

SECTION 4C

FRONT AXLE DIFFERENTIAL (4-WHEEL DRIVE)

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FRONT AXLE DIFFERENTIAL

Differential Case

Removal (Fig. 4C-1)

1. If front axle assembly is removed from vehicle, mount assembly in suitable holding fixture and remove axle shafts as outlined in Axle Shaft Removal, Truck Service Manual.

2. Remove cover attaching bolts and lock washers and the metal tag secured by one of the attaching bolts. Remove cover and gasket.

NOTE: The tag shows the number of teeth on pinion and drive gear.

3. Remove differential side bearing caps, making sure

they are marked for reassembly in the same position.

4. Position Spreader Tool J-5231-01 so the two dowels on tool fit into recesses in carrier, install two hold down bolts and install a dial indicator at one end of opening in carrier to indicate width of opening.

5. Expand spreader tool to spread carrier a maximum of .020".

CAUTION: Do not attempt to remove differential without using the spreader tool. Do not expand carrier more than .020 in. or it may be damaged and take a permanent set.

6. Remove dial indicator and, using a pry bar, lift out differential assembly. Remove and tag bearing cups so they may be reinstalled in their original positions. Relieve pressure on spreader tool and remove tool.

Oil Seal Replacement

The axle shaft inner oil seals are located just outboard of the differential bearings, item 28, Fig. 4C-2. They can be replaced only after the differential is removed from the carrier, using tool J-25111.

Disassembly

1. Remove bearing cups from differential case and identify for reassembly.

2. Remove bearing cones from case, using puller J-22888 and correct plug (fig. 4C-4) and remove shims from case. Identify all parts so they may be reassembled in their original location.

3. Drive the pinion shaft lock pin out of case.

4. Remove ring gear bolts from case and separate ring gear from case.

5. Remove pinion shaft, pinions, side gears and thrust washers from case.

DRIVE PINION

Removal

1. Using Holding Bar J-8614-1, attached to pinion shaft flange, remove self-locking nut and washer from pinion shaft.

2. Install Tool J-8614-2, and 3 into holding bar as shown in Figure 4C-5 and remove flange from drive pinion. Remove

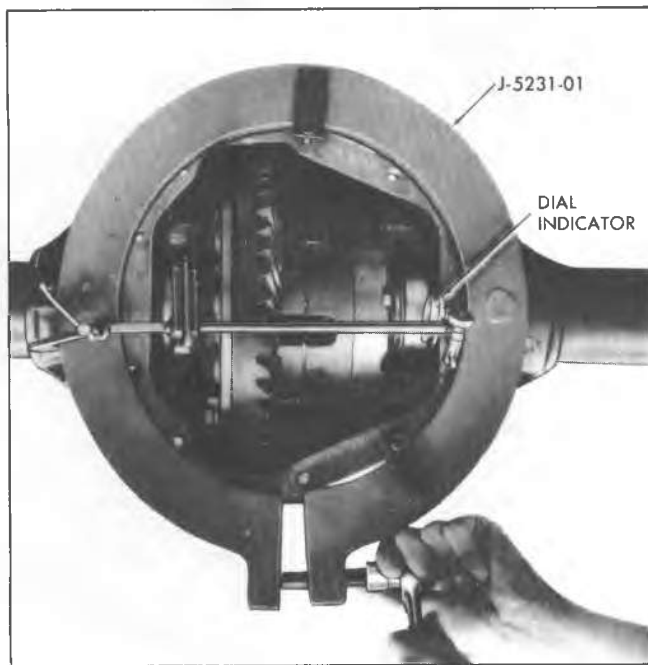
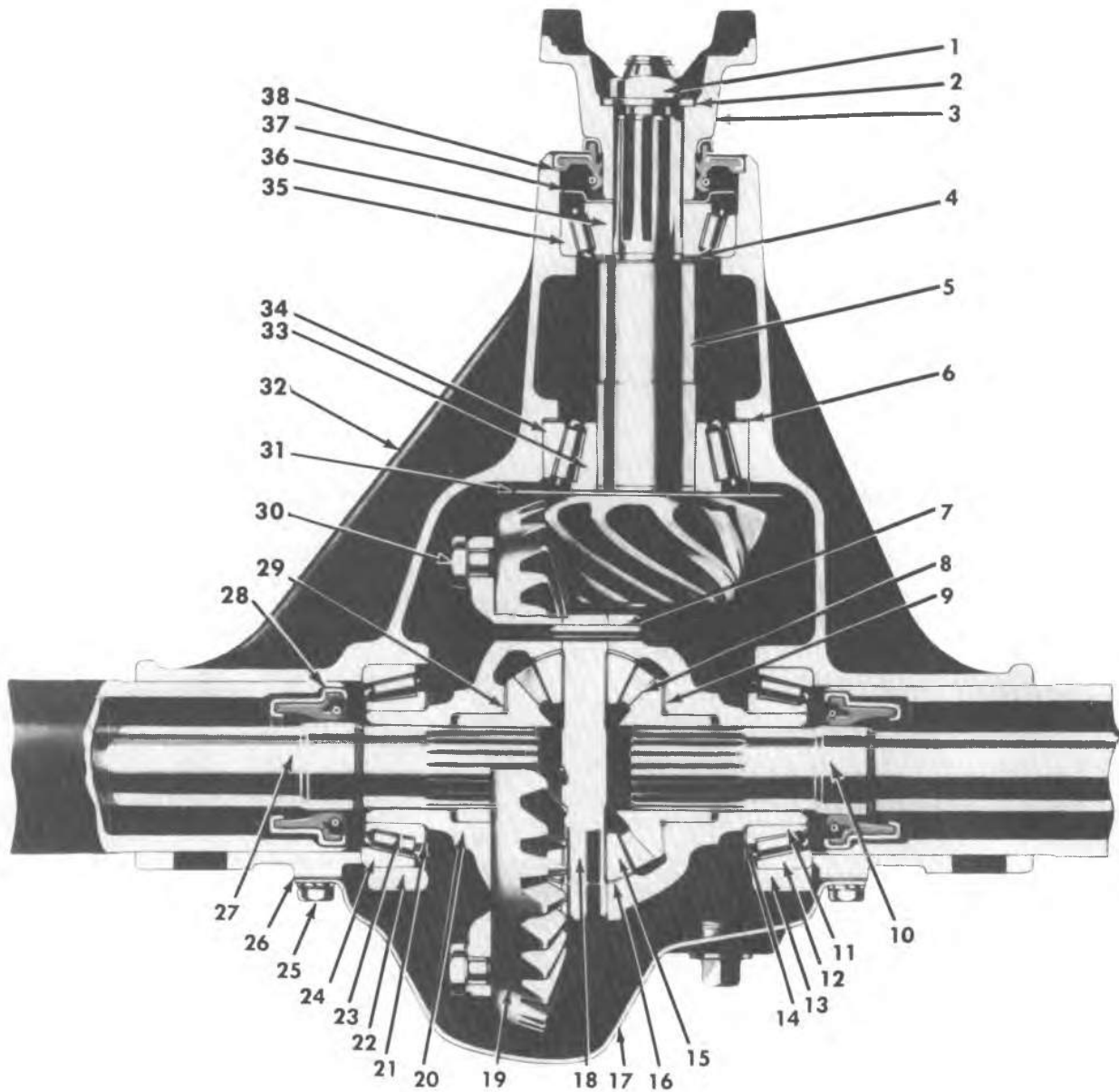
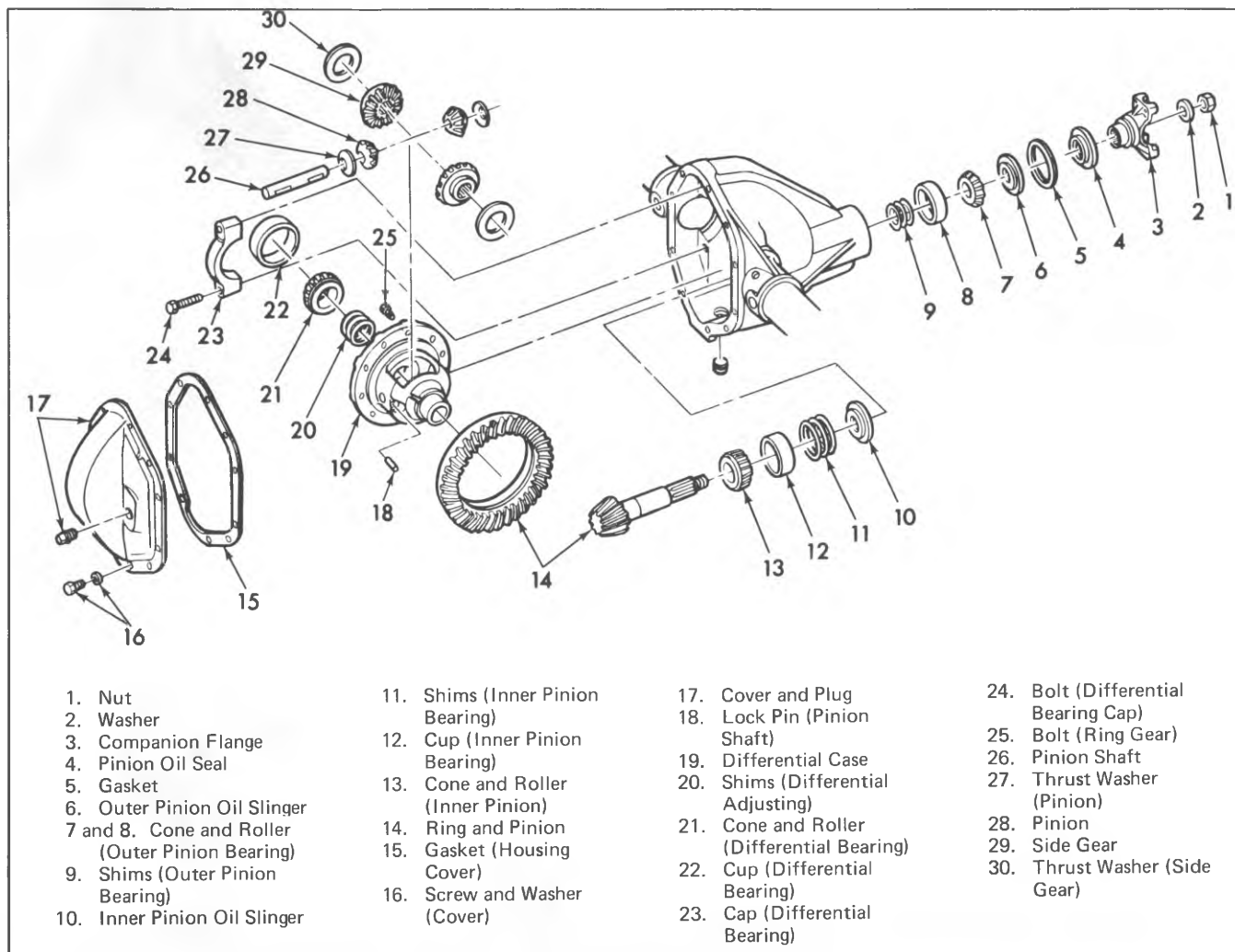


Fig. 4C-1--Spreading Case With J-5231-01



- | | | | |
|---------------------------|--|--|--------------------------|
| 1. Nut | 11. Differential Bearing Cone | 20. Differential Case | 29. Thrust Washer |
| 2. Washer | 12. Differential Bearing Cup | 21. Differential Bearing Adjusting Shims | 30. Ring Gear Bolt |
| 3. Pinion Flange | 13. Bearing Cap | 22. Differential Bearing Cap | 31. Oil Slinger |
| 4. Outer Bearing Shims | 14. Differential Bearing Adjusting Shims | 23. Differential Bearing Cone | 32. Differential Carrier |
| 5. Drive Pinion | 15. Differential Pinion | 24. Differential Bearing Cup | 33. Inner Bearing Cone |
| 6. Inner Bearing Shims | 16. Thrust Washer | 25. Cover Bolt | 34. Inner Bearing Cup |
| 7. Lock Pin | 17. Cover | 26. Gasket | 35. Outer Bearing Cup |
| 8. Differential Side Gear | 18. Pinion Cross Shaft | 27. Axle Shaft | 36. Outer Bearing Cone |
| 9. Thrust Washer | 19. Ring Gear | 28. Oil Seal | 37. Oil Slinger |
| 10. Axle Shaft | | | 38. Oil Seal |

Fig. 4C-2--Front Axle Differential Assembly



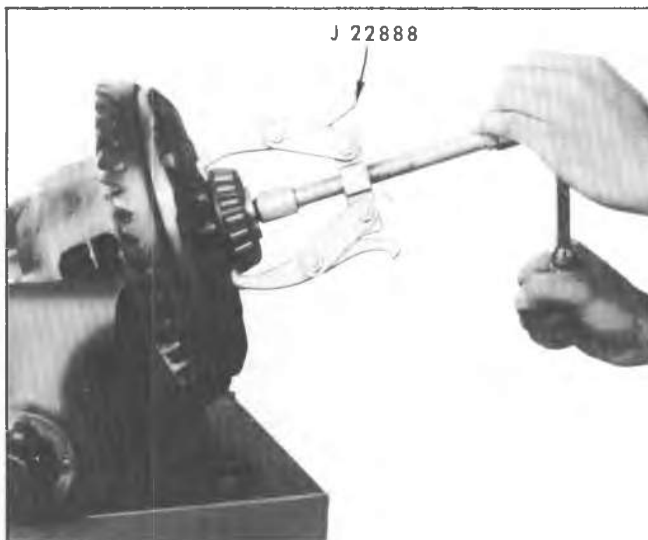


Fig. 4C-4--Removing Side Bearing

drive pinion from carrier.

3. With a long drift, tap on inner race of outer pinion bearing to remove pinion oil seal, slinger, gasket, outer pinion cone and roller and shim pack. Tag shim pack for reassembly.

4. Should inspection indicate necessity, pinion bearing cups can be removed from carrier using a long drift and hammer. Remove shims and oil slinger which are located behind the inner bearing cup. Tag shims for reassembly.

5. Remove inner pinion cone and roller using Tool J-22912, installed as shown in Figure 4C-6, and press pinion from bearing.

Inspection

1. Clean all gears and bearings in cleaning solvent and inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear. On pinion bearing rollers, inspect large end of rollers for wear. This is where wear is most evident on tapered roller bearings.

NOTE: The pinion bearings are of the tapered type, and the natural wear pattern is a frosted condition with occasional slight scratches on races or rollers. This does

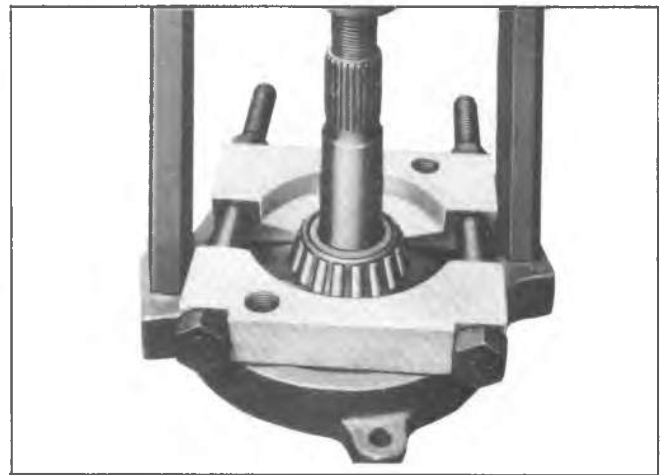


Fig. 4C-6--Removing Inner Pinion Bearing Cone and Roller

not indicate a defective bearing.

2. Inspect pinion splines and flange splines for evidence of excessive wear.

3. Inspect ring gear and pinion teeth for possible scoring, cracking or chipping.

4. Inspect differential case for cracks or scores on side gears, thrust washers, and pinion thrust faces.

5. Check fit of differential side gears in case.

6. Check fit of side gears and axle shaft splines.

7. Inspect differential pinion shaft and spacer for scoring or evidence of excessive wear.

DIFFERENTIAL CASE

Reassembly

1. Position differential side gears and new thrust washers in differential case.

2. Position differential pinions and new thrust washers in differential case. Align pinions with holes in differential case.

3. Install pinion shaft in differential case. Align hole in shaft with hole in case, then install lock pin. Peen hole to prevent pin dropping out of case.

4. Position ring gear to case, then install cap screws. Tighten cap screws evenly and alternately to specifications.

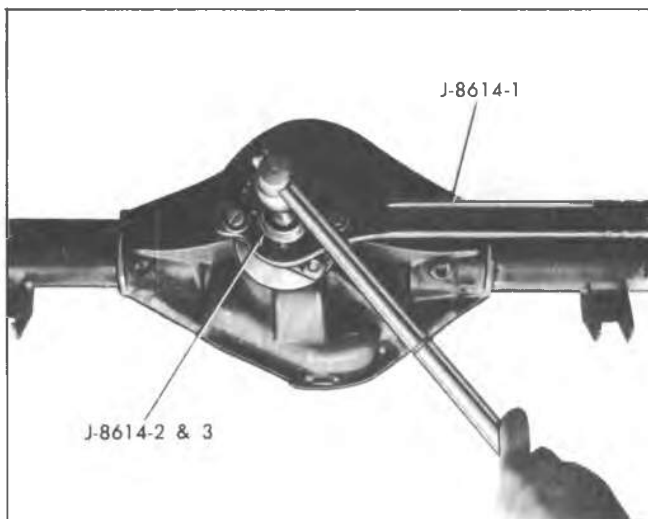


Fig. 4C-5--Removing Pinion Flange

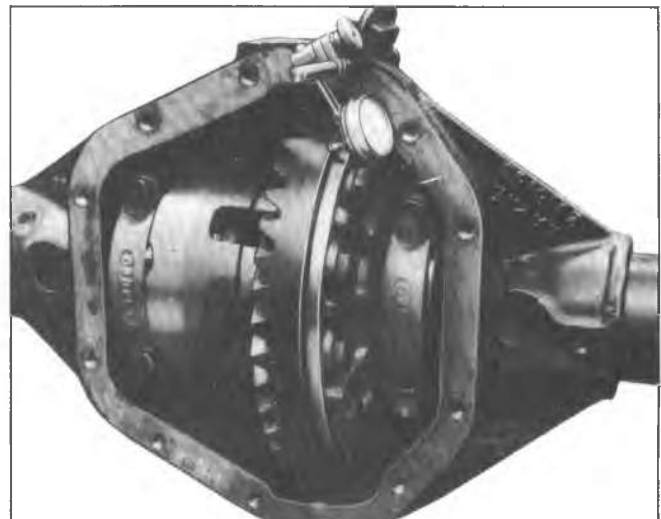


Fig. 4C-7--Checking Runout

Old Pinion Marking	New Pinion Marking								
	- 4	- 3	- 2	- 1	0	+ 1	+ 2	+ 3	+ 4
+ 4	+ 0.008	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0
+ 3	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001
+ 2	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002
+ 1	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003
0	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004
- 1	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005
- 2	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006
- 3	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007
- 4	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007	- 0.008

Fig. 4C-8--Drive Pinion Shim Chart

5. With an arbor press, press differential side bearings onto case using Tool J-22175. Do not install shims at this time.

6. Place differential case in carrier and install bearing caps. Care should be taken to install caps in original position. Use mark placed on caps and carrier at removal. Tighten caps just enough to keep bearing caps in place.

7. Install dial indicator on carrier with indicator button contacting back of ring gear (Fig. 4C-7). Rotate differential case and check for runout. If runout is greater than .002", the assembly should be removed and the ring gear removed from case. Again install differential case and check runout at differential case flange.

8. Should runout of case flange be greater than .002", the defect is probably due to bearings or differential case, and should be corrected before proceeding further.

9. Position two screwdrivers between bearing cup and carrier on opposite side of ring gear (away from dial indicator side). Pull on screwdrivers and force differential case as far as possible toward the dial indicator. Rock the ring gear to set the bearings. With force still applied, set indicator at "0".

10. Reposition screwdrivers between bearing cup and carrier on ring gear side. Pull on screwdrivers and force differential case as far as possible toward center of carrier. Repeat several times until the same reading is obtained. Record the indicator reading. This will be the total amount of shims needed (less preload) for setting backlash later during assembly.

11. Remove differential from carrier.

DRIVE PINION

Installation and Adjustment of Depth and Preload

Ring gears and pinions are supplied in matched sets only. Matching numbers on both pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers of each pinion and ring before proceeding with assembly.

On the button end of each pinion there is etched a plus + number, a minus - number, or a zero(0) number, which indicates the best running position for each particular gear

set. This dimension is controlled by the shimming behind the inner bearing cup. Whenever baffles or oil slingers are used, they become a part of the adjusting shim pack.

For example: If a pinion is etched +3, this pinion would require .003" less shims than a pinion etched "0". This means by removing shims, the mounting distance of the pinion is increased by .003" which is just what a +3 etching indicates. Or if a pinion is etched -3, we would want to add .003" more shims than would be required if the pinions were etched "0". By adding .003" shims, the mounting distance of the pinion was decreased .003" which is just what a -3 etching indicated.

If the old ring and pinion set is to be reused, measure the old shim pack and build a new shim pack to this same dimension. If baffle is in the axle assembly, it is considered as part of the shim pack.

To change the pinion adjustment, shims are available in thicknesses of .003", .005" and .010".

NOTE: If baffle or slinger is bent or mutilated, it should be replaced.

Measure each shim separately with a micrometer and add together to get total shim pack thickness from original build up.

If a new gear set is being used, notice the plus or minus etching on both the old and new pinion, and adjust the thickness of the old shim pack to compensate for the difference of these two figures.

For example: If the old pinion reads +2 and the new pinion is -2, add .004" shims to the original shim pack.

1. Determine proper inner shim pack (for setting pinion depth) by using chart (fig. 4C-8).

2. Install inner shim pack and oil slinger in inner cup bore and drive inner cup into position using Tool J-21059 used with J-8092.

3. To the outer shim pack (for setting preload) add or remove an equal amount as was added or removed from the inner shim pack.

4. Install outer cup in carrier bore, using installer J-7818 with Drive Handle J-8092.

5. Press inner pinion bearing cone and roller onto pinion shaft using Installer J-9772 on arbor press as shown in Figure 4C-9.

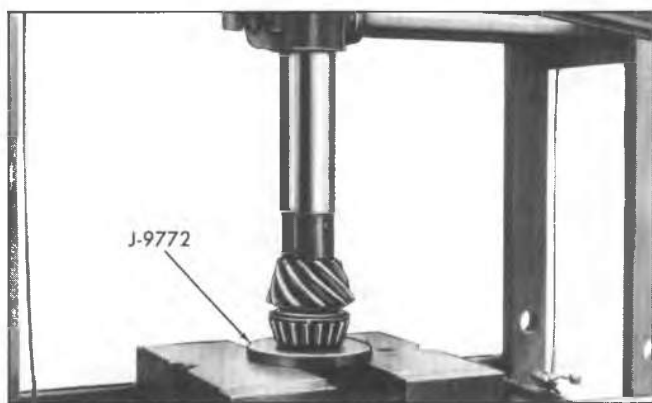


Fig. 4C-9--Installing Inner Pinion Core and Roller

6. Install drive pinion and inner bearing cone and roller assembly in differential carrier.

7. Install shims and outer pinion cone and roller on pinion shaft using Tool J-5590 and companion flange to press bearing onto pinion (Fig. 4C-10).

8. Install flange holding bar and install washer and nut on pinion shaft. Torque nut to 255 ft. lbs.

9. Remove holding bar and with an inch pound torque wrench measure rotating torque. Rotating torque should be 10 to 20 in. lbs. with original bearings or 20 to 40 in. lb. with new bearings.

NOTE: Torque reading to start shaft turning must be disregarded.

10. If torque requirements (preload) are not to specifications, adjust shim pack as necessary. Increase the outer shim pack to reduce rotation torque. Decrease shim pack to increase rotating torque.

11. Remove nut, washer and flange from pinion shaft.

12. Install oil slinger, gasket and using Tool J-22804 install oil seal.

13. Install flange, washer and nut. Torque nut to specifications.

DIFFERENTIAL CASE

Preload and Adjustment

1. Place differential assembly (with pinion assembled) into housing. Install bearing caps in their proper position and tighten screws just enough to hold the bearing cups in place.

2. Install dial indicator on carrier with indicator button contacting back of ring gear (Fig. 4C-7).

3. Place two screwdrivers between bearing cup and housing on ring gear side of case, and pry ring gear into mesh with pinion gear as far as it will go. Rock ring gear to allow bearings to seat and gears to mesh. With force still applied, set indicator to "0".

4. Reposition screw drivers on opposite side of ring gear and pry ring gear as far as it will go. Now take an indicator reading. Repeat until the same reading is obtained every time. This reading will be the necessary amount of shims between the differential case and differential bearing on the ring gear side. Remove differential bearing from the ring gear side and assemble proper amount of shims. Reassemble bearing.

5. Remove the differential bearing from the opposite side of ring gear. To determine the amount of shims needed here, use the following method.

a. Subtract the size of shim pack just installed on ring

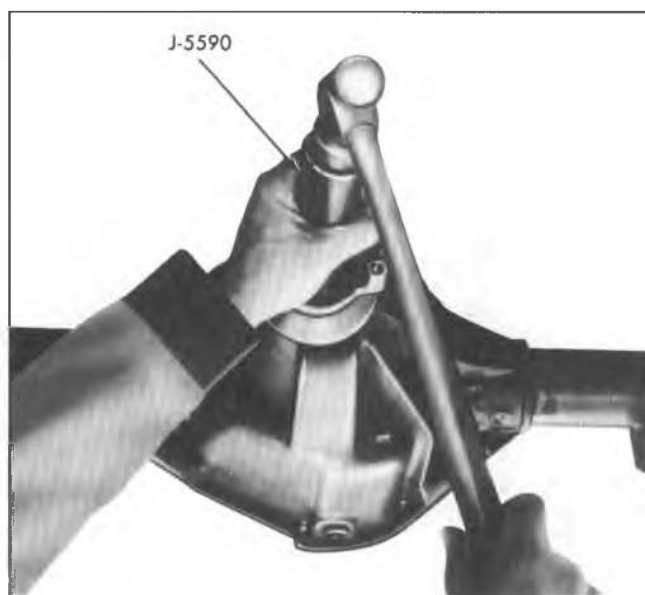


Fig. 4C-10--Installing Pinion Flange

gear side of case from the reading obtained and recorded in step 10 of Differential Case Reassembly.

b. To this figure, add an additional .015" shims to compensate for preload and backlash.

Example: If reading in step 10 of Differential Case-Reassembly was .085" and the shims installed on ring gear side of case was .055", the correct amount of shim will be $.085" - .055" + .015" = .045"$.

6. Install shims as indicated in step 5, (which will give the proper bearing preload and backlash) and install side bearing.

Installation

1. Spread differential carrier, using spreader as shown in Figure 4C-1.

2. Install differential bearing cups in their correct locations then install differential case into carrier.

3. Install differential bearing caps in the correct location as indicated by marks made at disassembly. Install cap screws finger tight. Rotate differential assembly and rap on case with a soft-faced hammer to ensure proper seating of case in carrier.

4. Remove spreader and torque cap bolts to specifications.

5. Install dial indicator and check ring gear backlash at four equally spaced points around the ring gear. Backlash must be held to .004" to .009" and must not vary more than .002" between positions checked.

6. Whenever backlash is not within limits, differential bearing shim pack should be corrected to bring backlash within limits.

7. Check gear tooth contact as described in "Gear Tooth Contact Pattern Check".

8. After a successful pattern check, install housing cover using a new gasket.

9. Install axle shafts and install axle assembly into vehicle (See Service Manual).

10. Fill with recommended lubricant, lower vehicle to floor and road test vehicle.

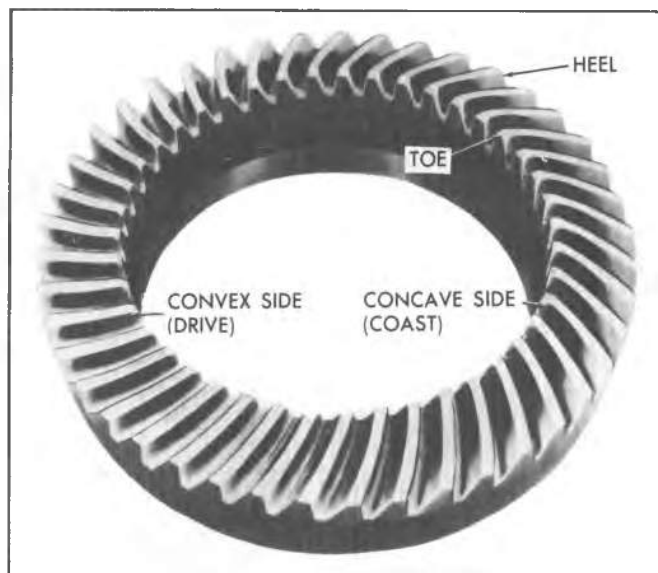


Fig. 4C-11--Gear Tooth Nomenclature

GEAR TOOTH CONTACT PATTERN CHECK

Prior to final assembly of the differential, a Gear Tooth Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 4C-11.

Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound and apply this mixture sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten bearing cap bolts to 55 lb. ft.
4. Apply a load until a torque of 40-50 lb. ft. is required to turn the pinion.

NOTE: A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with Figure 4C-12.

Adjustments Affecting Tooth Contact

Two adjustments can be made which will affect tooth contact pattern. These are backlash and position of drive pinion in carrier. The effects of bearing preloads are not readily apparent on hand loaded teeth pattern tests; however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

NOTE: It may be necessary to adjust both pinion depth and backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and inner race of rear bearing. The shim is used in the differential to compensate for manufacturing tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting shims are also used to set side bearing preload). To increase backlash, increase right shim and decrease left shim an equal amount. To decrease backlash, decrease right shim and increase left shim an equal amount.

The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

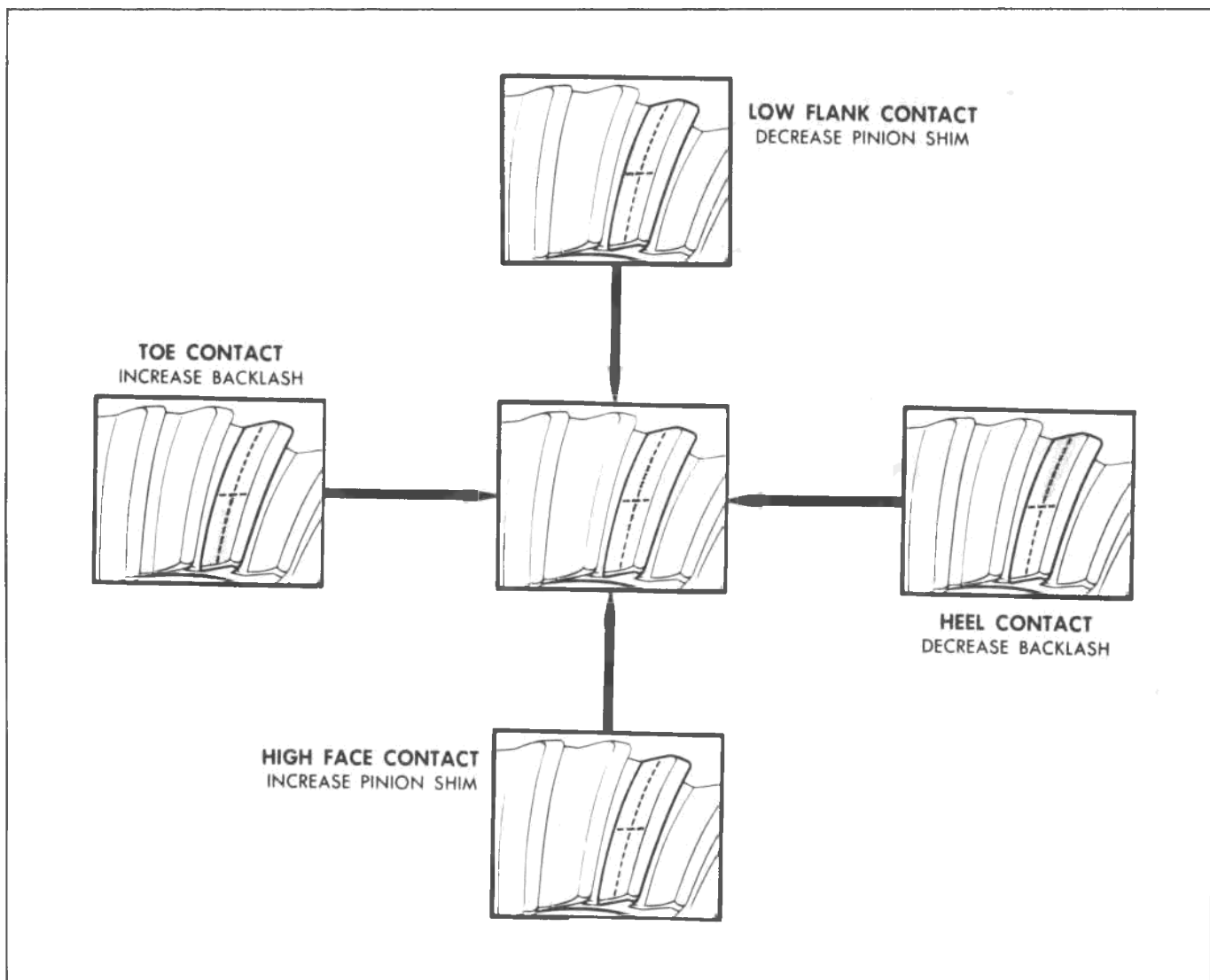
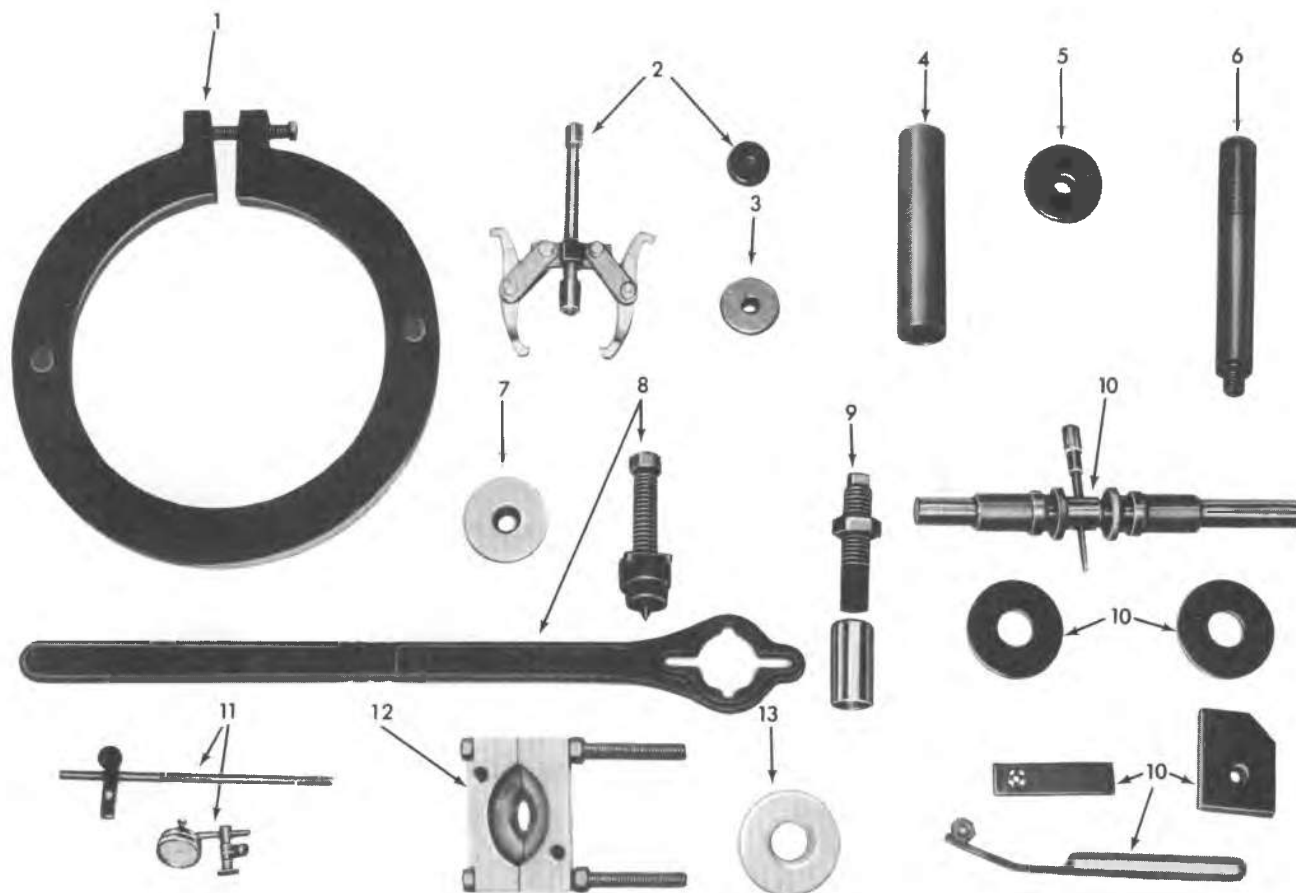


Fig. 4C-12--Gear Tooth Pattern Contact Pattern

SPECIAL TOOLS



1. J-5231-01 Spreader - Axle Carrier
2. J-22888 Puller - Side Bearing
3. J-22175 Installer - Side Bearing
4. J-5590 Installer - Pinion inner and outer bearing cone
5. J-6368 Installer - Pinion outer bearing cup (use with J-8092)
6. J-8092 Driver Handle (use with J-6368)
7. J-9276-2 Installer - Pinion inner bearing

8. J-8614-01 Holder and Remover - Companion Flange
9. J-23476 Installer - Companion Flange
10. J-5341 Gauge - Pinion Depth Consists of Parts:
(1) SE 1065-1, (2)-5, (2)-6, (2)-9SS, (1)-10, (1)-58 with 1" micrometer
11. J-8001 Dial Indicator Set
12. J-22912 Press Plate Pinion bearing
13. J-23494 Installer - Pinion oil seal use with J-23476

