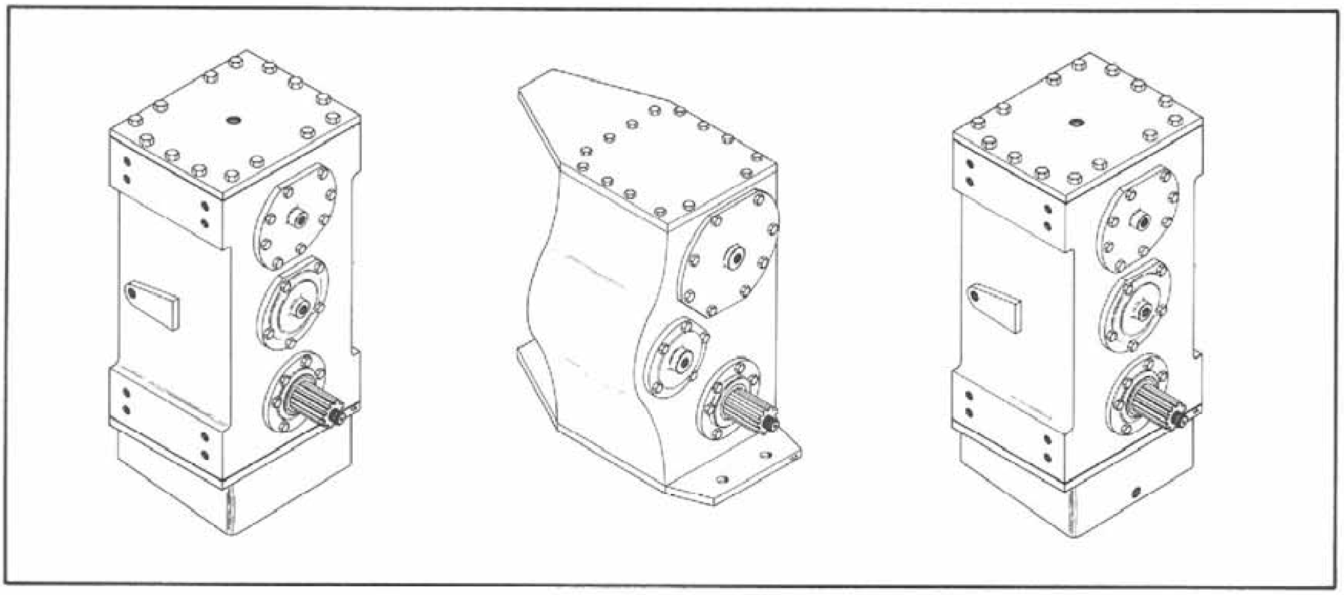
T.M.

# STEIGER®

# 2-SPEED TRANSFER CASE

## SERVICE MANUAL



IMMEDIATE ACTION LETTER REFERENCE:

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# Contents



Issued Jan. 15, 1978

## Identification

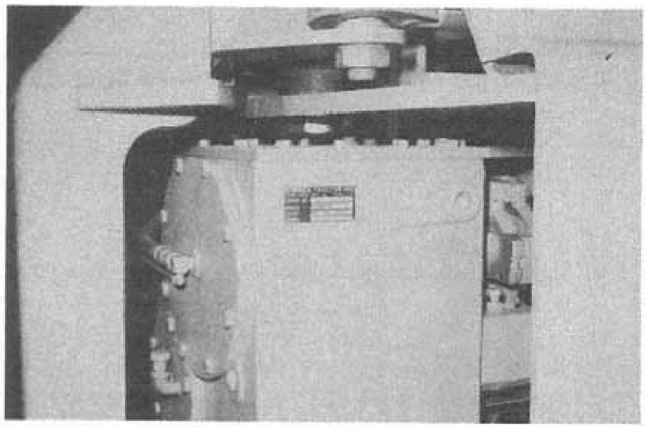

*Figure 1:*

Model C: 2-speed Transfer Case

The identification plate location is on the upper right side of the transfer case housing (Fig. 1). If the unit lacks an identification plate, it may be visually identified by the following characteristics:

1. A shift detent block mounted on the front.
2. A hump cast into the left side of the housing.
3. The center shaft is offset toward the left.

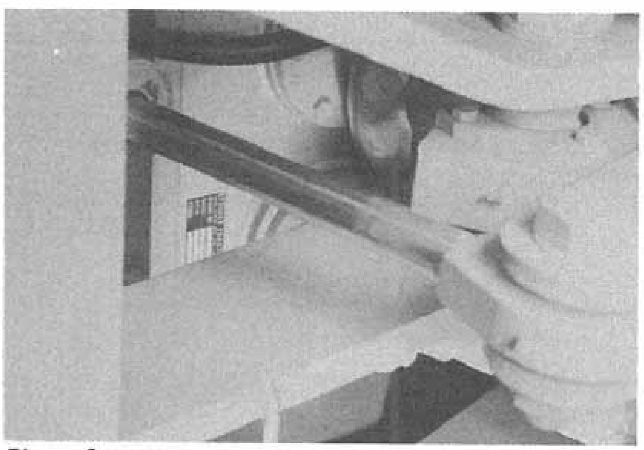

*Figure 2:*

Model E and Model F: 2-speed Transfer Case

The identification plate location is on the left rear surface of the transfer case housing near the oil reservoir (Fig. 2). If the unit lacks an identification plate, even though they are very similar externally, they may be identified by the following characteristics:

1. A shift detent block mounted on the front.
2. Shaft centers are all in line.
3. Internal oil reservoir and dipstick.
4. Model E gear ratio direct in low range.
5. Model F gear ratio direct in high range.

Refer to general specification.

## Application

The Model C transfer case is used in the Steiger Series II Cougar, Panther and Tiger, and also the Series III ST220, 250, 251, 270, 310, 320 and 325 tractors. The unit is designed to pivot in the frame as the tractor is articulated.

The Model E transfer case is used on the Steiger Series III PT225, 270 and 350 tractors. This unit is mounted stationary on rubber mounts in the tractor frame.

The Model F transfer case is used on the Steiger/Krac KS 500 drainage plow, and its mounting arrangement is identical to that of the Steiger Series III PT tractors.

## General Specifications

Model C:

Ratio — Low range, 1 to 1
Ratio — High range, .88 to 1
Type — Helical gearing, with sliding clutch arrangement for range selection.
Tapered roller bearings on shafts.
Lubrication — Pressure lubricated with filtered, air cooled oil pumped from central sump.

Model E:

Ratio — Low range, 1 to 1
Ratio — High range, .88 to 1
Type — Helical gearing, with sliding clutch arrangement for range selection. Tapered roller bearings on shafts.
Lubrication — Pressure lubricated with filtered, air cooled oil pumped from integral reservoir.

Model F:

Ratio — Low range, 2.303 to 1
Ratio — High range, 1 to 1
Type — Helical gearing, with sliding clutch arrangement for range selection. Tapered roller bearings on shafts.
Lubrication — Pressure lubricated with filtered, air cooled oil pumped from integral reservoir.

# General Information

## Operating Principles

### Power Flow

Driving forces from the tractor's transmission are admitted to the top shaft (input shaft) of the transfer case. The input shaft is fitted with a sliding clutch which contains internal splines that are constantly in mesh with the input shaft splines.

By means of a shift fork and rod, the clutch is moved either fore or aft. The internal splines mesh with the external splines of the selective gear hub that it is moved toward, thus mechanically locking the input shaft and selected gear together.

As the input shaft is forced to turn, the selected gear must turn with it. Since the selected gears are always in mesh with their mating gears, the center shaft and output shaft are also forced to turn. The non-selected gear will also turn, but the rate of speed will differ from that of the input shaft. The non-selected gear will idle on caged roller bearings between its bore and input shaft journal.

By studying the following power flow diagrams (Fig. 3-7) you can visualize how drive ratios (or ground speeds) are dependent upon which gears are utilized for a given range selection.

**Model C & E Power Flow Diagram — High Range**

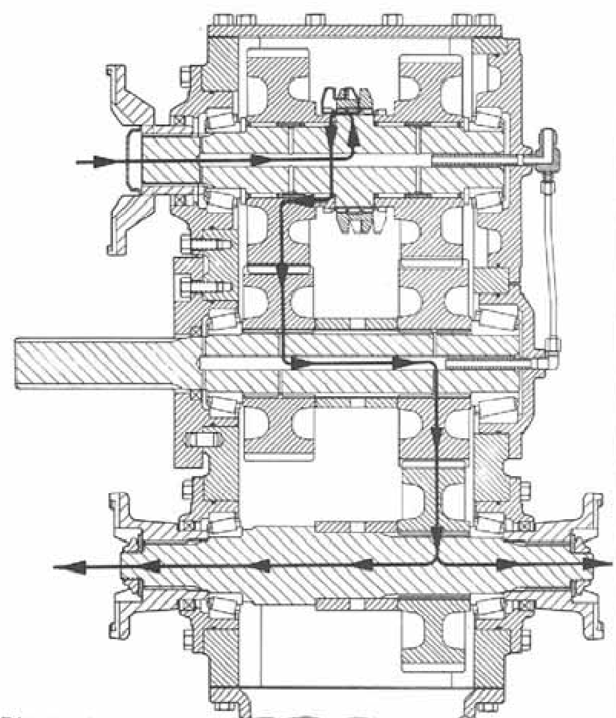

*Figure 4:*

**Model C & E Power Flow Diagram — Low Range**

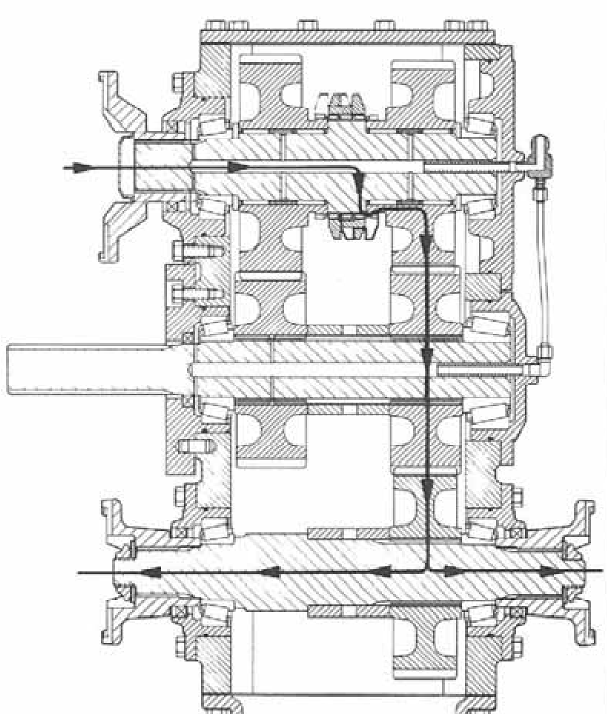

*Figure 3:*

**Model F Power Flow Diagram — Low Range**

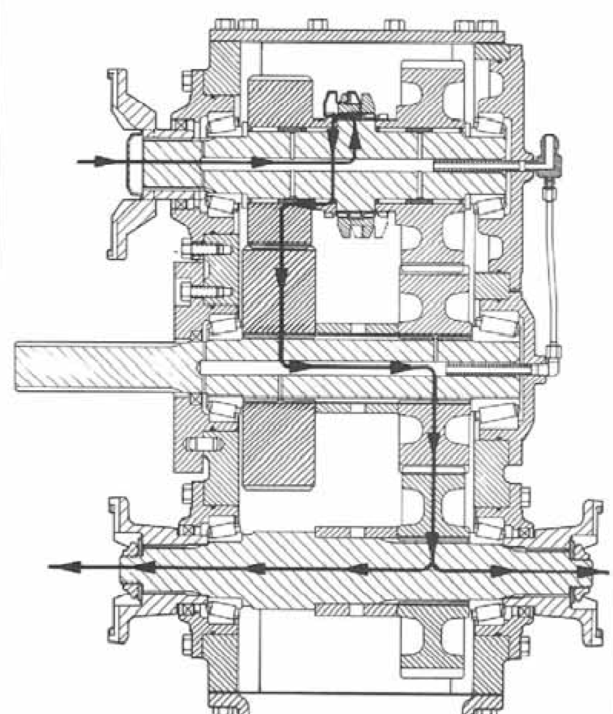

*Figure 5:*

Model F Power Flow Diagram — High Range

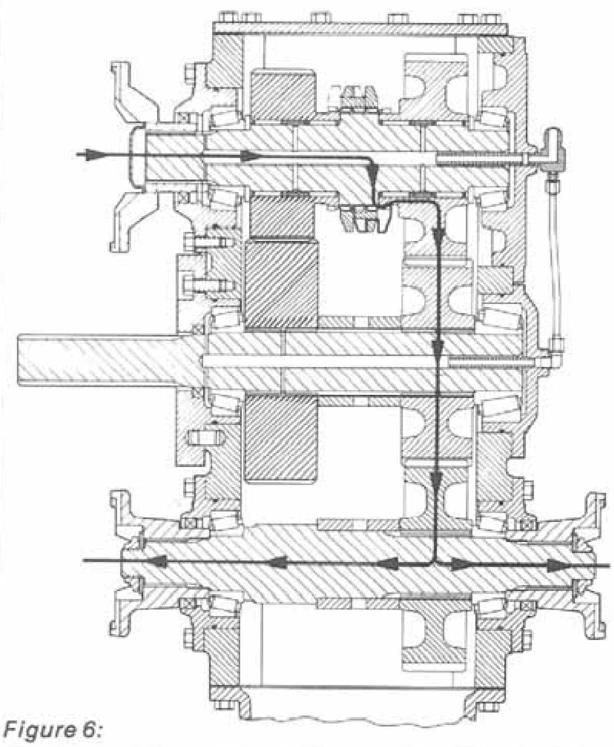

*Figure 6:*

Model C, E & F Power Flow Diagram — Braking

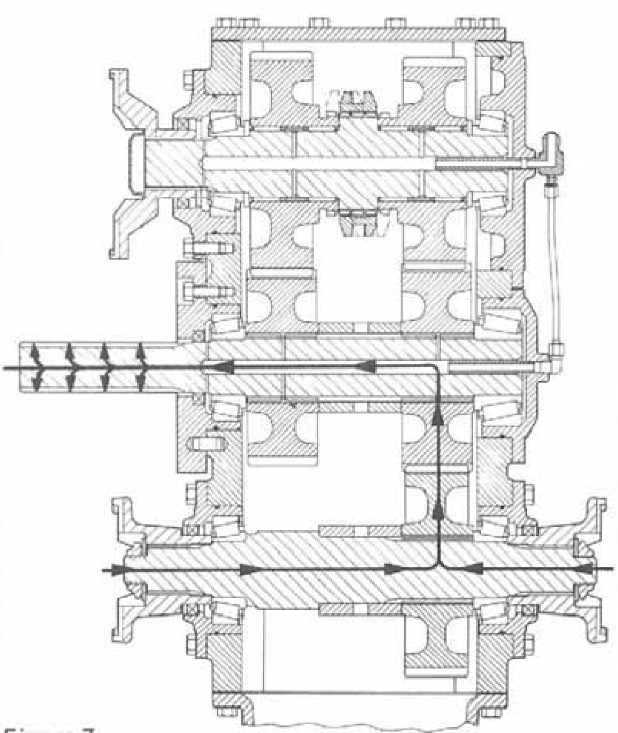

*Figure 7:*

The transfer cases are designed to incorporate an integral multiple disc brake arrangement. The brake discs are fitted directly to the protruding center shaft. Stationary brake parts are secured to the inside brake plate/bearing cap assembly. As the brake is applied, braking force is transmitted from each rotating brake disc, to the center shaft. In turn, the force is transmitted through the rear gear of the center shaft, its mating gear and the output shaft.

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**Lubrication System**

Depending on the model, the static oil level in the transfer case is determined by one of two methods. The Model C transfer case automatically maintains the oil level by means of a spill port in the housing (Fig. 8 ), and this oil then returns to the central sump via gravity. The Model E and Model F transfer cases incorporate an oil fill spout and dipstick on the lower left side of the housing. Splash lubrication is furnished by the output shaft and gears spinning in oil.

Pressure lubrication is furnished by a transmission driven pump, engine driven when a Model F unit is used. The pump draws oil from the central sump (Model C) or integral reservoir (Model E and Model F), through a filter, then into the pump. Oil is then sent under pressure to the oil cooler and routed to the transmission and transfer case (Fig. 8 and Fig. 9 ) or the transfer case only (Fig. 10). Note that the transmission is omitted from the transfer case lubrication circuit when the Model F transfer case is used.

The early production transfer case assembly lubrication diagram (Fig.11 ) illustrates the path taken by the oil as it enters the unit. The oil under pressure enters at two (2) locations, one being the brake plate/bearing cap assembly, and the second being the input shaft rear cover assembly. A constant supply of oil reaches all bearings of the input shaft and front bearings of the center shaft. From this point, as the oil has passed the pressure circuit, it serves as splash lubrication.

The late production transfer case lubrication diagram (Fig.12) varies slightly from the early production unit. The center shaft is drilled to distribute oil entering the rear bearing cap to both support bearings and internal gear splines.

# General Information

**Model C Transfer Case Lubrication and Cooling Circuit.**

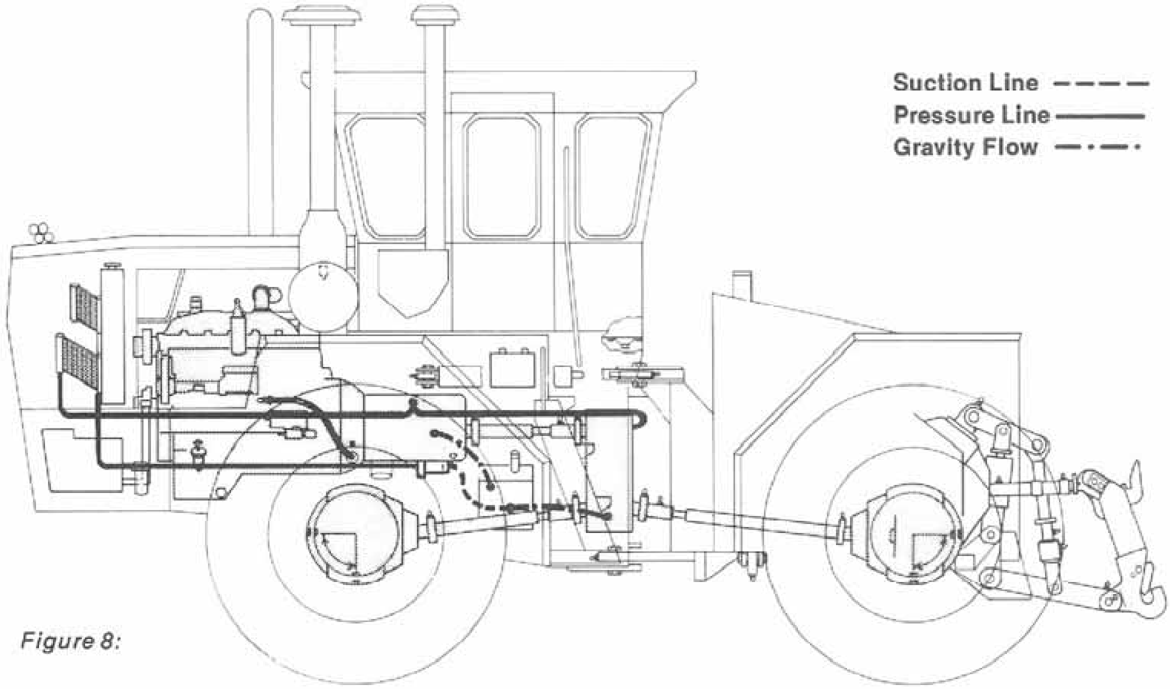



*Figure 8:*

**Model E Transfer Case Lubrication and Cooling Circuit.**

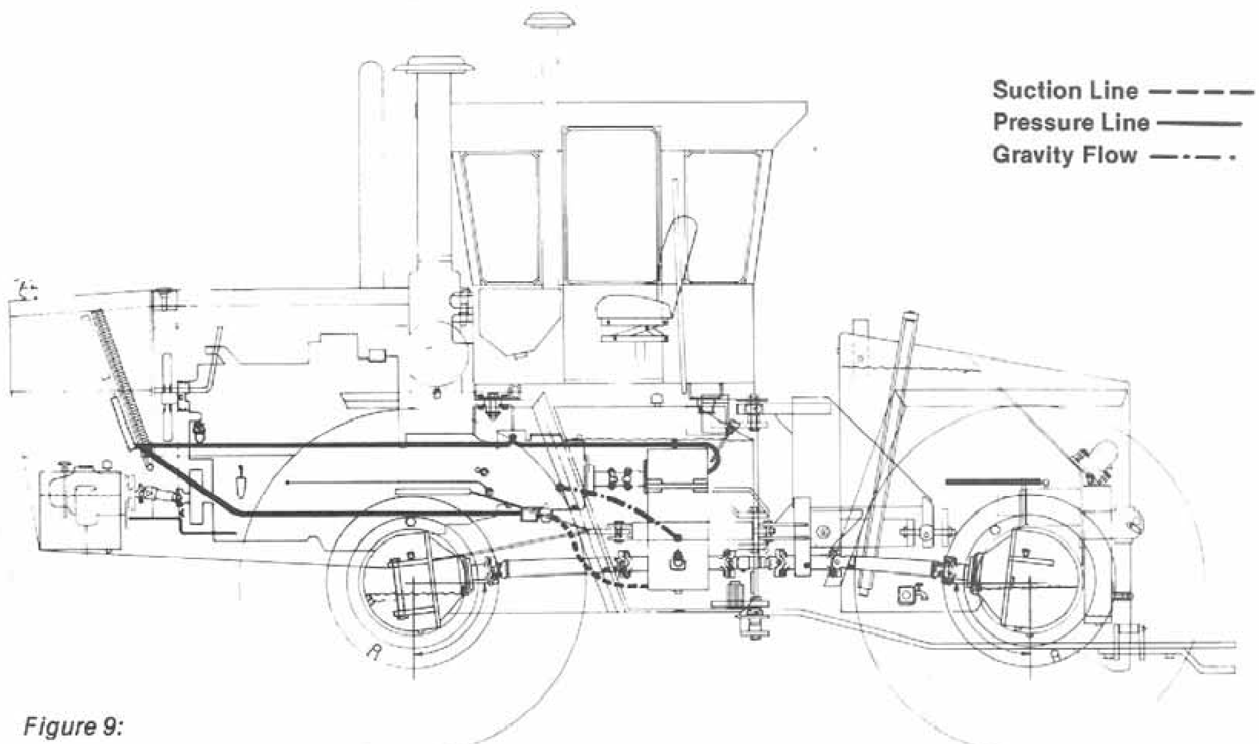



*Figure 9:*

Model F Transfer Case Lubrication and Cooling Circuit.

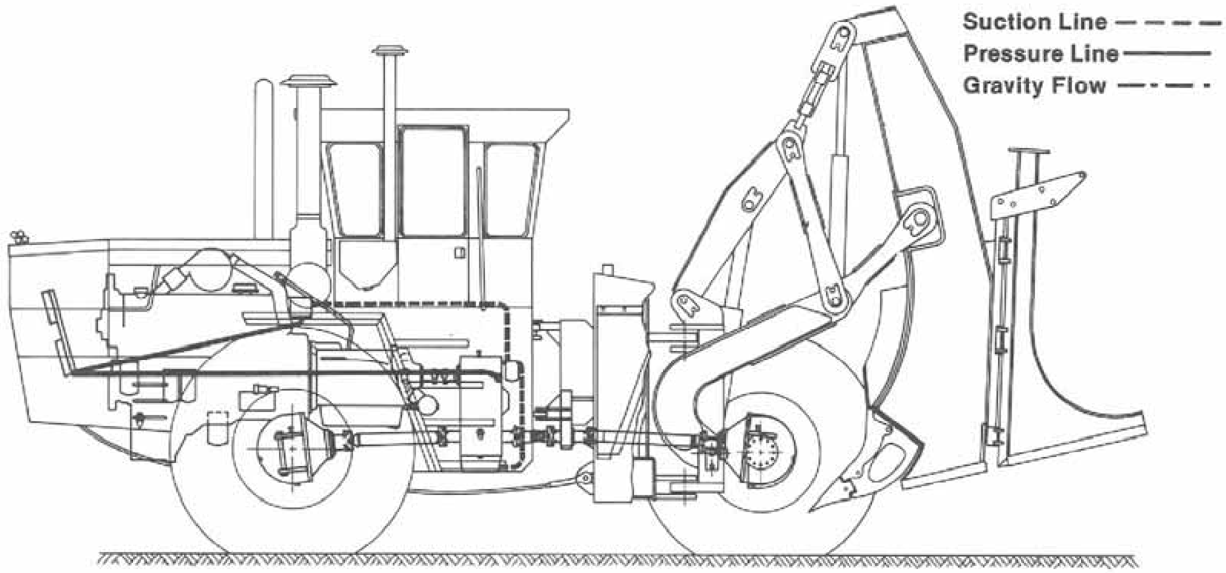



*Figure 10:*

Model C, E & F Lubrication Diagram- Early Production

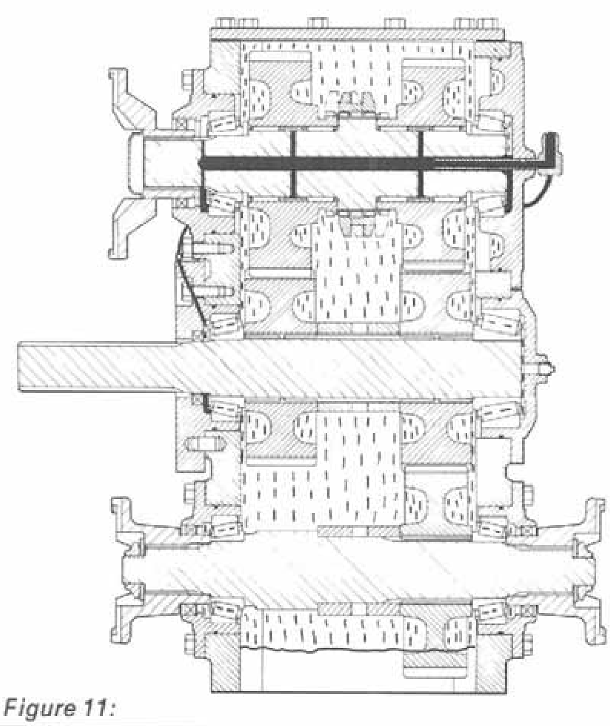


*Figure 11:*

Model C, E & F Lubrication Diagram - Late Production

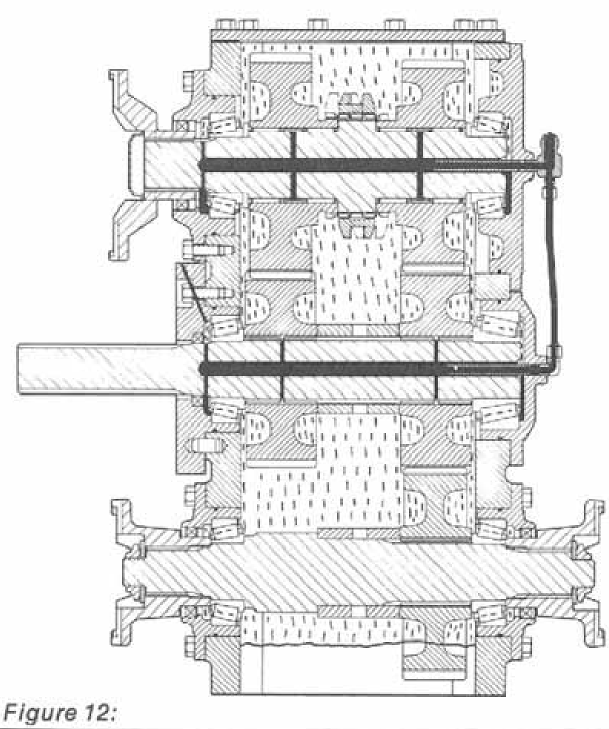


*Figure 12:*

**Oil Under Pressure**
**Oil Delivered by Splash**

**Oil Under Pressure**
**Oil Delivered by Splash**

# General Information

## Suggested Tool List

| Quantity | Steiger Part Number | Description |
|---|---|---|
| 1 | | Overhaul Stand |
| 1 | 58-029 | Torque Wrench |
| 1 | 58-035 | Transmission Mainshaft Alignment Tool |
| 1 | 58-015 | Socket Set (7/16 to 1-1/8 inches, 1/2 inch drive) |
| 1 | 58-017 | Combination wrench set |
| 1 | | Socket 3/4 inch drive, 2-1/8 inch nut size (S-K47168) |
| 1 | 58-075 | 1-1/2 ton coffen hoist |
| 1 | 58-054 | 3/4 ton coffen hoist |
| 1 | 58-034 | Bearing Driver |
| 2 | 58-061 | Spacer Slave |
| 1 | | 598 Axle spindle adapter (from 58-006 tool set) |
| 1 | 58-003 | Transmission lift stand (two required for PT350) |
| 1 | 58-004 | Roller and yoke assembly (two required for PT350) |
| 1 | | Transfer case lifting fixture |
| 3 | | Lift stand extensions (fabricate locally) |
| 4 | 19-942 | 1/2 - 13 x 6-1/2 capscrew |
| 1 | | Bearing Separator (OTC 951) |
| 1 | | Dial indicator with magnetic base (Starret 25-441, 657 AA) |
| 2 | | Pry bar (Ken-Tool T45) |
| 1 | 58-021 | Socket 3/4 inch drive, 1-1/2 inch nut size |
| 2 | | 1/2 - 20 x 2 threaded studs (fabricate from capscrew) |
| 1 | | Puller-press set (Proto 4019) |
| 2 | | Support plate 7x7x1/2 inches (fabricate locally) |
| 1 | | Shop press |
| 1 | | Feeler gauge package (K-D Tool #162) |
| 1 | | Screwdriver 1/2 inch blade |

## Model C, ST220, 250, 251, 270, 310, 320, 325

1. Chock the wheels to prevent the tractor from rolling, then disconnect the drivelines and remove them from the tractor.

2. Steer the tractor to the extreme left to allow a larger workspace at the right side hinge area.

3. Remove the key to prevent accidental starting of the engine.

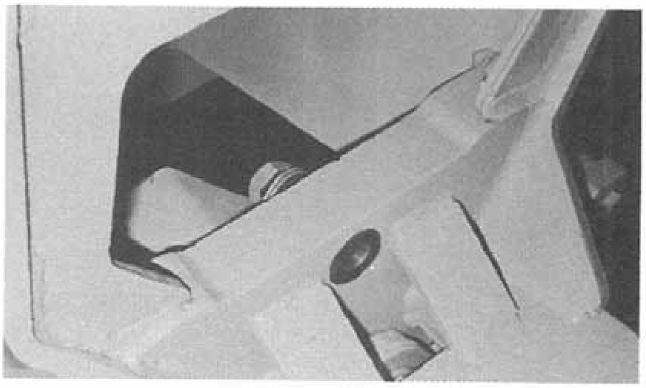


*Figure 1:*

4. Remove the tailpiece from the transfer case (Fig. 1).

5. Drain the lubricant from the transfer case and central sump. Use a clean container if the lubricant is to be reused.

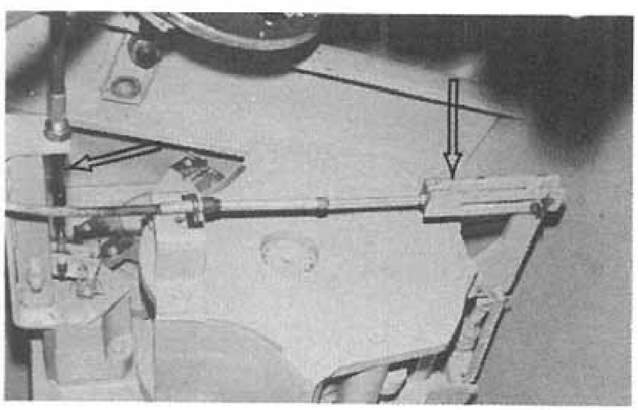


*Figure 2:*

6. Disconnect the shift cable/yoke and park brake cable/yoke from their linkages (Fig. 2), then disconnect the oil feed hose (Fig. 3) on the rear of the unit.

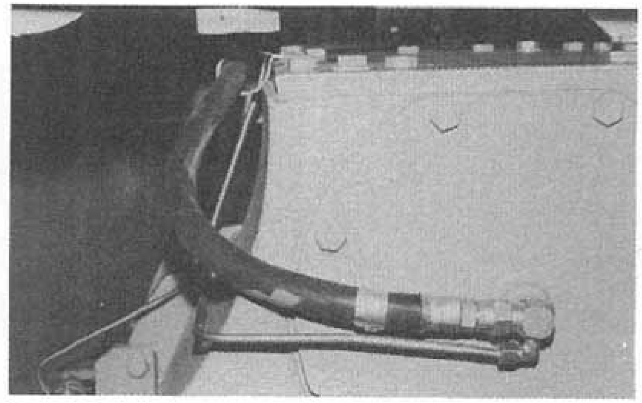


*Figure 3:*

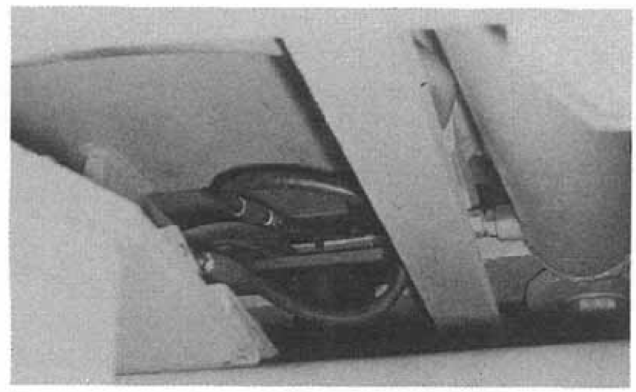


*Figure 4:*

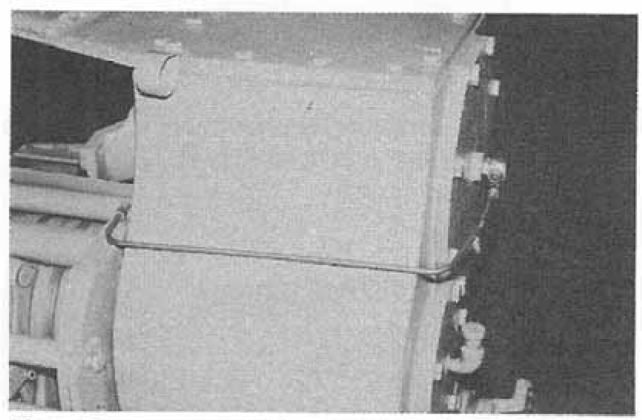


*Figure 5:*

7. Remove the brake hose (Fig. 4) from the fitting on the bracket and quickly plug the hose to prevent total loss of fluid. Proceed to remove the bracket and line as an assembly (Fig. 5), as extra clearance is needed upon removal of the transfer case. Cap the slave cylinder port.

# Removal Procedures

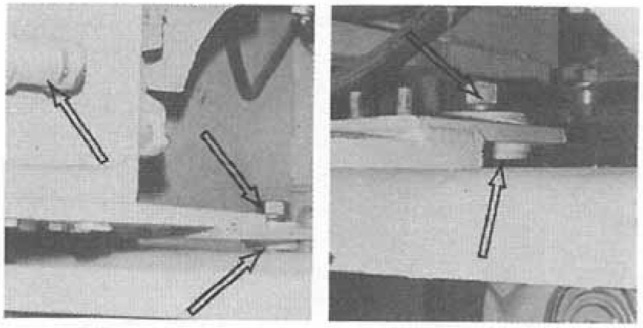


*Figure 6:*

8. Detach the oil return tube from the transfer case. Support the transfer case and remove the upper and lower uniball bushing bolts (Fig. 6).

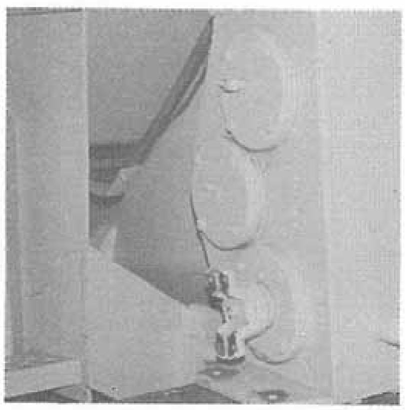


*Figure 7:*

9. Remove the transfer case assembly from the tractor using a forklift or hoist (Fig. 7).

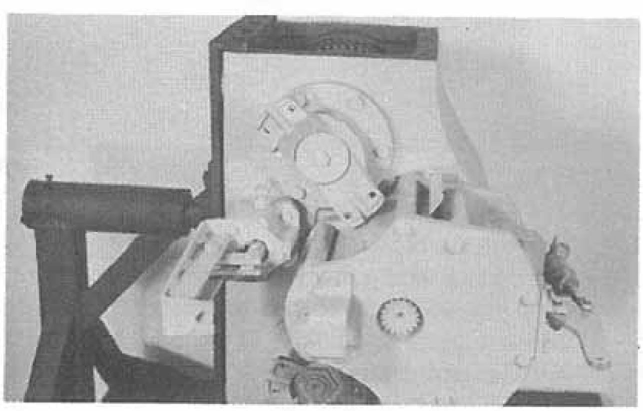


*Figure 8:*

10. If the unit is to be disassembled, mount it in a holding fixture which will safely support its weight and also allow it to swivel (Fig. 8).

## Model E and Model F, PT225 and PT270

1. Park the tractor with the front and rear frames aligned. Remove the key to prevent accidental starting of the engine. Chock the wheels to prevent rolling of the tractor.

2. Drain the lubricant from the transfer case. Use a clean container if the lubricant is to be reused.

*Figure 1:*

3. Remove the seat and pedestal, each separately, to avoid interference through the door opening (the use of an overhead hoist is suggested for removal of the seat assembly). Remove the shift lever knob and the boot/ring fixture (Fig. 1).

*Figure 2:*

4. Remove the left instrument panel skirt, unfasten the right instrument panel skirt, then carefully remove the floormat (Fig. 2) and floorboard.

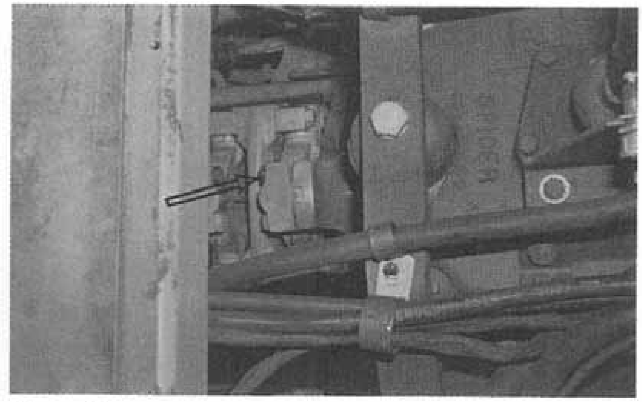


*Figure 3:*

5. At this time the upper driveline can be separated (Fig. 3). Loosen the four through-bolts which fasten the u-joints to a center coupling, then slide the transfer case yoke completely rearward (this yoke also functions as a slip joint). Withdraw the through bolts far enough so the center coupling can be taken out. If desired the through-bolts can be removed after turning the u-joint bearing caps.

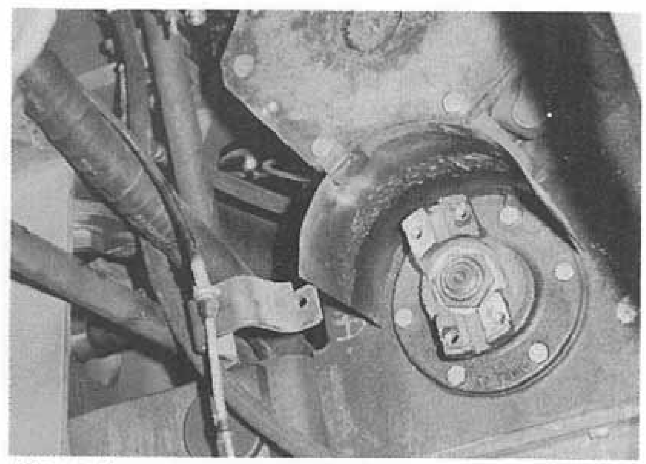


*Figure 4:*

6. Remove the front lower driveline and disconnect the park brake cable intact with its bracket and yoke (Fig. 4).

# Removal Procedures

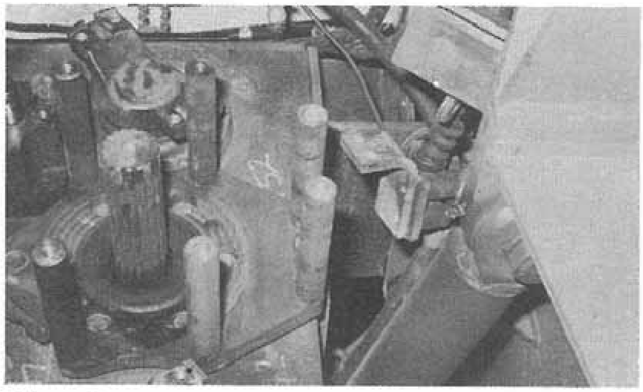


*Figure 5:*

7. Remove the brake lever intact with its bracket from the outer brake plate (Fig. 5) and proceed to remove the slave cylinder and bracket as an assembly. Leave the line connected to prevent loss of fluid while it hangs near the frame.

**NOTE:** *Removal of the outer brake plate, brake discs and shields is NOT required to perform removal procedures. They have been removed in these figures only for pictorial clarity.*

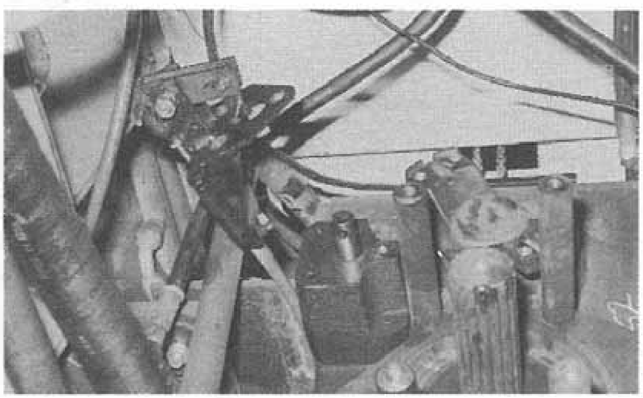


*Figure 6:*

8. Detach the shift cable and bracket assembly from the detent block and fork rod of the transfer case (Fig. 6), then secure it close to the frame using a piece of wire.

9. Disconnect the overflow tube from the transmission, but leave it connected to the transfer case.

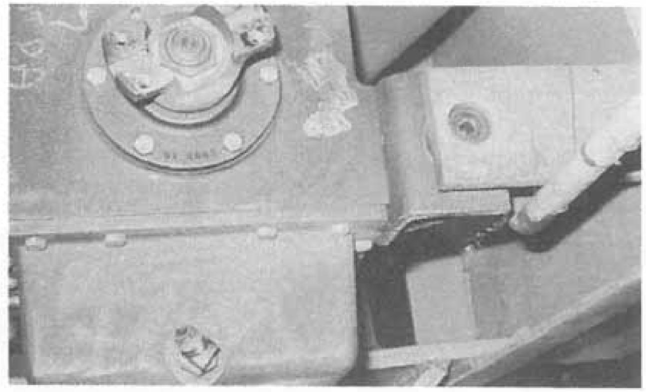


*Figure 7:*

10. Remove the oil suction hose at the front of the transfer case oil reservoir (Fig. 7), and remove the through-bolts from the lower rubber mount assemblies.

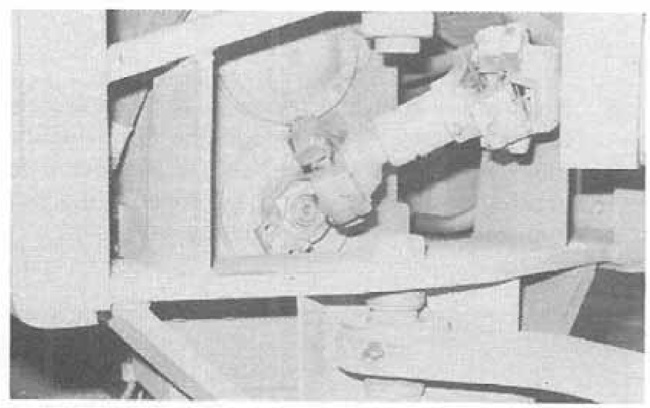


*Figure 8:*

11. Disconnect the lower intermediate driveline from the rear transfer case output yoke (Fig. 8).

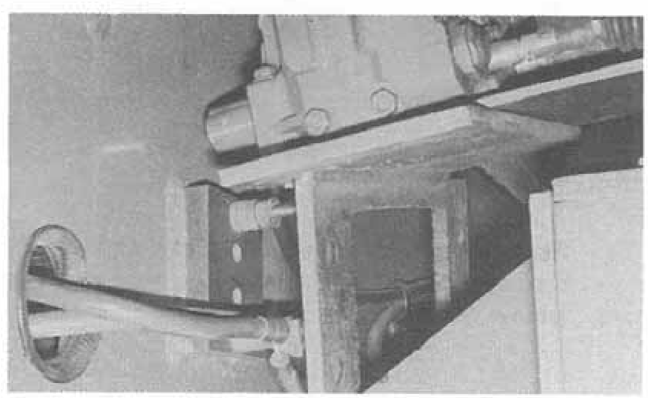


*Figure 9:*

12. At the electrical terminal block inside the frame, remove the two (2) battery ground cables from the stud (Fig. 9), and proceed to remove the valve bracket from the side of the transfer case.

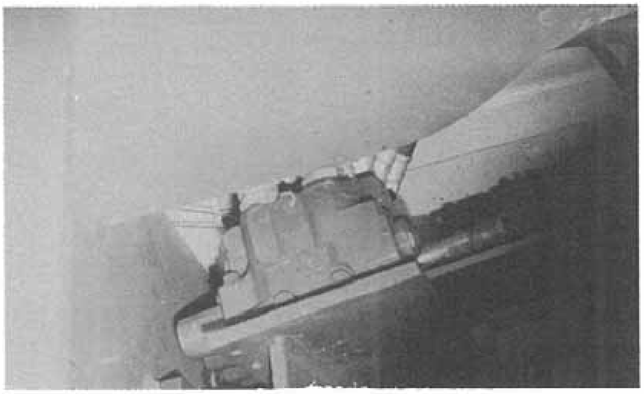


*Figure 10:*

13. Inside the cab, be sure the right hand control console is fully tilted upward. Under the cab, move the hydraulic control valve to the extreme left and as far upward as possible (Fig. 10), and secure with a wire routed through the cab handrail.

**NOTE:** *In some cases it may be necessary to disconnect the inlet line of the hydraulic control valve at the flow divider end. Slack for other hoses may be obtained by loosening the hose supports on the center yoke assembly.*

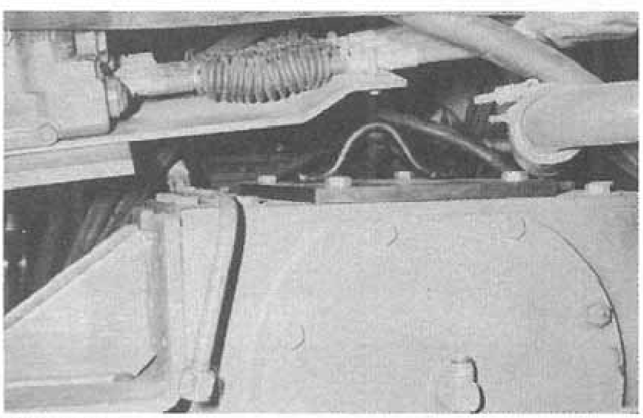


*Figure 11:*

14. Remove the oil line, vent assembly, return line clamp band and the four (4) middle capscrews from the top of the transfer case. Use the four (4) capscrews to attach the lifting fixture to the transfer case assembly (Fig. 11).

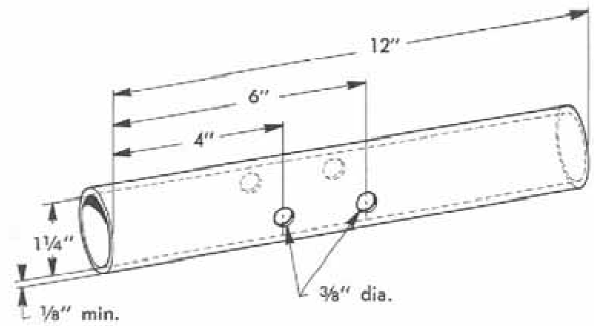



*Figure 12:*

15. Fabricate three (3) lift stand extensions as shown (Fig. 12), using one and one-fourth inch (1-1/4") inside diameter iron tubing with a MINIMUM wall thickness of one-eighth of an inch (1/8").

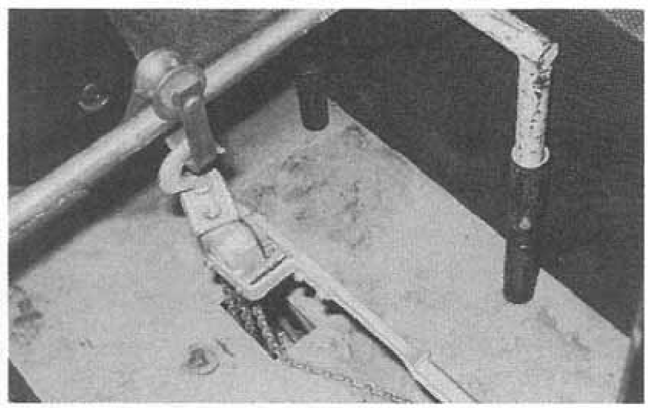


*Figure 13:*

16. Install clevis pins, three-eighths of an inch (3/8") in diameter, through the lift stand extensions. Slip the extensions onto the lift stand legs (Fig. 13). Hook the lifting hoist onto the roller/yoke assembly. Place the lower hoist hook through the transfer case lifting fixture and remove all slack in the lift hoist chain.

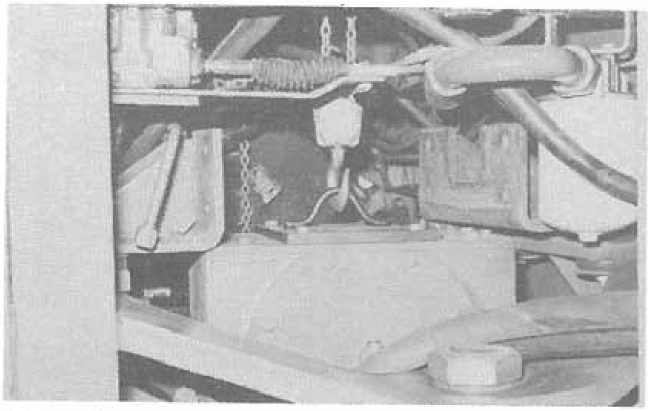


*Figure 14:*

17. Remove the remaining capscrews from the upper side mount brackets.

**NOTE:** *The hydraulic oil filter element may be removed, as a matter of personal preference, to gain greater access to the right side of the transfer case.*

Carefully lower the transfer case assembly while checking for interference within its travel (Fig. 14).

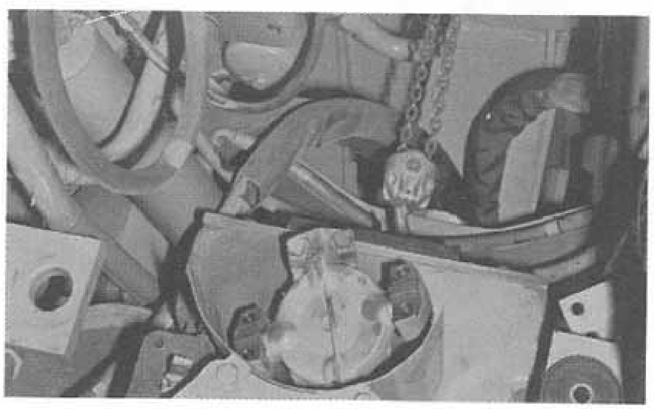


*Figure 15:*

*Figure 16:*

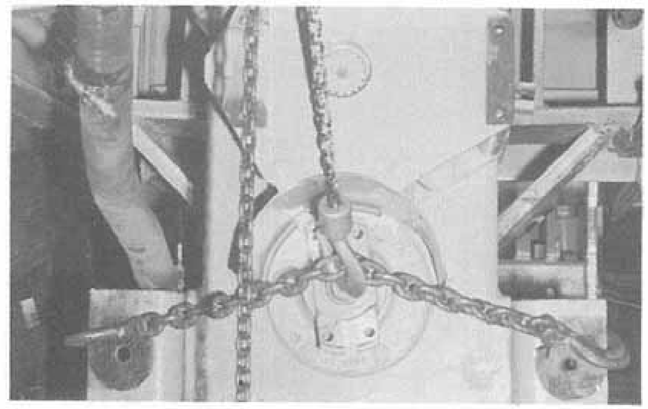


*Figure 17:*

18. Lower the transfer case until its oil reservoir approaches floor level (Fig. 15). Hook a lifting chain to each of the rear engine mount brackets. This will provide a pulling point near the flywheel housing (Fig. 16). Use a short chain between the lower transfer case mount brackets (Fig. 17). Attach the lifting hoist and remove all slack in the chains.

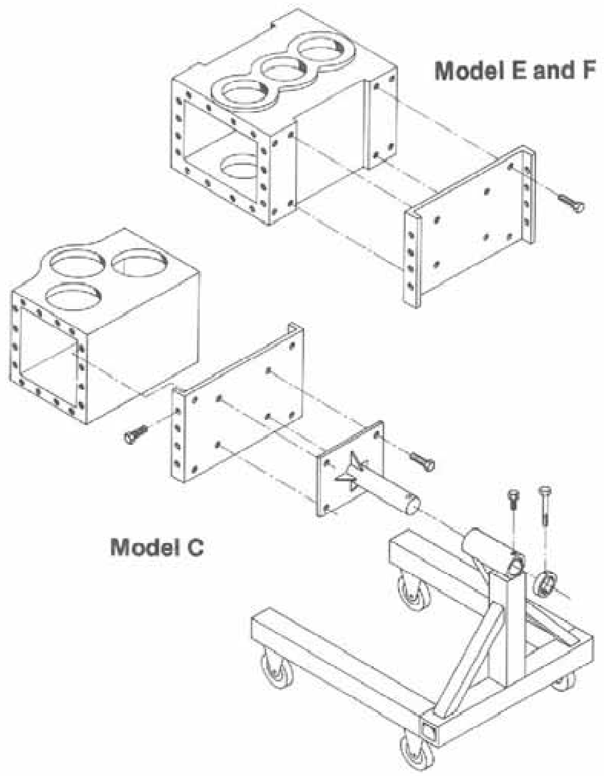
*Figure 18:*

*Figure 19:*

19. Tilt the transfer case by lifting with the front hoist (Fig. 18), continue to lift with the front hoist and lower with the rear hoist in equal steps until the assembly is horizontal (Fig. 19).

20. Rest the transfer case assembly on a forklift or a set of dollies for removal from beneath the tractor.

21. If the unit is to be disassembled, mount it in a holding fixture which will safely support its weight and also allow it to swivel.




Overhaul Stand

# Removal Procedures

## Model E and Model F, PT350

1. Park the tractor with the front and rear frames aligned. Remove the key to prevent accidental starting of the engine. Chock the wheels to prevent rolling of the tractor.

2. Drain the lubricant from the transfer case. Use a clean container if the lubricant is to be reused.

*Figure 1:*

3. Remove the seat and pedestal, each separatêly, to avoid interference through the door opening (the use of an overhead hoist is suggested for removal of the seat assembly). Remove the shift lever knob and the boot/ring fixture (Fig. 1).

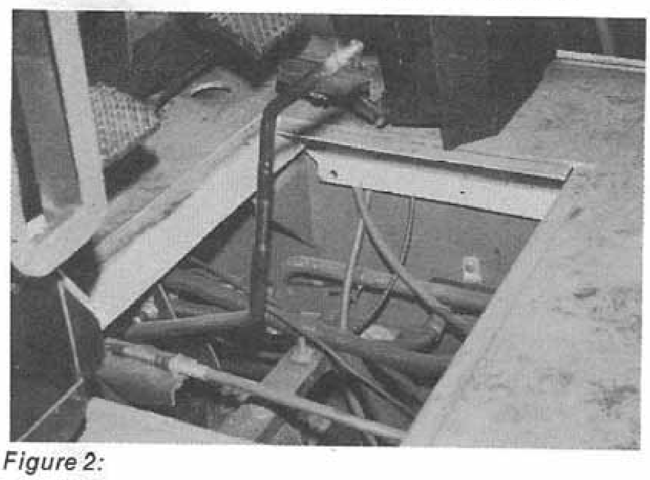


*Figure 2:*

4. Remove the left instrument panel skirt, unfasten the right instrument panel skirt, then carefully remove the floormat (Fig. 2), and floorboard.

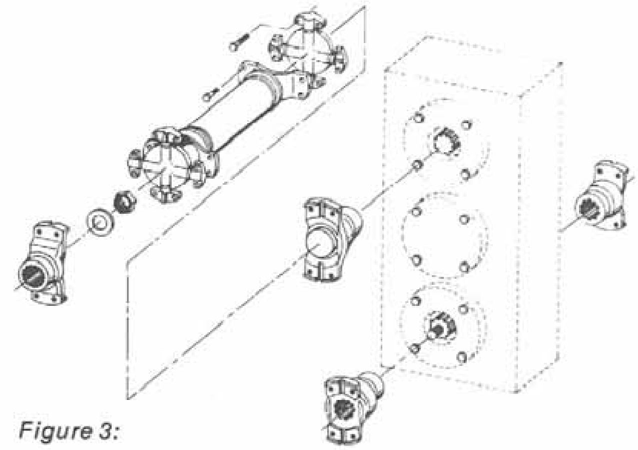


*Figure 3:*

5. At this time the upper driveline can be removed (Fig. 3). Uncouple the u-joints from the transmission and transfer case yokes, then slide the transfer case yoke completely rearward (this yoke also functions as a slip joint). Lift the driveline assembly from access opening.

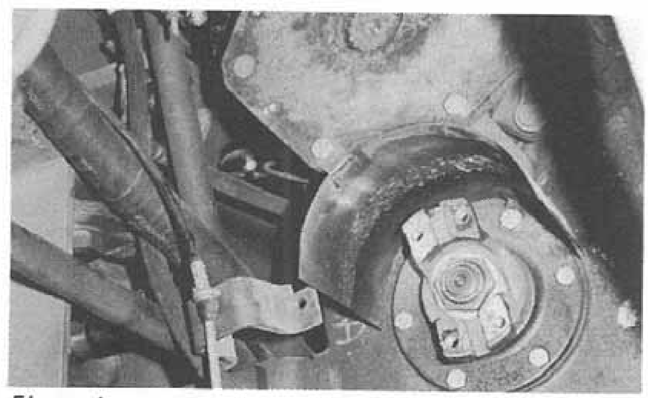


*Figure 4:*

6. Remove the front lower driveline and disconnect the park brake cable intact with its bracket and yoke (Fig. 4).

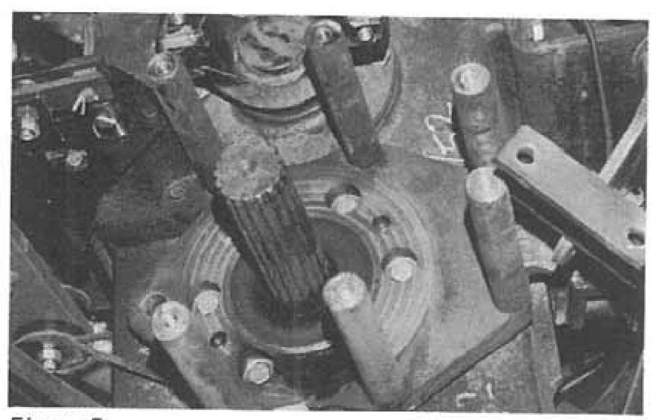


*Figure 5:*

7. Unfasten the brake lever bracket from the outside brake plate, proceed by removing the outside brake plate, brake discs and shields (Fig. 5). The

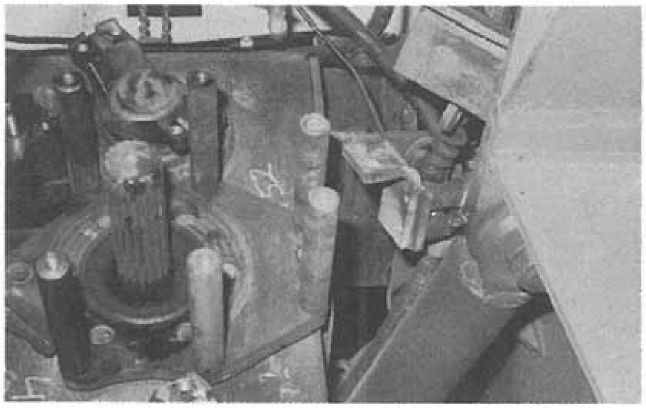


*Figure 6:*

slave cylinder bracket is now accessible, remove it intact with the slave cylinder (Fig. 6), but leave the line connected to prevent loss of fluid while the assembly hangs near the frame.

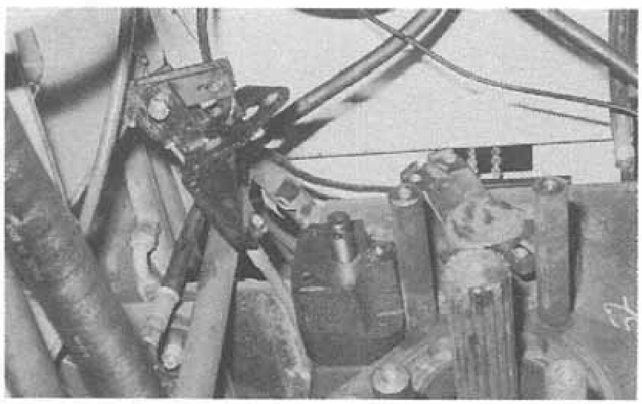


*Figure 7:*

8. Detach the shift cable and bracket assembly from the detent block and fork rod of the transfer case (Fig. 7), then secure it close to the frame using wire.

*Figure 8:*

9. Disconnect the overflow tube from the transmission, but leave it connected to the transfer case.

10. Remove the oil suction hose at the front of the transfer case oil reservoir (Fig. 8), and remove the through-bolts from the lower rubber mount assemblies.

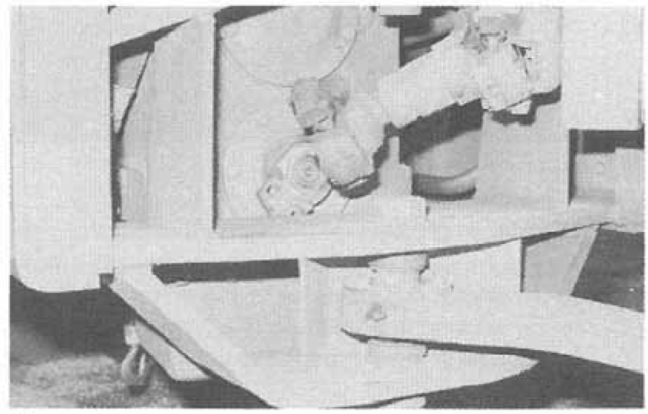


*Figure 9:*

11. Disconnect the lower intermediate driveline from the rear transfer case output yoke (Fig. 9).

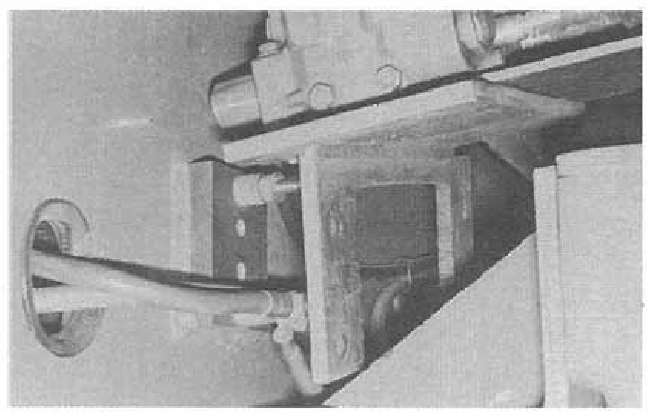


*Figure 10:*

12. At the electrical terminal block inside the frame, remove the two (2) battery ground cables from the stud (Fig. 10), and proceed to remove the valve bracket from the side of the transfer case.

# Removal Procedures

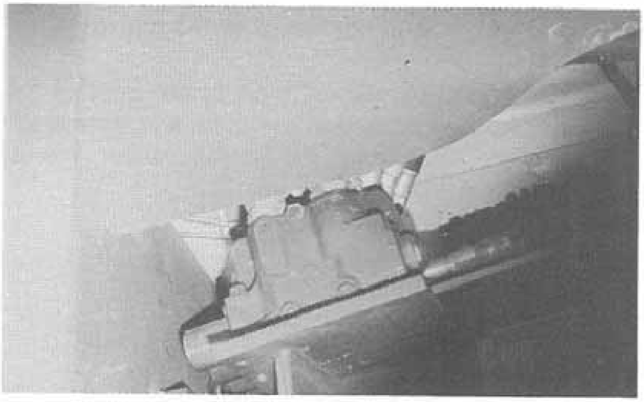


*Figure 11:*

13. Inside the cab, be sure the right hand control console is fully tilted upward. Under the cab, move the hydraulic control valve to the extreme left and as far upward as possible (Fig. 11), and secure with a wire routed through the cab handrail.

**NOTE:** *In some cases it may be necessary to disconnect the inlet line of the hydraulic control valve at the flow divider end. Slack for other hoses may be obtained by loosening the hose supports on the center yoke assembly.*

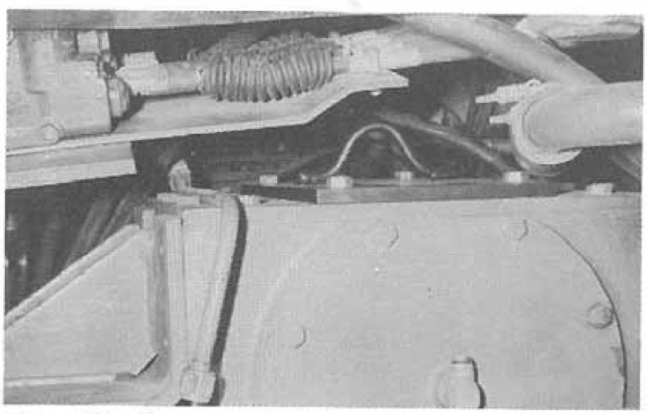


*Figure 12:*

14. Remove the oil line, vent assembly, return line clamp band and the four (4) middle capscrews from the top of the transfer case. Use the four (4) capscrews to attach the lifting fixture to the transfer case assembly (Fig. 12).

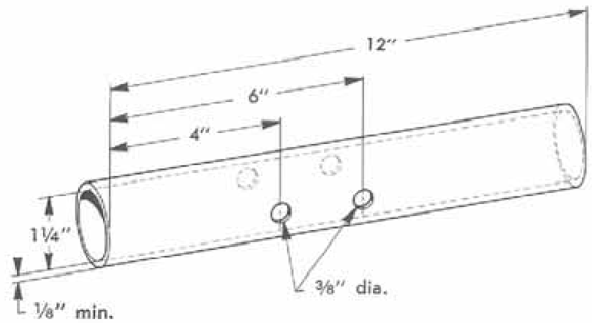



*Figure 13:*

15. Fabricate three (3) lift stand extensions as shown (Fig. 13), using one and one-fourth inch (1-1/4") inside diameter iron tubing with a MINIMUM wall thickness of one-eighth of an inch (1/8").

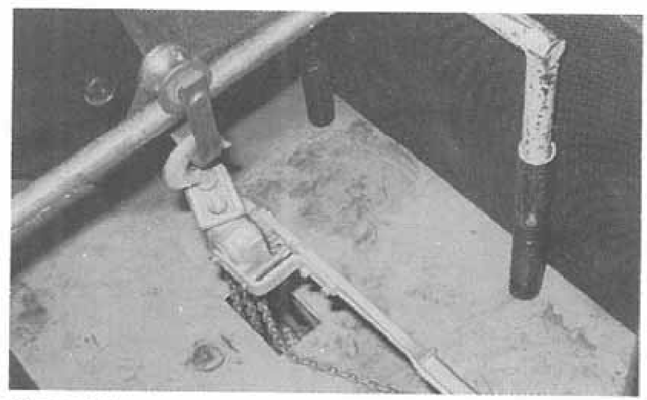


*Figure 14:*

16. Install clevis pins, three-eighths of an inch (3/8") in diameter, through the lift stand extensions. Slip the extensions onto the lift stand legs (Fig. 14). Hook the lifting hoist onto the roller/yoke assembly. Place the lower hoist hook through the transfer case lifting fixture and remove all slack in the lift hoist chain.

*Figure 15:*

17. Remove the remaining capscrews from the upper side mount brackets.

**NOTE:** *The hydraulic oil filter element may be removed, as a matter of personal preference, to gain greater access to the right side of the transfer case.*

Carefully lower the transfer case assembly while checking for interference within its travel (Fig. 15).

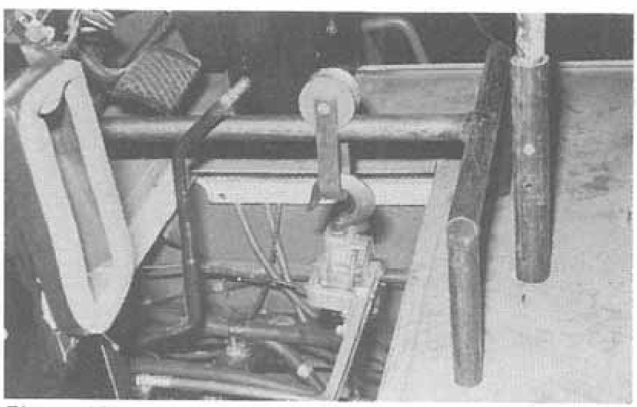


*Figure 16:*

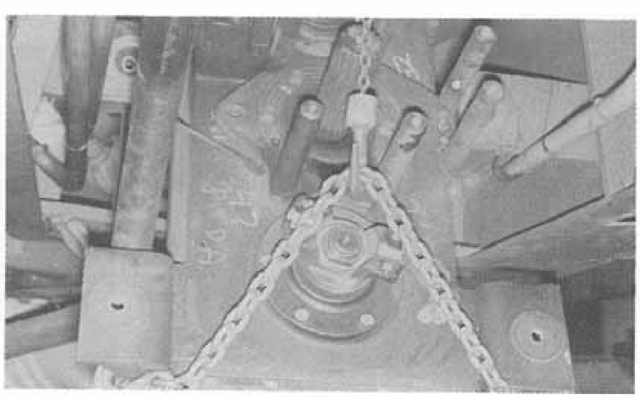


*Figure 17:*

18. Lower the transfer case assembly until its oil reservoir approaches floor level. Position another lift stand, roller/yoke assembly and lifting hoist over the large floor opening (Fig. 16). Hook a short chain to the lower transfer case mount brackets (Fig. 17). Attach the lifting hoist and remove all slack in the chains.

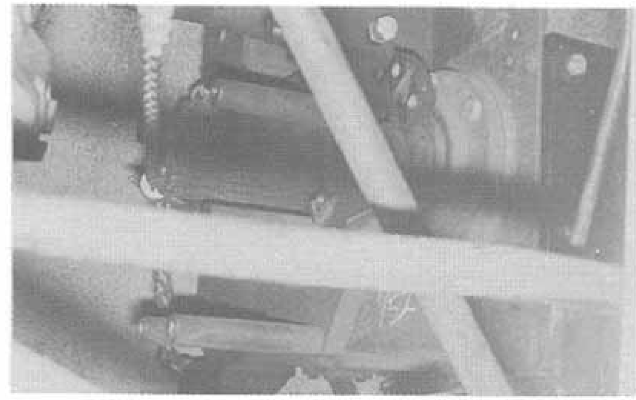


*Figure 18:*

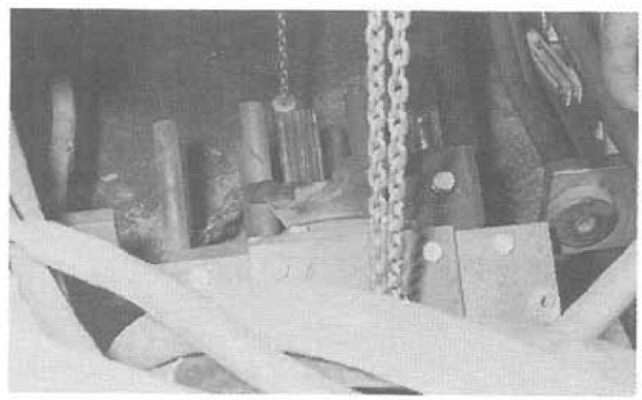


*Figure 19:*

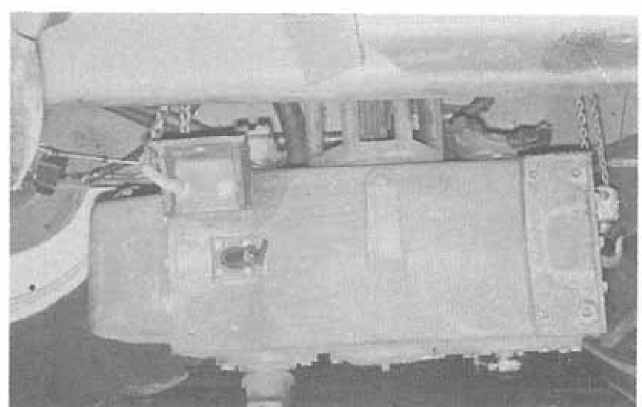


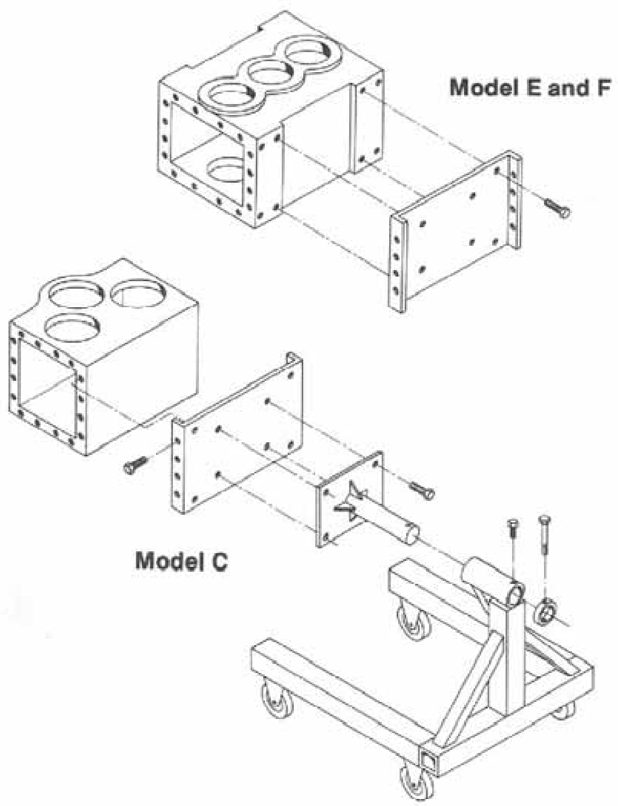
*Figure 20:*

19. Tilt the transfer case by lifting with the front hoist (Fig. 18), continue to lift with the front hoist and lower with the rear hoist in equal steps (Fig. 19) until the assembly is horizontal (Fig. 20).

# Removal Procedures

20. Rest the transfer case assembly on a forklift or a set of dollies for removal from beneath the tractor.

21. If the unit is to be disassembled, mount it in a holding fixture which will safely support its weight and also allow it to swivel.




**Overhaul Stand**

## Model C, Model E and Model F

### General Information

The instructions contained in this section cover the disassembly sequence that would normally be followed after the transfer case has been removed from the tractor and is to be completely overhauled. However, minor repairs such as seal replacement, can be performed with the unit in the tractor.

Cleanliness is of extreme importance in the repair or overhaul of this unit. Before disassembly, it is recommended that the exterior of the unit be thoroughly cleaned to prevent the possibility of foreign matter entering the unit.

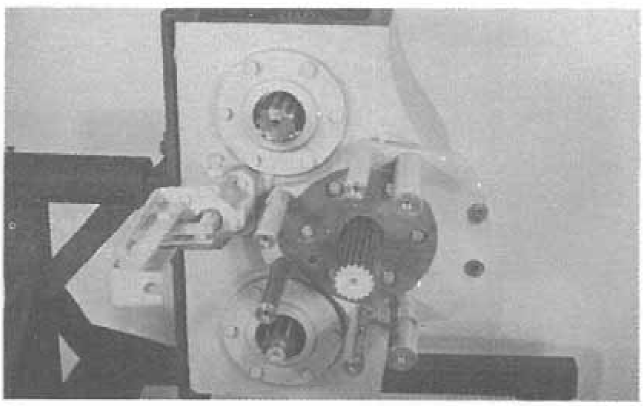


*Figure 1:*

### Disassembly

1. Remove the drive yokes from the input and output shafts. Then remove the brake group from the center shaft (Fig. 1), if it has not been previously removed.

**NOTE:** *For additional information on the brake, refer to the Steiger Brake Systems Service Manual.*

2. Remove the upper and lower covers (or upper cover and oil reservoir if servicing the Model E or Model F transfer case).

**NOTE:** *The covers on the Model C unit will require removal before the unit can be mounted in the overhaul stand.*

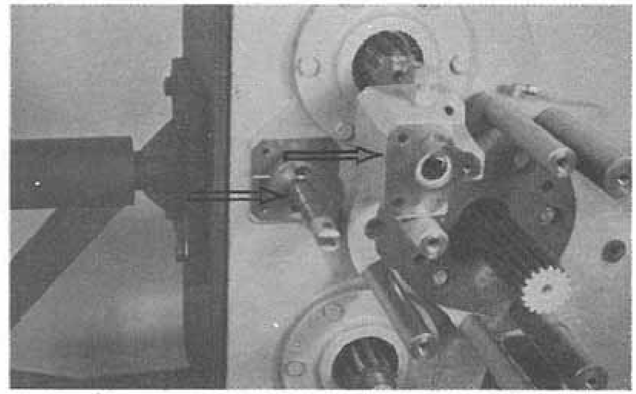


*Figure 2:*

3. Remove the detent block and shift rod adjustment block from the front of the housing (Fig. 2).

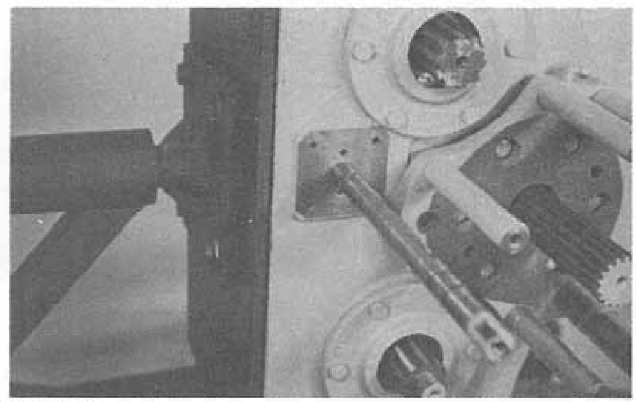


*Figure 3:*

4. Remove the shift fork capscrew and withdraw the shift rod from the front of the housing (Fig. 3). The shift fork is now free for removal.

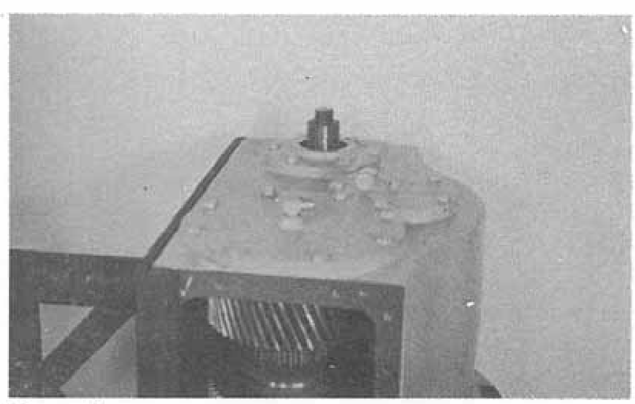


*Figure 4:*

# Disassembly Procedures

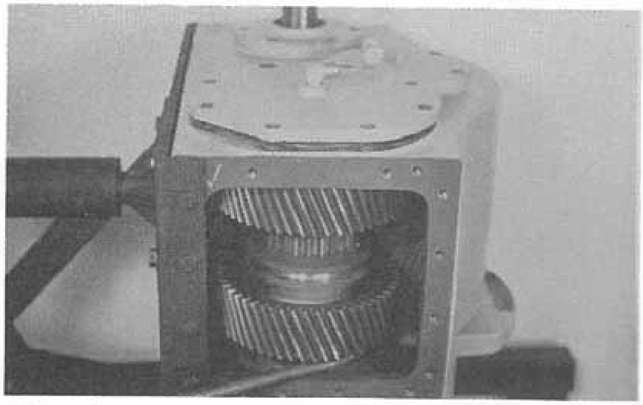


*Figure 5:*

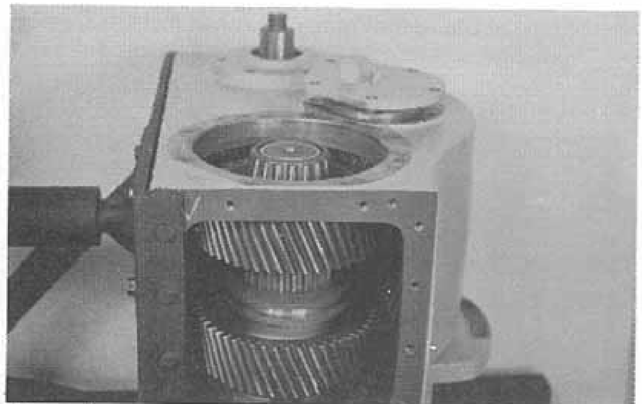


*Figure 6:*

5. Position the transfer case assembly as shown (Fig. 4) when removing the rear bearing caps. The caps are fitted with O-ring seals and may require a slight prying force on the gears inside to push the cap from its bore (Fig. 5). Note the number and location of shims under each bearing cap flange and use caution to prevent damage to the shims (Fig. 6).

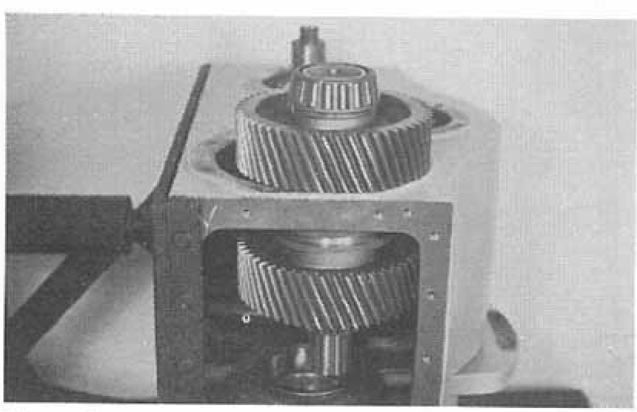


*Figure 7:*

6. The input shaft/gear subassembly may be removed from the rear of the housing (Fig. 7).

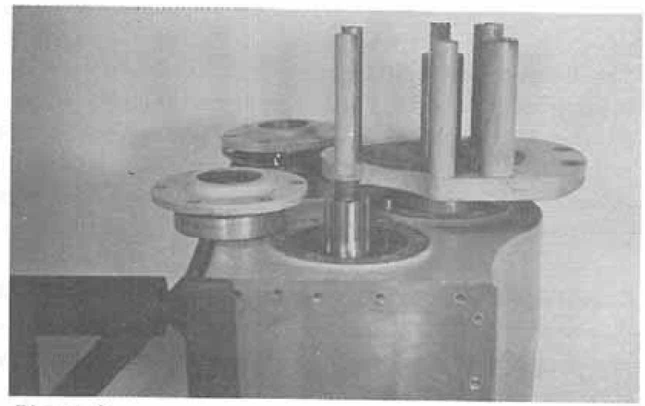


*Figure 8:*

7. Rotate the transfer case slowly in the stand and remove the bearing caps on the front side (Fig. 8), and the inner brake plate/bearing cap assembly.

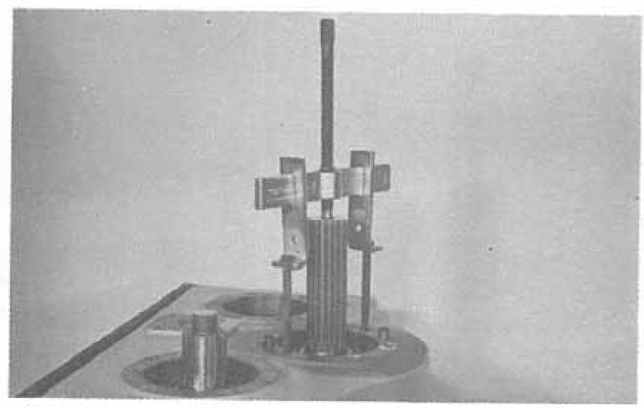


*Figure 9:*

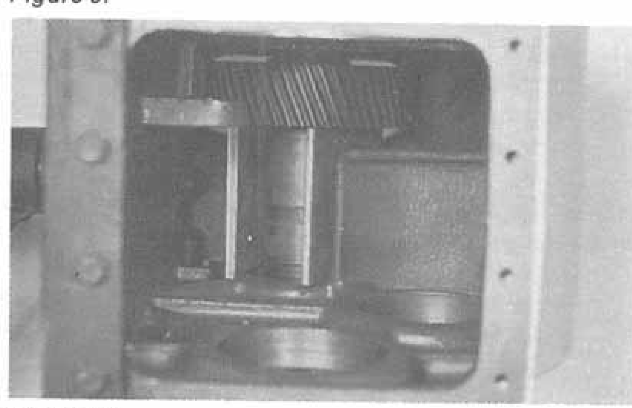


*Figure 10:*

8. The center shaft may be pressed out from either direction using a press. However, exercise caution to prevent damage to splines, if pressing on the protruding end of the center shaft (Fig. 9). After the shaft has been pressed free of its bearing, it may be free to fall from the housing. Carefully remove the gears and spacer.

   Support the output gear inside the housing as shown (Fig. 10).

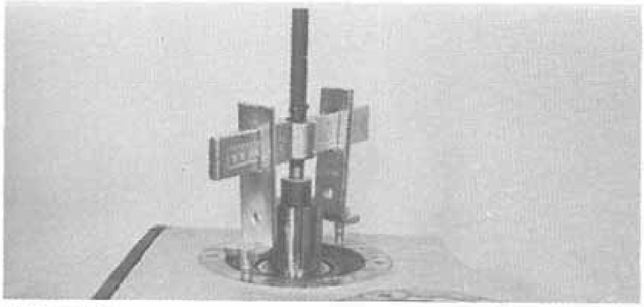


*Figure 11:*

9. The output shaft must exit from the FRONT of the housing (Fig. 11) when pressing to remove the bearings or shaft. Protect the threads on the shaft ends during pressing operations. Remove the gear from the housing.

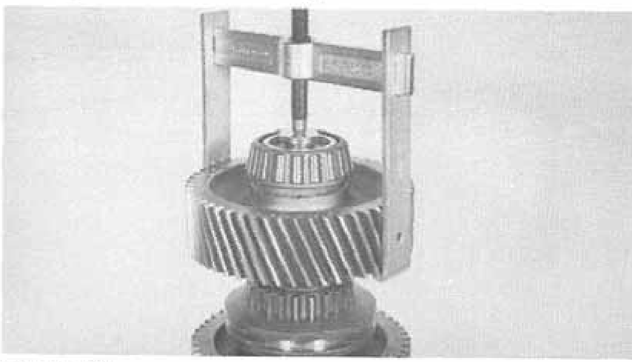


*Figure 12:*

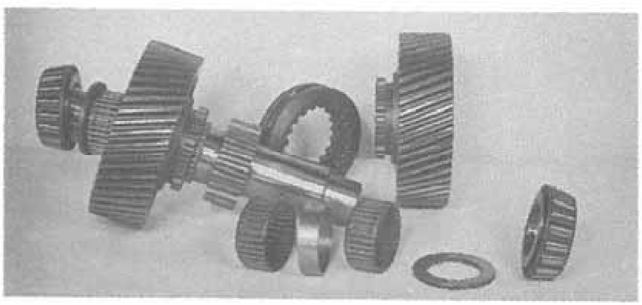


*Figure 13:*

10. The input shaft/gear subassembly is disassembled by supporting the gear and pressing the bearing from the shaft (Fig. 12). Do this for each end. Gears, bearings, spacers and sliding clutch are now ready for removal (Fig. 13).

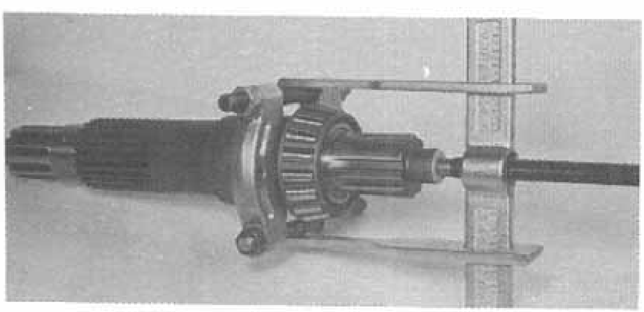


*Figure 14:*

11. Use a bearing separator to retain the bearing while the output shaft is being pressed out (Fig. 14). Use the same method for the remaining bearing on the center shaft.

12. On later production transfer cases, the input and output shaft bearing caps have oil seals installed from the outside, and they may be pried out or driven out from the inside.

    On early production units the bearing cap with seals requires the removal of the bearing cup, before the seal can be removed and reinstalled.

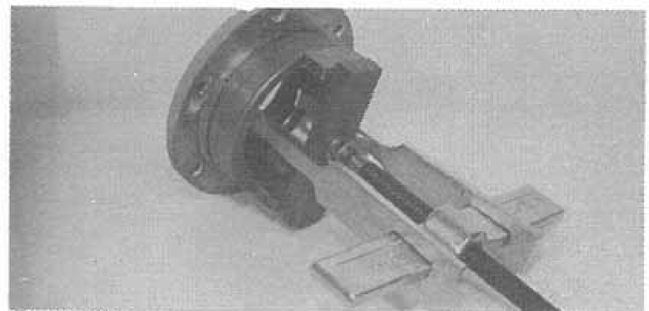


*Figure 15:*

13. To remove the bearing cups from the bearing caps, use a puller set up as shown (Fig. 15) or a welder to run a bead in the inside diameter of the bearing cup. This weld will shrink it enough to allow it to drop out.

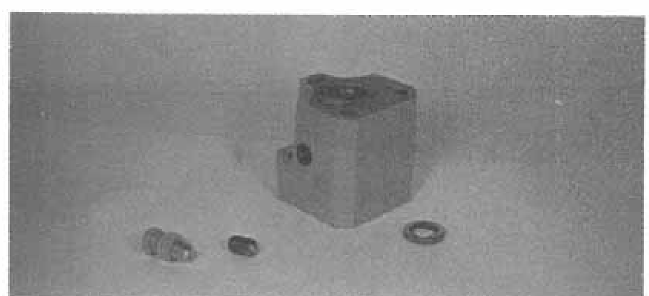


*Figure 16:*

14. To totally disassemble the detent block, remove the jam nut/capscrew, plunger/ball assembly and shift rod oil seal (Fig. 16).

## Cleaning Operations

Parts that require inspection should be thoroughly cleaned to prevent all traces of wear, metal particles, dirt and grease. This can be accomplished with cleaning solvent, by steam cleaning or a high pressure hot water spray. Blow-dry the cleaned parts with compressed air before attempting inspection. Careful inspection before assembly is most important to prevent unintentional disassembly of the unit during reassembly and also to avoid the risk of a recurring failure.

## Visual Inspection

General Information:
Because of the simple design of the Steiger two-speed transfer case, the inspection procedures can normally be accomplished without the use of expensive inspection equipment. Determining reusability of used parts can be done by visual inspection methods when using the following examples listed under Reusable Parts and Non-Reusable Parts.

## Reusable Parts

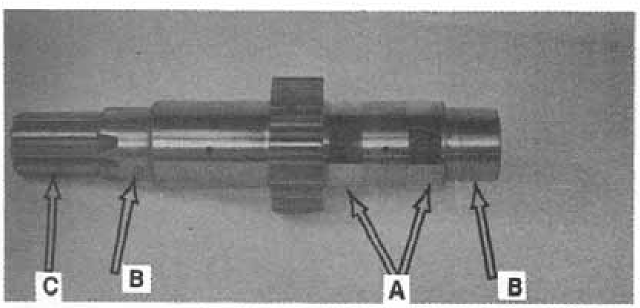


*Figure 1:*

**Shaft Journals and Splines**

The input shaft displayed (Fig. 1) is reusable as long as the highly polished areas (A) do not show any spalling or dimensional change and there is no evidence of bearing creeping on the support bearing journals (B). If the input shaft is from a Model E or Model F transfer case where the splined yoke serves as a slip joint on the shaft (C), spline wear should also be a consideration.

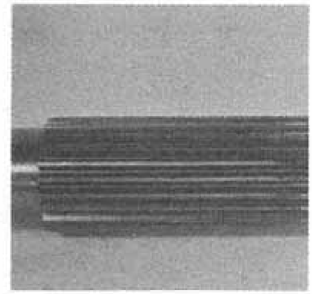


*Figure 2:*

The splined center shaft (Fig. 2) and output shaft may be reused if the splines are not worn or cause gear misalignment in any way.

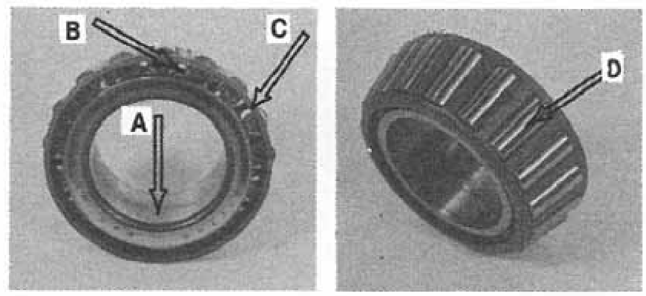


*Figure 3:*

**Bearings**

Bearing cones (Fig. 3) must be thoroughly examined before reuse to ensure reliability. Reuse of this bearing is permitted, providing there is no bore wear of the inner race (A), spalling of the inner raceway (B), end wearing of the rollers (C) and no spalling or severe scratching of the roller surfaces (D).

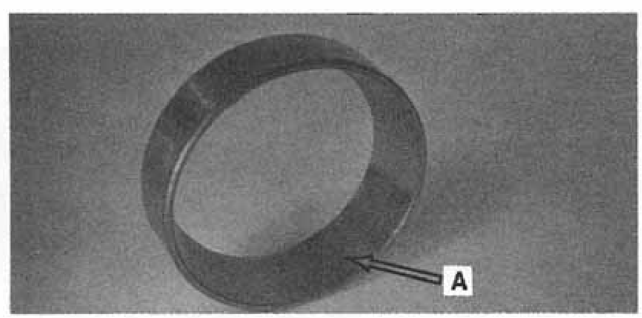


*Figure 4:*

The bearing cup exhibited (Fig. 4) has a slight amount of debris indentation in the raceway (A) but no evidence of spalling, brinelling or pitting and therefore is reusable.

# Inspection Procedures

*Figure 5:*

Reuse of the bearing cup pictured (Fig. 5) would be acceptable since it shows no visible damage or wear.

**Gears**

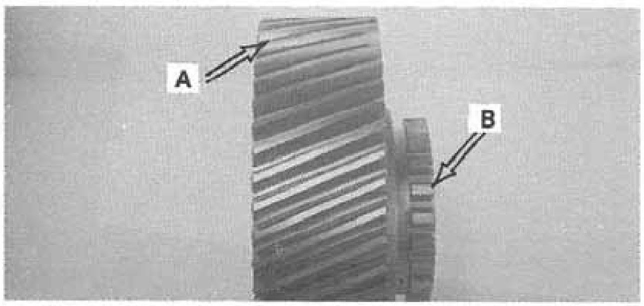



*Figure 6:*

New or only slightly worn gearteeth usually possess harmless irregularities which occur during manufacture. An example is the gear illustrated (Fig. 6 ) in which the gearteeth (A) and gear hub splines (B) have shaving marks. This gear is reusable if there are no cracked or damaged gearteeth and the bearing bore passes inspection.

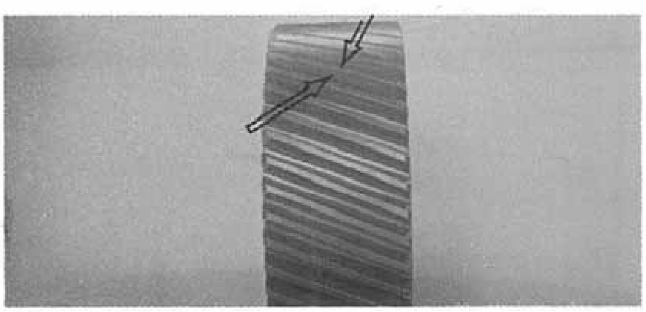


*Figure 7:*

Mild or light debris indentations or very light pitting (Fig. 7) are usually considered harmless and the gear can be used if it has no further faults.

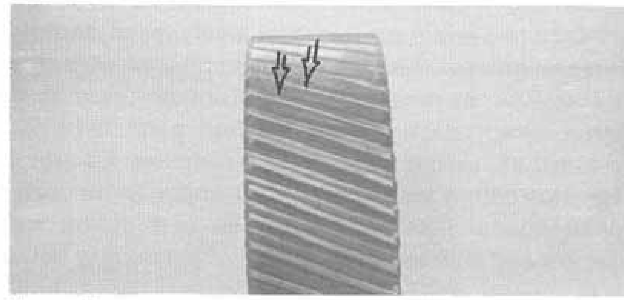


*Figure 8:*

Slight lipping of the gearteeth will form a sharp edge at the extreme outside diameter of the gear, usually only on one side of the teeth (Fig. 8). This condition can be caused from extremely heavy loads which can displace metal on the tooth surface. If there are no other defects, the gear can be used.

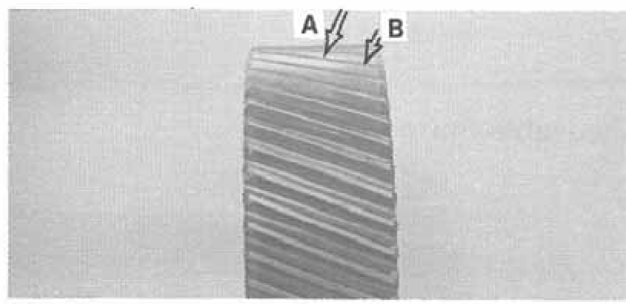



*Figure 9:*

Gears that have highly polished teeth are generally acceptable. However, if polishing varies from bright (A) to dull (B, Fig. 9), misalignment should be suspected. It would be advisable to test the fit of the gear on its shaft and proper bearing adjustments at reassembly.

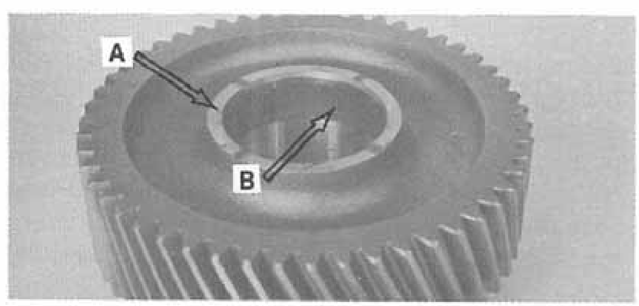



*Figure 10:*

On the gear hub (Fig.10), thrust surfaces (A) and bearing bore (B), polishing is allowable as long as the surfaces remain true.

## Failure Analysis

General Information:
The contents of the Non-reusable Parts section will explain the most likely cause of excessive wear or failure. Use of broken or damaged parts is out of the question, however, in the examination of worn parts, consideration usually must also be given to the mating parts that could also become worn or damaged during operation.

## Non-reusable Parts

**Shaft Journals and Splines**

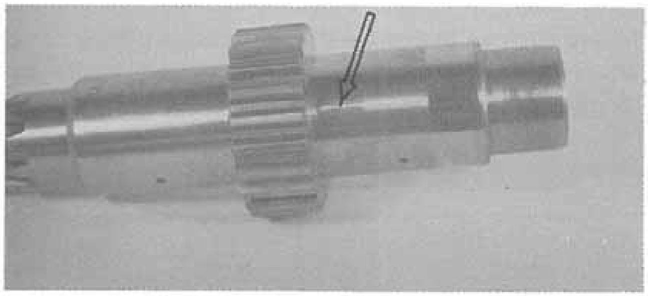


*Figure 1:*

Brinelling on this input shaft (Fig. 1) would eventually cause serious bearing and gear damage. Brinelling can be detected at partial assembly, then rotating. If roughness is noted, do not reuse the part causing the roughness, for it could be caused by a bearing or gear as well as the shaft. Brinelling is usually caused by vibration under load, while the bearing is stationary.

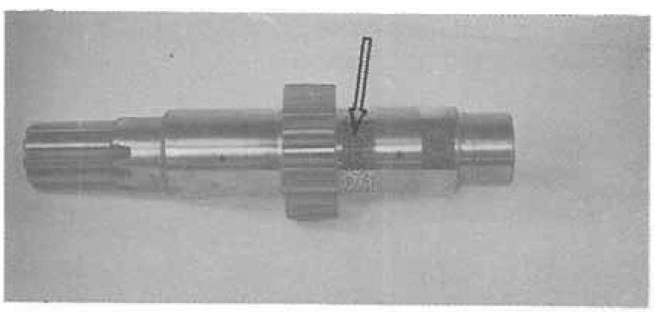


*Figure 2:*

Spalling of the input shaft needle bearing raceway (Fig. 2) is the result of fatigue beneath the hardened surface of the shaft. Extreme overloads at low speeds are a very likely cause.

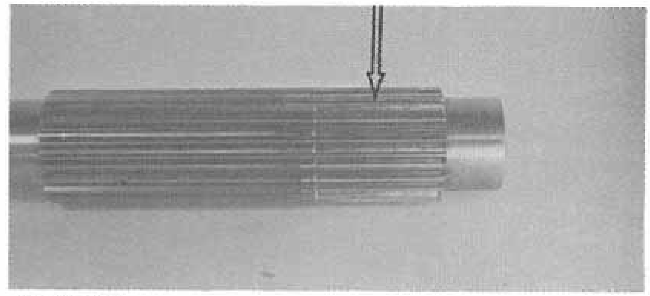


*Figure 3:*

Fretting corrosion as seen on this center shaft (Fig. 3) will cause cocking and misalignment of the gear as well as fretting on the gear hub splines. When the gear is misaligned, edge loading of the gearteeth will result. Fretting of this type is caused by gear and/or shaft distortion while under continuous overloads at low speed condition.

**Bearings**

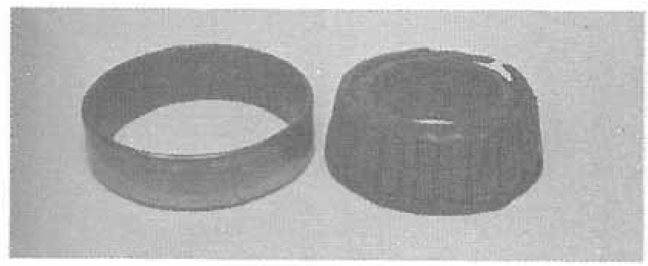


*Figure 4:*

Overheated or burned-up bearing set (Fig. 4) is usually caused by lack of lubrication. However, if an advanced burn-up occurs, the cause may be from other faults such as excessive preload or secondary damage from another failure.

*Figure 5:*

Spalling of the bearing cone rollers and/or inner raceway (Fig. 5) may originate from various conditions. Overloading of the bearing may cause fatigue and consequent flaking of bearing material. Mechanical damage through mishandling of the bearing or debris circulating with lubricant will contribute to bearing failure of this type. Life of the bearing is governed by load, speed and lubricant quality.

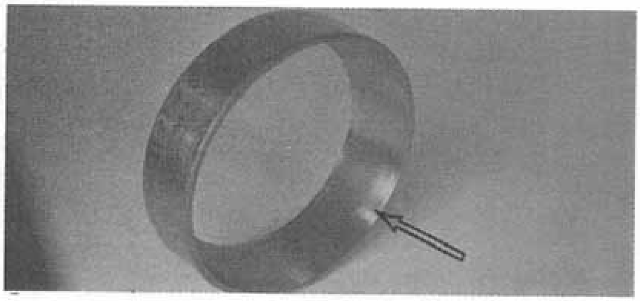


*Figure 6:*

Severe debris indentation in the bearing cup (Fig. 6) is generally caused by foreign material (mostly metal particles) in the lubricant. As the rollers run over the contaminants, they are forced against the surface of the raceway and leave small dents. The indentations, if the cup is not changed, will progress into pitting or spalling depending upon the severity of application.

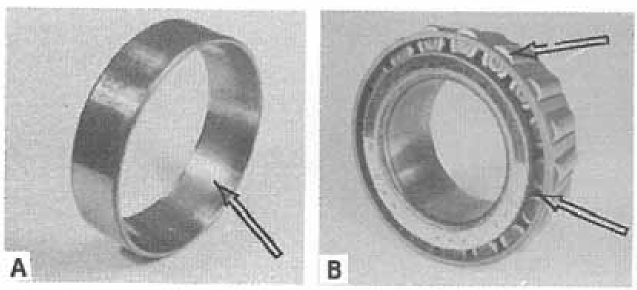



*Figure 7:*

Bearing sets which are worn because of abrasive contaminants (Fig. 7) may usually be identified by a dull satin finish in the bearing cup (A) raceway and worn roller ends with loose roller cage on the bearing cone (B).

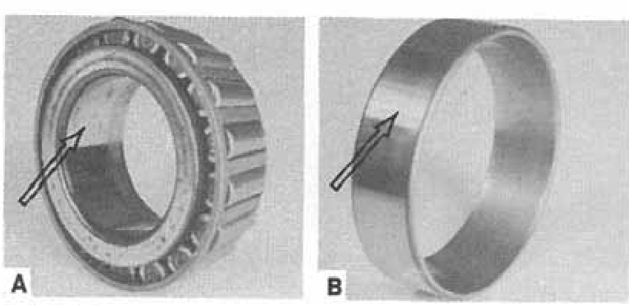



*Figure 8:*

If a bearing cone (A) or bearing cup (B) (Fig. 8) shows evidence of creeping, they should be replaced to restore accurate fit. Check the fit of the new bearing pieces to their mating parts also, in this case; bearing cap counterbores and shaft support journals.

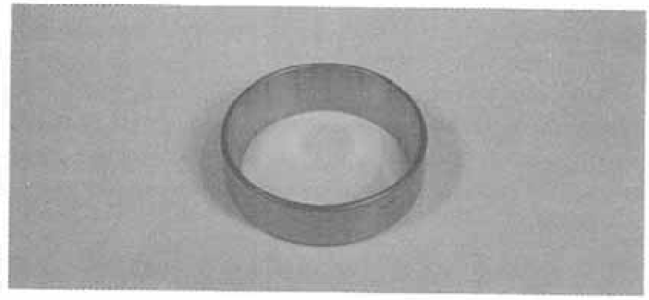


*Figure 9:*

A shock loaded bearing cup (Fig. 9) will show indentations to match the spacing of the rollers in the bearing cone. If this is found it is usually the result of another failure such as broken gearteeth or large pieces being pinched between gearsets. Checking all shafts for straightness is recommended.

**Gears**

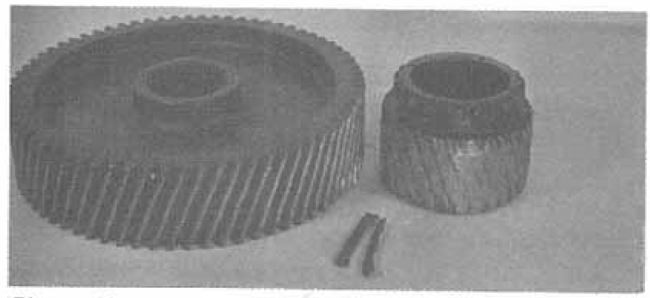


*Figure 10:*

The overheated, failed gearset seen here (Fig.10) was caused by lack of lubrication. Note the color of the gears and the failure characteristics. Without enough lubrication, friction generated enough heat to soften the gearteeth and strip them off.

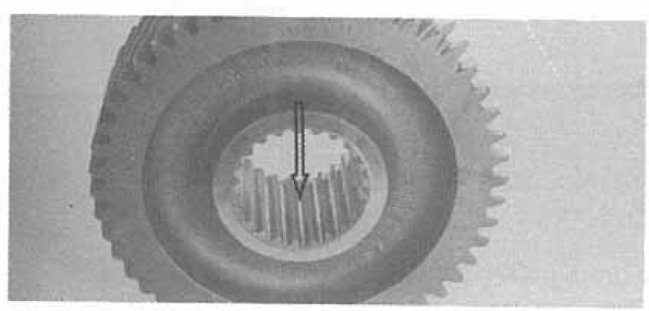


*Figure 11:*

If examination of the splined gear bore reveals fretting corrosion (Fig.11), it is likely that the shaft it mates with has similar damage. The severity of fretting and load on the gear will govern its life. As fretting wear

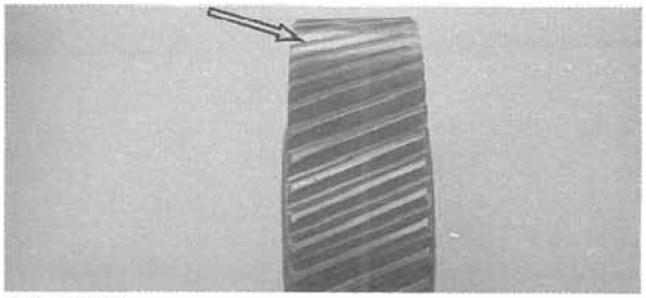


*Figure 12*

*Figure 13:*

increases, so will edge loading of the gearteeth (Fig. 12). If proper repairs are not performed or the unit is operated severely under these conditions, edge loaded gearteeth will become fatigued and break off (Fig.13). This is termed as a misalignment fracture.

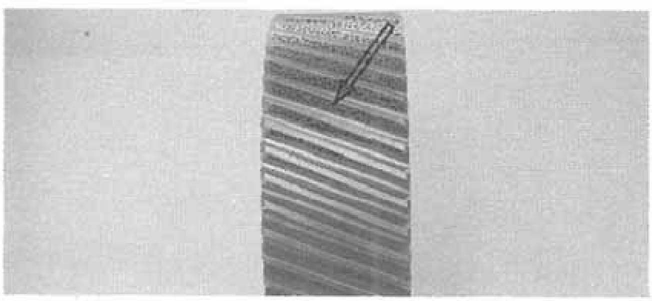


*Figure 14:*

Severely pitted gears (Fig.14) could be the result of the wrong type of lubricant. If the lubricant does not offer the proper anti-friction properties, geartooth scuffing, scoring, pitting or spalling may follow.

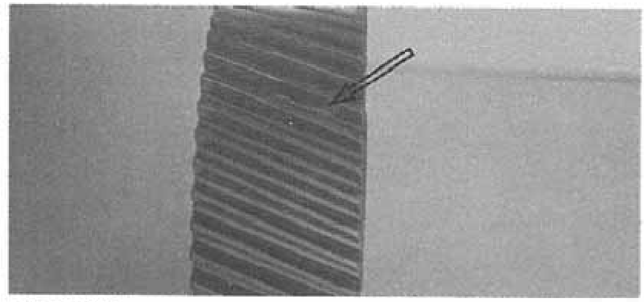


*Figure 15:*

Fatigue fractures on a geartooth may be identified by a tooth broken at the mid-tooth area (Fig.15). When the tooth is completely broken off, examination of the metal grain structure will usually show separation in stages.

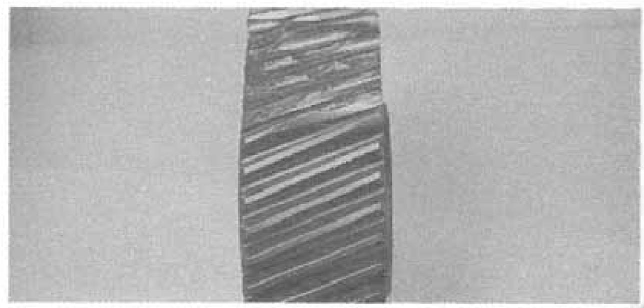


*Figure 16:*

A gear with shock fractures (Fig.16) will display geartooth separation at the base of the tooth as if it were done in a single motion (not in stages). Abusive operation is the most likely single cause for this type of failure.