SERVICE MANUAL

FOR HYSTER POWER CONTROLLED WINCHES

D89C

599248
~~Form 299248~~

SAFETY PRECAUTIONS

Observe the following PRECAUTIONS to prevent injury to personnel and damage to equipment.

- Do not operate winch unless tractor is equipped with a rear screen for operator protection against cable breakage.

- Authorized operators only!

- Report damage or erratic operation of winch or pressure gauge immediately.

- Do not stand while operating the tractor or the winch.

- Make sure that instruments and controls are operative before working the unit.

- Do not use control levers or handles as machine mounting assists.

- Do not use control levers or handles as hangers for clothes, water bags, grease guns, lunch pails, etc.

- Do not permit personnel in the control area when working or making checks on the machine.

- Do not allow riders on the machine or load.

- Use extreme care when operating close to other machines.

- Avoid operating near anyone working or standing.

- Do not stand or permit others to stand in the bight (loop) of a cable.

- Do not stand or permit others to stand near the winch or cable when it is under tension.

- Do not work a damaged cable (broken wire or strands, or a decrease in the diameter of the cable, are warning signs).

- Do not leave the tractor while the winch line is under tension.

- Avoid pulling the hook over the drum and through the throat of the winch.

- Do not anchor a double or two-part line to the winch.

- When not operating the winch, always leave it in neutral with the brake on.

- Never attempt to clean, oil or adjust a machine while it is in motion.

- Use extreme care when removing cable and ferrule from the drum. When the ferrule is released the cable may spring out with force.

Winch Serial Number _____

Date put in service _____

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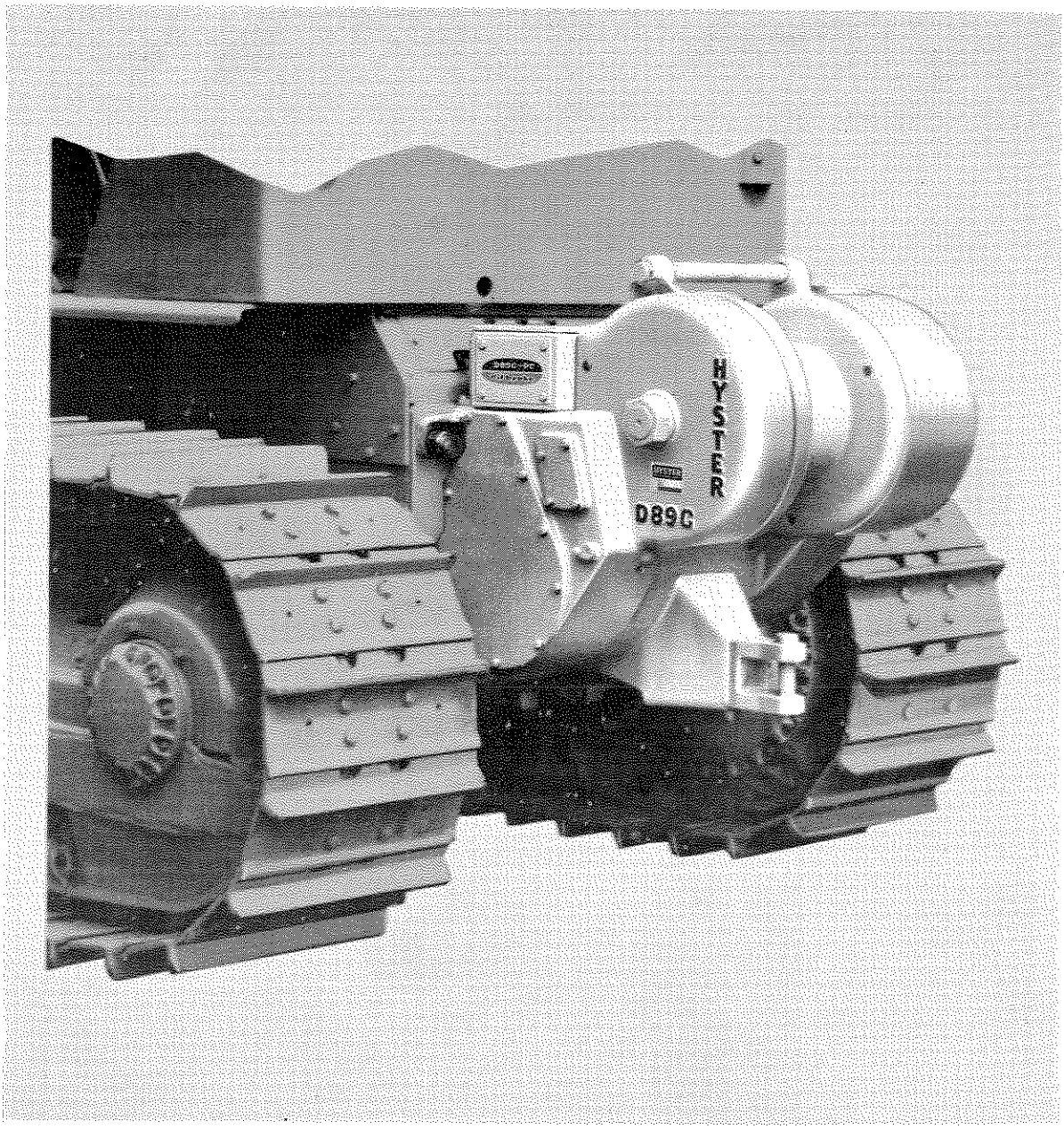
INTRODUCTION

This Service Manual contains operation, maintenance and repair instructions for the D89C Power Controlled Towing Winch. Instructions are also included for removal and installation of the winch on the tractor. Specification tables are provided which contain winch design data. Complete physical and functional descriptions of the winch are given to aid the repairman in understanding the operation of the winch and its subassemblies.



SPECIFICATIONS & DESCRIPTIONS

1-1. SPECIFICATIONS.

1-2. Specifications for the D89C Power Controlled Towing Winch are given in Tables 1-1 through 1-5.

1-3. SERIAL NUMBER DATA. (See Figure 1-1.)

1-4. The nameplate is located on the left-hand side of the winch frame and contains the Serial Number, Model Number and Special Application Data. The serial number is also stamped just above the nameplate. The serial number indicates the design series, manufacturing plant, serial number and year manufactured. A typical serial number designates the following:

Example:	C68	P	0000	M
	(1)	(2)	(3)	(4)

(1) The first letter and number denote the design series and model of the unit. In the example, C68 denotes the D89C Power Controlled winch series.

(2) The second letter (P) denotes the plant at which the unit was manufactured. The following letters have been assigned to the various manufacturing plants.

A. Scotland	G. Belgium	R. Ipswich
B. Tacoma	H. South Africa	S. Australia
C. Kewanee	J. Africa	T. Canada
D. Danville	L. Peoria	Y. Brazil
E. Nijmegen	N. New Zealand	
F. France	P. Portland	

(3) The number series designates the unit serial number.

(4) The final letter designates the year of unit manufacture, starting with the letter "A" indicating 1957. The letters I, O, and Q are not used.

TABLE 1-1. COMPONENT SPECIFICATIONS (Sheet 1 of 4)

ITEM	DESIGN DATA		REFERENCE FIGURE
	Std-Speed	Lo-Speed	
GEAR RATIOS			
Forward	46 to 1	83.6 to 1	
Reverse	21.7 to 1	28.4 to 1	
NUMBER OF GEAR TEETH			
PTO Shaft Bevel Gear	21	21	5-3
Bevel Gear Shaft:			
Bevel Gear	41	41	5-5, Sheet 3
2nd Reduction Pinion - Forward	24	19	5-5, Sheet 3
2nd Reduction Pinion - Reverse	17	17	5-5, Sheet 3
Brake Shaft:			
2nd Reduction Pinion	17	17	5-7, Step 4
2nd Reduction Driven Gear	51	56	5-7, Step 3
Intermediate Shaft:			
Intermediate Driven Gear	48	48	5-8, Step 3
Intermediate Pinion	14	14	5-8, Step 4
Drum Gear	55	55	5-9, Step 7
DRUM			5-9, Step 10
Barrel Diameter	14	9-1/4	
Barrel Length	10-3/4	10-3/4	
Flange Diameter	25	25	

TABLE 1-1. COMPONENT SPECIFICATIONS (Sheet 2 of 4)

ITEM	DESIGN DATA		REFERENCE FIGURE
	Std-Speed	Lo-Speed	
DRUM (Cont.)			
LH Seal Bore Diameter	7.002 - 7.004	7.002 - 7.004	5-9, Step 11
Bearing Bore Diameter	7.002 - 7.004	7.002 - 7.004	5-9, Step 11
Cable Capacity (Allow for loose or unevenly spooled cable):			
7/8-Inch	355	406	
1-Inch	275	345	
1-1/8 Inch	220	276	
1-1/4 Inch	175	220	
Ferrule Sizes	J7 (7/8-In.), J8 (1-In.), J9 (1-1/8 In.), J10 (1-1/4-In.) Drill out J10 ferrule for 1-3/8 Inch cable.		
DRUM SHAFT ASSEMBLY			
Shaft:			
Bearing Journal Diameter (RH and LH Side)	4.4990 - 4.5005		5-9, Step 5
Retainer Journal Diameter	4.373 - 4.375		5-9, Step 5
Gear Bore Diameter	7.002 - 7.004		5-9, Step 7
Outer Retainer:			
Bore Diameter	4.377 - 4.380		5-9, Step 2
Pilot Diameter	11.061 - 11.063		5-9, Step 2
PTO SHAFT AND CARRIER			
Shaft:			
Bearing Journal Diameter	2.5586 - 2.5595		5-3
Seal Journal (Spacer) Diameter	2.995 - 3.005		5-3
Carrier:			
Bearing Bore Diameter	4.001 - 4.005		5-3
Pilot Diameter	6.746 - 6.749		5-3
BEVEL GEAR SHAFT ASSEMBLY			
Shaft:			
LH and RH Bearing Journal Diameter	2.3746 - 2.3751		5-5, Step 13
Seal Ring Groove Width	0.125 - 0.133		5-5, Step 3
Seal Ring Groove Diameter	1.329 - 1.333		5-5, Step 3
Seal Ring:			5-5, Step 3
Type	Locked Joint		
Thickness	0.0925 - 0.0935		
Spacers:			5-5, Sheet 3 of 3
Long Spacer:			
Length	3.808 - 3.813		
Both Ends Parallel Within	0.002		
Short Spacer:			
Length	2.685		
Both Ends Parallel Within	0.002		

TABLE 1-1. COMPONENT SPECIFICATIONS (Sheet 3 of 4)

ITEM	DESIGN DATA	REFERENCE FIGURE
BEVEL GEAR SHAFT ASSEMBLY (Cont.)		
Spacers (Cont.):		
Center Bearing Carrier:		5-5, Step 15
Bearing Seat	3.3465 - 3.3472	
Number of Teeth	17	
Overall Length	2-25/32	
Both Ends Parallel Within	0.002	
LH Bearing Retainer:		5-5, Step 1
Seal Ring Bore Diameter	1.500 - 1.505	
Bearing Cup Bore Diameter	4.8750 - 4.8760	
Pilot Diameter	6.747 - 6.749	
RH Bearing Retainer:		5-5, Step 2
Seal Ring Bore Diameter	1.500 - 1.505	
Bearing Cup Bore Diameter	4.8750 - 4.8760	
Pilot Diameter	5.997 - 5.999	
Shaft Preload	0.000 - 0.004	5-19, Sheet 4 of 4
Bevel Gear Backlash	0.006 - 0.014	5-19, Sheet 4 of 4
BRAKE SHAFT ASSEMBLY		
Shaft:		5-7
RH Bearing Journal Diameter	2.5000 - 2.5010	
LH Bearing Journal Diameter	3.0000 - 3.0010	
Shaft Endplay	0.006 - 0.009	5-18, Step 6
INTERMEDIATE SHAFT ASSEMBLY		
Bearing Journal Diameter	2.750 - 2.751	5-8, Step 2
Shaft Endplay	0.004 - 0.007	5-17, Step 4
TRANSMISSION HOUSING		
Bore Diameters:		5-9
PTO Shaft Bearing Retainer	7.000 - 7.002	
Bevel Gear Shaft Tapered Bearing Retainer	6.750 - 6.752	
Ball Bearing Bore (Bevel Gear Shaft Bearing)	5.9053 - 5.9067	
Brake Shaft Bearing Retainer	5.5130 - 5.5145	
Drum Shaft Bore	4.377 - 4.380	
RIGHT-HAND SIDE FRAME		
Bore Diameters:		5-9
Bevel Gear Shaft Tapered Roller Bearing Retainer	6.000 - 6.002	
Ball Bearing (Bevel Gear Shaft Bearing)	5.9053 - 5.9067	
Drum Shaft Outer Retainer	11.065 - 11.070	
Intermediate Shaft Bearing	6.6260 - 6.6270	
Brake Shaft Bearing Retainer	5.9100 - 5.9110	
Drum Seal	10.998 - 11.002	
OIL CLUTCH ASSEMBLY		
Piston:		5-6, Step 7
Outside Diameter	9.996 - 9.998	
Inside Diameter	6.000 - 6.002	

TABLE 1-1. COMPONENT SPECIFICATIONS (Sheet 4 of 4)

ITEM	DESIGN DATA	REFERENCE FIGURE
OIL CLUTCH ASSEMBLY (Cont.)		
Piston Housing:		5-6, Step 7
Piston Bore:		
Large Diameter	10.006 - 10.008	
Inside Diameter	3.626 - 3.628	
Hub - Small Diameter	3.623 - 3.635	5-6, Step 5
Friction Disc:		5-6, Step 4
Overall Width	0.122 - 0.128	
Friction Material Thickness	0.275 - 0.365	
Separator Plates:		5-6, Step 4
Width	0.080 - 0.084	
Dish	0.020 - 0.030	
Cooling Oil Valve Spring:		5-6, Step 6
Free Length	2-11/16	
Pressure at Two Inches	11.0 Oz.	
Disc to Plate Clearance	0.065 - 0.125	
OIL BRAKE ASSEMBLY		
Brake Apply Spring:		5-4, Step 3
Dish	0.325 - 0.335	
Pressure at 1/4-Inch Deflection	8000 - 9750 Lbs.	
Piston:		5-4, Step 11
Outside Diameter	12.246 - 12.248	
Inside Diameter	4.255 - 4.260	
Piston Housing:		5-4, Step, 11
Piston Bore:		
Large Diameter	12.253 - 12.255	
Small Diameter	4.243 - 4.246	
Inside Diameter	3.015 - 3.020	
Push Rod:		5-4, Step 5
Diameter	0.373 - 0.375	
Length	3.422 - 3.425	
Friction Discs:		5-4, Step 4
Overall Width	0.122 - 0.128	
Friction Material Thickness	0.0275 - 0.0365	
Separator Plates:		5-4, Step 4
Width	0.080 - 0.084	
Dish	0.020 - 0.030	

TABLE 1-2. HYDRAULIC SPECIFICATIONS (Sheet 1 of 2)

ITEM	DESIGN DATA	REFERENCE FIGURE
CONTROL VALVE		
High Pressure Relief	225 (±10) PSI	
Cooling Oil Pressure	3 - 10 PSI	
FILTERS		
Pressure	25 - Micron Cartridge	4-2
Suction	50 - Mesh Screen	4-3

TABLE 1-2. HYDRAULIC SPECIFICATIONS (Sheet 2 of 2)

ITEM	DESIGN DATA	REFERENCE FIGURE
OIL Capacity Type	 22 Gals. SAE10, MIL-L-2104B NOTE: Series 3 oil may be substituted for MIL-L-2104B.	4-1
PUMP OUTPUT NOTE: Pump output is given at tractor engine RPM. On D8 Tractors: At 500 RPM At 1200 RPM On D9 Tractors: At 500 RPM At 1280 RPM	 7 GPM 18 GPM 7 GPM 18 GPM	

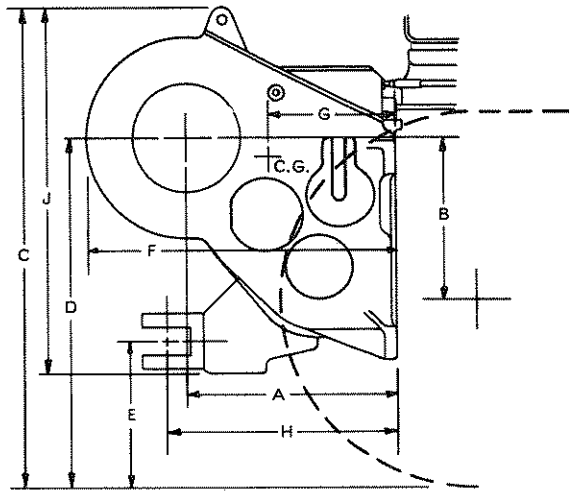
TABLE 1-3. TORQUE SPECIFICATIONS

ITEM	DESIGN DATA	REFERENCE FIGURE
NOTE: All torque values are given in foot-pounds and with threads lubricated.		
DRUM SHAFT ASSEMBLY Bearing Retainer Capscrews (RH Side) Drum Gear-to-Drum	 75 146	 5-16, Step 15 5-16, Step 12
PTO SHAFT ASSEMBLY Retainer Capscrews	 75	 5-19, Step 17
BEVEL GEAR SHAFT ASSEMBLY Bearing Retainer Capscrews: LH Side RH Side Bearing Locknut	 75 75 200 (±25)	5-19 5-19, Step 15
INTERMEDIATE SHAFT ASSEMBLY Bearing Retainer Capscrews (RH Side)	 75	 5-17, Step 4
BRAKE SHAFT ASSEMBLY Oil Brake Cover Nuts Brake Compartment Cover Capscrews	 200 Lubed w/G-8 nuts 75	 5-20, Step 12
CONTROL VALVE MOUNTING CAPSCREWS	15	5-2, Step 5

TABLE 1-4. DIMENSION AND WEIGHT SPECIFICATIONS

DIMENSION	INCHES (To Nearest 1/8-Inch)
A	25-5/8
B	28-1/4
C	68-1/8
D	51-7/8
E	26-3/8
F	38-1/8
G	14
H	29-1/4
J	38

WEIGHT
3810 Lbs.



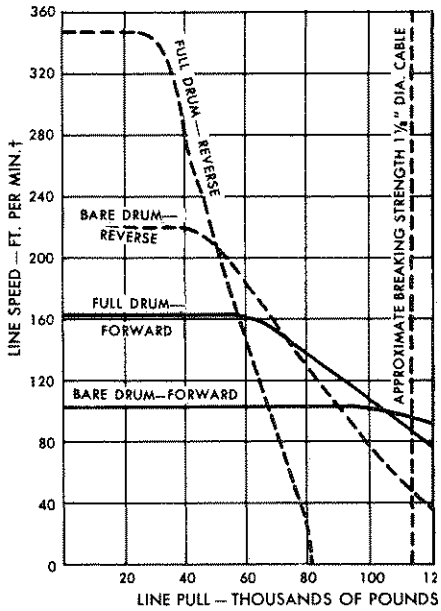
1-5. PHYSICAL DESCRIPTION.

1-6. Towing Winch. (See Figure 1-1.)

1-7. The D89C Towing Winch is manufactured as a power controlled winch only. The D89C winch can be mounted on direct drive, torque converter and power shift tractors equipped with a constant running power take-off (PTO). The winch consists of an intermediate shaft assembly, brake shaft assembly, bevel gear shaft assembly, drum and drum shaft assembly, two oil clutch assemblies and an oil brake assembly mounted inside of a two-piece housing. The intermediate shaft assembly is mounted in the right-hand section of the housing and is accessible by removing the top, right-hand cover plate. The brake shaft assembly is located in the bottom, center section of the housing and extends across the full width of the housing. The oil brake assembly is located on the left-hand end of the brake shaft and is accessible by removing the left-hand side cover. The bevel shaft assembly is located directly above the brake shaft assembly and also extends across the entire width of the housing. An oil clutch assembly is mounted on each end of the bevel gear shaft. When locked-up, the left-hand oil clutch rotates the winch gear train in a direction that will cause the drum to haul-in line. The oil clutch mounted on the right-hand end of the shaft rotates the gear train in a direction that will cause the drum to pay-out line. The bevel gear shaft components are accessible by removing the suction manifold and cover. A PTO shaft assembly extends through the forward, center section of the winch housing. A spiral bevel pinion on the PTO shaft mates with a spiral bevel gear on the bevel gear shaft to rotate the bevel gear shaft during operation of the tractor. The two sections of the winch housing can be separated by removing the seven 3/4 UNF x 1-3/4 inch capscrews that hold the two sections together. The winch is manufactured for either lo-speed or standard-speed drum rotation. The speeds are determined by the number of teeth on the PTO shaft spiral bevel pinion, bevel gear shaft spiral bevel gear, large brakeshaft gear and the forward clutch spider gear.

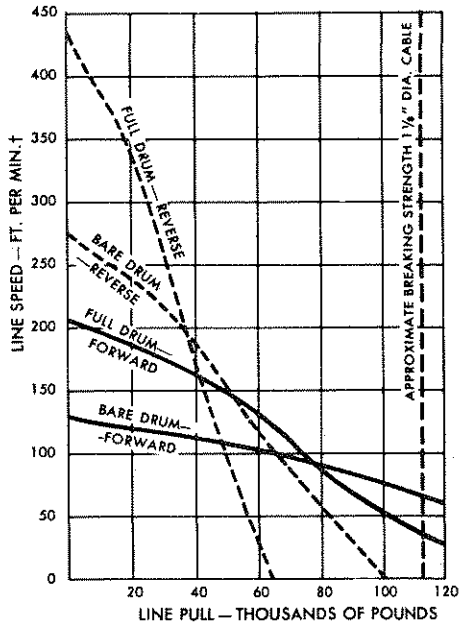
1-8. WINCH GEAR TRAIN. (See Figure 1-2.) The PTO shaft assembly, bevel gear shaft assembly, brake shaft assembly, intermediate shaft assembly, drum and drum shaft assembly and the two oil clutch assemblies form the winch gear train. The PTO shaft assembly used on the lo-speed winch is an integral assembly with the spiral bevel pinion and shaft machined as one component. On the standard-speed winch, the spiral bevel pinion is splined to the PTO shaft and is locked in place by means of a snap ring. The bevel gear shaft assembly consists primarily of a spiral bevel gear, two spacers and two oil clutch assemblies mounted on a common shaft. The bevel gear shaft is center-drilled on each end and cross-drilled at the clutch assembly locations to allow oil under pressure to flow to the clutches. The shaft is also cross-drilled at the roller bearing locations to allow oil to flow to the bearings. A cast iron seal ring on each end of the shaft prevents this pressurized oil from escaping between the bearing retainers and the shaft ends. Roller bearings allow the clutch spider gears to rotate independently of the bevel gear shaft. The brake shaft assembly rotates on two single taper roller bearings (one on each end of the shaft). The brake shaft transfers torque to the intermediate shaft gear when the unit is in forward and prevents the gear train from rotating when the oil brake is

D89C POWER CONTROLLED



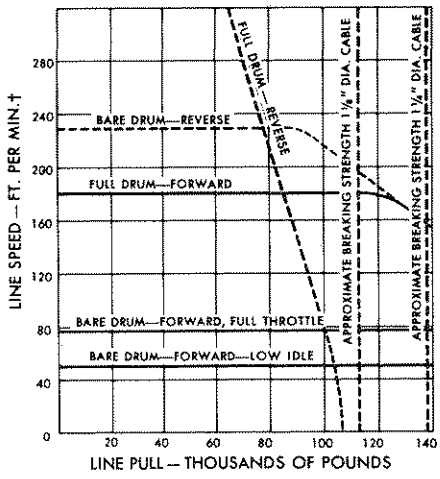
Winch performance on D9, Series G, Power Shift Tractor, and 594 Pipelayer, 385 HP (at flywheel) at 1330 RPM using 1-1/8-inch cable.

†Lower line speeds can be obtained by decreasing throttle.

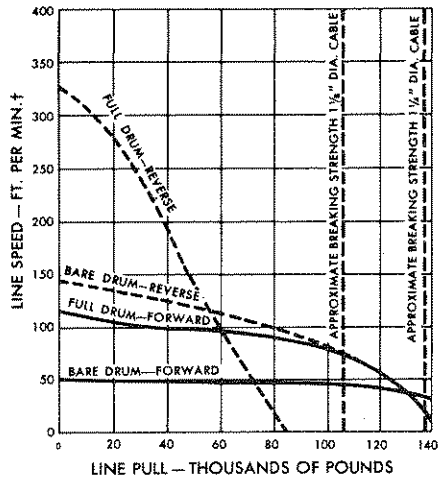


Winch performance on D8, Series H, Power Shift Tractor, and 583 Pipelayer, 270 HP (at flywheel) at 1280 RPM, using 1-1/8-inch cable.

D89C POWER CONTROLLED LO-SPEED

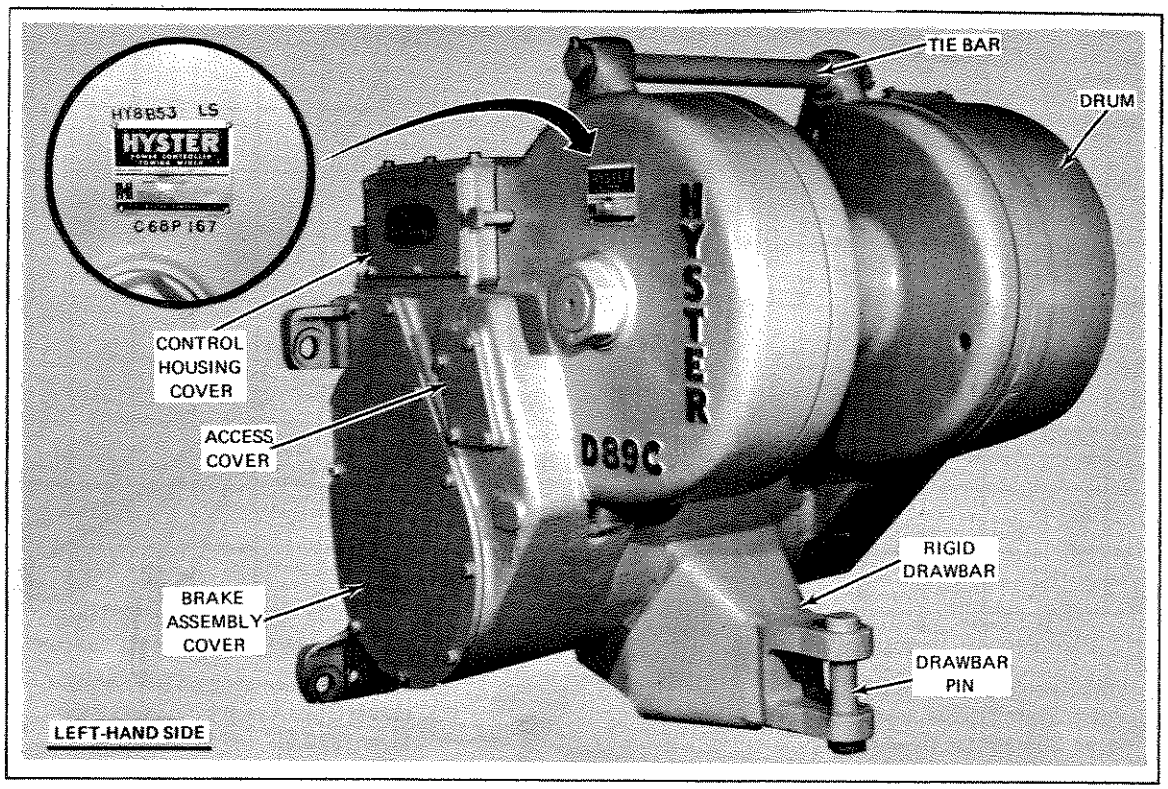


Winch performance on D9, Series G, Power Shift Tractor, and 594 Pipelayer, 385 HP (at flywheel) at 1330 RPM using 1-1/8-inch cable.



Winch performance on D8, Series H, Power Shift Tractor, and 583 Pipelayer 270 HP (at flywheel) at 1280 RPM using 1-1/8-inch cable.

NOTE: Winches will develop line pulls beyond breaking strength of any practical size cable. Cable size should conform to all safety regulations applicable to job.



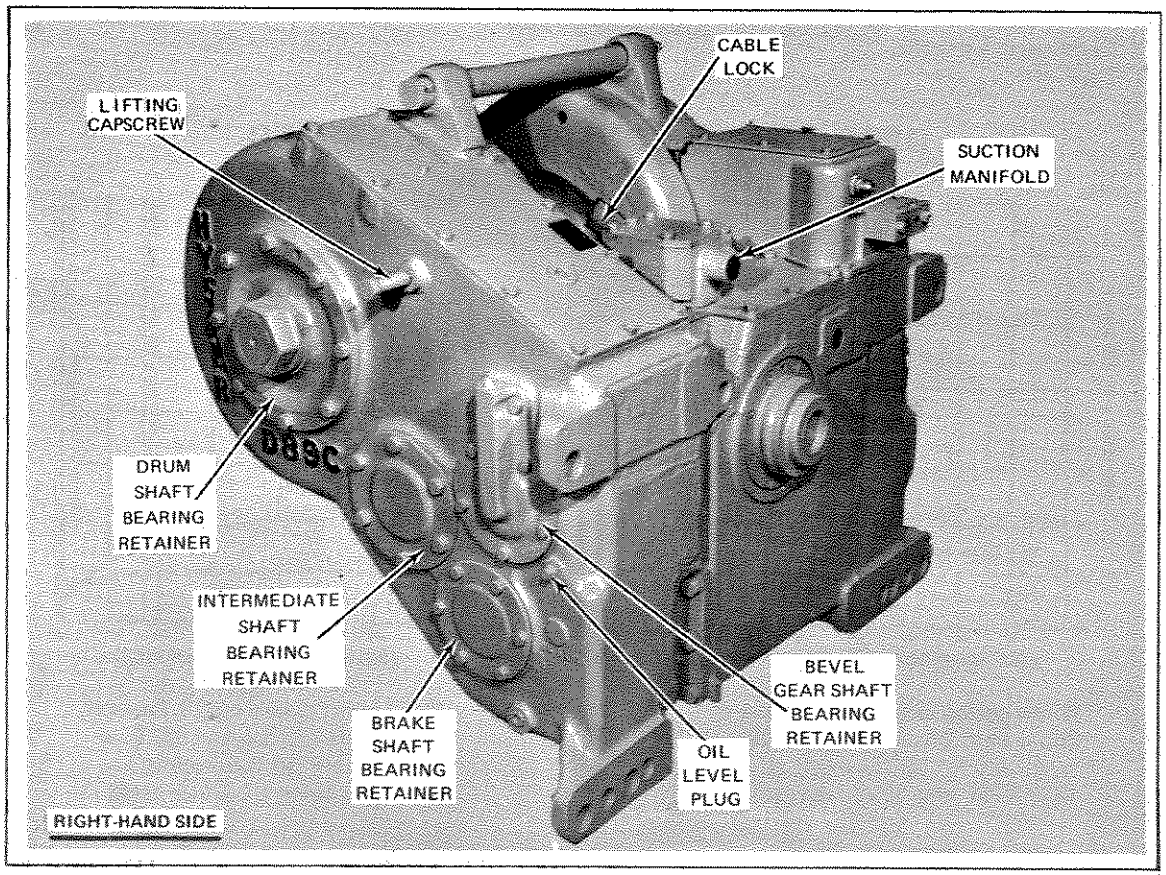


Figure 1-1. D89C Power Controlled Towing Winch

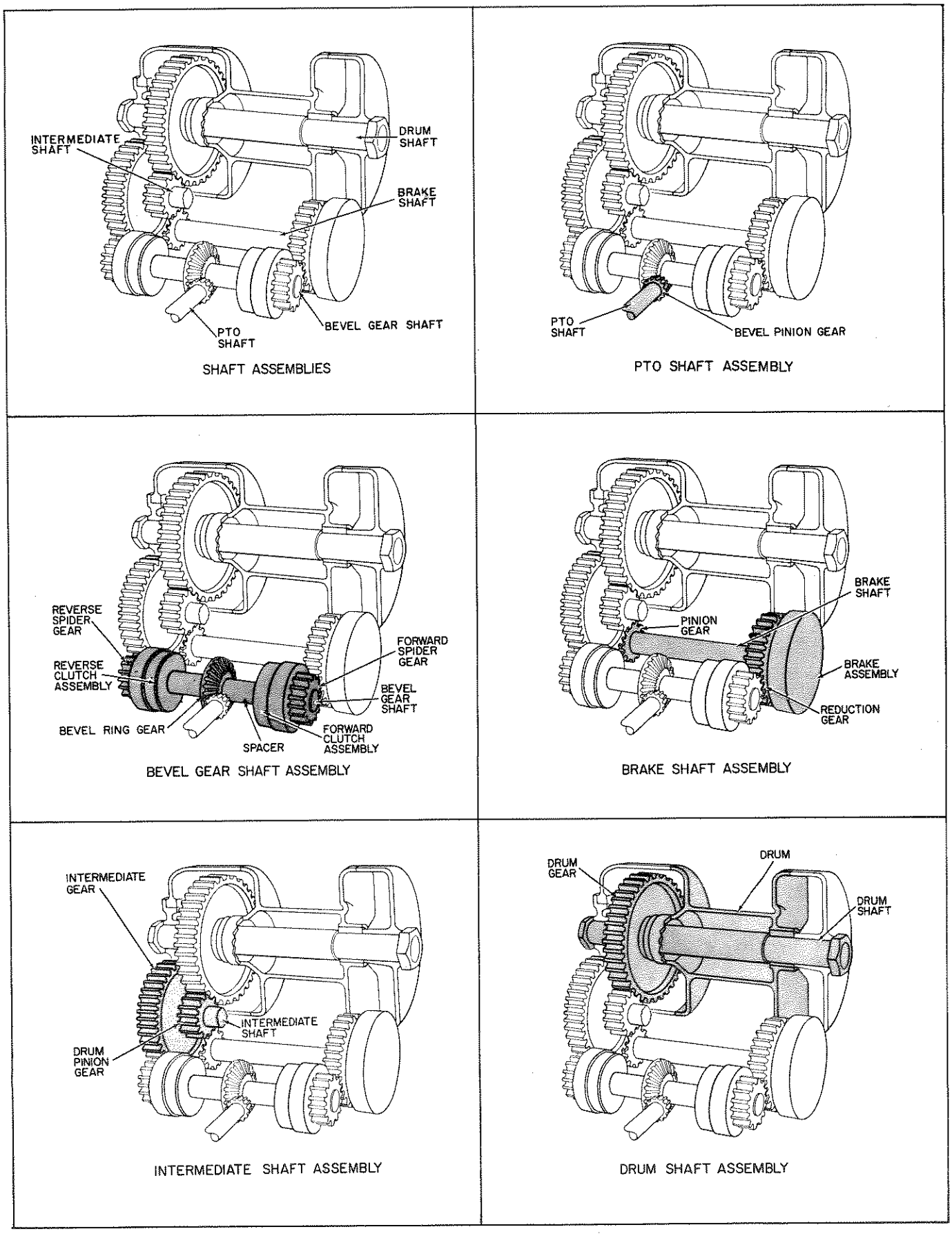


Figure 1-2. Winch Gear Train

applied. The intermediate shaft assembly contains a large intermediate gear and a smaller drum pinion gear that are splined together on the shaft between two taper roller bearings. The intermediate shaft is rotated by the right-hand (reverse) oil clutch when the unit is in reverse, brake released. The intermediate pinion gear is in constant mesh with the large drum gear and therefore, turns the drum gear when the remainder of the gear train is turning. The drum shaft is fastened to the winch housing and therefore DOES NOT ROTATE. The drum gear is bolted and splined to an adapter plate that is bolted to the drum. This allows the drum adapter plate, drum gear and drum to rotate on the stationary drum shaft. All gear train gears are heat-treated to provide maximum service life.

1-9. OIL BRAKE ASSEMBLY. (See Figure 1-3.) The oil brake assembly consists of a cover, two belleville springs, thrust ring, multiple disc assembly, hub, cage, pressure plate, piston and piston housing. The multiple disc assembly consists of ten separator plates and eleven friction discs placed alternately on the hub. The separator plates are dished and have internal teeth. These teeth mate with the external splines on the hub. The hub also has internal splines and rotates with the brakeshaft. Since the separator plates are splined to the hub, they must also rotate with the brake shaft. The friction discs have external teeth. These teeth mate with the internal splines on the cage. The cage is bolted to the winch housing; therefore, the friction discs must remain stationary at all times. The brake assembly is spring-applied (by the belleville springs) and hydraulically-released (by the piston and pushpins). When the brake is released, the separator plates rotate freely between the friction discs and offer very little resistance to the rotation of the brake shaft. To release the brake, hydraulic oil (under pressure) is forced into the cavity between the piston and piston housing. This forces the piston against the pushpins inserted through the cage. The pushpins then force the thrust ring and belleville springs away from the multiple disc assembly, allowing the separator plates to rotate freely between the friction discs. The brake is applied by removing the hydraulic pressure. This allows the belleville springs to expand, forcing the thrust ring against the multiple disc assembly. This compresses the separator plates

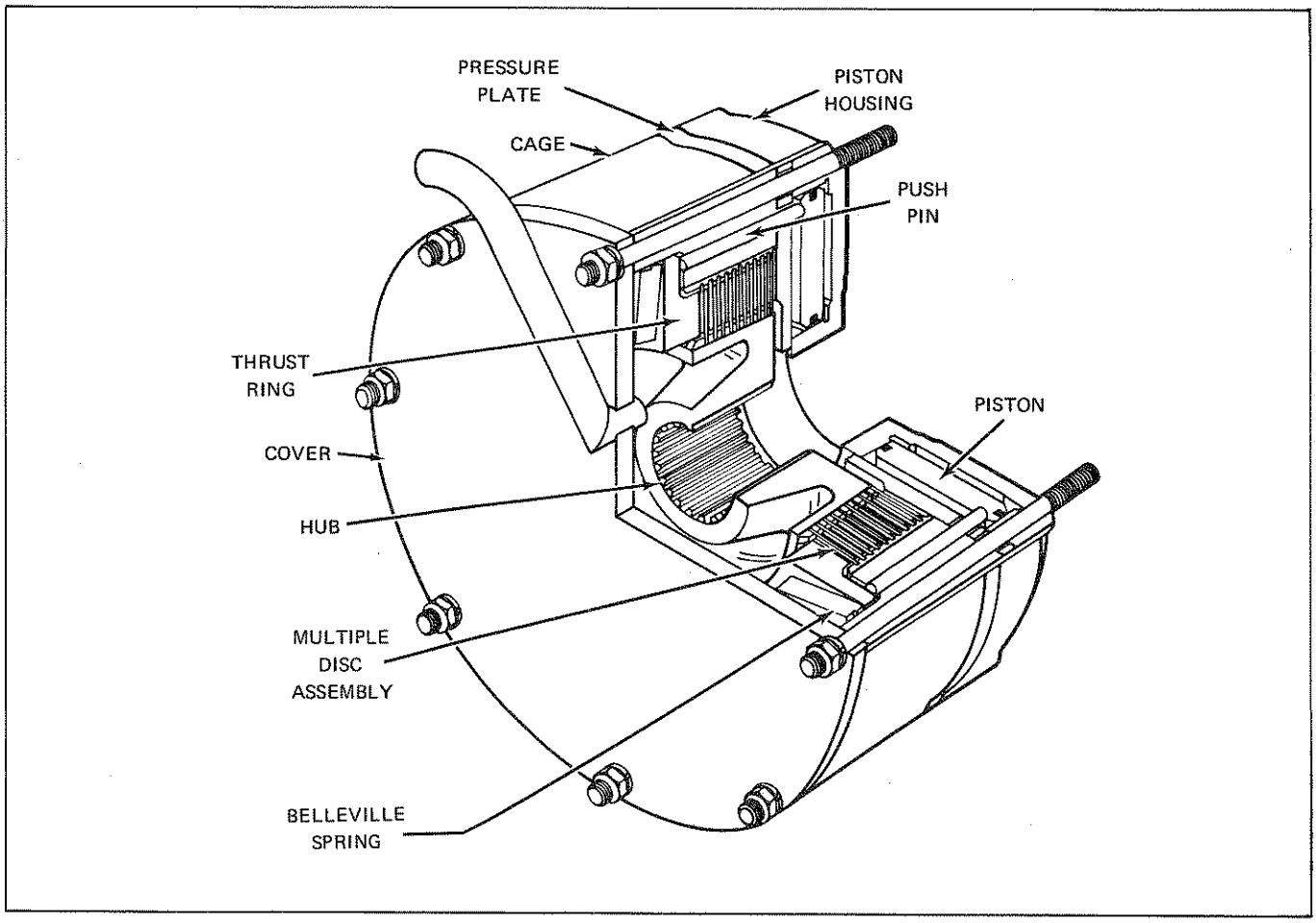


Figure 1-3. Oil Brake Assembly, Location of Components

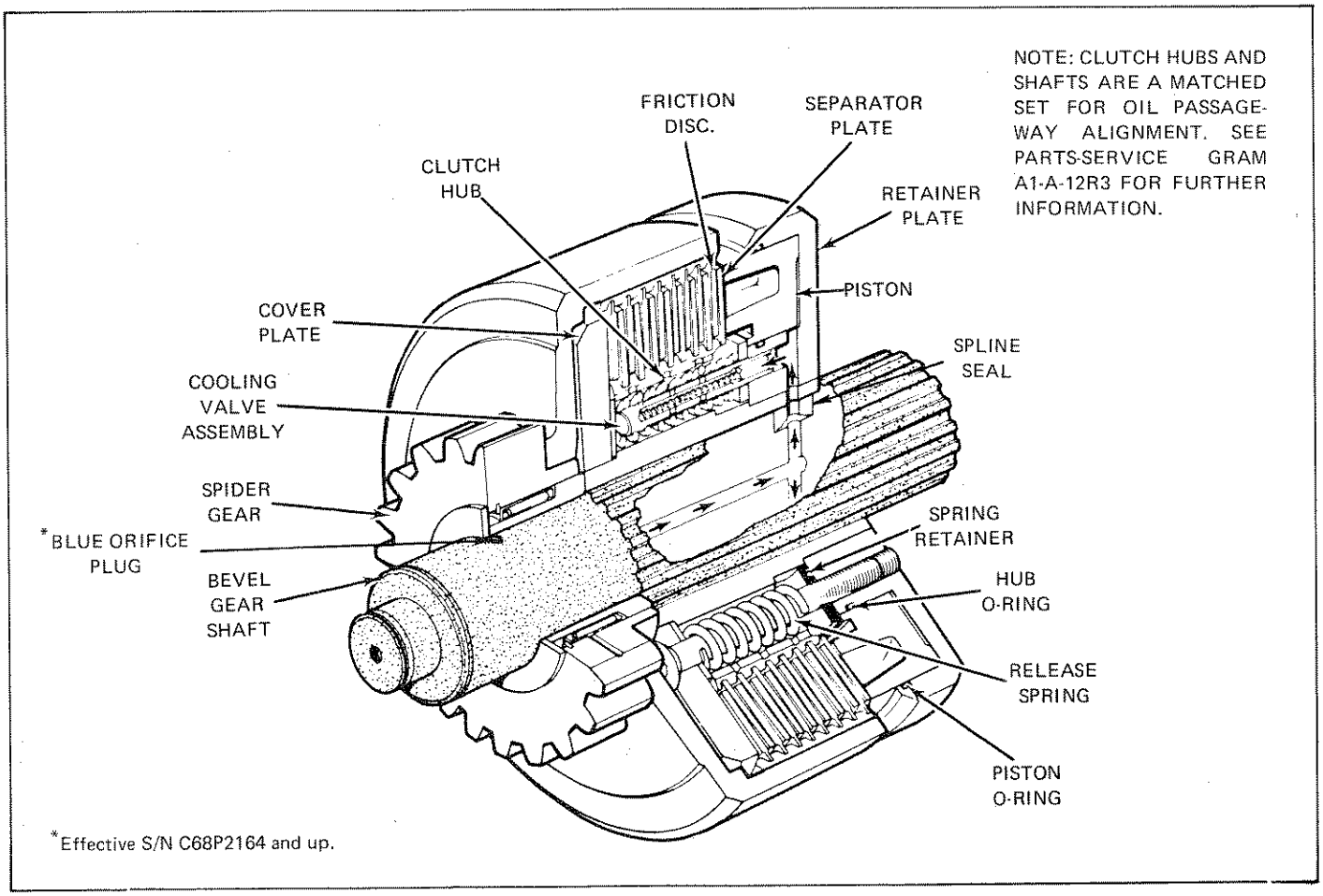


Figure 1-4. Oil Clutch Assembly, Location of Components

against the friction discs which stops rotation of the separator plates which then stops (locks-up) the brake shaft.

1-10. OIL CLUTCH ASSEMBLY. (See figure 1-4.) The oil clutch assembly consists of a piston retainer plate, clutch piston, eight friction discs, eight separator plates, cooling oil valve assembly, clutch hub, eight release springs and a cover plate. The clutch piston is installed inside of the retainer plate and is sealed by two O-rings. The body of the cooling oil valve is externally threaded and is inserted through one of the retainer bores and screwed into the retainer plate. The clutch hub is installed over the cooling oil valve and rests on the retainer plate. The hub is internally splined to mate with the bevel gear shaft and is externally splined to mate with the eight separator plates. The eight separator plates and friction discs are alternately mounted over the external splines of the clutch hub. The separator plates are dished and have internal teeth that mate with the external splines of the clutch hub. The separator plates must therefore rotate with the hub during operation of the clutch assembly. The friction discs are sintered bronze discs having external teeth. These teeth mate with the internal splines of a spider gear that is positioned over all discs during final assembly. The friction discs rotate with the spider gear. The eight release springs are installed into the eight bores in the clutch hub. During clutch operation, pressurized oil flows into a cavity between the clutch piston and retainer plate. The oil forces the clutch piston away from the retainer plate and compresses the separator plates against the friction discs. The separator plates are always rotating with the bevel gear shaft during operation of the winch. Compressing the separator plates against the friction discs causes the friction discs to rotate. The friction discs are externally splined to the spider gear and therefore rotate the spider gear. Depending upon the clutch assembly, the spider gear then transfers torque to either the intermediate pinion or brake shaft pinion gear. When the pressurized oil is removed, the six release springs force the separator plates in the opposite direction, which releases the friction discs. At this time, the spider gear stops because the friction discs are no longer rotating. When the clutch assembly is locked-up (separator plates and friction discs compressed), cooling oil flows through the cooling oil valve to lubricate and cool the discs.

1-11. CONTROL VALVE ASSEMBLY. (See Figure 1-5.) The control valve assembly consists primarily of a valve body, relief valve assembly, inching spool assembly and selector spool assembly. The valve body is an open center design; however, the system is a closed one. Passages within the valve body connect the spool bores with inlet, forward, reverse, brake and outlet ports. Actuating the spools connects these passages to obtain the desired hydraulic oil flow (refer to paragraph 1-21). The relief valve assembly consists of a poppet assembly, poppet spring, poppet seat, pilot valve, pilot spring and relief pressure adjusting screw. The pressure adjusting screw determines the spring tension applied to the pilot valve. The pilot valve regulates the hydraulic system maximum pressure. This pilot-operated feature assures nearly constant pressure regulation over the full flow range of the pump. The inching spool assembly consists primarily of an inching spool (D9), retainers, neutral return spring, locking screw, O-rings and cap assembly. The selector spool assembly consists primarily of a selector spool (D23), detent assembly, retainers, neutral return spring, snap ring, O-rings and cap assembly. The spool caps are NOT interchangeable. The O-rings prevent escape of oil and entry of contaminants between the spools and valve body. Each spool is connected to the handling gear, in the tractor operator's compartment, by separate push-pull cables.

NOTE: The spool stamped D-20 was used on earlier production units. The spool stamped D-23 is

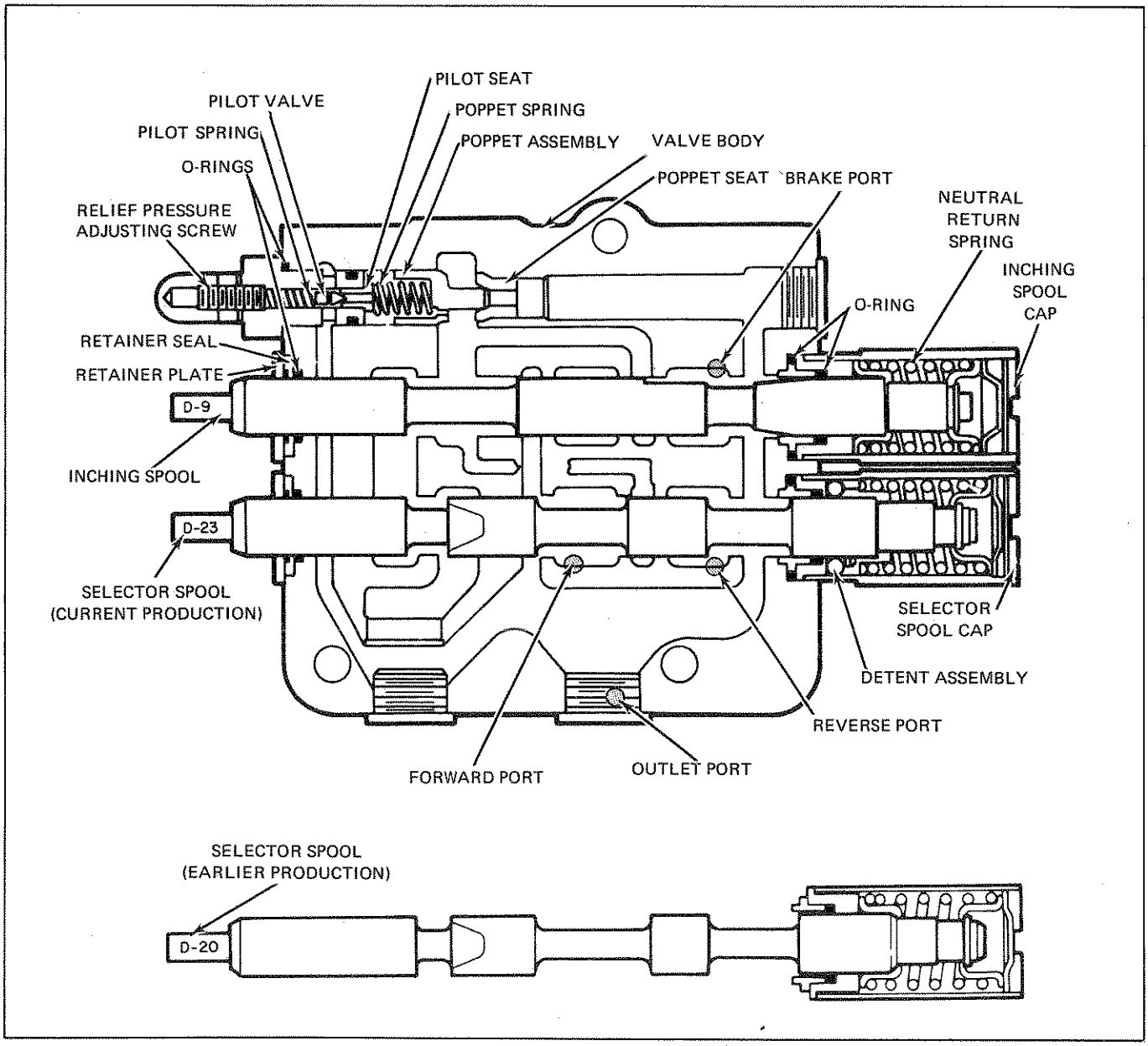


Figure 1-5. Control Valve Assembly, Location of Components

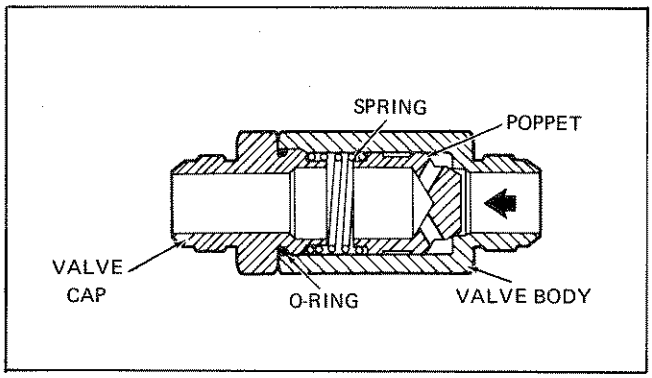


Figure 1-6. Cooling Oil Relief Valve Assembly

used on current production units. These spool assemblies ARE interchangeable; however, the spools cannot be changed without cable adjustments (refer to Section 4).

1-12. COOLING OIL RELIEF VALVE ASSEMBLY. (See Figure 1-6.) The cooling oil relief valve consists of a valve body, valve cap, O-ring, spring and poppet. The valve body end screws directly into the outlet port of the control valve assembly. This valve assembly is a simple poppet and spring type relief valve. It regulates the hydraulic system cooling oil pressure.

1-13. Hydraulic Pump Assembly. (See Figure 1-7.)

1-14. The hydraulic pump assembly is a positive displacement, external gear pump that supplies the hydraulic energy necessary for operation of the winch. The hydraulic pump consists primarily of a drive gear, driven gear and four bearings mounted inside of a cast aluminum body. A cover is attached to each end of the pump body to retain the gears and bearings and to provide the necessary porting for proper pump operation. Each of the two pump gears are mounted between two bearings. The shaft of the drive gear extends through the bore in the front cover assembly and is sealed by an oil seal pressed into the cover bore. The teeth of the drive gear mate with the teeth of the driven gear. The drive gear is driven externally by an auxiliary power take-off at the tractor engine. The pump inlet and outlet ports are located in the rear cover in most applications. On the 572-E and 583-H pipelayers, the inlet and outlet ports are located on the sides of the pump body. The inlet port is connected, through a hose assembly, to the winch intake manifold. The outlet port is connected through a hose assembly to the pressure filter assembly, then through another hose assembly to the winch control valve assembly. Oil drawn into the inlet port is carried to the outlet port in pumping chambers

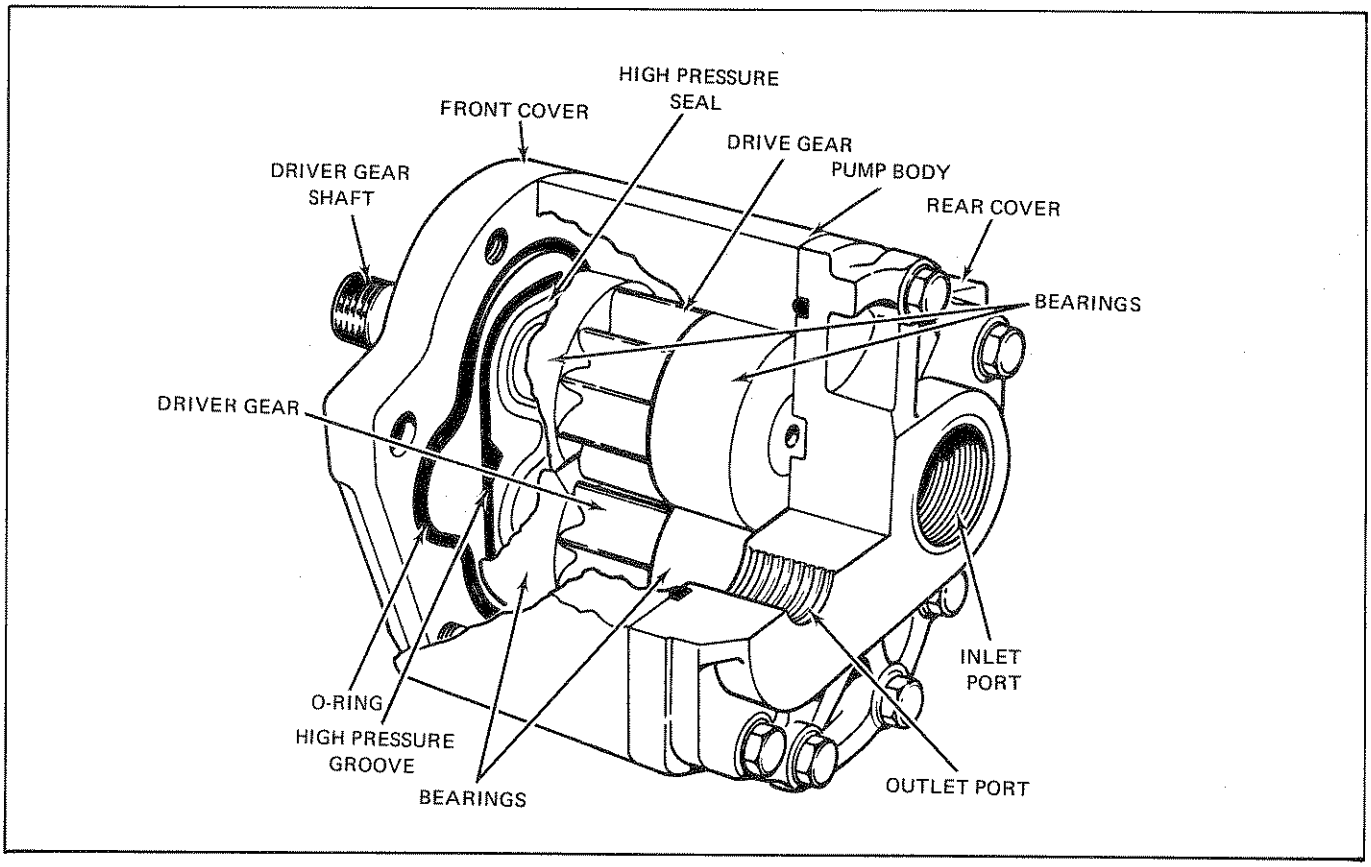


Figure 1-7. Hydraulic Pump Assembly, Location of Components

formed between the gear teeth and pump housing. As the gear teeth mesh, the oil must flow toward the outlet port and cannot reverse its flow through the gear teeth. A "U"-shaped groove in the front cover directs high-pressure oil to the bearing faces. This forces the bearings against the pump gears to provide a stabilized output. Without this groove, the bearings tend to drift outward from the gear faces, causing a fluxuation in the pump output volume.

1-15. Handling Gear.

1-16. EARLIER PRODUCTION HANDLING GEAR. (See Figure 1-8.) The handling gear used to control earlier production winches consists of a housing, control lever, selector lever, oil pressure gauge and handlever gate assembly. The handling gear is mounted on the right-hand side of the operator's seat (for most applications) and is connected to the winch control valve by two teflon-lined push-pull cables. The control lever is the short lever mounted in the front, right-hand corner of the housing and determines one of two shift patterns for the selector lever. The selector lever is mounted to the handlever gate assembly and operates within one of the two shift patterns to control the winch brake and clutch operation. The oil pressure gauge is mounted directly behind the selector lever and indicates brake release pressure.

1-17. CURRENT PRODUCTION HANDLING GEAR. (See Figure 1-8.) The handling gear used to control current production winches consists of a housing, inching lever, selector lever, oil pressure gauge and an inching stop latch. The major change from the earlier design is that the push-pull cables are no longer linked together through the handlever gate assembly. The selector and inching levers on the current production handling gear are positioned independently of each other. The inching lever, which is spring-loaded to the Brake-On position, has an inching stop latch to lock it in the Brake-Off position. The selector lever is mounted parallel to the inching lever and controls winch clutch and brake operation. The handling gear is normally mounted at the right-hand side of the operator's seat; however, on some applications, the handling gear is mounted on the left-hand side of the operator's seat.

1-17A. OPTIONAL PRODUCTION HANDLING GEAR. (See Figure 1-8.) This option is for applications where close control of line speed is not required. The selector lever is the only lever used to control winch clutch and brake operation. The detent that holds the selector lever in the Brake-Off position is removed, requiring the operator to hold the lever in this position. The inching lever is removed from the control housing. The inching spool in the control valve is locked in the Brake-Off (normal operating) position with a spacer.

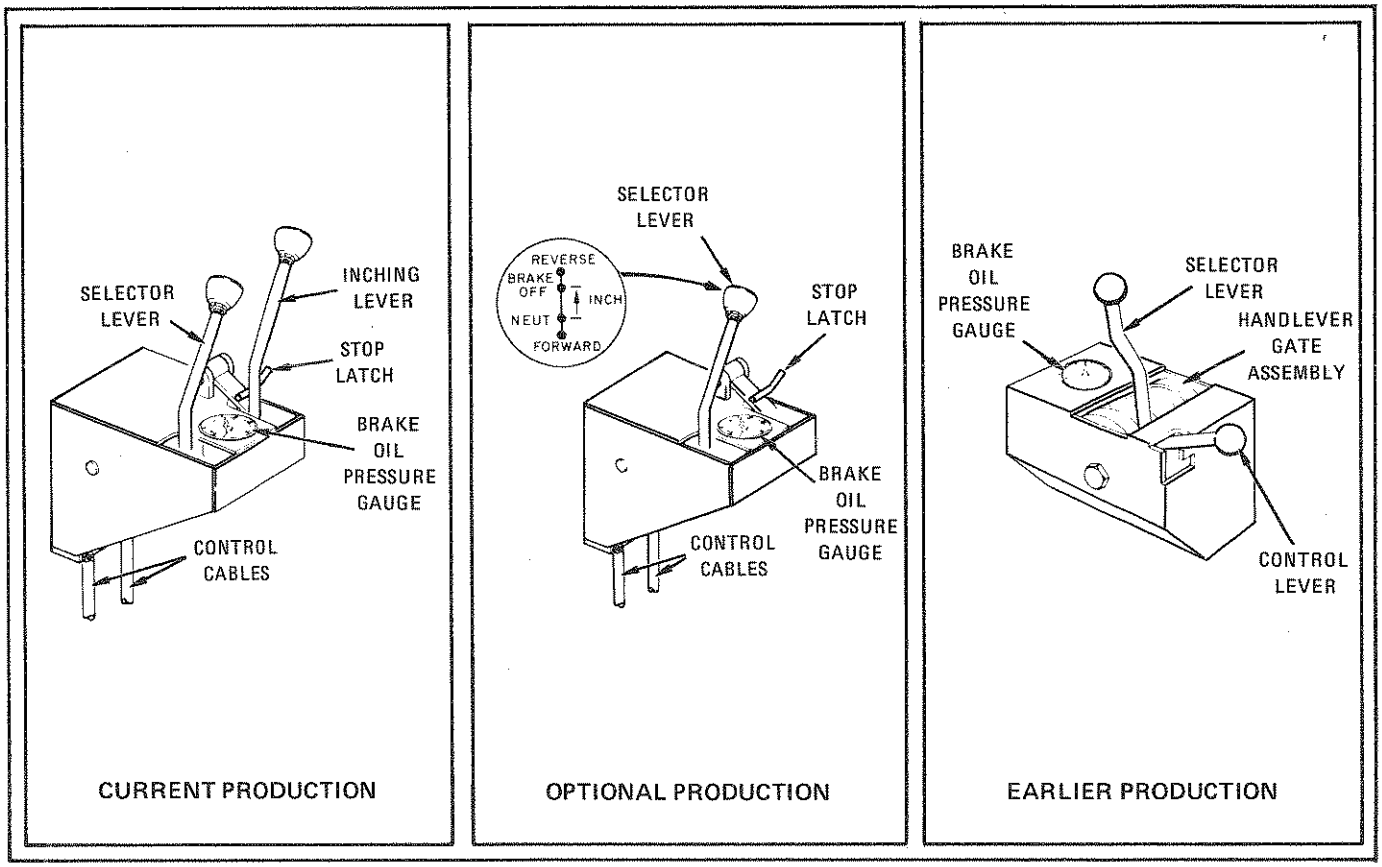


Figure 1-8. Handling Gear, Location of Components

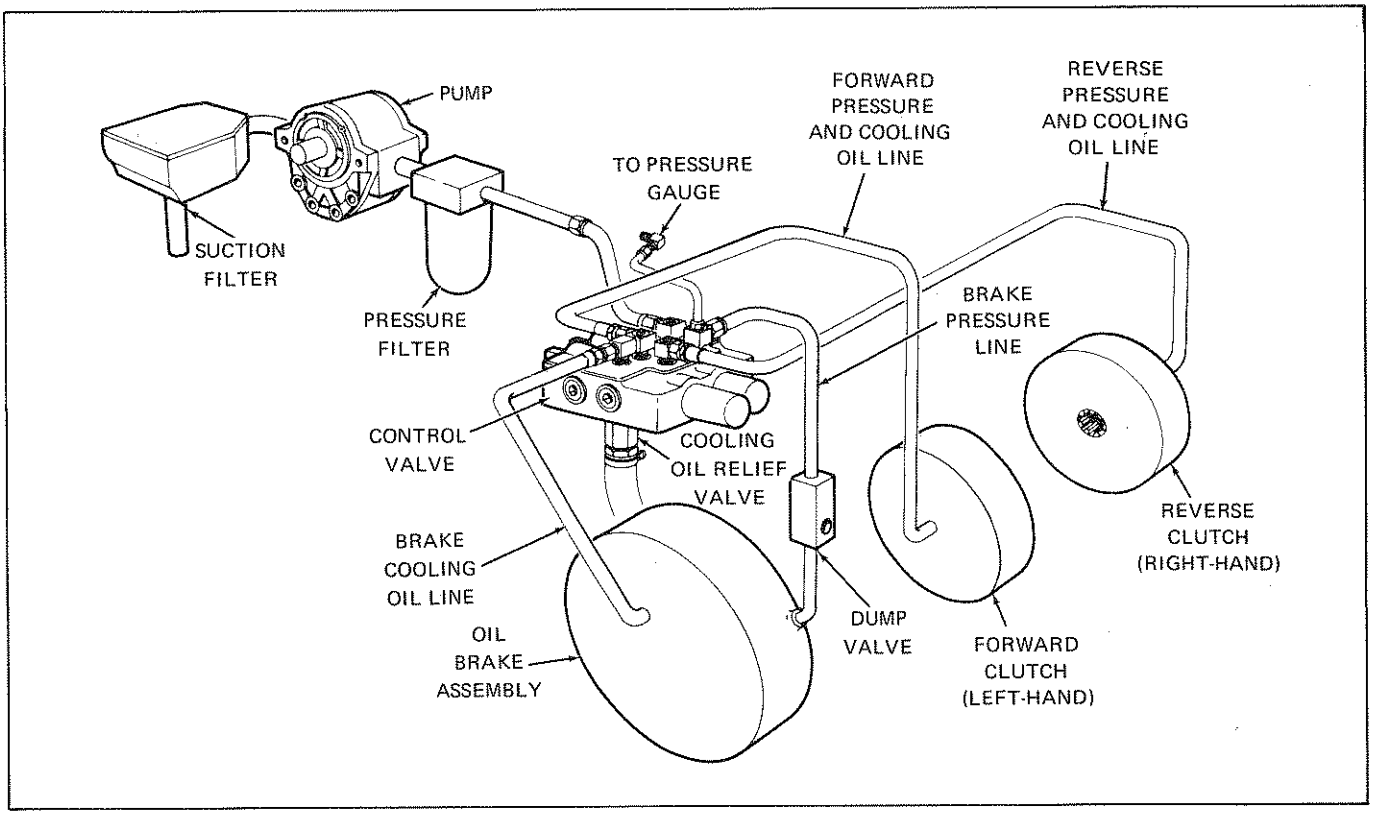


Figure 1-9. Hydraulic System Interconnection Diagram

1-18. FUNCTIONAL DESCRIPTION.

1-19. Gear Train. (See Figure 1-10.)

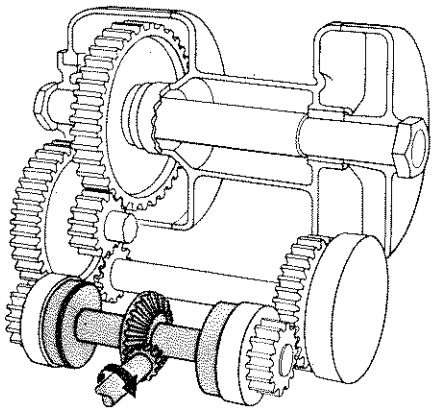
1-20. The PTO shaft assembly rotates clockwise as viewed from the front of the tractor. Torque is transmitted from the PTO bevel pinion gear to the bevel gear shaft spiral bevel gear. This causes the bevel gear shaft to rotate clockwise as viewed from the left-hand side of the winch. In Neutral, the bevel gear shaft, spiral bevel gear, two spacers and oil clutch assemblies rotate, but the associated spider gears do not. This is because neither clutch assembly is engaged. In Forward, the left-hand (forward) clutch assembly is locked-up to the spider gear by hydraulic pressure. This causes torque to be transferred from the forward spider gear to the brakeshaft reduction gear, forcing the brakeshaft assembly to rotate counterclockwise. The brakeshaft pinion gear will now turn the large intermediate gear, causing the intermediate shaft assembly to rotate clockwise. The intermediate shaft drum pinion gear will now turn the large drum gear and drum counterclockwise. In Reverse, the right-hand (reverse) clutch assembly is locked-up to the spider gear by hydraulic pressure. This will cause torque to be transferred from the reverse spider gear to the large intermediate gear, causing the intermediate shaft assembly to rotate counterclockwise. The intermediate shaft drum pinion gear will now turn the large drum gear and drum clockwise.

1-21. Hydraulic System. (See Figure 1-9.)

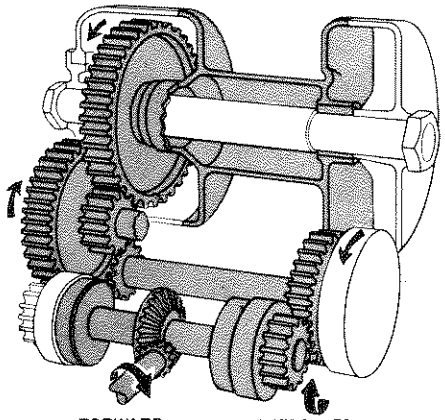
1-22. The hydraulic system consists primarily of a suction filter, pressure filter, hydraulic pump assembly, control valve assembly, cooling oil relief valve assembly, dump valve assembly, pressure valve, two oil clutch assemblies, oil brake assembly and related hydraulic lines. The hydraulic pump assembly supplies oil necessary for operation of the system. The control valve, which is actuated by the handling gear, distributes and regulates the flow of hydraulic oil. The two filters remove contaminants from the oil. The cooling oil relief valve maintains the proper oil flow to the oil clutch assemblies. The dump valve is placed in the hydraulic system to assure fast evacuation of brake release oil. This is necessary for rapid brake application. The pressure gauge is mounted on the handling gear and indicates brake release pressure.

1-23. There are eight modes of winch operation. These modes are as follows (refer to paragraphs 1-24 through 1-31):

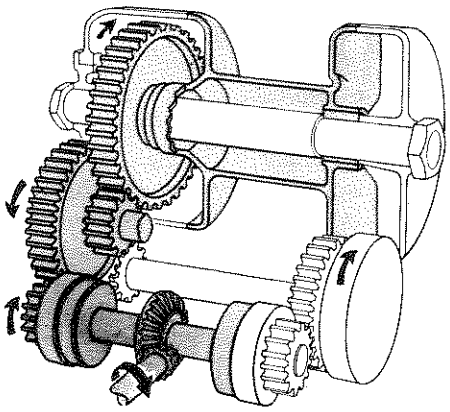
1. NEUTRAL, Normal Operation
2. FORWARD, Normal Operation



NEUTRAL, POWER CONTROLLED



FORWARD, POWER CONTROLLED



REVERSE, POWER CONTROLLED

Figure 1-10. Torque Transfer Diagram

3. GRADUAL BRAKE RELEASE, Normal Operation
4. REVERSE, Normal Operation
5. FORWARD, Inching Operation (Brake Applied)
6. FORWARD, Inching Operation (Brake Slipping)
7. REVERSE, Inching Operation (Brake Applied)
8. REVERSE, Inching Operation (Brake Slipping)

1-24. HYDRAULIC SYSTEM IN NEUTRAL, NORMAL OPERATION. (See Figure 1-11.) On Earlier Production Handling Gear, the system is placed in NEUTRAL, Normal Operation by: (1) Moving the Control Lever Down and locking it in place and (2) Shifting the Selector Lever to the NEUTRAL position. On Current Production Handling Gear, this is accomplished by: (1) Locking the Inching Lever in the BRAKE OFF position and (2) Shifting the Selector Lever to the NEUTRAL position. When the Control Lever is locked in the Down position or the Inching Lever is locked in the BRAKE OFF position, the inching spool is pulled to its extreme Out position. With the Selector Lever in the NEUTRAL position, the selector spool is in its relaxed position. With the spools in these positions, the hydraulic pump draws oil from the reservoir through the suction filter and delivers it through the pressure filter to the control valve inlet port. Oil will then flow through the control valve, past both spools and fill the complete hydraulic circuit. At this point, there is no exit from the circuit for the hydraulic fluid and the pressure will increase. This pressure increases until the low-pressure cooling oil relief valve opens and dumps the oil. The oil in the circuit is now regulated at cooling oil pressure. This pressure is not high enough to release the brake or actuate either oil clutch assembly, but is adequate to lubricate both oil clutches and the oil brake.

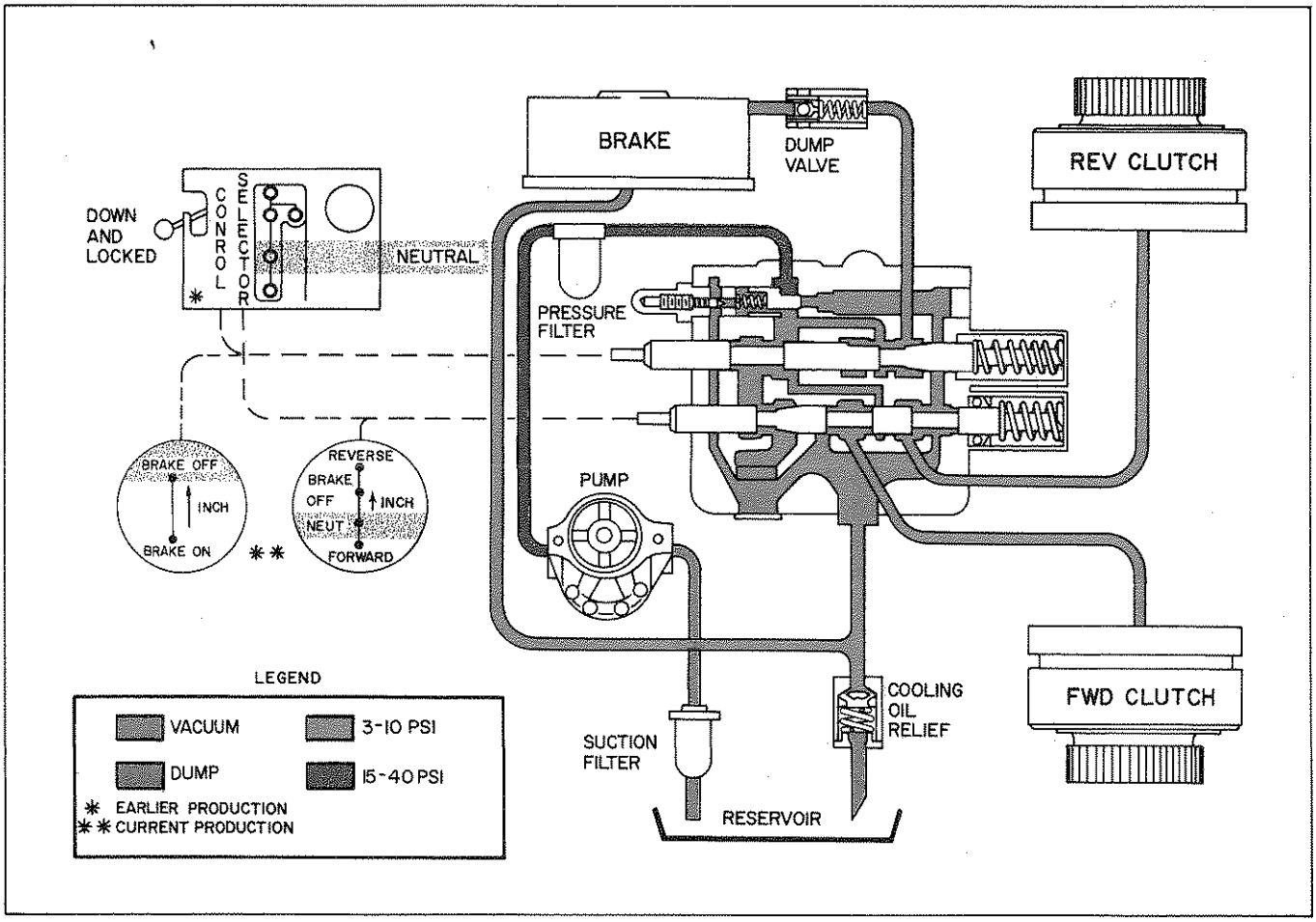


Figure 1-11. Hydraulic Flow Diagram, Neutral, Normal Operation

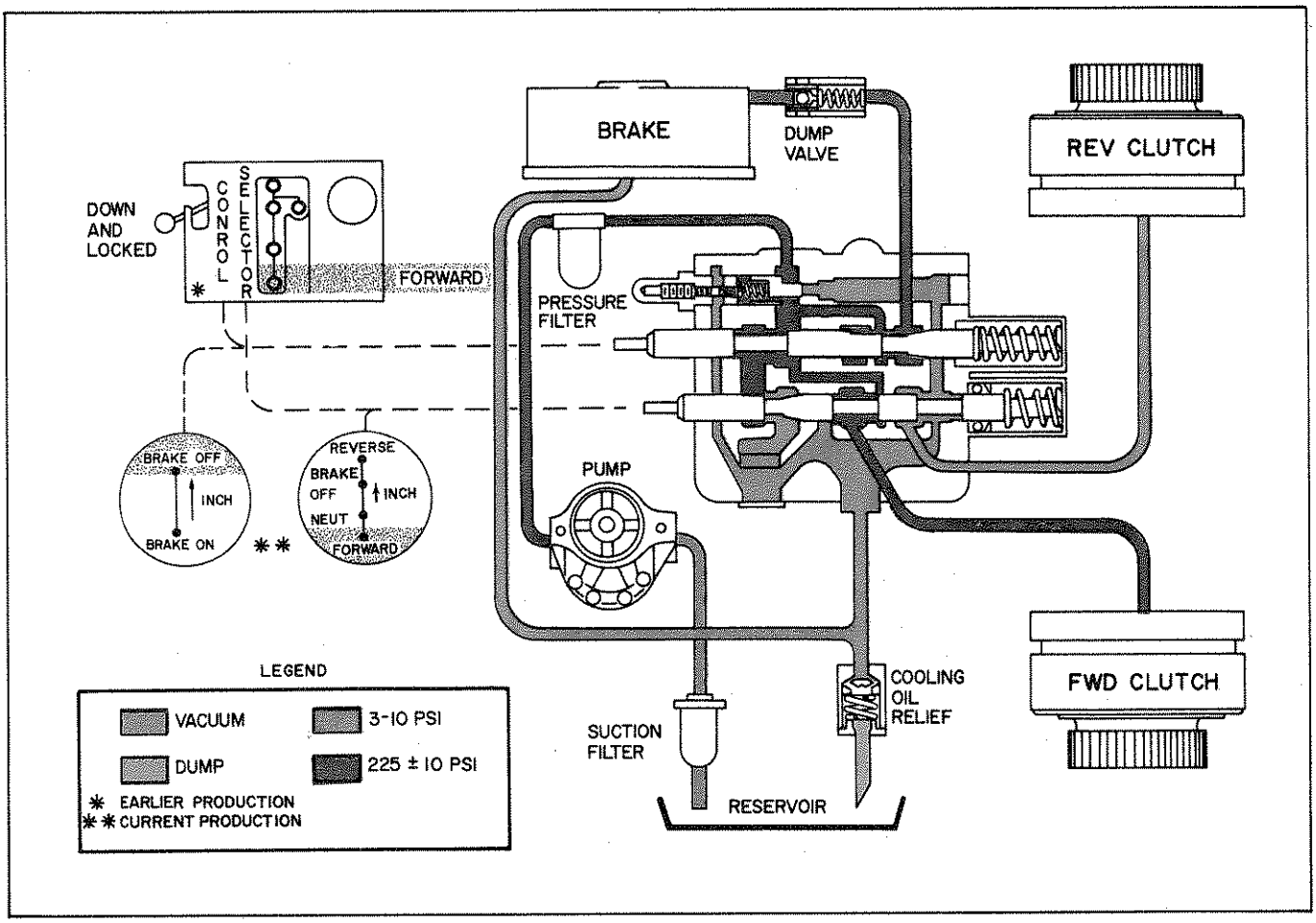


Figure 1-12. Hydraulic Flow Diagram, Forward, Normal Operation

1-25. HYDRAULIC SYSTEM IN FORWARD, NORMAL OPERATION. (See Figure 1-12.) On Earlier Production Handling Gear, the system is placed in FORWARD, Normal Operation by: (1) Moving the Control Lever Down and locking it in place and (2) Shifting the Selector Lever to the FORWARD position. On the Current Production Handling Gear, this is accomplished by: (1) Locking the Inching Lever in the BRAKE OFF position and (2) Shifting the Selector Lever to the NEUTRAL position. When the Control Lever is locked in the Down position or the Inching Lever is locked in the BRAKE OFF position, the inching spool is pulled to its extreme Out position. With the spools in these positions, the hydraulic pump draws oil from the reservoir through the suction filter and delivers it through the pressure filter to the control valve inlet port. Oil will then enter the control valve inlet and flow past the inching spool to the selector spool. At this time, the oil is dead-headed since the selector spool has been pushed back into the valve, closing off the passage between the valve body and the spool. The oil will then back up and fill the cavities leading to the forward clutch assembly and the brake hydraulic cylinder. When the valve cavities are filled with oil, the pressure to the forward clutch assembly and brake cylinder will increase. The pressure increases very quickly, engaging the forward clutch assembly and releasing the brake at the same time. The pressure will continue to increase until it is relieved through the pilot-operated relief valve. Overflow from the pilot-operated relief valve is regulated by the cooling oil relief valve. This low pressure oil circulates to the reverse clutch assembly to cool the clutch discs.

1-26. HYDRAULIC SYSTEM IN GRADUAL BRAKE RELEASE, NORMAL OPERATION. (See Figure 1-13.) On Earlier Production Handling Gear, the system is placed in GRADUAL BRAKE RELEASE, Normal Operation by: (1) Moving the Control Lever Down and locking it in place and (2) Shifting the Selector Lever to the INCH position. On Current Production Handling Gear, this is accomplished by: (1) Locking the Inching Lever in the BRAKE OFF position and (2) Shifting the Selector Lever to the INCH position. When the Control Lever is locked in the Down position or the Inching Lever is locked in the BRAKE OFF position, the inching spool is pulled to its extreme Out position. With the Selector Lever in the INCH position, the selector spool is slightly pulled out from its relaxed position. With the spools in these positions, the hydraulic pump draws oil from the reservoir through the suction filter and delivers it through the pressure filter to the control valve inlet port. Oil will then flow through the valve, past both spools and fill the complete hydraulic circuit. At this time, there is no exit from the circuit for the hydraulic oil and the pressure increases. The pressure will continue to increase until the cooling oil relief valve opens and dumps the oil. The oil in the circuit is now regulated by the cooling oil relief valve. To gradually release the brake, the Selector Lever is slowly moved toward the BRAKE OFF position. This pulls the selector spool out of the valve, thus metering the oil between the spool and the control valve body. This metering of the oil causes a partial restriction and a slow pressure increase to the brake. This gradual pressure increase will gradually release the brake. When the selector spool is pulled out to the BRAKE OFF position (D-23 spool is detented to this position), the oil flow between the selector spool and the valve body will stop. The pressure will now increase to a pressure that will completely release the brake and relieve itself through the pilot-operated relief valve. This low pressure oil circulates to both clutches to cool the clutch discs.

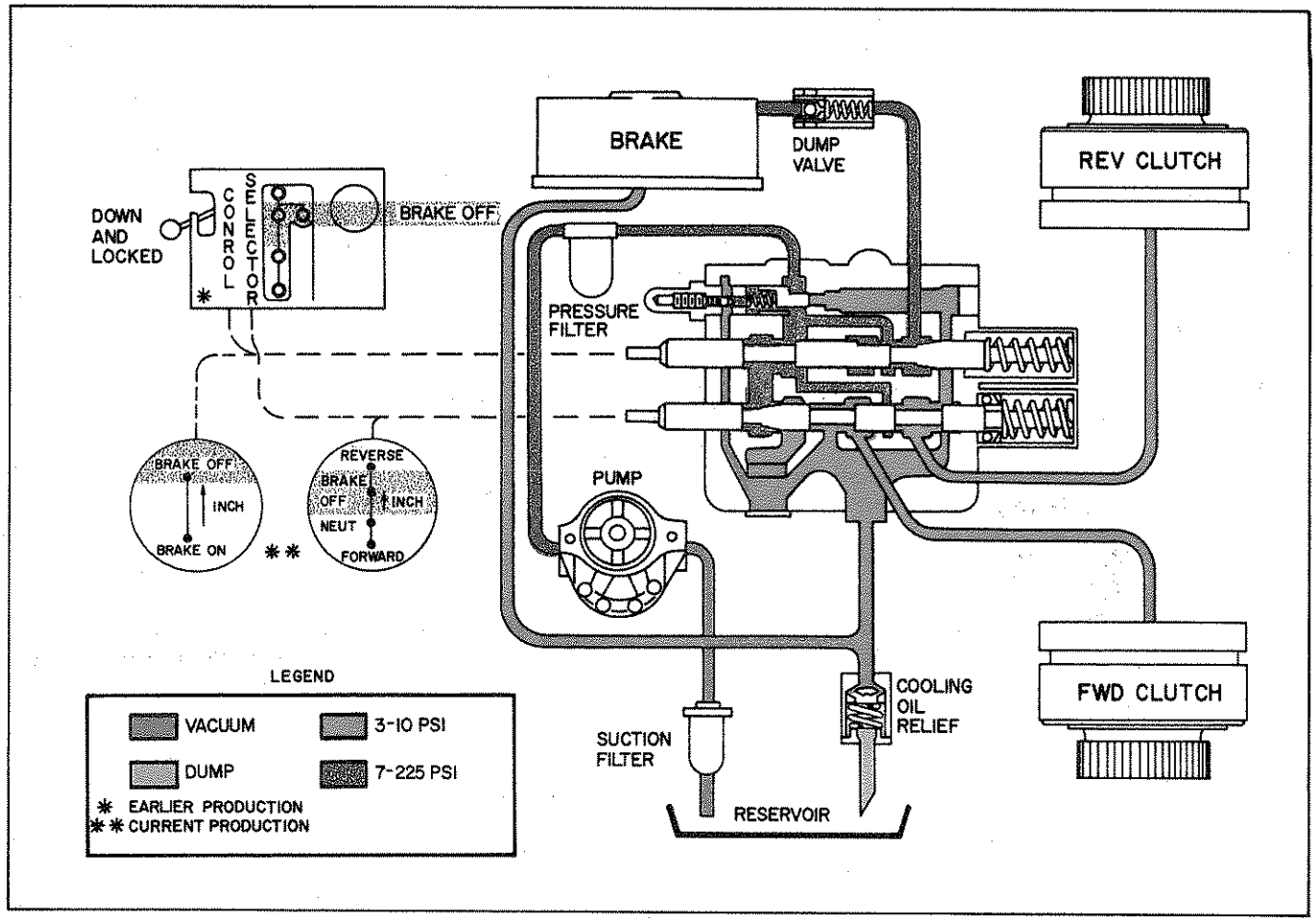


Figure 1-13. Hydraulic Flow Diagram, Gradual Brake Release, Normal Operation

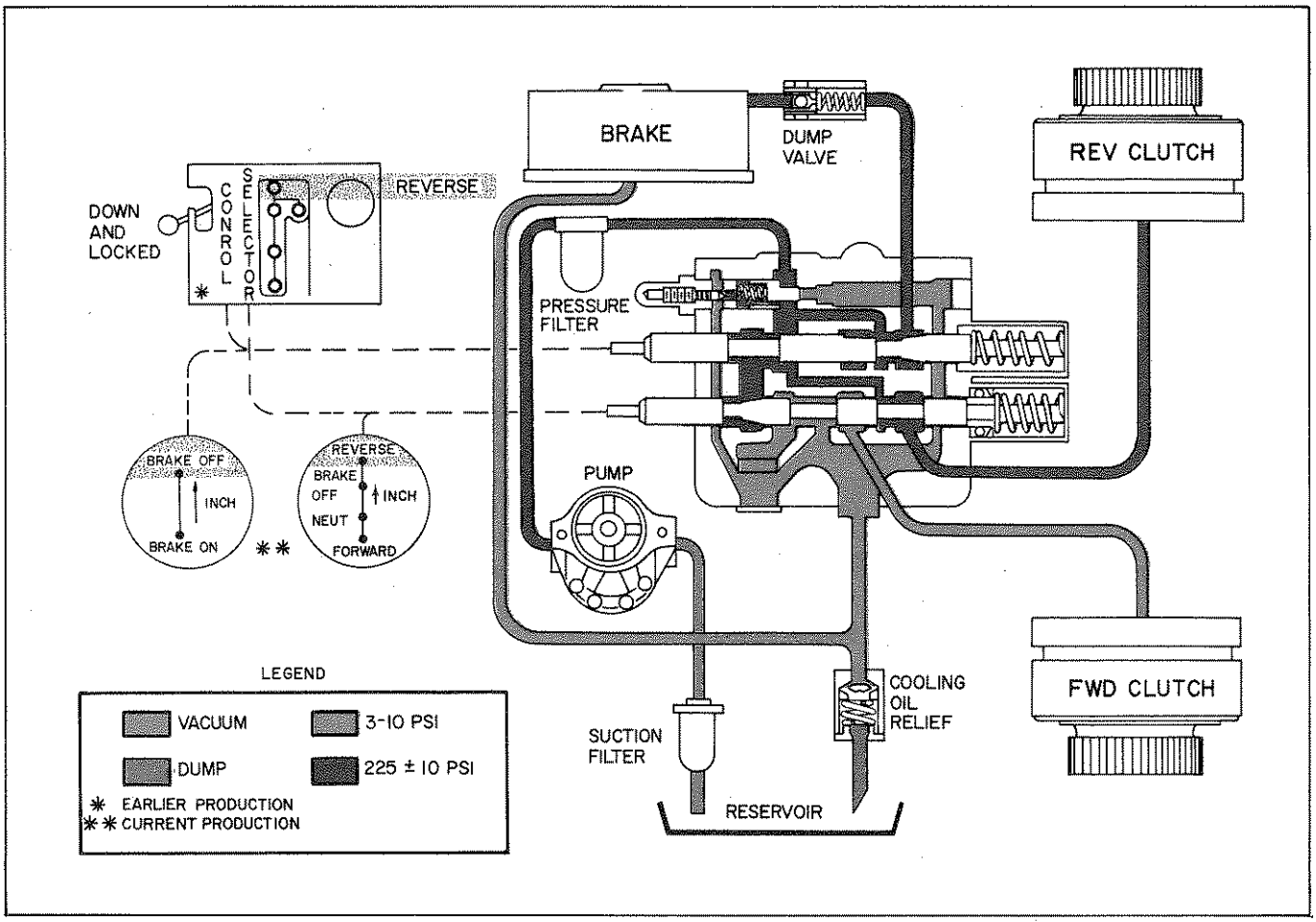


Figure 1-14. Hydraulic Flow Diagram, Reverse, Normal Operation

1-27. HYDRAULIC SYSTEM IN REVERSE, NORMAL OPERATION. (See Figure 1-14.) On Earlier Production Handling Gear, the system is placed in REVERSE, Normal Operation by: (1) Moving the Control Lever Down and locking it in place and (2) Shifting the Selector Lever to the REVERSE position. On the Current Production Handling Gear, this is accomplished by: (1) Locking the Inching Lever in the BRAKE OFF position and (2) Shifting the Selector Lever to the REVERSE position. When the Control Lever is locked in the Down position or the Inching Lever is locked in the BRAKE OFF position, the inching spool is pulled to its extreme Out position. With the Selector Lever in the REVERSE position, the selector spool is pulled to its extreme Out position. With the spools in these positions, the hydraulic pump draws oil from the reservoir through the suction filter and delivers it through the pressure filter to the control valve inlet port. Oil will then enter the control valve inlet and flow past the inching spool to the selector spool. At this point, the oil is dead-headed since the selector spool has been pulled to the extreme Out position which closes the passage between the valve body and spool. The oil will back-up and fill the cavities leading to the reverse clutch and the brake cylinder. When the valve cavities are filled with oil, the oil pressure to the reverse clutch and brake cylinder will increase. The pressure increases very quickly and engages the reverse clutch assembly and releases the brake at the same time. This pressure will continue to increase until it relieves through the pilot-operated relief valve. Overflow from the pilot operated relief valve is regulated by the cooling oil relief valve. This low-pressure oil circulates to the forward clutch assembly to cool the clutch discs.

1-28. HYDRAULIC SYSTEM IN FORWARD INCHING, BRAKE APPLIED. (See Figure 1-15.) On Earlier Production Handling Gear, the system is placed in FORWARD INCHING OPERATION by: (1) Moving the Control Lever Up and locking it in place and (2) holding the Selector Lever in the FORWARD position. On the Current Production Handling Gear, this is accomplished by: (1) Lifting the Stop Latch away from the Inching Lever which will allow the Inching Lever to spring-return to the BRAKE ON position and (2) holding the Selector Lever in the FORWARD position. When the Control Lever is Up and locked in place or the Inching Lever is in the BRAKE ON position, the inching spool is spring-returned to its Neutral position. With the Selector Lever in the FORWARD position, the selector spool is pushed to its extreme In position. With the spools in these positions, the pump draws oil from the reservoir through the suction filter and delivers it through the pressure filter to the control valve inlet. Oil will then enter the control valve inlet and flow past the inching spool to the selector spool. At this time, the oil is dead-headed since the selector spool has been pushed back into the valve, closing off the passage between the valve body and the spool. The oil will back up and fill the cavities leading to the forward clutch and the brake cylinder. As shown in figure 1-15, the entrance to the brake port is much smaller than the exit from the brake port. Therefore, the oil entering the brake port will not increase to a high pressure in that port. Pressure upstream of the brake port will continue to increase until it is relieved at the high-pressure relief valve. This pressure engages the forward clutch. Overflow from the pilot operated relief valve is regulated by the cooling oil relief valve. This low pressure oil circulates to the reverse clutch to cool the clutch discs. At this time, the forward clutch has been applied, but the brake has not been released. The torque converter on the tractor will therefore assume a stalled condition.

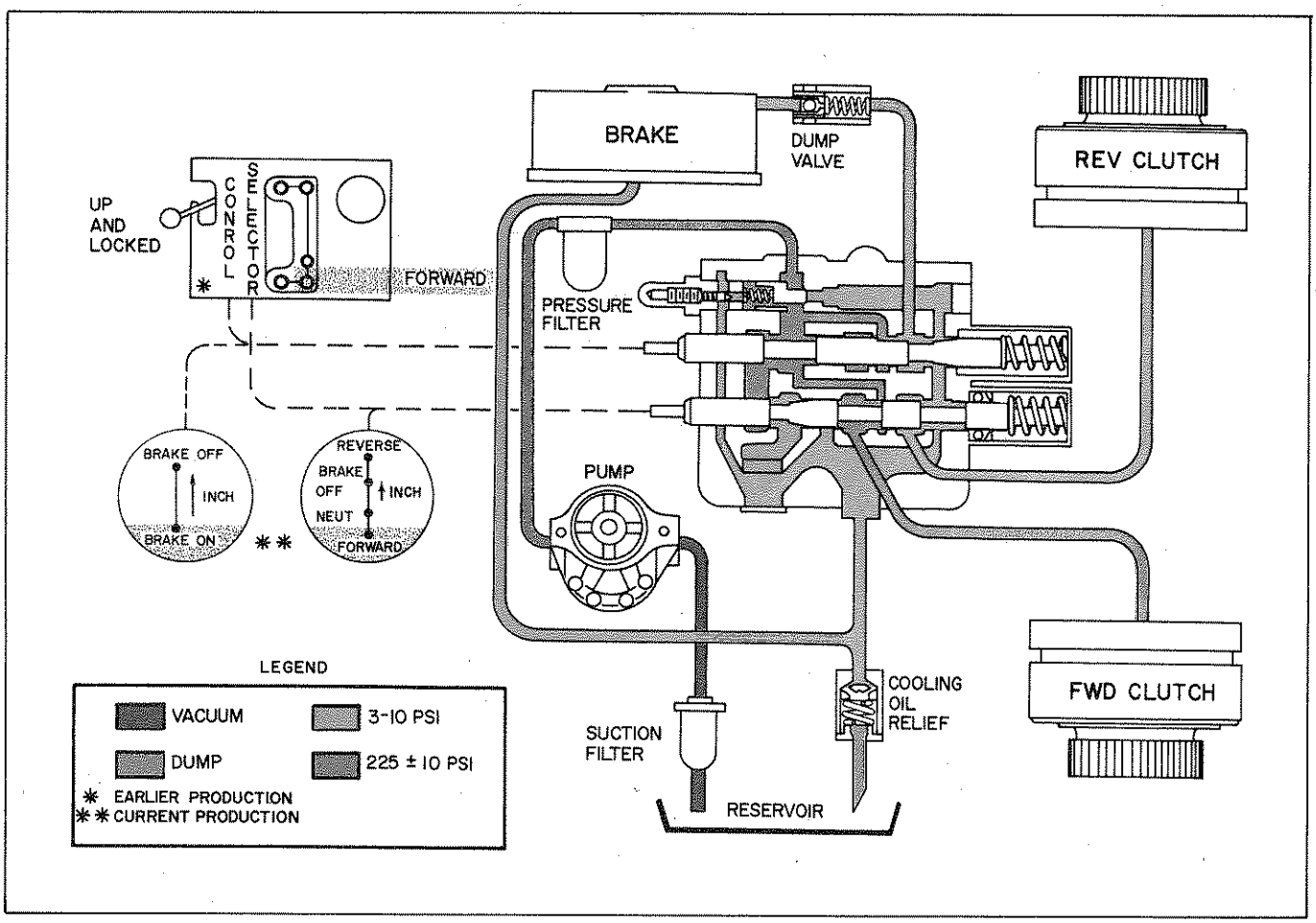


Figure 1-15. Hydraulic Flow Diagram, Forward Inching, Brake Applied

1-29. HYDRAULIC SYSTEM IN FORWARD INCHING, BRAKE SLIPPING. (See Figure 1-16.) On Earlier Production Handling Gear, the system is placed in FORWARD INCHING OPERATION by: (1) Moving the Control Lever Up and locking it in place and (2) Moving the Selector Lever toward the front of the handlever housing. On Current Production Handling Gear, this is accomplished by: (1) Holding the Selector Lever in the FORWARD position and (2) Moving the Inching Lever toward the BRAKE OFF position. When the Selector Lever (earlier production) is moved toward the front of the handlever housing or the Inching Lever (current production) is moved toward the BRAKE OFF position, the inching spool is gradually pulled Out of the control valve. This gradually stops the flow of oil exiting at the brake release port. This is because the orifice entering the port remains the same, but the orifice for the oil exiting the port is gradually reduced. This change in orifice size causes a pressure build-up within the brake release port which slowly releases the brake. As the brake is released, the forward clutch assembly and the tractor torque converter gradually overpower the brake which causes the winch to inch in the load under power.

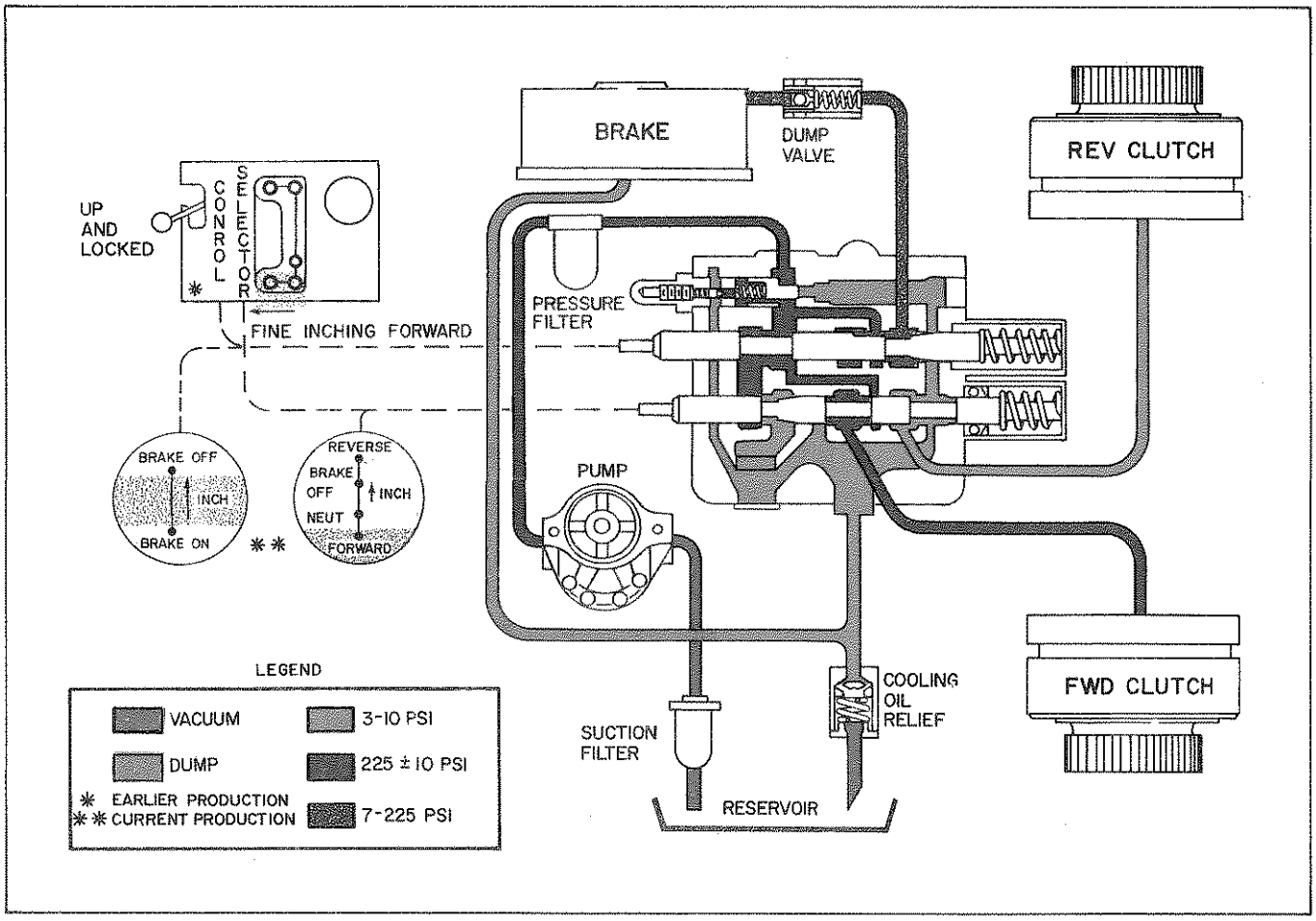


Figure 1-16. Hydraulic Flow Diagram, Forward Inching, Brake Slipping

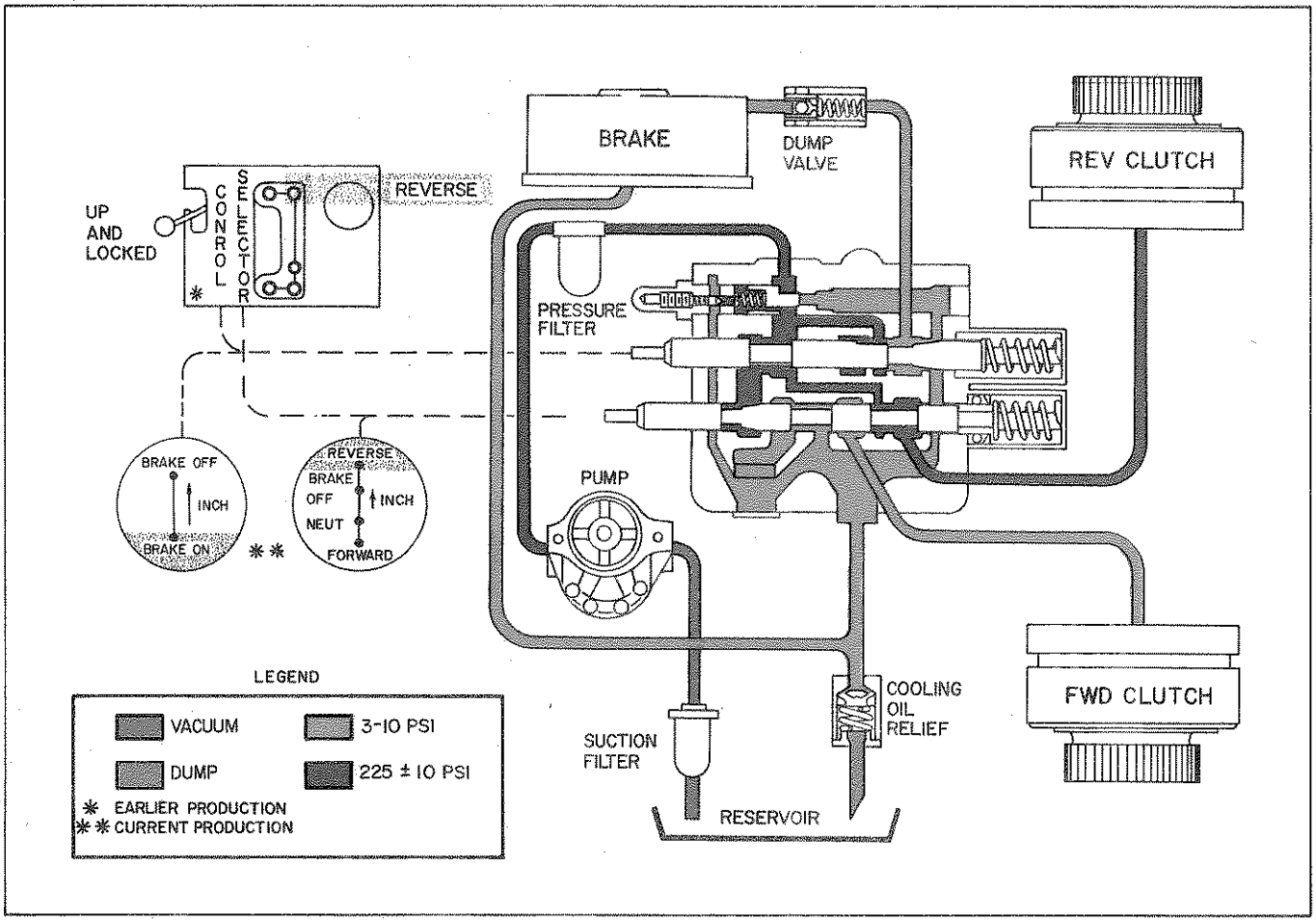


Figure 1-17. Hydraulic Flow Diagram, Reverse Inching, Brake Applied

1-30. HYDRAULIC SYSTEM IN REVERSE INCHING, BRAKE APPLIED. (See Figure 1-17.) On Earlier Production Handling Gear, the system is placed in REVERSE INCHING OPERATION by: (1) Moving the Control Lever Up and locking it in place and (2) Holding the Selector Lever in the REVERSE position. On the Current Production Handling Gear, this is accomplished by: (1) Lifting the Stop Latch away from the Inching Lever which will allow the Inching Lever to spring-return to the BRAKE ON position and (2) Holding the Selector Lever in the REVERSE position. When the Control Lever is Up and locked, or when the Inching Lever is in the BRAKE ON position, the inching spool is spring-returned to its Neutral position. With the Selector Lever in the REVERSE position, the selector spool is pushed to its extreme Out position. With the spools in these positions, the hydraulic pump draws oil from the reservoir through the suction filter and delivers it through the pressure filter to the control valve inlet. Oil will then enter the control valve inlet and flow past the inching spool to the selector spool. At this time, the oil is dead-headed since the selector spool has been pulled to its extreme Out position which closes off the passage between the valve body and the spool. The oil will then back up and fill the cavities leading to the reverse clutch assembly and the brake cylinder. As shown in figure 1-17, the entrance to the brake port is much smaller than the exit from the brake port. Therefore, the oil entering the brake port will not increase to a high pressure in that port. Pressure upstream of the brake port will continue to increase until it is relieved at the high pressure relief valve. This pressure engages the reverse clutch assembly. Overflow from the pilot-operated relief valve is regulated by the cooling oil relief valve. This low-pressure oil circulates to the forward clutch assembly to cool the clutch discs. At this time, the reverse clutch has been applied, but the brake has not been released. The torque converter on the tractor will therefore assume a stalled condition.

1-31. HYDRAULIC SYSTEM IN REVERSE INCHING, BRAKE SLIPPING. (See Figure 1-18.) On Earlier Production Handling Gear, the system is placed in REVERSE INCHING OPERATION by: (1) Moving the Control Lever Up and locking it in place and (2) Moving the Selector Lever toward the front of the handlever housing. On the Current Production Handling Gear, this is accomplished by (1) Holding the Selector Lever in the REVERSE position and (2) Moving the Inching Lever toward the BRAKE OFF position. When the Selector Lever (Earlier Production) is moved toward the front of the handlever housing or the Inching Lever (Current Production) is moved towards the BRAKE OFF position, the inching spool is gradually pulled Out of the control valve. This movement gradually stops the flow of oil exiting at the brake release port. This is because the orifice entering the port remains the same, but the orifice for the oil exiting the port is gradually reduced. This change in orifice size causes a pressure buildup within the brake release port which slowly releases the brake. As the brake is released, the reverse clutch assembly and the tractor torque converter gradually overpower the brake and inch out the load under power.

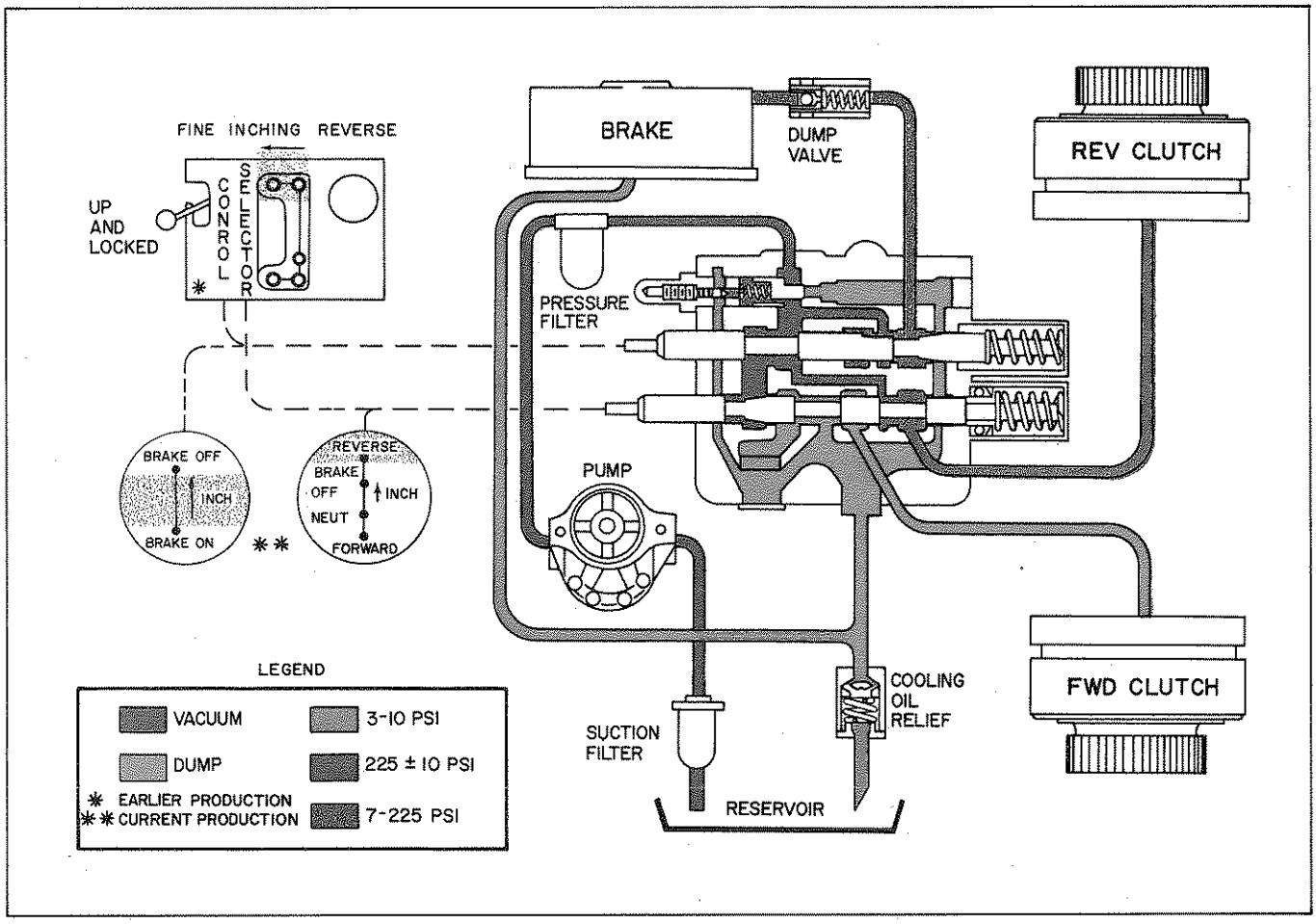


Figure 1-18. Hydraulic Flow Diagram, Reverse Inching, Brake Slipping

2-1. GENERAL.

2-2. Operation of the winch is controlled through the handling gear mounted in the tractor operator's compartment. The handling gear may be mounted on either the left-hand side or right-hand side of the operator's seat, depending upon the tractor model. Before operating the winch, review the operational precautions given in paragraph 2-3.

2-3. OPERATION PRECAUTIONS.

2-4. Observe the following PRECAUTIONS to prevent injury to personnel and damage to the equipment.

a. Report damage or erratic operation of the winch or pressure gauge immediately.

b. Do not stand while operating the tractor or the winch.

c. Make sure that instruments and controls are operative before operating the unit.

d. Do not use control levers or handles as machine mounting assists.

e. Do not use control levers or handles as hangers for clothing, water bags, grease guns, lunch pails, etc.

f. Do not permit personnel in the control area when working or making checks on the machine.

g. Do not allow riders on the machine or lead.

h. Use extreme care when operating close to other machines.

i. Avoid operating near other personnel.

j. Do not stand or permit others to stand in the bight (loop) of a cable.

k. Do not stand or permit others to stand near the winch or cable when it is under tension.

l. Do not use a damaged cable (broken wire or strands, or a decrease in the diameter of the cable are warning signs).

m. Do not leave the tractor while the winch cable is under tension.

n. Do not anchor a double or two-part line to the winch.

o. Never attempt to clean, oil, or adjust a machine while it is in motion.

p. Authorized operators only!

2-5. OPERATING PROCEDURES.

2-6. Winch operating procedures vary between tractors equipped with earlier production handling gear and current production handling gear. Review figures 2-1 and 2-2 and determine your handling gear design before operating the winch.

2-7. Earlier Production Handling Gear. (See Figure 2-1.)

2-8. There are two different shift patterns that can be selected for winch operation. These are Normal Control and Fine Inching Control. The Normal Control shift pattern should be used for routine or normal operation encountered in logging and heavy construction. The Fine Inching Control should be used in: (1) Pipelining for positioning pipe and lowering backhoes, (2) Oil field work in rigging wells, towing and leveling derricks, and placing pipe, (3) Mining for towing control stations and matching pipe flanges, (4) General construction for various handling, rising, lowering, towing, yo-yo operation and rescue work.

2-9. OPERATING IN NORMAL CONTROL. To operate earlier production handling gear in the Normal Control shift pattern, move the Control Lever down and lock in place. This will allow the Selector Lever to be shifted as follows:

a. For Neutral, shift the Selector Lever to the NEUTRAL position. In NEUTRAL, the brake is applied. The winch brake oil pressure gauge will be in the lower green zone.

b. For Forward, hold the Selector Lever in the FORWARD position. In FORWARD, the brake is completely released and the drum will haul-in line. The winch brake oil pressure gauge should indicate in the upper green zone.

c. For Gradual Brake Release (INCH), move the Selector Lever from the NEUTRAL position towards the BRAKE OFF position. The closer the Selector Lever is moved toward the BRAKE OFF position, the

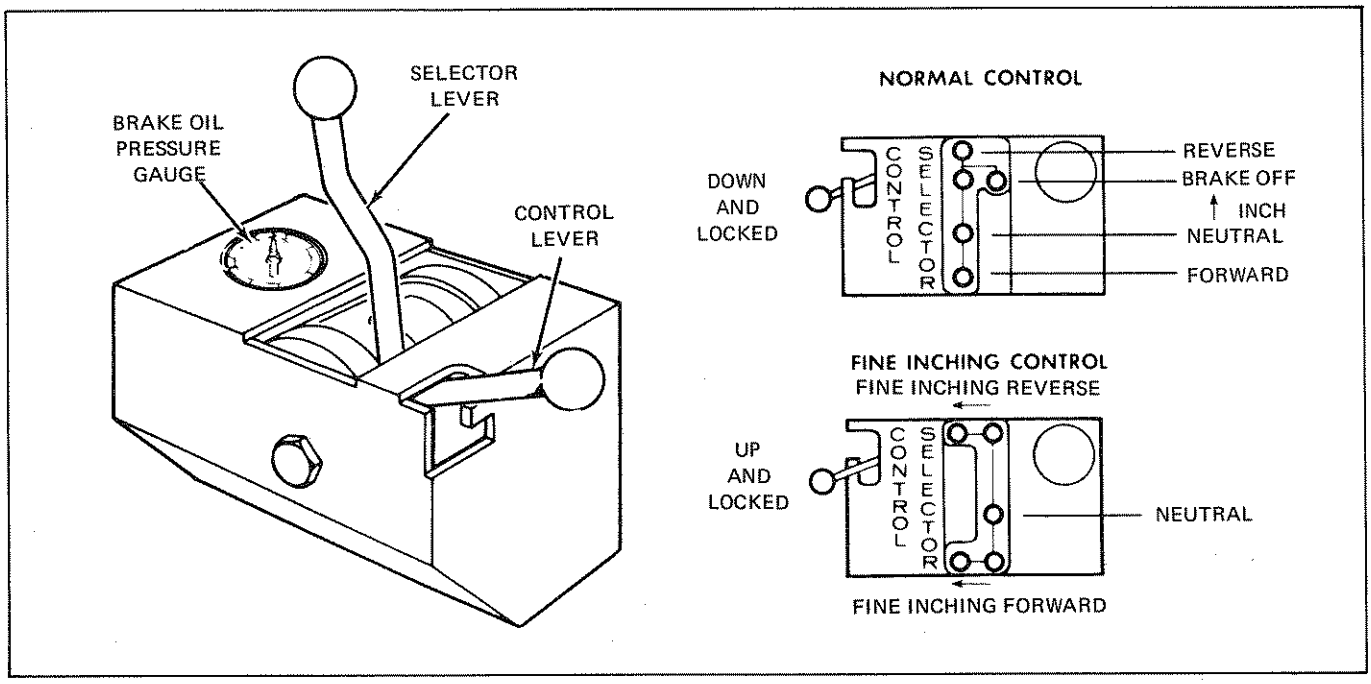


Figure 2-1. Operating Controls, Earlier Production Handling Gear

more the brake will be released. This will allow the drum to gradually pay-out line. During Gradual Brake Release, the winch brake oil pressure gauge will indicate in the red zone.

d. For Brake Off, shift the Selector Lever to the BRAKE OFF position. In BRAKE OFF, the brake is completely released which allows the drum to free-wheel. The brake oil pressure gauge should indicate in the upper green zone.

NOTE: It will be necessary to shift the Selector Lever into the BRAKE OFF notch of the handlever gate on some earlier production winches to maintain a Brake-Off condition. On current production winches equipped with earlier production handling gear, the Selector Lever linkage is detented to the BRAKE-OFF position.

CAUTION: Do not operate the winch for extended periods of time in the BRAKE OFF position.

e. For Reverse, hold the Selector Lever in the REVERSE position. In REVERSE, the brake is completely released and the drum will pay-out line under power. The winch brake oil pressure gauge will indicate in the upper green zone.

2-10. OPERATING IN FINE INCHING CONTROL. To operate in the Fine Inching Control Shift Pattern, move the Control Lever up and lock in place. This will allow the Selector Lever to be shifted as follows:

CAUTION: Keep the tractor stationary while operating in Fine Inching Control.

a. For Neutral, shift the Selector Lever to the NEUTRAL position. In NEUTRAL, the brake is applied and neither clutch assembly is locked-up. The winch brake oil pressure gauge will indicate in the lower green zone.

b. For Forward (Brake Applied), hold the Selector Lever in the FORWARD position. In the FORWARD position, the winch brake will remain applied and the forward clutch assembly will be locked-up. This will stall the tractor torque converter. The winch brake oil pressure gauge will indicate in the red zone, close to the lower green zone.

CAUTION: Do not stall the tractor torque converter for prolonged periods of time.

c. For Forward (Brake Slipping), slowly move the Selector Lever from the FORWARD position towards the Control Lever end of the handlever housing. This will gradually release the brake. As the brake is gradually released, the tractor torque converter and the forward clutch assembly will assume control of the load to Inch-In under power. The winch brake oil pressure gauge will indicate in the red zone while

inching; however, when the Selector Lever is moved as far as possible toward the Control Lever, the brake oil pressure gauge will indicate in the upper green zone.

NOTE: Low engine speed is recommended for Fine Inching in Forward. The engine speed may need to be increased when Inching In a heavy load.

d. For Reverse (Brake Applied), hold the Selector Lever in the REVERSE position. In the REVERSE position, the winch brake will remain applied and the reverse clutch assembly will be locked-up. This will stall the tractor torque converter. The winch brake oil pressure gauge will indicate in the red zone, close to the lower green zone.

CAUTION: Do not stall the tractor torque converter for prolonged periods of time.

e. For Reverse (Brake Slipping), slowly move the Selector Lever from the REVERSE position towards the Control Lever end of the handlever housing. This will gradually release the brake. As the brake is released, the tractor torque converter and the reverse clutch assembly will assume control of the load to Inch Out under power. The winch brake oil pressure gauge will indicate in the red zone while inching; however, when the Selector Lever is moved as far as possible toward the Control Lever, the brake oil pressure gauge will indicate in the upper green zone.

NOTE: Low engine speed is recommended for Fine Inching in Reverse.

2-11. Current Production Handling Gear. (See Figure 2-2.)

2-12. There are two shift patterns that can be selected for winch operation. These are Normal Control and Fine Inching Control. These shift patterns can be used for the same operations described in paragraph 2-8.

2-13. OPERATING IN NORMAL CONTROL. To operate current production handling gear in Normal Control, lock the Inching Lever in the BRAKE OFF position. This will allow the Selector Lever to be shifted as follows:

a. For Neutral, shift the Selector Lever to the NEUTRAL position. In NEUTRAL, the brake is applied. The winch brake oil pressure gauge will indicate in the lower green zone.

b. For Forward, hold the Selector Lever in the FORWARD position. In FORWARD, the brake is completely released and the drum will haul-in line. The winch brake oil pressure gauge will indicate in the upper green zone.

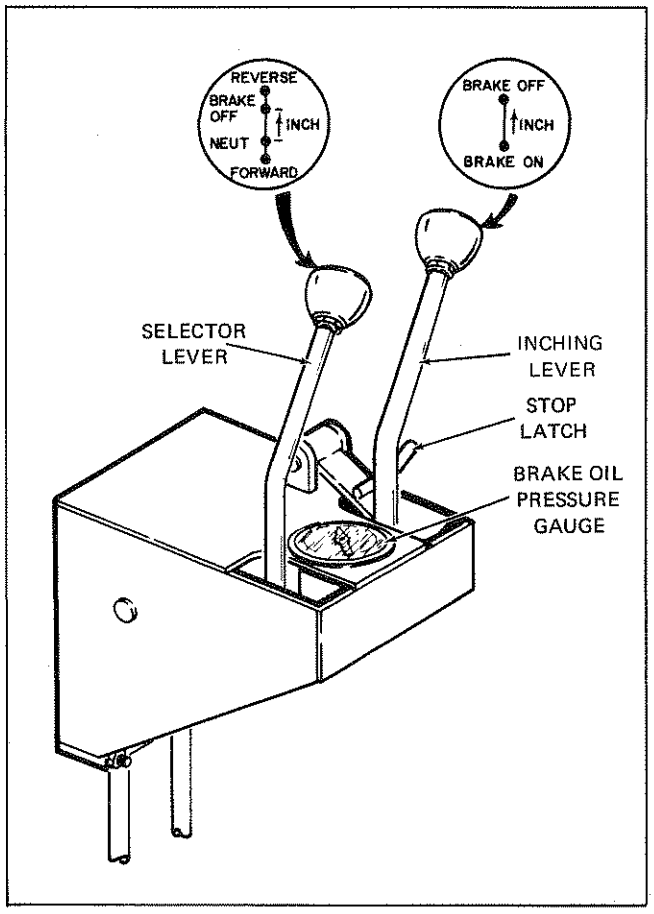


Figure 2-2. Operating Controls, Current Production Handling Gear

c. For Gradual Brake Release (INCH), move the Selector Lever from the NEUTRAL position toward the BRAKE OFF position. The closer the Selector Lever is moved toward the BRAKE OFF position, the more the brake will be released. This will allow the drum to gradually pay-out line. During gradual brake release, the winch brake oil pressure gauge will indicate in the red zone.

d. For Brake Off, shift the Selector Lever to BRAKE OFF position. In BRAKE OFF, the brake is completely released which allows the drum to free-wheel. The brake oil pressure gauge will indicate in the upper green zone.

NOTE: The Selector Lever linkage is detented to the BRAKE OFF position.

CAUTION: Do not operate the winch for extended periods of time in the BRAKE OFF position.

2-14. OPERATING IN FINE INCHING CONTROL. To operate in Fine Inching Control, lift the stop latch away from the Inching Lever. This will allow the Inching Lever to spring-return to the BRAKE ON position. The winch will now operate as follows:

CAUTION: Keep the tractor stationary while operating in Fine Inching Control.

a. For Neutral, shift the Selector Lever to the NEUTRAL position. In NEUTRAL, the brake is applied and neither clutch assembly is locked-up. The winch brake oil pressure gauge will be in the lower green zone.

b. For Forward (Brake Applied). Hold the Selector Lever in the FORWARD position. In FORWARD, the winch brake will remain applied and the forward clutch assembly will be locked-up. The winch brake oil pressure gauge will indicate in the red zone, close to the lower green zone. At this time, the tractor torque converter will be installed.

CAUTION: Do not stall the tractor torque converter for prolonged periods of time.

c. For Forward (Brake Slipping), hold the Selector Lever in the FORWARD position and slowly move the Inching Lever towards the Brake OFF position. This will gradually release the brake. As the brake is gradually released, the tractor torque converter and the forward clutch assembly will assume control of the load to Inch IN under power. The winch brake oil pressure gauge will indicate in the red zone while inching; however, when the Inching Lever is moved to the BRAKE OFF position, the brake oil pressure gauge will indicate in the upper green zone.

d. For Reverse (Brake Applied), hold the Selector Lever in the REVERSE position. In the REVERSE position, the winch brake will remain applied and the reverse clutch assembly will be locked-up. This will stall the tractor torque converter. The winch brake oil pressure gauge will indicate in the red zone, close to the lower green zone.

CAUTION: Do not stall the tractor torque converter for prolonged periods of time.

e. For Reverse (Brake Slipping), hold the Selector Lever in the REVERSE position and slowly move the Inching Lever towards the BRAKE OFF position. This will gradually release the brake. As the brake is gradually released, the tractor torque converter and the reverse clutch assembly will assume control of the load to Inch OUT under power. The winch brake oil pressure gauge will indicate in the red zone while inching; however, when the Inching Lever is moved to the BRAKE OFF position, the gauge will indicate in the upper green zone.

NOTE: Low engine speed is recommended for Fine Inching in Reverse.

2-15. OPTIONAL PRODUCTION HANDLING GEAR. (See Figure 2-3.)

2-16. The shift pattern for the optional production handling gear is the same as paragraph 2-13. OPERATING IN NORMAL CONTROL. With this control it is necessary to hold the selector lever in the Brake-Off position since the detent is removed. Operating in fine inching control is not possible with the optional production handling gear. The inching lever is removed from the housing and the inching spool in the control valve is blocked in the Brake-Off position with a spacer.

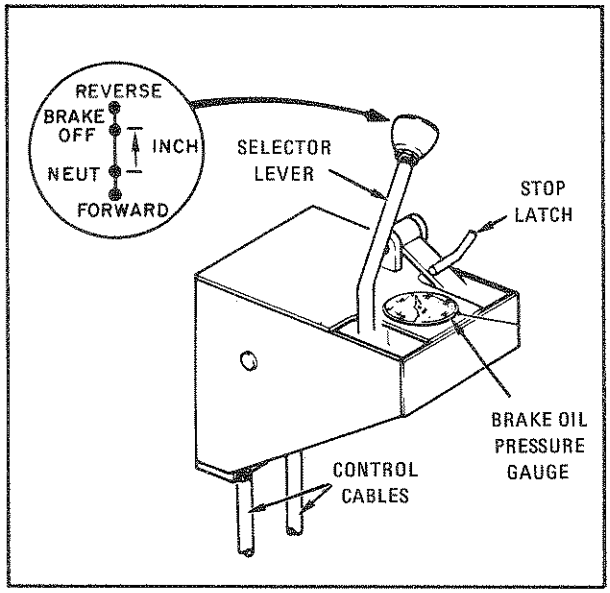


Figure 2-3. Optional Production Handling Gear

TROUBLESHOOTING

3-1. GENERAL.

3-2. Table 3-1 is a trouble analysis check chart that includes the most common troubles that may be encountered, the probable causes of the trouble and the corrective action that should be taken to restore the winch to a normal operating condition. Always observe the four basic principles of good systematic troubleshooting: Know the System, Determine the Symptoms, List the Causes, then Take Corrective Action. Hit-or-miss troubleshooting wastes time and can cause further damage.

TABLE 3-1. TROUBLE ANALYSIS CHECK CHART (Sheet 1 of 4)

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Erratic Operation	Low oil level.	Add oil as necessary to raise to proper level. Refer to Table 4-1.
	Pump cavitating due to air leaks in hydraulic system.	Check the following for air leaks: a. Suction manifold cover gasket.
		b. Suction manifold anchor screw stato-seals.
		c. Suction hose to manifold connection.
		d. Suction hose to pump connection.
		e. Suction hose for cracks or collapsed condition.
		f. Suction manifold pick-up tube weld connection to manifold.
		g. Pump shaft seal.
		NOTE: Damaged stato-seals are the most common cause of air leaks. ALWAYS replace with new stato-seals when suction manifold has been loosened. See figure 5-22. **CAUTION:** Use only Hyster Approved seals and hoses.
	Push-pull cables out of adjustment.	Check for proper adjustment as outlined in paragraph 4-16. Adjust if necessary. Double check push-pull cable housing to be sure it is securely anchored on both ends.
	Tractor engine idling too low.	Adjust to correct idle RPM.
	Oil viscosity too high.	Drain oil and refill with specified hydraulic oil. Refer to table 4-1.
	Oil too cold.	Allow oil to warm before operating the winch.
	Low oil pressure.	Refer to LOW OIL PRESSURE troubleshooting procedures.

TABLE 3-1. TROUBLE ANALYSIS CHECK CHART (Sheet 2 of 4)

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Low Oil Pressure	Refer to ERRATIC OPERATION troubleshooting procedures.	
	Leaking pressure hoses and fittings.	Check for leaks and replace components where necessary.
	Defective or improperly adjusted relief valve.	Check relief valve setting with pressure gauge as outlined in paragraph 4-15, step e. Replace Relief Valve Assembly if defective.
		NOTE: Do not rely on brake oil pressure gauge when adjusting relief pressure. Always use a calibrated gauge.
	Internal slippage (leakage) in the pump.	Check pump for pressure output only after all the above checks have been made. If pump is at fault, remove and overhaul or replace as outlined in paragraph 5-33.
	Dump valve spool stuck open.	Replace dump valve assembly, then drain oil, flush, and refill with oil.
		NOTE: Dump valve cannot tolerate contamination.
	Damaged brake piston retainer or O-rings.	Check piston retainer cavity for damage. Replace if scored or broken. Always replace both O-rings when brake is repaired.
	Brake oil pressure gauge defective.	Check gauge reading against a calibrated gauge. Replace if gauge is faulty.
Oil Brake Not Releasing	Refer to LOW OIL PRESSURE troubleshooting procedure.	
Overheating	Operating in Brake-Off too long.	Position selector lever in NEUTRAL when free spool condition is not required. In BRAKE OFF position the pump continually works against high pressure release.
	Improperly adjusted inching spool travel.	Check and adjust as necessary. Refer to paragraph 4-18.
	Excessive inching.	Allow oil to cool periodically.
		NOTE: Install heat exchanger if excessive inching is necessary.
	Defective clutch cooling oil valve.	Replace valve. See figure 5-6, step 6.
	Plugged suction filter.	Remove suction filter, clean, and replace. See figure 4-3.

TABLE 3-1. TROUBLE ANALYSIS CHECK CHART (Sheet 3 of 4)

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Overheating (Cont.)	High cooling oil pressure.	Check cooling oil pressure. Replace cooling oil relief valve assembly if reading is over 10 PSI at the forward or reverse port. See figure 5-2.
	Insufficient clutch assembly clearance.	Adjust to correct clearance. See figure 5-15, step 10.
	Check causes listed above.	Check all points listed above.
Variation of Pressure Between Ports	Control valve spool travel improperly adjusted.	Check spools for correct travel. Refer to paragraph 4-18.
	Broken cast iron seal rings on the bevel gear shaft.	Replace: a. The left-hand seal ring if low pressure is indicated when the selector lever is shifted to the FORWARD position.
		b. The right-hand seal ring if low pressure is indicated when the selector lever is shifted into REVERSE position.
		NOTE: A broken seal ring is the most common cause of a pressure differential between the two clutches. Check preload on bevel gear shaft and adjust if necessary to prevent additional breakage of seal rings. See figure 5-5.
	Damaged bevel gear shaft seal ring grooves.	Check grooves for taper, scoring, and rust. Replace or rebuild shaft if mating surfaces between the inner side of groove and seal ring are not flat.
	Damaged bevel gear shaft bearing retainers.	Check retainers for grooves, scoring, and rust. Replace retainers if found defective.
	Defective spline seals on the bevel gear shaft.	Always replace these seals when the bevel gear shaft has been removed. See figure 5-19.
	Damaged clutch piston retainer or O-rings.	Check piston retainer cavity for damage. Replace if scored or broken. Always replace both O-rings when clutch is repaired. See figure 5-15, step 1.
Oil Brake Slipping	Worn friction discs.	Replace the friction discs and the separator plates if scored. See figure 5-20.
	Notches worn in brake assembly cage or hub.	Replace the cage and/or hub. See figure 5-20.
	Broken belleville spring.	Replace with a new spring. See figure 5-20.

TABLE 3-1. TROUBLE ANALYSIS CHECK CHART (Sheet 4 of 4)

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Instant Shifting	D-20 Selector spool.	Replace with D-23 Selector spool.
High Oil Level	Engine oil transferring past pump shaft seal into winch hydraulic system.	Replace pump shaft seal. Refer to paragraph 5-13.

4-1. GENERAL.

4-2. This section contains instructions for performing SafeGuard Maintenance, adjustment of control linkage and the hydraulic system, and for unit painting. All instructions given in this section may be performed using standard shop tools. No special tools are required.

4-3. SAFEGUARD MAINTENANCE.

4-4. Safeguard Maintenance is a planned maintenance program which includes periodic inspection and lubrication. SafeGuard Maintenance should be correlated closely with the operating hours recorded on the tractor SERVICE METER.

4-5. SAFEGUARD MAINTENANCE AND SERVICE INSPECTION SCHEDULE. (Refer to Table 4-1.)

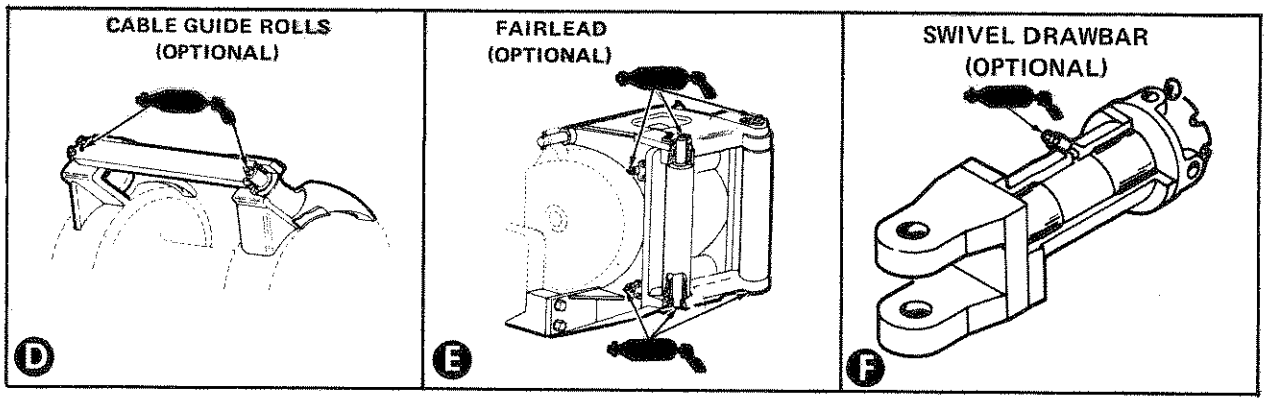
4-6. The following table is outlined in two schedules; the hourly schedule and the periodic schedule. If the unit is operated more than 8 hours per day, the hourly schedule should be followed. If the unit is operated 8 hours or less per day, the periodic schedule should be followed.

TABLE 4-1. SAFEGUARD MAINTENANCE AND SERVICE INSPECTION SCHEDULE (Sheet 1 of 2)

REFER TO FIG. NO.	ITEM	SCHEDULE (HOUR/PERIOD) 8/ Day	50/ Wk	500/ 3 Mo.	1000/ 6 Mo.	QUANTITY	TYPE	PROCEDURE
4-1	Oil Level				CHANGE	22 Gals.	SAE 10, MIL-L-2104B NOTE: Series 3 oil may be substituted for 2104B. In temperatures -10°F and lower, it may be necessary to dilute oil with kerosene so that it will be fluid enough to ensure free circulation. This should be done before stopping, then operate the winch for a few minutes to mix kerosene and oil. Evaporation in the winch reservoir under steady operation may make it necessary to again add kerosene to maintain proper fluidity.	Check winch oil level at plug (A) on right-hand side of winch. Add oil as required at plug (B). Drain oil at plug (C) as required. **NOTE:** When checking oil level, stop the tractor engine to obtain correct reading. **CAUTION:** If winch is new, drain after 50 hours of operation, then flush and refill.

TABLE 4-1. SAFEGUARD MAINTENANCE AND SERVICE INSPECTION SCHEDULE (Sheet 2 of 2)

REFER TO FIG. NO.	ITEM	SCHEDULE (HOUR/PERIOD) 8/ Day	50/ Wk	500/ 3 Mo.	1000/ 6 Mo.	QUANTITY	TYPE	PROCEDURE
2-1 2-2	Handling Gear	√				Few Drops	SAE 30	Lubricate pivot points and other moving parts at end of each 8 hour shift.
4-2	Pressure Filter			C H A N G E			Refer to applicable parts manual.	Replace with Hyster Approved filter. Coat O-ring and backup ring with film of multi-purpose grease to ensure a leakproof seal between filter head and case.
4-3 5-22	Suction Filter			S E R V I C E		One	Refer to applicable parts manual.	Remove suction filter (D), clean thoroughly and re-install. CAUTION: Suction manifold cover gasket must be in good condition to prevent air leaks. Replace with Hyster Approved gasket.
5-28	Suction Hose Clamps		√					Check both ends of suction hose to see that hose clamps are tight. Retighten as necessary.
5-1	Control Cables		√					Check both ends of each cable housing to see that they are securely anchored. Retighten setscrew as required.
4-1	Cable Guide Rolls (Optional)	√					Multi-purpose grease.	Lubricate two grease fittings as required.
4-1	Fairlead (Optional	√					Multi-purpose grease.	Lubricate six grease fittings as required.
4-1	Swiveling Drawbar (Optional)	√					Multi-purpose grease.	Lubricate one grease fitting as required.



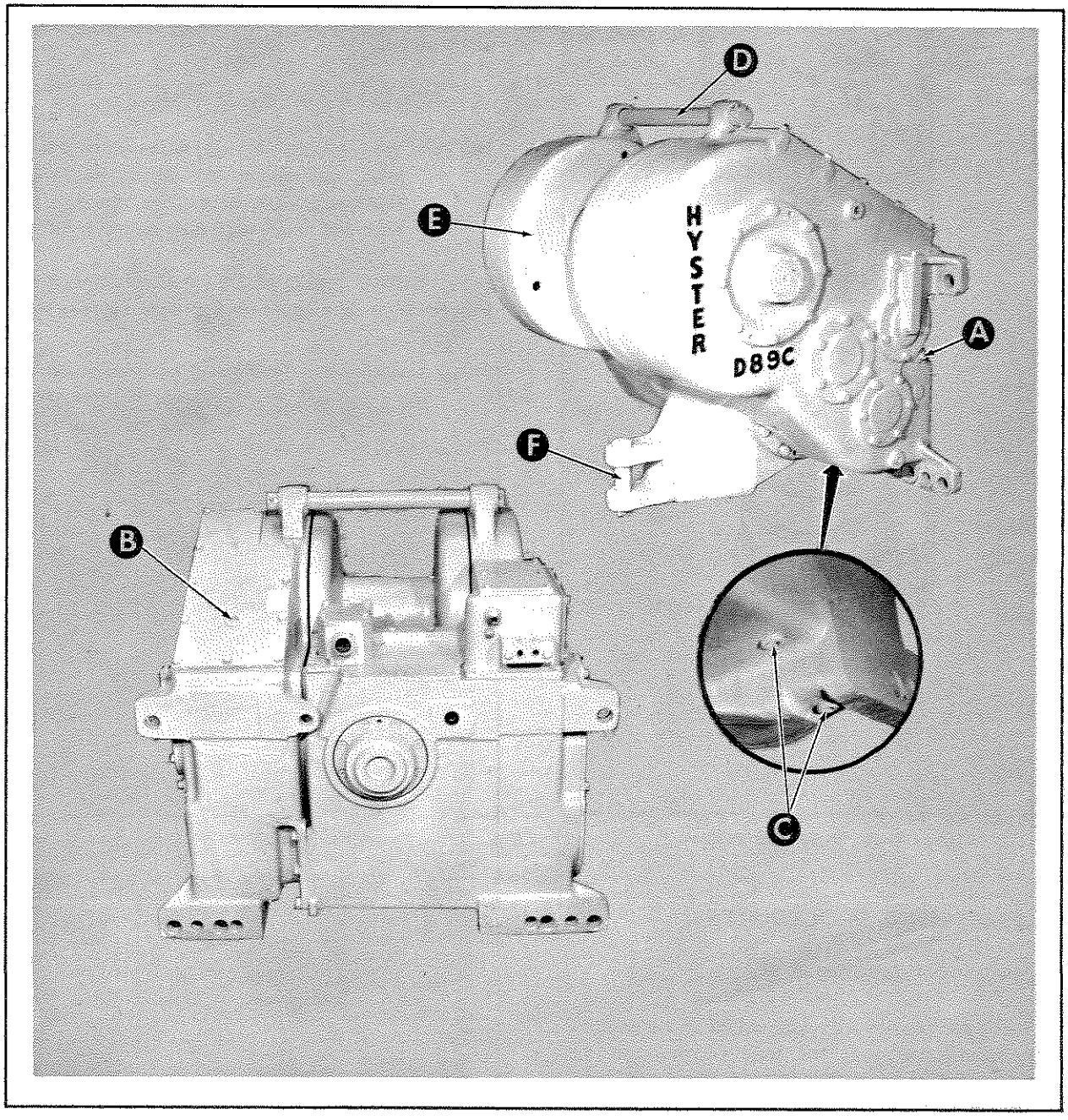


Figure 4-1. SafeGuard Maintenance Diagram

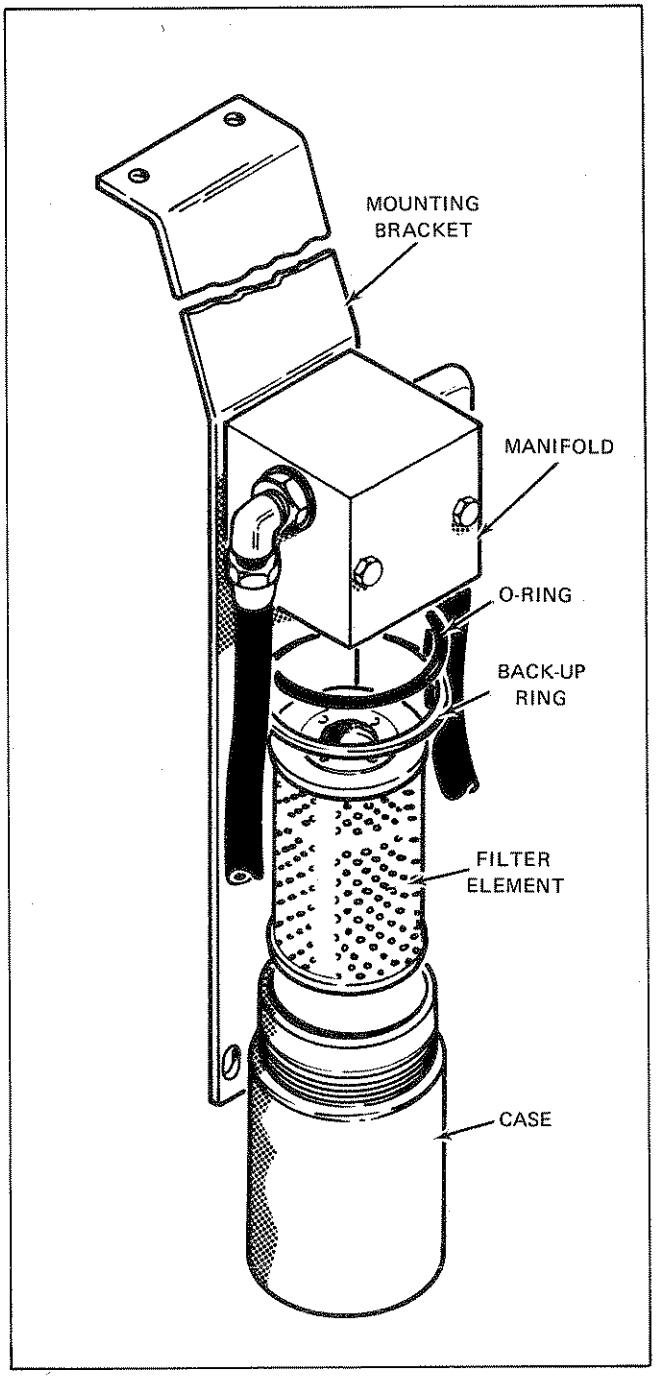


Figure 4-2. Pressure Filter

4-7. ADJUSTMENT PROCEDURES.

4-8. Overwind Adjustments.

4-9. The winch is normally assembled at the factory for Overwind operation, but may be ordered for Underwind when desired. When assembled for overwind, the cable passes over the top of the drum when the winch is hauling-in line. When assembled for underwind, the cable passes under the drum. When a winch is initially assembled for underwind, and overwind operation is desired, rearrange the bevel gear shaft assembly and the winch drum as described in paragraphs 4-10 and 4-11.

4-10. BEVEL GEAR SHAFT ARRANGEMENT. (See Figure 4-4.) To arrange the bevel gear shaft assembly for overwind operation, proceed as follows:

a. Pull the bevel gear shaft from the right-hand side of the winch (see Figure 5-5) far enough to enable switching of the bevel gear and the spacer.

b. Arrange the spacer and bevel gear so that the bevel gear meshes on the right-hand side of the PTO shaft pinion.

c. Reinstall the bevel gear shaft.

NOTE: This change in operation may affect gear lash, but should not affect shaft endplay. However, both should be checked and adjusted if necessary (see figure 5-19).

4-11. DRUM ASSEMBLY ARRANGEMENT. (See Figure 4-4.) The cable on the drum must be anchored

Figure 4-3. Suction Filter

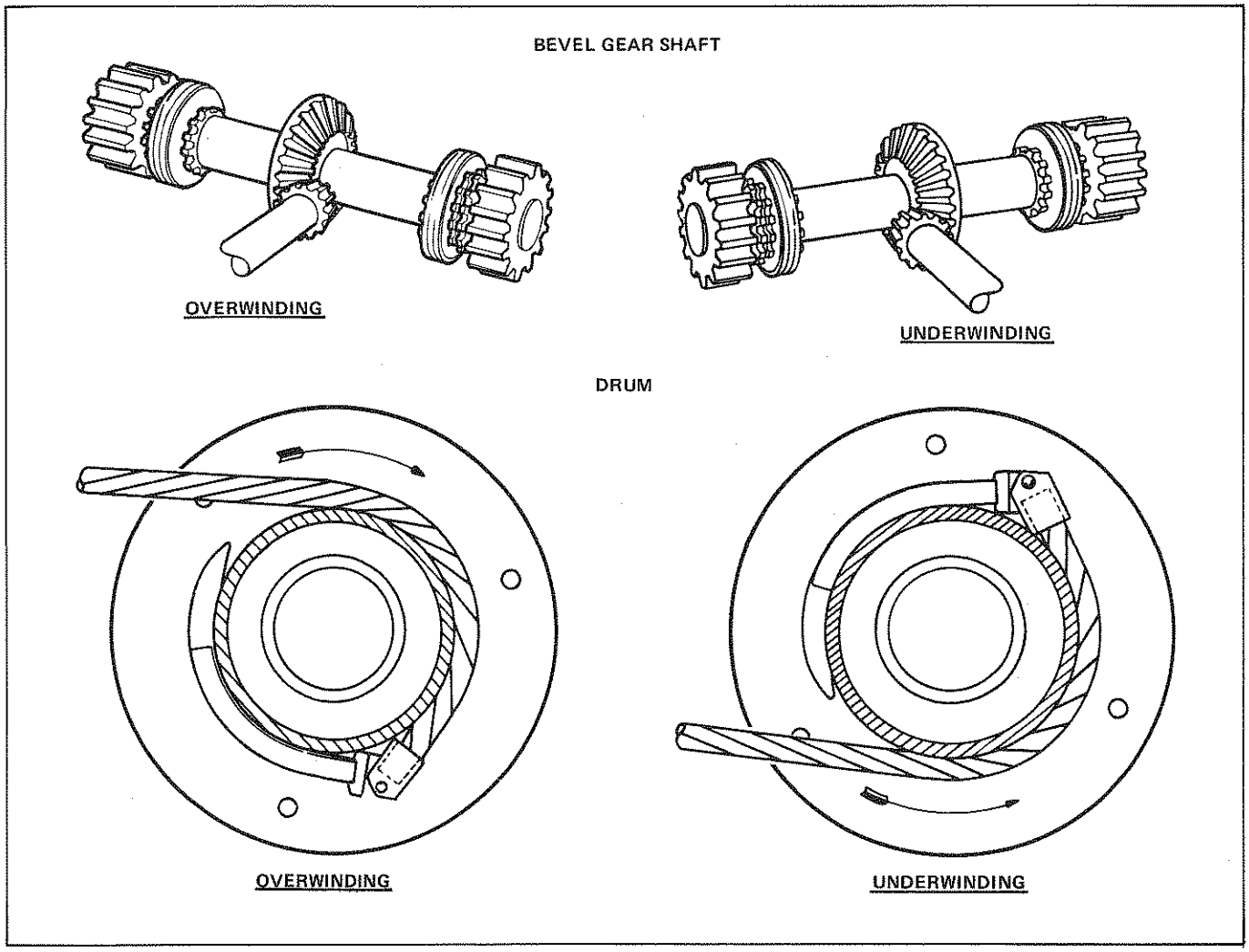


Figure 4-4. Overwind and Underwind Arrangement Diagram

and wound in the opposite direction when an underwind winch is rearranged for overwind. To set the drum assembly for overwind, proceed as follows:

a. Unwind the cable.

b. Remove the capscrew and lockwasher from the ferrule lock.

c. Remove the ferrule lock and ferrule.

d. Break or cut the tack welds securing the cable filler. Smooth the edges of the filler and drum groove.

e. Tack weld the cable filler at the opposite side of the drum as shown in figure 4-4.

f. Reinstall the ferrule and ferrule lock using the capscrew and lockwasher. Make sure that the capscrew is securely tightened.

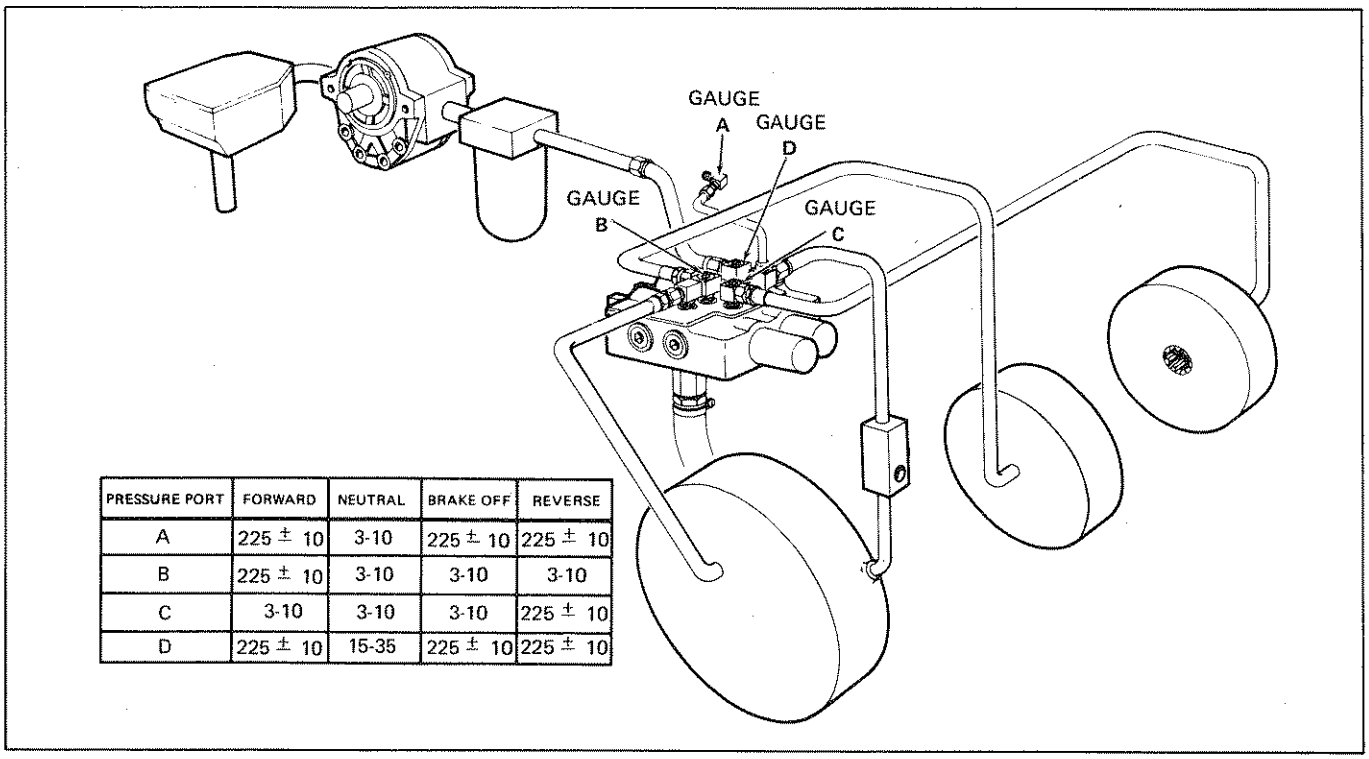
4-12. Underwind Adjustments. (See Figure 4-4.)

4-13. Paragraphs 4-10 and 4-11 list the procedures required for changing an underwind winch to overwind operation. To change an overwind winch to underwind operation, the same procedures must be followed, except that the bevel gear should mesh on the left-hand side of the PTO shaft pinion and the winch drum arranged as shown in figure 4-4.

4-14. Hydraulic System Pressure Checks. (See Figure 4-5.)

4-15. The following pressure checks should be performed periodically to ensure that the hydraulic system is functioning properly.

NOTE: Winch oil pressure should be at least 70°F before making pressure checks.



PRESSURE PORT	FORWARD	NEUTRAL	BRAKE OFF	REVERSE
A	225 ± 10	3-10	225 ± 10	225 ± 10
B	225 ± 10	3-10	3-10	3-10
C	3-10	3-10	3-10	225 ± 10
D	225 ± 10	15-35	225 ± 10	225 ± 10

Figure 4-5. Hydraulic System Pressure Check Diagram

a. Remove the cable from the drum to prevent entanglement during operation.

WARNING: Tractor engine must be OFF before disconnecting pressure lines.

b. Disconnect the small pressure line from the front of the control valve housing. Connect a 400 PSI gauge to the bulkhead fitting (Port A). This will eliminate the possibility of inaccurate readings from a faulty winch brake oil pressure gauge.

c. Start the engine and set engine speed at 1000 RPM.

d. Place the hydraulic system in NORMAL CONTROL. On Earlier Production Handling Gear, this is accomplished by moving the Control Lever to the Down position. On Current Production Handling Gear, this is accomplished by locking the Inching Lever in the BRAKE OFF position.

e. Check the pressure when the Selector Lever is moved to the FORWARD, BRAKE OFF, and REVERSE positions. These pressures should be 225 (±10) PSI. If these three pressures ARE WITHIN 7 PSI OF EACH OTHER, but not 225 (±10) PSI, then:

1. Remove the cover from the control valve housing.

2. Change the relief pressure by turning the relief pressure adjusting screw IN to increase pressure or OUT to decrease pressure.

If these three pressures ARE NOT WITHIN 7 PSI OF EACH OTHER, then perform steps f, g, and h.

f. Remove the plugs from the Forward (B) and Reverse (C) ports. Install a 400 PSI gauge in each port.

g. Check the Control Cable Adjustment and make necessary adjustments to correct pressures. (Refer to paragraph 4-16.)

h. To check the COOLING OIL pressure (non-adjustable), engage the Forward clutch and note the pressure indicated at the Reverse port. Pressure should be 3-10 PSI. Engage the Reverse clutch with low pressure gauge in Forward port and note the pressure. Pressure should be 3-10 PSI.

CAUTION: Do not engage the reverse clutch with low-pressure gauge in Reverse port.

NOTE: The high pressure (225 ±10 PSI) is clutch lock-up pressure. The low pressure (3-10 PSI) is cooling oil pressure.

4-16. Control Cable Adjustments. (See Figure 4-6.)

4-17. Two teflon-lined control cables connect the handling gear assembly to the winch control valve. Make certain that each control cable housing is securely anchored on each end before making any adjustments. The control cable adjustment determines spool travel in the control valve. The distance each spool travels is extremely important. In all cases, the spools are stopped internally at their extremes and should be adjusted to these locations. The correct spool travel should be obtained first, then the measured spool travel should be double checked by making pressure checks when the winch is operating.

4-18. MEASURING SPOOL TRAVEL. Adjust the cable ends so that the following spool movement is obtained:

NOTE: The position that the spools assume before the cables are connected is the Spool Neutral position. In this position, the spool end should protrude about 1-1/4 inch from the valve retainer plate.

a. The Inching spool (D9) should move Out 11/16-inch from its neutral position when the Control Lever (earlier production) is moved Down and Locked or when the Inching Lever (current production) is moved from the BRAKE ON position to the BRAKE OFF position.

NOTE: The spool stamped D-20 was used in earlier production control valves. The spool stamped D-23 is used in current production control valves. These spool assemblies are interchangeable; however, they DO NOT have the same travel.

b. The Selector spool should move In 3/16-inch (D-23) or 3/8-inch (D-20) from the Neutral position when the Selector Lever is moved to FORWARD.

c. The Selector spool should move Out 19/32-inch (D-23) or 7/16-inch (D-20) from the Neutral position when the Selector Lever is moved to BRAKE OFF. (Spools marked D-23 are detented to this position.)

d. The Selector spool should move Out 3/4-inch (D-23) or 9/16-inch (D-20) from the Neutral position when the Selector Lever is moved to REVERSE.

4-19. SPOOL TRAVEL PRESSURE CHECKS. The spool travel must be correct to obtain normal operating pressures. The handlever ends of the control cables should be adjusted to obtain maximum pressure readings (except in Neutral) when the Selector Lever is moved to the following positions:

NOTE: The Control Lever (earlier production) must be Down and Locked or the Inching Lever (current production) must be in the BRAKE OFF position.

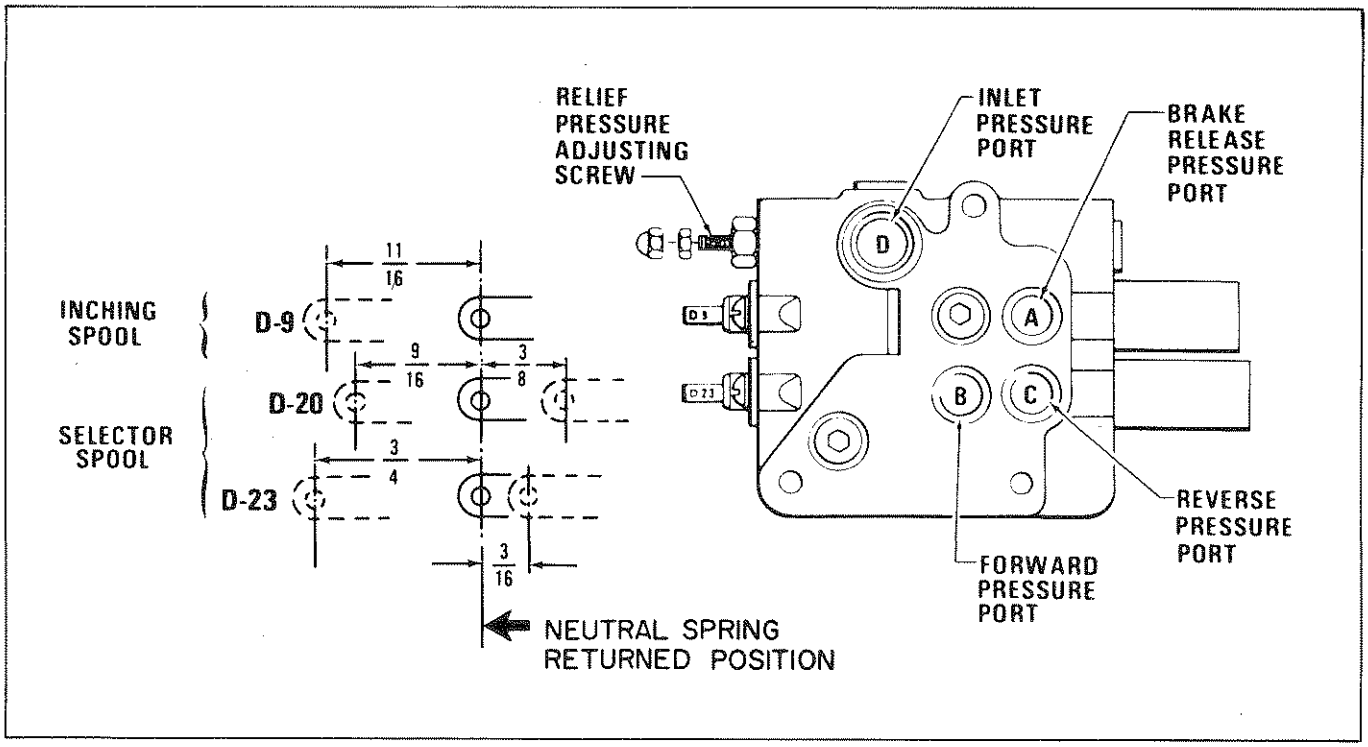


Figure 4-6. Control Cable Adjustment Diagram

a. In FORWARD, the pressure should be 225 (±10) PSI at the Forward, Inlet and Brake Release ports.

b. In NEUTRAL, the pressure should be 15 - 35 PSI at the Inlet port.

c. In BRAKE OFF, the pressure should be 225 (±10) PSI at the Brake and Inlet ports.

d. In REVERSE, the pressure should be 225 (±10) PSI at the Reverse, Inlet and Brake Release ports.

4-20. UNIT PAINTING. (See Figure 4-7.)

4-21. Upon completion of unit overhaul or major repairs, paint the exterior section of the winch as follows:

a. Remove any corrosion or peeling paint using a stiff wire brush or coarse sandpaper.

b. Touch-up bare metal surfaces using zinc chromate primer. Allow primer to air-dry for four hours.

c. Install all bearing retainers and covers. Cover the winch Nameplate and Caution decal with masking tape.

d. Spray paint the entire external surface of the winch with HYSTER YELLOW Enamel.

e. Touch-up the D89C Model Designation and HYSTER letters using black enamel.

4-22. DECAL AND NAMEPLATE INSTALLATION.

4-23. A Caution Decal is located on the drum gear cover as shown in Figure 4-7. Make sure that all markings on the decal are clearly legible and that the decal is installed in the correct location. If the decal has been lost or damaged, install a new decal in the proper location as shown in Figure 4-7.

4-24. The Unit Nameplate is located on the left-hand side of the winch housing above the drum shaft nut as shown in Figure 4-7. Data contained on the nameplate is given in paragraph 1-3. If the nameplate has been damaged, install a new nameplate in the proper location. Use drive screws for nameplate installation.

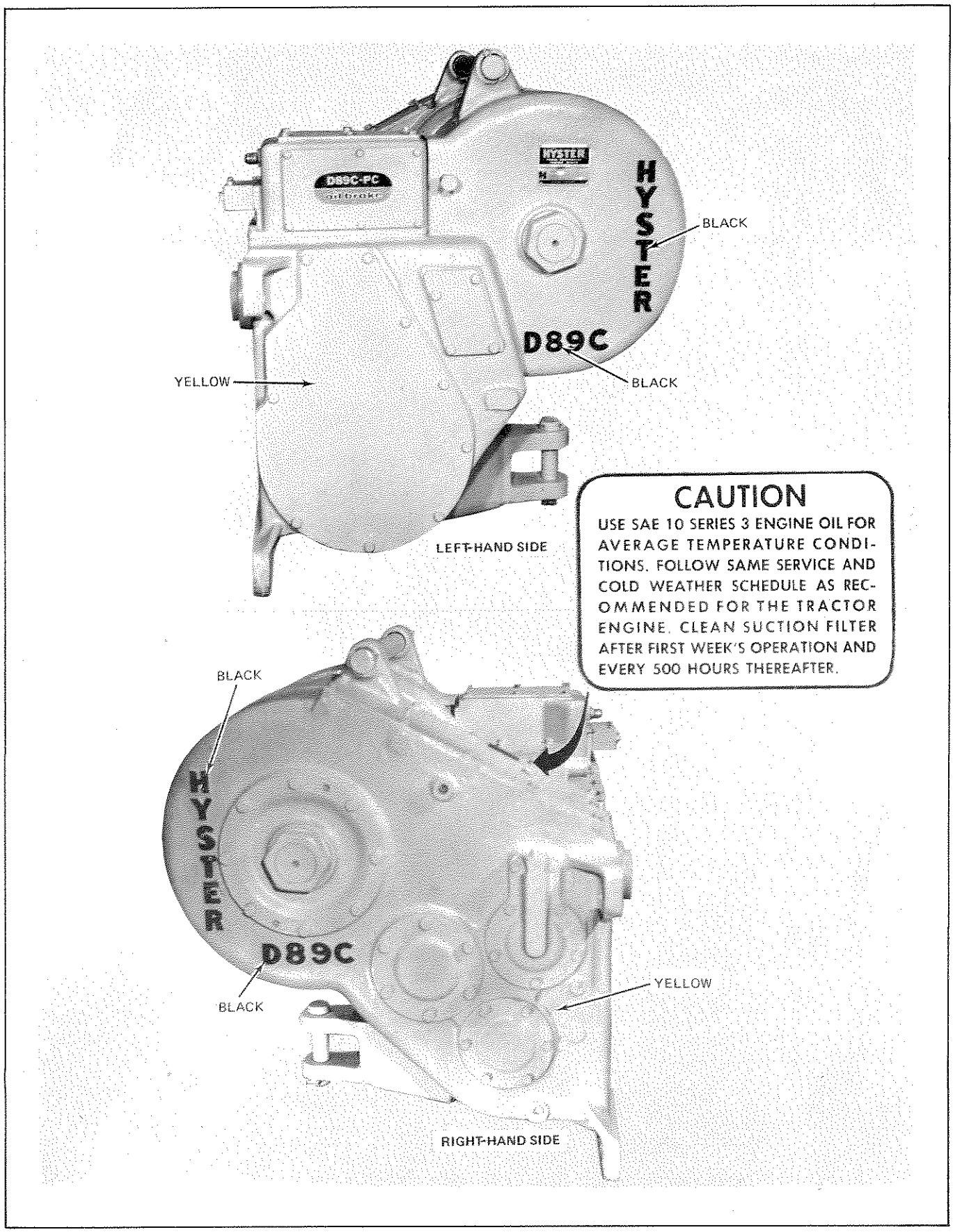


Figure 4-7. Painting and Decal Installation

OVERHAUL INSTRUCTIONS

5-1. GENERAL.

5-2. This section contains overhaul instructions for the D89C Power Controlled Winch. Overhaul instructions include removal of the winch from the tractor, removal and disassembly of all major shaft assemblies, inspection of components, reassembly and installation. Micrometer symbols have been added to the disassembly illustrations to show critical wear points. It is recommended that these measurements be taken at the time of disassembly so that defective parts may be ordered and replaced prior to reassembly. If a winch is to be completely overhauled, perform the removal and disassembly, inspection, and reassembly procedures in the sequence of the following paragraphs. Always use the trouble-shooting procedures given in Section 3 to locate a malfunction before performing major overhaul of the unit. Make all checks in a systematic manner. Haphazard checking wastes time and can cause further damage. Review and perform any adjustments that may be the cause of a malfunction (refer to Section 4).

5-3. REMOVAL AND DISASSEMBLY INSTRUCTIONS.

5-4. Removal of Winch from Tractor.

5-5. All major assemblies (except the brake shaft and PTO shaft) can be removed with the winch mounted on the tractor. Most major components of the brake shaft can be removed with the winch mounted, however, the brake shaft will not clear the tractor tracks for complete removal of the shaft. The winch must therefore be removed from the tractor before removing the brake shaft. Removal of the Power Controlled Winch is shown in figure 5-1. Make sure that the two control cables and three hydraulic hoses between the tractor and winch are removed before separating the winch from the mounting pad.

WARNING: Make sure that the lifting device has a minimum capacity of 4,500 pounds before lifting the winch off of the mounting pad.

5-6. Removal of Control Valve.

5-7. Access to the control valve may be obtained by removing the two control housing covers. When removing the control valve, the brake cover must also be removed for access to the hydraulic hose fittings. Removal of the hydraulic hoses and control cables is shown in Figure 5-1. Removal of the control valve is shown in Figure 5-2.

NOTE: Control valve repairs are given in paragraph 5-31.

5-8. Removal and Disassembly of PTO Shaft Assembly.

5-9. Removal and disassembly of the PTO shaft is shown in Figure 5-3. Before removing the PTO shaft assembly, the winch must be removed from the tractor as shown in Figure 5-1.

5-10. Removal and Disassembly of Oil Brake Assembly.

5-11. Removal and disassembly of the oil brake assembly used in the Power Controlled Winch is shown in Figure 5-4. Removal and disassembly of the oil brake can be accomplished while the winch is mounted on the tractor. During disassembly, place all parts in a clean container to protect from dust, dirt and moisture.

5-12. Removal and Disassembly of Bevel Gear Shaft Assembly.

5-13. Removal and disassembly of the bevel gear shaft assembly is shown in Figure 5-5. Removal of the bevel gear shaft and associated components can be accomplished with the winch mounted on the tractor. Prior to removal of the bevel gear shaft, perform the following:

a. Drain oil from winch (see Figure 4-1.)

b. Remove all brake components as shown in Figure 5-4.

c. Remove the hydraulic hose from the bearing retainer at each end of the bevel gear shaft.

5-14. Disassembly of Clutch Assemblies.

5-15. Disassembly of the clutch assembly is shown in Figure 5-6. Removal of the clutch assemblies is shown in Figure 5-5.

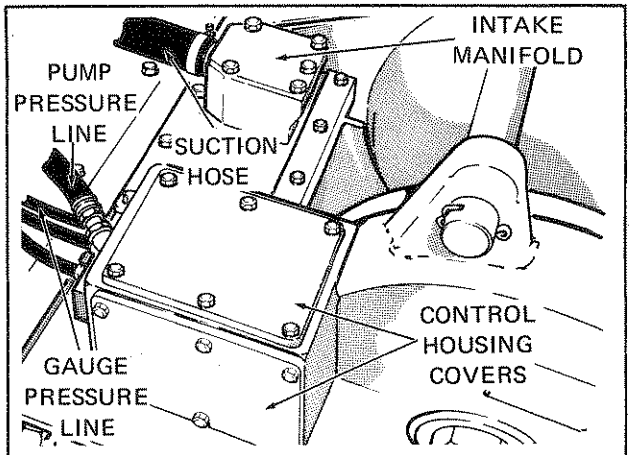
5-16. Removal of Brake Shaft Assembly.

5-17. Removal of the brake shaft assembly is shown in Figure 5-7. The brake shaft cannot be removed when the winch is mounted on the tractor. Prior to removal of the brake shaft assembly, perform the following:

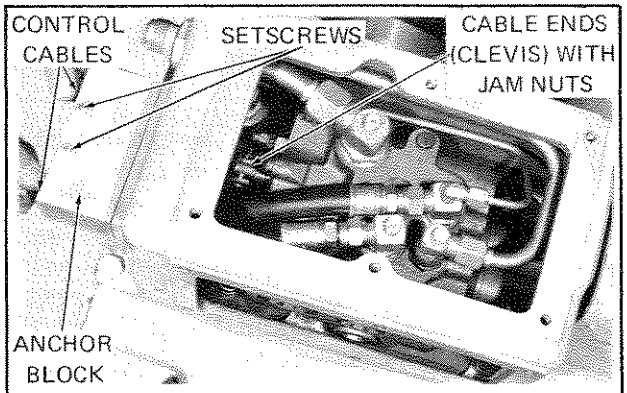
a. Remove the winch from the tractor (see Figure 5-1).

b. Drain oil from winch (see Figure 4-1).

c. Remove all brake components as shown in Figure 5-4.

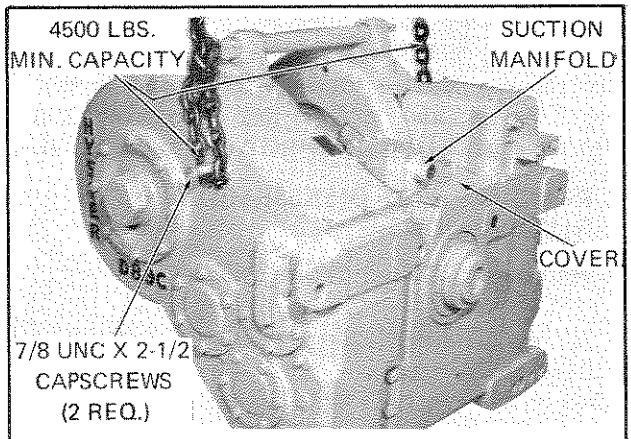


STEP 1. Remove suction hose from intake manifold. Disconnect pump pressure line and gauge pressure line.

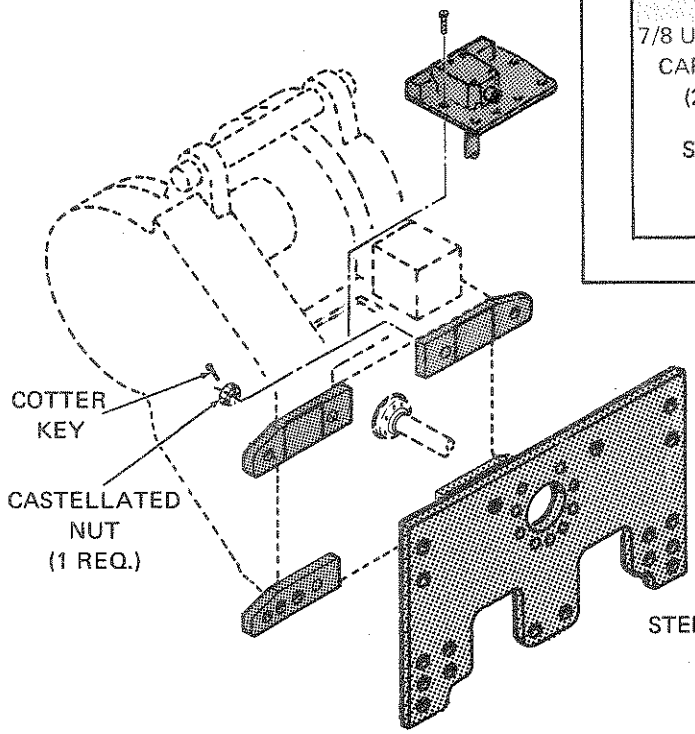


STEP 2. Loosen the two set screws on cable anchor block. Remove control housing covers, then disconnect the cable end (clevis) at end of each cable. Pull out cables.

NOTE: When removing the eight nuts, loosen all nuts slightly, then pry winch away from mounting pad. Loosen all nuts again and pry winch again. Continue this sequence until winch can be removed.

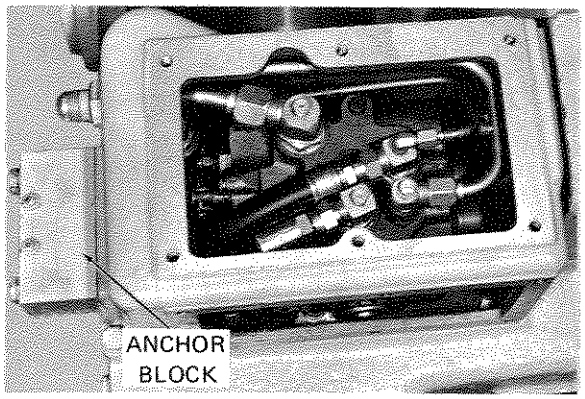


STEP 3. Connect lifting device to winch. Winch will be balanced when hoist is connected as shown.



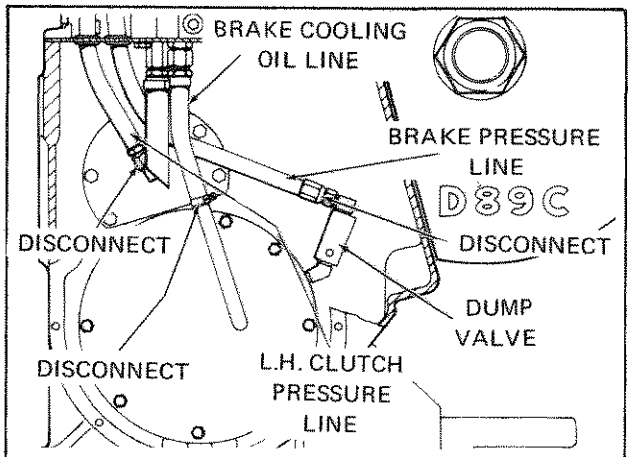
STEP 4. Remove suction manifold and cover. Remove the eight nuts and seven lock washers attaching winch to mounting pad.

Figure 5-1. Removal of Winch From Tractor

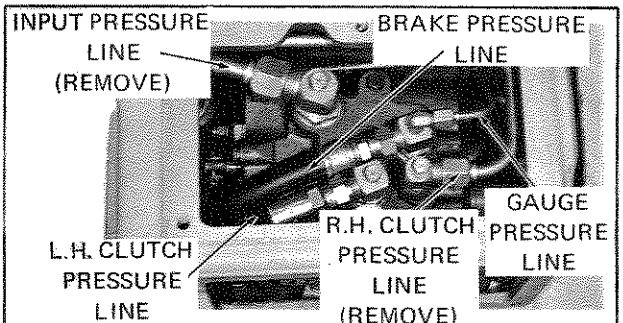


STEP 1. Remove the two control housing covers and cable anchor block.

NOTE: Remove control cables and hydraulic hoses as shown in Figure 5-1.

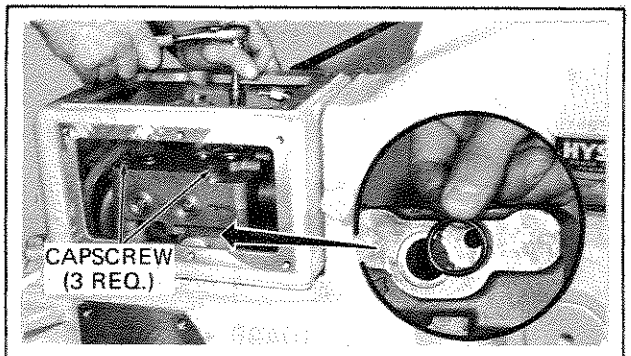


STEP 2. Disconnect the hydraulic hose from dump valve, oil brake cover, and left-hand bevel gear shaft retainer.

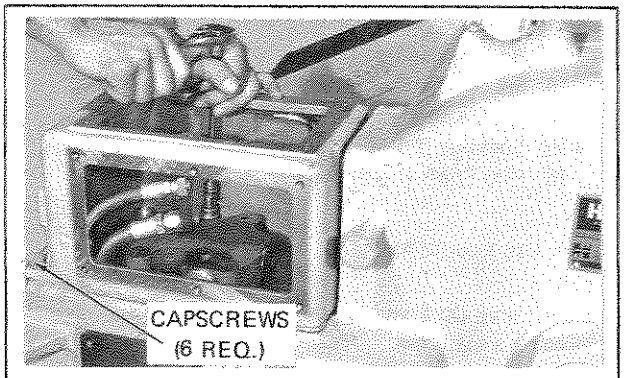


STEP 3. Disconnect left-hand clutch pressure line, oil brake pressure line and gauge pressure line from control valve. Completely remove right-hand clutch pressure line and input pressure line.

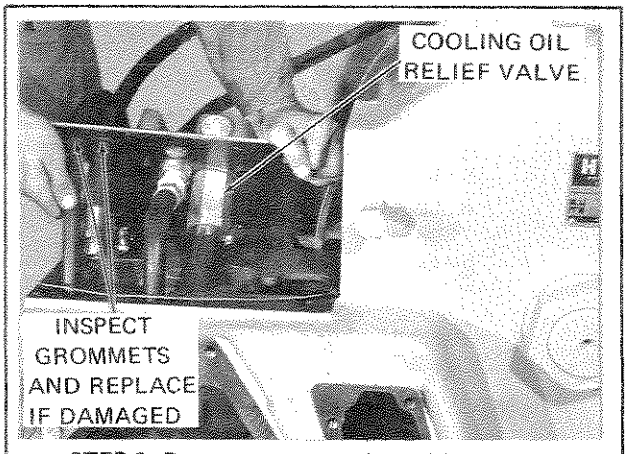
CAUTION: Do not pull the left-hand clutch pressure line or oil brake pressure line out of the two rubber grommets at this time (see step 6). Damage may result to the grommets.



STEP 4. Remove control valve by removing the three capscrews. It is necessary to remove fittings at the top of control valve prior to removing the valve. Tag all fittings for reference during reassembly.

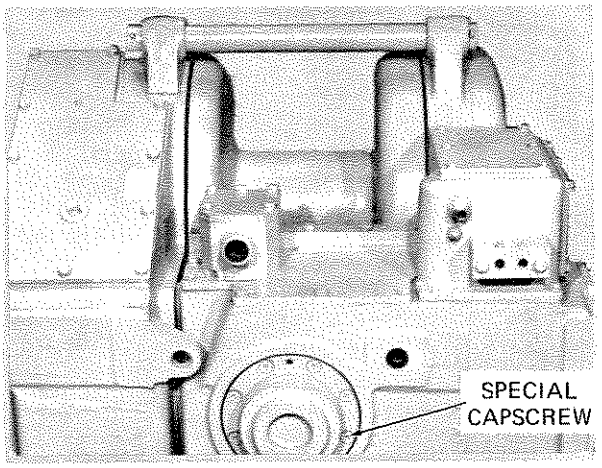


STEP 5. Remove control housing by removing the six capscrews.

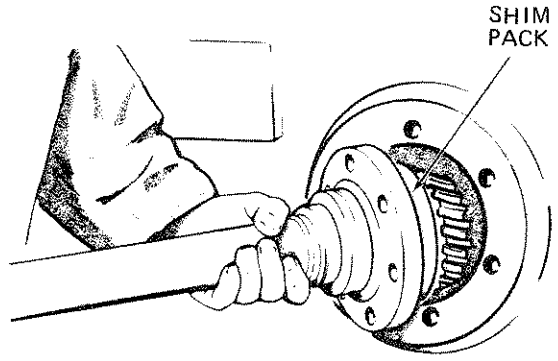


STEP 6. Remove mounting plate with hydraulic hoses attached. Inspect grommets and replace if damaged.

Figure 5-2. Removal of Control Valve Assembly

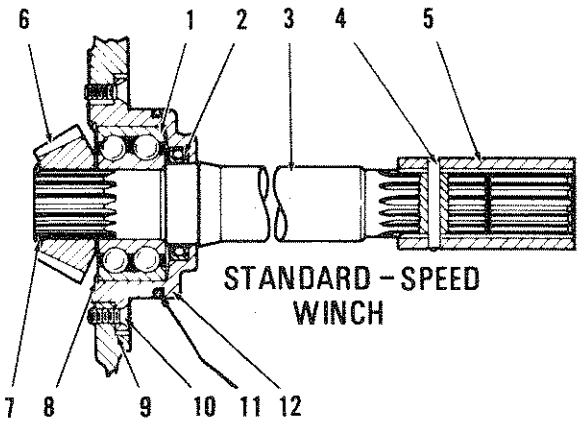


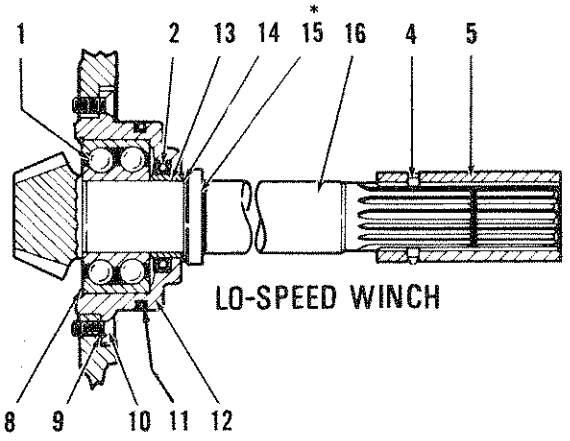
STEP 1. Remove the wire locking the six special capscrews, then remove the capscrews



STEP 2. Pull PTO shaft assembly straight out.

CAUTION: Tag the shim pack so that exact number of shims are re-installed.





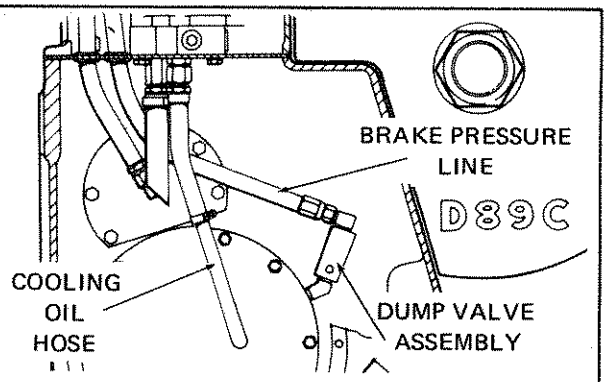
STEP 3. Disassemble PTO shaft as required

1. Bearing
2. Oil Seal
3. PTO Shaft (Std.-Speed Winch Only)
4. Lock Ring
5. Coupling
6. Spiral Bevel Gear (Std.-Speed Winch Only)
7. Snap Ring (Std.-Speed Winch Only)
8. Snap Ring
9. Shims
10. Capscrew (8 Req.)
11. O-Ring
12. Bearing Carrier
13. Spacer (Lo-Speed Winch Only)
14. Lockwasher (Lo-Speed Winch Only)
*15. Locknut (Lo-Speed Winch Only)
16. PTO Shaft (Lo-Speed Winch Only)

*Item 15 must be torqued to 100 FT-LBS (13.8 Kgm). Use Loctite No. 271.

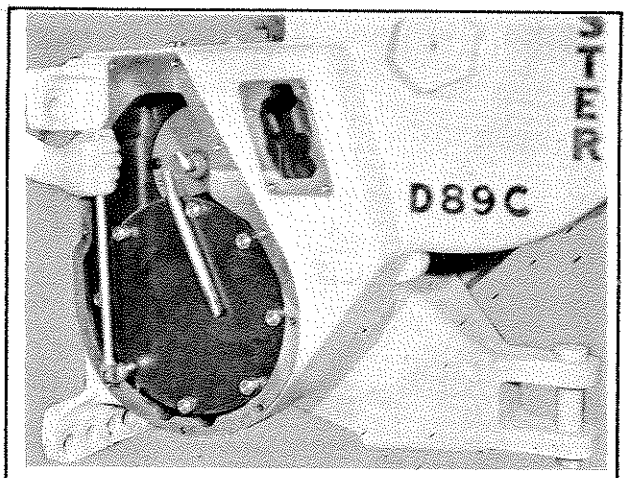
NOTE: On Lo-speed winches the PTO shaft and pinion are integral. On Standard speed winches, pinion gear is splined on the shaft and locked in place by a snap ring.

Figure 5-3. Removal and Disassembly of PTO Shaft Assembly

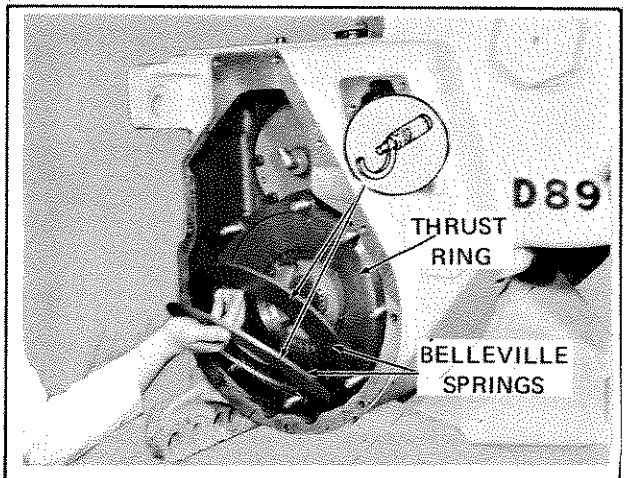


NOTE: Drain oil from winch (See figure 4-1) or position winch with left-hand side up. Remove brake assembly covers.

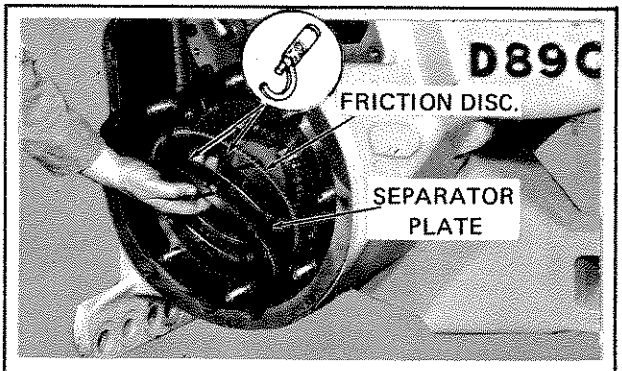
STEP 1. Remove cooling oil hose, brake pressure line and dump valve assembly.



STEP 2. Remove eight locknuts and lockwashers, then remove cover.

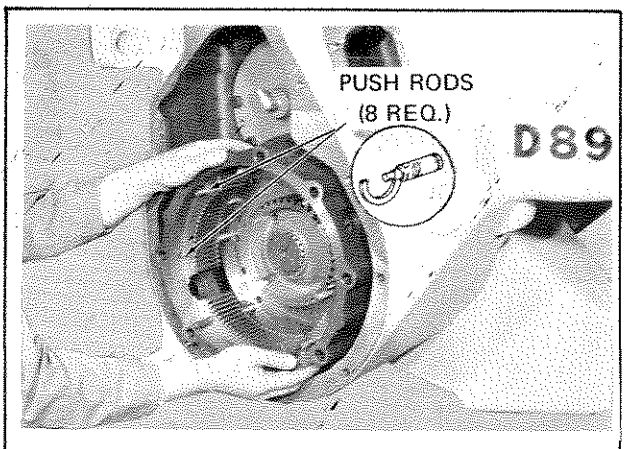


STEP 3. Remove the two belleville springs and thrust ring.

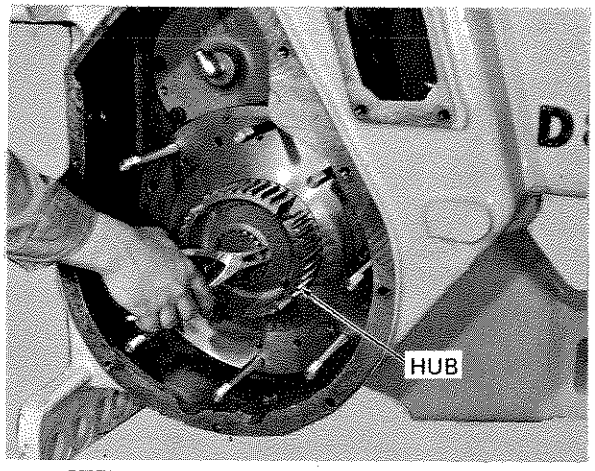


STEP 4. Remove the 11 friction discs and 10 separator plates from the hub.

CAUTION: Keep friction discs and separator plates in order. They must contact same mating surface when re-installed.

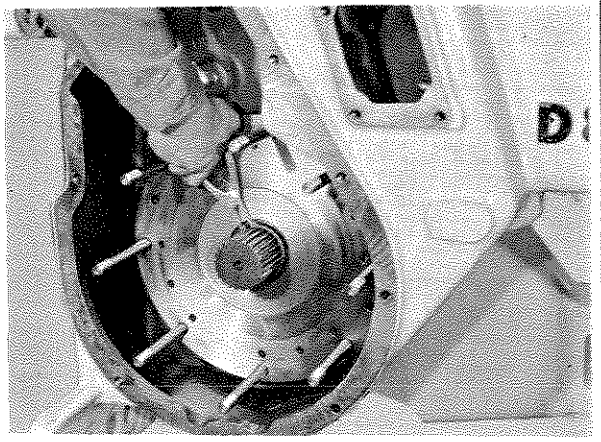


STEP 5. Remove cage from studs. It may be necessary to tap cage with soft hammer to loosen.

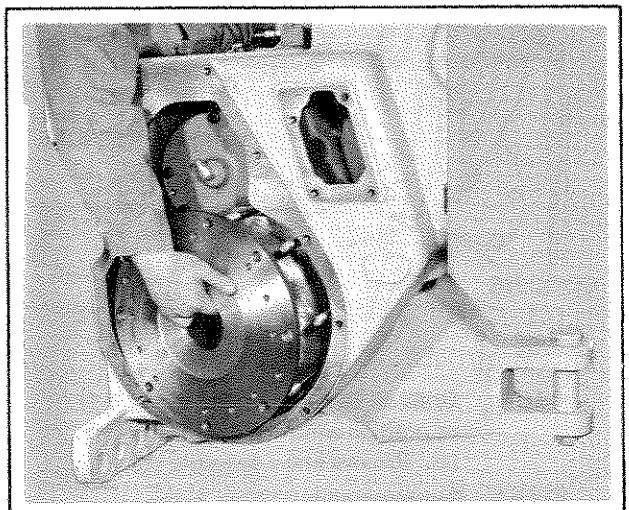


STEP 6. Remove snap ring from brake shaft, then pull off hub.

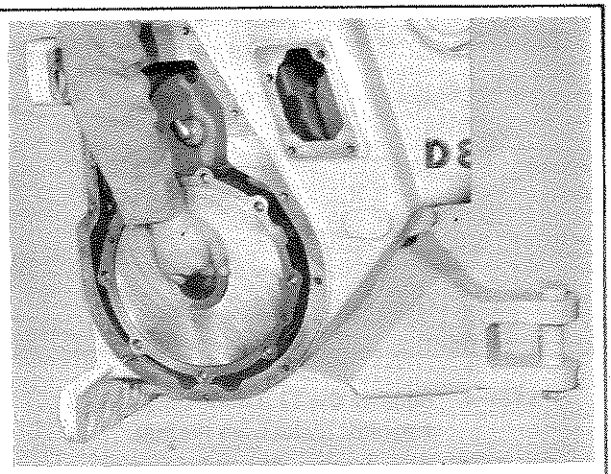
Figure 5-4. Removal and Disassembly of Oil Brake Assembly (Sheet 1 of 2)



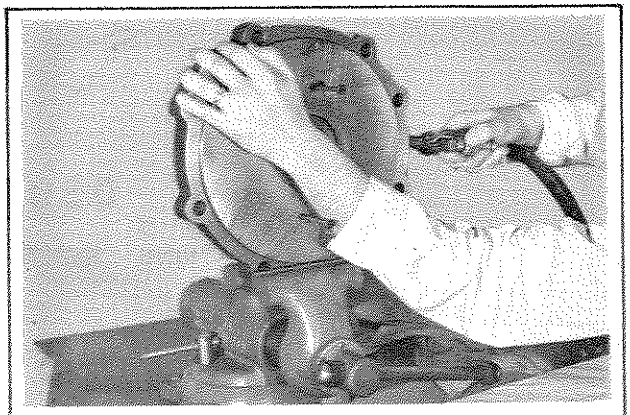
STEP 7. Early style shafts have a snap ring. Remove it. Newer shafts have a spacer. Remove it.



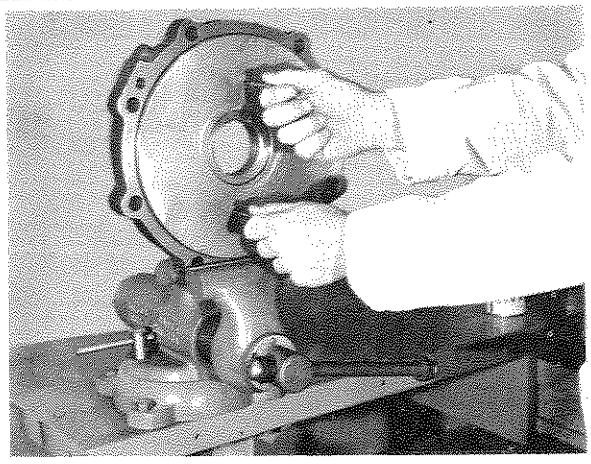
STEP 8. Remove pressure plate from studs.



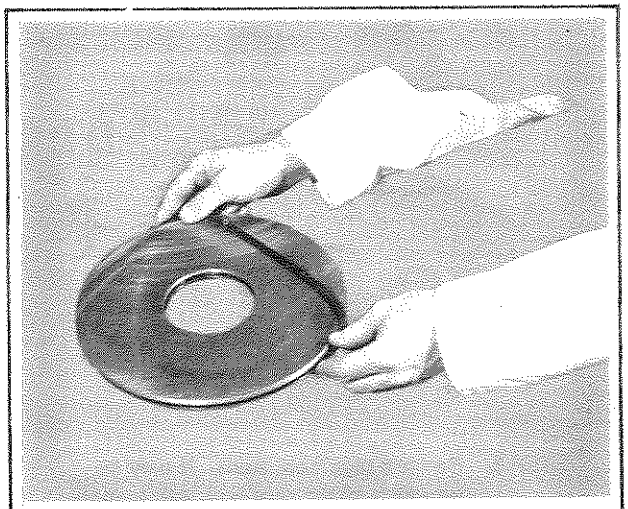
STEP 9. Remove piston housing with piston in place.



STEP 10. Place piston housing in vise. Start piston from housing by applying compressed air to piston housing pressure port.



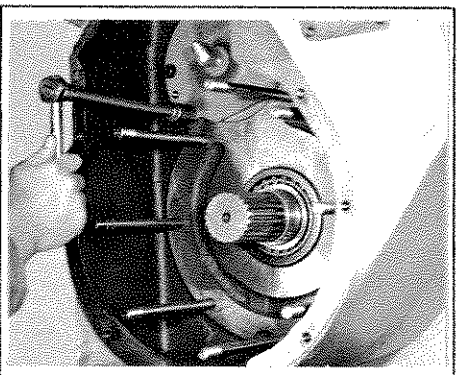
STEP 11. Pull piston out of housing using two 1/4-inch capscrews.



STEP 12. Remove the two O-rings from piston.

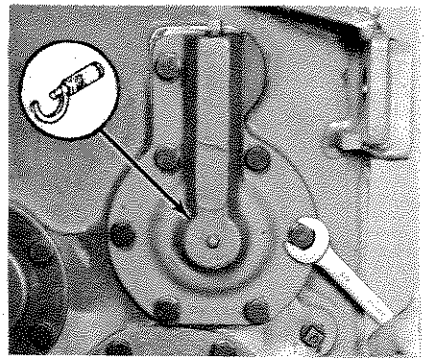
Figure 5-4. Removal and Disassembly of Oil Brake Assembly (Sheet 2 of 2)

NOTE: Prior to removal and disassembly of the bevel gear shaft assembly, perform the procedures given in paragraph 5-12



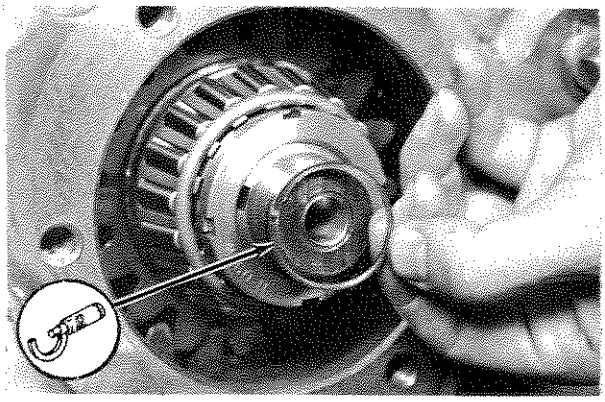
STEP 1. Remove left-hand bearing retainer with shims by removing the five capscrews.

NOTE: Keep shim pack with the retainer.

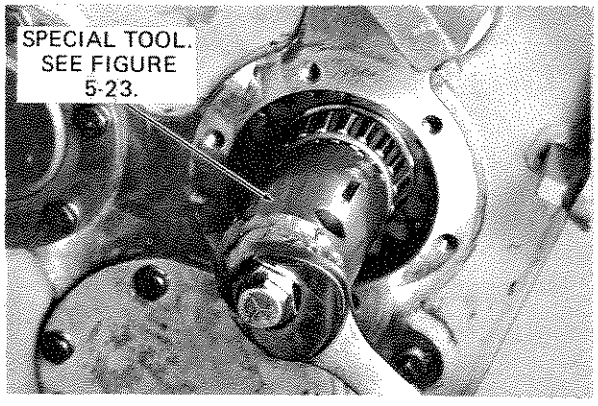


STEP 2. Remove right hand bearing retainer with shims by removing the seven capscrews.

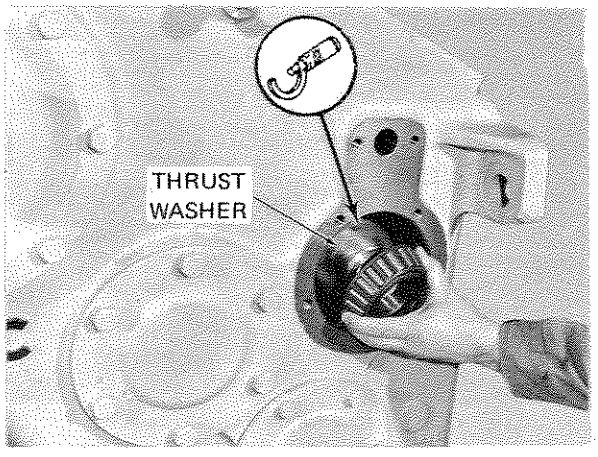
NOTE: Keep shim pack with the retainer



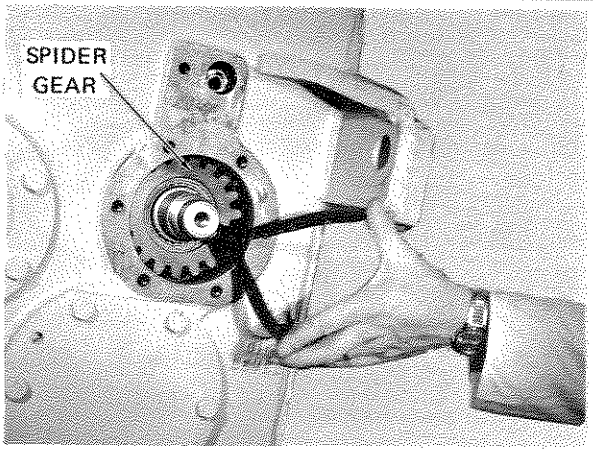
STEP 3. Remove cast-iron seal rings (one on each end of bevel gear shaft). Expand seal rings just enough to slip over the end of the shaft.



STEP 4. Straighten the lockwasher tangs securing the locknut. Remove locknut by turning counterclockwise. Remove lockwasher.

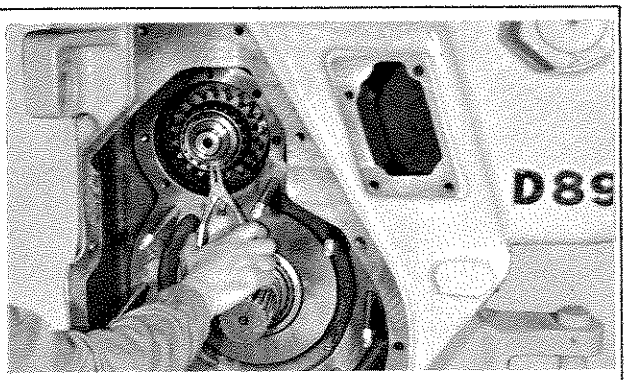


STEP 5. Remove taper roller bearing and thrust washer

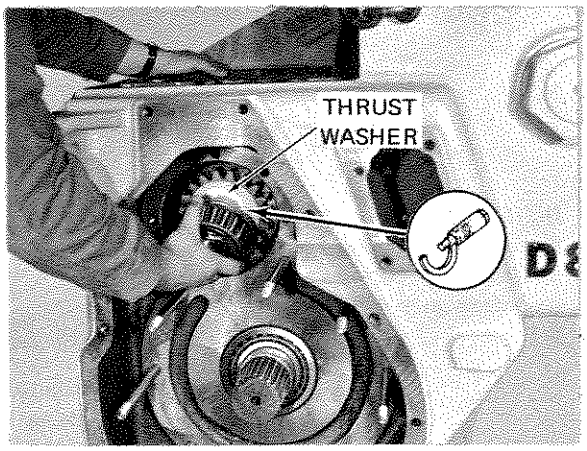


STEP 6. Remove the internal snap ring from the reverse spider gear bore.

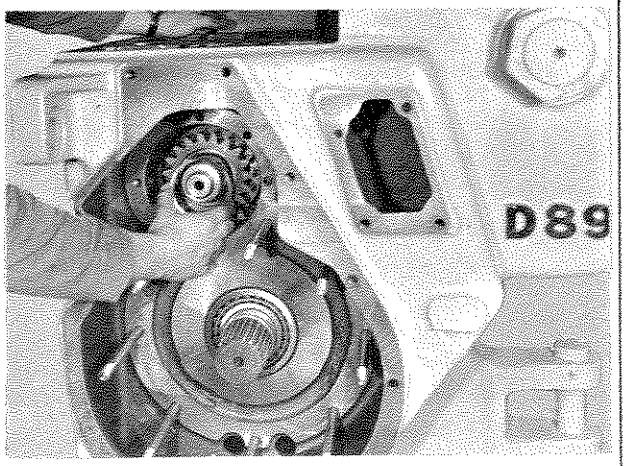
Figure 5-5. Removal and Disassembly of Bevel Gear Shaft Assembly (Sheet 1 of 3)



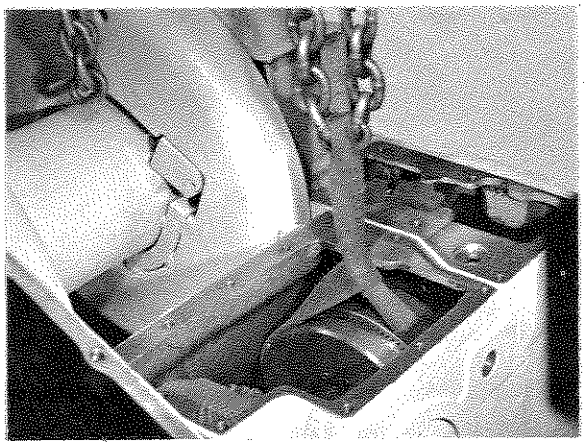
STEP 7. Remove external snap ring from left-hand end of the bevel gear shaft. It may be necessary to tap right-hand end of bevelgear shaft to relieve pressure on snap ring



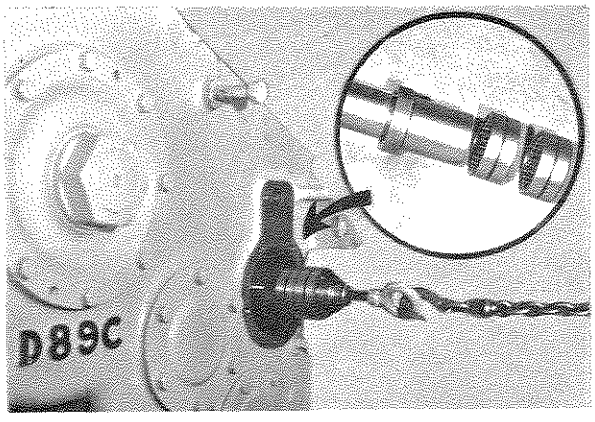
STEP 8. Remove taper roller bearing and thrust washer.



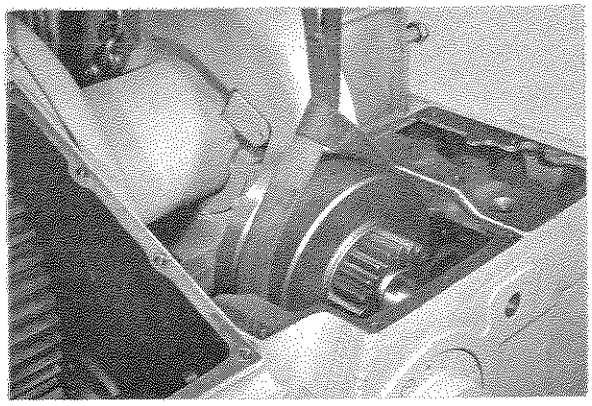
STEP 9. Remove the internal snap ring from the forward spider gear bore.



STEP 10. Install a sling around forward clutch assembly. Hoist until sling just starts to lift clutch assembly.

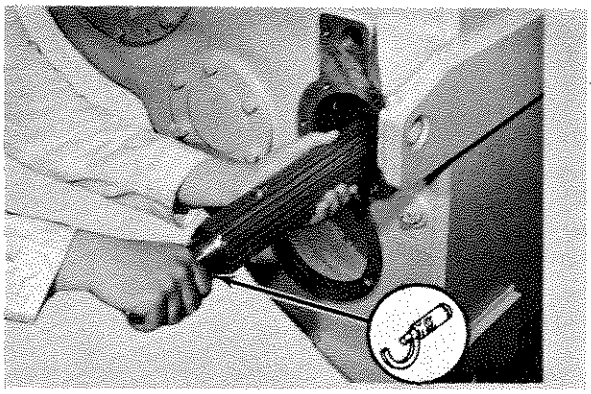


STEP 11. Pull bevel gear shaft straight out.
CAUTION: Pull out just far enough for removal of forward clutch assembly.

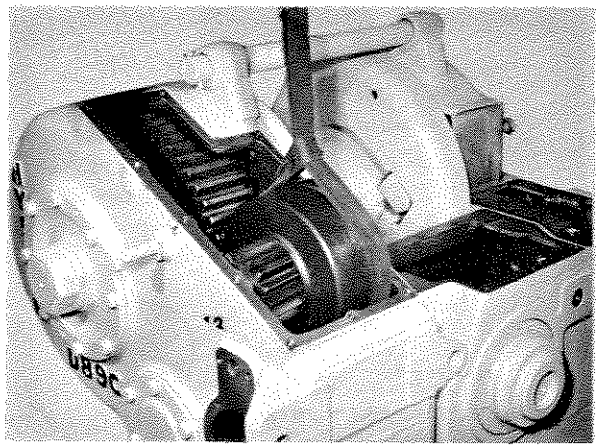


STEP 12. Remove forward clutch pack by rotating 90° from position shown. Lift straight out after rotating. Remove bevel gear and two spacers.

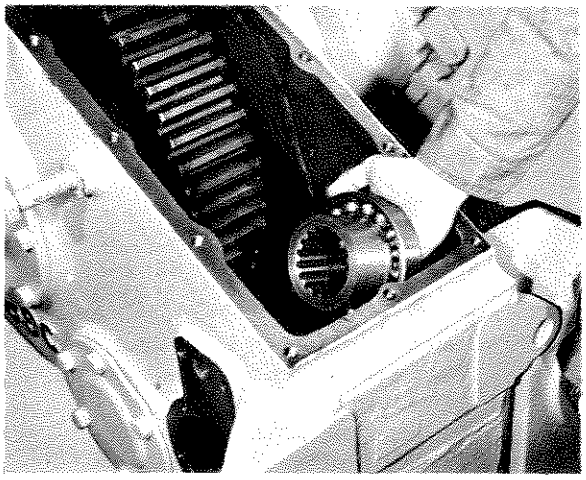
Figure 5-5. Removal and Disassembly of Bevel Gear Shaft Assembly (Sheet 2 of 3)



STEP 13. Install a sling around the reverse clutch pack. Hoist until sling just starts to lift clutch pack, then remove bevel gear shaft.



STEP 14. Remove reverse clutch assembly and center bearing.



STEP 15. Remove ball bearing.

1. RH Bearing Retainer
2. Capscrew
3. Lockwasher
4. Bearing Cup
5. Bearing Cone
6. Reverse Spider
7. Reverse Clutch Assembly
8. Bevel Gear Hub
9. Rivet
10. Spiral Bevel Gear
11. Ball Bearing
12. O-Ring
13. Spacer (LH)
14. Bearing Carrier
15. Shims
16. LH Bearing Retainer
17. Seal Ring
18. Snap Ring (External)
19. Washer
20. Snap Ring (Internal)
21. Roller Bearing
22. Spacer (RH)
23. Spacer (Center)
24. Seal (Two-Teeth)
25. Seal (Three-Teeth)
26. Locknut
27. Lockwasher

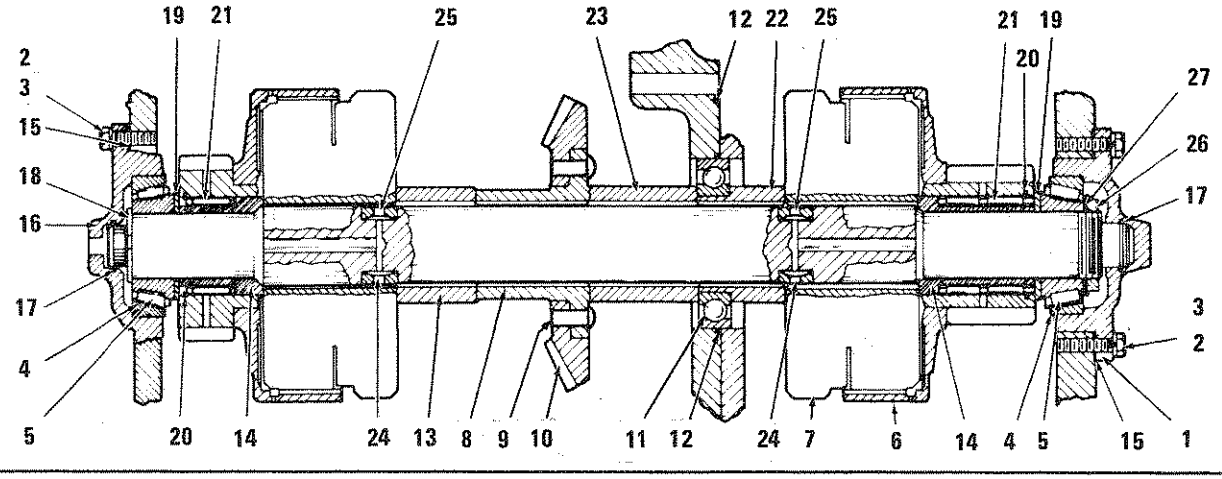
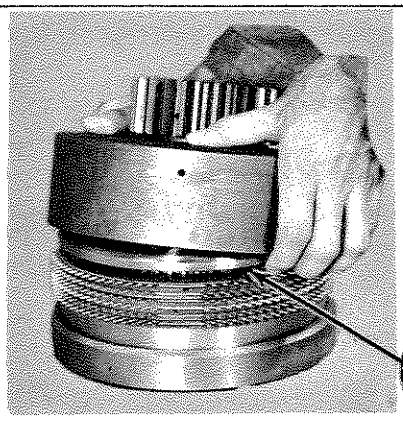
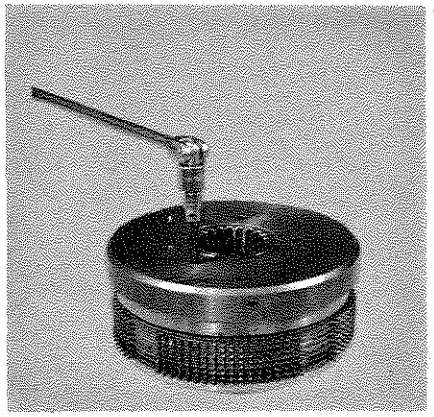


Figure 5-5. Removal and Disassembly of Bevel Gear Shaft Assembly (Sheet 3 of 3)

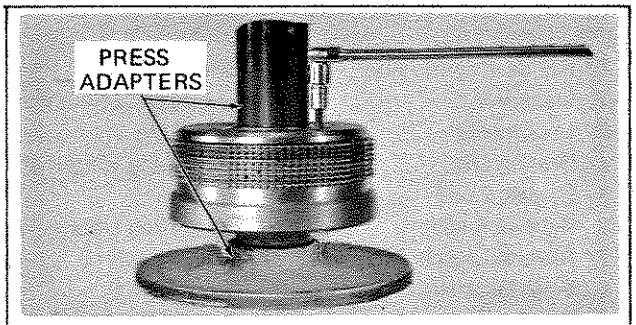


NOTE: Two feeler gauges placed 180° apart are required to obtain an accurate measurement. (See Step 10 figure 5- 15.)

STEP 1. Lift spider gear from clutch pack. Measure clearance between cover plate and friction disc.

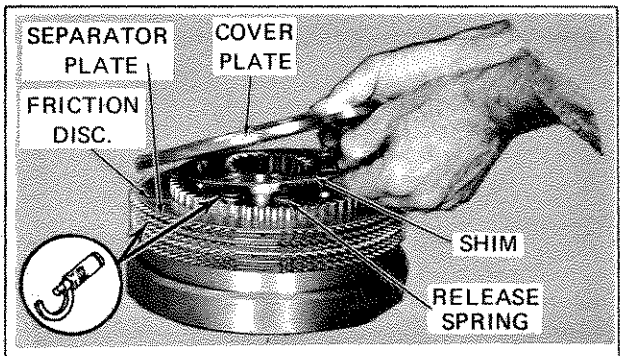


STEP 2. Remove eight set screws that lock the special capscrews on opposite end of clutch.



STEP 3. Remove eight special capscrews. Hold assembly in press as shown.

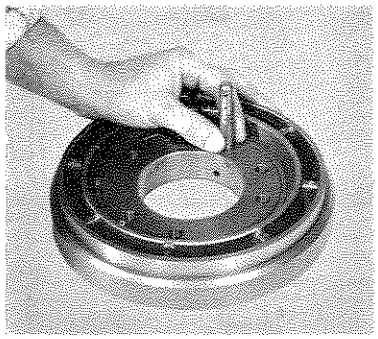
CAUTION: The press adapters should contact the hub only. Apply only enough pressure to prevent the assembly from turning when capscrews are removed.



STEP 4. Lift cover plate, shim, eight release springs, eight friction discs, and eight separator plates from clutch hub.

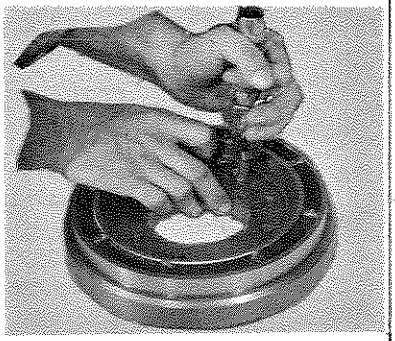
CAUTION: Keep friction discs and separator plates in order. They must contact same surface when Re-installed

STEP 5. Remove hub and spring retainer from clutch piston.



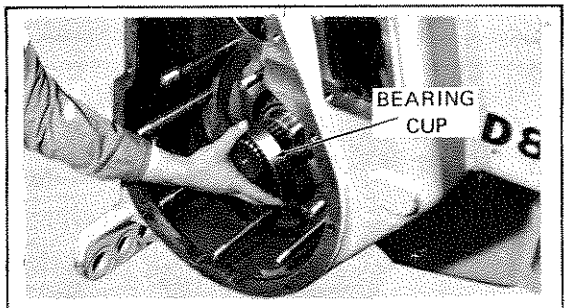
STEP 6. Remove clutch cooling oil valve. Use special tool (See figure 5-24.)

CAUTION: Do not insert any tool through valve body.



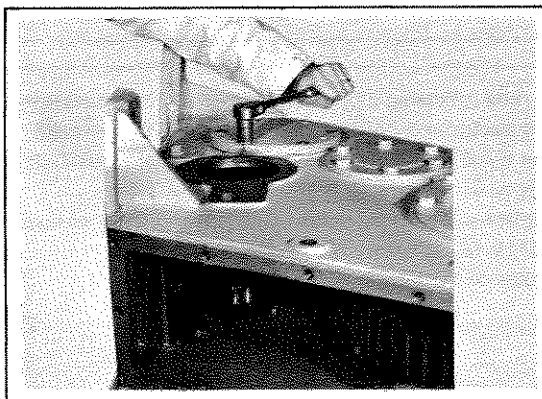
STEP 7. Remove clutch piston from piston retainer by applying compressed air at the cooling oil valve port. Then remove two o-rings.

Figure 5-6. Disassembly of Clutch Assembly

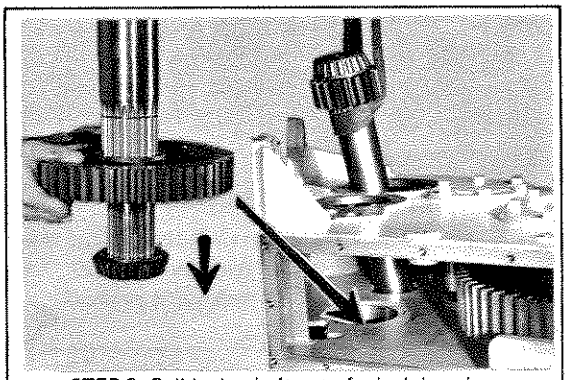


NOTE: Prior to removal and disassembly of the brake shaft, perform the procedures given in paragraph 5-16.

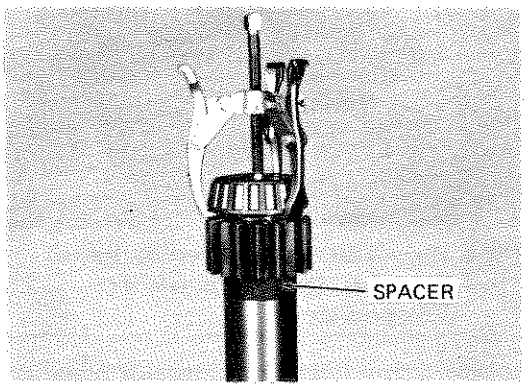
STEP 1. Remove left-hand bearing cup (outer race). Tag cup for reference during reassembly.



STEP 2. If winch is removed from tractor, position with right-hand side facing upward. Remove bearing retainer.



STEP 3. Pull brake shaft out of winch housing to approximate position shown. Tap bearing off of shaft using reduction gear as driver if necessary.



STEP 4. Remove bearing, pinion gear and spacer if required.

Figure 5-7. Removal of Brake Shaft Assembly

NOTE: If removal of the brake shaft reduction gear is not necessary, the brake shaft can be removed with the bevel gear shaft installed. To remove the brake shaft reduction gear, the bevel gear shaft must be removed as shown in Figure 5-5.

5-18. Removal of Intermediate Shaft Assembly.

5-19. Removal of the intermediate shaft and associated components is shown in Figure 5-8. The intermediate shaft can be removed with the winch mounted on the tractor. Prior to removal of the intermediate shaft, intermediate gear, and drum pinion gear, sufficient clearance can be obtained by removing the drum shaft bearing retainer as shown in Figure 5-9.

NOTE: Figure 5-8 shows the winch removed from the tractor with the bevel gear shaft and brake shaft removed. This is the normal sequence for complete unit overhaul but is not necessary for removal of the intermediate shaft only.

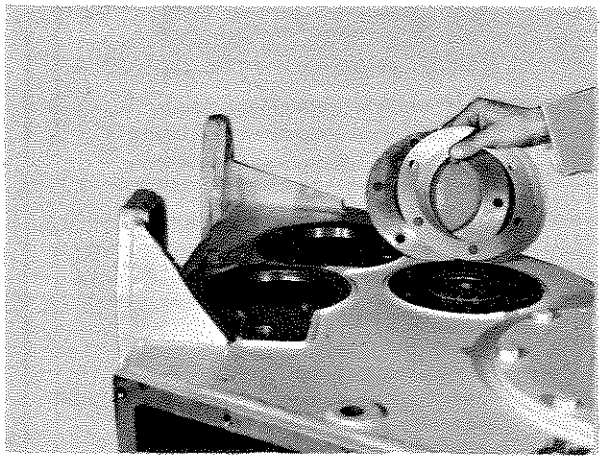
5-20. Removal of Drum Shaft and Drum.

5-21. Removal of the drum shaft and drum is shown in Figure 5-9. The winch must be removed from the tractor before the drum shaft and drum can be removed. During removal of the drum shaft and drum, see the illustration of special tools (Figure 5-23) and locally fabricate the tools if possible. Do not attempt to remove heavy components (such as the drum or drum gear) by hand. Use the recommended attachments whenever possible. Removal of the intermediate shaft (see Figure 5-8) and the reverse clutch assembly (see Figure 5-5) is required prior to removal of the drum shaft and drum.

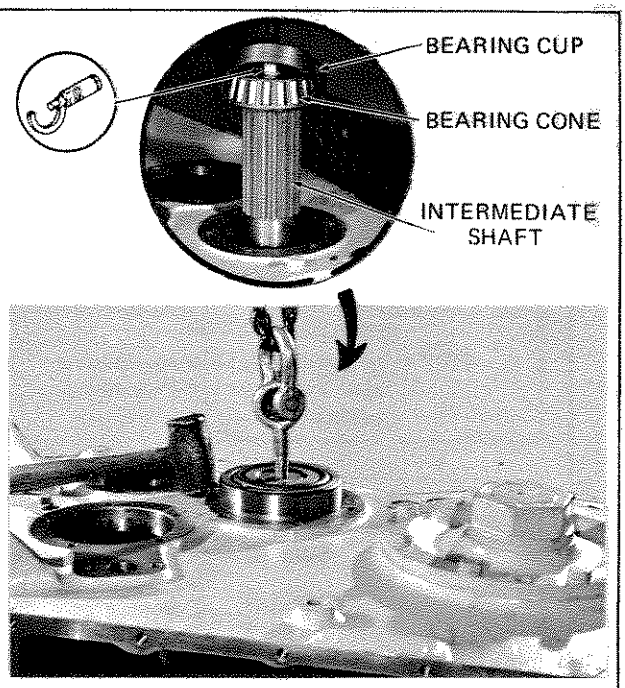
5-22. Removal of Dump Valve Assembly.

5-23. The dump valve assembly is accessible by removing the small left-hand side cover (see Figure 5-1). Drain oil from the winch (see Figure 4-1) to a level below the access opening before removing the cover.

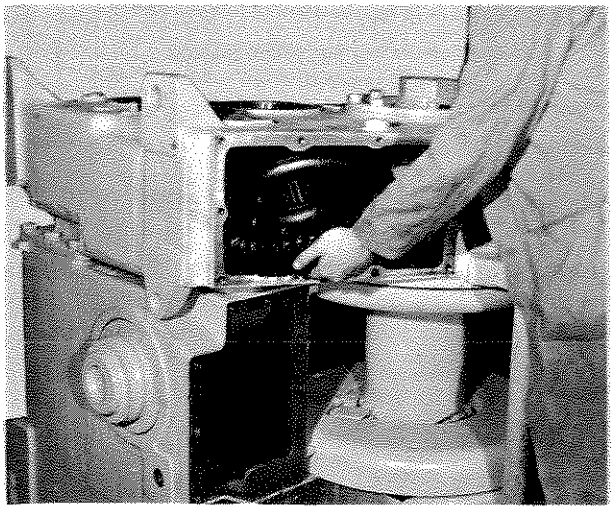
NOTE: The following illustrations show the winch removed from the tractor and positioned on its side with the brake shaft and bevel gear shaft removed. Removal of these shafts is not necessary for ON TRACTOR REPAIR of the intermediate shaft. Remove the drum shaft bearing retainer (see figure 5- 9) to obtain the necessary clearance for removal of the intermediate shaft gears.



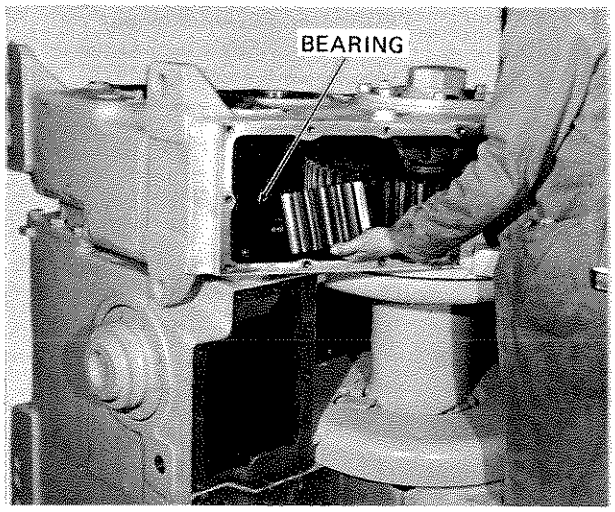
STEP 1. Remove the right-hand bearing retainer with shims. Tag shims for reference during reassembly.



STEP 2. Screw a 3/4 inch UNF eyebolt into the end of intermediate shaft and pull out shaft. Tap on winch frame to break loose the bearing.

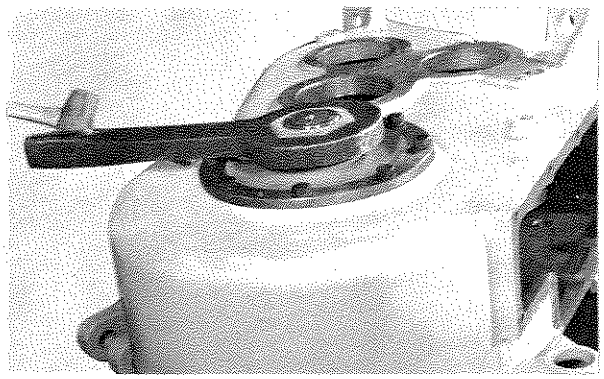


STEP 3. Remove intermediate gear.

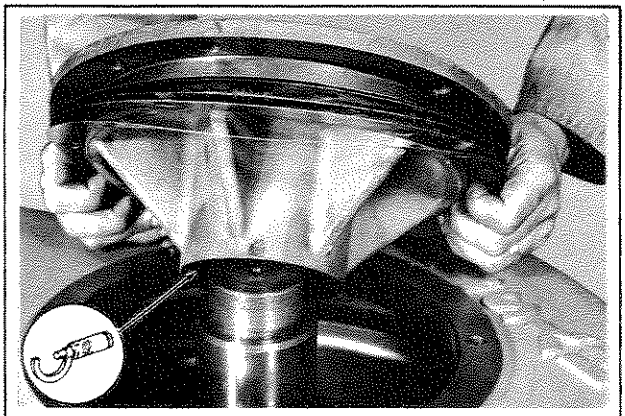


STEP 4. Remove drum pinion and bearing.

Figure 5-8. Removal of Intermediate Shaft Assembly

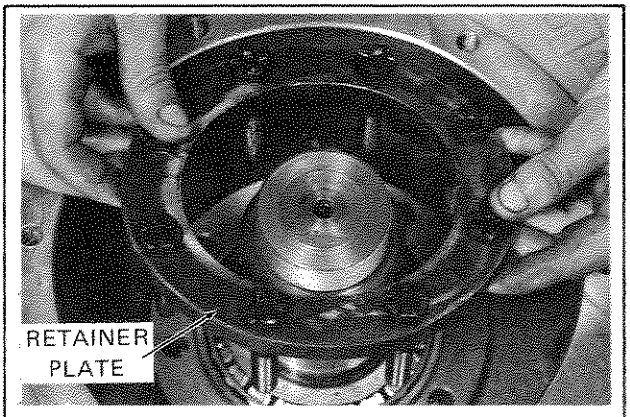


STEP 1. Remove left-hand drum shaft locknut, then turn winch so that right-hand side faces upward. Remove second drum shaft locknut.

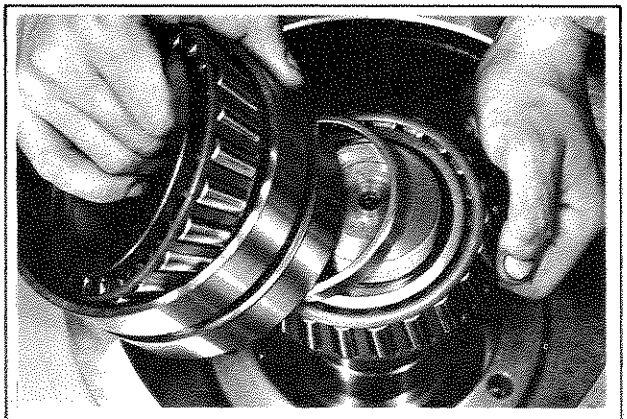


STEP 2. Remove retainer and shim pack.

NOTE: Tag shim pack for reference during reassembly.

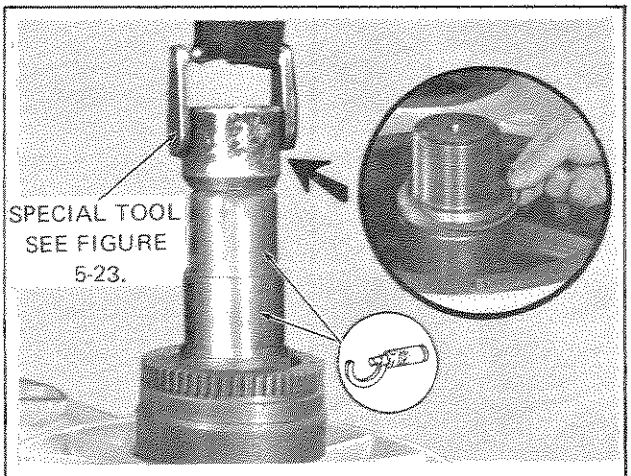


STEP 3. Remove retainer plate by removing the eight special capscrews.

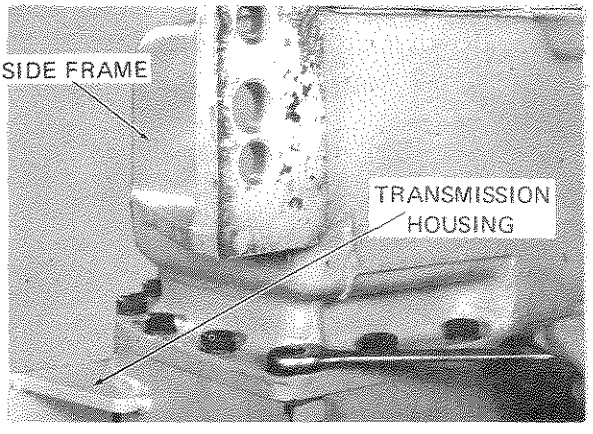


STEP 4. Remove double taper roller bearing assembly.

NOTE: Bearing assembly may be removed with the drum shaft if it is seized to the shaft.

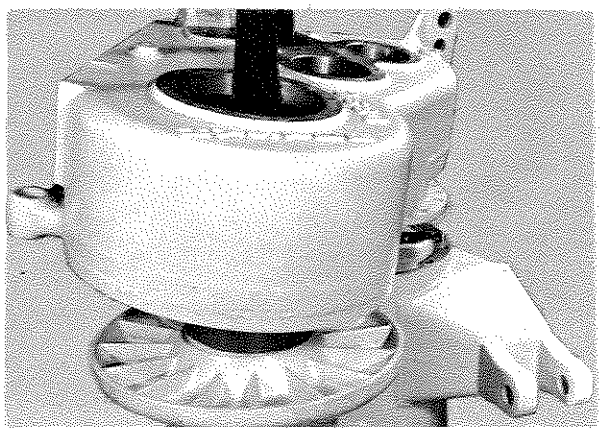


STEP 5. Remove the drum shaft using special attachment. Remove O-ring from shaft.

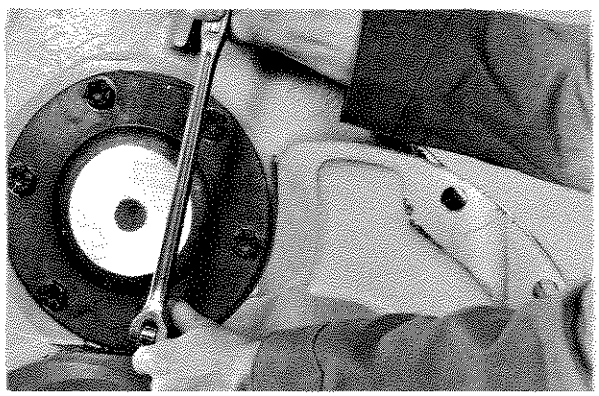


STEP 6. Remove the seven capscrews securing the side frame to the transmission housing.

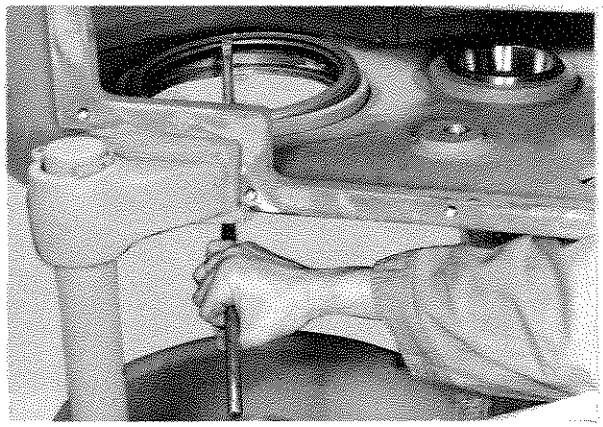
Figure 5-9. Removal of Drum Shaft and Drum (Sheet 1 of 2)



STEP 7. Connect a sling as shown, then lift off side frame. Remove drum gear from side frame if required.

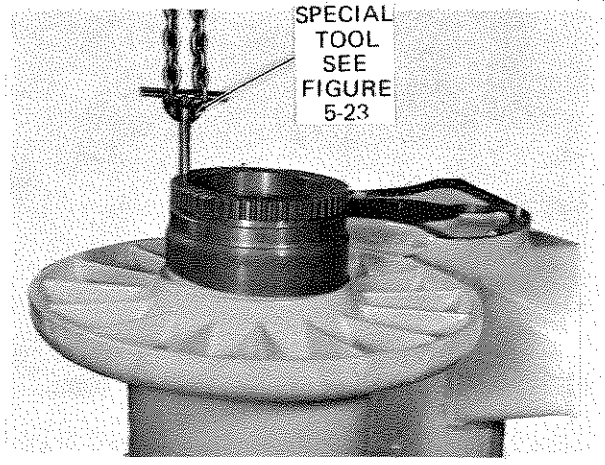


STEP 8. Remove intermediate shaft retainer and inspect bearing cup. If cup is satisfactory, reinstall retainer. Tighten retainer cap-screws to 150 foot-pounds.

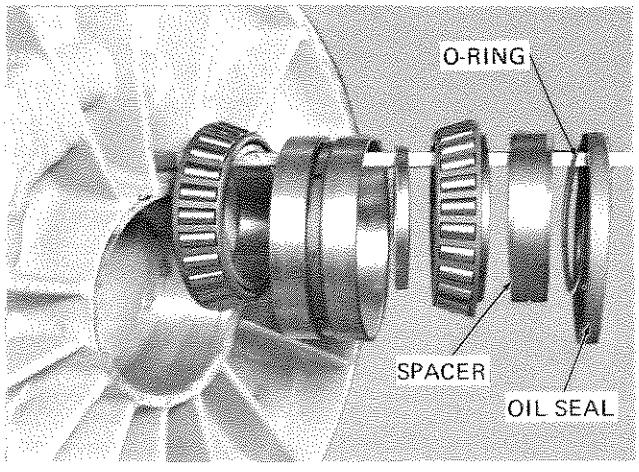


STEP 9. Remove drum seal.

NOTE: This seal must be replaced with a New Hyster Approved seal during installation.



STEP 10. Lift drum off of transmission housing.



STEP 11. Remove double taper roller bearing assembly with spacer and seal.

Figure 5-9. Removal of Drum Shaft and Drum (Sheet 2 of 2)

5-24. Removal of Hydraulic Pump Assembly (D8 and D9 Tractors).

5-25. On D8 tractors, the hydraulic pump assembly is mounted under the floor plate at the operator's compartment (see Figure 5-10). On D9 tractors, the hydraulic pump is mounted under the floor plate adjacent to the right-hand fender of the tractor (see Figure 5-11). On both tractor models, the pump is mounted to the tractor auxiliary PTO through a pump adapter. The pump is mounted in place by two 3/8 UNC X 5-1/8 inch long capscrews with lockwashers. Discard the pump-to-adapter gasket and install a new gasket during installation of the pump. Refer to the applicable winch parts manual for location of pump assembly and adapter parts.

CAUTION: Clean the area around the pump and adapter thoroughly prior to removal of the two capscrews. Serious damage can result to the pump and towing winch if dirt, sand or other foreign material is allowed to enter the hydraulic system.

NOTE: Hydraulic pump repair procedures are given in paragraph 5-33.

5-26. CLEANING.

5-27. When parts are removed from the winch, remove accumulated grease and dirt using mineral spirits or other suitable cleaning solvents. Never inspect parts coated with excessive amounts of grease or dirt. Damage to a part may not be obvious unless thoroughly cleaned. Steam clean all external surfaces of the winch prior to reassembly.

5-28. VISUAL INSPECTION.

5-29. Table 5-1 contains procedures for visual inspection of all critical parts of the winch assembly.

5-30. MINOR REPAIRS.

5-31. Control Valve Repairs.

5-32. Repair of the control valve is limited to removal and replacement of individual components shown in Figure 5-12. Replace defective components as required, observing the following:

CAUTION: Do not attempt to machine any part of the control valve. If parts are found to be defective, replace the part. Do not hone the valve spool bores.

a. Lubricate all O-rings with hydraulic oil before installation.

b. Tag valve spools when removed to make sure that they are re-installed in the correct bores.

c. Check all threads in the valve body and on external fittings. If threads in valve body have been damaged, re-thread using same size tap. Make sure that all metal chips are removed from the valve ports.

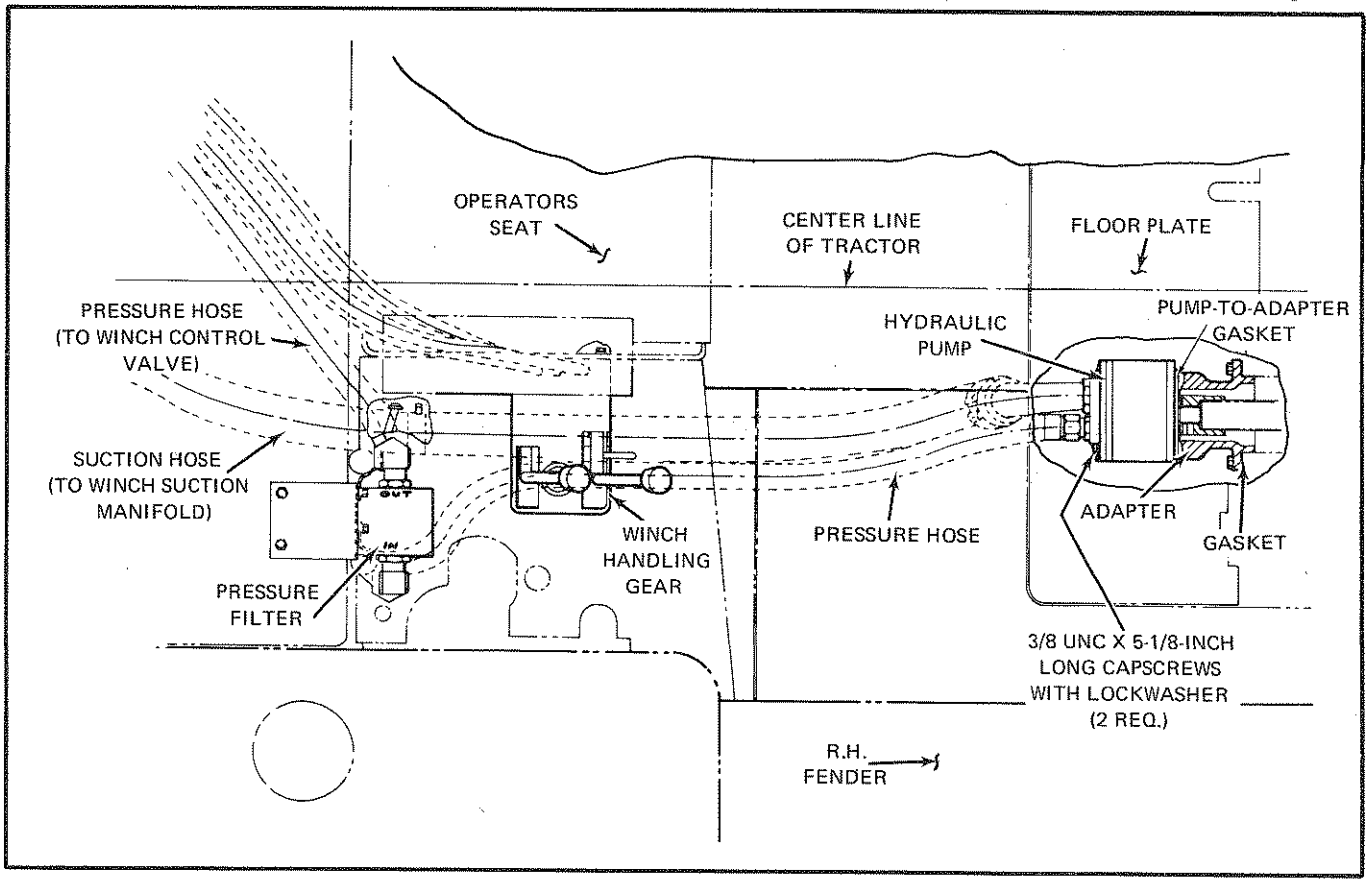


Figure 5-10. Removal of Hydraulic Pump (D8 Tractors).

TABLE 5-1. VISUAL INSPECTION (Sheet 1 of 3)

ITEM	INSPECTION REQUIREMENTS	CORRECTIVE ACTION
PTO Shaft, Lo-Speed	Check for broken or worn bevel gear teeth. Also check spline for wear or twisting.	Replace shaft if gear teeth are broken or severely worn or if splines are not true.
PTO Shaft, Standard-Speed	Check splines for wear or twisting.	Replace shaft if splines are severely worn or twisted.
PTO Shaft Bevel Gear Standard-Speed	Check for broken or worn bevel gear teeth.	Replace bevel gear if teeth are broken or severely worn.
Bevel Gear Shaft	Check for deep scratches or scoring on bearing journals at each end of shaft.	Machine bearing journal as required but do not exceed minimum dimensions given in Table 1-1.
	Inspect bevel gear shaft seal ring grooves for taper, scoring, burrs, and corrosion.	Replace or repair shaft if mating surfaces between the inner side of groove and seal are not FLAT.
	Check for broken, scored, pitted, and corroded cast iron seal rings.	Replace seal rings if worn or damaged slightly.
	Check threads on right-hand end of bevel gear shaft for scoring or distortion. a. Puller Hole (internal threads) b. Locknut (external threads)	Dress threads with a thread chaser.
	Check for broken or severely worn splines.	Replace shaft if splines are broken or severely worn.
	Inspect spline seal counterbore for damage.	Replace or rebuild shaft if a new spline seal will not seat properly.
Bevel Gear Shaft Bearing Retainers	Check retainer seal ring bore for grooves, scoring, and rust.	Replace if scored, rusted, or if they are not within specifications given in Table 1-1.
Bevel Gear Shaft Spacers	Inspect spacer ends for scoring, mushrooming, or corrosion.	Replace if damaged in any way or if they are not within specifications given in Table 1-1.
Bevel Gear	Check for broken or worn teeth.	Replace if teeth are broken or severely worn.
	Inspect gear hub faces for scoring, mushrooming, or corrosion.	The gear should be replaced if the hub faces are defective in any way. **NOTE:** Do not machine gear faces. Overall length of components is critical.

TABLE 5-1. VISUAL INSPECTION (Sheet 2 of 3)

ITEM	INSPECTION REQUIREMENTS	CORRECTIVE ACTION
Clutch Assembly	Check for plugged oil holes in clutch hub and cooling oil valve. Also check cooling oil valve plunger for free movement.	Clean oil holes as necessary. See Figure 5-15, Step 4.
	Carefully inspect friction discs for facing wear, distortion, and damaged teeth.	Replace friction disc if oil grooves are worn from sintered bronze facing or if distorted in any way.
	Carefully inspect separator plates to verify that surfaces are conical (dished).	Replace separator plate if surface is flat, warped, or scored. **NOTE:** Separator plates must be dished to assist clutch release.
	Inspect piston retainer O-ring grooves for scoring, burrs, and corrosion.	Replace piston retainer if damaged.
	Inspect spider gear for broken or worn gear teeth. Check for broken welds between gear hub and clutch housing.	Replace gear if teeth are broken or severely worn or if there are any apparent cracks.
Oil Brake Assembly	Check for cracked or broken belleville spring.	Replace spring if cracked or broken.
	Inspect oil brake cover for scoring, burrs, or cracks.	Replace cover if severely damaged.
	Carefully inspect friction discs for facing wear, distortion, and damaged teeth.	Replace friction discs if oil grooves are worn from sintered bronze facing or if distorted in any way.
	Carefully inspect separator plates to verify that surfaces are conical (dished).	Replace separator plates if surface is flat, warped, or scored.
	Inspect piston retainer grooves for scoring, burrs, and corrosion.	Replace piston retainer if damaged.
	Inspect brake cage for wear, scoring, burrs, and cracks.	Replace cage if splines are notched or cage is cracked.
	Inspect brake hub for wear, scoring, burrs, and cracks.	Replace hub if splines are notched or hub is cracked.
	Check push rods for grooves and mushrooming.	Replace if slightly damaged.
	Carefully check aligning dowels for grooves and distortion.	Replace if slightly damaged.

TABLE 5-1. VISUAL INSPECTION (Sheet 3 of 3)

ITEM	INSPECTION REQUIREMENTS	CORRECTIVE ACTION
Brakeshaft	Check for deep scratches or scoring on bearing journals at each end of shaft.	Machine bearing journal as required but do not exceed minimum dimensions in Table 1-1.
	Check for broken or severely worn splines.	Replace if splines are broken or severely worn.
Brakeshaft Gears	Check for broken or worn gear teeth. Pay particular attention to leading edges of straight-cut gear teeth.	Replace gear if teeth are broken or severely worn.
Intermediate Shaft	Check for deep scratches or scoring on bearing journals at each end of shaft.	Machine bearing journal as required but do not exceed minimum dimensions in Table 1-1.
	Check for broken or severely worn splines.	Replace if splines are broken or severely worn.
Intermediate Gears	Inspect both gears for broken or severely worn teeth. Pay particular attention to leading edges of straight-cut gear teeth.	Replace gears if teeth are broken or severely worn.
Drum Shaft	Check for deep scratches or scoring on bearing journal at each end of shaft.	Machine shaft as required but do not exceed minimum dimensions specified in Table 1-1.
	Check for cross threaded or damaged threads.	Dress threads with thread chaser.
Drum Gear	Check for broken or severely worn gear teeth. Pay particular attention to leading edges of straight-cut gear teeth.	Replace gear if teeth are broken or severely worn.
Drum	Inspect for broken or severely worn teeth.	Replace drum if teeth are severely worn or broken.
Drum Adapter	Carefully inspect double seal contact surface for deep scratches, burrs, and rust.	Replace if damaged.

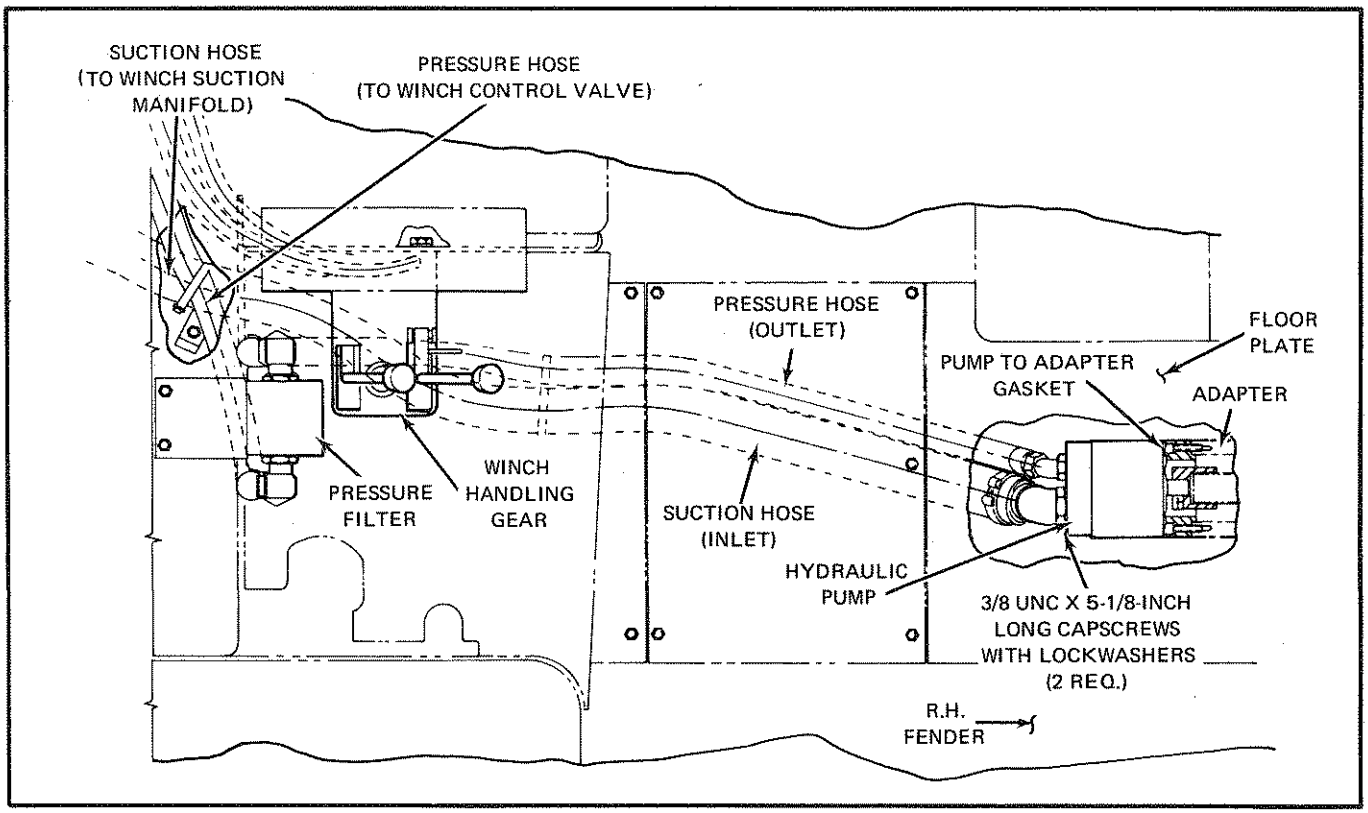


Figure 5-11. Removal of Hydraulic Pump Assembly (D9 Tractors).

CAUTION: When removing the end caps, tag the caps for reference during reassembly. THESE CAPS ARE NOT INTERCHANGEABLE.

5-33. Hydraulic Pump Repairs.

5-34. Seal wear or deterioration is the most common failure occurring in the hydraulic pump. The pump bearings, gears and shafts are subject to wear and should be checked when the pump is disassembled. Do not attempt to machine or otherwise repair these parts. To prevent future failures, always replace parts that are worn or damaged. If severe pump wear or damage is evident, replacement of the complete pump is recommended.

5-35. PUMP DISASSEMBLY. Disassemble the pump as required, observing the following (see Figure 5-13, View A):

a. Clean the pump exterior prior to disassembly.

b. Scribe a thin line across the pump covers and pump body before disassembly. This will assure proper installation of the covers. (See View G.)

c. After removal of the front cover, place match marks on pump body and bearings as shown in View C. DO NOT SCRIBE: Use prussion blue for marking.

d. Push on rear end of gears (7 and 8, View A) until front bearings are free of the pump body. (See View D.)

5-36. INSPECTION AND REPAIR OF PUMP PARTS. Inspect or repair pump parts as follows:

NOTE: Recommended repair of parts is limited to dressing bearing faces.

a. Check gears and shafts for nicks, burrs, cracks or deep scratches. Discard any damaged components.

b. Check interior section of pump body. Although wear greater than 0.015-inch is abnormal, it is not critical if bearings are not worn or damaged. Bearings can be dressed as shown in View E. Use fine sandpaper on a true-flat surface plate when dressing bearing faces. Dress the flats until the bearings slide into place freely. Clearance between the flats when assembled in the body should be 0.0002 to 0.0005 inch.

c. Check bearing flats and bearings for wedging in the respective housings. This is evident by a smooth shiny appearance on the bearing flat and circumference.

d. Check milled seal and gasket recess in the front cover for any obstruction that will prevent normal seating. Make sure that internal threads in pump body are clean.

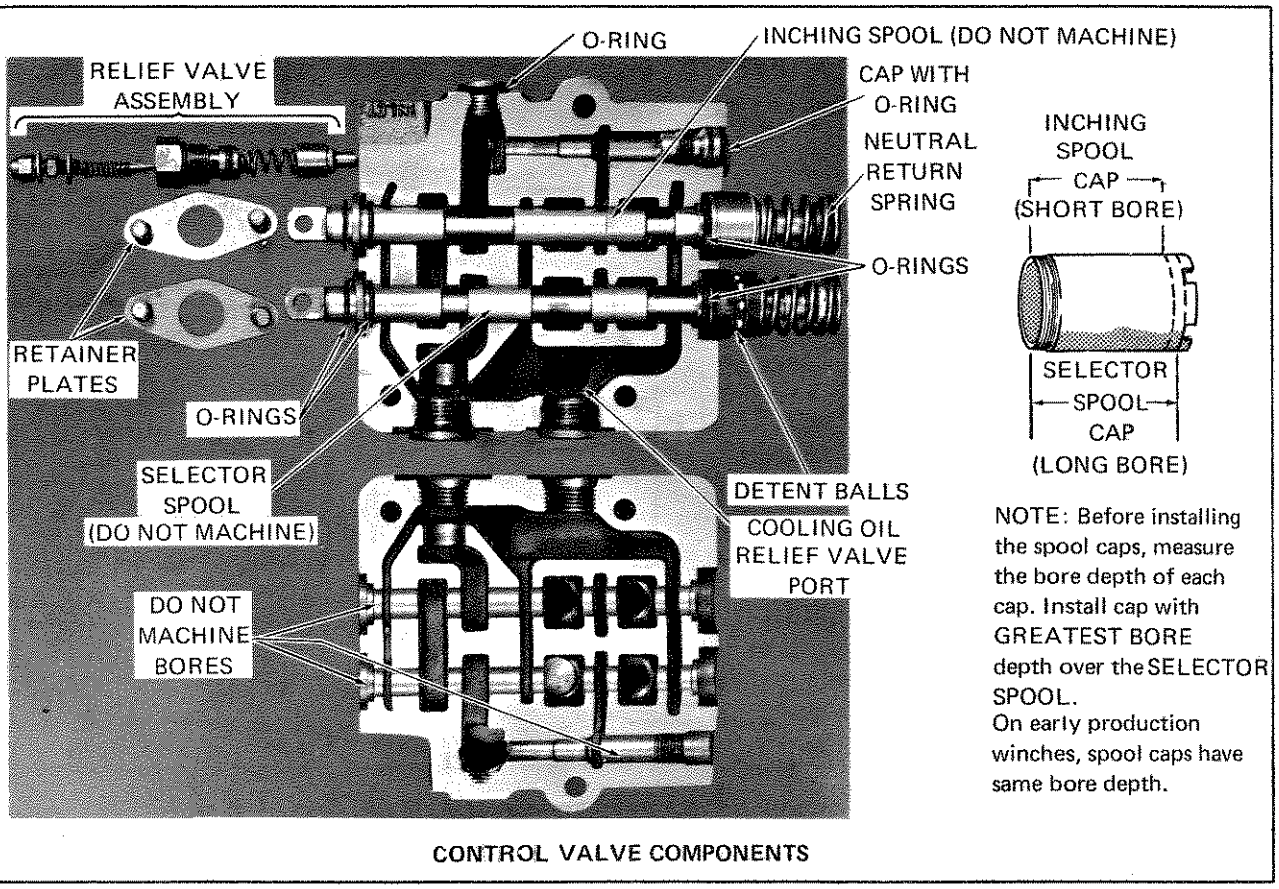


Figure 5-12. Control Valve Repair Diagram

5-37. PUMP REASSEMBLY. Observe the following during reassembly of the pump:

a. Apply a light coat of non-hardening gasket cement to the shaft seal bore in the front cover (See View B). Press the new shaft seal into cover. Remove excess cement, then stake seal in place by peening the cover in three places around the seal.

b. Apply a liberal amount of SAE 10W oil to all parts during reassembly.

c. When installing bearings and gears, make sure that all match marks (View C) are aligned.

CAUTION: Do not distort or attempt to straighten the high pressure seal (View B) during installation.

d. When installing the covers, align the scribe line made during disassembly (see View G).

e. Torque cover capscrews to 28-32 ft-lbs.

CAUTION: Do not overtighten the cover capscrews. Threads in the aluminum casting are easily damaged.

5-38. Dump Valve Repairs. (See Figure 5-14.)

5-39. Repair of the dump valve is limited to replacement of parts. Do not attempt to hone the valve body bore. If the valve bore is severely scratched or otherwise damaged, replacement of the complete valve assembly is recommended. If the valve bore is not damaged, replace the spring assembly (1) or spool (2) as required.

5-40. REASSEMBLY AND INSTALLATION.

5-41. Before reassembly and installation of the winch, make sure that all removed parts have been inspected as specified in Table 5-1. Check all measurements specified in Table 5-1 and as shown in the disassembly illustrations. Replace any part that is not within the specified limits. Carefully check all bearings that have been removed. Used bearings often appear to be satisfactory, but may fail when placed under a load. When in doubt, installation of new bearings is recommended. New bearings may prevent future troubles.

CAUTION: Apply a light coat of sealing compound (John Crane, or equal) to all external bearing retainer and cover plate capscrews.

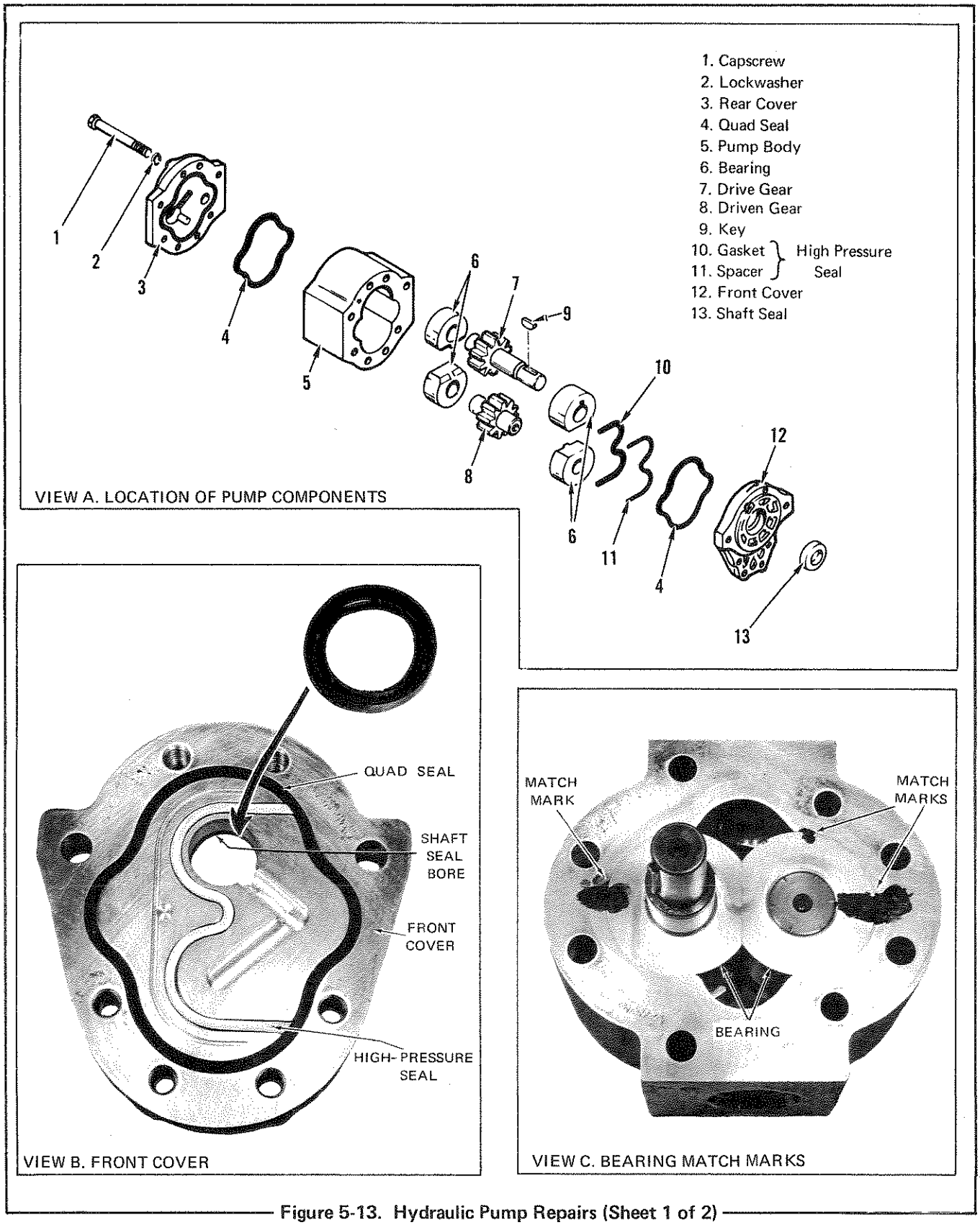
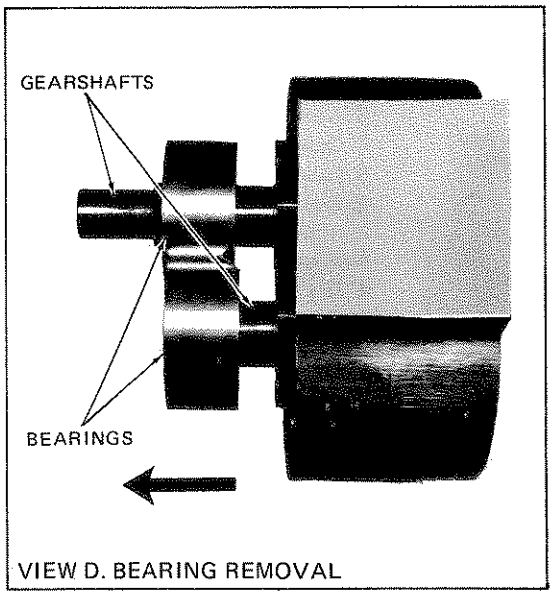
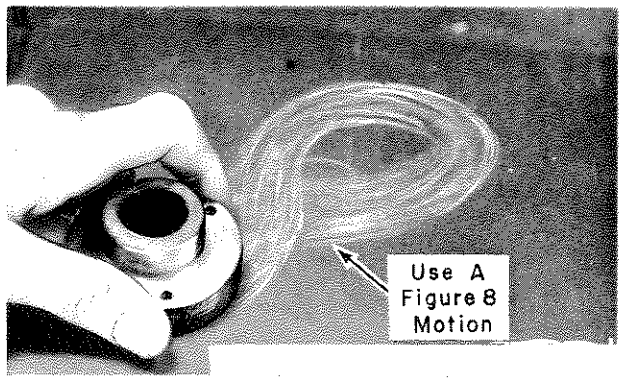
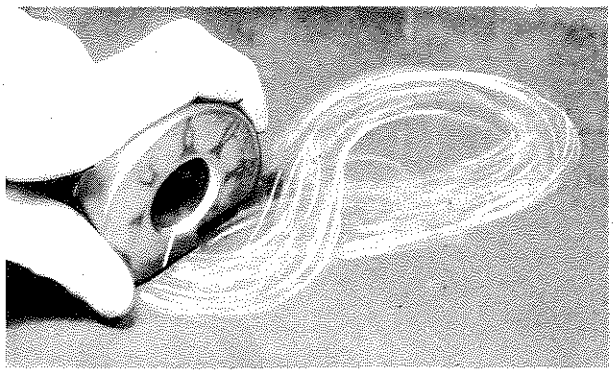


Figure 5-13. Hydraulic Pump Repairs (Sheet 1 of 2)

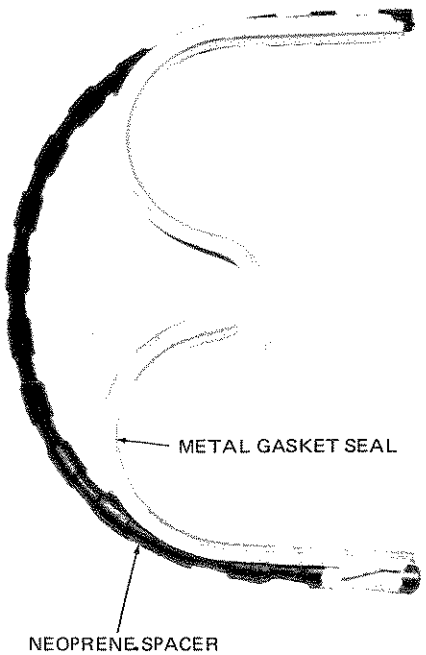


VIEW D. BEARING REMOVAL

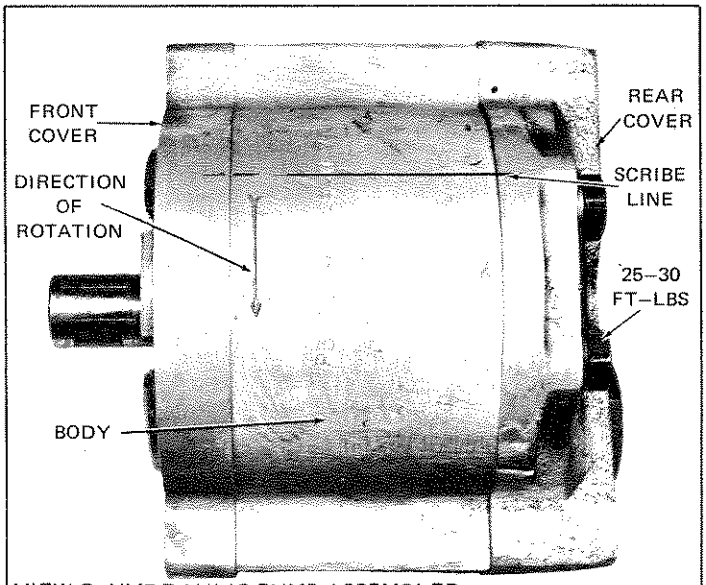




VIEW E. DRESSING BEARING FACES



VIEW F. SPACER AND GASKET (HIGH PRESSURE SEAL)



VIEW G. HYDRAULIC PUMP ASSEMBLED

Figure 5-13. Hydraulic Pump Repairs (Sheet 2 of 2)

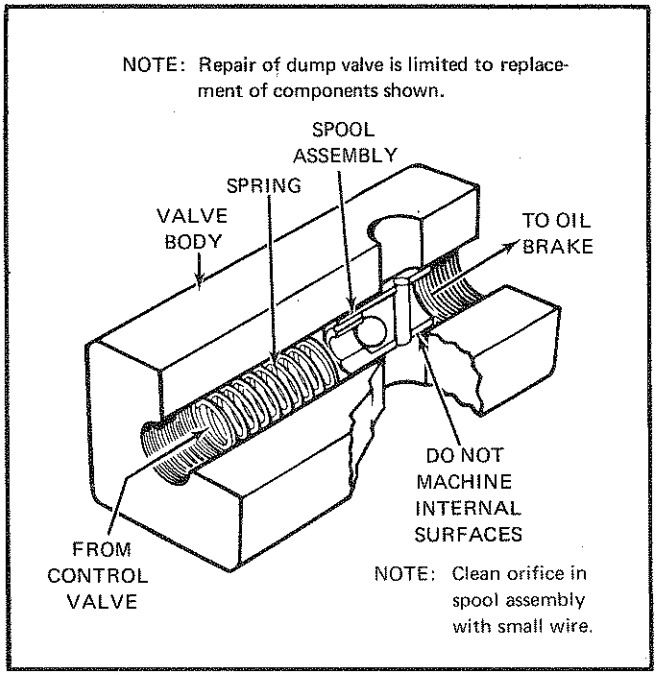


Figure 5-14. Dump Valve Repairs.

5-42. Reassembly of Clutch Assemblies.

5-43. Reassembly of the clutch assemblies is shown in Figure 5-15.

CAUTION: Make certain that all parts have been thoroughly cleaned prior to reassembly. Dirt particles will seriously affect operation of the clutch assembly.

5-44. Installation of Drum and Drum Shaft.

5-45. Reassembly and installation of the drum and drum shaft is shown in figure 5-16. During installation of the drum and drum shaft, see the illustration of special tools (figure 5-23) and locally fabricate the tools if possible. The intermediate shaft and reverse clutch assembly must be removed before installation of the drum and drum shaft.

5-46. Installation of Intermediate Shaft.

5-47. Installation of the intermediate shaft and associated components is shown in Figure 5-17. Figure 5-17 shows the winch removed from the tractor with the bevel gear shaft and brake shaft removed. However, the intermediate shaft can be installed with the drum shaft bearing retainer removed for the necessary clearance.

5-48. Installation of Brake Shaft Assembly.

5-49. Installation of the brake shaft and associated components is shown in Figure 5-18. The brake shaft and reduction gear must be installed before installation of the bevel gear shaft assembly. The brake shaft cannot be installed when the winch is mounted on the tractor, unless the tractor tracks are removed or disconnected.

5-50. Reassembly and Installation of Bevel Gear Shaft Assembly.

5-51. Reassembly and installation of the bevel gear shaft assembly is shown in Figure 5-19. Installation of the bevel gear shaft can be accomplished with the winch mounted on the tractor.

NOTE: The reduction gear (see Figure 5-18) must be installed before installation of the bevel gear shaft assembly. This is due to insufficient clearance for installing the reduction gear when the bevel gear shaft is installed.

5-52. Reassembly and Installation of Oil Brake Assembly.

5-53. Reassembly and installation of the oil brake is shown in Figure 5-20. Reassembly and installation of the oil brake can be accomplished with the winch mounted on the tractor. Make sure that the bevel gear shaft is installed prior to installation of the oil brake.

5-54. Installation of Winch on Tractor.

5-55. The D89C winch is attached to the tractor by using the parts listed in Table 5-2. Prior to installing the winch, remove the suction manifold and transmission cover for access to the inside stud. When installing the winch, observe the following:

WARNING: Make sure that the lifting device has a minimum capacity of 4,500 pounds before lifting the winch. Carefully check the cable or chain for damage.

a. Make sure that all shipping plugs are removed before mounting the winch.

b. Carefully check all hydraulic hose fittings for damage.

c. Carefully check all hydraulic hoses for damage.

d. Clean the mounting surfaces of the winch and tractor prior to mounting the winch.

e. Raise the winch and guide the PTO shaft into the tractor flange. Move the winch toward the tractor and align the PTO shaft splines with the tractor power take-off splines. Route the control cables through the anchor block on the control housing.

NOTE: Install the castellated nut before the winch is completely pulled against the tractor.

f. Secure the winch in place using the parts listed in Table 5-2. Tighten the nuts alternately at each side of the winch to pull the winch evenly against the tractor. Final torque on the nuts should be 550 to 650 ft-lbs.

g. Install the transmission cover with gasket. Tighten cover capscrews to 40 ft-lbs.

h. Install the suction manifold as shown in Figure 5-22).

i. Connect the hydraulic hoses as shown in Figure 5-1.

WARNING: Make sure that all hydraulic hose clamps are tightened securely.

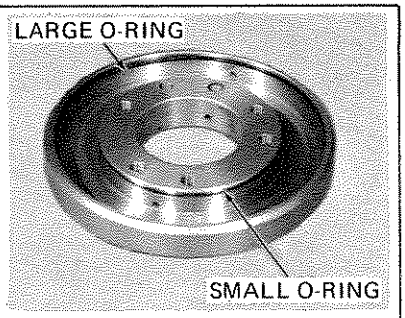
j. Adust the control linkage as described in paragraph 4-16.

5-56. Installation of Suction Manifold.

5-57. Installation of the suction manifold with filter is shown in Figure 5-22. Installation of the manifold should be performed after the winch is mounted on the tractor. Install new gaskets on the manifold cover and at the bottom of the suction manifold. Do not install used gaskets.

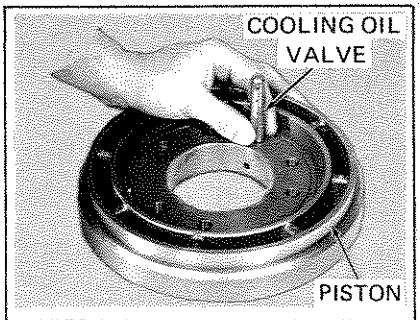
5-58. SPECIAL TOOLS.

5-59. Figure 5-23 contains a listing of tools required during repair of the winch.



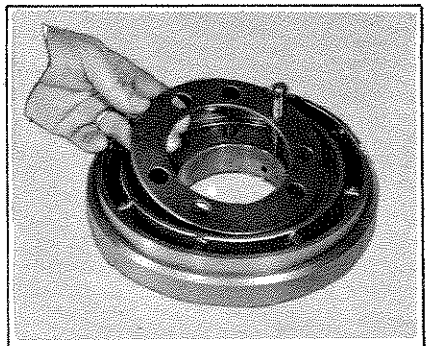
STEP 1. Install two new O-rings. Lubricate piston retainer cavity.

NOTE: It may be necessary to stretch large O-ring so it will stay in its groove when piston is installed.



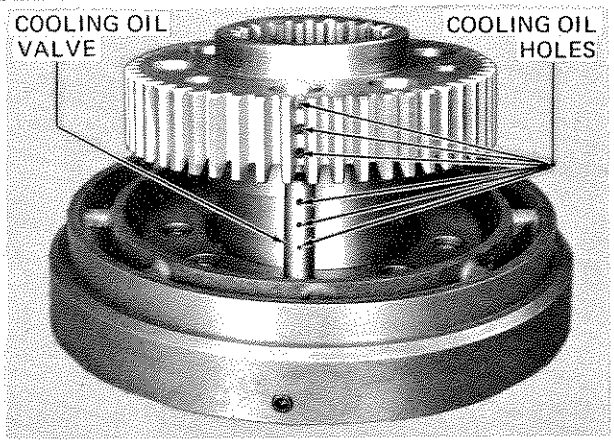
STEP 2. Install piston and cooling oil valve.

CAUTION: Do not insert any tool through valve body. It will damage spring.



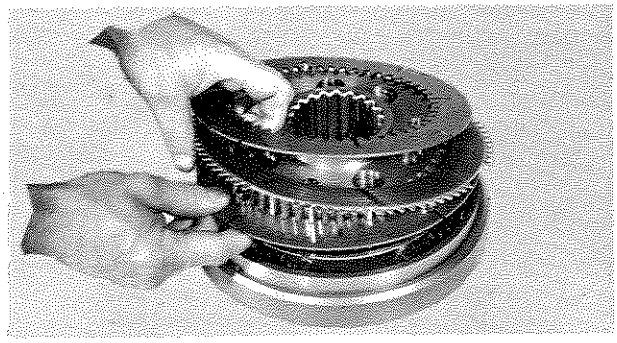
STEP 3. Install spring retainer with smooth side up.

NOTE: Holes are sequenced so spring retainer can only be installed as shown.



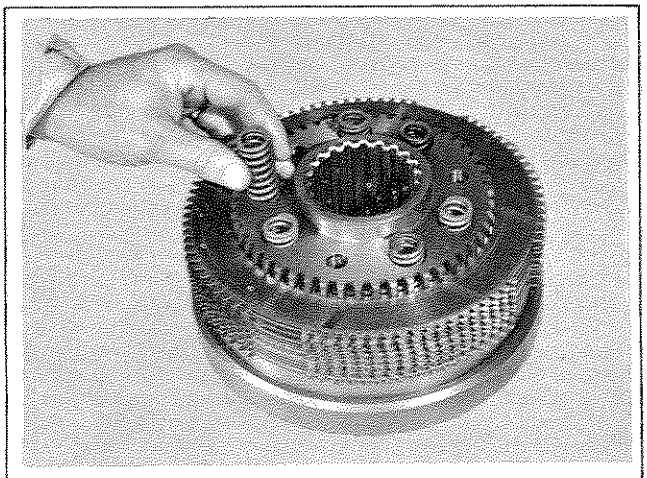
STEP 4. Install clutch hub.

CAUTION: Cooling oil holes in the clutch hub must align with the holes in cooling oil valve.

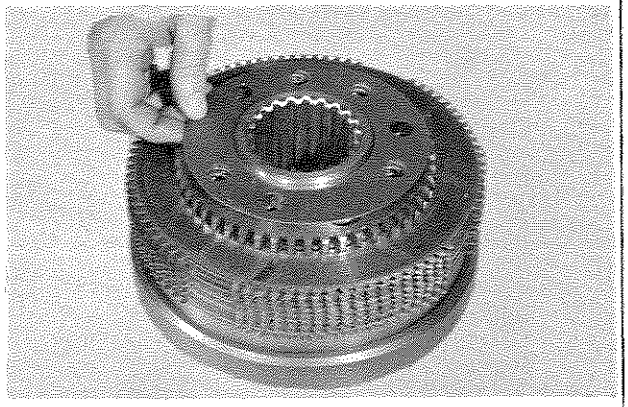


STEP 5. Place eight separator plates and eight friction discs ALTERNATELY on clutch hub.

CAUTION: Separator plate must be placed next to piston. Separator plates are slightly conical (dished). Install ALL the plates facing the same direction.



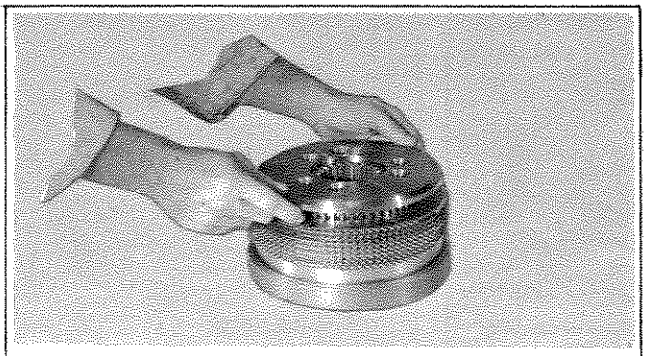
STEP 6. Install eight release springs.(six shown)



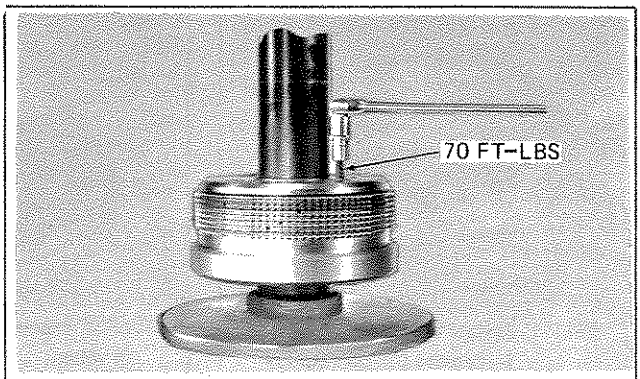
STEP 7. Install shim if required (See STEP 10.)

CAUTION: Holes are sequenced so shim can only be installed as shown.

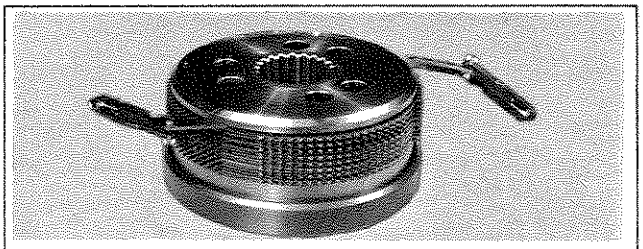
Figure 5-15. Reassembly of Clutch Assembly (Sheet 1 of 2)



STEP 8. Install cover plate.
CAUTION: Holes are sequenced so cover plate can only be installed as shown.

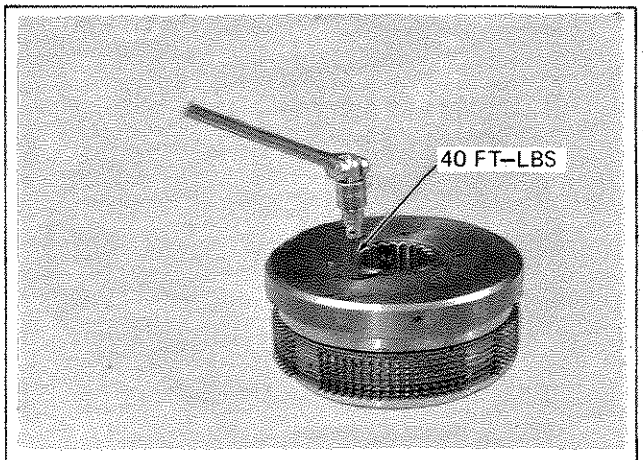


STEP 9. Install and tighten eight special capscrews.
CAUTION: The press adapters should contact the hub only. Apply only enough pressure to prevent assembly from turning when capscrews are tightened.

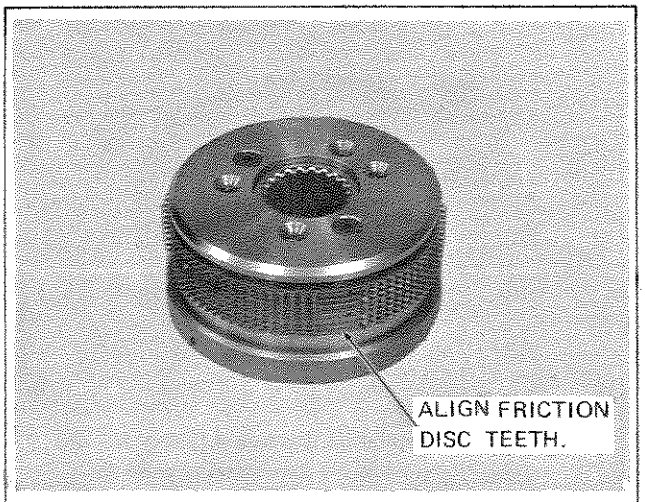


STEP 10. Measure air gap between cover plate and top friction disc with two feeler gauges placed 180° apart as shown. Gap should be 0.085 to 0.125 inch: Add or delete shims as required to obtain correct clearance (see Step 7).

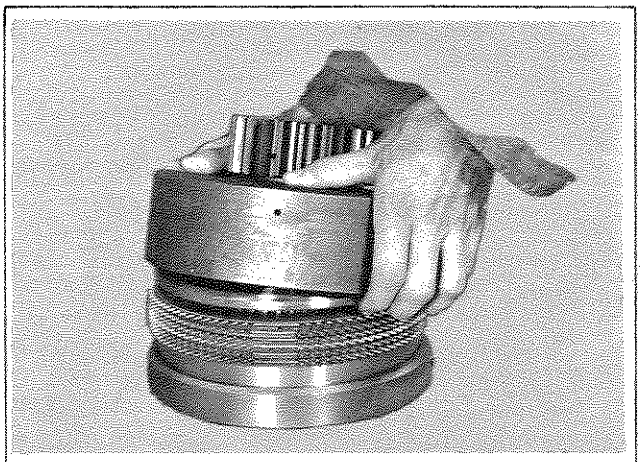
CAUTION: When only one feeler gauge is used, friction disc will tip slightly giving false clearance. Do not depress pack.



STEP 11. Tighten eight set screws that lock the special capscrews.

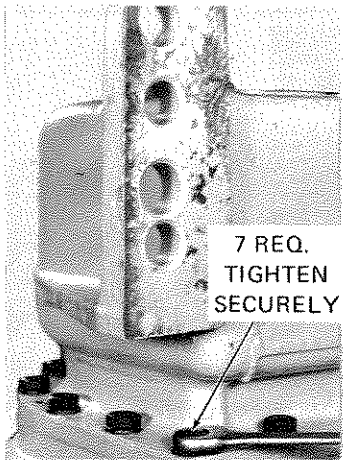


STEP 12. Align friction discs as shown.



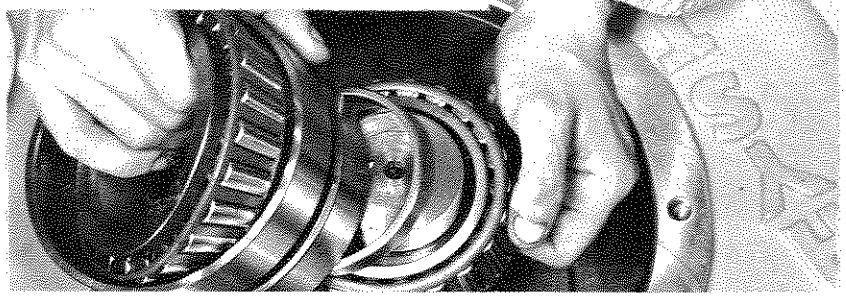
STEP 13. Carefully slide spider gear over clutch pack.

Figure 5-15. Reassembly of Clutch Assembly (Sheet 2 of 2)

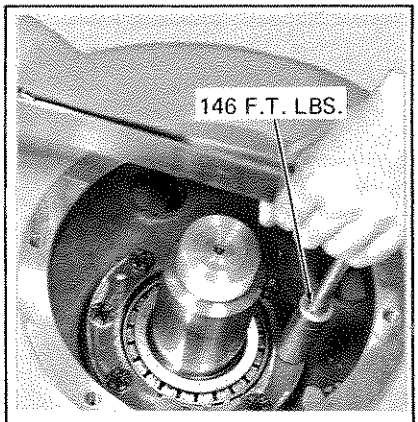


STEP 10. Install the seven capscrews.

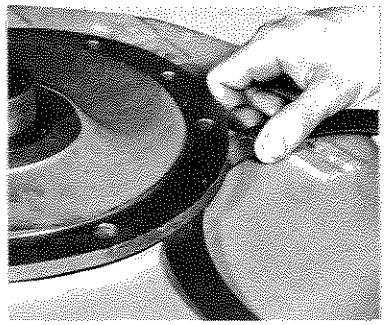
CAUTION: Prior to installing bearing assembly, pour 2 quarts of SAE 10 oil over drum shaft. This provides initial lubrication for the lower bearing assembly.



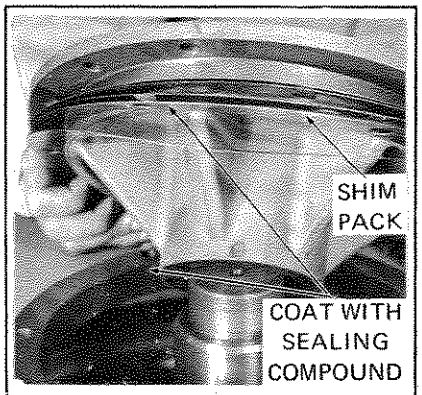
STEP 11. Install bearing assembly. Install bearing parts in sequence shown. Tap into place.



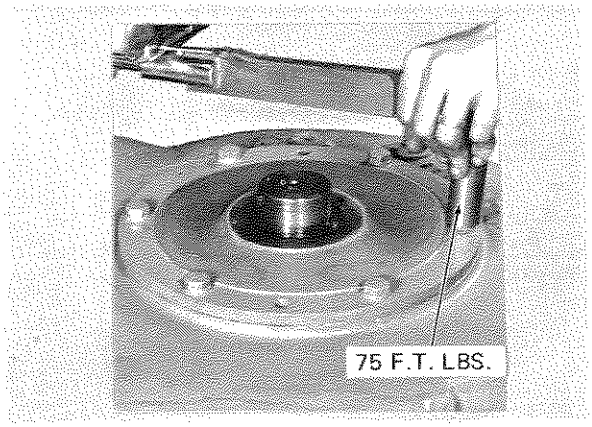
STEP 12. Install retainer plate using eight special capscrews. Tighten capscrews to 146 Ft. Lbs.



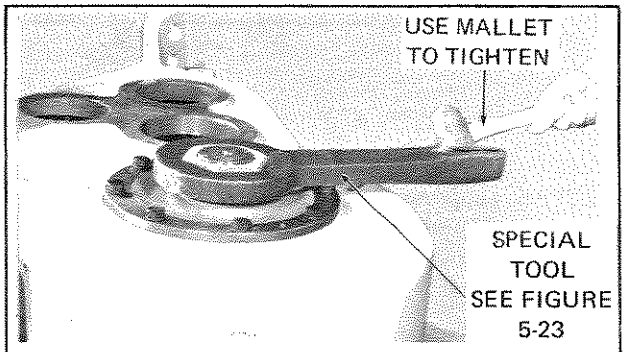
STEP 13. Set bearing retainer in place. Determine shim pack by sliding segment of shim between retainer and side frame. Add shims until slight drag is felt. Remove retainer.



STEP 14. Coat side frame bore and retainer flange with sealing compound (John Crane or equal). Install shim pack determined in Step 13

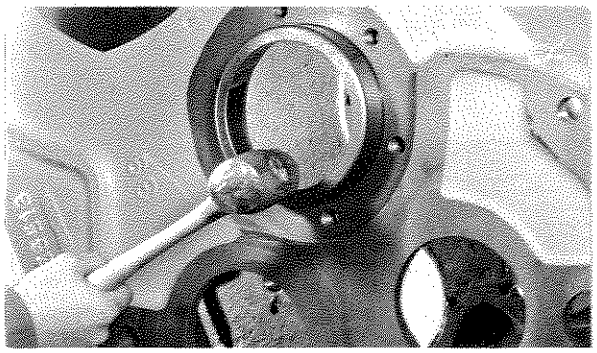


STEP 15. Secure retainer in place using eight capscrews and lockwashers. Tighten capscrews to 75 Ft. Lbs.

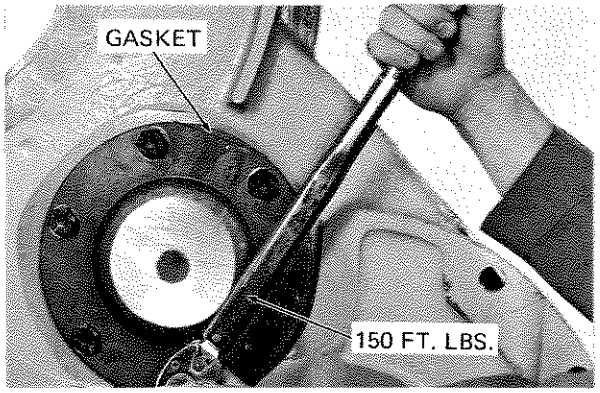


STEP 16. Coat locknut threads with sealing compound (John Crane or equal). Install nut and tighten securely as shown. Place winch in normal operating position and install locknut on opposite end of shaft.

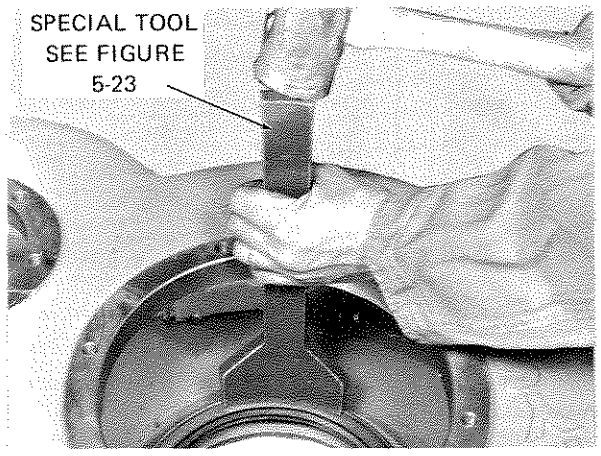
Figure 5-16. Installation of Drum and Drum Shaft (Sheet 3 of 3)



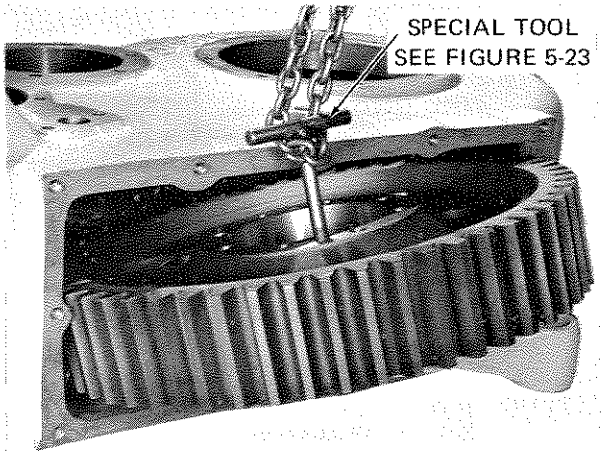
STEP 1. Lubricate intermediate shaft bore with lubriplate and install bearing cup. Do not tap bearing cup flush against side frame. Use retainer to pull cup against frame. (See Step 2).



STEP 2. Coat retainer flange and side frame with sealing compound (John Crane or equal), then install gasket and retainer. Tighten capscrews to 150 Ft. Lbs.



STEP 3. Lubricate seal bore with lubriplate, then install seal.



STEP 4. Install drum gear in side frame using special attachment as shown.

STEP 5. Lubricate drum bore with petrolatum, then install double taper roller bearing assembly, seal and spacer as shown.

NOTE: Smooth side of seal must face inward.

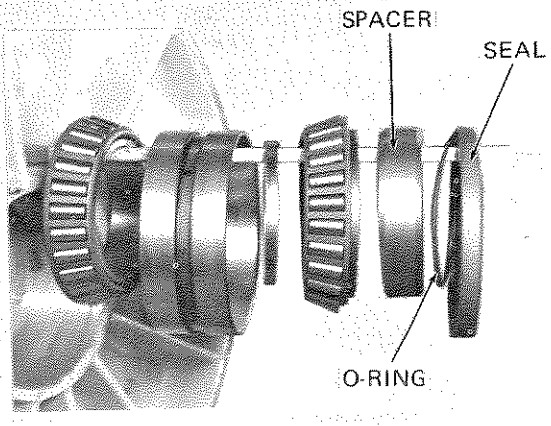
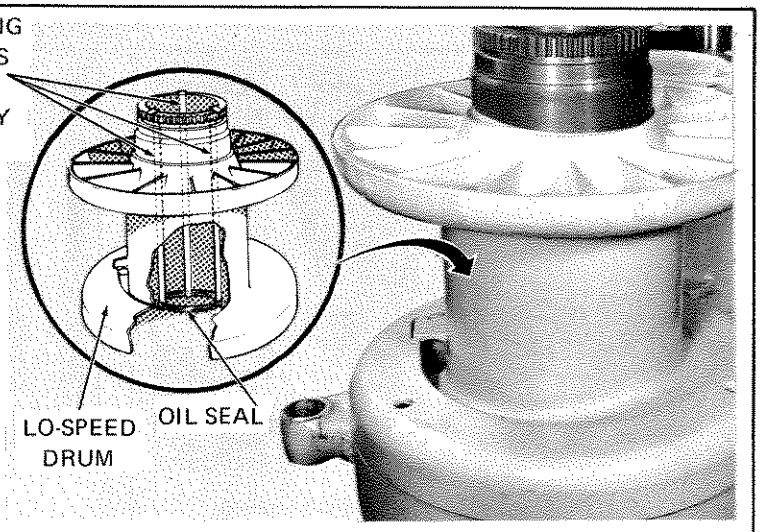


Figure 5-16. Installation of Drum and Drum Shaft (Sheet 1 of 3)

STEP 6. Install drum on transmission case.

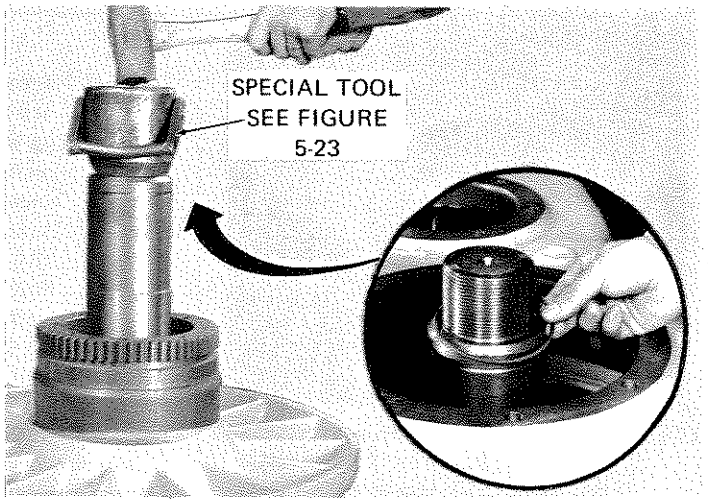
NOTE: On Lo-Speed winches, use heavy wire or shipping bands to hold seal, spacer and O-ring in place when installing drum shaft.

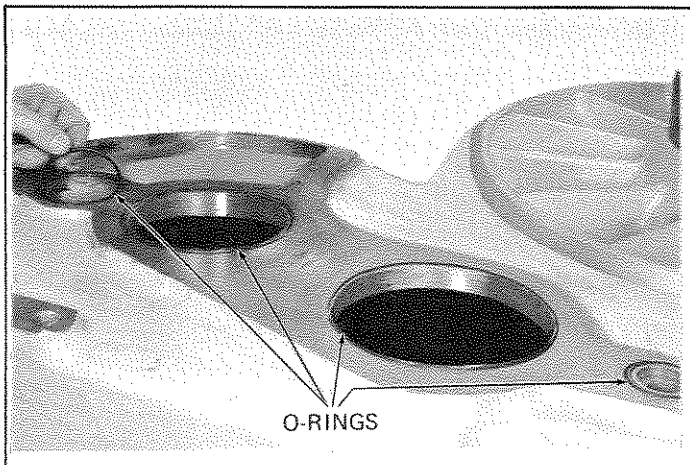
CAUTION: Use extreme care not to damage oil seal. Seal damage will cause severe oil leakage during winch operation.



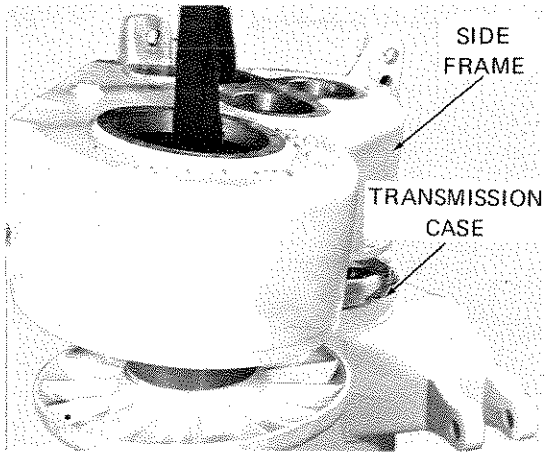
STEP 7. Lubricate lower section of drum shaft with lubriplate, then install drum using special attachment as shown. Remove sling and drive shaft down until it bottoms solidly against lower taper roller bearing. Install O-ring.

CAUTION: Make certain that oil seal is held in place as shown in Step 6.



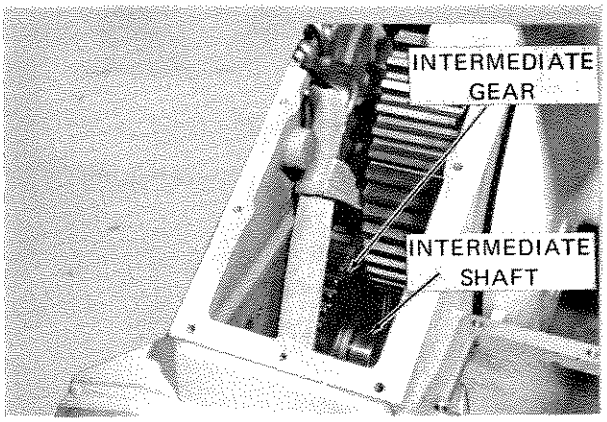


STEP 8. Install the four O-rings in transmission case.

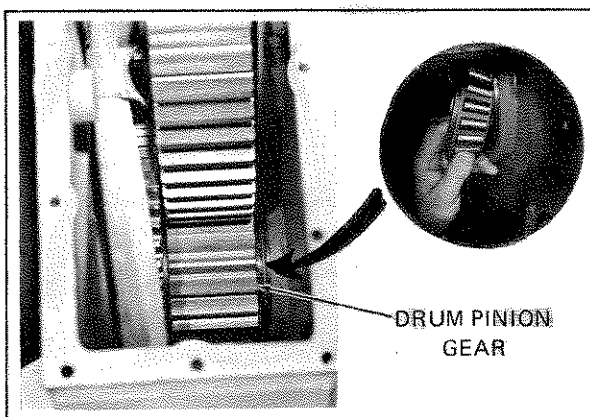


STEP 9. Align the drum gear, then install side frame on transmission case.

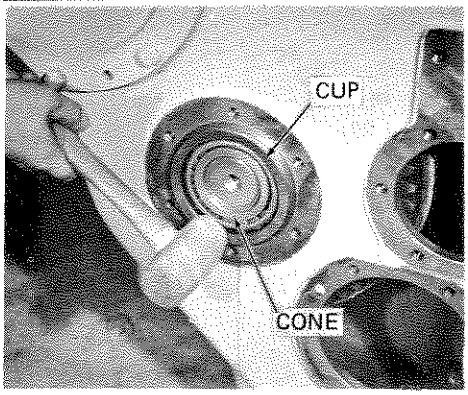
Figure 5-16. Installation of Drum and Drum Shaft (Sheet 2 of 3)



STEP 1. Position intermediate gear in housing and install intermediate shaft far enough to support the gear.



STEP 2. Install the intermediate shaft bearing and drum pinion gear. Tap the shaft through the pinion gear and against the bearing.



STEP 3. Install the bearing cone (inner race) and bearing cup (outer race). Make sure that cup is firmly seated against the bearing cone.

STEP 4. Measure the distance from the face of the bearing cup to the winch housing. Add shim pack 0.004 to 0.007 inch greater than the measured distance. For example, if the measure distance is 0.004 inch, add a shim pack with a total thickness of 0.008 to 0.011 inch. This will allow 0.004 to 0.007 inch endplay of the shaft. Install bearing retainer.

NOTE: Shafts requiring a shim pack greater than 0.020 are not uncommon.

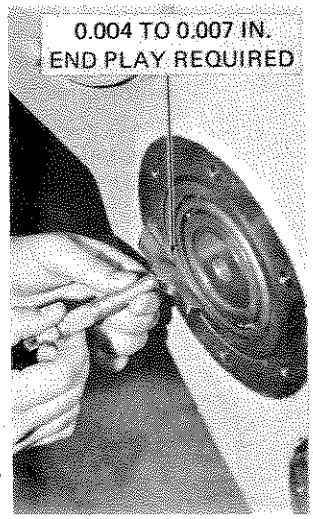
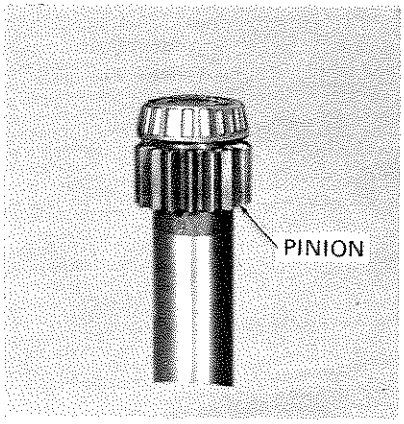
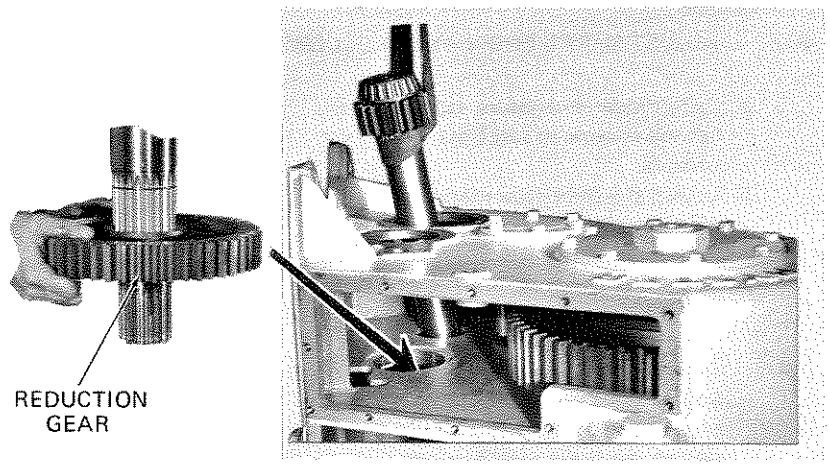


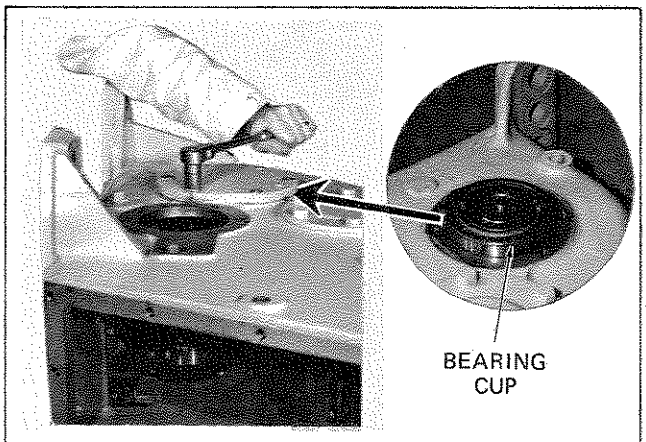
Figure 5-17. Installation of Intermediate Shaft Assembly



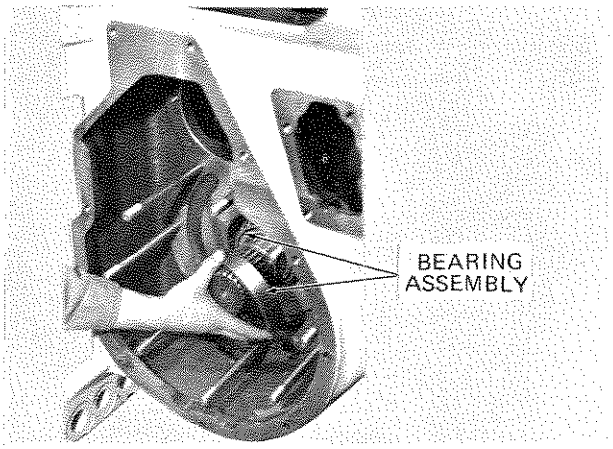
STEP 1. Press pinion and bearing on right-hand end of brake shaft.



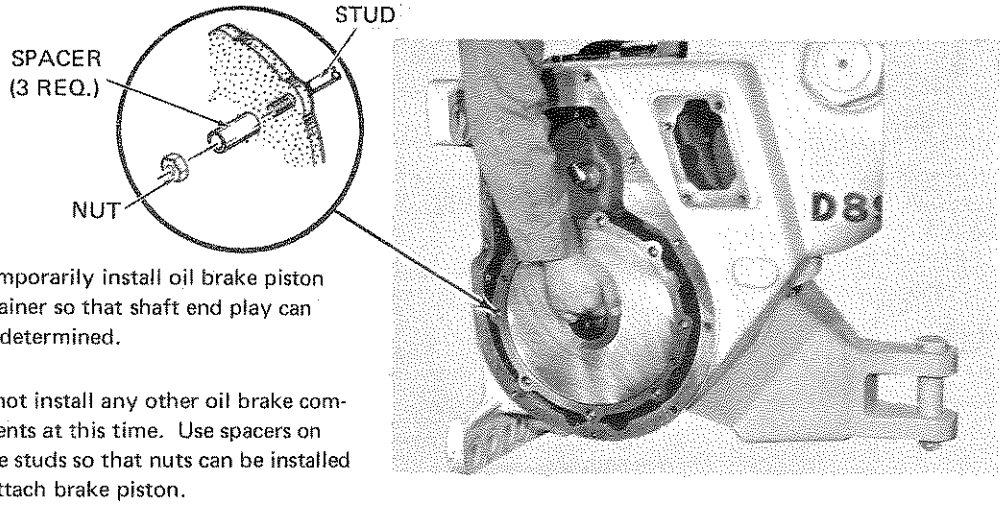
STEP 2. Lower shaft into winch housing and install Reduction Gear.



STEP 3. Install bearing cup on right-hand end of shaft. Install retainer using three capscrews only. Tighten capscrews snugly.



STEP 4. Set winch in normal operating position and install left-hand bearing assembly.



STEP 5. Temporarily install oil brake piston retainer so that shaft end play can be determined.

NOTE: Do not install any other oil brake components at this time. Use spacers on three studs so that nuts can be installed to attach brake piston.

Figure 5-18. Installation of Brake Shaft Assembly (Sheet 1 of 2)

STEP 6. ADJUST SHAFT ENDPLAY AS FOLLOWS:

a. Using moderate pressure, tap right-hand bearing retainer to seat brake shaft components.
b. Loosen the three capscrews previously installed in step 3 above. Tighten capscrews finger tight only.
c. Measure gap between retainer and winch frame. Measure in three places around retainer. Add the three indications and divide by 3. This will give the average gap. Add shim pack 0.005 inch greater than the average gap. This will place 0.005 inch endplay on the brake shaft bearings.

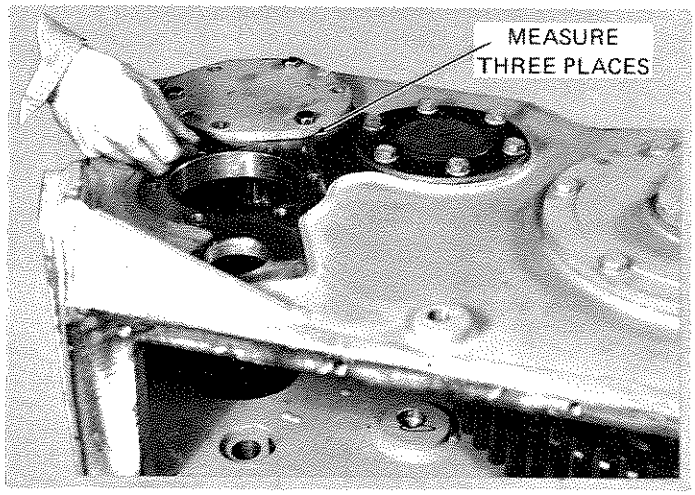
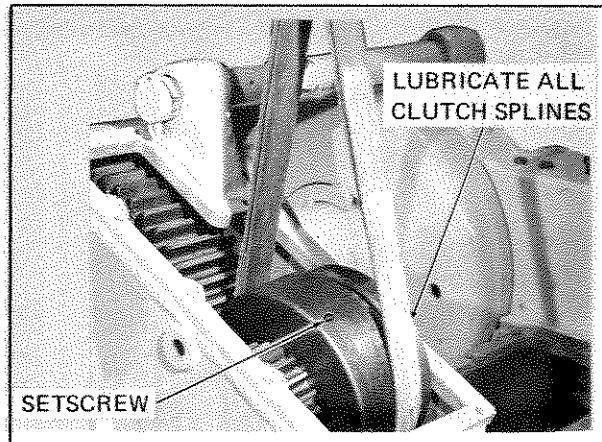
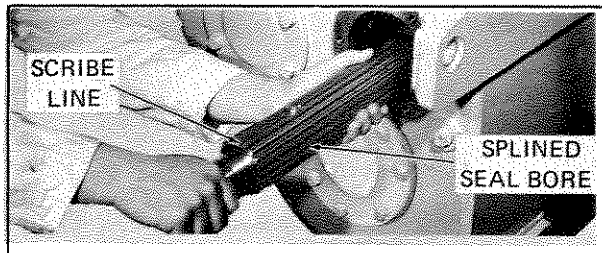


Figure 5-18. Installation of Brake Shaft Assembly (Sheet 2 of 2)

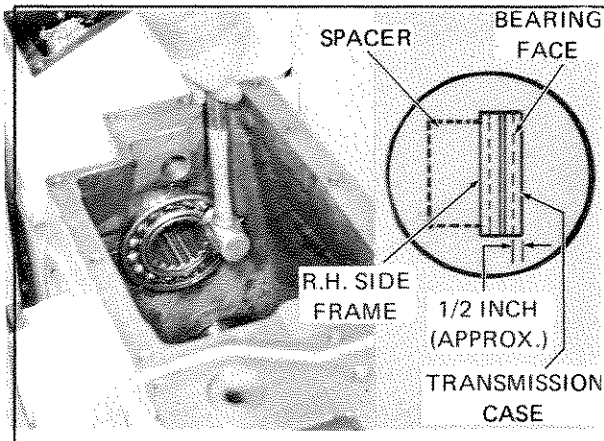


STEP 1. Lower reverse clutch assembly into housing. Rotate clutch assembly so that setscrew is at the top as shown.

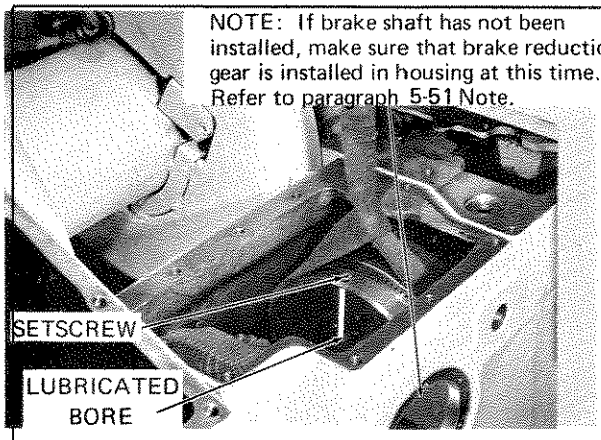


STEP 2. Position bevel gear shaft so that splined seal bore is directly in line with the setscrew at the top of reverse clutch assembly, then insert shaft. Make sure that scribe line on spline faces up. Lubricate entire shaft.

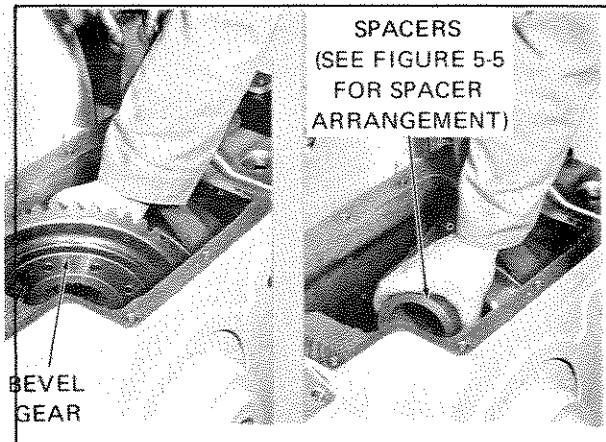
CAUTION: Make sure that the splined seals are removed before inserting the shaft. Splined seals may be damaged if installed at this time.



STEP 3. Install bearing assembly so that it is recessed approximately 1/2 inch into transmission case bore.

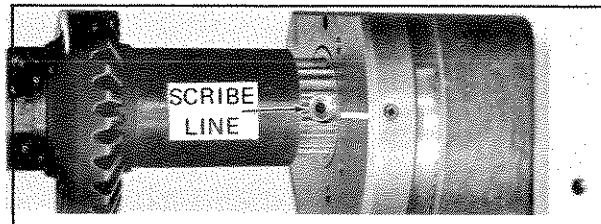


STEP 4. Lower forward clutch assembly into housing as shown. Rotate clutch assembly so that setscrew is at the top as shown.



STEP 5. Install the two spacers and bevel gear.

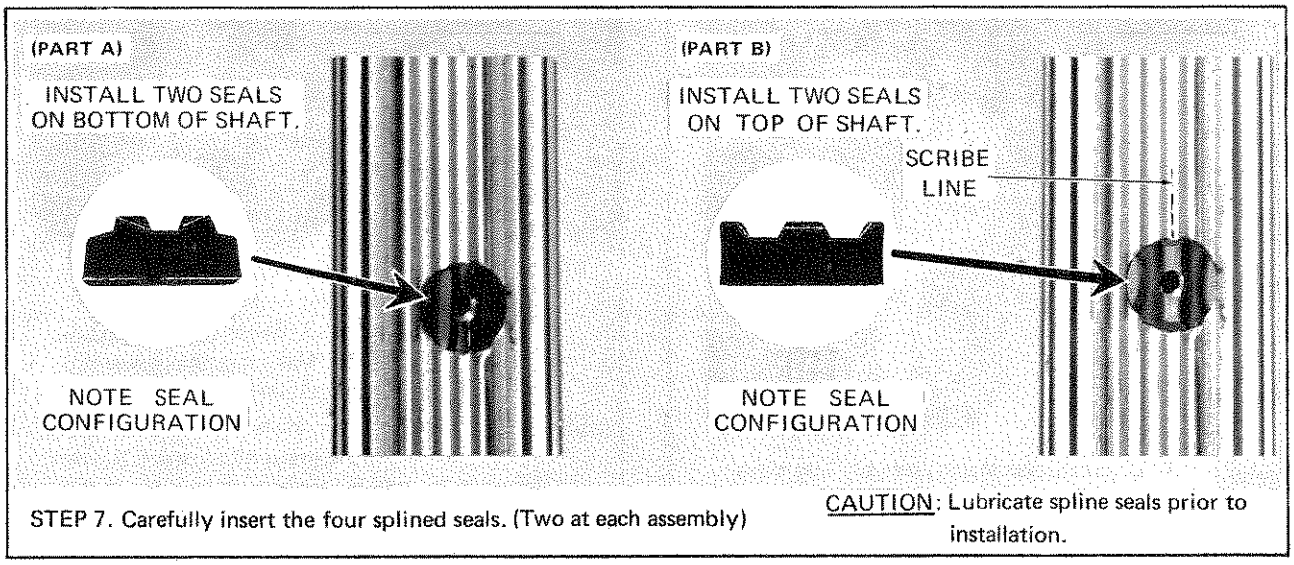
NOTE: Bevel gear and spacers are shown in overwind position. Refer to Paragraph 4-12. for underwind.



STEP 6. Tap bevel gear shaft through forward clutch assembly to position shown. Make sure that splined seal bore is aligned with setscrew at top of forward clutch assembly.

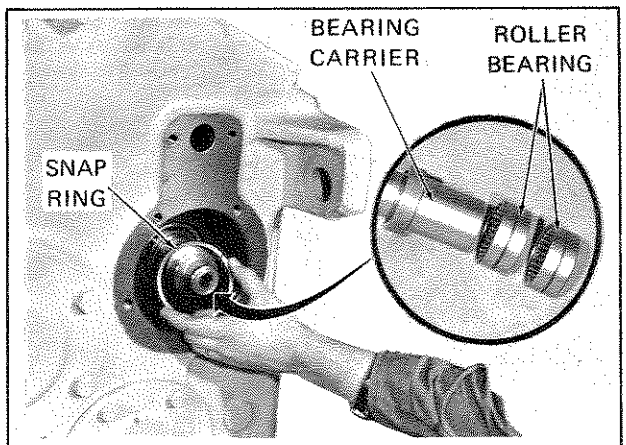
CAUTION: Splined seal bore and setscrew in clutch assembly must be exactly aligned. Misalignment of only one spline distance will impede flow of cooling oil during operation of the winch. Use scribe line on shaft spline for reference.

Figure 5-19. Reassembly and Installation of Bevel Gear Shaft Assembly (Sheet 1 of 4)

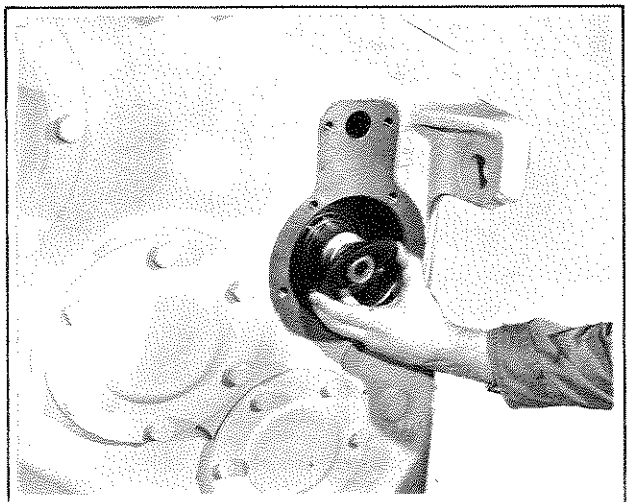


STEP 7. Carefully insert the four splined seals. (Two at each assembly)

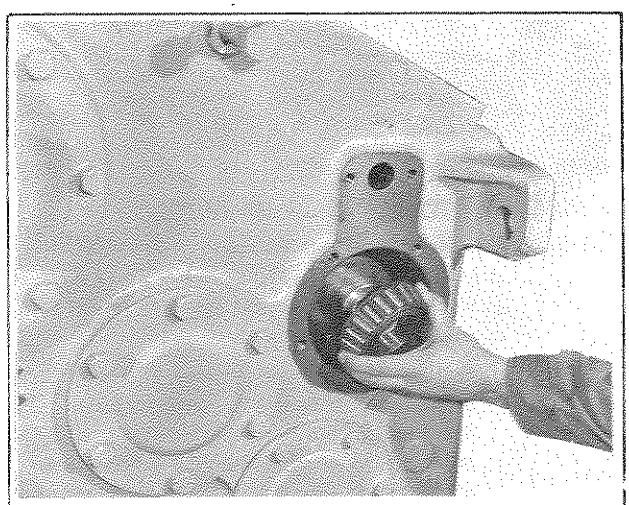
CAUTION: Lubricate spline seals prior to installation.



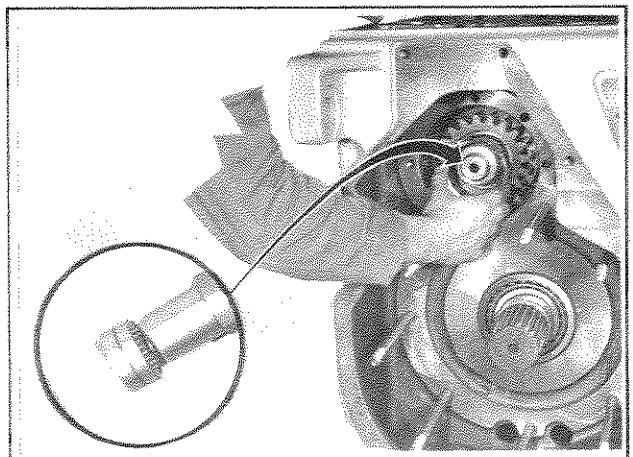
STEP 8. Carefully tap bevel gear shaft through the clutch assemblies. Install bearing assembly on right-hand end of gear shaft.



STEP 9. Install washer.

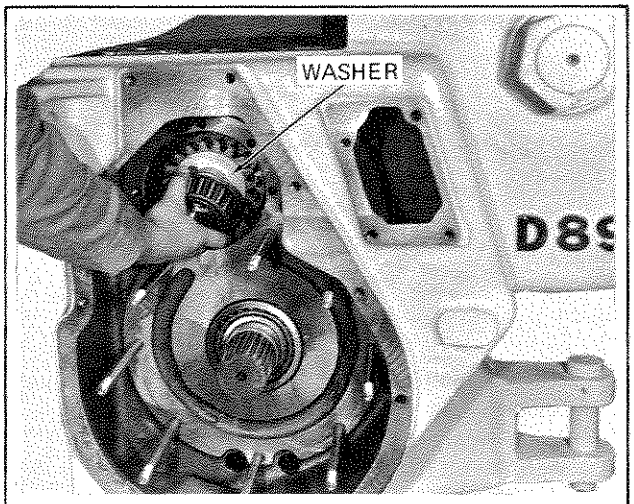


STEP 10. Install bearing cone.

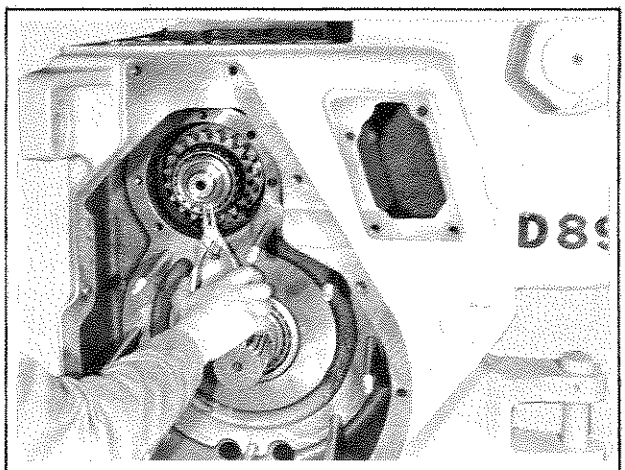


STEP 11. Install bearing assembly on left-hand end of shaft, then install snap ring.

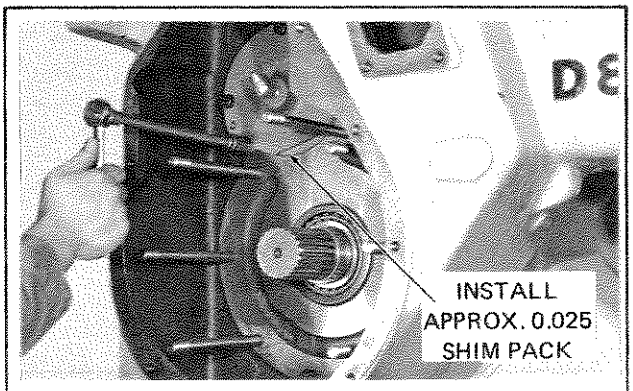
Figure 5-19. Reassembly and Installation of Bevel Gear Shaft Assembly (Sheet 2 of 4)



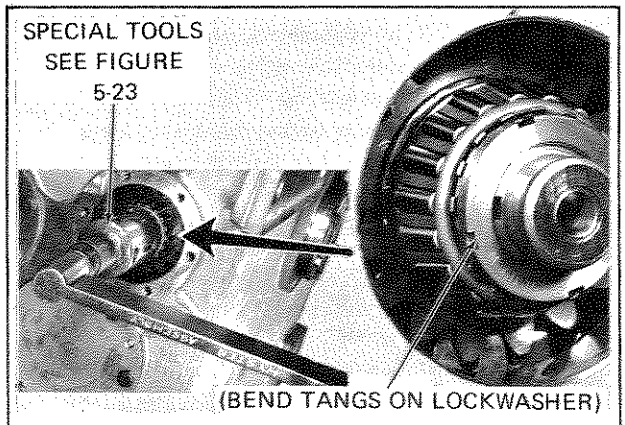
STEP 12. Install washer and bearing.



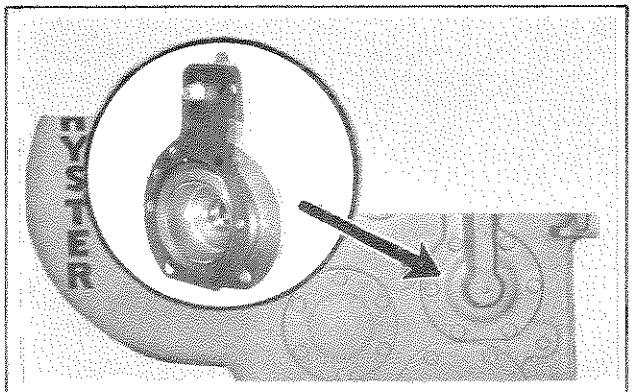
STEP 13. Tap bearing against clutch assembly, then install snap ring.



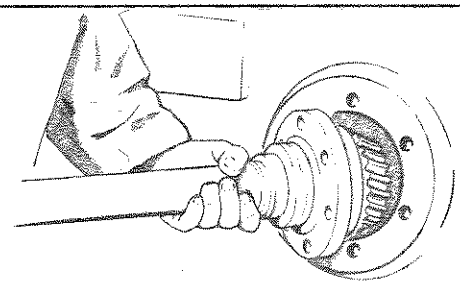
STEP 14. Install approximately 0.025 inch shim pack on left-hand bearing retainer, then install retainer. Tighten capscrews securely. Final torque at this time is not necessary.



STEP 15. Install lockwasher and locknut on right-hand end of gear shaft. Tighten locknut to 200 ft–lbs. Bend lockwasher tangs over flats of locknut.

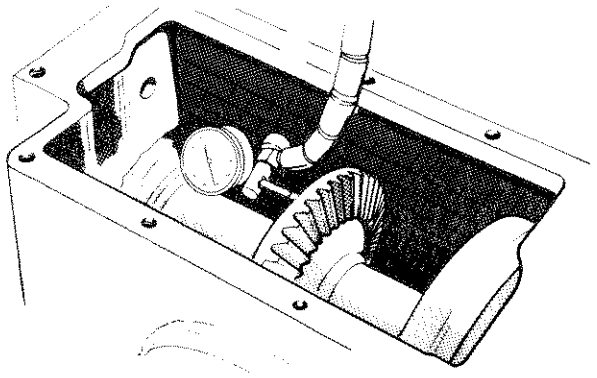


STEP 16. Install approximately 0.040 shim pack on right-hand bearing retainer and install retainer. Tighten capscrews securely. Final torque at this time is not necessary.



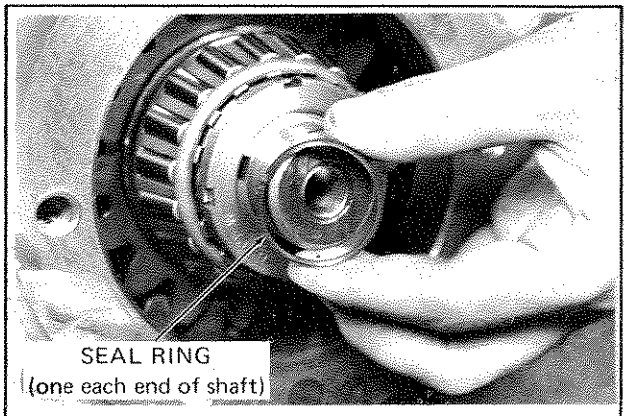
STEP 17. Install approximately 0.025 inch shim pack on PTO shaft and install shaft. Tighten capscrews securely. Check that PTO pinion teeth are positioned in the center of bevel gear teeth. Add or subtract shims at PTO shaft to center gear teeth. Tighten capscrews to 75 ft–lbs.

Figure 5-19. Reassembly and Installation of Bevel Gear Shaft Assembly (Sheet 3 of 4)



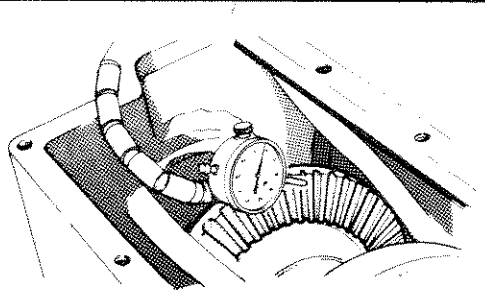
STEP 18. Connect dial indicator as shown to check bevel gear shaft preload. Add or subtract shims from the two bearing retainers to obtain zero endplay as indicated on dial indicator. When zero endplay is obtained, subtract 0.004 inch shim from either the right-hand or left-hand bearing retainer.

NOTE: Adding or subtracting shims from these retainers will effect pinion-to-bevel gear backlash. See step 19.



STEP 20. Remove right-hand and left-hand bearing retainers, then install two cast-iron seal rings. Re-install retainers (with shims) and tighten capscrews to 75 ft-lbs.

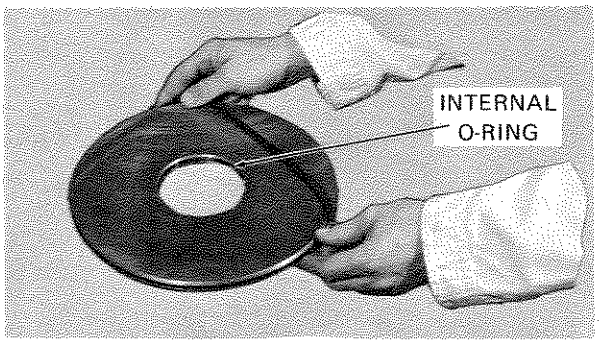
CAUTION: Use care when expanding seal rings. Seal ring material is fragile and breaks easily.



NOTE: Before checking backlash, place a pry-bar between the forward clutch pack and winch frame. Apply medium pressure to move gear-shaft toward right-hand side of winch. This will place bevel gear in normal operating position. The bevel gear tends to move toward the right-hand side of winch when turned by PTO pinion during winch operation.

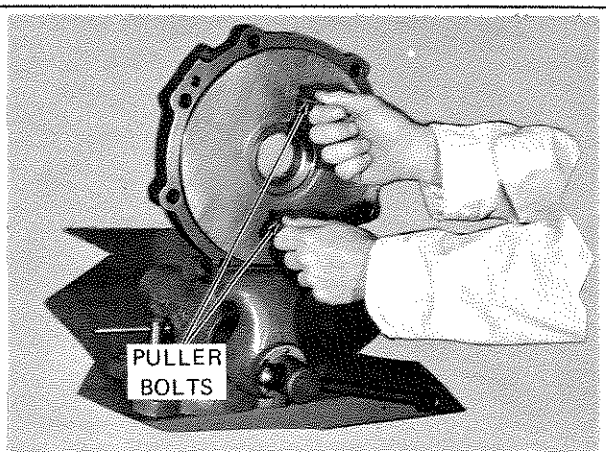
STEP 19. Connect dial indicator as shown to check pinion-to-bevel gear backlash. Backlash should be 0.008-0.012 inch. If less than 0.008, remove shims from right-hand bearing retainer as required. Add same amount to retainer at opposite end of shaft to maintain preload. If greater than 0.012, remove shims from left-hand retainer as required. Add same amount to right-hand retainer to maintain preload.

Figure 5-19. Reassembly and Installation of Bevel Gear Shaft Assembly (Sheet 4 of 4)

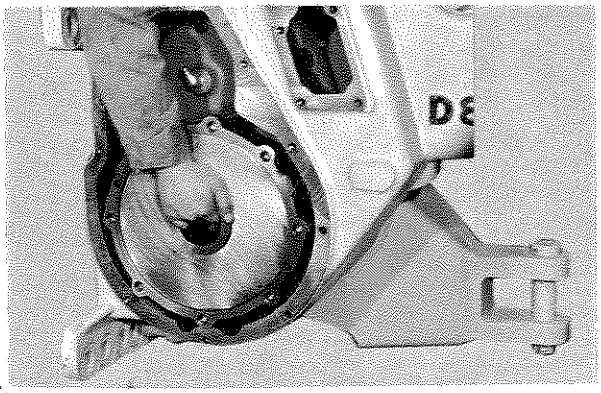


STEP 1. Install two new o-rings in piston. It may be necessary to stretch internal o-ring to hold it in place until piston is installed in piston housing.

CAUTION: Use only Hyster Approved o-rings to ensure proper sealing.

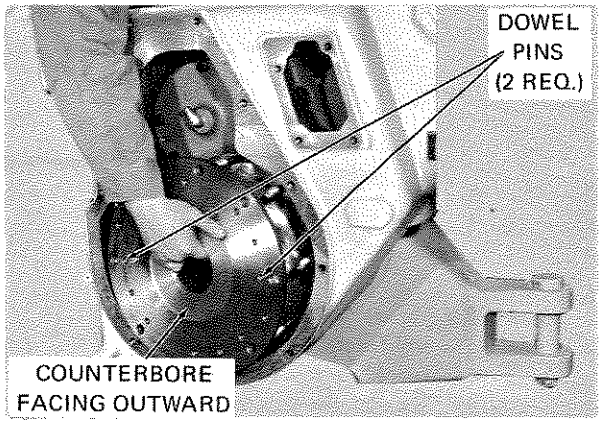


STEP 2. Install piston in housing, then remove puller bolts.

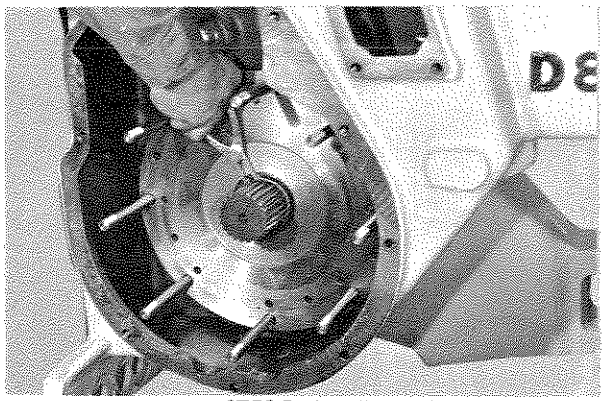


STEP 3. Install assembled piston retainer

NOTE: Make sure that bearing on brake shaft is properly positioned before installing retainer.

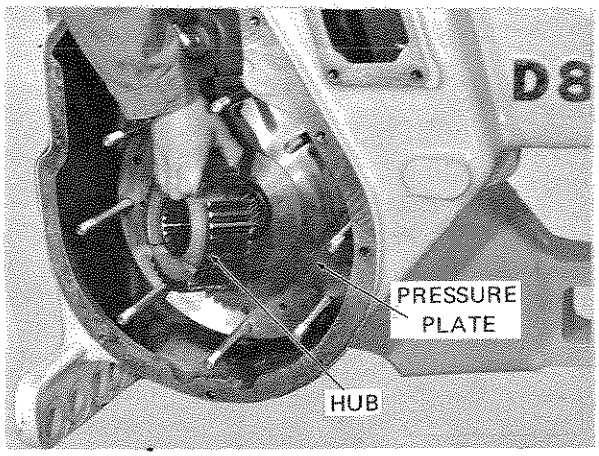


STEP 4. Install pressure plate. Push plate against piston retainer. Then install dowel pins.



STEP 5: Install snap ring or spacer.

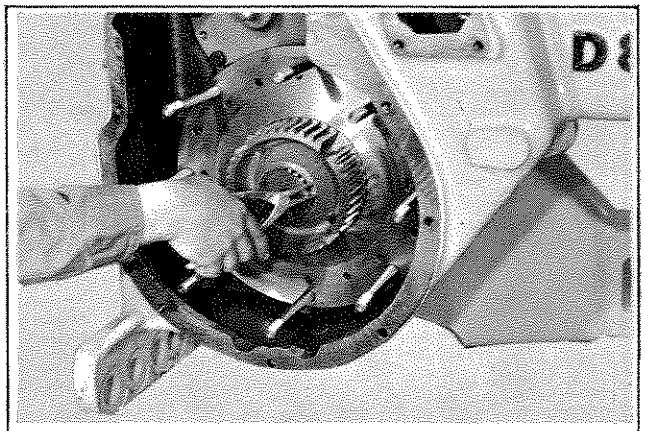
CAUTION: Make sure that snap ring is securely positioned in brake shaft groove.



STEP 6. Install hub as shown.

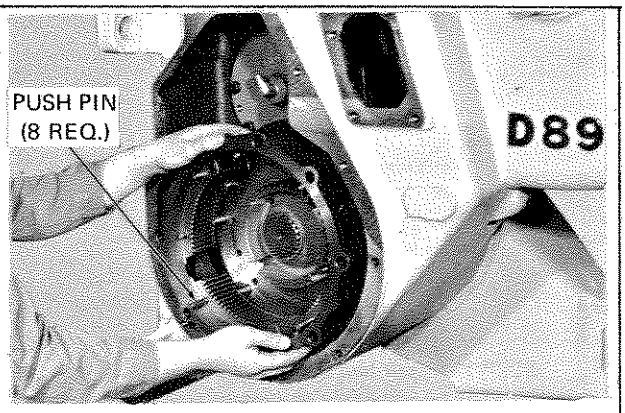
CAUTION: Do not reverse hub.

Figure 5-20. Reassembly and Installation of Oil Brake Assembly (Sheet 1 of 2)



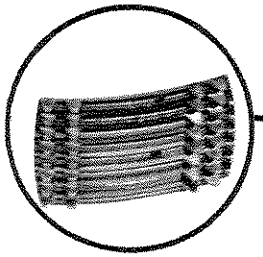
STEP 7. Install snap ring.

CAUTION: Make sure that snap ring is securely positioned in brake shaft groove.



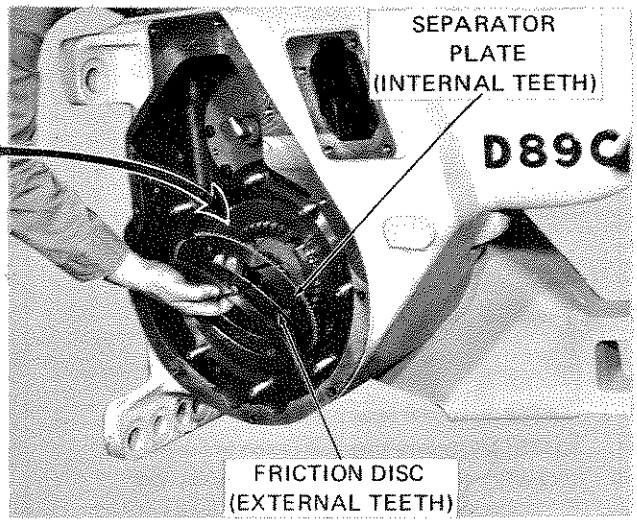
STEP 8. Install cage against pressure plate. Then install eight push pins.

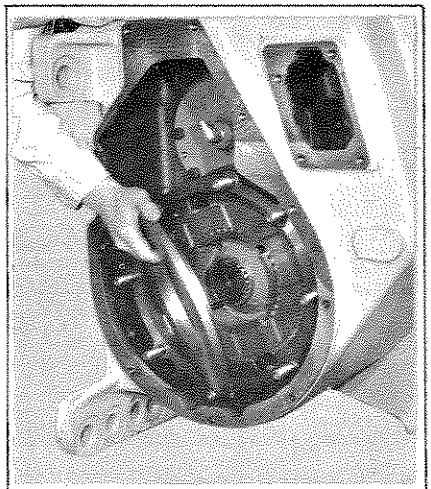
NOTE: Holes in cage are sequenced so that cage can only be installed as shown.



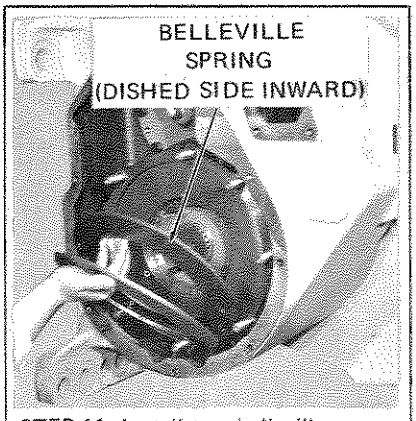
STEP 9. Install the 11 friction discs and 10 separator plates ALTERNATELY starting with a friction disc. align friction disc slots as shown.

CAUTION: Separator plates are conical (dished) Face all separator plates in the same direction. All dished (concave) sides must face either inward or outward.



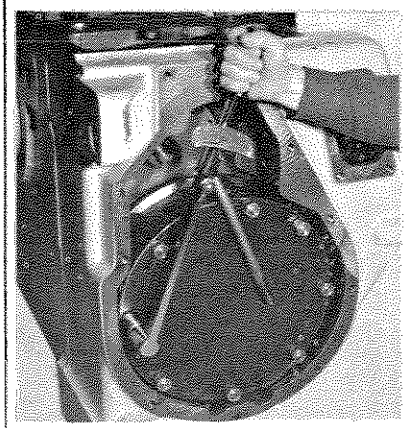


STEP 10. Install thrust ring.



STEP 11. Install two belleville springs and brake cover.

CAUTION: Dished (concave) side of belleville springs must face inward.



STEP 12. Install eight nuts (with lockwashers). Tighten nuts alternately to 150 ft. lbs.

Figure 5-20. Reassembly and Installation of Oil Brake Assembly (Sheet 2 of 2)

TABLE 5-2. WINCH INSTALLATION DATA

TRACTOR	PART	TYPE	SIZE	QTY. USED	LOCATION (FIGURE 5-21)
D8	Nut	Plain Hex	1-1/2 UNF	2	C
	Nut	Slotted Jam	1-1/4 UNF	1	B
	Nut	Hex Jam	1-1/4 UNF	1	A
	Nut	Plain Hex	1-1/4 UNF	4	D
	Lockwasher	Split Lock	1-1/2	2	C
	Lockwasher	Split Lock	1-1/4	4	D
	Lockwasher	Shakeproof	1-5/16	1	A
	Key	Cotter	5/32 x 2-1/2	1	B
D9	Nut	Plain Hex	1-1/2 UNF	6	C
	Nut	Slotted Jam	1-1/4 UNF	1	B
	Nut	Hex Jam	1-1/4 UNF	1	A
	Lockwasher	Split Lock	1-1/2	6	C
	Key	Cotter	5/32 x 2-1/2	1	B
	Lockwasher	Shakeproof	1-5/16	1	A

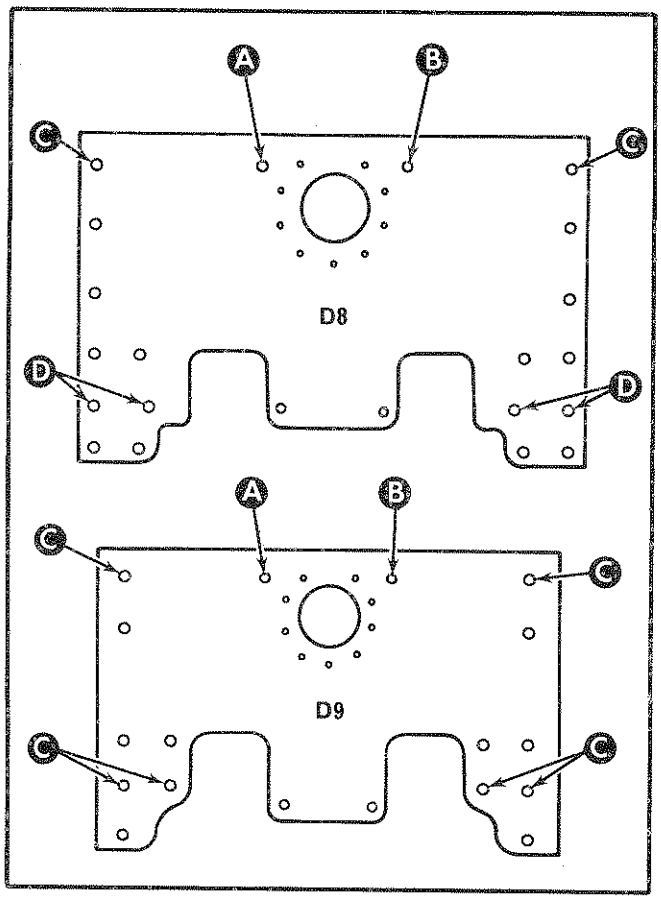
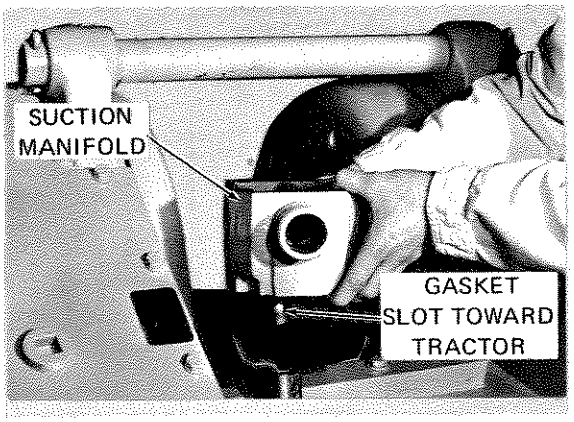
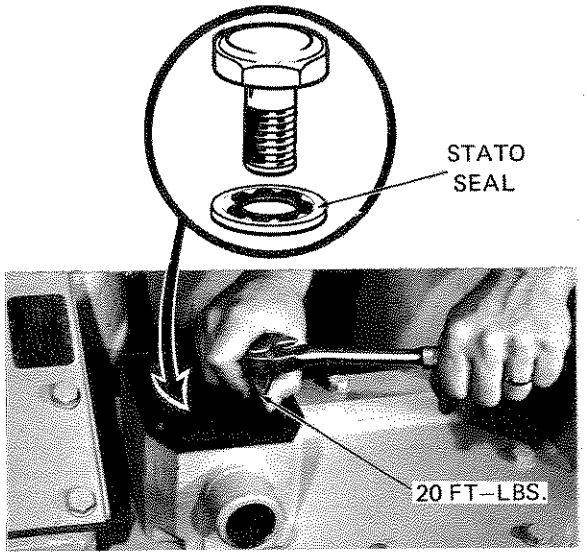


Figure 5-21. Installation of Winch on Tractor

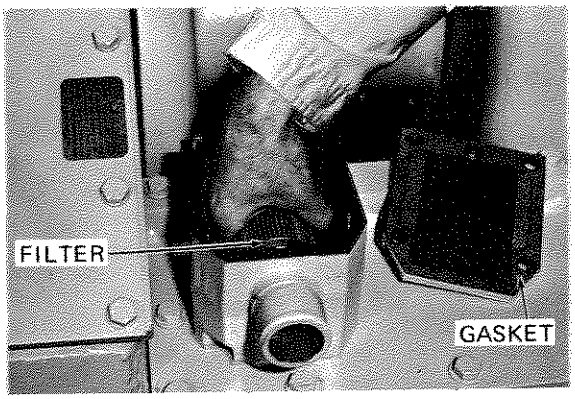


STEP 1. Install transmission cover with NEW GASKET Install suction manifold with the NEW GASKET positioned as shown.

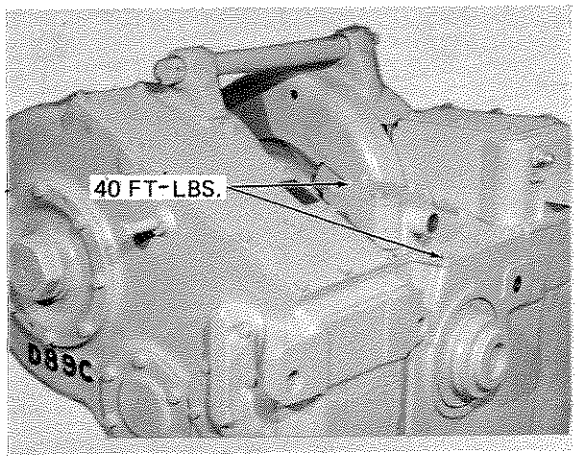


STEP 2. Install the three capscrews with stato-seals.

CAUTION: Installation of the stato-seals is critical. Use care not to damage the seals during installation. Always install NEW Hyster Approved seals. Never install used seals.

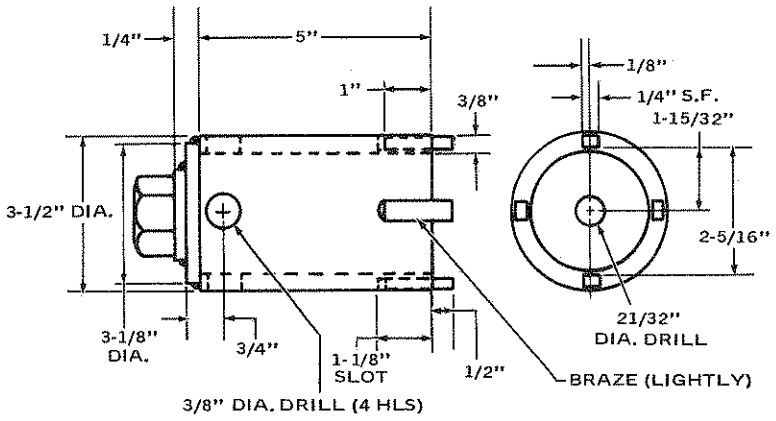


STEP 3. Install filter element and cover (with gasket). Do not over-tighten the filter element. The filter is difficult to remove it over-tightened.

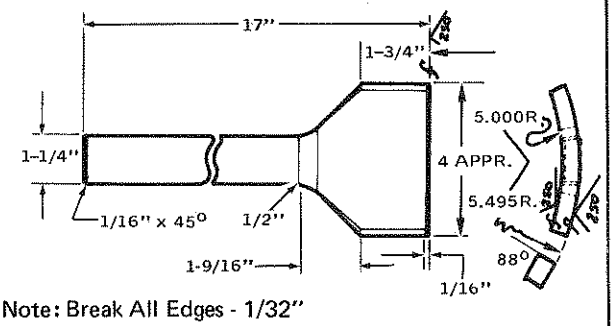


STEP 4. Tighten the manifold cover and transmission cover to 40 foot-pounds

Figure 5-22. Installation of Suction Manifold



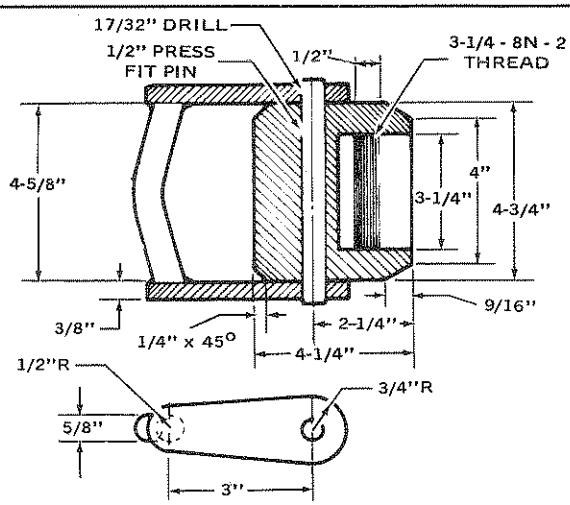
BEVEL GEAR SHAFT LOCKNUT REMOVAL AND INSTALLATION



Note: Break All Edges - 1/32"

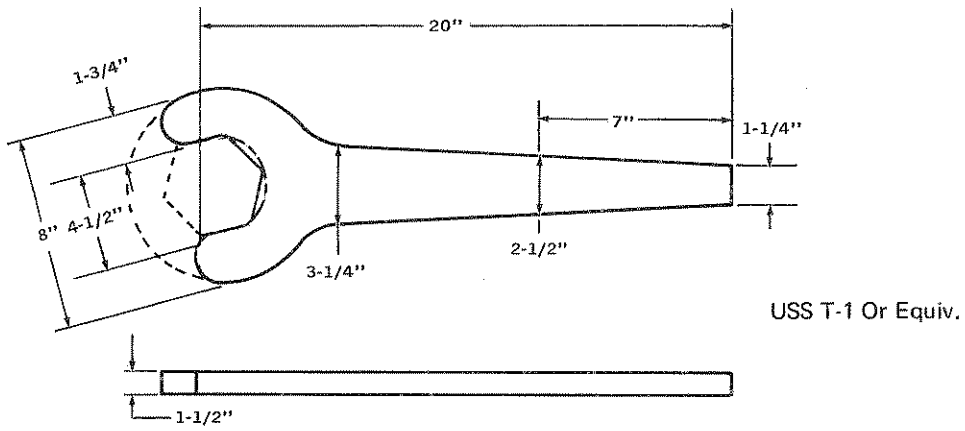
One Req'd 1" x 4" x 14-1/8" SAE C-1018.

DRUM OIL SEAL INSTALLATION

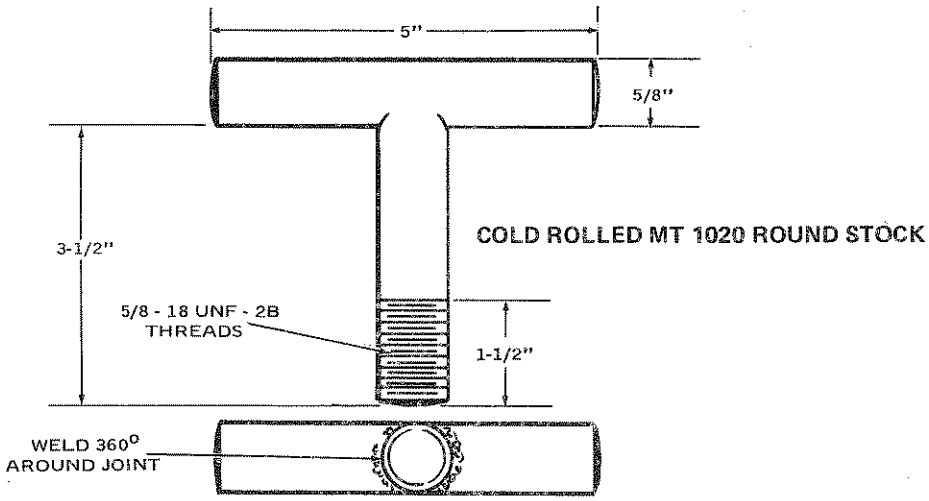


DRUM SHAFT REMOVAL AND INSTALLATION

Figure 5-23. Special Tools (Sheet 1 of 2)



DRUM SHAFT NUT REMOVAL AND INSTALLATION



DRUM AND DRUM GEAR REMOVAL – INSTALLATION

Figure 5-23. .Special Tools (Sheet 2 of 2)

"THE QUALITY KEEPERS"

HYSTER APPROVED PARTS

HYSTER COMPANY
TRACTOR ATTACHMENT OPERATIONS

500 5/80 LL Litho