibility of the axle shaft thrust block rotating out of proper position in the differential, make frequent checks during the support blade tightening by pulling the axle shaft in and out to see that the axle shaft has sufficient end play.

8. Perform previously described operations on opposite side of rear axle.

9. Attach the Axle Shaft Remover J-2552 and bump the shaft back and forth several times to seat the shaft and bearings in place. Remove the bumping tool and install Checking Gauge J-2560.

With the axle shaft forced in towards the differential, turn the long

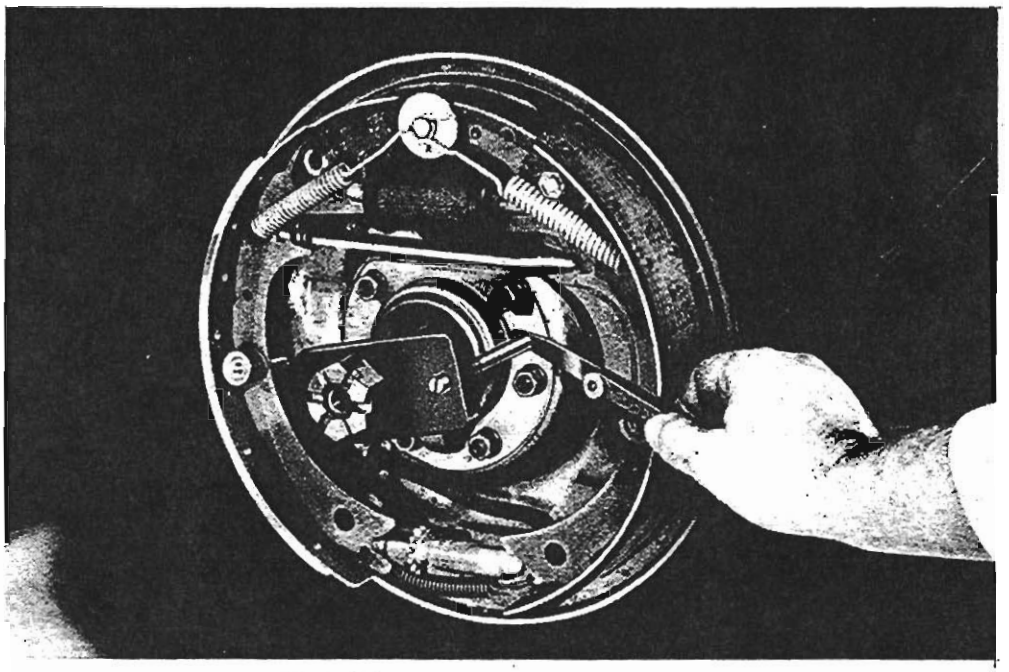

Fig. 36—Check End Play with Checking Gauge and Feeler. End Play Should Be .004" to .007"

adjusting screw to bear against the backing plate, then pull the shaft outward. Check with feeler gauge to determine the clearance, which should be .004 inch to .007 inch (See figure 36.) Shims for this adjustment are available in .005 inch, .007 inch, and .020 inch thickness. Add or remove shims at the backing plate, to obtain the specified clearance.

End play of less than .050 inch can be adujsted at one side only. Remove shims from both sides if end play exceeds .050 inch in order to keep the thrust block centralized.

10. Connect the brake hydraulic line to the brake cylinder. Thoroughly wipe all oil and grease from the tapered portion of the axle shaft and bore in the wheel hub; then install the brake drum and hub assembly.

11. Install the axle shaft nut washer and nut and tighten securely. Install and bend the cotter pin.

12. Perform previously described operations 10 and 11 on opposite side of rear axle.

13. Bleed both the rear brake cylinders and fill the master cylinder.

14. Mount the wheels and remove the car from the stands. After completion of the road testing for differential performance, reinspect the differential for possible oil leaks and correct if necessary.

AXLE NOISE ANALYSIS

When diagnosing rear axle troubles, extreme care should be used to be sure that the noise in question is not caused by rough rear wheel bearings, noisy muffler or tire tread, or worn universal joints.

Rear axle noise is generally a hum or, in severe cases, a growl. The tone of this hum or growl will usually change depending on whether the car is coasting or being driven by the engine. This noise is generally caused by rough pinion bearings or by a pinion and ring gear that are rough or improperly adjusted.

In cases where the noise is continuous and does not change on the pull or coast, the rear wheel bearings or tires may be the cause. Muffler noise usually can be duplicated, with the car standing still, by very slowly opening and closing the throttle. For a further check, apply the parking brake, place the shift lever in high gear, and slip the clutch while slowly opening the throttle. This check should be made as quickly as possible to avoid overheating the clutch.

If excessive backlash is the complaint, carefully check the condition of the universal joints before condemning the rear axle. Check the rear axle driving pinion for end play. If end play is evident, the universal joint flange retaining nut should be checked for tightness. If loose, it should be carefully tightened and the lash rechecked. Avoid over-tightening.

If excessive backlash is still evident, it is no doubt due to improper adjustment of the ring gear and pinion.

When a rear axle is noisy on turns only, the cause is generally chipped or rough differential gears and pinions, or improper backlash between differential gears and pinions.

The following list of conditions should be checked and taken into consideration when diagnosing rear axle problems and complaints.

1. Insufficient lubricant in housing.
2. Use of poor quality or incorrect grade of lubricant.
3. Rear wheel bearings scored or rough.
4. Ring gear and pinion not matched.

5. Ring gear or pinion teeth badly worn, scuffed, or chipped.
6. Excessive or insufficient ring gear backlash.
7. Loose pinion bearings—improper preloading.
8. Loose differential side bearings—improper carrier spread.
9. Pitted or broken pinion or differential bearings.
10. Ring gear does not run true (intermittent hum).
    a. Loose or broken differential bearings.
    b. Differential case sprung or cracked.
    c. Ring gear bolts drawn up unevenly.
    d. Warped ring gear.
    e. Foreign substance between ring gear and differential case.
11. Rear axle noisy on turns only, resulting from:
    a. Differential pinion gears tight on pinion pin.
    b. Differential pinion or side gears chipped, scuffed, or otherwise damaged.
    c. Differential side gears or case thrust bearings worn, rough, scored, or otherwise damaged.
    d. Excessive backlash between differential gears and differential pinions.
12. Oil loss at rear axle shafts caused by:
    a. Lubricant level too high in rear axle housing.
    b. Rear axle shaft oil seal worn or improperly installed.
    c. Rear axle shaft rough at oil seal surface.
    d. Oil loss due to excessive axle shaft end play.
13. Oil loss at rear axle pinion shaft.
    a. Lubricant level too high in rear axle housing.
    b. Axle housing breather or vent plugged.
    c. Pinion oil seal badly worn or improperly installed.
    d. Universal joint companion flange hub rough, scored, or out of round.

* * *

REAR AXLE LEAK CORRECTION

OIL LEVEL

Many oil leaks are caused by an excessive amount of oil in the rear axle housing. The oil level should always be maintained at the bottom of the filler plug.

VENT

The rear axle housing is provided with a pressure vent or breather at the left side of the axle housing. This breather is in the form of a bolt that has been drilled through the center and is used for anchoring the brake tube junction to the axle housing. A tight fitting cap keeps dirt and foreign matter from entering axle housing but permits the normal breathing of the axle housing when changes in temperature so demand. If the vent becomes plugged with road dirt the normal rear axle heat will cause a considerable build-up of pressure in the housing and force oil past the gaskets and oil seals. Always make the vent a point of regular inspection when correcting oil leaks around the rear axle.

LEAK AT PINION SHAFT SEAL

Perform the installation of a new seal as follows:

Disconnect the universal joint at the pinion flange. The location of the pinion flange nut must be very carefully noted before loosening so that the nut can be returned to exactly the same spot when the unit is reassembled or the pinion bearing preload will be altered.

Bearing preload over or under the specified amount may result in a noisy axle or failure of the complete unit. Mark the location of the nut by a punch or scratch mark on the end of the nut, and directly in line with this mark also mark the end of the pinion shaft. Then either count the total number of threads or measure the length of the shaft protruding through the nut and make a note of it for reference when reassembling. Remove the nut, washer, and the flange from the pinion shaft and pry out the oil seal. Install a new oil seal and then reinstall the flange, washer, and nut to the previously

marked and measured position.

CARRIER GASKET LEAKS

Oil leaks around the carrier to housing gasket are usually the result of loose carrier to housing retaining nuts. This condition can be corrected by installing gaskets and self-locking nuts. (See "Rear Axle Oil Leaks", *Service Counselor,* Volume 20, Number 9.)

NOTE

In the event the carrier is removed and a new carrier to housing gasket installed, also install a copper wire ring on each stud before installing the carrier. The copper ring will be compressed into the chamfer around the stud hole when the carrier is tightened up and will prevent oil leaking by the studs.

LEAK AT AXLE SHAFT SEAL

Oil leaks at the rear wheel brake support plate drain hole are usually indicative of a faulty axle shaft inner oil seal. However, in some instances, wheel bearing grease will work out of the drain hole and run down the support plate. This occurs when the wheel bearing has been overpacked during assembly. If a close examination reveals that the drained material is bearing grease, then disassembly of the unit should not be necessary. But, if differential oil is found mixed with the bearing grease, then the axle shaft should be removed, examined, and a new inner oil seal installed.

In all cases where the inner oil seal has been leaking, closely inspect the axle shaft for roughness or machine marks on the seal running surface and correct, if necessary, before reassembling.

Particular attention should always be directed to the amount of axle shaft end play present, as in many cases axle shaft seals become worn and leaky from axle shaft end movement when the end play is allowed to remain excessive.

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REAR AXLE SPECIFICATIONS

Axle shaft	
Bearing cup in axle housing	.0015″ loose to .0005″ tight
Bearings on shaft	.0005″ to .0015″ tight
End play	.004″ to .007″
Differential case	
Ring gear flange runout	.001″ maximum
Ring gear pilot runout	.001″ maximum
Side Bearing	
Cup in carrier bearing bores	.0006″ loose to .0009″ tight
On case hub	.001″ to .002″ tight
Preload (Pedestal spread)	.010″ to .012″
Gear end play in case (Each gear)	.002″ to .005″
Pinion bearing	
Cup fit in carrier bearing bores	.001″ to .003″ tight
Preloading (Torque to turn shaft)	2 to 2.5 ft-lb
Ring gear	
Back face runout	.004″ maximum
To idler roller—clearance	.005″
To pinion—back lash	.004″ to .006″
Universal joint flange—runout	.004″ maximum

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REAR AXLE TIGHTENING TORQUE SPECIFICATIONS

Part Description	Thread Size	Torque Ft-Lb
Ring gear retaining—screw	3/8″-24	50-55
Ring gear retaining—screw	7/16″-20	70-80
Differential carrier bearing cap—stud nut	1/2″-20	65-70
Differential carrier bearing cap—screw	1/2″-20	55-60
Differential carrier to axle housing—nut	3/8″-24	35-40
Brake support plate to housing—nut	3/8″-24	35-40

Inch pounds may be determined by multiplying the foot pound recommendation by 12.

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Additional copies of this section of the Service Manual may be obtained from any Packard Zone Parts and Service Department at 25 cents per copy.

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