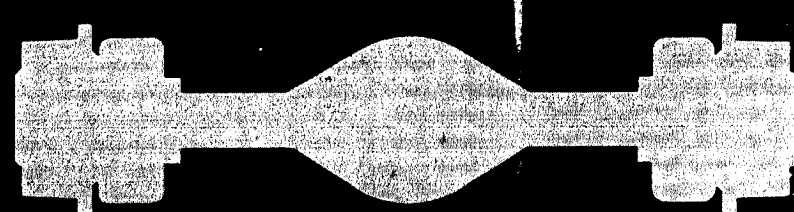
DRIVE AXLE SHOP MANUAL

SERIES FD-30001, FD-30500, FD-30600, FD-36500, FD-37500, RD-30500, RD-30600, RD-36500, RD-37500



CLARK

Michigan Company

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FD-30001, FD-30500, FD-30600,
FD-36500, FD-37500, RD-30500,
RD-30600, RD-36500, RD-37500
SERIES DRIVE AXLE

SHOP MANUAL

PUBLICATION NO. 1989

SPECIFICATION

130192	130998	131928
130269	131403	131929
130786	131507	190010
130787	131569	190011
130788	131720	190087
130790	131722	190088
130824	131927	190094

1M 8411 CGAC

CLARK

NOTES

FOREWORD

This manual has been prepared to provide the customer and the maintenance personnel with information and instructions on the maintenance and repair of the FD-30001, FD-30500, FD-30600, FD-36500, FD-37500, RD-30500, RD-30600, RD-36500 and RD-37500 Series Drive Axle Assemblies.

Extreme care has been exercised in the design, selection of materials and manufacturing of these units. The slight outlay in personal attention and cost required to provide regular and proper lubrication, inspections at stated intervals, and such adjustments as may be indicated will be reimbursed many times in low cost operation and trouble-free service.

In order to become familiar with the various parts of the axle, its overhaul and adjustments, it is urged that the mechanic study the instructions in this manual carefully and use it as a reference when performing maintenance and repair operations.

To assure the best results and to maintain the original quality built into the axle, it is important that only Clark-approved parts be used when new parts are required. IMPORTANT: Always furnish the Distributor with the machine serial number when ordering parts.

Many owners of MICHIGAN Equipment employ the Distributor's Service Department to perform all repair operations other than routine lubrication, care and adjustments. This practice is encouraged as our Distributors are kept well informed by the factory regarding proper methods of servicing our products and are equipped to render this service.

TABLE OF CONTENTS

FD-30001, FD-30500, FD-30600, FD-36500, FD-37500, RD-30500, RD-30600, RD-36500 and RD-37500 Series Drive Axles

DESCRIPTION

The axle assembly is a full-floating spiral bevel type with further reduction provided by planetary gear set within the wheel hub.

PRIMARY REDUCTION

The spiral bevel pinion and ring gear transmit power through the center differential pinions and side gears or through a NoSPIN differential to the axle shaft. The spiral bevel differential assembly is mounted on tapered roller bearings which are adjusted by positioning of the two threaded adjusting nuts mounted in the differential carrier and cap assembly. The tapered roller pinion bearing preload is adjusted and maintained by a hardened and precision ground spacer positioned between inner and outer bearings. Spacer is selected at assembly.

SECONDARY REDUCTION

In the wheel hub, a self-centering sun gear is spline fitted to the axle shaft and drives three planetary pinion gears. These gears in turn mesh with and react against a rigidly mounted internal ring gear. The planet gears rotate on needle roller bearings mounted on hardened and ground pins located in the planet carrier which in turn drives the wheel hub. Positive lubrication keeps all moving parts bathed in lubricant to reduce friction, heat and wear.

Brake assemblies are actuated by hardened and ground cam shafts which in turn are actuated by air chambers mounted externally on the axle. Air pressure is provided to the air chambers from the air system of the vehicle when foot pressure is applied to the brake treadle valve mounted on the floorboard of the operator's compartment.

Manually operated parking brakes are supplied on some models. These consist of a brake drum, mounted on the companion flange, which encompasses a mechanically operated brake shoe and lining assembly.

AXLE APPLICATION

Following is a list of axles covered in this manual and the application of these axles.

Part No.	Model No.	Model Usage
130192	FD-30001-2	180-I (175A-I)
130269	FD-30001-3	175A-I
130786	FD-30500	110-I (175A-I)
130787	FD-30500-1	175A-I
130788	FD-30500-2	180-I
130790	FD-30001-7	175A-1
130824	FD-30500-3	110-I
130998	FD-36500-2	175A-II
131403	FD-36500-6	110-I
131507	FD-36500-10	180-III
131569	FD-36500-11	110-III
131720	FD-30500-8	125-III
131722	FD-36500-12	175-III, 175-IIIA
131927	FD-30500-12	125-IIIA
131928	RD-30500-11	125-IIIA
131929	RD-36500-6	175-IIIA
190010	FD-37500-4	180-III
190011	FD-37500-5	175-III, 175-IIIA
190087	FD-30600-2	125-IIIA
190088	FD-30600-1	125-IIIA
190094	RD-37500-2	175-IIIA

LUBRICATION

Proper lubrication is necessary to assure long periods of trouble-free operation. Not only is it important that the required lubrication schedule be maintained, but also that the proper type of lubricant be used. The following are the only lubricants recommended for use in these axles. Consult applicable Operators Manual for machine model involved for capacities and lubrication schedules.

DIFFERENTIAL AND PLANETARIES

*SAE 90 Extreme Pressure Gear Lube, SCL Type (Sulfo-Chloro-Lead), per MS-8 Specifications given herein.

*NOTE: When operating at ambient temperatures consistently below 0° F, use SAE 80 and when consistently above 100° F, use SAE 140. SAE 80 and SAE 140 grades when used should contain like additives specified for SAE 90 grade.

EXTREME PRESSURE GEAR LUBE
Specifications MS-8

Lubricants purchased under this specification shall be a well-refined mineral oil properly compounded with sulphur-chlorine-lead type extreme pressure additives. They shall be free of fillers or abrasives, such as fuller's earth, talc, graphite, cork, etc. They shall be stable, non-abrasive, and non-corrosive whether or not in the presence of small percentages of water.

PHYSICAL AND CHEMICAL PROPERTIES

S. S. U @ 210° F	90-100 Seconds
S. S. U @ 100° F	1400 Seconds Max.
A. P. I. Gravity	14.4-15.9 Degrees
Pour Point	—10° F. Max.
Flash Point	350° F. Min.
Fire Point	400° F. Min.
Sulphur (Added)	1.20% Min.
Sulphur (Total)	3.00% Min.
Chlorine	1.20% Min.
Lead as Lead Oxide (PbO)	2.00% Min.
Moisture	.20% Max.
Load Carrying Capacity	
Timken Test Lever Load	70 lbs. Min.
Timken Abrasion Test (Total Loss)	2.0 mg. Max.
Heating Test	
Evaporation Loss	4.0% Max.
Viscosity Increase	10.0% Max.

DIFFERENCES IN MODELS

The following differences exist among the axles covered in this manual:

Part No.	Differential Ratio	Differential Type	Differential Pinion Spiral	Total Axle Ratio	Brake Size	Parking Brake Installed
130192	6.5:1	Standard	Left Hand	23.833:1	16.5 x 6	Yes
130269	6.5:1	Standard	Left Hand	23.833:1	16.5 x 6	Yes
130786	4.625:1	Standard	Left Hand	16.958:1	16.5 x 6	Yes
130787	6.5:1	Standard	Left Hand	23.833:1	16.5 x 6	Yes
130788	6.5:1	NoSPIN	Left Hand	23.833:1	16.5 x 6	Yes
130790	6.5:1	Standard	Left Hand	23.833:1	16.5 x 6	Yes
130824	4.625:1	Standard	Left Hand	16.958:1	20 x 7	Yes
130998	6.5:1	Standard	Left Hand	23.833:1	20 x 5	Yes
131403	6.333:1	Standard	Left Hand	23.222:1	20 x 7	No
131507	6.333:1	NoSPIN	Left Hand	23.222:1	20 x 5	Yes
131569	6.333:1	Standard	Right Hand	23.222:1	20 x 7	No
131720	6.333:1	Standard	Left Hand	23.222:1	20 x 5	Yes
131722	6.333:1	Standard	Left Hand	23.222:1	20 x 5	Yes
131927	6.333:1	Standard	Left Hand	23.222:1	20 x 5	Yes
131928	6.333:1	Standard	Right Hand	23.222:1	20 x 5	No
131929	6.333:1	Standard	Right Hand	23.222:1	20 x 5	No
190010	5.429:1	NoSPIN	Left Hand	22.393:1	20 x 5	Yes
190011	5.429:1	Standard	Left Hand	22.393:1	20 x 5	Yes
190087	6.333:1	Standard	Left Hand	26.125:1	20 x 5	Yes
190088	6.333:1	Standard	Left Hand	26.125:1	20 x 5	No
190094	5.429:1	Standard	Right Hand	22.393:1	20 x 5	No

EXPLODED VIEWS

To supplement the illustrations provided in the overhaul section of the manual, exploded view illustrations are supplied. Legends, keyed to the index numbers on the illustrations, are adjacent to the illustrations to aid in parts identification on the axles. The exploded views are as follows:

Fig. A — Drive Axle Assembly

Fig. B — Differential and Carrier Assembly

Fig. C — NoSPIN Differential

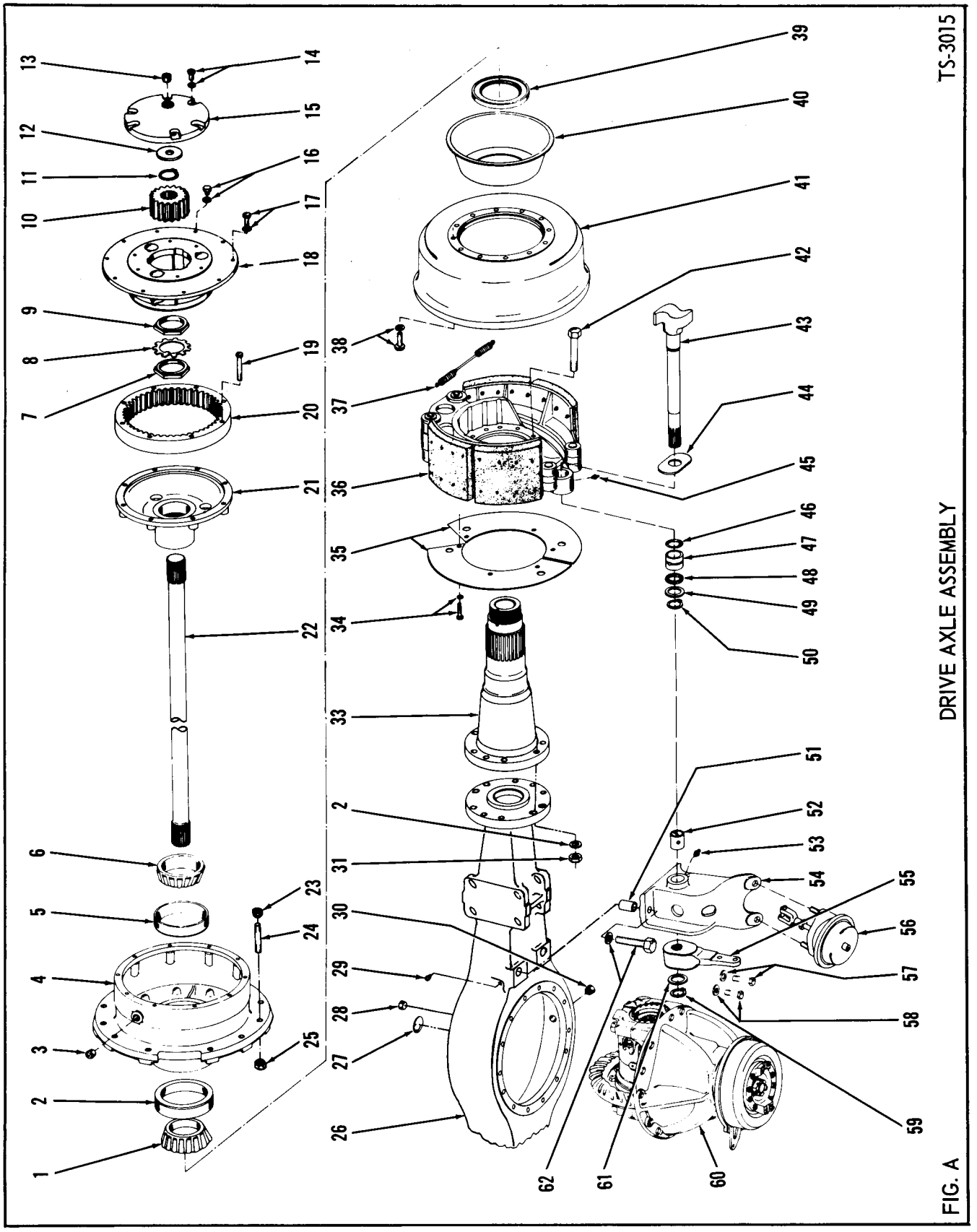
Fig. D — Planet Carrier Assembly

Fig. E — Service Brake Assembly

Fig. F — Parking Brake Assembly

The following compounds, or their equivalent, are required for the overhaul of these axles:

Material	Use
Lubriplate	Apply to lips of all oil seals at reassembly.
Mixture of Red Lead and Linseed Oil	Paint ring gear teeth to check for proper differential gear and pinion engagement.
Never-Seez Compound	Apply to eccentric anchor pins of brake.
Permatex No. 2	Used for numerous sealing applications.


TS-3015
DRIVE AXLE ASSEMBLY
FIG. A

DRIVE AXLE ASSEMBLY

Item No.	Description	No. Req'd.
1	CONE, Inner Hub Bearing	2
2	CUP, Inner Hub Bearing	2
3	PLUG, Hub Filler	2
4	HUB ASSY	2
5	CUP, Outer Hub Bearing	2
6	CONE, Outer Hub Bearing	2
7	NUT, Inner Spindle	2
8	LOCK, Spindle Nut	2
9	NUT, Outer Spindle	2
10	GEAR, Sun	2
11	RING, Sun Gear Retaining	2
12	WASHER, Sun Gear Thrust	2
13	PLUG, Thrust Cap	2
14	BOLT & LOCKWASHER, Thrust Cap	12
15	CAP, Sun Gear Thrust	2
16	BOLT & LOCKWASHER, Puller Hole	4
17	BOLT & WASHER, Planet Carrier to Hub	20
18	PLANET CARRIER	2
19	BOLT, Internal Gear to Hub	16
20	GEAR, Internal	2
21	HUB, Internal Gear	2
22	AXLE SHAFT	2
23	NUT, Wheel	20
24	STUD, Wheel	20
25	NUT, Wheel Stud	20
26	HOUSING, Axle	1
27	PLUG, Expansion	2
28	PLUG, Housing Filler	1
29	BREATHER, Axle Housing	1
30	PLUG, Housing Drain	1
31	NUT, Spindle & Brake Attaching	20
32	WASHER, Spindle & Brake Attaching	20
33	SPINDLE	2
34	BOLT & LOCKWASHER, Dust Cover	8
35	COVER, Brake Dust	4
36	REAR BRAKE ASSY	2
37	SPRING, Brake Shoe Return	2
38	BOLT & WASHER, Brake Drum to Hub	24
39	SEAL, Hub Oil	2
40	CATCHER, Oil	2
41	DRUM, Brake	2
42	BOLT, Spindle & Brake Attaching	20
43	CAM SHAFT	1
44	WASHER, Cam Shaft Thrust	2
45	FITTING, Brake Spider Grease	2
46	"O" RING, Cam Shaft	2
47	BUSHING, Brake Spider	2
48	RETAINER, Brake Spider Grease	2
49	WASHER, Cam Shaft	2
50	RING, Washer Retaining	2
51	SPACER, Air Chamber Bracket	4
52	BUSHING, Air Chamber Bracket	4
53	FITTING, Air Chamber Bracket Grease	2
54	BRACKET ASSY, Air Chamber	2
55	ADJUSTER, Slack	2
56	AIR CHAMBER	2
57	BOLT & WASHER, Carrier to Axle Housing	10
58	BOLT & WASHER, Carrier to Axle Housing	4
59	RING, Slack Adjuster Retaining	2
60	DIFFERENTIAL & CARRIER ASSY	1
61	WASHER, Slack Adjuster Retaining	2
62	BOLT, Air Chamber Bracket	4

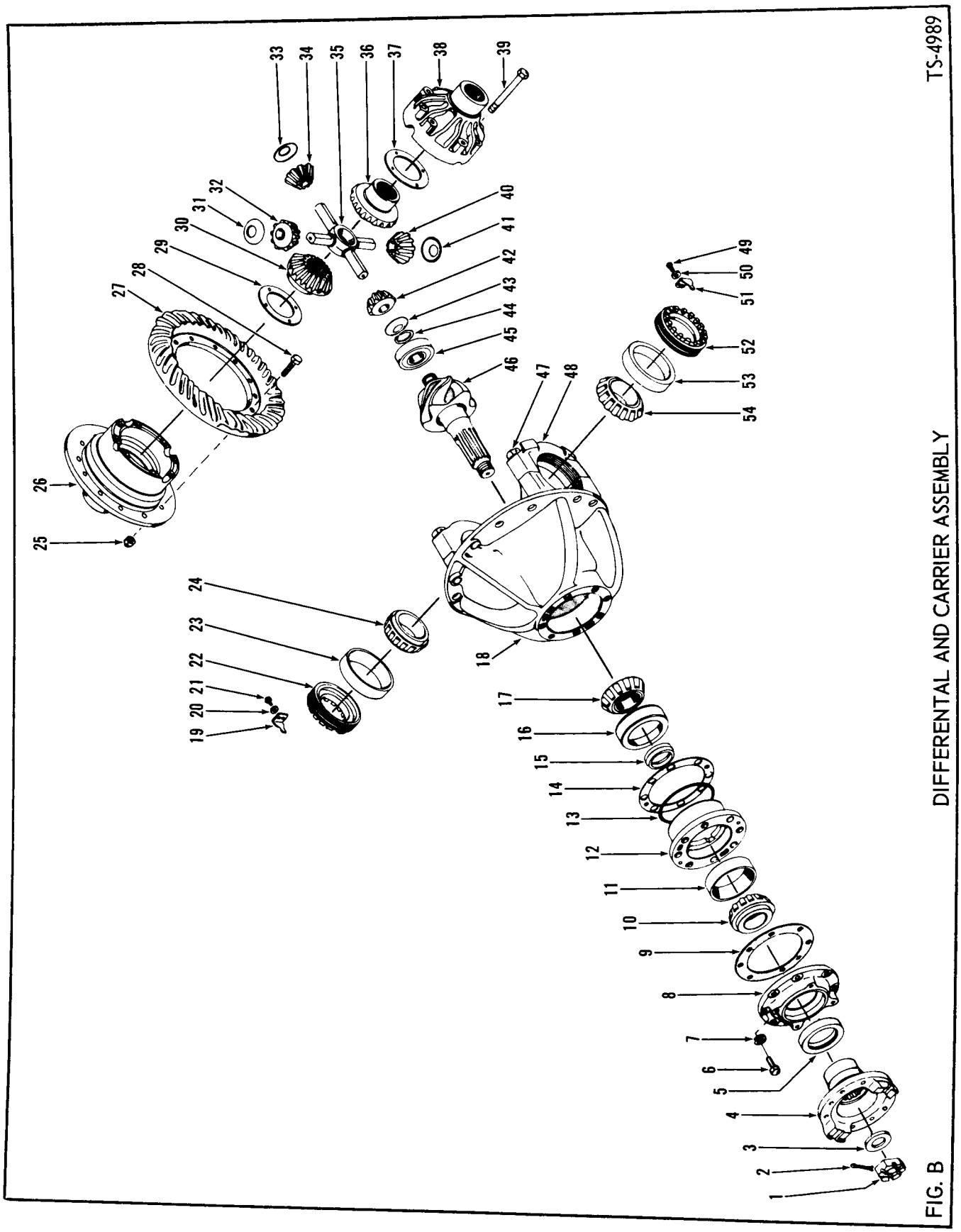

TS-4989
DIFFERENTIAL AND CARRIER ASSEMBLY
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FIG. B

DIFFERENTIAL AND CARRIER ASSEMBLY

Item No.	Description	No. Req'd.
1	NUT, Pinion Shaft	1
2	COTTER, Pinion Shaft Nut	1
3	WASHER, Pinion Shaft	1
4	FLANGE, Companion	1
5	SEAL, Pinion Oil	1
6	BOLT, Pinion Oil Seal Retainer	8
7	LOCKWASHER, Pinion Oil Seal Retainer	8
8	RETAINER, Pinion Oil Seal	1
9	GASKET, Pinion Oil Seal Retainer	1
10	CONE, Outer Pinion Bearing	1
11	CUP, Outer Pinion Bearing	1
12	CAGE ASSEMBLY, Pinion Bearing	1
13	"O" RING, Outer Pinion Bearing Cage	1
14	SHIM, Bearing Cage	AR
15	SPACER, Pinion Bearing	1
16	CUP, Center Pinion Bearing	1
17	CONE, Center Pinion Bearing	1
18	CARRIER ASSEMBLY, Differential	1
19	LOCK, Adjusting Nut	1
20	LOCKWASHER, Adjusting Nut Lock	1
21	BOLT, Adjusting Nut Lock	1
22	Nut, Differential Adjusting	1
23	CUP, Differential Bearing	1
24	CONE, Differential Bearing	1
25	NUT, Ring Gear	12
26	DIFFERENTIAL CASE, Flange Half	1
27	RING GEAR	1
28	BOLT, Ring Gear	12
29	WASHER, Side Gear Thrust	1
30	GEAR, Differential Side	1
31	WASHER, Differential Pinion Thrust	1
32	PINION, Differential	1
33	WASHER, Differential Pinion Thrust	1
34	PINION, Differential	1
35	SPIDER, Differential	1
36	GEAR, Differential Side	1
37	WASHER, Side Gear Thrust	1
38	DIFFERENTIAL CASE, Plain Half	1
39	BOLT, Differential Case	8
40	PINION, Differential	4
41	WASHER, Differential Pinion Thrust	1
42	PINION, Differential	1
43	WASHER, Differential Pinion Thrust	1
44	RING, Inner Bearing Snap	1
45	BEARING, Inner Pinion	1
46	PINION	1
47	BOLT & WASHER, Carrier Cap	4
48	CAP, Carrier	2
49	BOLT, Adjusting Nut Lock	1
50	LOCKWASHER, Adjusting Nut Lock	1
51	LOCK, Adjusting Nut	1
52	NUT, Differential Adjusting	1
53	CUP, Differential Bearing	1
54	CONE, Differential Bearing	1

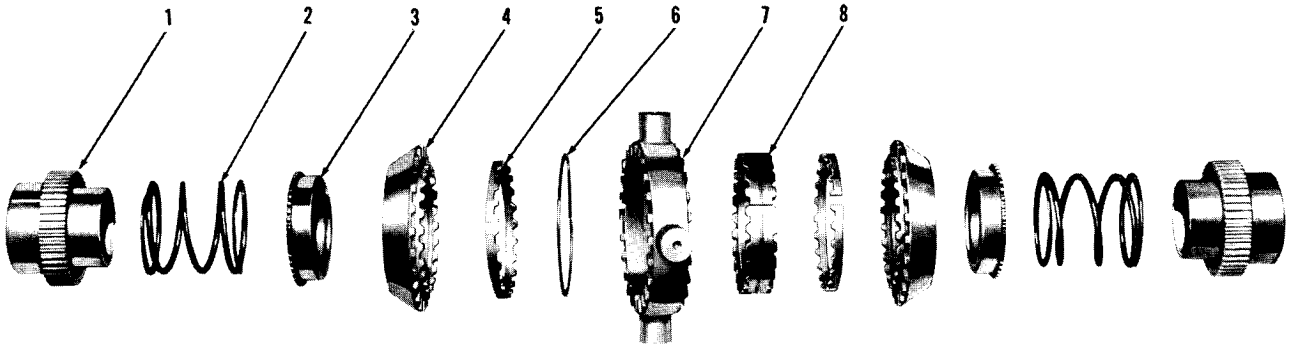


FIG. C TS-249-P

NoSPIN DIFFERENTIAL ASSEMBLY

Item No.	Description	No. Req'd.
1	GEAR, Side	2
2	SPRING	2
3	RETAINER, Spring	2
4	CLUTCH, Driven	2
5	RING, Holdout	2
6	RING, Retaining	1
7	SPIDER	1
8	CAM, Center	1

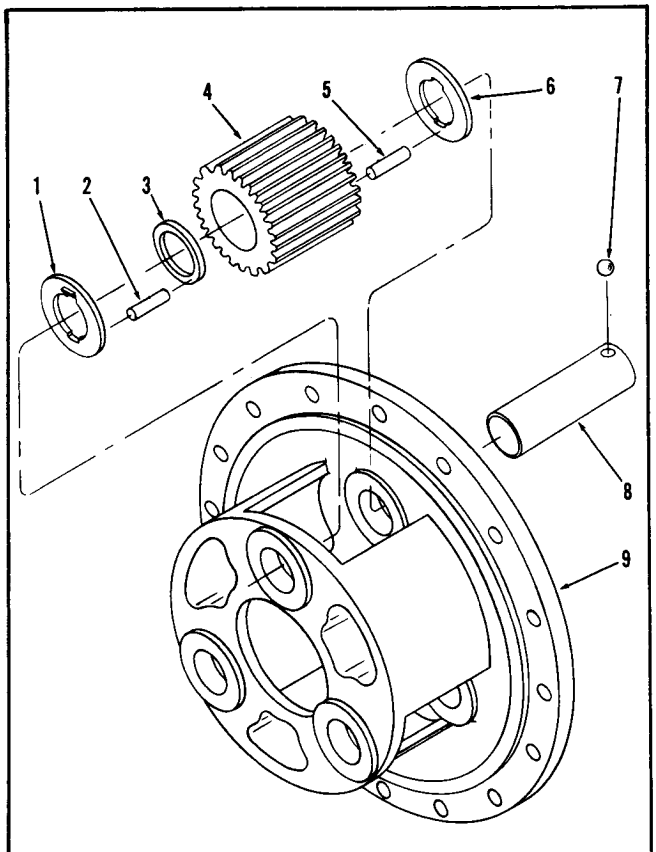
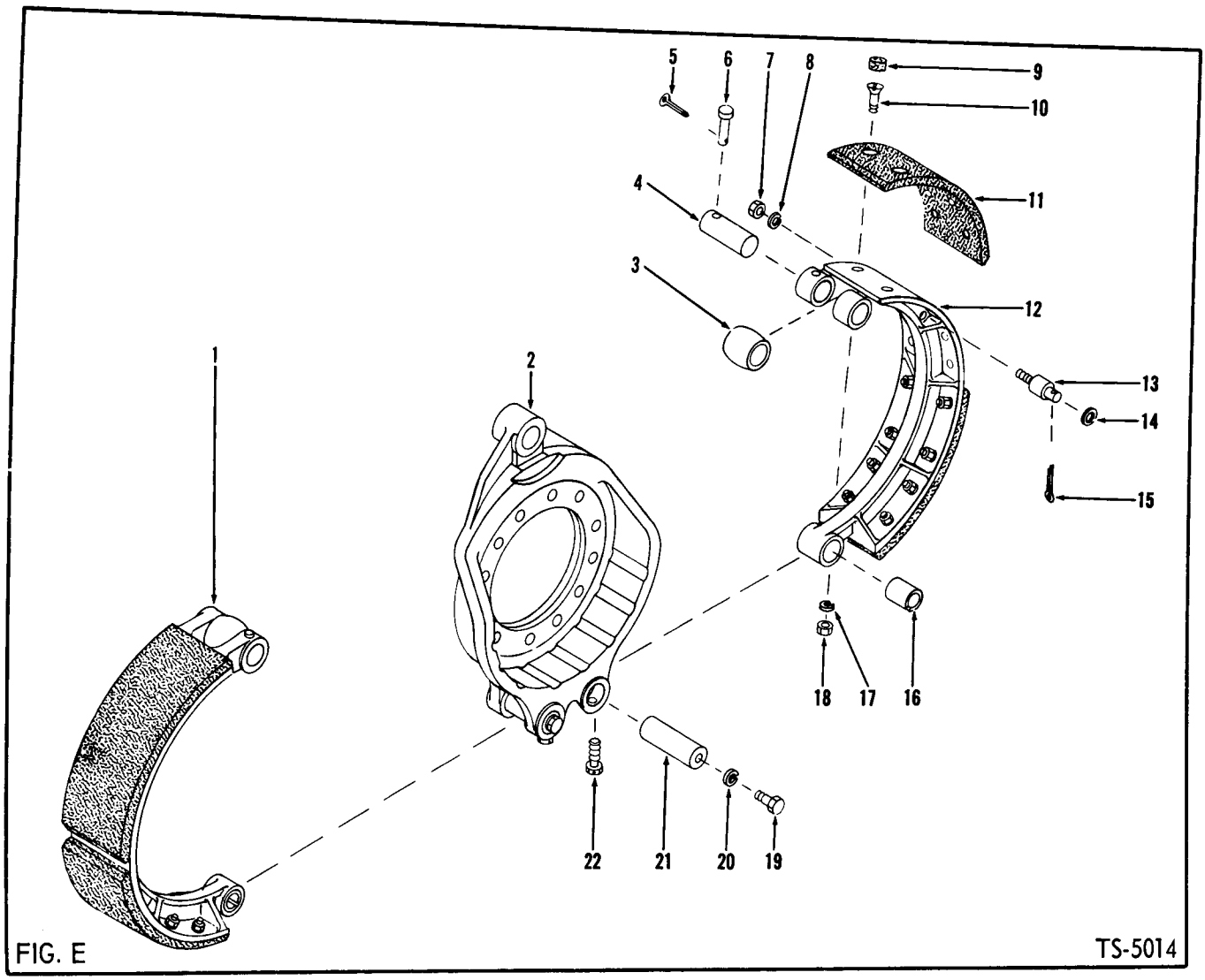


FIG. D TS-460P

Figure D—PLANET CARRIER ASSEMBLY

Item No.	Description	No. Req'd.
1	WASHER, Pinion Thrust	3
2	ROLLER, Pinion	78
3	SPACER, Pinion Roller	3
4	PINION	3
5	ROLLER, Pinion	78
6	WASHER, Pinion Thrust	3
7	BALL, Pinion Shaft Lock	3
8	SHAFT, Pinion	3
9	CARRIER, Planet	1



SERVICE BRAKE ASSEMBLY

Item No.	Description	No. Req'd.
1	SHOE ASSEMBLY, Brake	2
2	SPIDER, Brake	1
3	ROLLER, Brake Cam	2
4	PIN, Brake Cam Roller	2
5	COTTER, Roller Pin Lock	2
6	PIN, Cam Roller Pin Lock	2
7	NUT, Spring Anchor Pin	2
8	LOCKWASHER, Spring Anchor Pin	2
9	PLUG, Brake Lining	32
10	BOLT, Lining to Shoe	32
11	LINING, Brake Shoe	4
12	SHOE Brake	2
13	PIN, Spring Anchor	2
14	WASHER, Spring Anchor Pin	2
15	COTTER, Spring Anchor Pin	2
16	BUSHING, Brake Shoe	32
17	LOCKWASHER, Lining to Shoe	32
18	NUT, Lining to Shoe	[illegible]
19	BOLT, Puller Hole Plug	2
20	LOCKWASHER, Puller Hole Plug	2
21	PIN, Anchor	2
22	SCREW, Anchor Pin Set	2

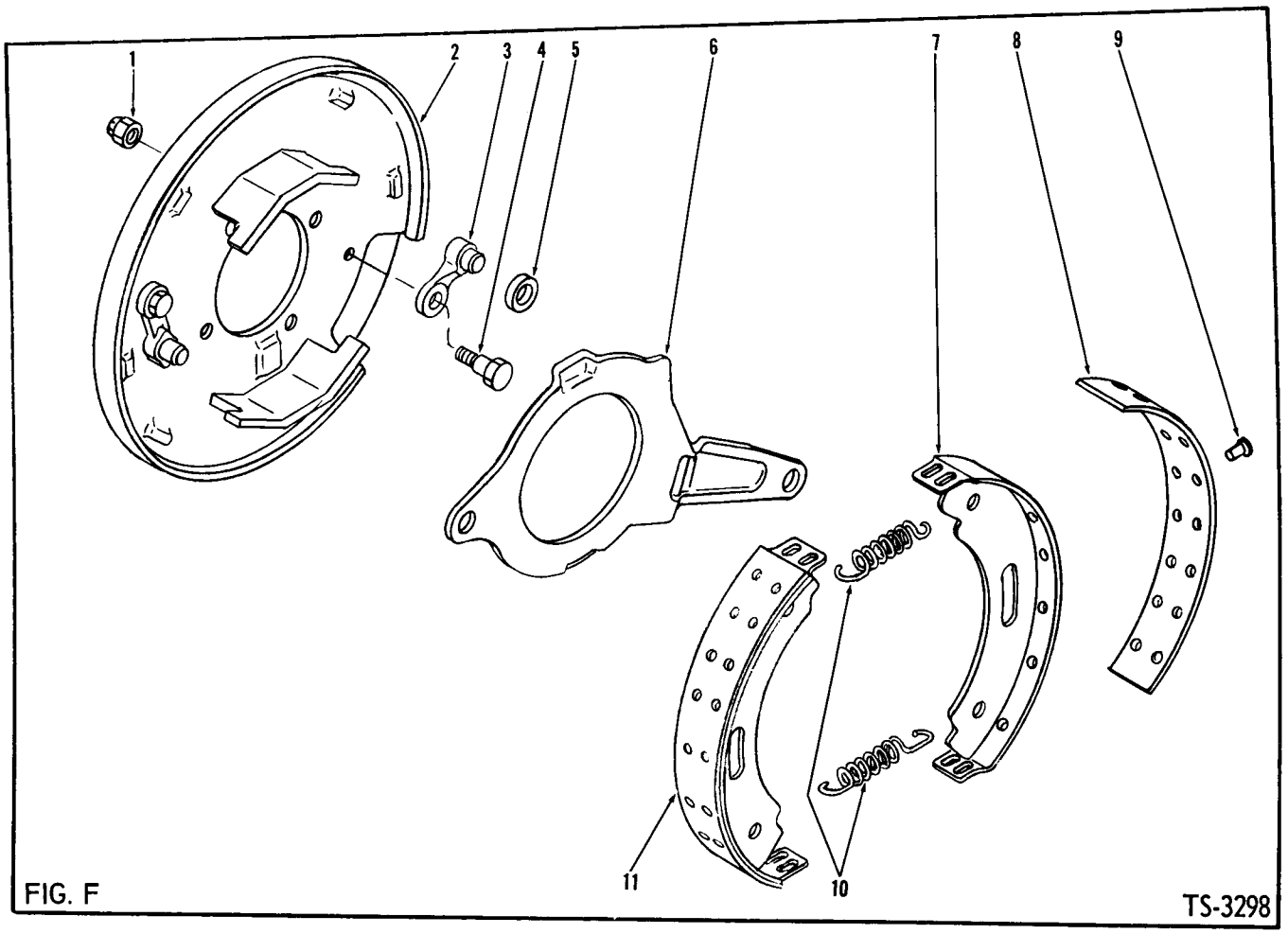


FIG. F

PARKING BRAKE ASSEMBLY

Item No.	Description	No. Req'd.
1	NUT, Pawl to Plate	2
2	PLATE, Brake Backing	1
3	PAWL, Brake	2
4	BOLT, Pawl to Plate	2
5	ROLLER, Brake Actuating	1
6	LEVER, Cam Operating	1
7	SHOE, Brake	2
8	LINING, Brake Shoe	1
9	RIVET, Lining to Shoe	28
10	SPRING, Shoe Return	2
11	SHOE ASSEMBLY, Brake	2

OVERHAUL OF AXLE ASSEMBLY

The instructions contained herein cover the disassembly and reassembly of the axle assembly in a sequence that would normally be followed after the unit has been removed from the machine and is to be completely overhauled.

CAUTION: Cleanliness is of extreme importance and an absolute must in the repair and overhaul of this unit. Before attempting any repairs, the exterior of the unit must be thoroughly cleaned to prevent the possibility of dirt and foreign matter entering the mechanism.

NOTE: Placing axles on steel horses facilitates disassembly and reassembly. Greater stability is gained by resting axle mounting pads on horses so that axles are inverted from normal operating positions. Photographs showing this overhaul procedure were taken with axle in inverted position.

DISASSEMBLY OF AXLE

1. Remove drain plugs from planetary housings and from differential housing to drain axle (Fig. 1).

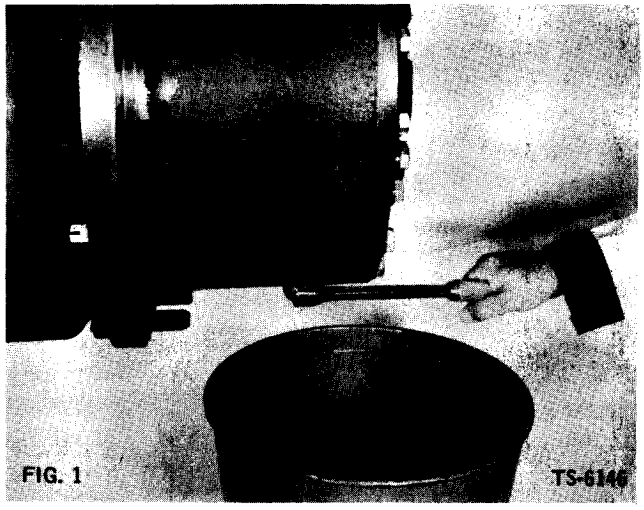
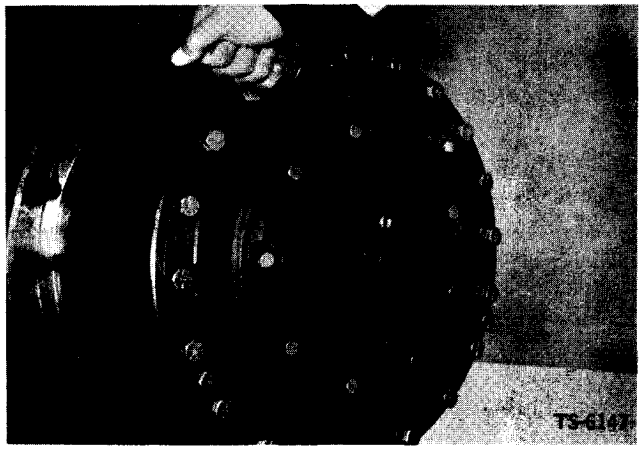


FIG. 1 TS-6148

2. Remove bolts and flat washers securing sun gear thrust cap (Fig. 2).


TS-6147

3. Remove sun gear thrust cap (Fig. 3). Remove "O" ring from cap.

NOTE: Some early versions of axle assemblies do not have "O" ring feature in thrust cap.

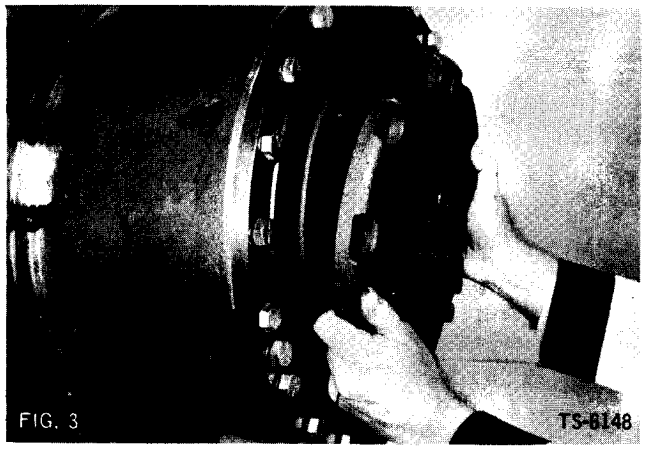


FIG. 3 TS-6148

4. Remove bolts and lockwashers retaining planet carrier (Fig. 4).

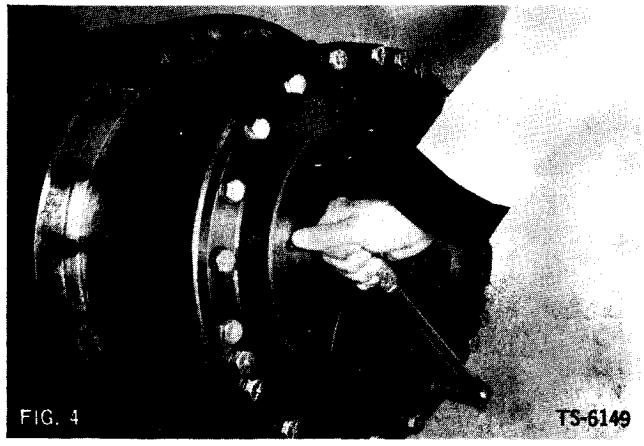
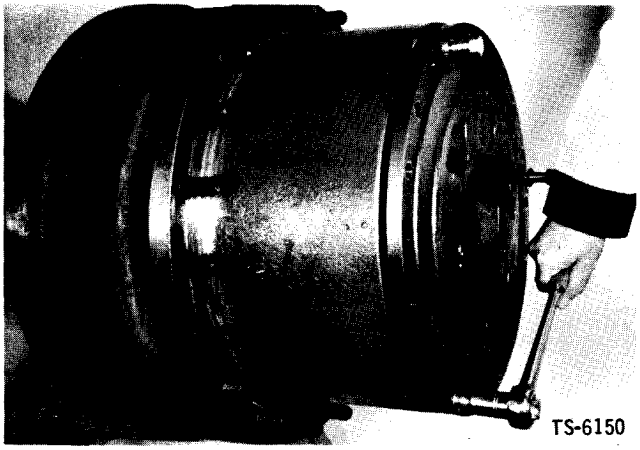
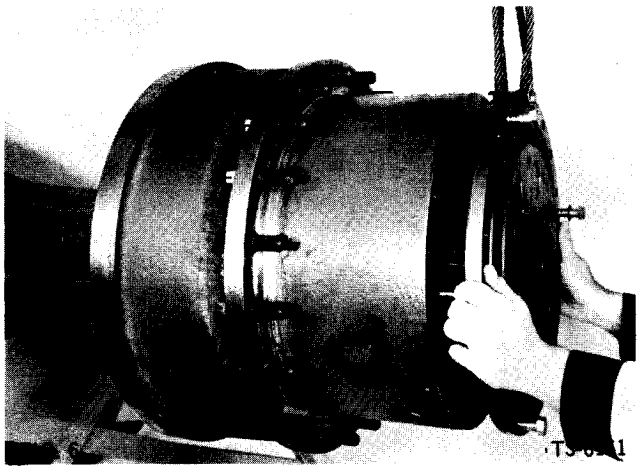


FIG. 4 TS-6149

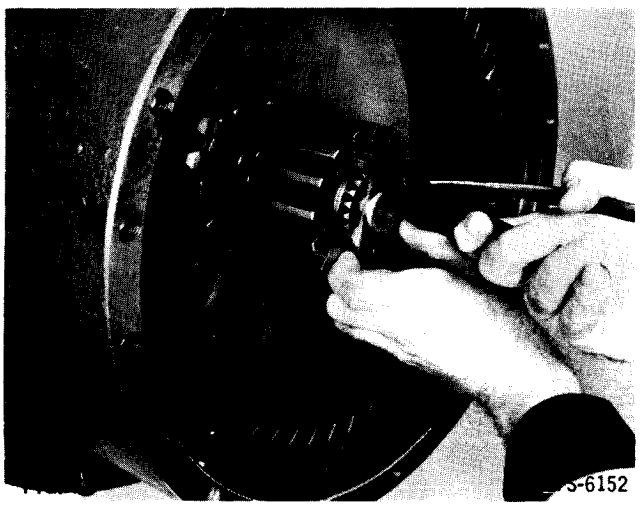
5. Install three mounting bolts in puller holes to pull planet carrier from hub assembly (Fig. 5).


TS-6150

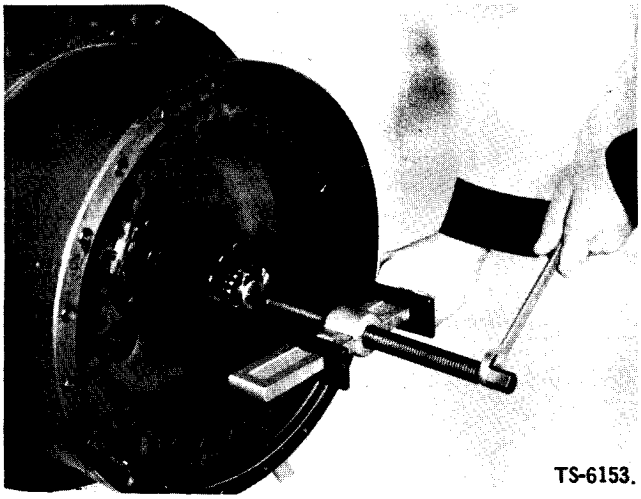
6. Remove planetary assembly (Fig. 6). Remove "O" ring from planetary assembly.



7. Remove sun gear retaining ring (Fig. 7).


TS-6152

8. Remove sun gear using suitable puller (Fig. 8).


TS-6153.

9. Some axle models have thrust ring pressed lightly into end of spindle. If provided, use pry bar to remove thrust ring from end of spindle (Fig. 9).

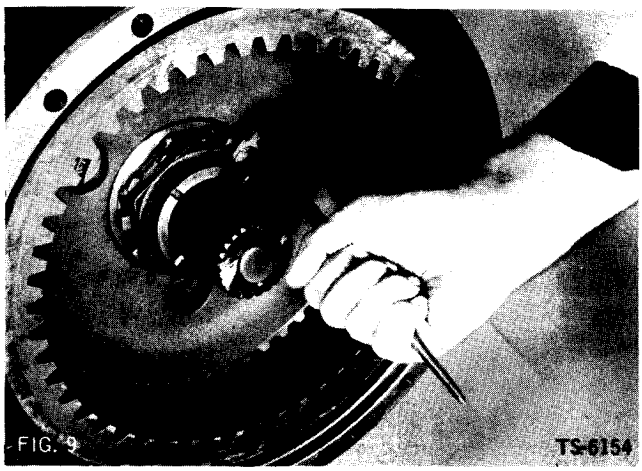
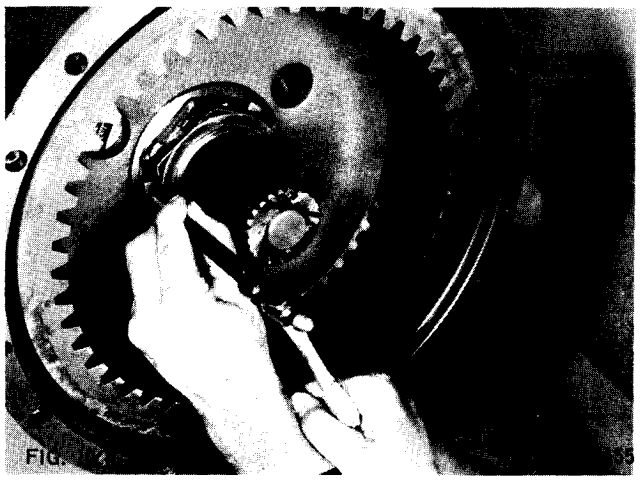


FIG. 9 TS-6154

10. Straighten tangs on nut lock as shown in Fig. 10.



11. Support weight of hub and drum assembly with hoist. Wrap several turns of .010" to .020" shim stock around end of axle shaft to protect shaft splines (Fig. 11). Install special wrench (Clark No. 945940) on outside spindle nut. Tighten guide screws lightly against shim stock.

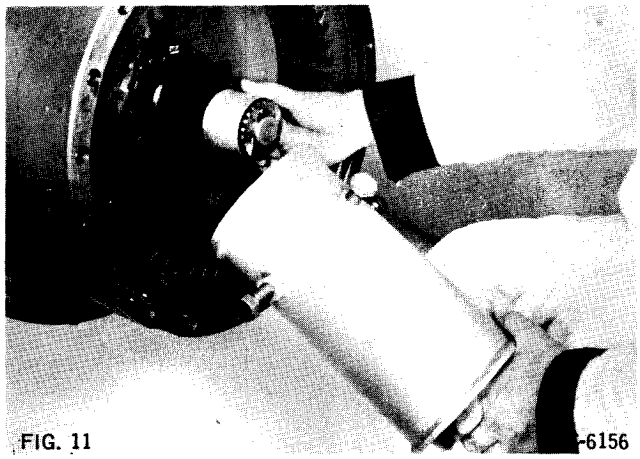


FIG. 11 -6156

12. Remove outside spindle nut, nut lock, and inside spindle nut (Fig. 12).

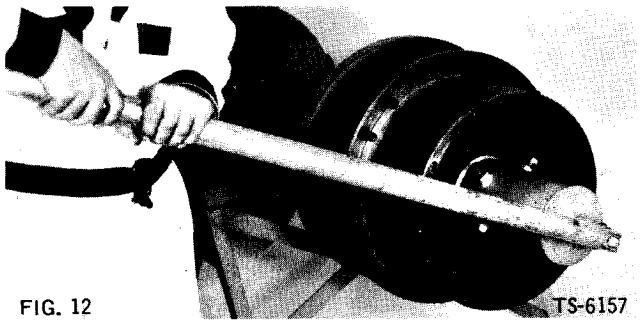


FIG. 12 TS-6157

13. Support weight of brake drum and hub assembly with hoist. Remove internal gear and hub from spindle assembly (Fig. 13). In some cases it will be necessary to use pry bars as shown.

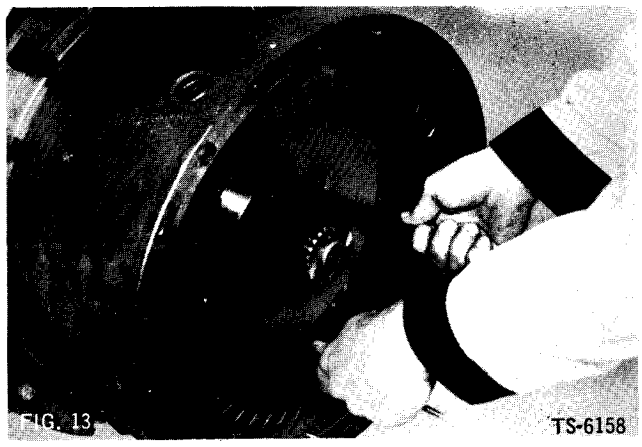


FIG. 13 TS-6158

14. Pull straight out on brake drum and hub assembly to remove it from axle (Fig. 14). Be sure brake shoes are in fully released position.

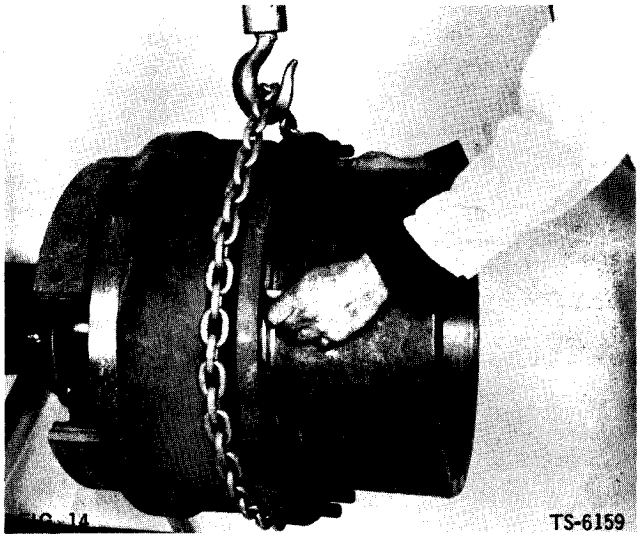


FIG. 14 TS-6159

15. Remove cotter pin and spring anchor pin washer. Disengage and remove brake shoe return spring from anchor pin (Fig. 15). *Discard old return spring.*

CAUTION: Use care when removing return spring so as not to cause injury. Spring is under tension and can be projected some distance when released from anchor pin. Support lower brake shoe or it will pivot around anchor pin when spring is released.

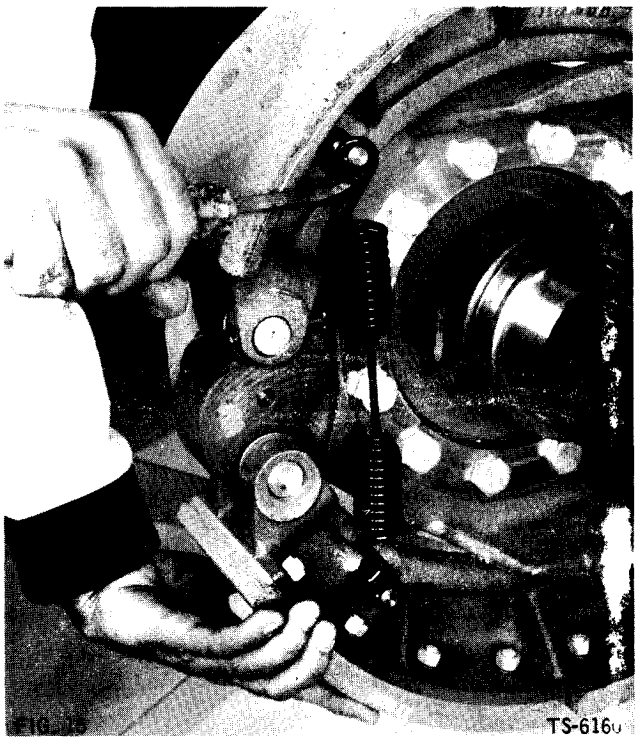
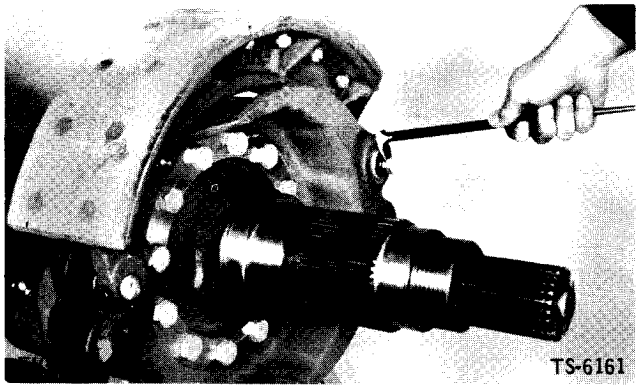
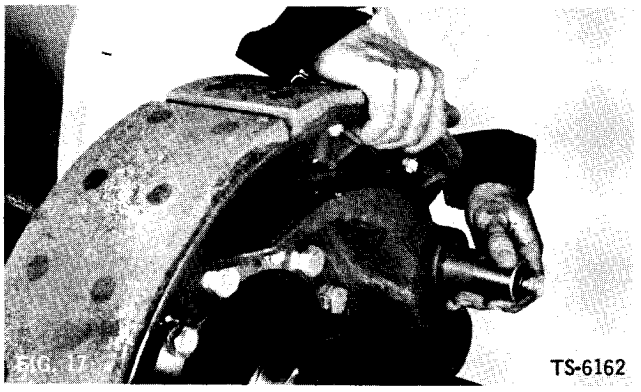


FIG. 15 TS-6160

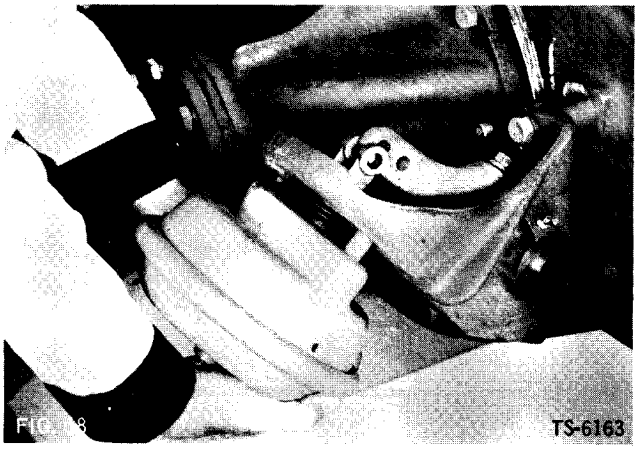
16. Cut lockwire and remove anchor pin set screws. Unscrew bolt in anchor pin several turns. Use pry bar under screw head to start anchor pin from spindle support assembly (Fig. 16).
NOTE: Anchor pins of some axle models are held in place by retaining plate and bolt. Remove bolt and anchor plate to remove pins.



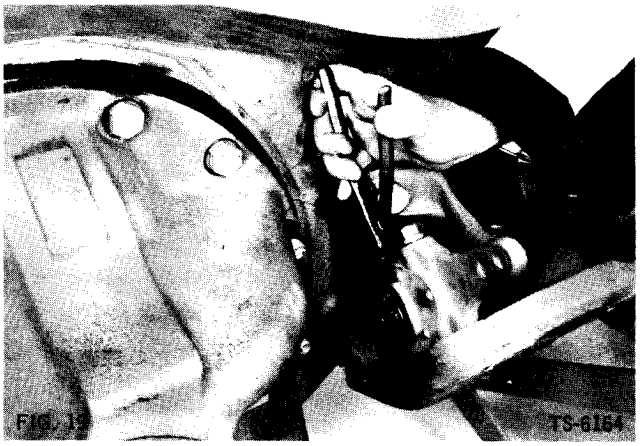
17. Remove anchor pin and remove brake shoe (Fig. 17).



18. Remove cotter pin and pin securing clevis of air chamber to slack adjuster. Remove nuts and lockwashers securing air chamber to air chamber bracket; remove air chamber (Fig. 18).

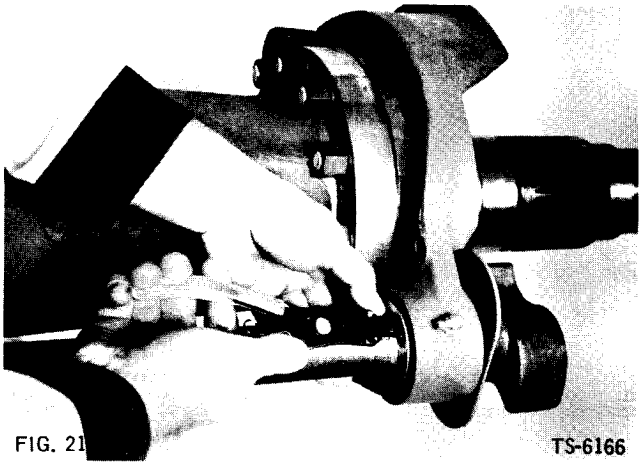


19. Remove slack adjuster retaining ring (Fig. 19). Remove slack adjuster retaining washer. Note position of slack adjuster adjusting screw. In some applications, screw is adjacent to air chamber bracket. In other applications, it is as shown in Fig. 19.

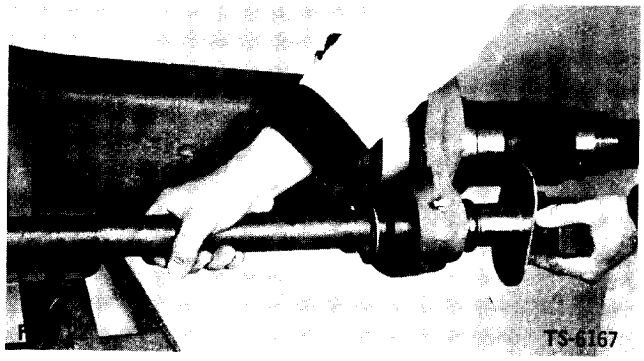


20. Use soft mallet to drive slack adjuster from brake cam shaft (Fig. 20).

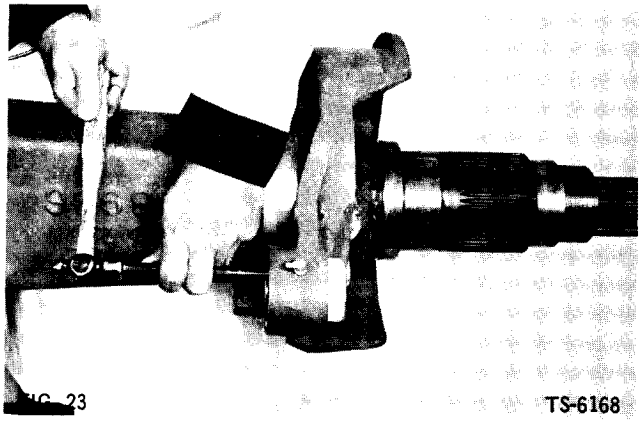
21. Unseat retaining ring that holds cam shaft positioned in brake spider (Fig. 21).



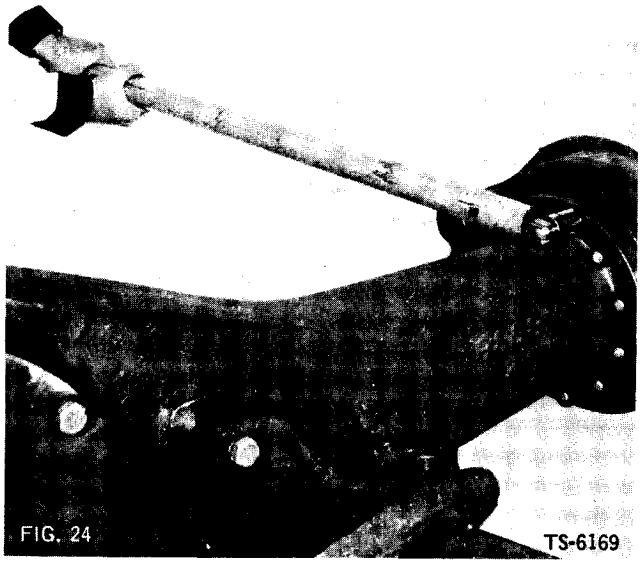
22. Remove brake cam shaft and cam shaft thrust washer from brake spider (Fig. 22). Remove cam shaft grease washer, felt grease retainer, and "O" ring.



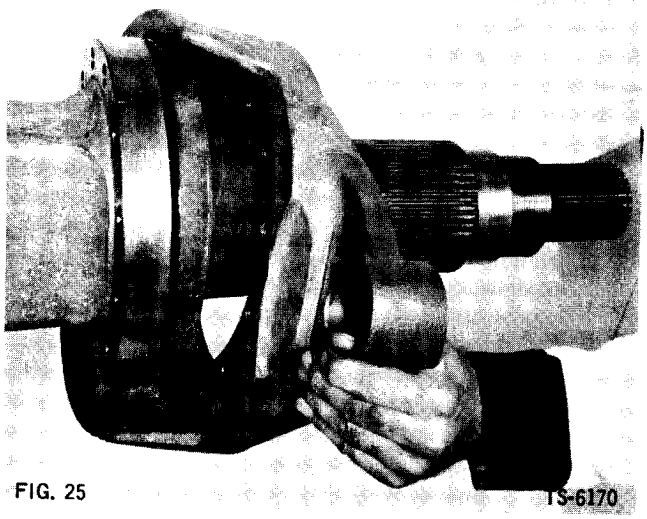
23. If damaged, drive brake cam shaft bushing from brake spider (Fig. 23).



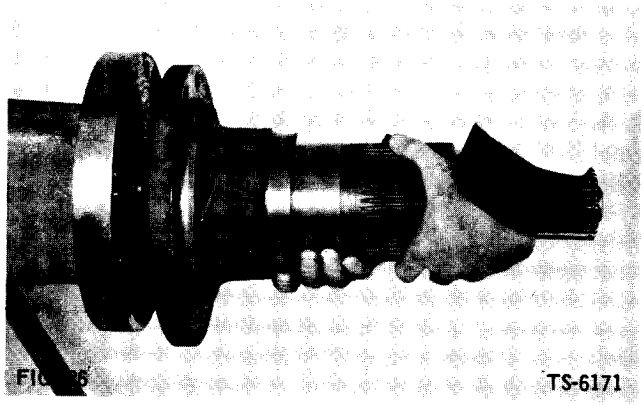
24. Remove mounting bolts and washer securing spindle and brake spider to axle housing (Fig. 24).



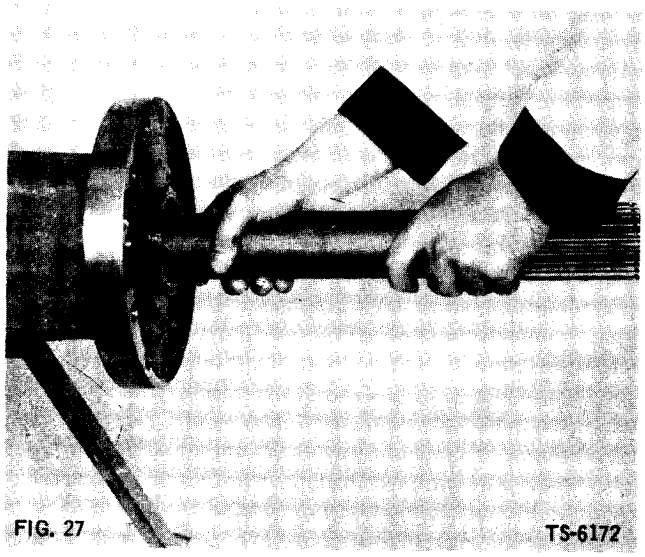
25. Remove brake spider from spindle (Fig. 25).



26. Remove spindle from axle housing (Fig. 26).



27. Remove axle shaft from axle housing (Fig. 27).



28. Remove two bolts and lock washers that secure air chamber bracket to axle housing; remove bracket and spacers (Fig. 28).

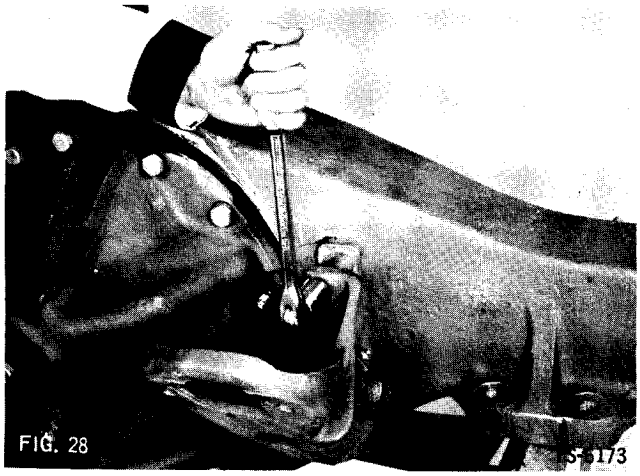


FIG. 28 TS-6173

29. Disassemble opposite side of axle following instructions given in steps 2 through 28.

30. If axle is equipped with parking brake, proceed as indicated below. If axle is not equipped with parking brake, proceed to step 39. Position socket on flange nut and then install flange retaining tool with two spacers between tool and flange. Spacer dimensions are given in Fig. 30. Loosen flange nut (Fig. 29). Remove flange retaining tool and remove flange nut and washer.

NOTE: Standard 2 5/8-inch socket will not fit flange nut because socket wall is too thick to enter recess in flange. Machine socket as shown in Fig. 31 to provide proper clearance.

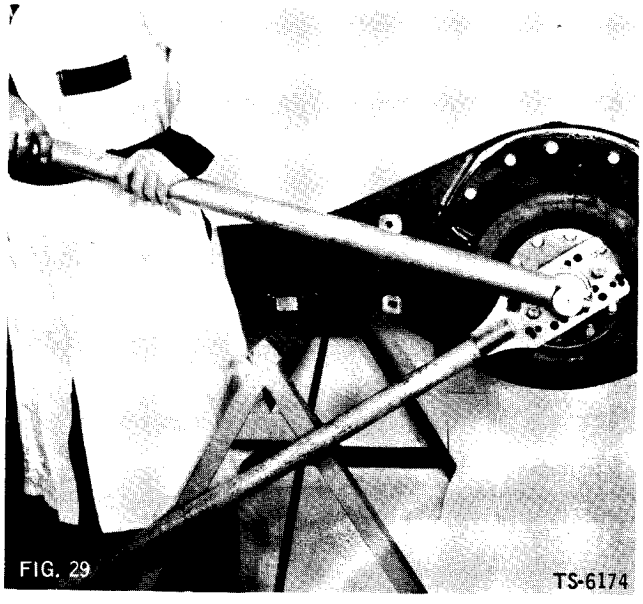
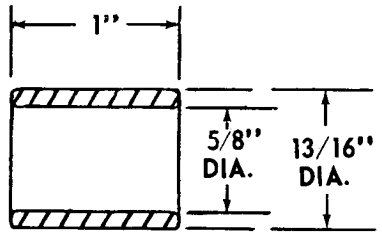


FIG. 29 TS-6174



1/32" DIA RADIUS ALL CORNERS

FIG. 30 TS-5685

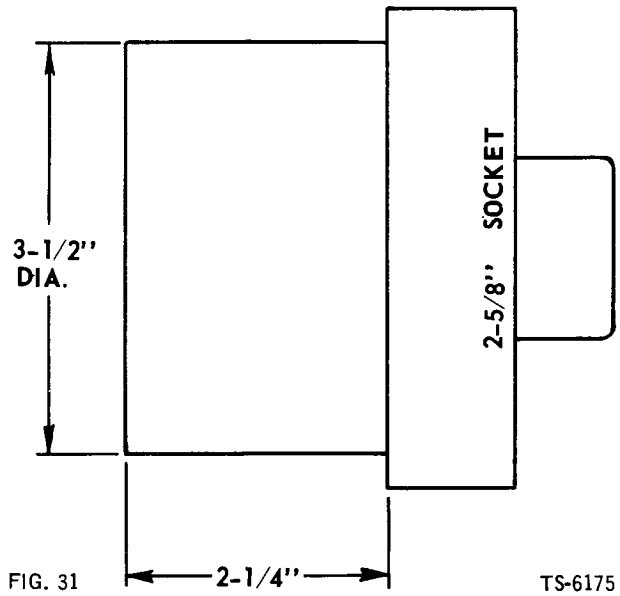


FIG. 31 TS-6175

31. Use suitable puller to pull assembled companion flange and parking brake drum from pinion shaft (Fig.32).

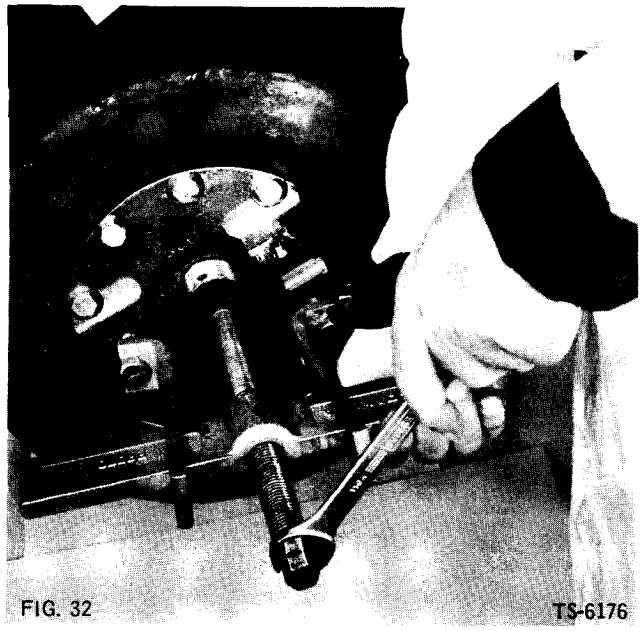
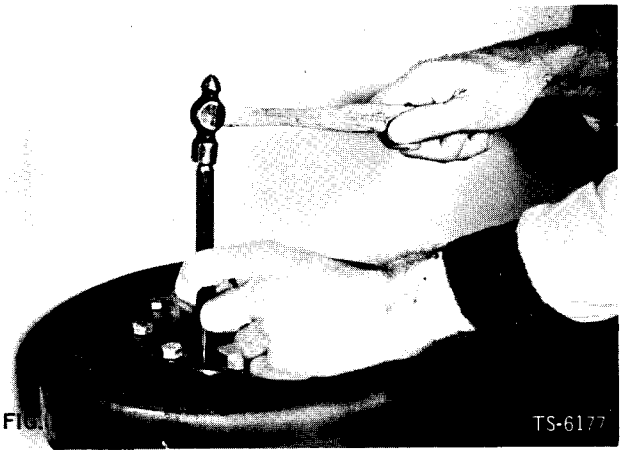
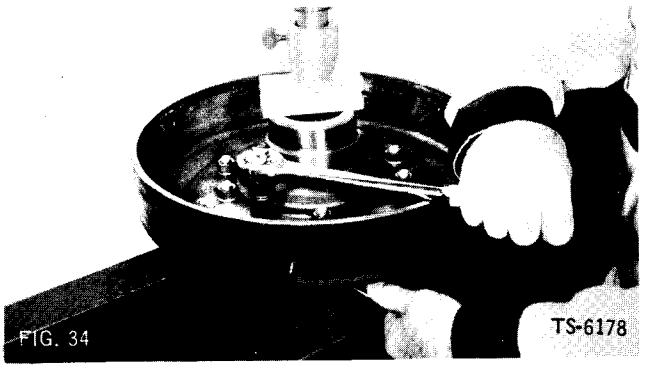


FIG. 32 TS-6176

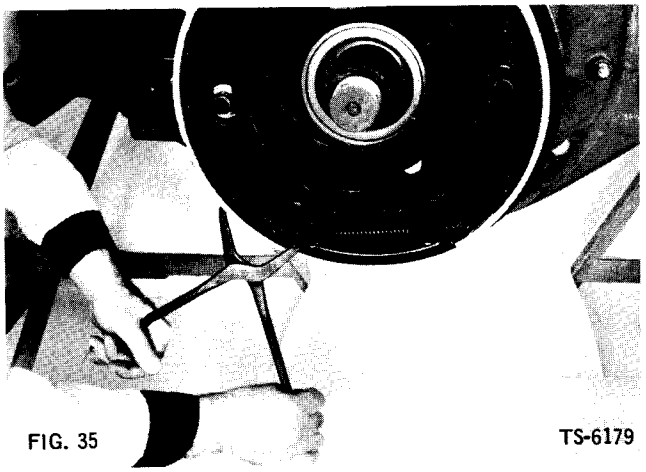
32. Match mark parking brake drum to companion flange (Fig. 33). This will assure proper balance of parts when reassembled.



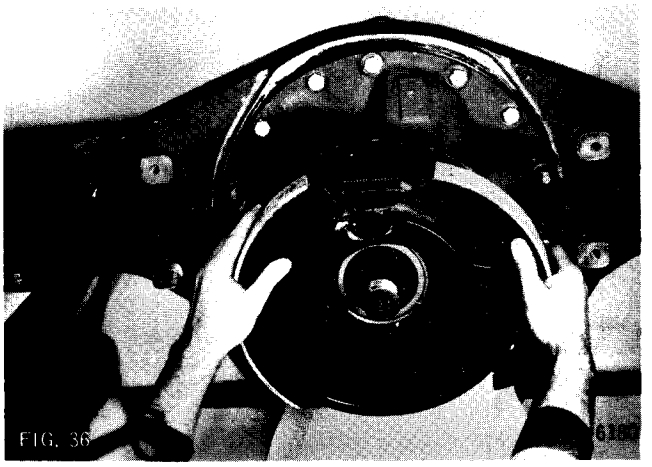
33. Position assembled parking brake drum and companion flange on press and apply light press pressure to retain parts while removing nuts, lockwashers, and bolts (Fig. 34). Do not distort or score parking brake drum by clamping tightly in vise.



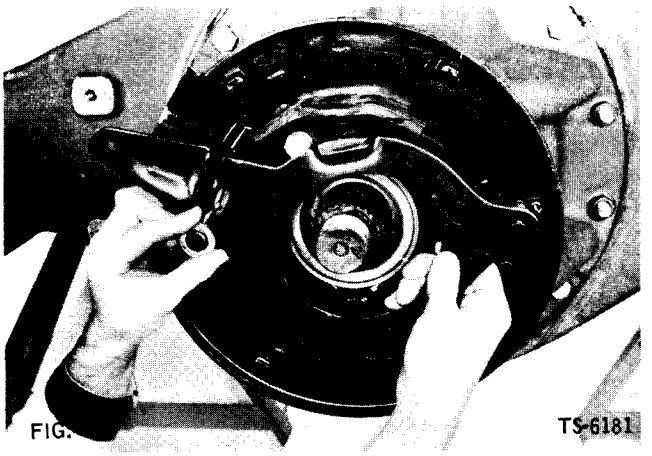
34. Remove lower parking brake spring with brake spring pliers (Fig. 35).



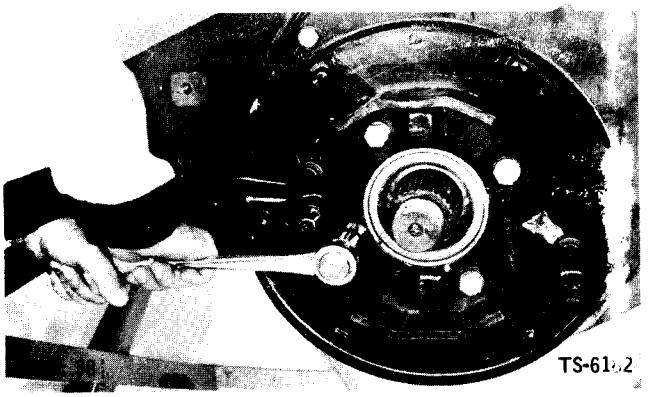
35. Spread brake shoes and remove assembled brake shoes and upper parking brake return spring (Fig. 36).



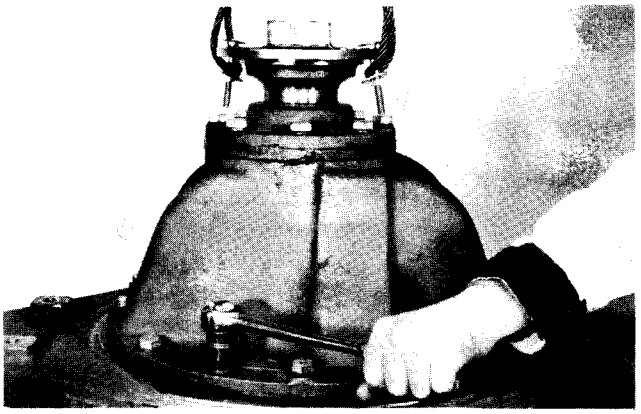
36. Remove brake operating cam lever and roller from brake backing plate (Fig. 37).



37. Remove bolts and lockwashers securing brake backing plate to differential and carrier assembly (Fig. 38). Temporarily reinstall companion flange on pinion shaft to facilitate removal of differential and carrier assembly.



38. Support weight of differential and carrier assembly with hoist. Remove bolts, nuts, washers, and dowels securing differential carrier to axle housing (Fig. 39).



39. Lift differential and carrier assembly from axle housing with hoist (Fig. 40). If necessary, break seal between parts by tapping with plastic hammer. Remove differential gasket.

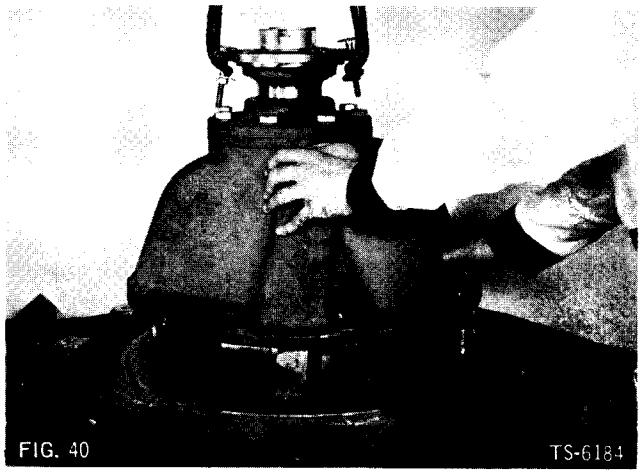


FIG. 40 TS-6184

Disassembly of Planet Carrier Assembly

1. Place planet carrier assembly in press as shown and press out pinion shaft (Fig. 41). Take care to catch pinion shaft lock ball released as shaft is pressed out.

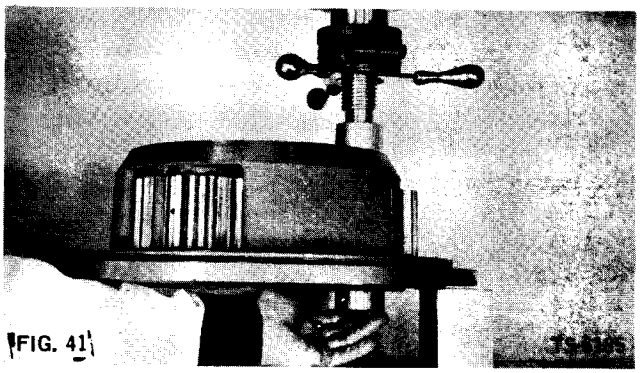
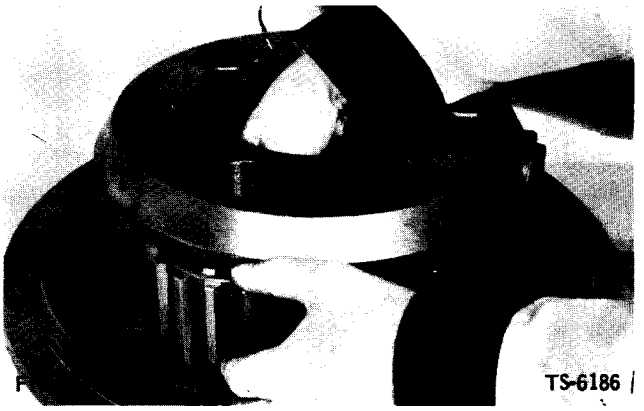


FIG. 41

2. Carefully remove pinion shaft, planet pinion, pinion thrust washers, pinion rollers, and pinion roller spacer (Fig. 42). Rollers will drop from pinions. Take care to prevent losing them.



TS-6186

Disassembly of Hub and Drum Assembly

1. Match-mark hub and drum to insure proper reassembly (Fig. 43).

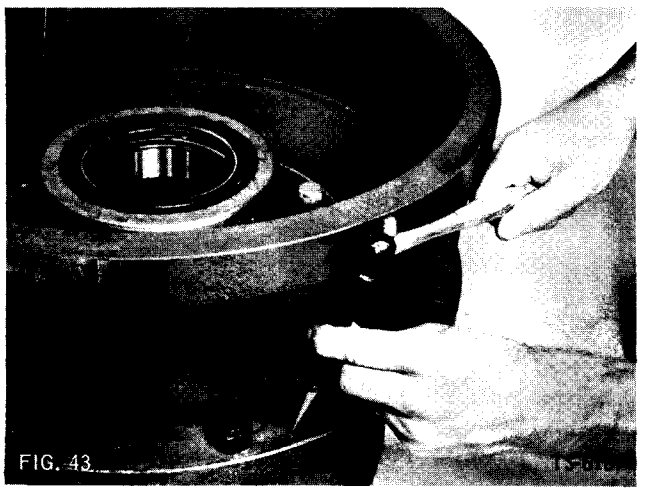
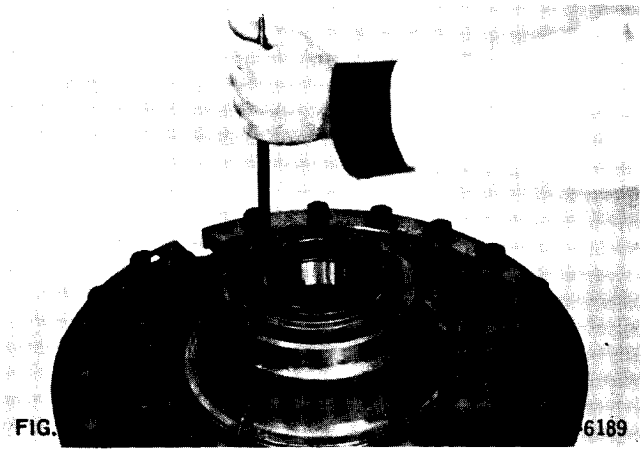


FIG. 43

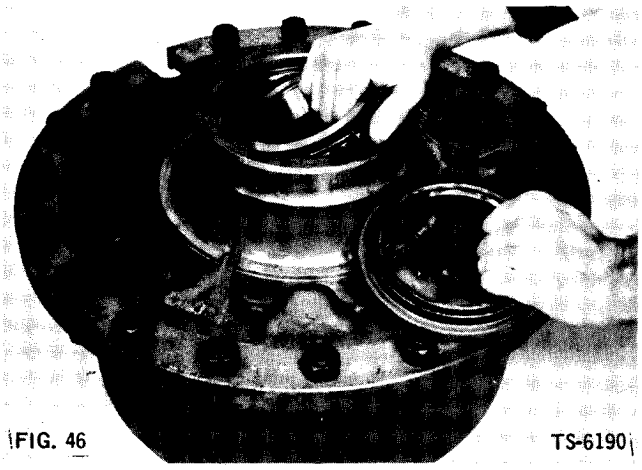
2. Cut lockwires and remove bolts securing brake drum to hub (Fig. 44). Remove brake drum and oil catcher.

FIG. 44 TS-6188

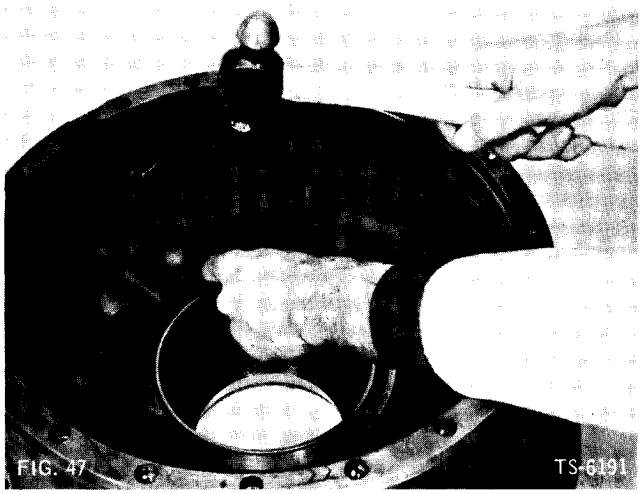
3. Pry out oil seal (Fig. 45).



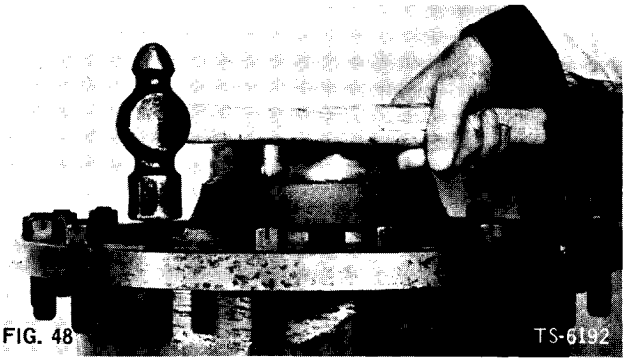
4. Lift out bearing cone (Fig. 46).



5. If replacement of the bearing cups is required, drive out cups with a soft drift (Fig. 47). Exercise care to prevent damage to the bearing bores when driving out cups.

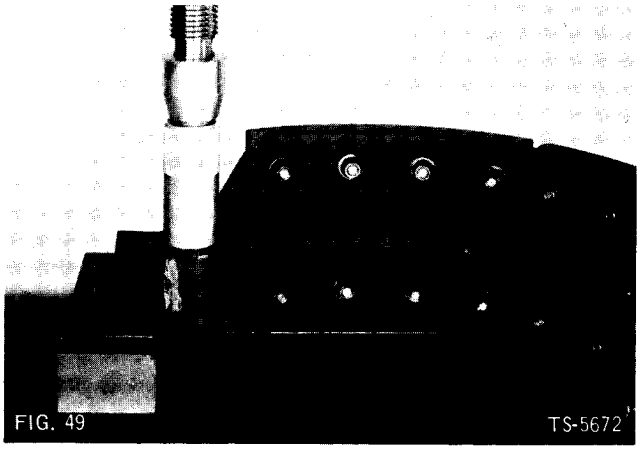


6. If any wheel studs are damaged, remove nut that secures each stud to hub. Drive out studs. Always replace entire set if any are damaged (Fig. 48).

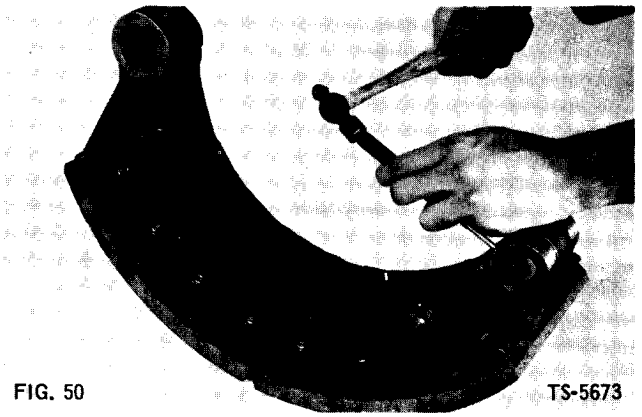


Disassembly of Brake Shoes

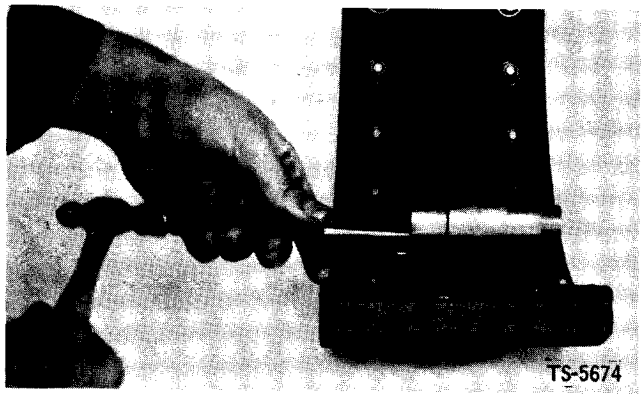
1. If worn or damaged, press brake shoe bushing from brake shoe (Fig. 49). If inside diameter of bushing exceeds 1.513" for 20x5 brakes, or 1.263" for 16½x6 brakes, it should be replaced.



2. Remove cotter pin and drive out cam roller pin lock pin with punch (Fig. 50).



3. Drive out cam roller pin (Fig. 51). Remove roller.



4. Check brake lining for oil or grease saturation, wear, and looseness. If loose, tighten retaining bolts to 200 to 220 *inch*-pounds torque. If saturated with grease, replace all lining blocks. To remove linings, remove nuts, lockwashers, and bolts retaining lining to shoes (Fig. 52).

NOTE: When replacing brake linings, all linings on both sides of axle assembly should be replaced at the same time.

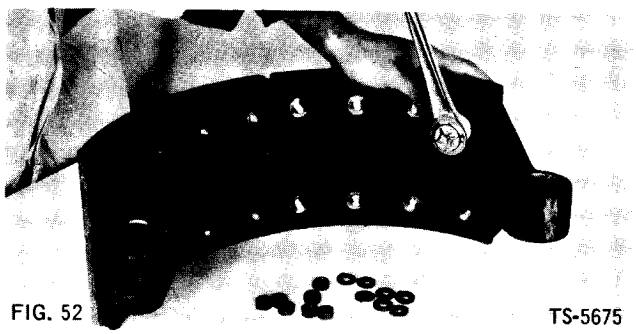


FIG. 52

Disassembly of Internal Gear and Hub

1. Drive bearing cone from hub (Fig. 53).

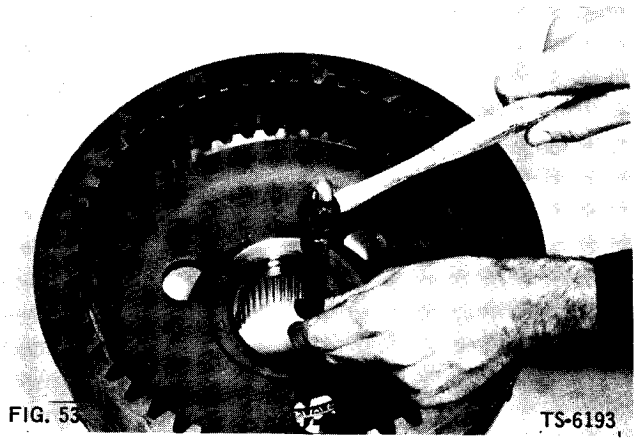


FIG. 53

2. If replacement of internal gear is necessary, cut lockwires and remove bolts securing internal gear to hub (Fig. 54). Separate internal gear from hub.

NOTE: On some axle models, internal gears are secured to hubs with bolts inserted through drilled holes in internal gear and screwed into hub instead of as shown in Fig. 54.

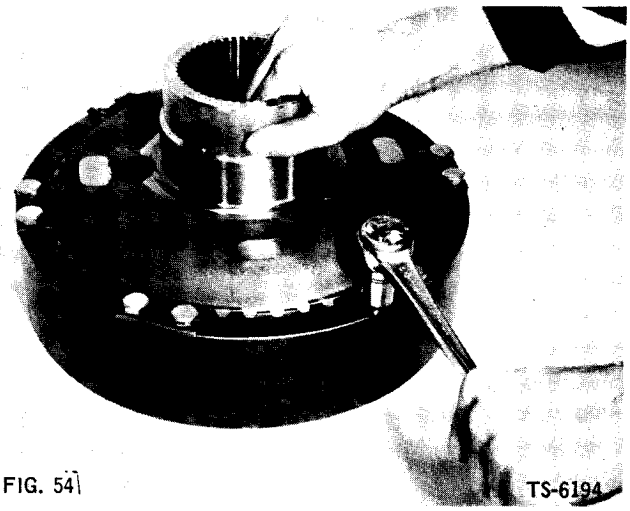


FIG. 54

Disassembly of Differential and Carrier

1. Mount differential on differential overhaul stand. Check and record ring gear backlash with dial indicator. This information is necessary for reassembly unless a new gear set is installed (Fig. 55).

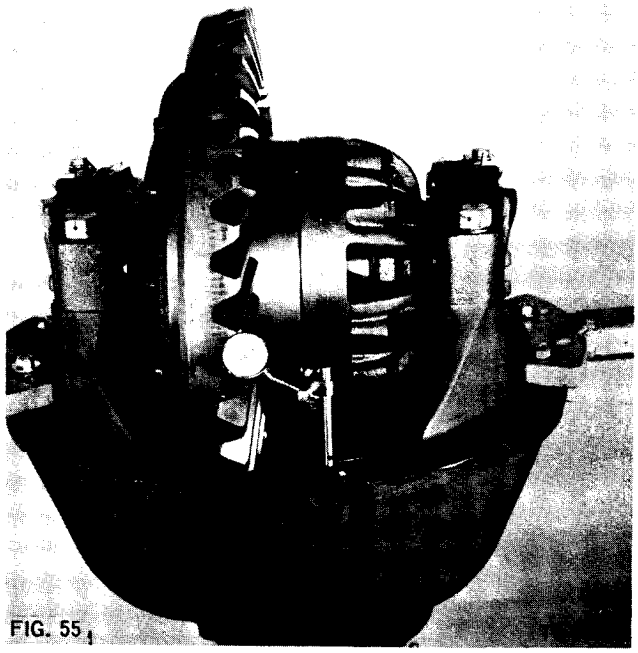


FIG. 55

2. If axle is not equipped with parking brake, companion flange nut should be loosened now to facilitate flange removal later. Position socket on flange nut and then install flange retainer tool with two spacers between tool and flange. Spacer dimensions are given in Fig. 30. Loosen flange nut (Fig. 56).

   NOTE: Standard 2 5/8-inch socket will not fit flange nut because socket walls are too thick to enter flange. Machine socket as shown in Fig. 31 to provide proper clearance.

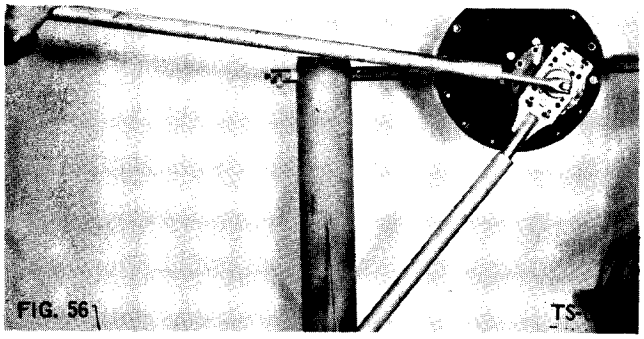


FIG. 56

3. Remove lockwire and adjusting nut lock. Before removing bearing cap bolts, use center punch to matchmark bearing caps to carrier assembly. This is to insure correct match in reassembly (Fig. 57).

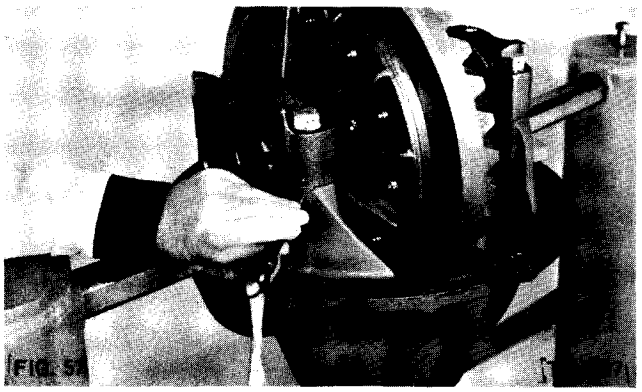


FIG. 57

4. Remove bearing cap bolts and bearing caps (Fig. 58).

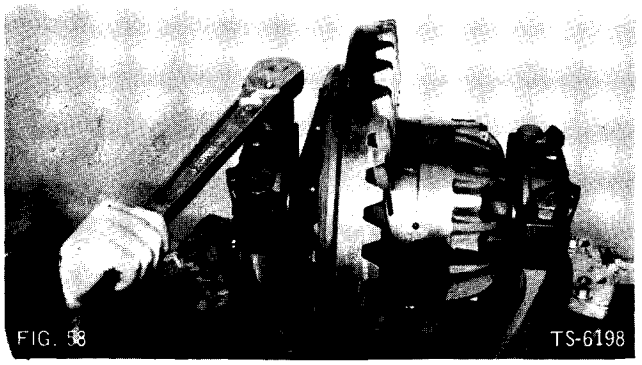


FIG. 58 TS-6198

5. Insert metal bar through differential to facilitate hoisting. Raise ends individually and remove adjusting nuts and bearing cups (Fig. 59).

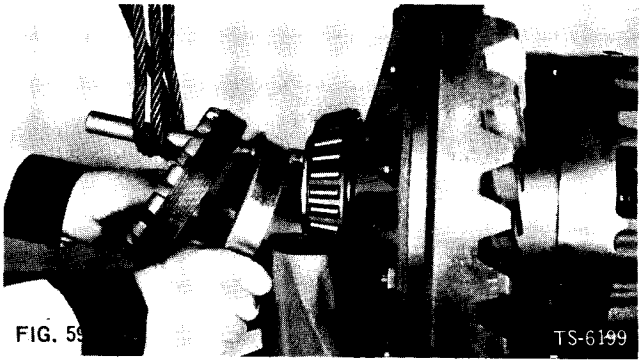


FIG. 59 TS-6199

6. Hoist differential with assembled bearing cones from carrier assembly (Fig. 60). Tilt differential to allow ring gear to pass web in differential carrier.

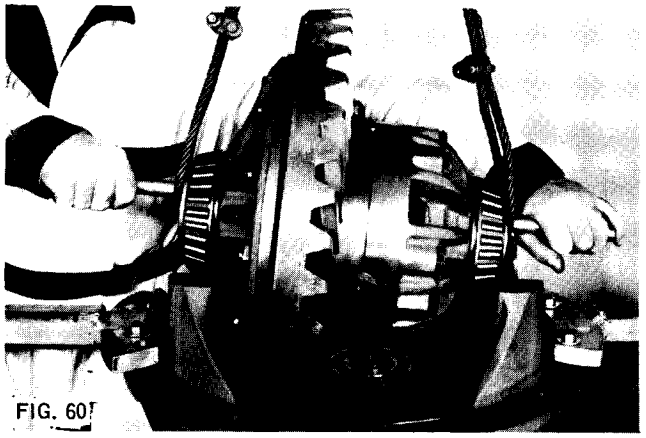


FIG. 60

7. If axle is not equipped with parking brake, remove shaft nut that was loosened as shown in Fig. 56. Remove washer. Remove companion flange from pinion shaft with puller (Fig. 61). If companion flange was removed to provide access to parking brake and reinstalled to facilitate handling differential, it can probably be removed by hand.

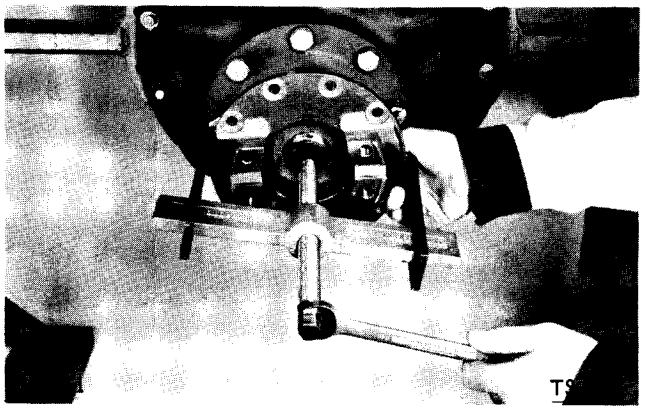


FIG. 61

8. Remove bolts securing seal retainer to carrier and remove retainer (Fig. 62). If necessary, tap with soft mallet to break seal between parts.

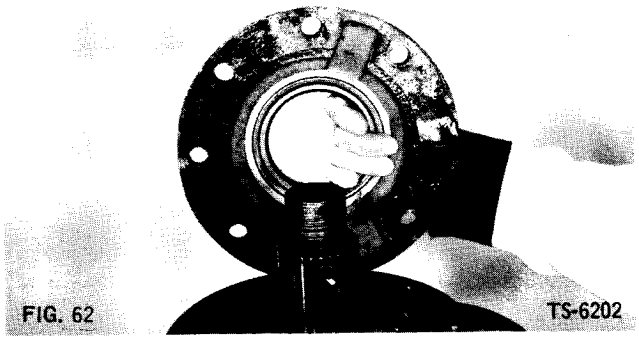


FIG. 62 TS-6202

9. Screw two bolts in puller holes and pull bearing cage from carrier assembly (Fig. 63). This pulls outer pinion bearing cone from shaft. Turn each bolt equally to prevent damage to carrier, shaft, or bearings. After bearing cage is pulled out a short distance, back off puller screws and insert .030" shim stock under puller screws before pulling is continued, to reduce possible damage to shim pack under flange of bearing cage.

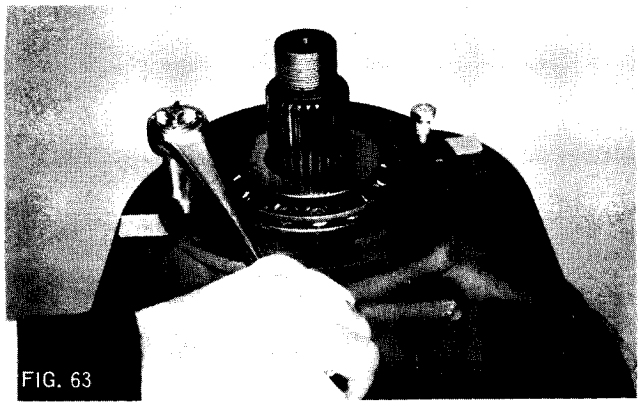


FIG. 63

10. Remove pinion shaft assembly from carrier (Fig. 64). Remove bearing cage shims. Retain bearing cage shim pack intact for possible reuse in reassembly.

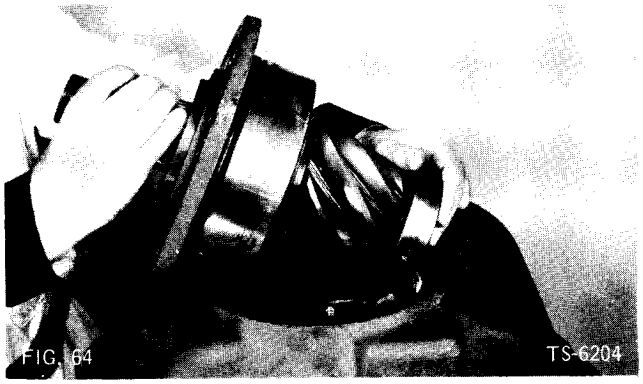


FIG. 64 TS-6204

Disassembly of Standard Differential

1. Match-mark case halves to insure correct reassembly (Fig. 65). Cut lockwires that secure differential case bolts.

   NOTE: If axle assembly is equipped with NoSPIN differential, proceed to Fig. 68 for special instructions.

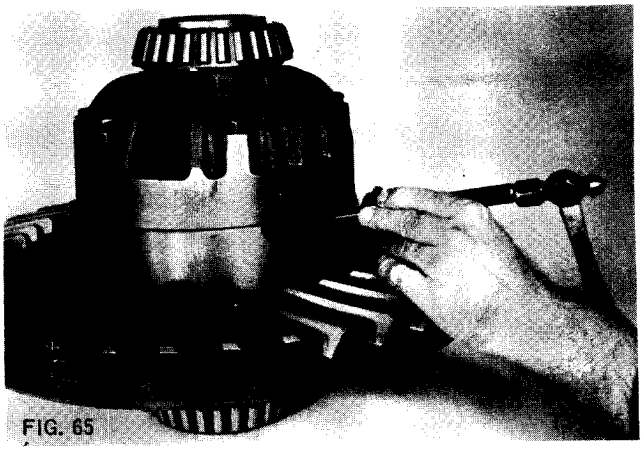
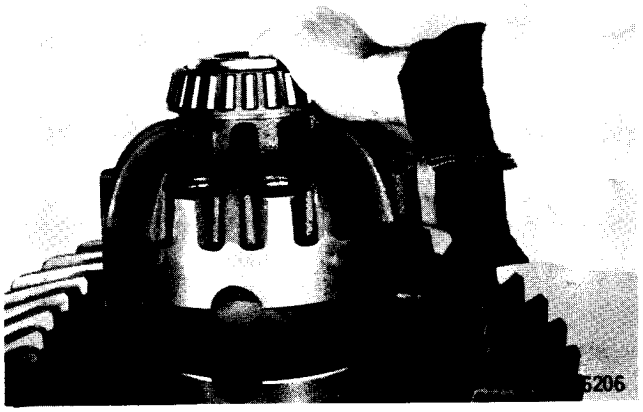


FIG. 65

2. Remove differential bolts securing case halves. Lift off plain case half (Fig. 66). Use soft mallet if necessary to aid removal.

   NOTE: Some differential case halves are secured with bolts and self-locking nuts instead of bolts and lockwires.


TS-6206

3. Remove spider, pinions, and thrust washers (Fig. 67).

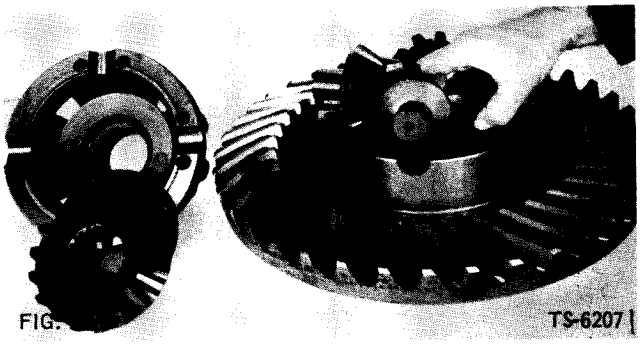


FIG. TS-6207

Disassembly of NoSPIN Differential

1. Remove alternate differential case half bolts. Back off remaining bolts slowly and evenly, turning each a few turns at a time (Fig. 68). This will release spring load of NoSPIN unit.

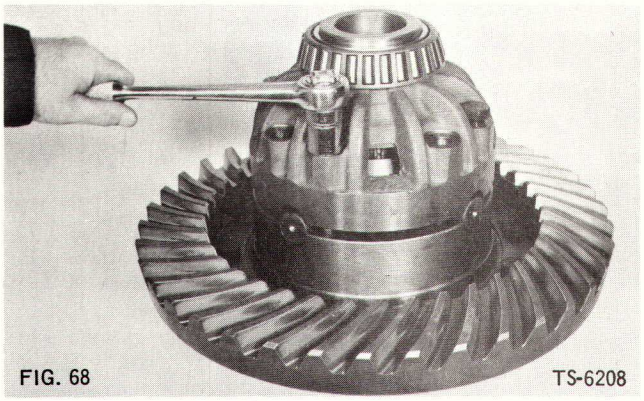


FIG. 68 TS-6208

2. Lift off differential case half to provide access to NoSPIN unit (Fig. 69).

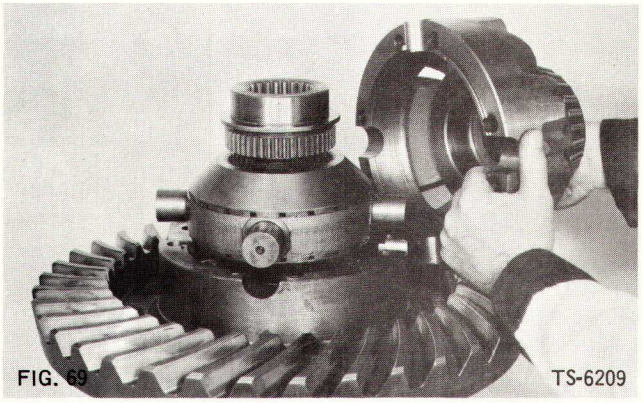


FIG. 69 TS-6209

3. Remove side gear and spring from differential (Fig. 70).

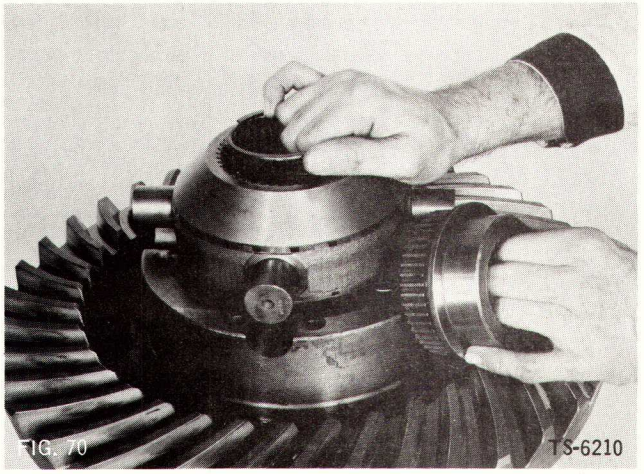


FIG. 70 TS-6210

4. Remove assembled driven clutch, spring retainer, and holdout ring from differential (Fig. 71).

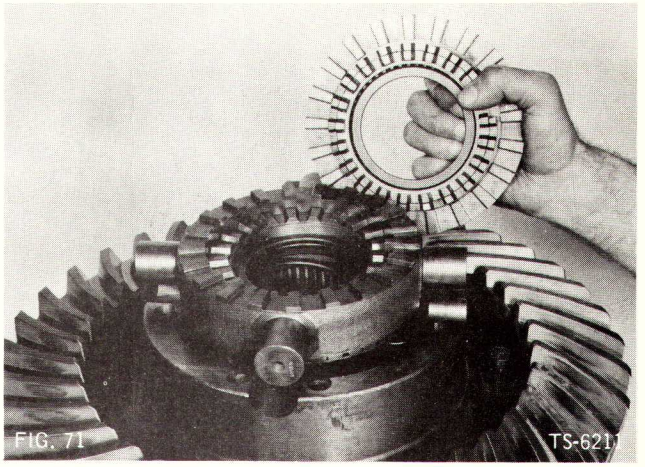


FIG. 71 TS-6211

5. Remove spider from differential (Fig. 72).

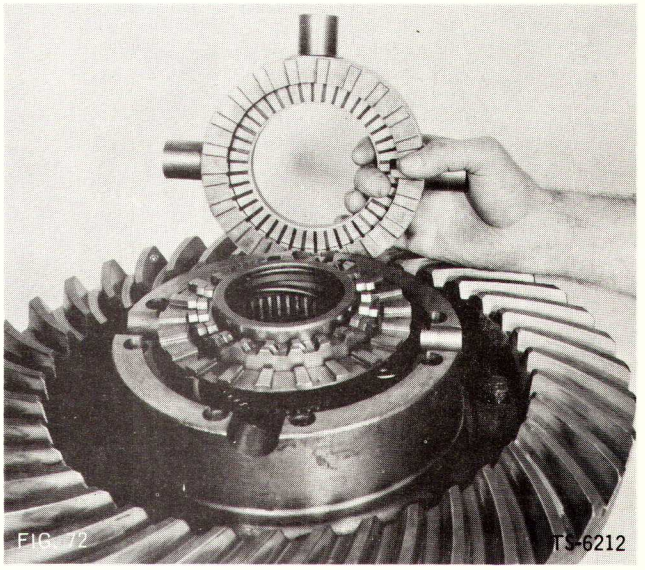


FIG. 72 TS-6212

6. Remove lower assembled driven clutch, spring retainer, and holdout ring from differential (Fig. 73).

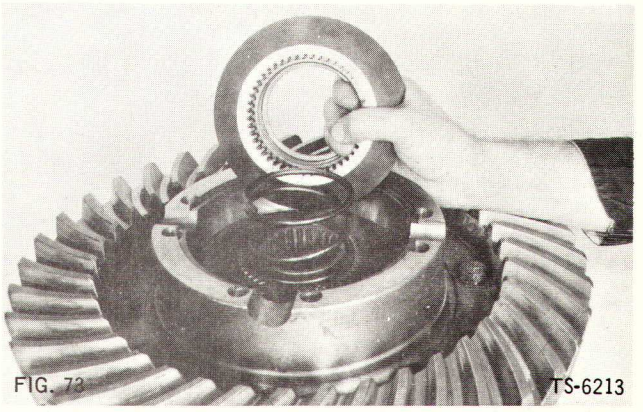


FIG. 73 TS-6213

7. Remove lower spring and side gear from differential case (Fig. 74).


FIG. 74 TS-6214

8. Lift spring retainer from driven clutch (Fig. 75).

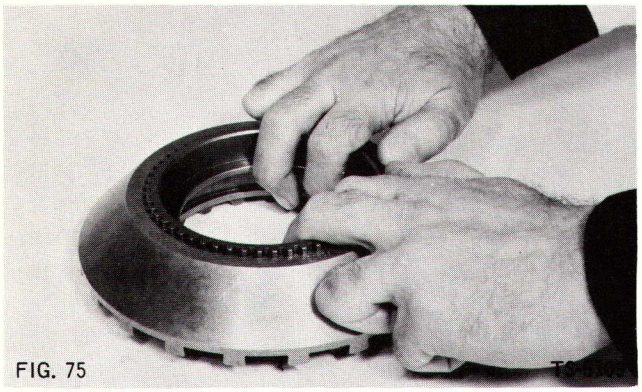


FIG. 75

9. Remove holdout ring, using expanding snap ring pliers (Fig. 76).

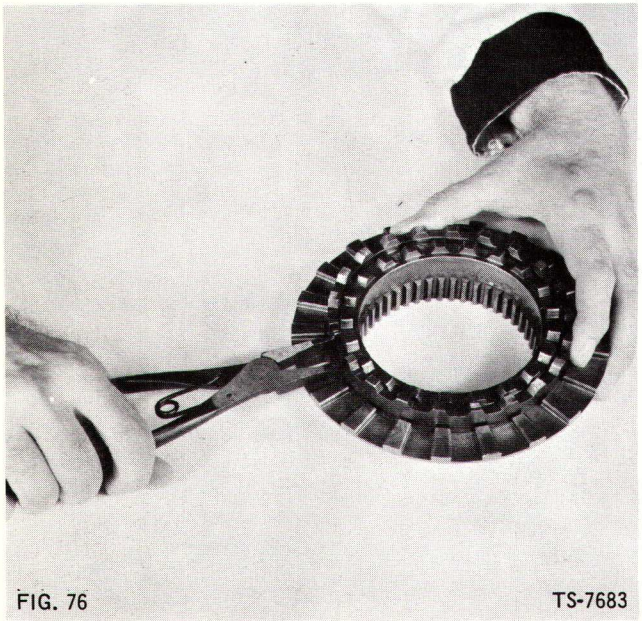


FIG. 76 TS-7683

10. If necessary to remove center cam from spider, use three small screwdrivers or tapered wedges to spread snap ring into spider (Fig. 77). Press center cam out through spider.

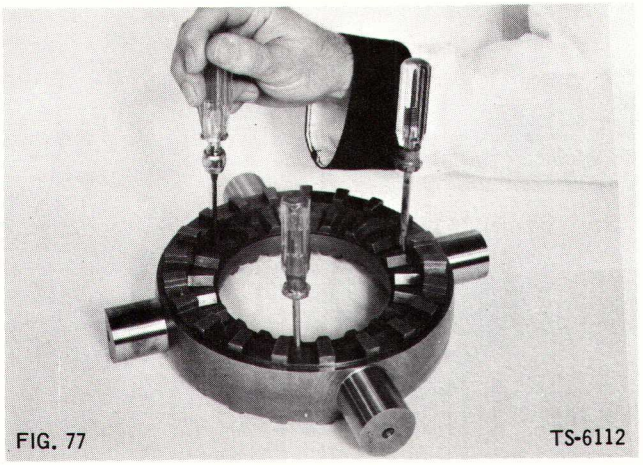


FIG. 77 TS-6112

11. Remove snap ring from spider (Fig. 78).

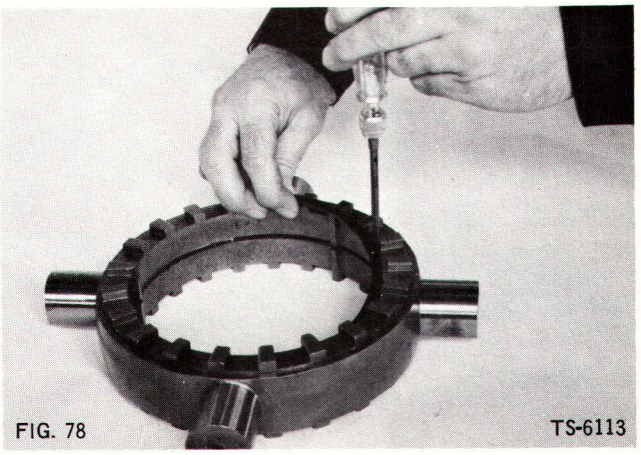


FIG. 78 TS-6113

Disassembly of Differential Case Parts

1. Remove nuts that secure ring gear to case half. Place case half and ring gear in press and apply light pressure to hold parts while removing nuts (Fig. 79).

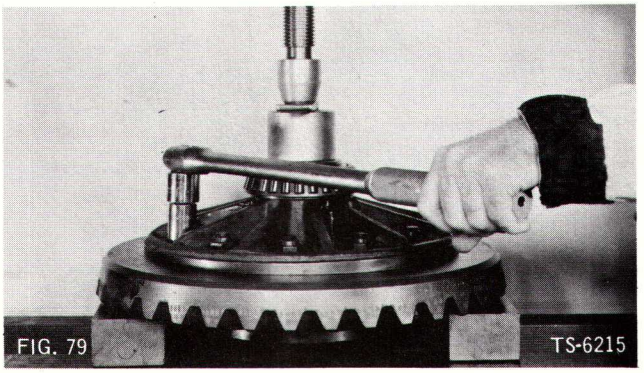


FIG. 79 TS-6215

2. Use soft hammer to drive ring gear from case half (Fig. 80).

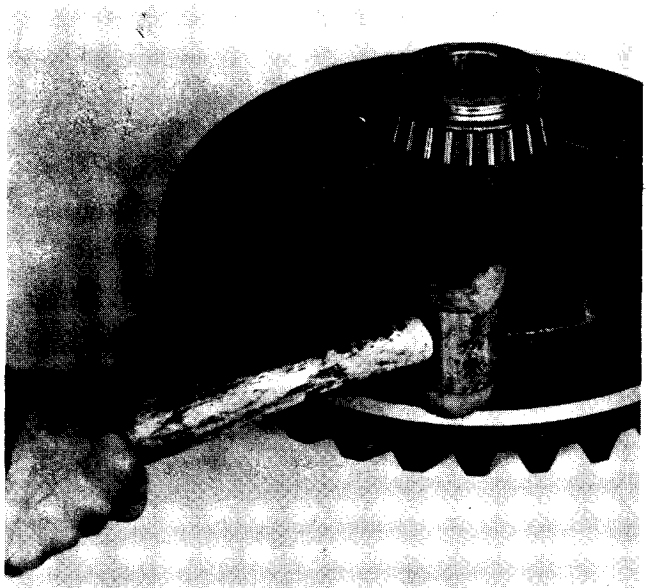


FIG. 80 TS-6216

3. If replacement is required, remove differential bearing cones with a suitable puller (Fig. 81).

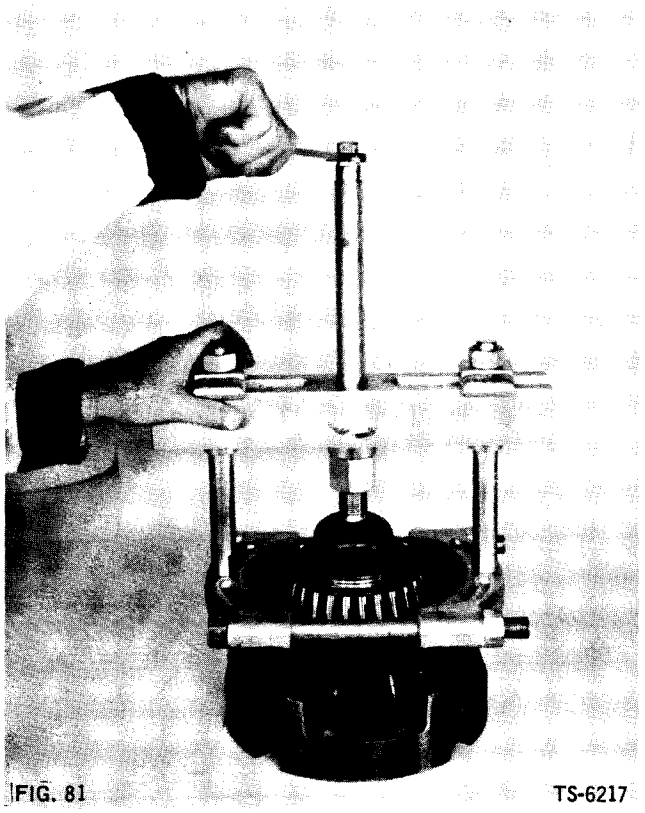


FIG. 81 TS-6217

Disassembly of Pinion Shaft Assembly

1. Press pinion shaft from pinion bearing cage assembly. This will release outer pinion bearing cone (Fig. 82).

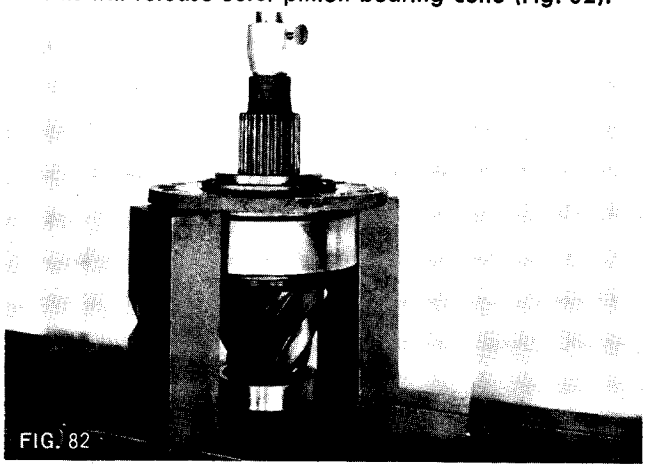


FIG. 82

2. Press center pinion bearing cone from pinion assembly (Fig. 83).

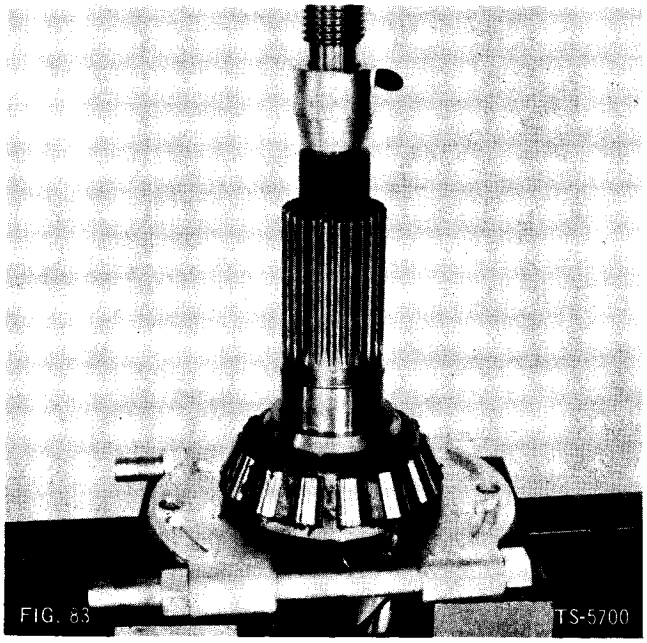


FIG. 83 TS-5700

3. Remove inner pinion bearing retaining ring (Fig. 84).

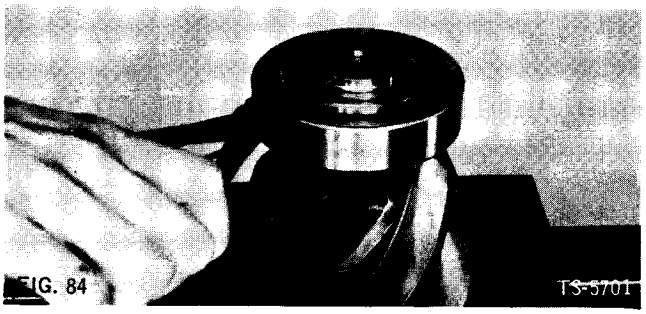


FIG. 84 TS-5701

4. Press inner bearing from pinion assembly (Fig. 85).

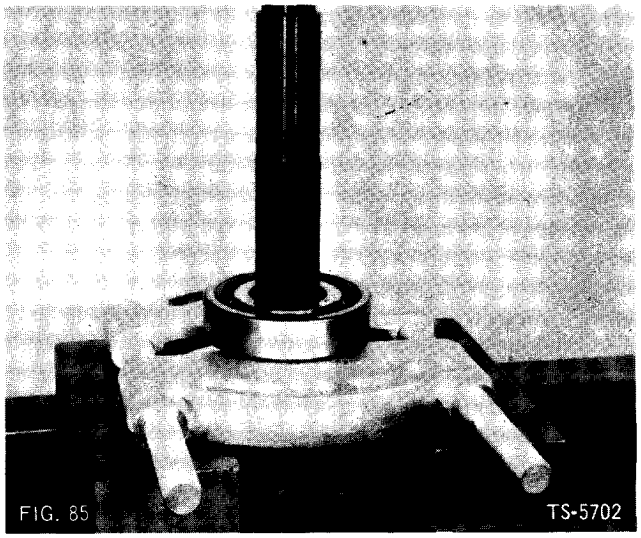


FIG. 85 TS-5702

5. If worn or damaged, drive bearing cups from pinion bearing cage (Fig. 86).

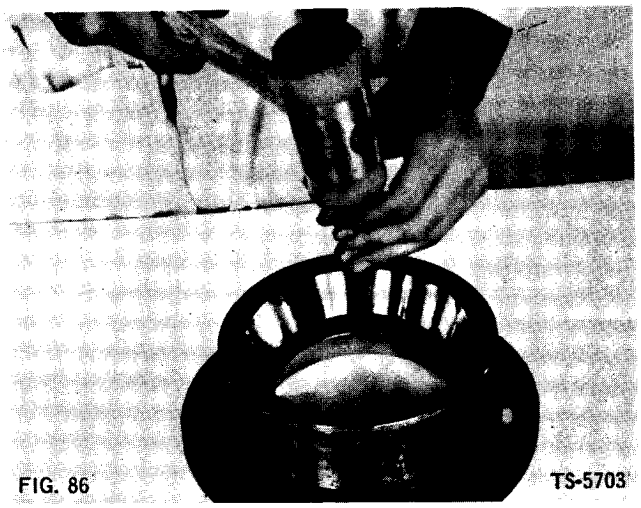


FIG. 86 TS-5703

CLEANING AND INSPECTION

CLEANING

Clean all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and slushed up and down slowly until all old lubricant and foreign material is dissolved and parts are thoroughly cleaned.

CAUTION: Care should be exercised to avoid skin rashes, fire hazards and inhalation of vapors when using solvent type cleaners.

Bearings

Remove bearings from cleaning fluid and strike larger side of cone flat against a block of wood to dislodge solidified particles of lubricant. Immerse again in cleaning fluid to flush out particles. Repeat above operation until bearings are thoroughly clean. Dry bearings using moisture-free compressed air. Be careful to direct air stream across bearing to avoid spinning. Do not spin bearings when drying. Bearings may be rotated slowly by hand to facilitate drying process.

Housings

Clean interior and exterior of housings, bearing caps, etc., thoroughly. Cast parts may be cleaned in hot solution tanks with mild alkali solutions providing these parts do not have ground or polished surfaces. Parts should remain in solution long enough to be thoroughly cleaned and heated. This will aid the evaporation of the cleaning solution and rinse water. Parts cleaned in solution tanks must be thoroughly rinsed with clean water to remove all traces of alkali. Cast parts may also be cleaned with steam cleaner.

CAUTION: Care should be exercised to avoid skin rashes and inhalation of vapors when using alkali cleaners.

Thoroughly dry all parts cleaned immediately by using moisture-free compressed air or soft, lintless absorbent wiping rags free of abrasive materials such as metal filings, contaminated oil or laping compound.

Brake Shoes and Brake Bands

Do not use solvents or cleaning fluids on brake shoes and linings. Thoroughly clean them with wire brush.

INSPECTION

The importance of careful and thorough inspection of all parts cannot be overstressed. Replacement of all parts showing indication of wear or stress will eliminate costly and avoidable failures at a later date.

Bearings

Carefully inspect all rollers, cages and cups for wear, chipping or nicks to determine fitness of bearings for further use. Do not replace a bearing cone or cup individually without replacing the mating cup or cone at the same time. After inspection, dip bearings in clean light oil and wrap in clean lintless cloth or paper to protect them until installed.

Oil Seals, Gaskets and Retaining Rings

Replacement of spring loaded oil seals, gaskets and snap rings is more economical when unit is disassembled than to risk premature overhaul to replace these parts at a future time. Loss of lubricant through a worn seal may result in failure of other more expensive parts of the assembly. Sealing members should be handled carefully, particularly when being installed. Cutting, scratching, or curling under of lip of seal seriously impairs its efficiency. At reassembly, lubricate lips of oil seals with Lubriplate.

Gears and Shafts

If magna-flux process is available, use process to check parts. Examine teeth and ground and polished surfaces on all gears and shafts carefully for wear, pitting, chipping, nicks, cracks or scores. If gear teeth are cracked or show spots where case hardening is worn through, replace with new gear. Small nicks may be removed with suitable hone. Inspect shafts to make certain they are not sprung, bent, or splines twisted, and that shafts are true. Differential pinions and side gears must be replaced as sets. Differential ring gear and bevel pinion must also be replaced as a set if either is damaged.

Housing and Covers

Inspect housing, covers and planet spider, and differential case to be certain they are thoroughly cleaned and that mating surfaces, bearing bores, etc., are free from nicks or burrs. Check all parts carefully for evidence of cracks or conditions which would cause subsequent oil leaks or failures.

Service Brakes

Inspect anchor pins for wear or damage. If they are worn beyond dimensions indicated in Brake Wear Limits Chart, or if they are pitted, scored or deeply nicked, replace anchor pins.

Check brake shoe bushings for wear. If inside diameter exceeds dimensions indicated in Brake Wear Limits Chart, replace bushings.

Check cam roller for wear and distortion. If inner diameter is worn beyond dimensions indicated in Brake Wear Limits Chart, or if outer diameter has flat spot more than ¼ inch wide extending across roller, replace rollers.

Check cam roller pins for wear and corrosion. If worn beyond dimensions indicated in Brake Wear Limits Chart, or if pitted, scored, or deeply nicked, replace cam roller pins.

Inspect cam shafts for wear or corrosion of bearing surfaces. If worn beyond dimensions indicated in Brake Wear Limits Chart, or if bearing surfaces are pitted, scored, or deeply nicked, replace cam shafts.

Check brake linings for wear, cracks, and oil saturation. If linings are worn to within 1/16" of retaining bolts or otherwise damaged, replace brake linings.

Check cam shaft brake spider bushings and brake chamber bracket bushings for wear, cracks, distortion, or other damage. If inside diameter is worn beyond dimensions indicated in Brake Wear Limits Chart, replace bushings.

Inspect brake drums for cracks, heat checks, scoring, or other damage. Turn down on lathe if necessary. If drum diameter exceeds dimensions indicated in Brake Wear Limits Chart, replace drum.

Replace brake shoe return springs each time axle is overhauled.

BRAKE WEAR LIMITS CHART

ITEM	20x5 20x7	16½x6
Anchor Pins—O. D.	1.478"	1.228"
Brake Drum—Max. Rebore	20.250"	16.750"
Brake Shoe Bushings—I. D.	1.513"	1.263"
Camshaft Bushings—I. D.	1.526"	1.526"
Camshaft—O. D.	1.469"	1.469"
Cam Roller—I. D.	.895"	.770"
Cam Roller Pin—O. D.	.859"	.735"

Parking Brake

Inspect brake backing plate for distortion. Check that cam levers on backing plate swivel freely, but that mounting rivets are firmly seated in plate. Replace backing plate if damaged or if cam levers are loosely mounted.

Inspect brake linings for grease saturation, wear, or looseness. Replace if worn to less than 5/32 inch. Rivet new brake linings to shoes following sequence indicated in Fig. 87.

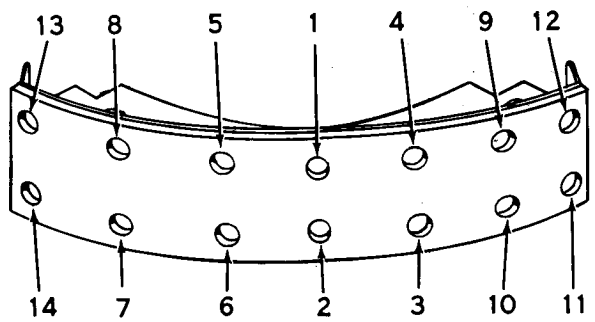


FIG. 87 TS-6219

Inspect brake drums for cracks, heat checks, scoring, or other damage. Turn down on lathe if necessary. If drum diameter exceeds 13.340 inches, replace drum.

NoSPIN Differential

Check splines on the side gear and driven clutch. Remove any burrs or small chipped edges with stone or burr grinder. If large sections of spline are broken away, replace part. Check side gear hub for fractures.

New springs will measure 4 1/4 inch or more in height. Old springs should not be less than 4 1/4 inch high.

Failure of hydrogen copper weld between cam and clutch member will result in erratic operation by alternately driving on one side only or driving both wheels with the NoSPIN locked. If weld failure has occurred, it will be possible to rotate cam ring in driven clutch member by lightly tapping cams.

Inspect driven clutch teeth on spider and driven clutches. Very slight chips can be touched up with a stone. If excessively chipped or rounded, these parts must be replaced. Compare shape of teeth with those on a new part. If a part is replaced due to chipped teeth, always replace the mating part as it may have invisible fractures.

Cams on the center cam and driven clutch must not be excessively chipped. A smooth wear pattern up to 50 percent face width is acceptable on clutch cams.

Holdout rings have a frictional resistance to rotation obtained by friction spring. Check for fractures or severe chipping of cams on this part.

Friction spring wear should not exceed .003 inch at points of contact. Compare with measurement at unworn portion. If extreme care is not exercised in removing this part, it may be damaged. Replace with new part if, after assembly, the holdout ring rotates easily. It should, however, be possible to rotate it by hand. Compare with a new part.

Center cam must be free to rotate within limits of keys in spider.

Check the spring retainers for fractures or spline damage.

Breathers

Wash breather on axle housing with solvent; shake dry. Make sure breather is not clogged.

REASSEMBLY OF AXLE

The following instructions describe the procedure to be followed when reassembling and installing components of axle. Instructions cover reassembly of only one side of axle. Reassembly of opposite group is identical unless otherwise noted.

IMPORTANT: Both Grade 5 and Grade 8 fastening hardware have been used in the production of the axle assemblies covered by this manual. A table of proper torque values for both Grade 5 and Grade 8 hardware is provided at the rear of this manual. Grade of hardware may be determined by the "hash" marks contained on the head of each bolt; Grade 5 having three hash marks and Grade 8 having six hash marks as indicated below. In all cases except where specified in text, use torque value specified in table for applicable bolts.

GRADE 5 

GRADE 8 

Reassembly of Pinion Shaft

1. Press inner pinion bearing on pinion using steel tubing for driver (Fig. 88). Driver dimensions are given in Fig. 89.

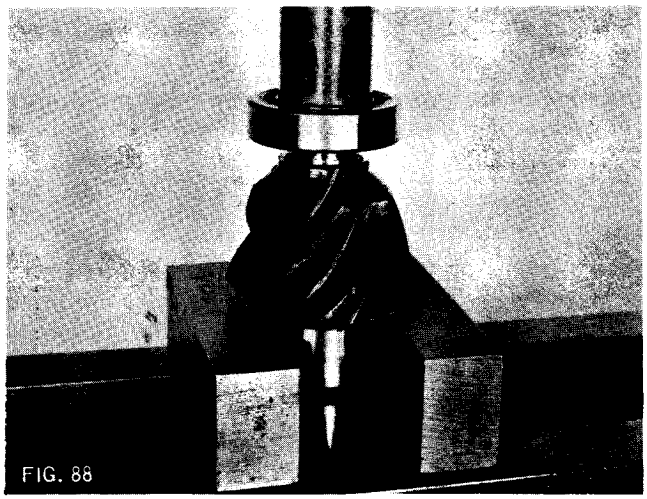


FIG. 88

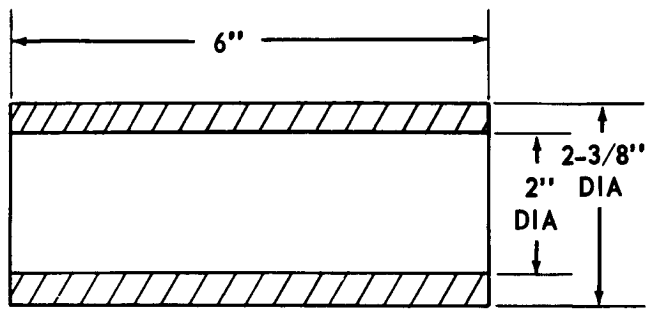


FIG. 89 TS-7684

2. Install inner pinion bearing retaining ring (Fig. 90).

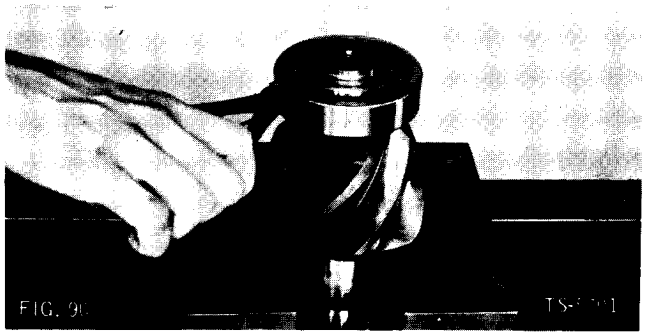


FIG. 90 TS-6221

3. Press center pinion bearing cone onto pinion shaft (Fig. 91). Bearing driver dimensions are given in Fig. 92.

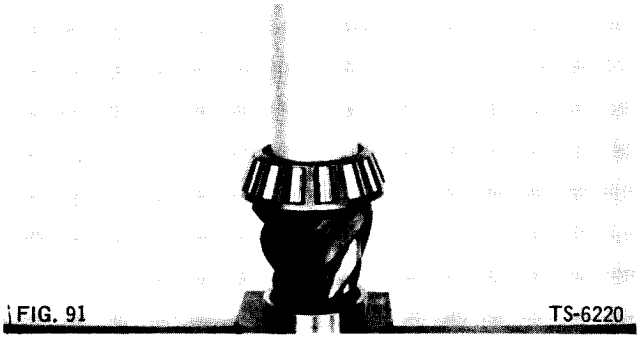


FIG. 91 TS-6220

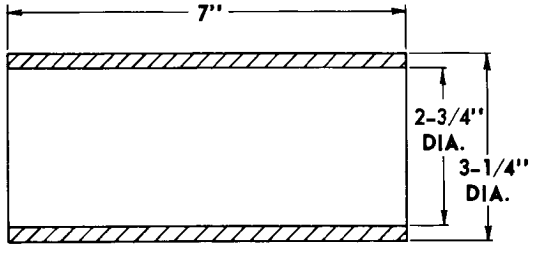
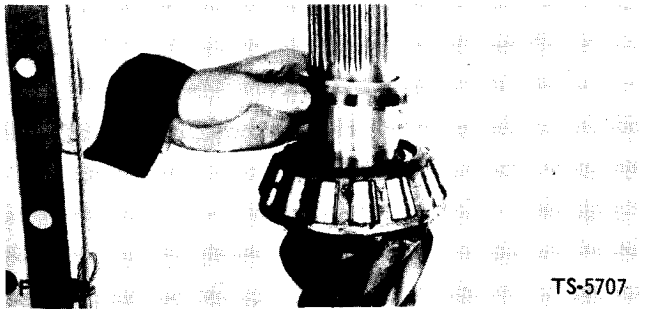


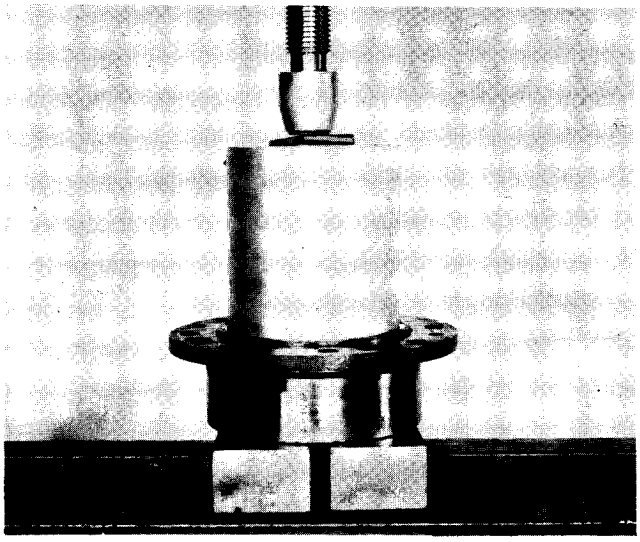
FIG. 92 1/32" DIA RADIUS ALL CORNERS TS-6221

4. A pinion bearing spacer and shim kit is provided for service repair of differential and carrier assemblies. This kit, consisting of a spacer and quantity of shims, is used to obtain proper pinion bearing preload as described below. Position bearing spacer and one .010" shim on pinion shaft (Fig. 93).



TS-5707

5. Press bearing cups into pinion bearing cage (Fig. 94). Bearing driver dimensions are shown in Figs. 95 and 96.



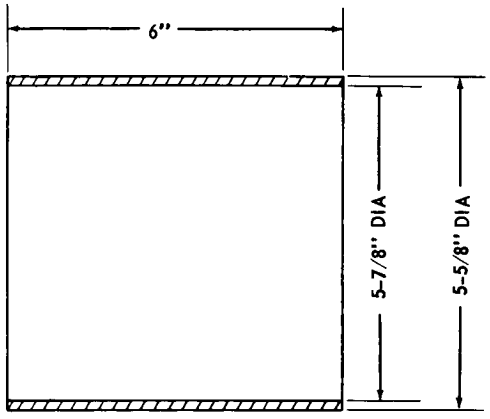
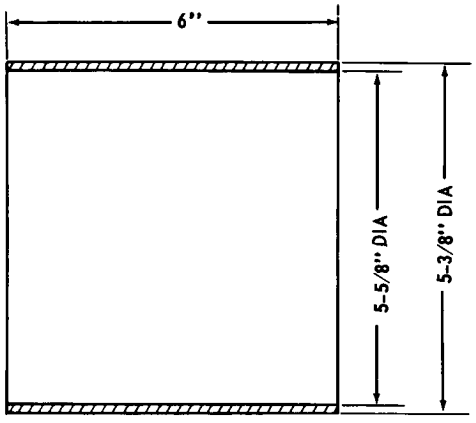


FIG. 95 1/32" DIA RADIUS ALL CORNERS TS-6284



1/32" DIA RADIUS ALL CORNERS

FIG. 96 TS-6222

6. Position pinion bearing cage assembly on pinion shaft. Position outer pinion bearing cone on pinion shaft and press into place using steel tubing for driver (Fig. 97). Driver dimensions are shown in Fig. 92.

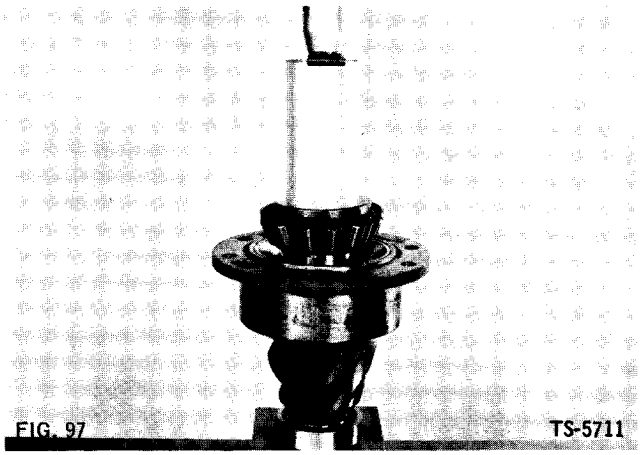


FIG. 97 TS-5711

7. Keep pinion and cage assembly in press with approximately 500 pounds of press pressure exerted on driver. Wrap several turns of soft wire or cord around pinion cage and pull in horizontal line with spring scale. While pulling in straight line, (90 degrees from centerline of shaft), read spring scale and measure rotating torque (Fig. 98). Multiply reading on spring scale by one-half diameter of bearing cage to obtain preload torque. Correct preload torque is 13 to 23 in. lbs. If preload is not within these limits, remove shims to increase preload or add shims to decrease preload.

   NOTE: This is a preliminary check. Final bearing preload check must be made with pinion shaft and bearing cage assembly in differential carrier housing.

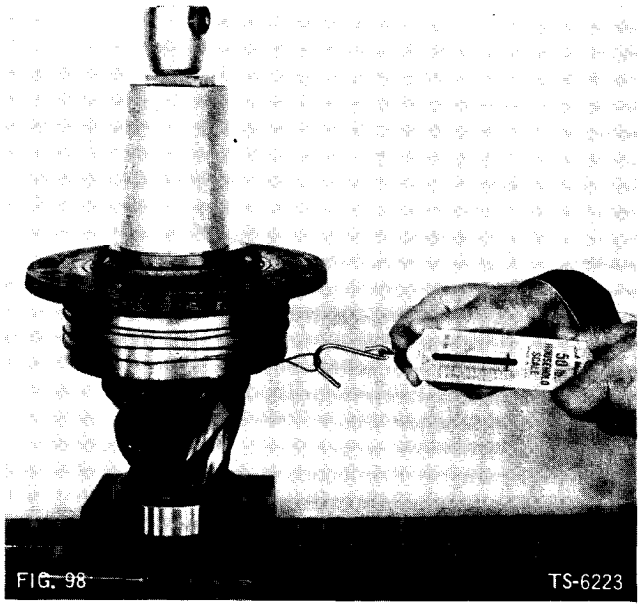


FIG. 98 TS-6223

Reassembly of Differential Ring Gear and Bearings

NOTE: Lubricate all differential bearings, gears, and thrust washers with SAE 90 EP lubricant, SCL type.

1. Press differential bearing cones on case halves (Fig. 99). Bearing driver dimensions are given in Fig. 100.

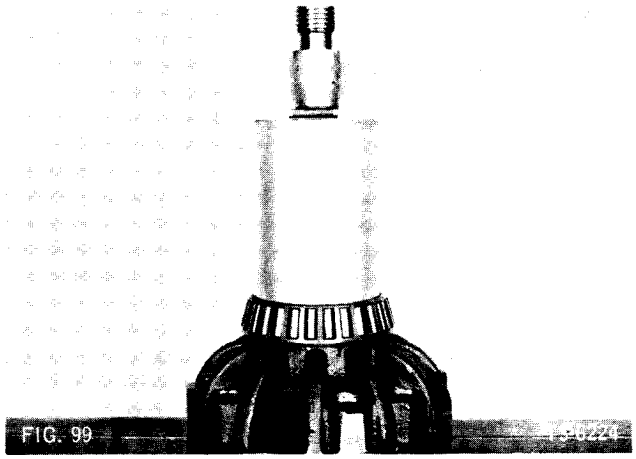


FIG. 99 TS-6224

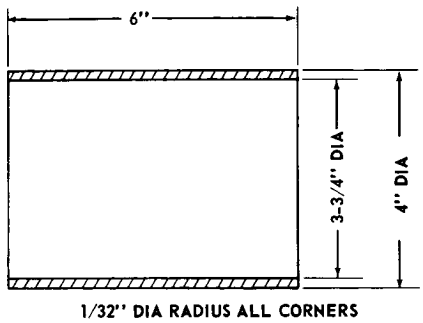


FIG. 100 TS-6225

2. Check ring gear mounting surface of flanged half of differential case for burrs. Remove burrs with file (Fig. 101).

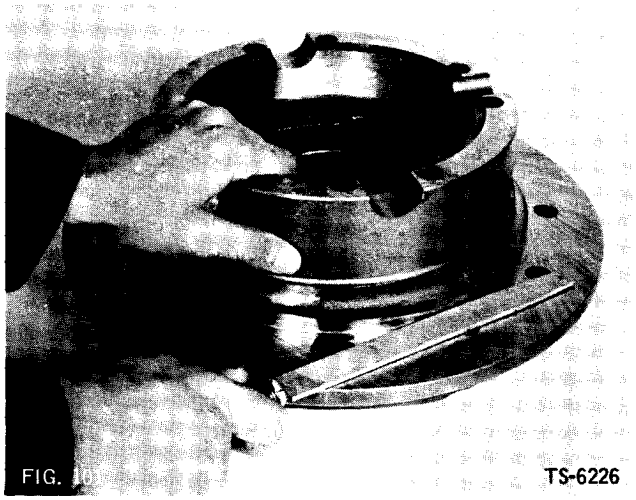


FIG. 101 TS-6226

3. Install ring gear. Install bolts so internal diameter of ring gear prevents turning of hex head. Install ring gear bolt nuts and torque to 120 to 135 ft. lbs. Position ring gear and flanged hub in press and apply light press pressure to facilitate torquing nuts (Fig. 102).

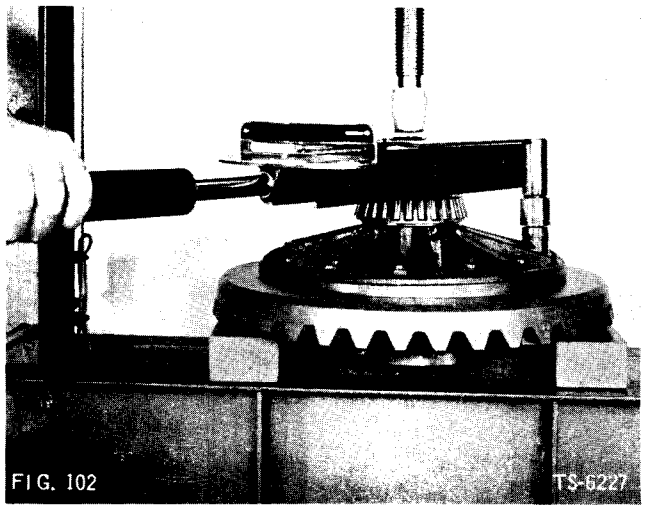


FIG. 102 TS-6227

NOTE: Axle Part Nos. 130788, 131507, and 190010 are equipped with NoSPIN differentials. Refer to Figs. 107 through 118 for reassembly instructions.

Reassembly of Conventional Differential

1. Lubricate and install thrust washer and side gear in differential case and ring gear assembly (Fig. 103). Engage holes in thrust washer on dowels projecting from thrust washer bearing surface in differential case.

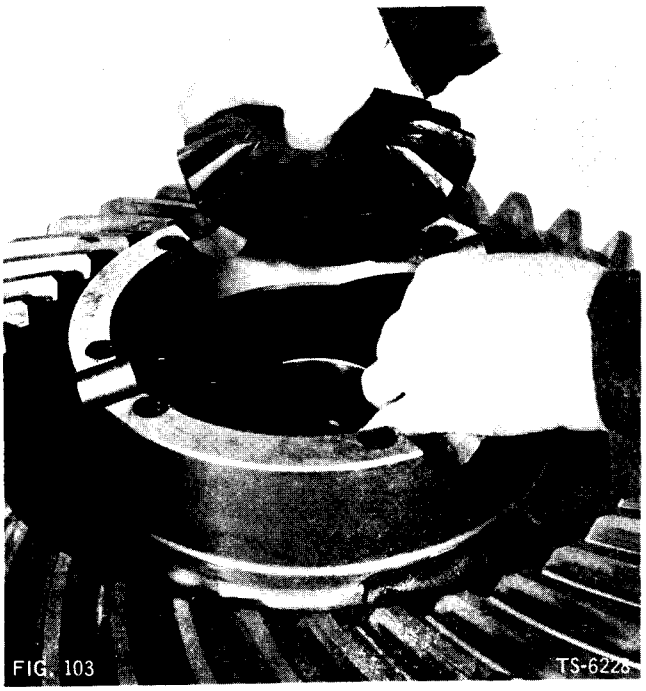


FIG. 103 TS-6228

2. Place pinions and thrust washers on differential spider, lubricate, and set in position on installed side gear.

   NOTE: It is very important that tang on each pinion thrust washer engages groove in case halves as shown by arrows in Fig. 104.

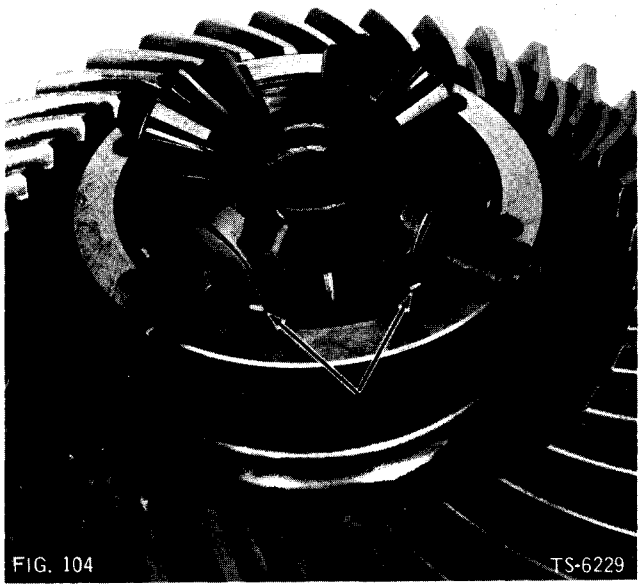


FIG. 104 TS-6229

3. Align match-marks and install remaining case half on other case half assembly, making sure of full gear engagement (Fig. 105). Install bolts and tighten to specified torque.

   NOTE: Some differential cases are held together with thru bolts and self-locking nuts instead of bolts in tapped holes. The bolt heads must extend from the ring gear side of the case assembly.

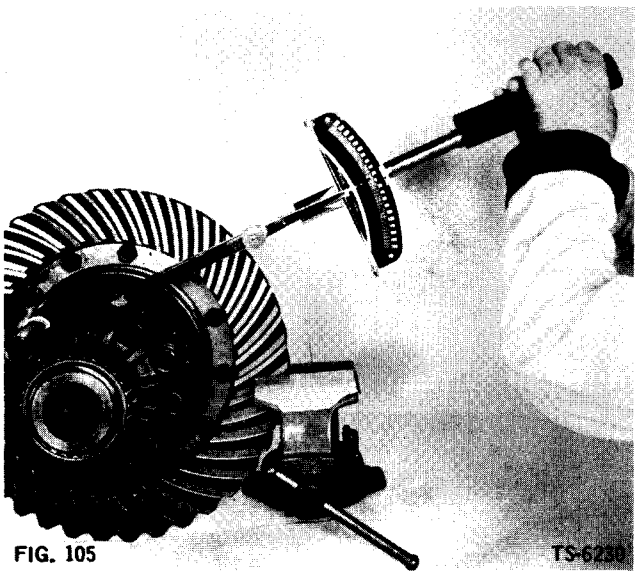


FIG. 105 TS-6230

4. Lockwire bolts in pairs (Fig. 106) on axles that use tapped differential case bolt holes.

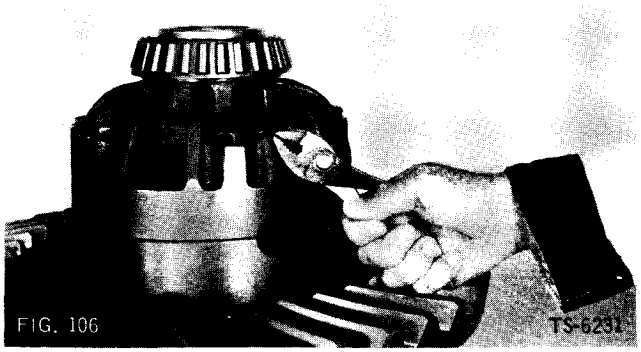


FIG. 106 TS-6231

Reassembly of NoSPIN Differential

NOTE: Lightly lubricate parts of NoSPIN differential during assembly. Special lubricants are not required for use with this differential.

1. Install snap ring in internal groove of spider (Fig. 107).

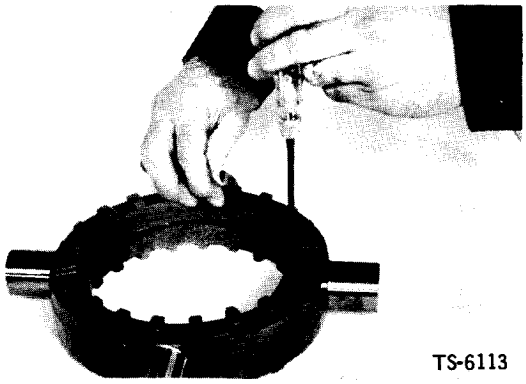


FIG. 107 TS-6113

2. Position center cam in spider. Spread snap ring while inserting center cam (Fig. 108). Make sure center cam ring groove is fully engaged by snap ring to retain center cam.

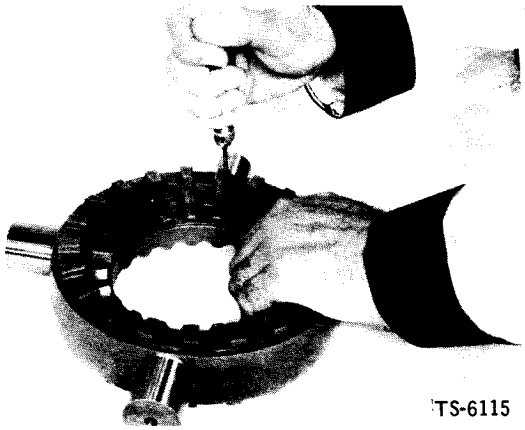


FIG. 108 TS-6115

3. Install holdout ring on drive clutch with snap ring pliers (Fig. 109).

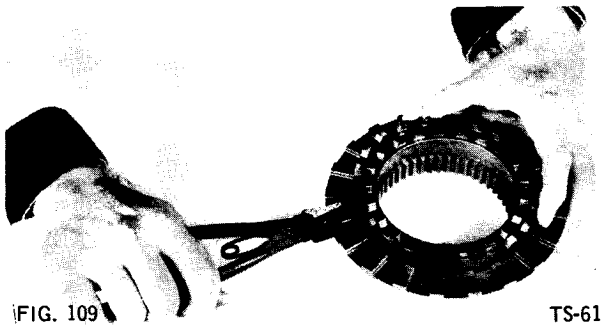


FIG. 109 TS-6116

4. Install spring retainer in driven clutch (Fig. 110).

FIG. 110 TS-6105

5. Install side gear and spring in differential case half (Fig. 111).

FIG. 111 TS-6214

6. Position assembled driven clutch, holdout ring, and spring retainer on spring (Fig. 112).

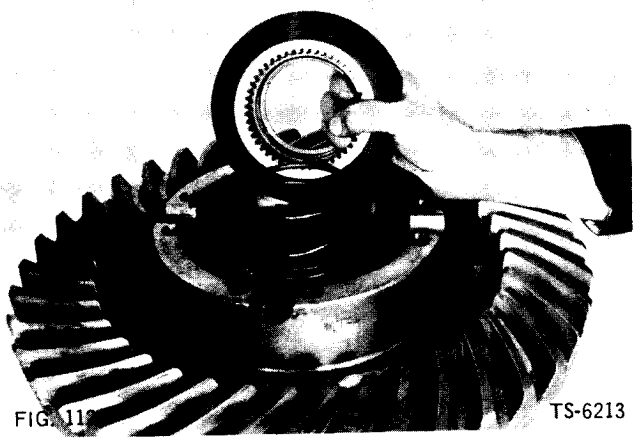


FIG. 112 TS-6213

7. Install assembled spider and center cam on driven clutch. Make sure that keys on spider engage keyways on driven clutch (Fig. 113).

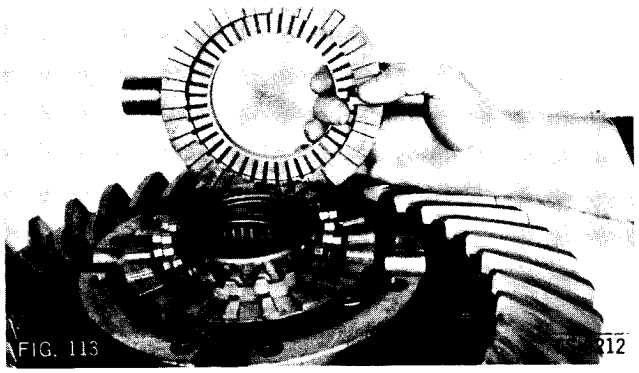


FIG. 113 TS-6212

8. Install the upper driven clutch, with its assembled holdout ring and spring retainer, on the spider. Make sure spider keys engage keyways in driven clutch (Fig. 114).

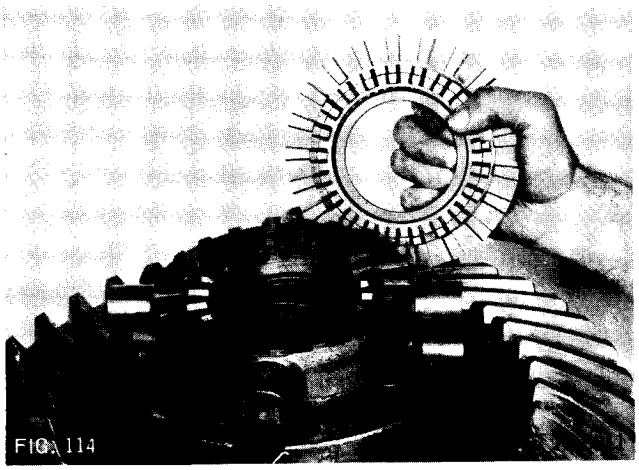


FIG. 114

9. Install spring and side gear on driven clutch (Fig. 115).

TS-6210

10. Position case half on differential (Fig. 116). Manually press on case half to compress springs to assure that case halves seat fully together. If they do not, splines in the NoSPIN parts are not properly aligned. Align parts and again check to make sure that case halves seat fully.

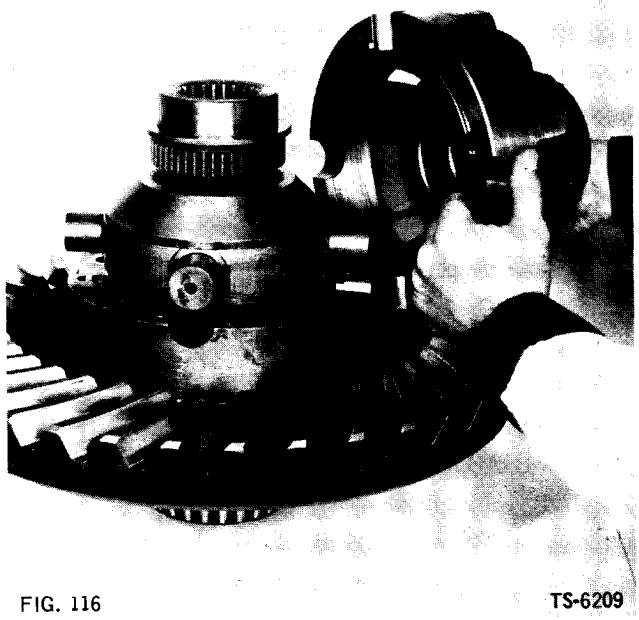


FIG. 116 TS-6209

11. Install four case bolts in alternate holes and tighten them evenly until all are seated, taking care that NoSPIN parts do not bind (Fig. 117). Install remaining bolts and tighten all bolts to specified torque as shown in Fig. 105.

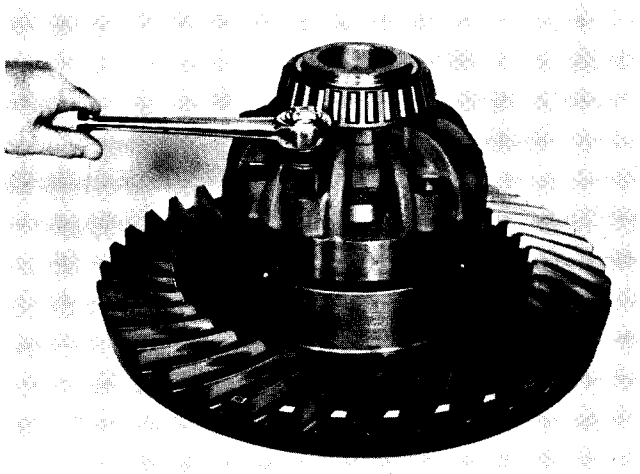


FIG. 117 TS-6208

12. After torquing bolts, insert axle shaft into differential so that it engages side gear and check for backlash between clutch teeth of NoSPIN differential (Fig. 118). A backlash of approximately 5/32 inch must be present. If proper backlash does not exist, disassemble differential case halves and recheck for correct assembly. After reassembly, torque case bolts and lockwire bolts in pairs as shown in Fig. 106.

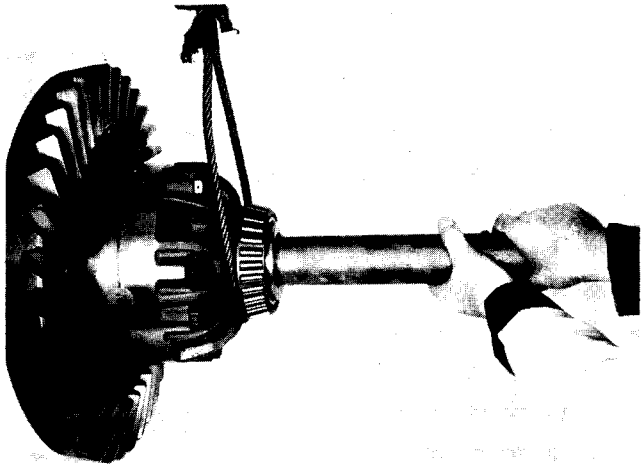
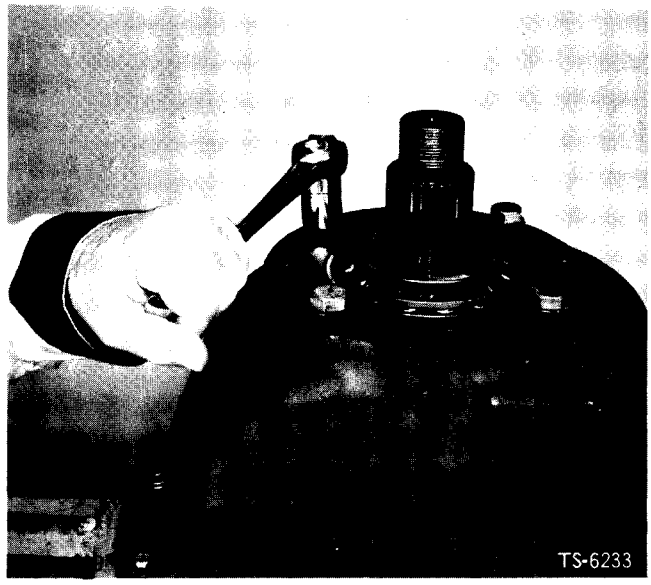


FIG. 118 TS-6232

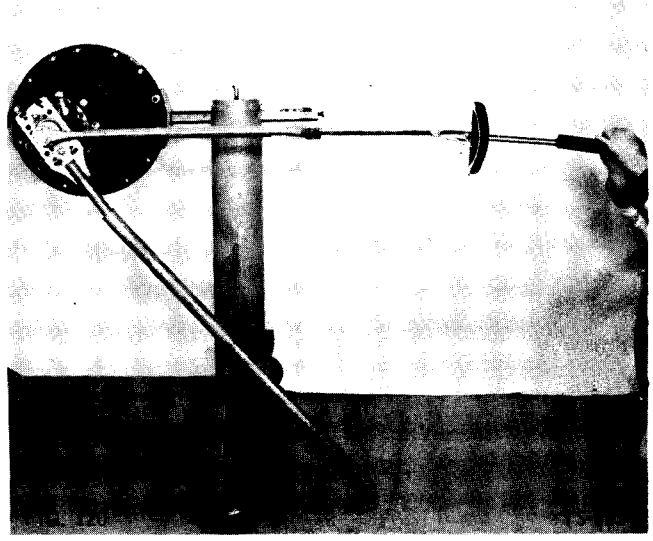
Reassembly of Differential and Carrier

1. Install bearing cage and pinion shaft assembly in differential carrier assembly, using original shim pack or its equivalent thickness. Use four pinion oil seal retainer bolts with flat washers to pull pinion shaft assembly fully into carrier assembly (Fig. 119). Make sure oil passages are aligned.

NOTE: Some differential carrier housings have blind tapped holes for mounting pinion shaft assembly. If holes are blind, use stacks of flat washers on bolts when installing pinion shaft assembly without oil seal retainer to prevent bolts from bottoming in blind holes.



2. Temporarily install companion flange on end of pinion shaft without installing pinion oil seal retainer. Install companion flange retaining tool on companion flange using spacers shown in Fig. 30 and socket shown in Fig. 31. Torque companion flange nut to 600 ft. lbs. (Fig. 120).



3. Use "inch-pound" torque wrench to check bearing preload (Fig. 121). If bearing preload is not between 13 and 23 in. lbs., disassemble parts and add shims to decrease preload or remove shims to increase preload.

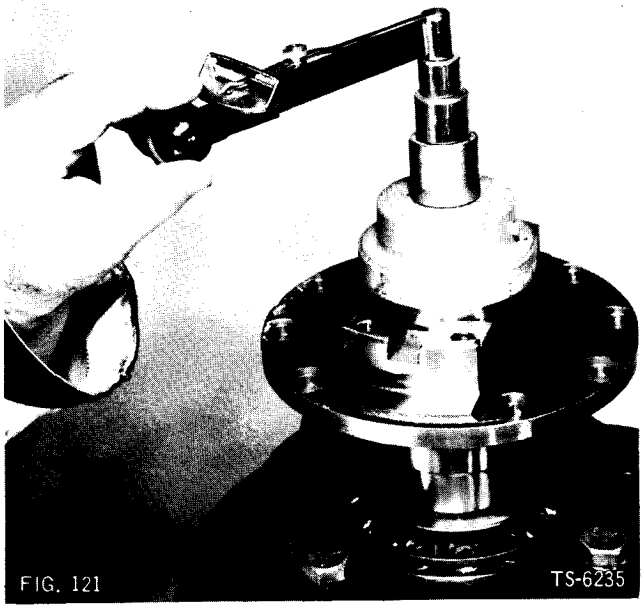


FIG. 121 TS-6235

4. Position differential carrier and pinion assembly in differential stand so that pinion shaft is down. Insert bar through differential to facilitate hoisting. Position differential into carrier, tilting it so that ring gear will clear inner bearing boss in carrier (Fig. 122).

NOTE: If differential bearing cones are replaced it is also necessary to replace differential bearing cups.

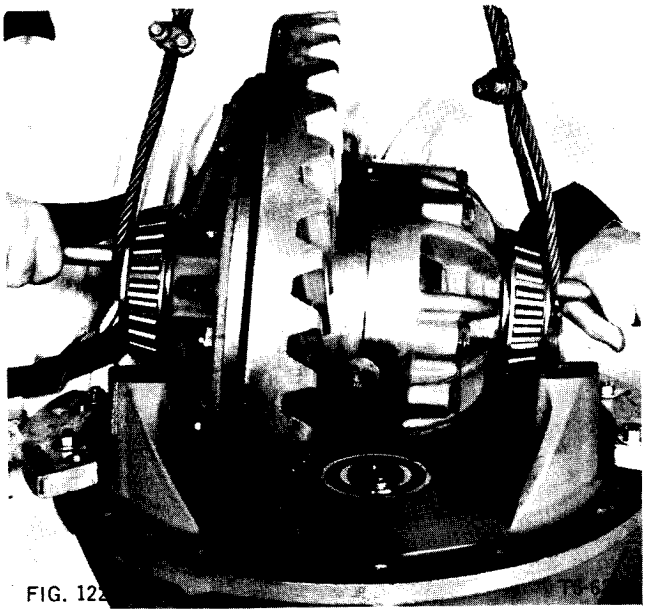


FIG. 122

5. Position differential bearing cup and differential adjusting nut on lifting bar on one side of differential and lift bar slightly with hoist. Position bearing cup and adjusting nut on carrier (Fig. 123). Repeat procedure to install opposite bearing cup and adjusting nut. Take care to prevent cross-threading of nuts.

NOTE: If differential bearing cones are replaced, new bearing cups must be used.

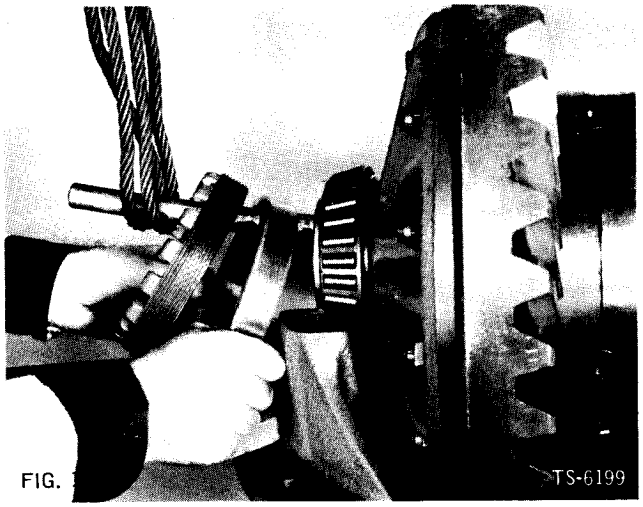


FIG. TS-6199

6. Position bearing caps on bearings and nuts, making sure match-marks made during disassembly are properly aligned. Install bearing cap bolts (Fig. 124) and tighten until snug, but do not torque. Rotate adjusting nuts from time to time to assure that they are not cross-threaded.

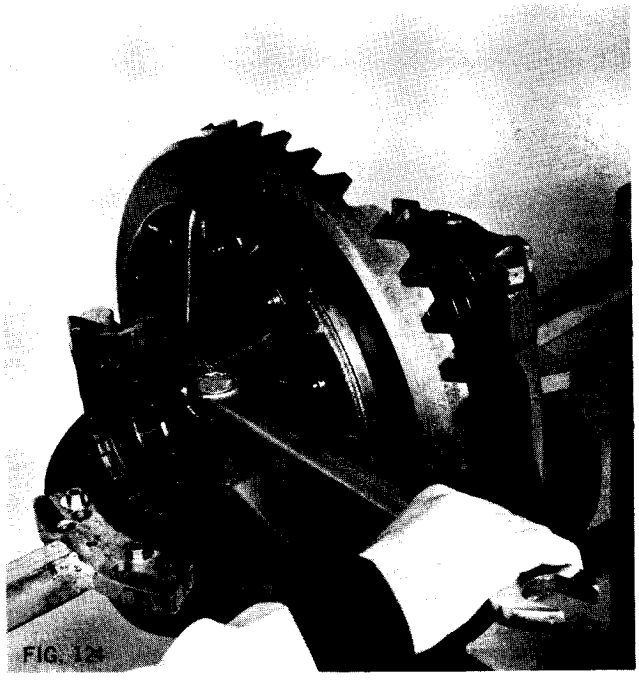


FIG. 124

7. Tighten bearing adjusting nuts to adjust bearings to zero end play (Fig. 125). This condition may be checked with screwdriver as shown (Fig. 126). All bearing rollers must rotate as ring gear rotates, but it should not be possible to move bearing rollers sideways in cage when prying against them with screwdriver.

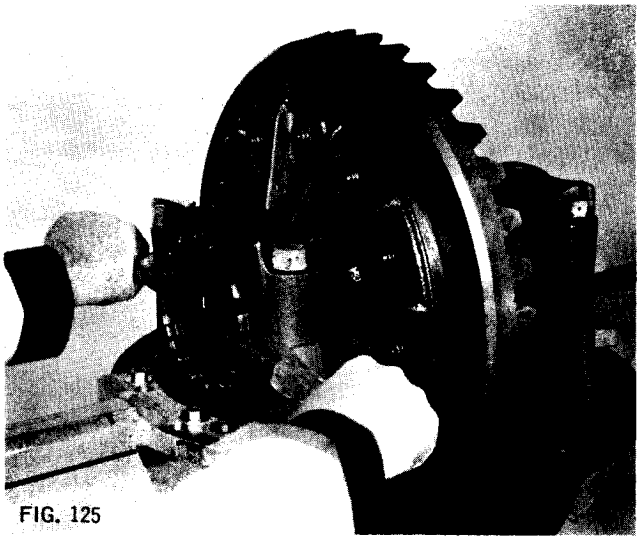


FIG. 125

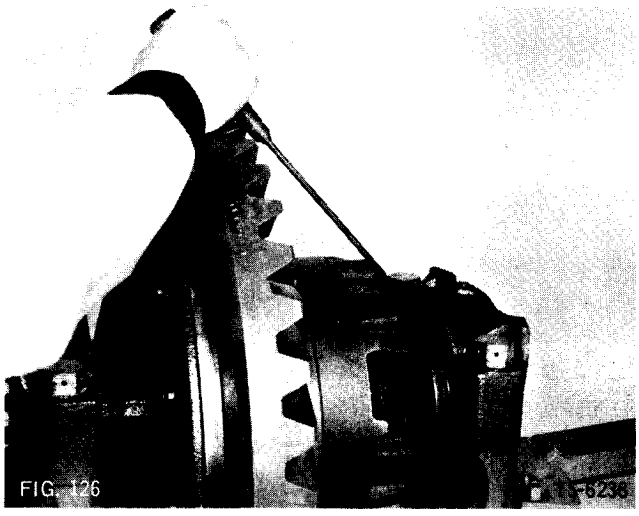


FIG. 126

8. Use a dial indicator to check backlash between ring gear and pinion shaft gear. Backlash is adjusted by moving ring gear toward or away from pinion shaft gear as shown in Fig. 127. Move ring gear by loosening one adjusting nut and tightening opposite lock nut. When loosening one lock nut and tightening opposite, move each lock nut same distance so that bearing adjustment made in previous paragraph is not disturbed. Adjust position until gear backlash is between .010" and .014" if new gear set is used, or adjust to backlash noted at disassembly for old gears.

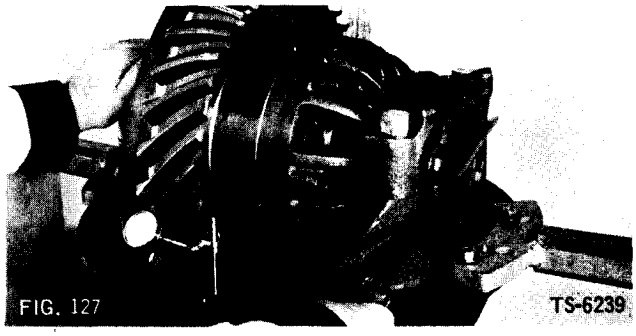


FIG. 127 TS-6239

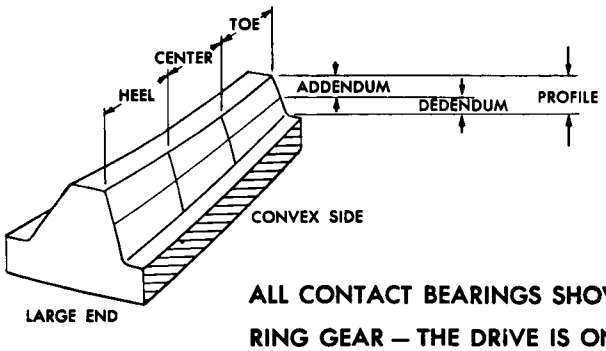
9. Check ring and pinion gear for proper tooth contact. Paint ring gear with a mixture of red lead and linseed oil (Fig. 128). When ring and pinion gears are rotated, the red lead is squeezed away by the contact of the teeth, leaving bare areas the exact size, shape and location of the contacts. As a rule, painting about 10 or 12 teeth is sufficient for checking purposes.

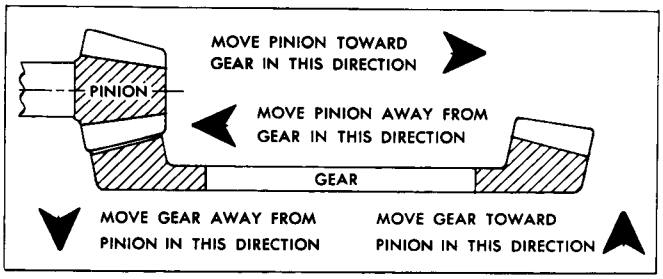
FIG. 128 TS-6240

Sharper impressions may be obtained by applying a small amount of resistance to the ring gear with a flat steel bar and using a wrench to rotate the pinion. Gears should be rotated, under slight load, until ring gear has turned at least one revolution in both directions.

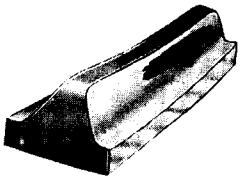
Check tooth contact pattern on drive side (convex side) of ring gear teeth. Coast side will automatically correct when drive side pattern is correct. Refer to gear tooth contact chart (Fig. 129). If proper tooth contact pattern is not as shown, readjust backlash or add to or subtract from shim pack between bearing cage flange and differential housing. Addition of or subtraction of shims should be made in small increments until proper contact is established. Split shims are provided to permit removal or insertion between bearing cage and differential housing.

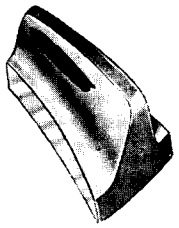
SPIRAL BEVEL AND HYPOID TOOTH BEARING CONTACT CHART





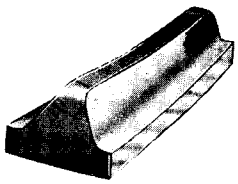
ALL CONTACT BEARINGS SHOWN BELOW ARE ON RIGHT HAND SPIRAL RING GEAR – THE DRIVE IS ON THE CONVEX SIDE OF THE TOOTH.

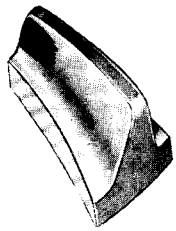




CONDITION 1

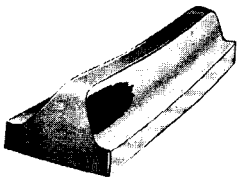
TYPICAL PREFERRED BEARING ON BOTH SIDES OF TOOTH WHILE UNDER A LIGHT LOAD

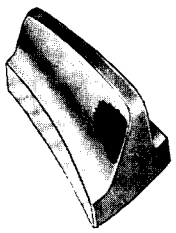




CONDITION 2

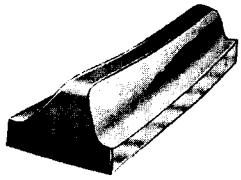
TOE BEARING ON BOTH SIDES OF TOOTH - GEAR SET NOISY. TO MOVE BEARING TOWARD HEEL INCREASE BACKLASH WITHIN LIMITS BY MOVING GEAR AWAY FROM PINION.

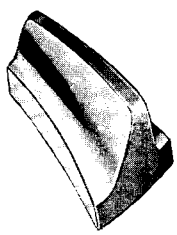




CONDITION 3

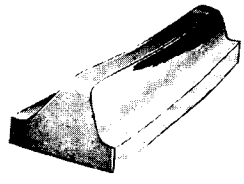
HEEL BEARING ON BOTH SIDES OF TOOTH - GEAR SET NOISY AND COULD RESULT IN EARLY GEAR FAILURE. TO MOVE BEARING TOWARD TOE DECREASE BACKLASH WITHIN LIMITS BY MOVING GEAR TOWARD PINION.

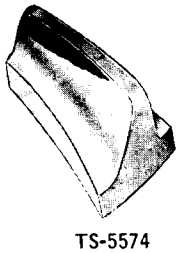




CONDITION 4

LOW BEARING ON GEAR AND HIGH BEARING ON PINION. CORRECT BY PULLING PINION AWAY FROM GEAR. INCREASE MOUNTING DISTANCE BY ADDING SHIMS BETWEEN BEARING CAGE AND DIFFERENTIAL HOUSING.





CONDITION 5

HIGH BEARING ON GEAR AND LOW BEARING ON PINION. CORRECT BY MOVING PINION IN TOWARD GEAR. DECREASE MOUNTING DISTANCE BY REMOVING SHIMS FROM BETWEEN BEARING CAGE AND DIFFERENTIAL HOUSING.

BACKLASH

BACKLASH SHOULD BE MEASURED WITH A DIAL INDICATOR RIGIDLY MOUNTED WITH THE STEM PERPENDICULAR TO THE TOOTH SURFACE AT THE EXTREME HEEL.

FIG. 129

TS-5574

10. Tighten bearing cap bolts to specified torque (Fig. 130). With dial indicator, recheck ring gear and pinion backlash. Recheck differential bearings for end play as described in step 4.

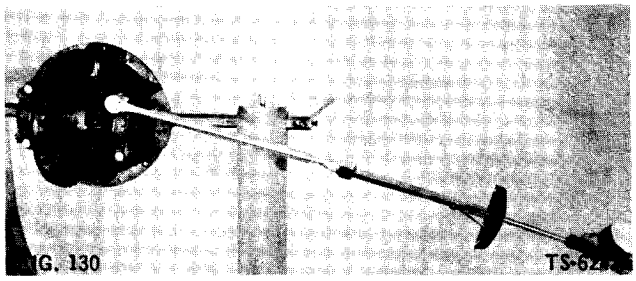


FIG. 130

11. Use dial indicator to check back face of ring gear. Rotate at least one full turn (Fig. 131). Runout must not exceed .005 total indicator reading. If runout is excessive, remove assembly and check for burrs or dirt under mounting surface of ring gear. Reassemble and recheck.

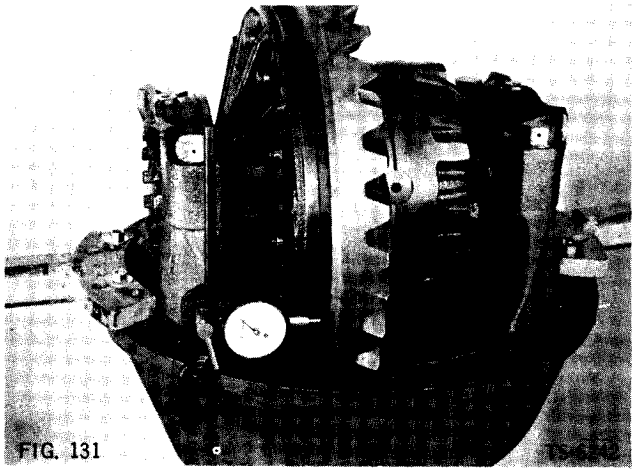


FIG. 131

12. Install adjusting nut lock with bolt and lockwasher (Fig. 132).

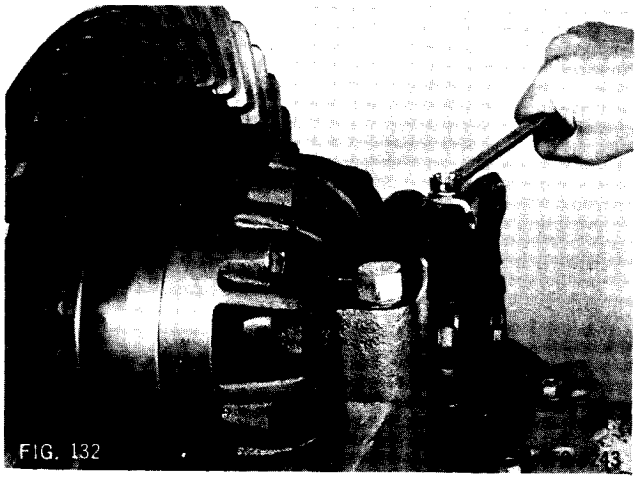


FIG. 132

13. Lockwire together the bearing cap bolts and adjusting nut bolt (Fig. 133).

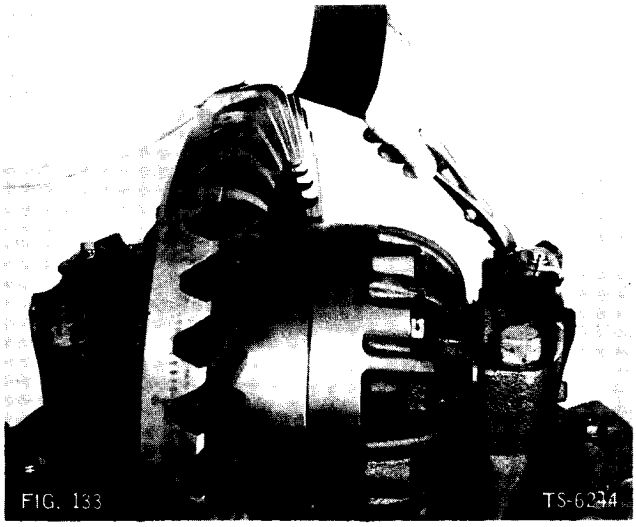


FIG. 133

14. Remove companion flange and remove bolts and washers that were used for temporary installation of pinion shaft assembly. Coat outside diameter of seal with Permatex No. 2 and press into pinion oil seal retainer so that lip of seal will face toward pinion. Coat lip with Lubriplate. Install gasket and pinion oil seal retainer. Secure with 8 bolts and lockwashers and tighten bolts to specified torque (Fig. 134).

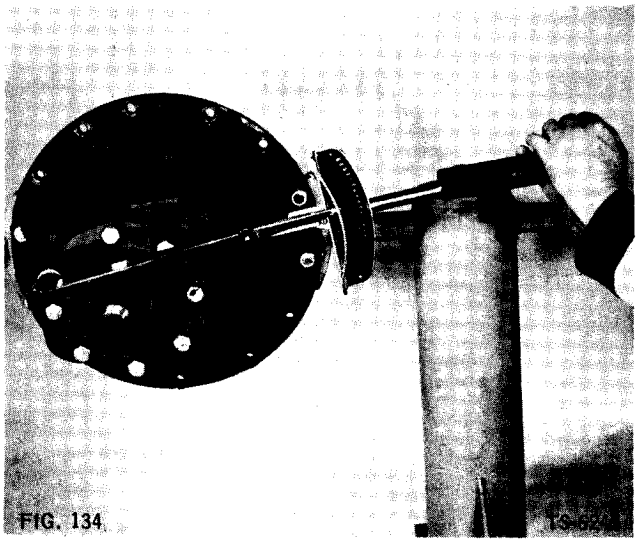


FIG. 134

15. On axle models that do not have a parking brake, install companion flange on end of pinion shaft with flat washer and nut. Torque nut to 600 ft. lbs. as shown in Fig. 120. Secure nut with cotter pin. On axle models with parking brake, companion flange should be installed temporarily to facilitate handling the differential.

Reassembly of Internal Gear and Hub

1. Position internal gear on hub, aligning matchmarks made at disassembly. Secure with bolts and locking plates and tighten to specified torque (Fig. 135). Lockwire bolts in pairs.

   NOTE: Some axles use bolts without locking plates, with bolts inserted through internal gear and threaded into hub.

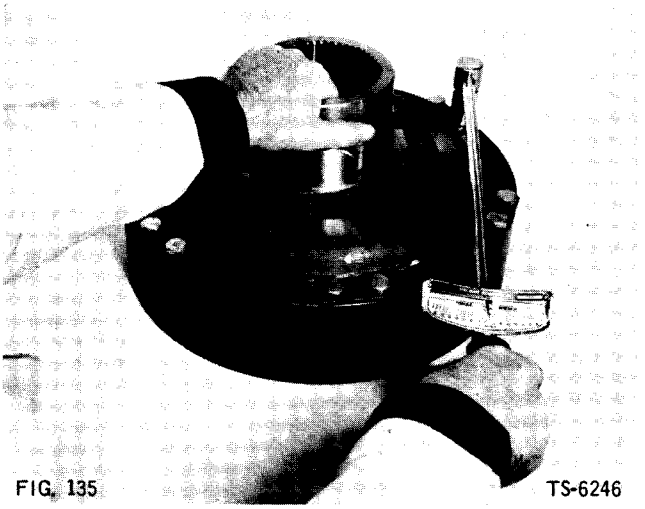


FIG. 135 TS-6246

2. Check that bearing seat on hub is free of nicks and burrs. Press bearing cone on internal gear and hub using bearing driver (Fig. 136). Bearing driver dimensions are given in Fig. 137.

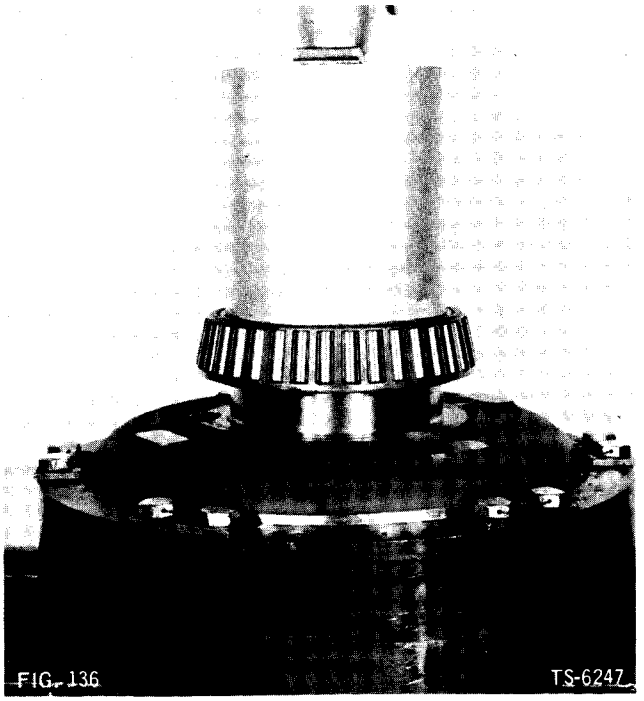
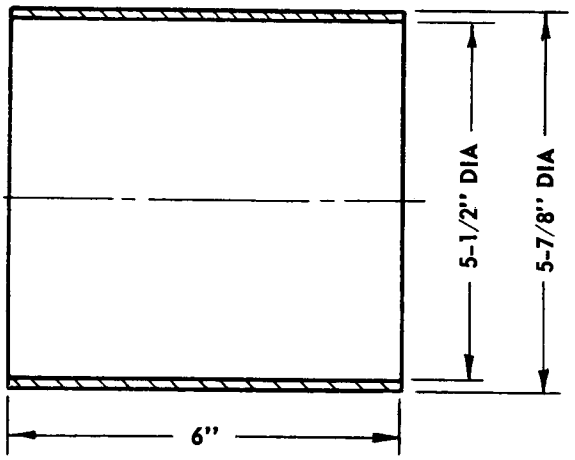


FIG. 136 TS-6247



1/32" DIA RADIUS ALL CORNERS

FIG. 137 TS-6248

Reassembly of Brake Shoes

1. Install brake linings on brake shoes with washers and nuts. Torque nuts to 200 to 220 in. lbs. (Fig. 138). Tighten nuts in sequence shown in Fig. 139.

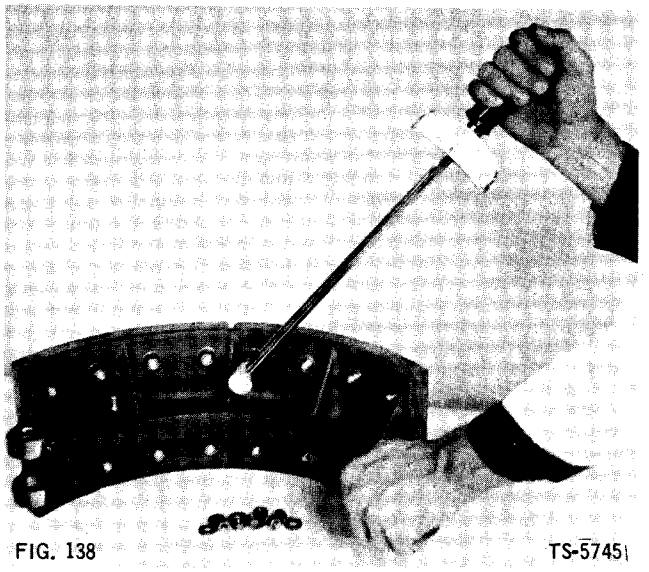


FIG. 138 TS-5745

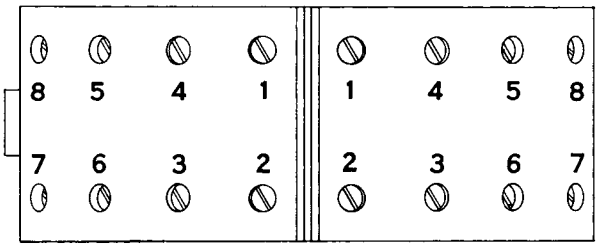


FIG. 139 TS-5746

2. Tap brake lining plugs into brake lining bolt holes (Fig. 140).

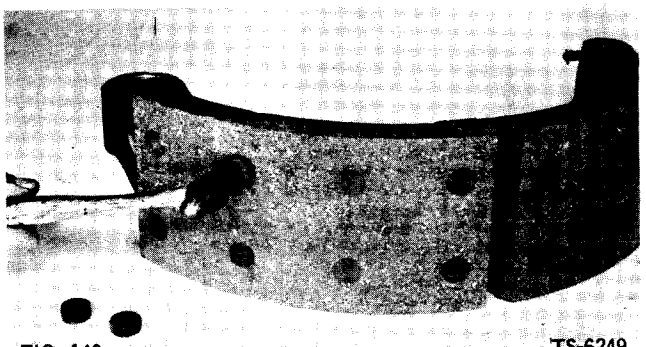
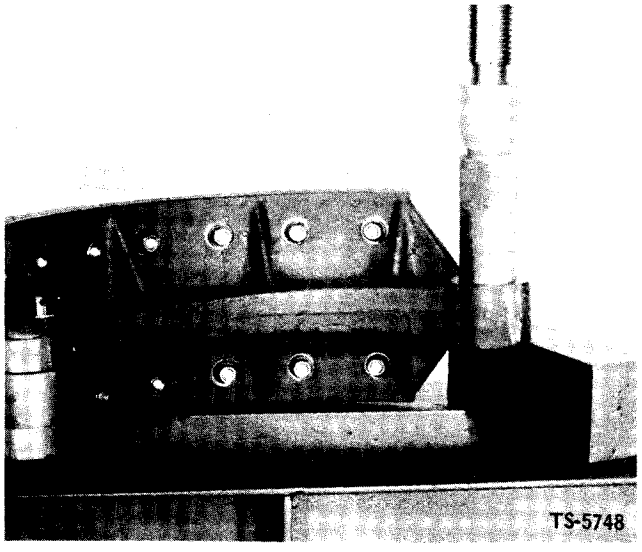


FIG. 140 TS-6249

3. Position brake cam roller on brake shoe. Apply light coat of Never-Seez on brake cam roller pin and insert pin. Secure pin with cam roller pin lock pin and cotter pin (Fig. 141).

FIG. 141 TS-5747

4. Press brake shoe bushings into brake shoe (Fig. 142).



TS-5748

Reassembly of Hub and Drum Assembly

1. If wheel studs were removed, replace entire set of studs with new set. Install stud nuts and tighen to 200 ft. lbs. torque (Fig. 143).

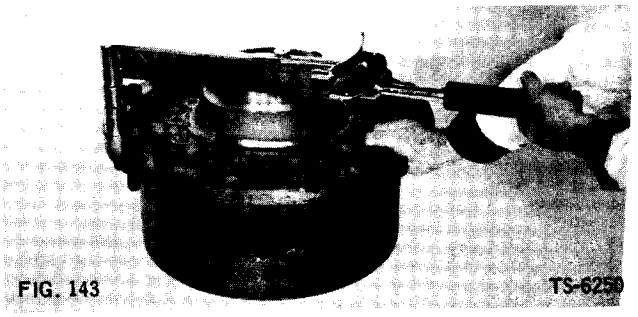


FIG. 143 TS-6250

2. Check bearing bores in wheel hub to be sure all nicks and burrs have been removed from both bores and bearing seats. Install bearing cups in hub with wide diameter of taper toward outside of hub. Use bearing driver to drive cups into place (Fig. 144). Bearing driver dimensions are given in Fig. 145. Make sure bearings are fully seated.

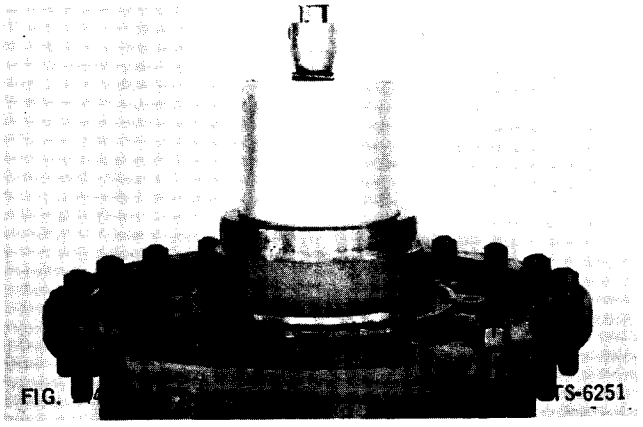
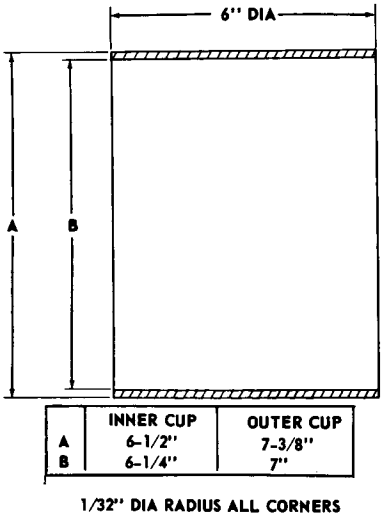


FIG. TS-6251



	INNER CUP	OUTER CUP
A	6-1/2"	7-3/8"
B	6-1/4"	7"

1/32" DIA RADIUS ALL CORNERS

FIG. 145 TS-6252

3. Lubricate inner wheel hub bearing cone with gear oil and position in wheel hub bearing cup (Fig. 146).

FIG. 146 TS-6190

4. Coat outside diameter of oil seal with Permatex No. 2. Lubricate lip of seal with Lubriplate. Press or drive oil seal into hub using seal driver (Fig. 147). Fig. 148 shows driver dimensions. Spring-loaded lip of seal must face inward. Wipe off excessive Permatex after seating seal.

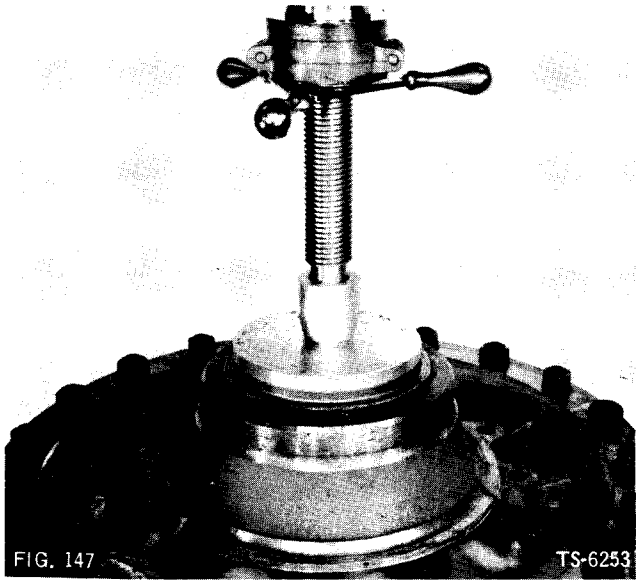


FIG. 147 TS-6253

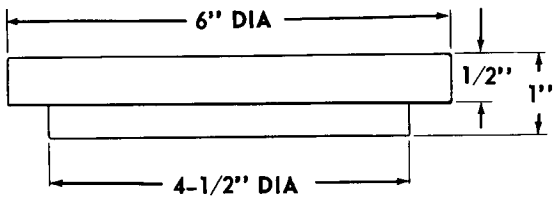


FIG. 148 TS-6254

5. Position oil catcher on hub (Fig. 149).

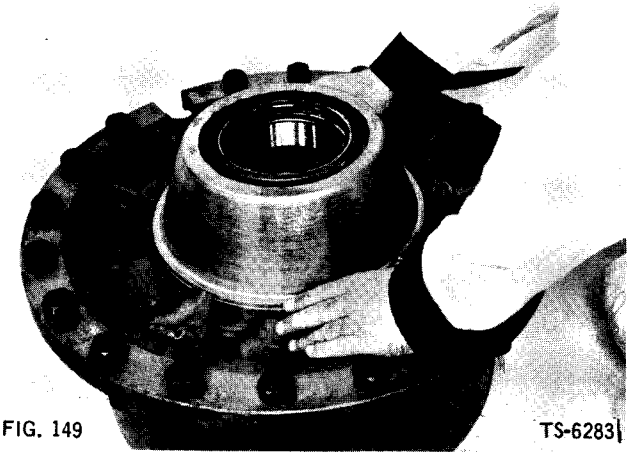


FIG. 149 TS-6283

6. Position brake drum on hub. Install bolts and flat washers. Tighten bolts to torque specifications (Fig. 150).

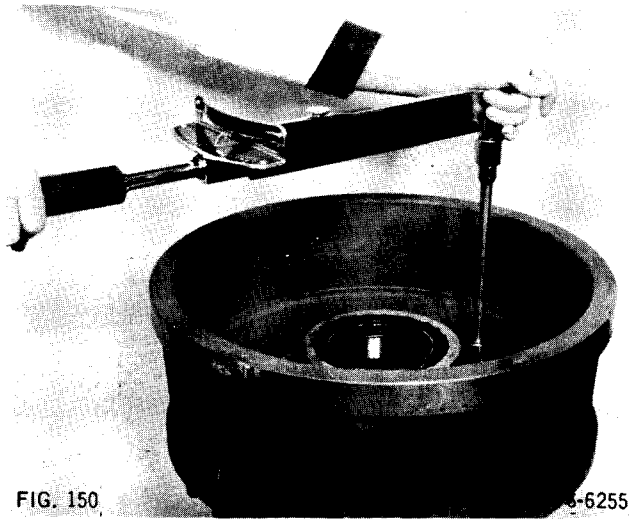


FIG. 150 -6255

7. Lock-wire bolts in pairs (Fig. 151).

FIG. 151 TS-6256

Reassembly of Planet Carrier

1. Coat inside of planet pinion with chassis grease to retain pinion needle rollers. Each pinion contains a double row of needle rollers, with a spacer between rows. Install a row of 28 rollers, roller spacer and another row of 28 rollers in each pinion (Fig. 152).

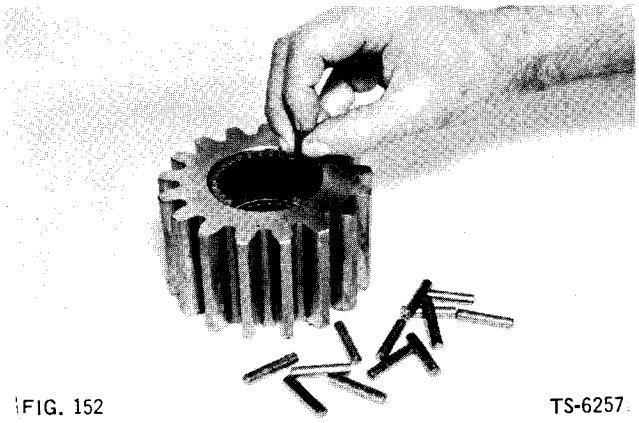


FIG. 152 TS-6257

2. Position assembled pinion and two pinion thrust washers in planet carrier, making sure tangs on thrust washer engage the grooves in the spider (Fig. 153).

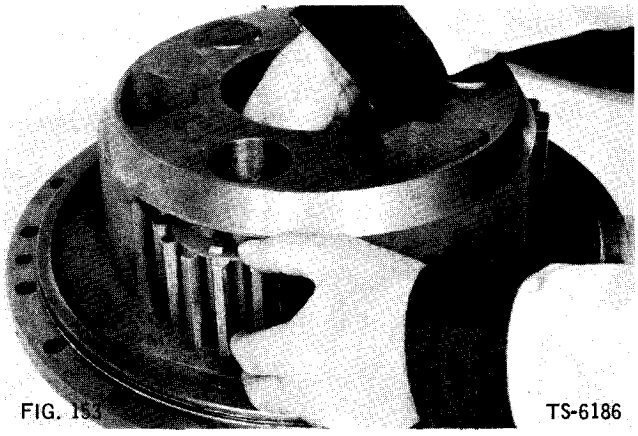


FIG. 153 TS-6186

3. Press in pinion shaft, making sure the pinion shaft ball recess aligns with groove in spider. Insert pinion shaft ball and complete press (Fig. 154). Press end of pinion shaft flush with face of carrier.

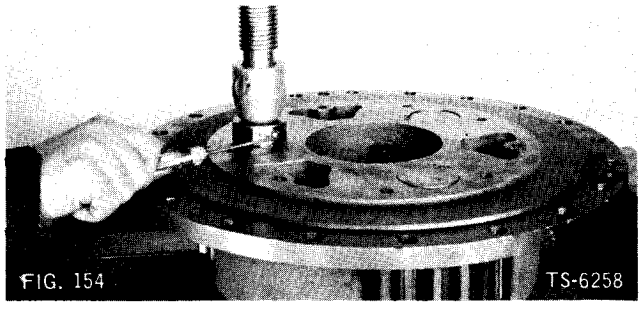


FIG. 154 TS-6258

4. Stake pinion shaft ball groove in two places to retain shaft (Fig. 155).

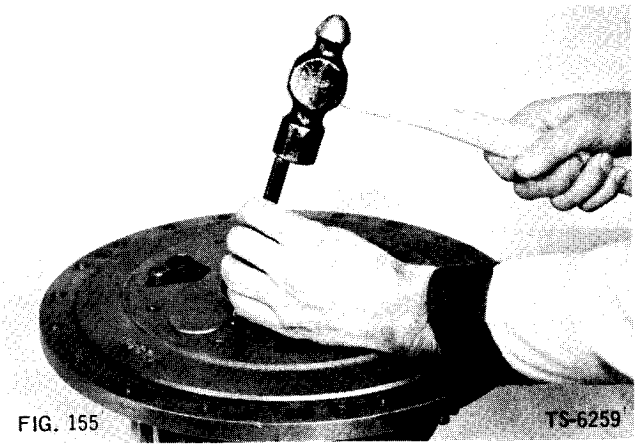


FIG. 155 TS-6259

Reassembly of Axle Parts

1. Coat both sides of differential gasket lightly with gasket sealer and position carefully on axle housing (Fig. 156).

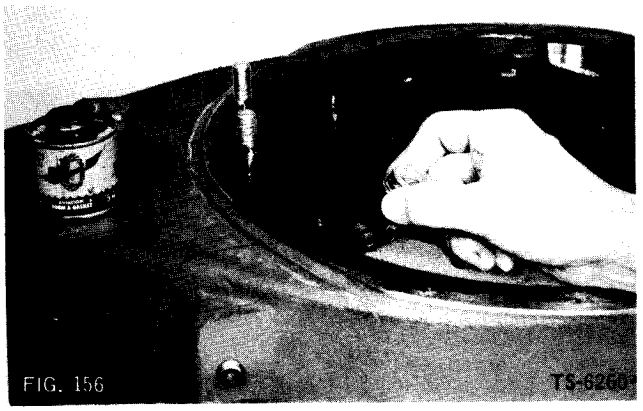


FIG. 156 TS-6260

2. Position differential carrier on axle housing (Fig. 157).

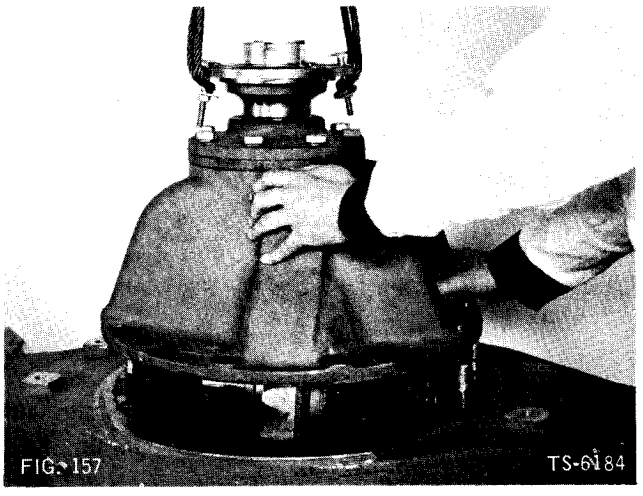


FIG. 157 TS-6184

3. Secure differential carrier to axle housing with bolts, nuts, washers, and tapered dowels (Fig. 158). Tighten nuts on the four studs first, then tighten all bolts evenly until they are snug. Tighten all nuts and bolts to specified torque.

   NOTE: Some axles use bolts of several different lengths without nuts and dowels. Determine length of bolt required by checking thickness of differential carrier flange and depth of mounting holes. Select correct bolt for each position.

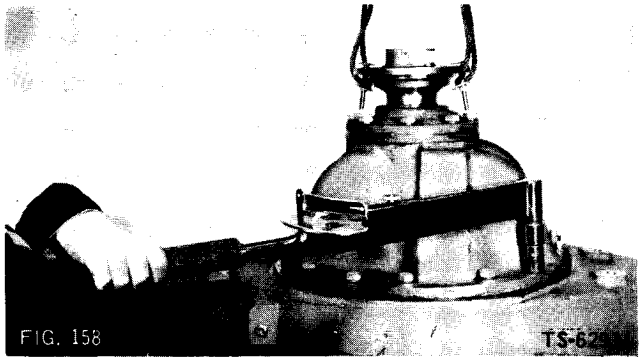
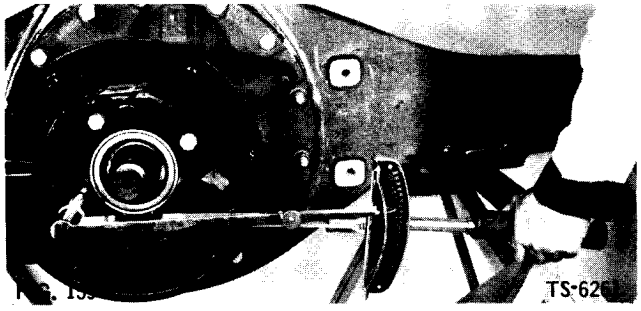


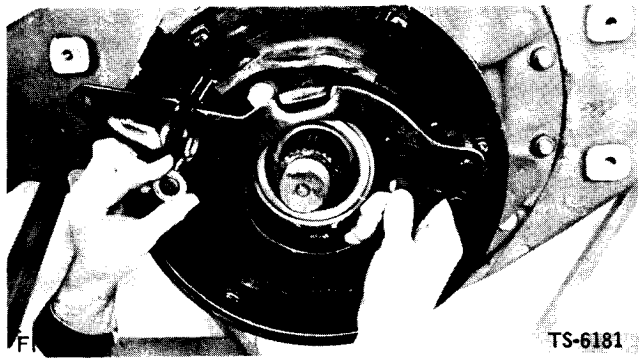
FIG. 158 TS-62

4. On axles which incorporate a parking brake, remove companion flange which was temporarily installed to facilitate hoisting differential. Position parking brake backing plate on differential and carrier assembly and secure with four bolts and lockwashers. Tighten bolts to specified torque (Fig. 159).



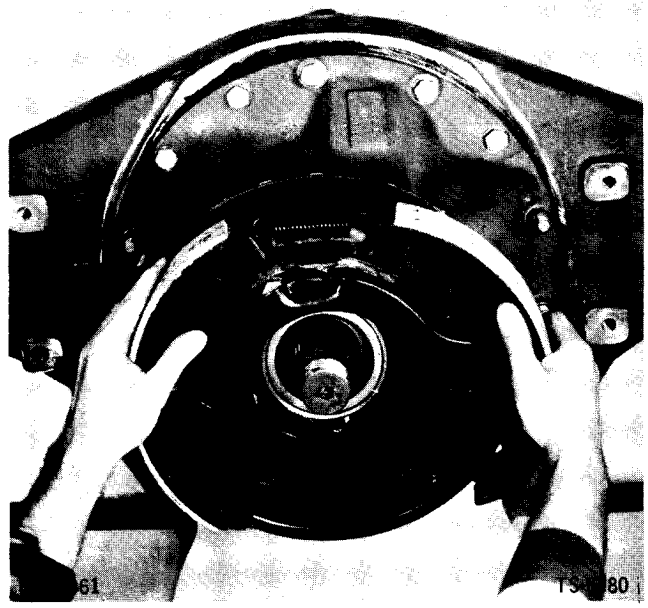
TS-626

5. Position brake operating cam lever and roller on brake backing plate (Fig. 160).



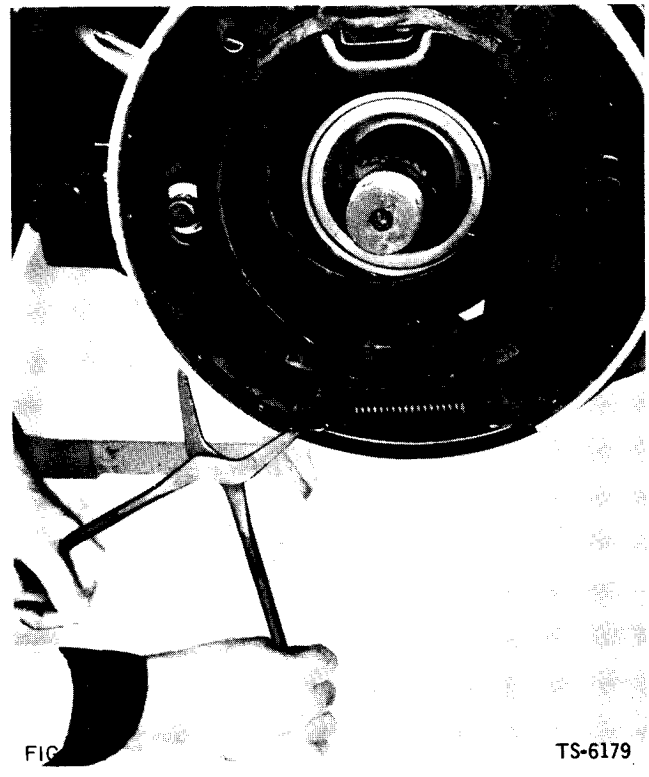
TS-6181

6. Assemble parking brake shoes and upper brake shoe return spring. Spread shoes apart and position shoes on brake backing in engagement with operating cam lever and roller (Fig. 161).



TS-6180

7. Install lower brake shoe return spring with brake spring pliers (Fig. 162).



TS-6179

8. Position parking brake drum on companion flange, taking care to match punch marks made at disassembly. Secure parts with bolts, nuts, and lockwashers. Tighten bolts to specified torque (Fig. 163). When torquing bolts, place companion flange under light pressure in press to hold assembled parts. Do not score or distort parking brake drum by clamping in a vise.

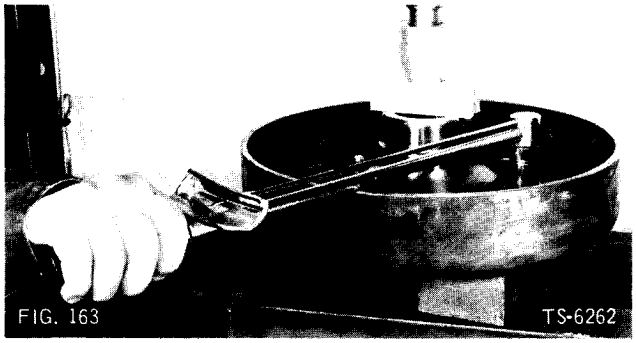


FIG. 163 TS-6262

9. Position assembled parking brake drum and companion flange on pinion shaft. Secure with flat washer and companion flange nut. Torque nut to 600 ft. lbs. (Fig. 164). Install cotter pin to retain nut.

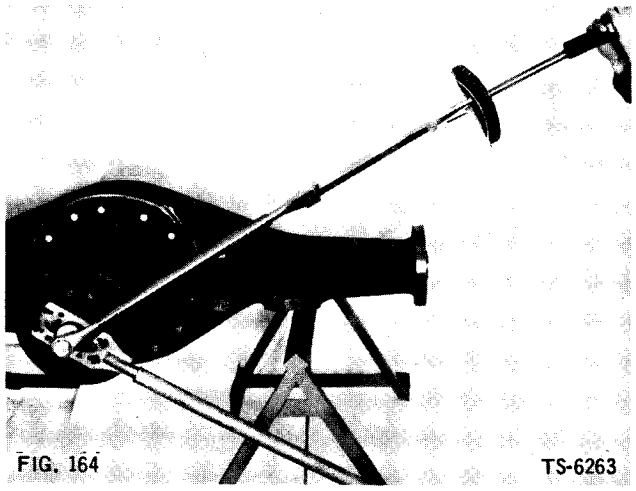


FIG. 164 TS-6263

10. Position air chamber brackets and spacers on axle housing; secure each bracket with two bolts and lockwashers. Tighten finger tight only to permit alignment of bracket after brake camshaft is installed (Fig. 165).

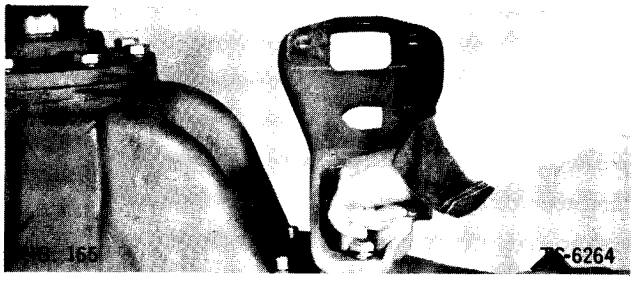


FIG. 165 TS-6264

11. Slide axle shaft into position in axle housing so that splines engage differential side gear. Position shaft so that end having retaining ring groove for sun gear is toward the outside (Fig. 166).

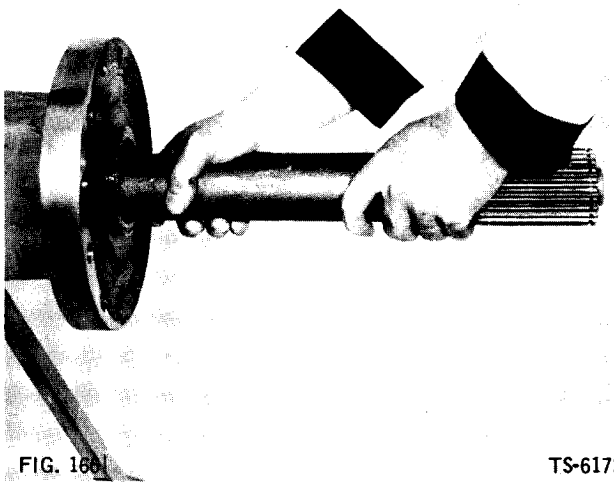


FIG. 166 TS-6172

12. Position spindle on spindle support assembly (Fig. 167).

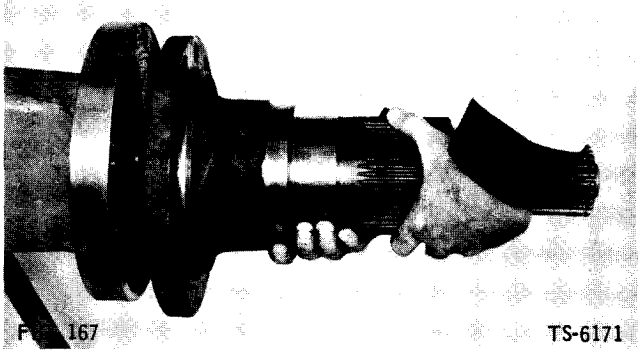


FIG. 167 TS-6171

13. Position brake spider on spindle (Fig. 168).

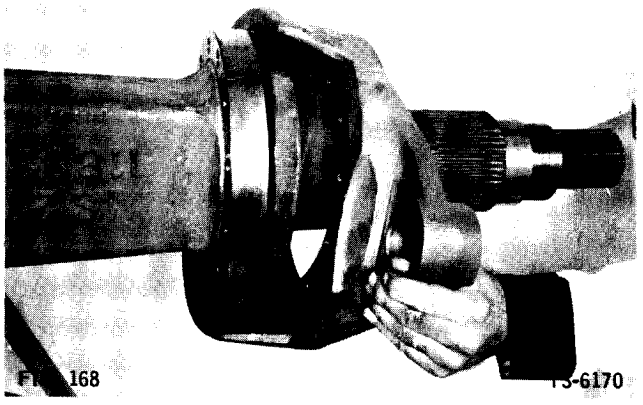
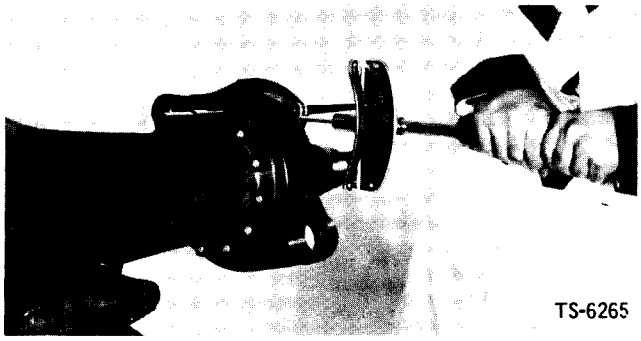
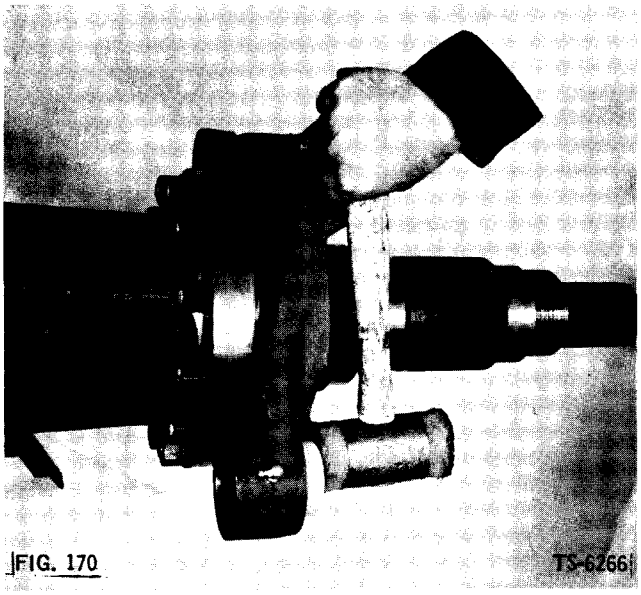


FIG. 168 TS-6170

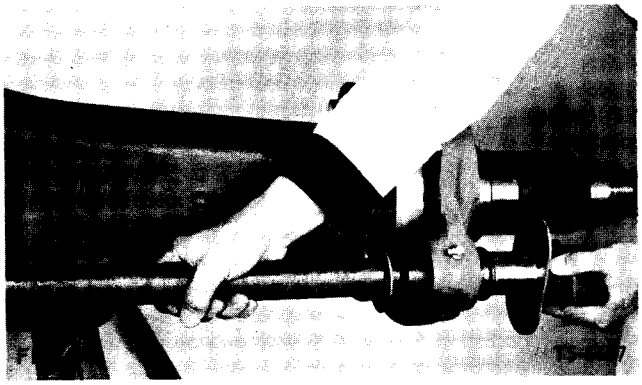
14. Secure spindle and brake spider to axle housing with bolts, lockwashers, and nuts and tighten to specified torque (Fig. 169).



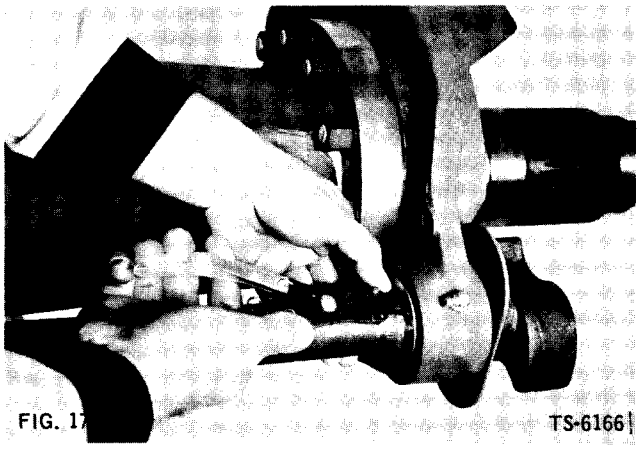
15. Tap brake camshaft bushing into brake spider (Fig. 170).



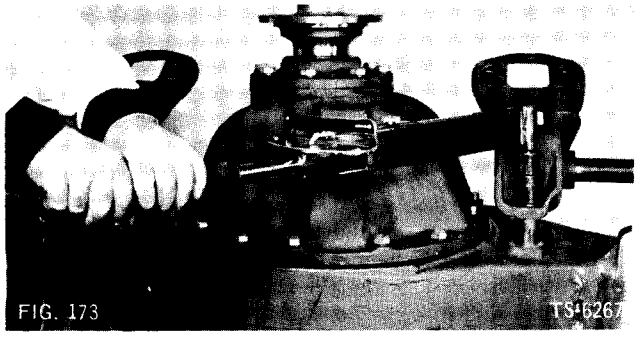
16. Position thrust washer and "O" ring on brake cam shaft. Insert cam shaft through bushing in brake spider and position felt grease retainer, grease washer, and retaining ring on cam shaft (Fig. 171).



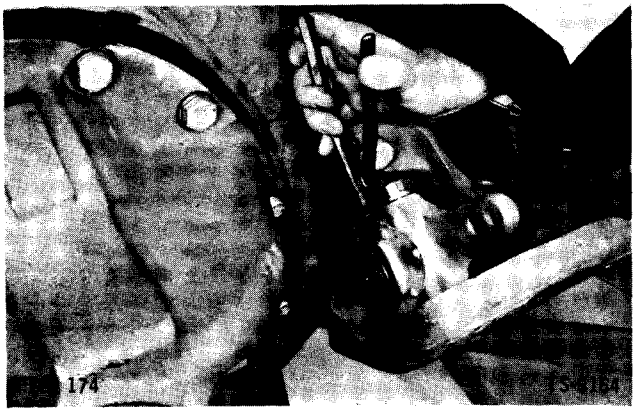
17. Seat felt grease retainer in recess in brake spider. Install retaining ring in retaining ring groove. (Fig. 172).



18. Position air chamber bracket and spacers, which were previously installed, so that there is no binding between cam shaft and air chamber bracket bushing. Tighten bracket mounting bolts to specified torque (Fig. 173).



19. Position slack adjuster on cam shaft. Secure with retaining ring and washer (Fig. 174). Be sure to install slack adjuster so that adjusting screw points in same direction as before disassembly. In some applications adjusting screw is adjacent to air chamber bracket. In others it is as shown in Fig. 174.



20. Position air chamber on air chamber bracket (Fig. 175). Secure with nuts and lockwashers. Tighten nuts to specified torque. Secure clevis of brake chamber to slack adjuster with pin and cotter pin.

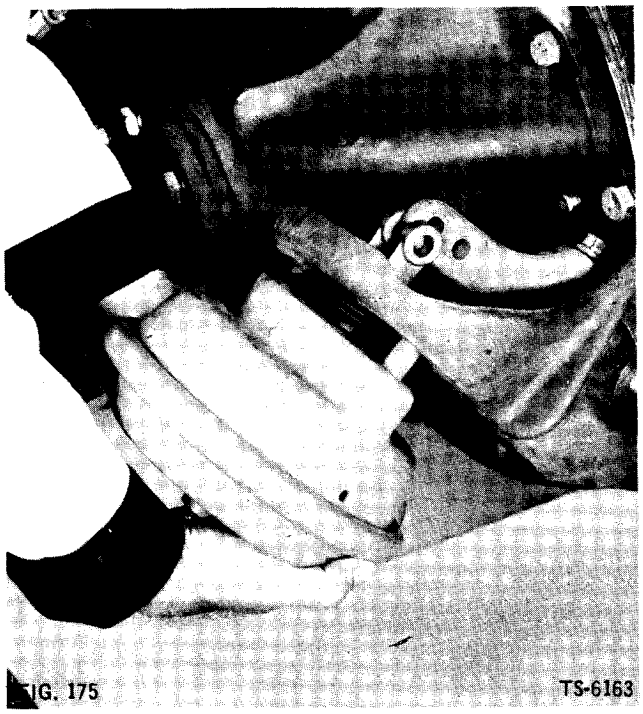
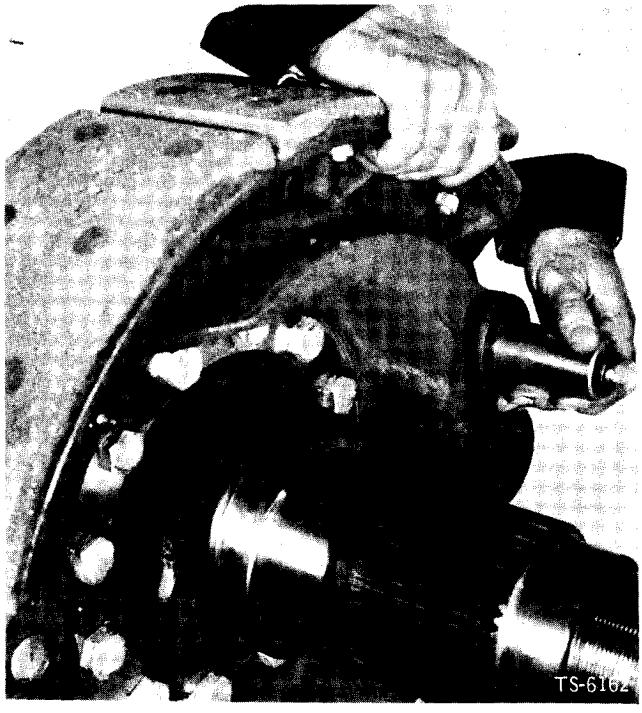


FIG. 175

21. Position brake shoe on spindle support. Retain brake shoe by inserting brake shoe anchor pin (Fig. 176). Install second brake shoe in same manner.



22. Install brake shoe return spring (Fig. 177). Before installing spring, make sure that slack adjusters are adjusted to allow brake shoes to come together as closely as possible so that spring tension will be at a minimum during installation. Install spring anchor pin washers and cotter pins.

CAUTION: Do not use pliers with serrated jaws to assemble brake spring. Do not use any tool which will nick or score spring. This will cause early failure. Tool shown is brake pliers which has provisions on end of handle for installing spring.

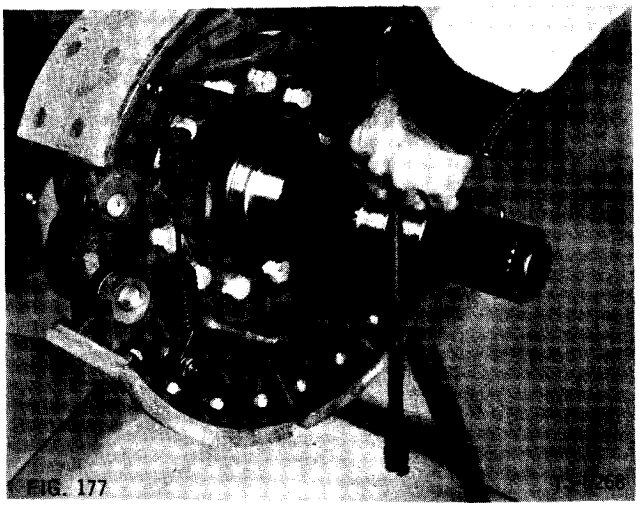
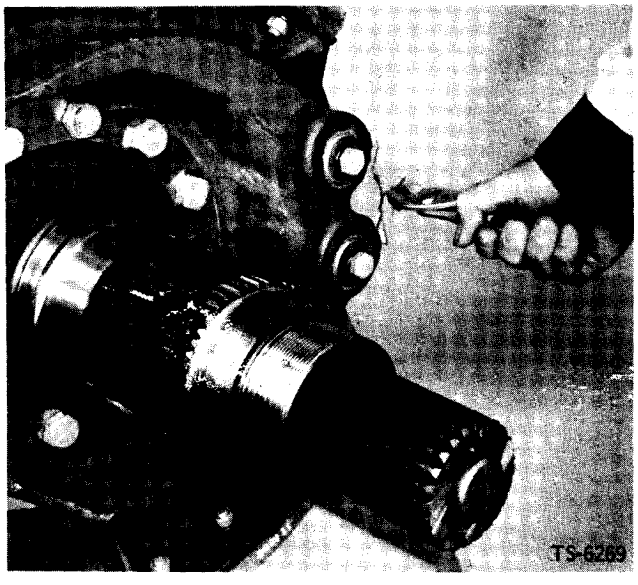


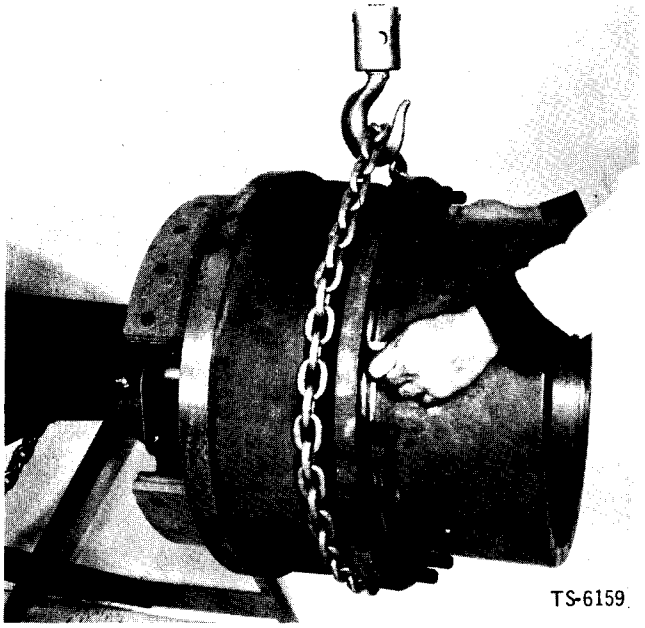
FIG. 177

23. Lock brake shoe anchor pins with anchor pin set screws. Lockwire set screws (Fig. 178).

NOTE: On some axles, brake anchor pins are held in place with retaining plate, bolt, and lockwasher. Tighten bolt to specified torque.



24. Lubricate lip of hub and drum oil seal with Lubriplate. Position hub and drum on axle (Fig. 179). Care should be taken to align hub and drum assembly with spindle so that no cocking of inner hub bearing occurs when sliding assembly on spindle. If difficulty is encountered when trying to position the brake drum over the brake shoes, check for improper adjustment of slack adjuster. During installation, slack adjusters must be adjusted to minimize brake spring tension.


TS-6159

25. Continue to support hub and drum with hoist. Position internal gear and hub on axle so that it engages splines on spindle (Fig. 180).

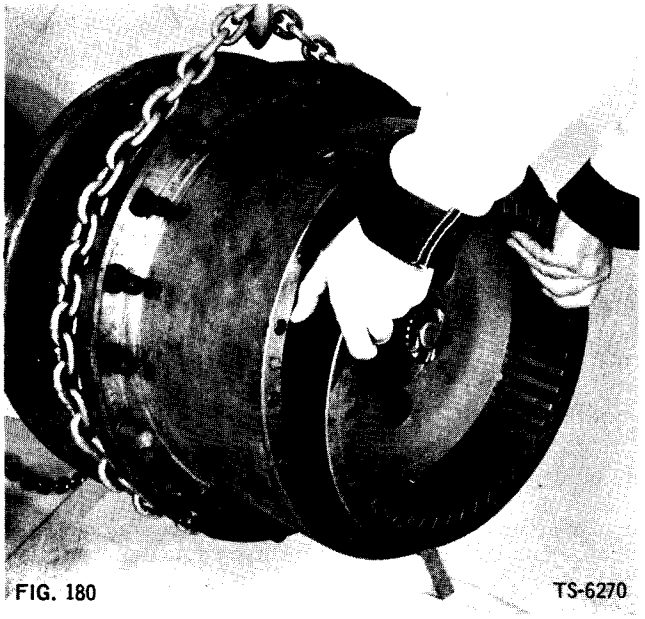
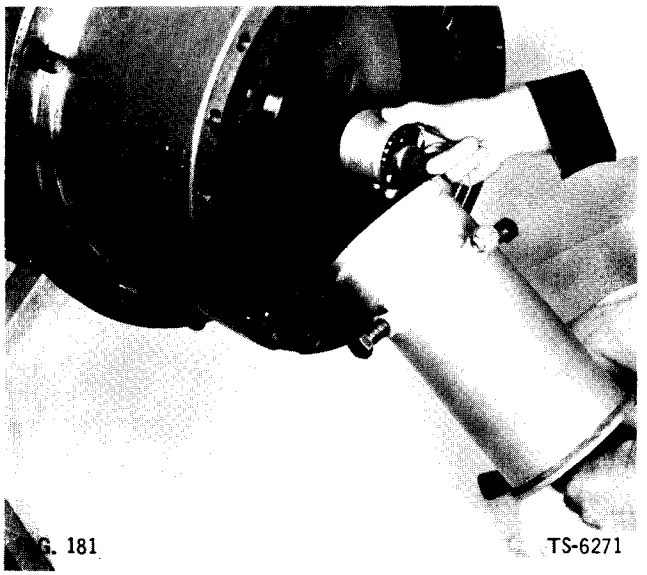


FIG. 180 TS-6270

26. Install inner spindle nut on spindle. Wrap several turns of .010 inch to .020 inch shim stock around splines of axle shaft to protect splines. Install spindle nut socket wrench, Part No. 945940, on nut (Fig. 181) and tighten guide bolts lightly against axle shaft.

NOTE: The tapered roller bearings utilized in wheel hub must be preloaded in accordance with procedure steps and specifications given below. One of two methods may be used in adjusting the required preload on these bearings. It should be noted that preload specifications differ for use of new bearings and when wheel bearings are being reused.


G. 181 TS-6271

First (Preferred) Method

27. Tighten inner nut while rotating wheel hub in both directions until there is a slight binding (Fig. 182).

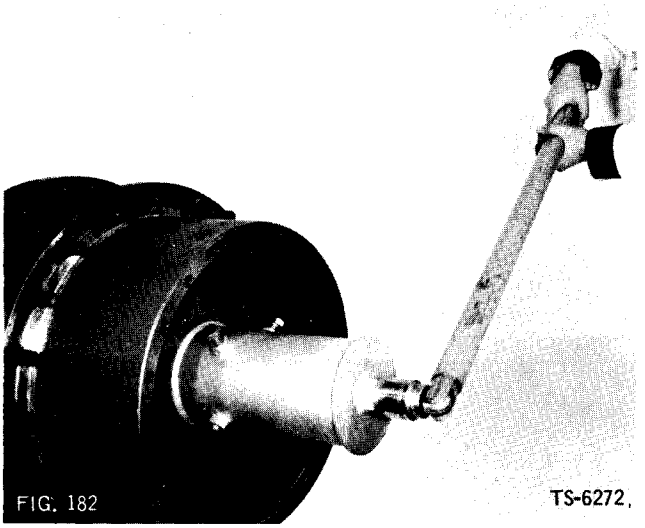
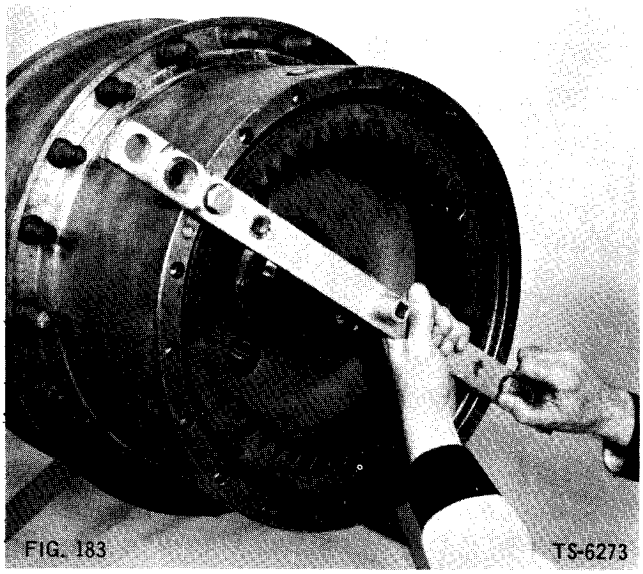


FIG. 182 TS-6272

28. Install torque wrench adapter bar, as shown in Fig. 183. The adapter bar can be fabricated locally to specifications outlined in Fig. 184. Bar illustrated will accommodate wheel hubs with planetary bolt circle diameters of 12½, 16½, 19½, and 23 inches.



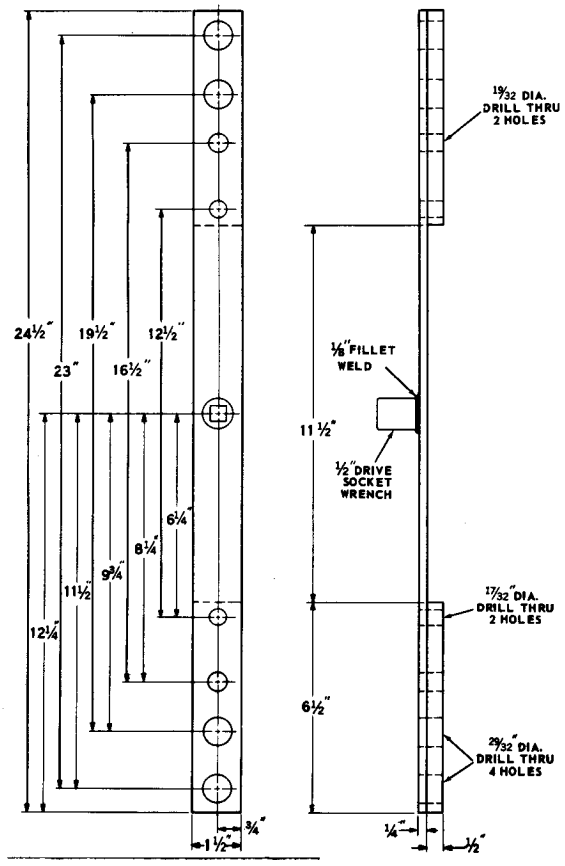
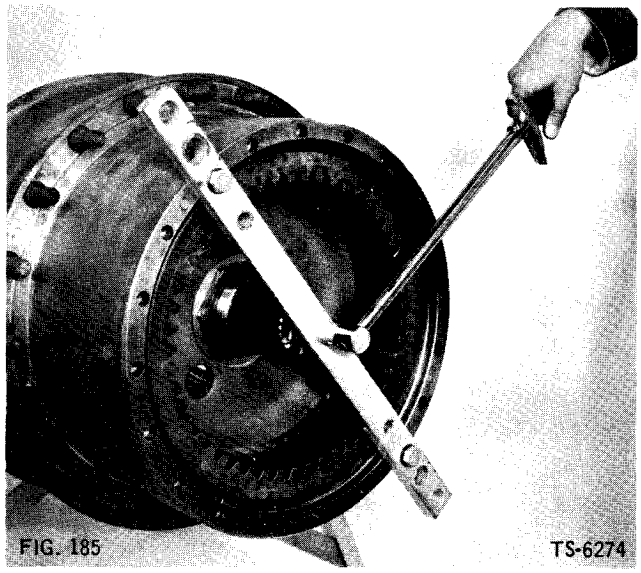


FIG. 184 TS-5623

29. Install torque wrench, 0 to 50 ft. lb. scale, if available, and check rotating torque or rolling resistance of wheel hub (Fig. 185). Rotating torque when using new bearings should be between 15 and 20 ft. lbs. On used bearings rotating torque should be between 6 and 12 ft. lbs.

CAUTION: Make certain wheel brake is in complete release position and that it is not dragging on brake drum.



30. If rotating torque is not to specifications given above, remove adapter bar and tighten or loosen inner nut until rotating torque is within specifications. After tightening or loosening nut as required, rap wheel hub several times with plastic or rawhide faced mallet while rotating hub to seat bearings. Recheck rotating torque as indicated in step 29.

Second (Optional) Method

31. Attach heavy string or cord to one of wheel studs on hub and wrap cord around wheel hub several times attaching pound pull scale to end of cord as shown in Fig. 186. Tighten inner nut until rotating torque measured on pull scale is between 21 and 28 lbs. for new bearings and between 9 and 17 llbs. for used bearings.

NOTE: Bearing preload rotating torque, using a pound pull scale, is figured by multiplying the radius (distance from center of wheel to outside diameter of wheel hub) by the reading on the pull scale and dividing by 12 to arrive at ft. lbs. of torque. For example: Wheel hub radius of 8-5/16 inches times 24

lbs. (reading on pull scale) equals 211 in. lbs. Dividing by 12 equals approximately 17 ft. lbs. which is within specifications of 15 to 20 ft. lbs. rotating torque for new bearings.

IG. 186 TS-6275

32. Install nut lock and outer nut and tighten securely as shown in Fig. 182 to lock inner nut in position. Recheck rotating preload torque by one of two methods outlined above.

33. Bend two tangs of nut lock against flats on inner nut and bend two tangs against flats of outer nut (Fig. 187).

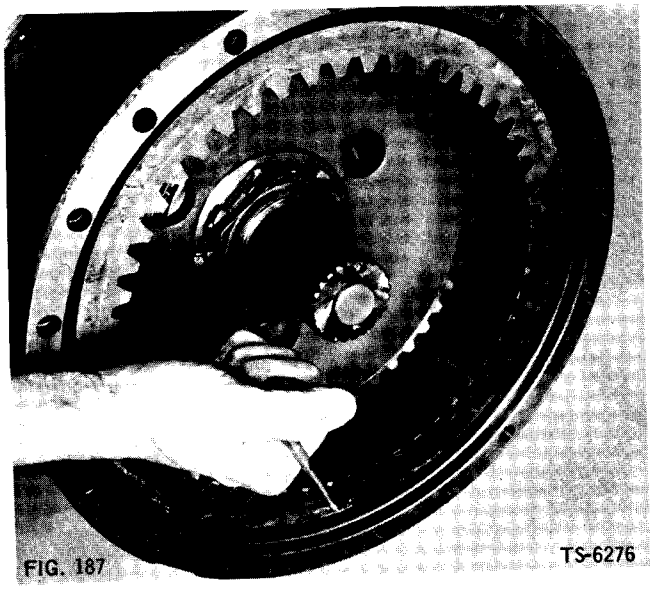
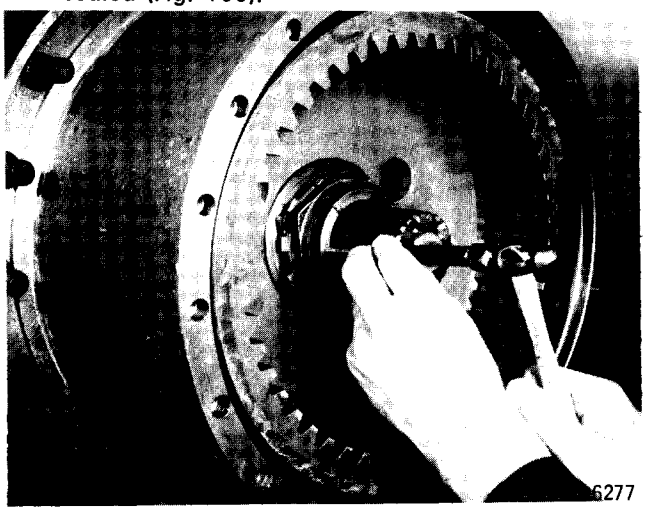


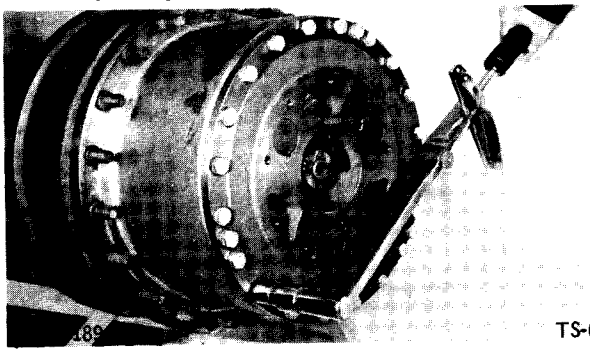
FIG. 187 TS-6276

34. Some axles use thrust ring in end of spindle. If provided, tap thrust ring into spindle until it is fully seated (Fig. 188).



6277

35. Install planet carrier "O" ring on planet carrier assembly, and install planet carrier assembly on hub with bolts and lockwashers. Tighten bolts to specified torque (Fig. 189).



TS-6278

36. Position sun gear on axle shaft; secure with sun gear retaining ring (Fig. 190).

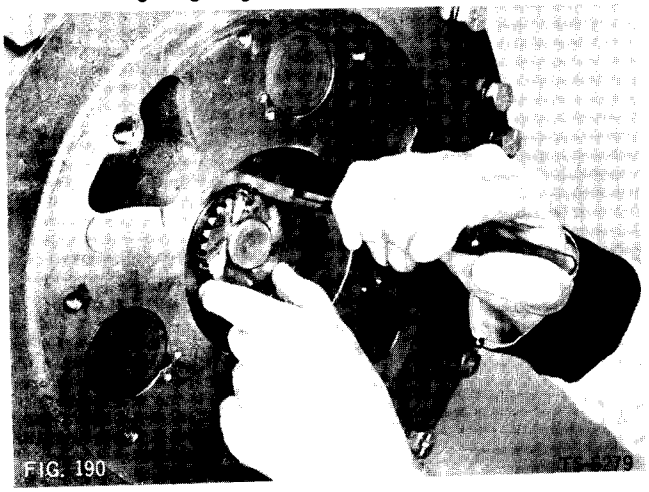


FIG. 190

37. Install cap-to-carrier "O" ring seal in groove in sun gear thrust cap assembly. Install thrust cap on planet carrier. Make certain that "O" ring, if used, is properly positioned in the groove in the mounting face, and is not twisted. Apply light coat of Permatex No. 2 to threads of bolts and install. Tighten to specified torque (Fig. 191).

NOTE: Early versions of some axles did not include "O" ring feature. On these units, apply light coat of Permatex No. 2 on mounting face of thrust cap before installing on planet carrier.

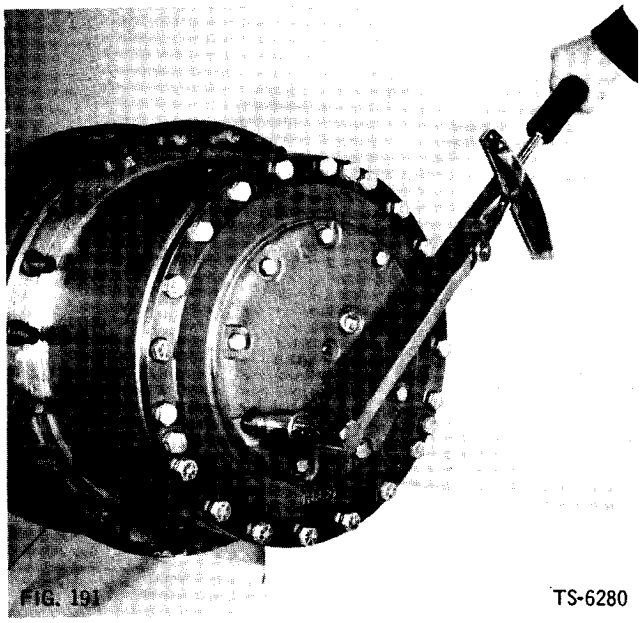


FIG. 191 TS-6280

Brake Adjustment

NOTE: Some axle models have slack adjuster positioned so that adjusting screw is adjacent to air chamber bracket (Fig. 192). Others have slack adjuster positioned so that adjusting screw points away from air chamber bracket (Fig. 193).

Adjust brakes of axle models that have slack adjusters positioned so that the adjusting screw is adjacent to the air chamber bracket as follows:

1. Use torque wrench and 9/16 inch socket to adjust slack adjusters to attain correct brake lining-to-brake drum clearance.

2. Position socket on adjusting screw and press it on screw far enough to cause locking collar to disengage locking mechanism.

3. While holding in locking collar, rotate adjusting screw clockwise until 20 ft. lbs. torque is indicated on torque wrench (Fig. 192).

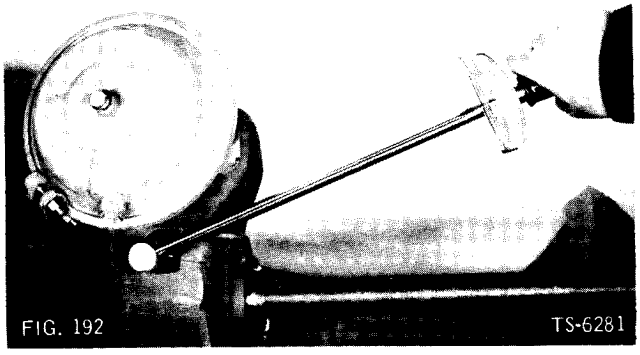


FIG. 192 TS-6281

4. Back off adjusting screw one-half turn. Locking collar should automatically return to locking position to lock adjustment when socket is removed. This provides proper brake lining-to-drum clearance.

5. After axle is assembled into machine and brake air lines are connected, recheck brake adjustment as follows: With minimum air pressure and with brakes fully activated and applied, adjust at slack adjuster to obtain 1 ½ inch travel on brake chamber push rod when brakes are released. Adjust all slack adjusters on machine for same travel distance.

Adjust brakes of axle models that have slack adjusters positioned so that adjusting screw points away from air chamber bracket as follows:

6. Use 9/16-inch, open-end wrench to make adjustment. Position wrench on adjusting screw and push in until locking collar releases adjusting screw (Fig. 193).

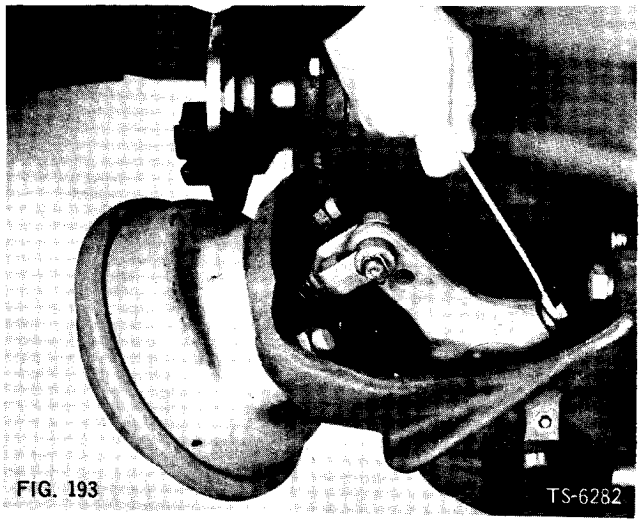


FIG. 193 TS-6282

7. While holding locking collar in, rotate adjusting screw clockwise until brake lining is snug against inside of brake drum.

8. Back off adjusting screw one-half turn. Locking collar should automatically return to locking position to lock adjustment when wrench is removed. This provides proper brake lining-to-drum clearance.

9. After axle is assembled into machine and air brake lines are connected, recheck brake adjustment as directed in step 5 above.

TABLE OF TORQUE LIMITS

COARSE THREADS	GRADE 5 DRY	GRADE 5 LUBRICATED OR PLATED	GRADE 8 DRY	GRADE 8 LUBRICATED OR PLATED
3/8 - 16	30-35	20-25	45-50	30-35
7/16 - 14	50-55	35-40	70-75	50-55
1/2 - 13	75-85	60-65	105-115	80-90
9/16 - 12	110-120	80-90	155-165	115-125
5/8 - 11	150-165	115-125	215-230	160-175
3/4 - 10	265-290	200-220	375-415	285-310
7/8 - 9	395-430	295-325	605-670	455-500
1 - 8	590-650	445-490	910-1000	685-750
1-1/8 - 7	795-875	595-655	1290-1415	965-1065
1-1/4 - 7	1120-1230	840-925	1820-2000	1360-1495
FINE THREADS				
3/8 - 24	35-40	25-30	50-55	35-40
7/16 - 20	55-60	40-45	80-85	60-65
1/2 - 20	85-95	65-70	120-130	90-100
9/16 - 18	120-130	90-100	175-185	130-140
5/8 - 18	170-185	130-140	240-260	180-200
3/4 - 16	300-325	225-245	420-460	315-345
7/8 - 14	435-475	325-360	670-735	500-550
1 - 12	645-710	485-535	995-1095	745-820
1-1/8 - 12	890-980	670-735	1445-1590	1085-1190
1-1/4 - 12	1240-1365	930-1025	2015-2215	1510-1660

NOTES

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