

# **SERVICE MANUAL**

**D6E TOWING WINCH**

**DD / PC**

## **SAFETY PRECAUTIONS MAINTENANCE AND REPAIR**

- Use extreme caution when removing the cable end ferrule from the drum. The cable may spring out with extreme force when the cable lock is removed.
- To hoist the winch, attach the lifting device securely as illustrated in this manual.
- When lifting components, double check all slings, chains or cables to make certain that they are properly tied, fastened and balanced before lifting. Do not spread the sides of the sling beyond a 90 degree angle.
- Do not attempt to lift heavy parts by hand when a lifting device should be used.
- Wear safety glasses when performing any service work on the unit.
- Do not attempt to remove any components while the engine is running.
- Never leave the unit and/or heavy parts in an unstable position. Always properly block the unit with appropriate materials.
- Keep the unit and working area clear of lubricants and litter.
- Use proper tools for the job at hand.
- Keep tools in first-class condition.
- Use **HYSTER APPROVED** replacement parts which are designed for the unit being repaired.
- Carefully check to see that all necessary nuts, bolts, snap rings and other locking devices are removed before using force to remove components.
- Always attach a sign in the control area stating **DO NOT OPERATE** when unit is being repaired.
- Always observe the **WARNING** and **CAUTION** statements used in this Service Manual.

# TABLE OF CONTENTS

	PAGE		PAGE
INTRODUCTION .....	V		
SECTION 1 - SPECIFICATIONS & DESCRIPTIONS			
1-1. GENERAL .....	1-1	2-19. OPERATING IN NORMAL CONTROL .....	2-4
1-3. LIST OF SPECIFICATIONS .....	1-1	2-20. OPERATING IN FINE INCHING CONTROL .....	2-5
1-5. SERIAL NUMBER DATA .....	1-6	2-21. FREE-SPOOLING .....	2-5
1-7. PHYSICAL DESCRIPTION .....	1-6	SECTION 3 - TROUBLESHOOTING	
1-8. TOWING WINCH .....	1-6	3-1. GENERAL .....	3-1
1-10. DIRECT DRIVE GEAR TRAIN .....	1-10	SECTION 4 - SERVICE INSTRUCTIONS	
1-11. POWER CONTROLLED GEAR TRAIN .....	1-10	4-1. GENERAL .....	4-1
1-12. DRY BRAKE ASSEMBLY .....	1-10	4-3. SAFEGUARD MAINTENANCE .....	4-1
1-13. AUTOMATIC BRAKE .....	1-10	4-5. SAFEGUARD MAINTENANCE AND SERVICE	
1-14. HYDRAULIC BRAKE ASSEMBLY .....	1-10	INSPECTION SCHEDULE .....	4-1
1-15. DENTAL CLUTCH ASSEMBLY .....	1-13	4-7. ADJUSTMENT PROCEDURES .....	4-5
1-16. OIL CLUTCH ASSEMBLY .....	1-14	4-9. DIRECT DRIVE WINCH ADJUSTMENTS .....	4-5
1-17. CONTROL VALVE ASSEMBLY .....	1-15	4-11. ADJUSTING CLUTCH HANDLEVER .....	4-5
1-18. COOLING OIL RELIEF VALVE ASSEMBLY .....	1-15	4-12. ADJUSTING THE BRAKE .....	4-5
1-19. COOLING OIL RELIEF VALVE ASSEMBLY .....	1-15	4-13. BRAKE BAND ADJUSTMENT .....	4-5
1-20. HYDRAULIC PUMP ASSEMBLY .....	1-16	4-14. BRAKE HANDLEVER ADJUSTMENT .....	4-6
1-21. D5 AND TRAXCAVATOR, D6 UP		4-15. OVERWIND ADJUSTMENT PROCEDURE .....	4-6
THROUGH WINCH SERIAL NO. C82P-1872 .....	1-16	4-16. BEVEL GEAR SHAFT ARRANGEMENT .....	4-6
1-22. D6 TRACTORS WITH WINCH SERIAL		4-17. BRAKE ASSEMBLY ARRANGEMENT .....	4-6
NO. C82P-1873 AND UP .....	1-18	4-18. DRUM ASSEMBLY ARRANGEMENT .....	4-7
1-23. HANDLING GEAR .....	1-18	4-19. UNDERWIND ADJUSTMENT PROCEDURE .....	4-8
1-24. DIRECT DRIVE WINCH .....	1-18	4-20. BEVEL GEAR SHAFT ARRANGEMENT .....	4-8
1-25. POWER CONTROLLED WINCH .....	1-19	4-21. BRAKE ASSEMBLY ARRANGEMENT .....	4-8
1-26. EARLY PRODUCTION HANDLING GEAR .....	1-19	4-22. DRUM ASSEMBLY ARRANGEMENT .....	4-8
1-27. LATER PRODUCTION HANDLING GEAR .....	1-20	4-23. POWER CONTROLLED WINCH	
1-28. FREE-SPOOLING HANDLING GEAR .....	1-20	ADJUSTMENTS .....	4-8
1-29. FUNCTIONAL DESCRIPTION .....	1-20	4-25. HYDRAULIC SYSTEM PRESSURE CHECKS .....	4-9
1-30. DIRECT DRIVE GEAR TRAIN .....	1-20	4-26. ADJUSTING THE CONTROL CABLES .....	4-11
1-32. POWER CONTROLLED GEAR TRAIN .....	1-22	4-27. MEASURING SPOOL TRAVEL .....	4-11
1-34. HYDRAULIC SYSTEM .....	1-23	4-28. SPOOL TRAVEL PRESSURE CHECKS .....	4-12
1-35. EARLY PRODUCTION .....	1-23	4-29. ADJUSTING THE BRAKE .....	4-12
1-36. LATER PRODUCTION .....	1-23	4-30. BRAKE CYLINDER ADJUSTMENT .....	4-12
1-37. OPERATIONAL MODES .....	1-23	4-31. BRAKE BAND ADJUSTMENT .....	4-12
1-38. HYDRAULIC SYSTEM IN NEUTRAL,		4-32. OVERWIND AND UNDERWIND	
NORMAL OPERATION .....	1-24	ADJUSTMENT PROCEDURES .....	4-12
1-39. HYDRAULIC SYSTEM IN FORWARD,		4-33. FREE-SPOOLING ADJUSTMENTS .....	4-12
NORMAL OPERATION .....	1-25	4-35. UNIT PAINTING .....	4-13
1-40. HYDRAULIC SYSTEM IN GRADUAL BRAKE		4-37. DECAL AND NAMEPLATE INSTALLATION .....	4-13
RELEASE, NORMAL OPERATION .....	1-27	SECTION 5 - OVERHAUL INSTRUCTIONS	
1-41. HYDRAULIC SYSTEM IN REVERSE,		5-1. GENERAL .....	5-1
NORMAL OPERATION .....	1-27	5-3. REMOVAL INSTRUCTIONS .....	5-1
1-42. HYDRAULIC SYSTEM IN FORWARD		5-4. REMOVAL OF WINCH FROM TRACTOR .....	5-1
INCHING, BRAKE APPLIED .....	1-27	5-6. REMOVAL OF DIRECT DRIVE WINCH .....	5-1
1-43. HYDRAULIC SYSTEM IN FORWARD		5-7. REMOVAL OF POWER CONTROLLED	
INCHING, BRAKE SLIPPING .....	1-27	WINCH .....	5-1
1-44. HYDRAULIC SYSTEM IN REVERSE		5-8. REMOVAL AND DISASSEMBLY OF PTO	
INCHING, BRAKE APPLIED .....	1-29	SHAFT ASSEMBLY .....	5-1
1-45. HYDRAULIC SYSTEM IN REVERSE		5-10. REMOVAL AND DISASSEMBLY OF	
INCHING, BRAKE SLIPPING .....	1-30	HYDRAULIC BRAKE ASSEMBLY .....	5-1
SECTION 2 - OPERATION		5-12. REMOVAL OF DRY BRAKE AND	
2-1. GENERAL .....	2-1	AUTOMATIC BRAKE .....	5-1
2-3. OPERATIONAL PRECAUTIONS .....	2-1	5-14. REMOVAL AND DISASSEMBLY OF BEVEL	
2-5. OPERATING PROCEDURES .....	2-1	GEAR SHAFT ASSEMBLY .....	5-1
2-6. DIRECT DRIVE WINCH .....	2-1	5-16. DISASSEMBLY OF CLUTCH ASSEMBLIES .....	5-4
2-7. SETTING THE BRAKE .....	2-1	5-18. REMOVAL OF BRAKE SHAFT ASSEMBLY .....	5-4
2-8. RELEASING THE BRAKE .....	2-1	5-20. REMOVAL OF INTERMEDIATE SHAFT	
2-9. HAULING-IN LINE .....	2-1	ASSEMBLY .....	5-7
2-10. STOPPING THE WINCH .....	2-1	5-22. REMOVAL OF DRUM SHAFT AND DRUM .....	5-7
2-11. PAYING-OUT LINE UNDER POWER .....	2-2	5-24. REMOVAL OF CONTROL VALVE .....	5-8
2-12. SHIFTING TO NEUTRAL .....	2-2	5-26. REMOVAL OF HYDRAULIC PUMP	
2-13. POWER CONTROLLED WINCH .....	2-2	ASSEMBLY .....	5-12
2-15. EARLY PRODUCTION HANDLING GEAR .....	2-2	5-28. FOR D5 TRACTOR SERIAL NUMBER	
2-16. OPERATING IN NORMAL CONTROL .....	2-3	81H1 THRU 84H1 AND UP .....	5-12
2-17. OPERATING IN FINE INCHING CONTROL .....	2-3	5-29. FOR D5 TRACTOR SERIAL NUMBER	
2-18. LATER PRODUCTION HANDLING GEAR .....	2-4	95J1 AND UP AND 96J1 AND UP .....	5-12

## TABLE OF CONTENTS (Cont.)

## PAGE

5-30.	FOR D6 TRACTOR SERIAL NUMBER 74A THRU 76A AND UP, 99J1 AND UP, AND 10K1 AND UP . . . . .	5-12
5-31.	FOR 977 TRAXCAVATOR SERIAL NUMBER 53A1 AND UP . . . . .	5-12
5-32.	FOR 977 TRAXCAVATOR SERIAL NUMBER 46H1 AND UP . . . . .	5-12
5-33.	CLEANING . . . . .	5-18
5-35.	BEVEL GEAR SHAFT OIL PASSAGES . . . . .	5-19
5-36.	VISUAL INSPECTION . . . . .	5-19
5-38.	MINOR REPAIRS . . . . .	5-22
5-39.	CONTROL VALVE REPAIRS . . . . .	5-22
5-41.	HYDRAULIC BRAKE CYLINDER REPAIRS . . . . .	5-23
5-42.	HYDRAULIC PUMP REPAIRS . . . . .	5-24
5-45.	PUMP DISASSEMBLY, CERTAIN CATCO D5, D6 AND TRAXCAVATOR TRACTORS . . . . .	5-24
5-46.	INSPECTION AND REPAIR OF PUMP PARTS, CERTAIN D5, D6, AND TRAXCAVATOR TRACTORS . . . . .	5-24
5-47.	PUMP REASSEMBLY, CERTAIN CATCO D5, D6 AND TRAXCAVATOR TRACTORS . . . . .	5-24
5-48.	PUMP DISASSEMBLY, LATER CATCO D6 TRACTOR . . . . .	5-24

## PAGE

5-49.	INSPECTION AND REPAIR OF PUMP PARTS, LATER CATCO D6 TRACTOR . . . . .	5-27
5-50.	PUMP REASSEMBLY, LATER CATCO D6 TRACTOR . . . . .	5-28
5-51.	REASSEMBLY AND INSTALLATION . . . . .	5-28
5-53.	REASSEMBLY OF CLUTCH ASSEMBLIES . . . . .	5-28
5-55.	INSTALLATION OF DRUM AND DRUM SHAFT . . . . .	5-28
5-57.	INSTALLATION OF INTERMEDIATE SHAFT ASSEMBLY . . . . .	5-34
5-59.	INSTALLATION OF BRAKE SHAFT ASSEMBLY . . . . .	5-34
5-61.	REASSEMBLY AND INSTALLATION OF BEVEL GEAR SHAFT ASSEMBLY (P.C.) . . . . .	5-36
5-63.	REASSEMBLY AND INSTALLATION OF BEVEL GEAR SHAFT ASSEMBLY (D.D.) . . . . .	5-36
5-65.	REASSEMBLY AND INSTALLATION OF HYDRAULIC BRAKE ASSEMBLY . . . . .	5-36
5-67.	INSTALLATION OF DRY BRAKE AND AUTOMATIC BRAKE . . . . .	5-36
5-69.	INSTALLATION OF WINCH ON TRACTOR . . . . .	5-38
5-71.	SPECIAL TOOLS . . . . .	5-44

## LIST OF ILLUSTRATIONS

## FIGURE NO.

## PAGE

1-1.	D6E TOWING WINCH . . . . .	1-8
1-2.	DIRECT DRIVE GEAR TRAIN . . . . .	1-11
1-3.	POWER CONTROLLED GEAR TRAIN . . . . .	1-12
1-4.	DRY BRAKE ASSEMBLY, DIRECT DRIVE WINCH . . . . .	1-13
1-5.	AUTOMATIC BRAKE, OPTIONAL, DIRECT DRIVE WINCH . . . . .	1-13
1-6.	HYDRAULIC BRAKE ASSEMBLY, POWER CONTROLLED WINCH . . . . .	1-14
1-7.	DENTAL CLUTCH ASSEMBLY, DIRECT DRIVE WINCH . . . . .	1-14
1-8.	OIL CLUTCH ASSEMBLY, POWER CONTROLLED WINCH . . . . .	1-15
1-9.	CONTROL VALVE ASSEMBLY, POWER CONTROLLED WINCH . . . . .	1-16
1-10.	COOLING OIL RELIEF VALVE ASSEMBLY, POWER CONTROLLED WINCH . . . . .	1-17
1-11.	HYDRAULIC PUMP ASSEMBLY . . . . .	1-17
1-12.	HANDLING GEAR FOR DIRECT DRIVE WINCH . . . . .	1-19
1-13.	HANDLING GEAR FOR POWER CONTROLLED WINCH . . . . .	1-19
1-14.	HANDLING GEAR FOR FREE-SPOOLING OPERATION, OPTIONAL . . . . .	1-20
1-15.	TORQUE TRANSFER, DIRECT DRIVE AND POWER CONTROLLED WINCH . . . . .	1-21
1-16.	HYDRAULIC SYSTEM INTERCONNECTION DIAGRAM . . . . .	1-22
1-17.	HYDRAULIC FLOW DIAGRAM, NEUTRAL, NORMAL OPERATION . . . . .	1-24
1-18.	HYDRAULIC FLOW DIAGRAM, FORWARD, NORMAL OPERATION . . . . .	1-25
1-19.	HYDRAULIC FLOW DIAGRAM, GRADUAL BRAKE RELEASE, NORMAL OPERATION . . . . .	1-26
1-20.	HYDRAULIC FLOW DIAGRAM, REVERSE, NORMAL OPERATION . . . . .	1-28
1-21.	HYDRAULIC FLOW DIAGRAM, FORWARD INCHING, BRAKE APPLIED . . . . .	1-29
1-22.	HYDRAULIC FLOW DIAGRAM, FORWARD INCHING, BRAKE SLIPPING . . . . .	1-30

## PAGE

1-23.	HYDRAULIC FLOW DIAGRAM, REVERSE INCHING, BRAKE APPLIED . . . . .	1-31
1-24.	HYDRAULIC FLOW DIAGRAM, REVERSE INCHING, BRAKE SLIPPING . . . . .	1-32
2-1.	OPERATING CONTROLS FOR DIRECT DRIVE WINCH . . . . .	2-2
2-2.	OPERATING CONTROLS, EARLY PRODUCTION POWER CONTROLLED WINCH . . . . .	2-3
2-3.	OPERATING CONTROLS, LATER PRODUCTION POWER CONTROLLED WINCH . . . . .	2-4
4-1.	SAFEGUARD MAINTENANCE DIAGRAM . . . . .	4-4
4-2.	SUCTION FILTER, POWER CONTROLLED WINCH . . . . .	4-5
4-3.	ADJUSTMENT OF CLUTCH LINKAGE, DIRECT DRIVE WINCH . . . . .	4-5
4-4.	BRAKE BAND ADJUSTMENT DIAGRAM, DIRECT DRIVE WINCH . . . . .	4-5
4-5.	ADJUSTMENT OF BRAKE LINKAGE, DIRECT DRIVE WINCH . . . . .	4-6
4-6.	BEVEL GEAR SHAFT OVERWIND AND UNDERWIND ARRANGEMENT . . . . .	4-6
4-7.	BRAKE BAND OVERWIND AND UNDERWIND ARRANGEMENT . . . . .	4-7
4-8.	AUTOMATIC BRAKE OVERWIND AND UNDERWIND ARRANGEMENT . . . . .	4-7
4-9.	WINCH DRUM OVERWIND AND UNDERWIND ARRANGEMENT . . . . .	4-8
4-10.	HYDRAULIC SYSTEM PRESSURE CHECKS . . . . .	4-9
4-11.	CONTROL CABLE ADJUSTMENT DIAGRAM . . . . .	4-11
4-12.	HYDRAULIC BRAKE CYLINDER AND BAND ADJUSTMENT DIAGRAM . . . . .	4-12
4-13.	PAINTING AND DECAL INSTALLATION . . . . .	4-14
5-1.	REMOVAL OF DIRECT DRIVE WINCH FROM TRACTOR . . . . .	5-2
5-2.	REMOVAL OF POWER CONTROLLED WINCH FROM TRACTOR . . . . .	5-3
5-3.	REMOVAL AND DISASSEMBLY OF PTO SHAFT ASSEMBLY . . . . .	5-5



## LIST OF ILLUSTRATIONS (Cont.)

PAGE

PAGE

5-4. REMOVAL OF HYDRAULIC BRAKE ASSEMBLY POWER CONTROLLED WINCH. ....	5-6	5-18. HYDRAULIC BRAKE CYLINDER REPAIRS, POWER CONTROLLED WINCH. ....	5-23
5-5. REMOVAL OF DRY BRAKE AND AUTOMATIC BRAKE, DIRECT DRIVE WINCH. ....	5-8	5-19. HYDRAULIC PUMP REPAIRS, CERTAIN EARLY D5, D6 AND TRAXCAVATOR TRACTORS. ....	5-25
5-6. BEVEL GEAR SHAFT, LOCATION OF COMPONENTS. ....	5-9	5-20. HYDRAULIC PUMP REPAIRS, LATER D6 TRACTORS. ....	5-27
5-7. REMOVAL AND DISASSEMBLY OF BEVEL GEAR SHAFT ASSEMBLY. ....	5-10	5-21. REASSEMBLY OF CLUTCH ASSEMBLY, POWER CONTROLLED WINCH. ....	5-29
5-8. DISASSEMBLY OF CLUTCH ASSEMBLY, POWER CONTROLLED WINCH. ....	5-13	5-22. INSTALLATION OF DRUM AND DRUM SHAFT. ....	5-31
5-9. REMOVAL OF BRAKE SHAFT ASSEMBLY. ....	5-14	5-23. INSTALLATION OF INTERMEDIATE SHAFT ASSEMBLY. ....	5-34
5-10. REMOVAL OF INTERMEDIATE SHAFT ASSEMBLY. ....	5-15	5-24. INSTALLATION OF INTERMEDIATE SHAFT ASSEMBLY FOR WINCH WITH FREE- SPOOLING. ....	5-35
5-11. REMOVAL OF DRUM SHAFT AND DRUM. ....	5-16	5-25. INSTALLATION OF BRAKE SHAFT. ....	5-37
5-12. REMOVAL OF HYDRAULIC PUMP ASSEMBLY CERTAIN D5 TRACTORS. ....	5-18	5-26. REASSEMBLY AND INSTALLATION OF BEVEL GEAR SHAFT ASSEMBLY. ....	5-39
5-13. REMOVAL OF HYDRAULIC PUMP ASSEMBLY, CERTAIN D5 TRACTORS. ....	5-18	5-27. INSTALLATION OF HYDRAULIC BRAKE ASSEMBLY, POWER CONTROLLED WINCH. ....	5-43
5-14. REMOVAL OF HYDRAULIC PUMP ASSEMBLY, CERTAIN D6 TRACTORS. ....	5-18	5-28. INSTALLATION OF DRY BRAKE AND AUTOMATIC BRAKE, DIRECT DRIVE WINCH. ....	5-45
5-15. REMOVAL OF HYDRAULIC PUMP ASSEMBLY, CERTAIN D977H TRAXCAVATOR TRACTORS. ....	5-18	5-29. INSTALLATION OF SUCTION MANIFOLD, POWER CONTROLLED WINCH. ....	5-46
5-16. REMOVAL OF HYDRAULIC PUMP ASSEMBLY, CERTAIN D977K TRAXCAVATOR TRACTORS. ....	5-19	5-30. SPECIAL TOOLS. ....	5-47
5-17. CONTROL VALVE REPAIR, POWER CONTROLLED WINCH. ....	5-22		

## LIST OF TABLES

TABLE	PAGE		PAGE
1-1. COMPONENT SPECIFICATIONS . . . . .	1-1	3-3. TROUBLE ANALYSIS CHECK CHART FOR OPTIONAL FREE-SPOOL WINCHES . . . . .	3-6
1-2. HYDRAULIC SPECIFICATIONS . . . . .	1-4	4-1. SAFEGUARD MAINTENANCE AND SERVICE INSPECTION SCHEDULE . . . . .	4-1
1-3. TORQUE SPECIFICATIONS . . . . .	1-5	5-1. VISUAL INSPECTION . . . . .	5-19
1-4. DIMENSION AND WEIGHT SPECIFICATIONS . . . . .	1-7		
3-1 TROUBLE ANALYSIS CHECK CHART FOR DIRECT DRIVE WINCH . . . . .	3-1		
3-2. TROUBLE ANALYSIS CHECK CHART FOR POWER CONTROLLED WINCH . . . . .	3-2		

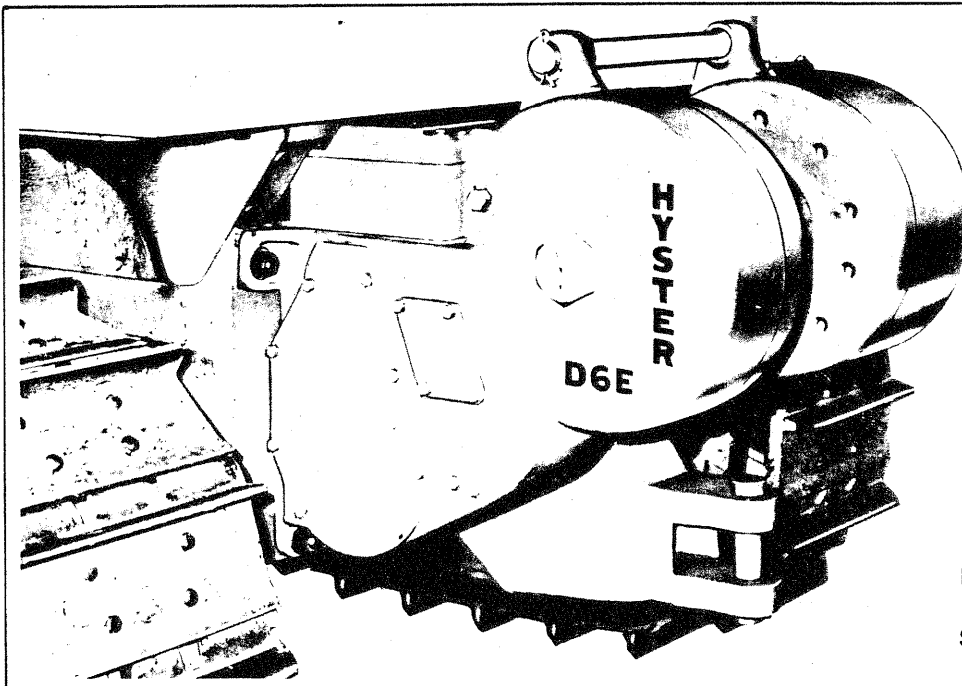




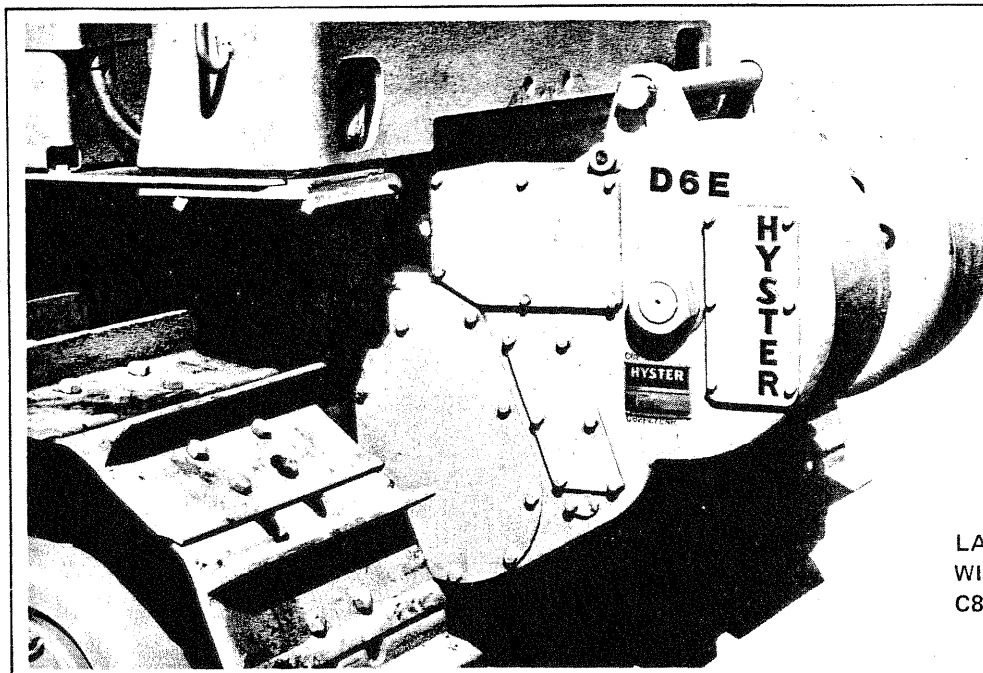
# INTRODUCTION

This Service Manual contains operation, maintenance and repair instructions for the D6E Direct Drive and Power Controlled Towing Winches. Instructions are also included for the removal and installation of the winch on the Tractor. Specification tables are pro-

vided 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 components.



EARLY PRODUCTION  
LAST USED WINCH  
SERIAL NO. C82P-2736



LATER PRODUCTION  
WINCH SERIAL NO.  
C82P-2737 AND UP

W322





## SPECIFICATIONS AND DESCRIPTIONS

## 1-1. GENERAL.

1-2. This section contains a list of specifications for the D6E Direct Drive and Power Controlled Towing Winches. Complete physical and functional descriptions of the winch and its subassemblies are also given. These descriptions will aid the repairman in understanding the construction and operation of the

winch and its subassemblies. (See Figures 1-1 through 1-21.)

## 1-3. LIST OF SPECIFICATIONS.

1-4. A complete list of specifications for the D6E Direct Drive and Power Controlled winches is given in Tables 1-1 through 1-4.

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

ITEM	DESIGN DATA			REFERENCE FIGURE
	Lo-Speed	Slo-Speed	Std-Speed	
GEAR RATIOS				
Forward	81 to 1	64.9 to 1	45.1 to 1	
Reverse	35 to 1	28 to 1	19.5 to 1	
NUMBER OF GEAR TEETH				
PTO Shaft Bevel Gear	16	23	23	5-3
Bevel Gear Shaft				
Bevel Gear	45	45	45	5-6
2nd Reduction Pinion-Fwd	22	22	22	5-6
2nd Reduction Pinion-Rev	17	20	20	5-6
Brake Shaft				
2nd Reduction Driven Gear	51	51	51	5-9
Intermediate Pinion	17	20	20	5-9
Intermediate Shaft				
Intermediate Driven Gear	52	49	49	5-10
Drum Pinion Gear	16	16	16	5-10
Drum Gear				
Internal Teeth	48	48	48	5-11, Step 7
External Teeth	65	65	65	5-11, Step 7
DRUM				
Barrel Diameter	7	10	10	5-11, Step 1
Barrel Length	10-9/16	10-9/16	10-9/16	5-11, Step 1
Flange Diameter	21	21	21	5-11, Step 9
LH Seal Bore Diameter	5.624	5.624	5.624	5-11, Step 9
Bearing Bore Diameter	5.5135	5.5135	5.5135	5-11, Step 11
Drive Flange Counterbore Diameter	14.000	14.000	14.000	5-11, Step 8
Drive Flange Outside Diameter	15.000	15.000	15.000	5-11, Step 8
Cable Capacity (Allow for loose or unevenly spooled cable)				
5/8-inch cable	666	580	580	
3/4-inch cable	461	401	401	
7/8-inch cable	339	295	295	
1 inch cable	260	226	226	
1-1/8 inch cable	205	178	178	

**NOTE** All dimensions given in inches unless otherwise specified.

# Specifications and Descriptions

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

ITEM	DESIGN DATA			REFERENCE FIGURE
	Lo-Speed	Slo-Speed	Std-Speed	
DRUM (cont.) Ferrule Size 5/8-inch cable 3/4-inch cable 7/8-inch cable 1-inch cable 1-1/8-inch cable	J5 J6 J7 J8 J9	J5 J6 J7 J8 J9	J5 J6 J7 J8 J9	
DRUM SHAFT ASSEMBLY Shaft Bearing Journal Diameter Retainer Journal Diameter Gear Bore Diameter Outer Retainer Bore Diameter Pilot Diameter	DESIGN DATA			
	3.2495-3.2505			5-11, Step 6
	3.1850-3.1870			5-11, Step 6
	5.5135-5.5155			5-11, Step 7
	3.189-3.191			5-11, Step 3
	10.120-10.123			5-11, Step 3
	PTO SHAFT AND CARRIER Shaft Bearing Journal Diameter Seal Journal Diameter Carrier Bearing Bore Diameter Seal Bore Diameter Pilot Diameter	1.9681-1.9688		
2.370-2.380			5-3, Step 3	
4.3304-4.3318			5-3, Step 3	
3.498-3.502			5-3, Step 3	
5.185-5.187			5-3, Step 3	
BEVEL GEAR SHAFT ASSEMBLY Shaft LH and RH Bearing Journal Diameter Seal Ring Groove Width Seal Ring Groove Diameter Seal Ring Type Thickness Spacers Ball Bearing Carrier Surface Diameter Width Both Ends Parallel Within Long Spacer Length Both Ends Parallel Within Medium Spacer Length Both Ends Parallel Within Short Spacer Length Both Ends Parallel Within	Direct Drive	Power Controlled		
	1.8744-1.8749	1.8744-1.8749	5-7, Step 13	
	None	0.125-0.133	5-7, Step 11	
	None	1.329-1.333	5-7, Step 11	
	None	Locked Joint	5-26, Step 22	
		0.0925-0.0935	5-26, Step 22	
	3.1491-3.1500	3.1491-3.1500	5-26, Step 3	
	1.630-1.635	1.630-1.635	5-26, Step 3	
	0.0013	0.0013	5-26, Step 3	
	4.250-4.255	4.250-4.255	5-7, Step 10	
	0.0035	0.0035	5-7, Step 10	
	3.500-3.505	None	5-6	
	0.003		5-6	
	1.687-1.689	3.500-3.505	5-7, Step 10	
	0.003	0.003	5-7, Step 10	

# Specifications and Descriptions

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

ITEM	DESIGN DATA		REFERENCE FIGURE
	Direct Drive	Power Controlled	
BEVEL GEAR SHAFT ASSEMBLY (Cont.)			
LH and RH Bearing Retainers			
Seal Ring Bore Diameter	None	1.500-1.505	5-7, Steps 1 and 2
Bearing Cup Bore Diameter	3.6705-3.6718	3.6705-3.6718	5-7, Steps 1 and 2
Pilot Diameter	4.997-4.999	4.997-4.999	5-7, Steps 1 and 2
Shaft Endplay	0.006-0.009	None	
Shaft Preload	None	0.000-0.004	
Bevel Gear Backlash	0.006-0.014	0.006-0.014	
Shaft Orifice Plug Orifice Diameter	None	0.030-0.034	5-6
BRAKE SHAFT ASSEMBLY			
Shaft			
Bearing Journal Diameter	2.500-2.501	2.500-2.501	5-9, Step 1
Seal Journal Diameter	2.495-2.499	2.495-2.499	5-9, Step 1
LH Bearing Retainer			
Seal Bore Diameter	3.496-3.498	3.496-3.498	5-9, Step 1
Bearing Cup Bore Diameter	4.252-4.255	4.252-4.255	5-9, Step 1
RH Bearing Retainer			
Bearing Cup Bore Diameter	4.249-2.250	4.249-2.250	5-9, Step 2
Pilot Diameter	5.997-6.000	5.997-5.600	5-9, Step 2
Shaft Preload	0.000-0.004	0.000-0.004	5-25, Step 6
Brake Wheel Diameter	9	9	5-5, Step 2
Brake Apply Spring (Last Used on Serial No. C82P-2736)			
Quantity	None	2	5-4
Free Length (Measured between end-loops)		8.5	
Pressure at 11-1/4 inches		260 (±20) lbs	
Brake Apply Spring (First Used on Serial No. C82P-2737)			
Quantity	None	2	5-4
Free Length (Measured between end-loops)		9.25	
Pressure at: 10.970 inches		334 (±20) lbs	
11.780 inches		450 (±20) lbs	
CLUTCH ASSEMBLY			
2nd Reduction Gear Bore Diameter	3.0000-3.0012	None	5-6
Dental Clutch Groove Width	0.510-0.515	None	5-6
Bearing Carrier Diameter	2.2494-2.2500	None	5-6
Piston	None		
Outside Diameter		8.496-8.498	5-8, Step 7
Inside Diameter		5.750-5.752	5-8, Step 7
Piston Housing	None		
Piston Cavity			
Large Diameter		8.506-8.508	5-8, Step 7
Small Diameter		5.486-5.491	5-8, Step 7
Inside Diameter		3.376-3.378	5-8, Step 7
Hub	None		
Piston O-ring Contact Surface		3.373-3.375	5-8, Step 5
Cover Plate Contact Surface		3.373-3.375	5-8, Step 5
Friction Disc	None		
Overall Width		0.122-0.128	5-8, Step 4
Friction Material Thickness		0.0275-0.0365	5-8, Step 4

# Specifications and Descriptions

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

ITEM	DESIGN DATA		REFERENCE FIGURE
	Direct Drive	Power Controlled	
CLUTCH ASSEMBLY (Cont.)			
Separator Plate	None		
Width		0.080-0.084	5-8, Step 4
Dish		0.012-0.022	5-8, Step 4
Cooling Valve Spring	None		
Free Length		2.0	5-8, Step 6
Pressure at 1-1/4 inch		13.8 oz.	5-8, Step 6
Cooling Valve (Installed)	None		
Height		1.875-1.906	5-8, Step 4
Release Spring	None		
Free-length		2-5/16	
Pressure at 2 inches		31.88 lbs.	
Plate to Friction Disc Clearance		0.065-0.125	5-21, Step 10
INTERMEDIATE SHAFT ASSEMBLY			
Bearing Journal Diameter (Without Free-spool)	2.3750-2.3755	2.3750-2.3755	5-10, Step 2
Bearing Journal Diameter (With Free-spool)	2.0000-2.0005	2.0000-2.0005	
Endplay (With or Without Free-spool)	0.004-0.007	0.004-0.007	
SIDE FRAME (RH SIDE)			
Bore Diameters			
Bevel Gear Shaft Bearing Retainer	5.000-5.002	5.000-5.002	5-7, Step 2
Drum Shaft Outer Retainer	10.125-10.128	10.125-10.128	5-11, Step 3
Intermediate Shaft Bearing	4.8765-4.8780	4.8765-4.8780	5-10, Step 1
Brake Shaft Bearing Retainer	6.000-6.002	6.000-6.002	5-9, Step 2
Drum Seal	9.998-10.002	9.998-10.002	5-11, Step 10
TRANSMISSION HOUSING (LH SIDE)			
Bore Diameters			
PTC Shaft Bearing Retainer	5.188-5.190	5.188-5.190	5-3, Step 2
Bevel Gear Shaft Bearing Retainer	5.000-5.002	5.000-5.002	5-7, Step 1
Ball Bearing Bore	4.9211-4.9225	4.9211-4.9225	5-26, Step 3
Brake Shaft Bearing Retainer	4.2515-4.2525	4.2515-4.2525	5-9, Step 1

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

ITEM	DESIGN DATA		REFERENCE FIGURE
	Direct Drive	Power Controlled	
CONTROL VALVE			
High Pressure Relief	None	225 (±10) PSI	
Cooling Oil Pressure (Last Used on Serial No. C82P-2736)		3-7 PSI	
Cooling Oil Pressure (First Used on Serial No. C82P-2737)		2-5 PSI	
HYDRAULIC PUMP OUTPUT			
<b>NOTE</b> Pump output is given at engine RPM.			
D5 Tractor Serial No. 81H thru 84H	None		
At 825 RPM		2.8 GPM	
At 3000 RPM		12.0 GPM	



## Specifications and Descriptions

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

ITEM	DESIGN DATA		REFERENCE FIGURE
	Direct Drive	Power Controlled	
HYDRAULIC PUMP OUTPUT (Cont.) D5 Tractor Serial No. 95J and 96J D6 Tractor Last Used on Serial No. C82P-1872 At 550 RPM At 1800 RPM D6 Tractor First Used on Serial No. C82P-1873 At 550 RPM At 1800 RPM 977 Traxcavator Serial No. 53A At 600 RPM At 1950 RPM 977 Traxcavator Serial No. 46H and 11K At 600 RPM At 1950 RPM	None     None     None     None	   2.7 GPM 8.9 GPM   4.3 GPM 14.1 GPM  4.9 GPM 13.8 GPM  4.7 GPM 15.3 GPM	
SUCTION FILTER  Relief Valve Opening	None	50-Mesh Screen, Full Flow 4.5-5.5 PSI	5-28
PRESSURE FILTER Relief Valve Opening	None	Full Flow 50 (±5) PSI	
OIL Capacity	10 Gal. SAE 90EP MIL-L-2105B	12 Gal. SAE 10 MIL-L-2104B*	

\*Series 3 oil may be substituted for MIL-L-2104B.

TABLE 1-3. TORQUE SPECIFICATIONS (Sheet 1 of 2)

ITEM	DESIGN DATA		REFERENCE FIGURE
	Direct Drive	Power Controlled	
<b>NOTE</b> All torque values given in foot-pounds and with threads lubricated.			
BEVEL GEAR SHAFT ASSEMBLY			
Bearing Retainer Bolts			
LH Side	75	75	5-26, Step 22
RH Side	75	75	5-26, Step 22
Bearing Locknut	None	200	5-26, Step 17
Control Valve Mounting Bolts	None	40 (Last Used on Serial No. C82P-2736) Std Only (First Used on Serial No. C82P-2737)	5-17

# Specifications and Descriptions

TABLE 1-3. TORQUE SPECIFICATIONS (Sheet 2 of 2)

ITEM	DESIGN DATA		REFERENCE FIGURE
	Direct Drive	Power Controlled	
DRUM SHAFT ASSEMBLY			
Bearing Retainer (RH Side)	75	75	5-22, Step 13
Internal Bearing Retainer	75	75	5-22, Step 10
Drum Capscrews	200	200	5-22, Step 15
Drum Shaft Nuts	400 (approx)	400 (approx)	5-22, Step 14
INTERMEDIATE SHAFT ASSEMBLY			
Bearing Retainer Bolts	75	75	5-23
PTO SHAFT RETAINER-BOLTS	75	75	5-26, Step 19
SIDE COVER CAPSCREW	75	75	

## 1-5. SERIAL NUMBER DATA. (See Figure 1-1.)

1-6. 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:      C82      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, C82 denotes the D6E Power Controlled 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	F. France	P. Portland
B. Tacoma	G. Belgium	R. Ipswich
C. Kewanee	H. South Africa	S. Australia
D. Danville	J. Africa	T. Canada
E. Nijmegen	L. Peoria	Y. Brazil
	N. New Zealand	

(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.

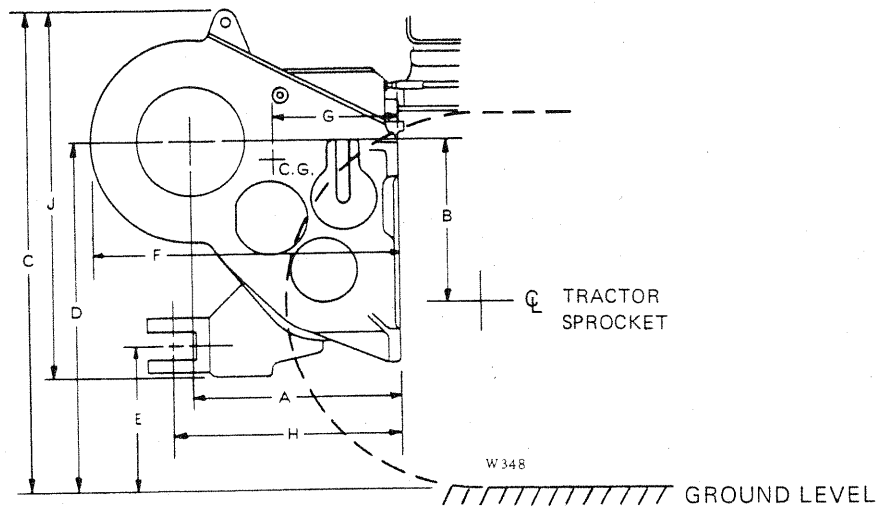
## 1-7. PHYSICAL DESCRIPTION.

### 1-8. Towing Winch. (See Figure 1-1.)

1-9. The D6E Towing Winch is manufactured as a Direct Drive or Power Controlled winch. The Direct Drive winch employs dental clutches with related mechanical linkage to shift the winch gear train to Forward, Neutral or Reverse. A brake drum and band arrangement with related mechanical linkage provides braking on the Direct Drive and Power Controlled winches. The Direct Drive winch is primarily designed for use on direct drive and torque converter tractors equipped with an interruptable power-take-off (PTO). The Power Controlled winch can be used on direct drive, torque converter and power shift tractors equipped with a constant running PTO. The Power Controlled winch is basically the same as the Direct Drive winch, except that multiple disc oil clutch assemblies are used to hydraulically shift the winch into Forward, Neutral or Reverse. All major gear train components and brake assembly components for the Direct Drive and Power Controlled winches are mounted inside of a cast/fabricated weldment or all fabricated weldment. The gear train consists primarily of a PTO Shaft Assembly, Bevel Gear Shaft Assembly, Brake Shaft Assembly, Intermediate Shaft Assembly and a Drum Gear. The PTO shaft assembly, bevel gear shaft assembly and brake shaft assembly are mounted in the center and right-hand section of the weldment. The brake assembly and associated linkage are mounted in the left-hand section. These components are accessible by removing the transmission cover and left-hand side covers that are bolt-mounted to the weldment. The drum gear, intermediate shaft assembly and reverse

# Specifications and Descriptions

TABLE 1-4. DIMENSION AND WEIGHT SPECIFICATIONS



Winch Model	Weight	A	B	C	D	E	F	G	H	J	Overall Width
D6E Direct Drive (Cast Housing) on D5 Tractor	1960	22-3/4	18-3/8	51.03	36.65	15.78 *13.50	33-1/4	14-3/4	25-3/8 *31-3/8	44 *46	39-3/4
D6E Power Controlled **(Cast Housing) on D5 Tractor	2140	22-3/4	18-3/8	51.03	36.65	15.78 *13.50	33-1/4	14-1/8	25-3/8 *31-3/8	44 *46	39-3/4
D6E Direct Drive (Cast Housing) on D6 Tractor	1960	22-3/4	18-3/8	55-3/8	41	20-1/8 *17-7/8	33-1/4	14-3/4	25-3/8 *31-3/8	44 *46	39-3/4
D6E Power Controlled **(Cast Housing) on D6 Tractor	2140	22-3/4	18-3/8	55-3/8	41	20-1/8 *17-7/8	33-1/4	14-1/8	25-3/8 *31-3/8	44 *46	39-3/4
D6E Direct Drive (Fab. Housing) on D5 Tractor	1960	22.82	18-3/8	50.96	36.65	17.93 *15.65	33.32	14-3/4	21.37 *27.44	36.78 *38.81	40.38
D6E Power Controlled *** (Fab. Housing) on D5 Tractor	2140	22.82	18-3/8	50.96	36.65	17.93 *15.65	33.32	14-1/8	21.37 *27.44	36.78 *38.81	40.38
D6E Direct Drive (Fab. Housing) on D6 Tractor	1960	22.82	18-3/8	55.31	41	22.28 *20.00	33.32	14-3/4	21.37 *27.44	36.78 *38.81	40.38
D6E Power Controlled *** (Fab. Housing) on D6 Tractor	2140	22.82	18-3/8	55.31	41	22.28 *20.00	33.32	14-1/8	21.37 *27.44	36.78 *38.81	40.38

\* Swivel drawbar  
 \*\* Cast housing last used on Serial No. C82P-2736.  
 \*\*\* Fabricated housing first used on Serial No. C82P-2737.

## Specifications and Descriptions

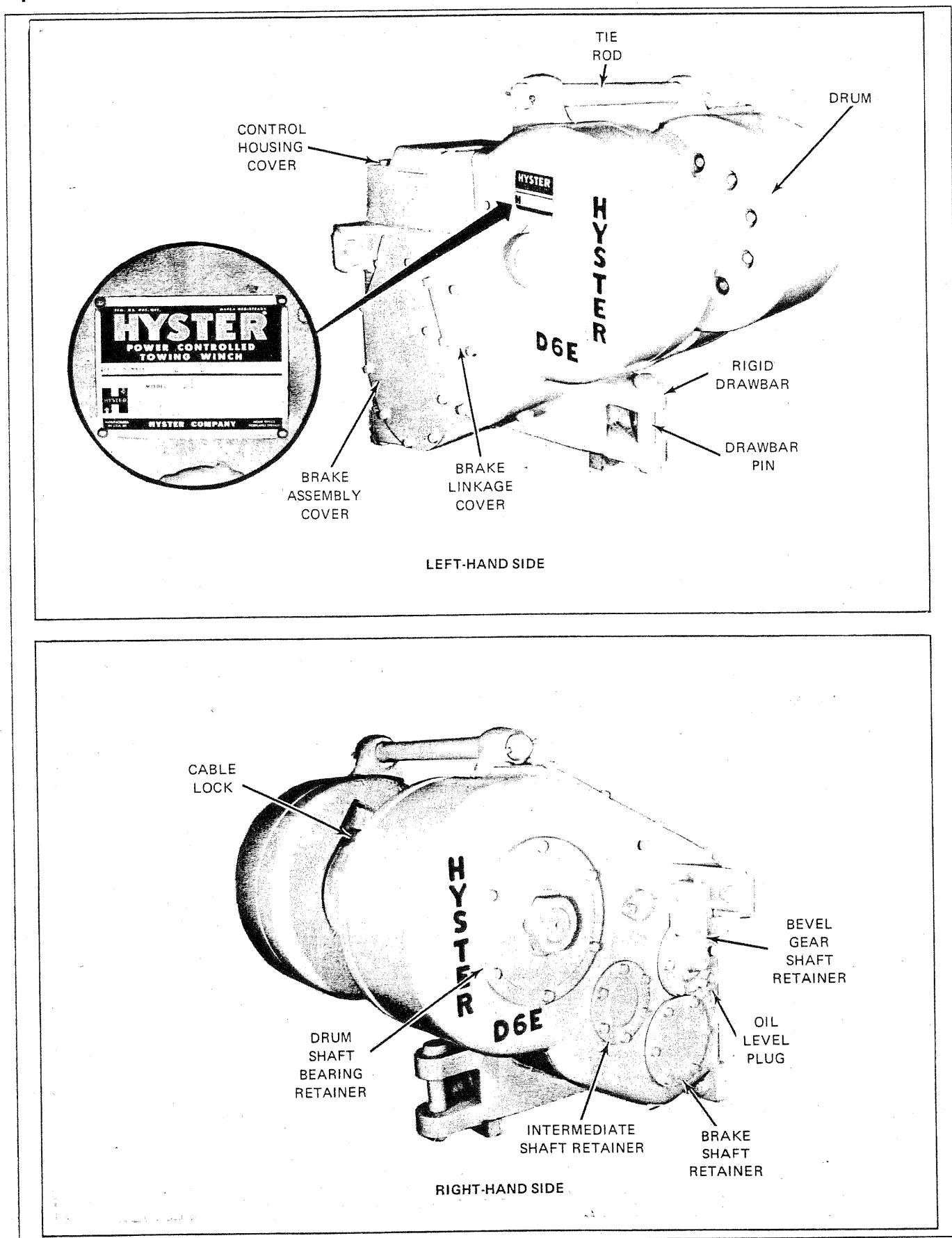


FIGURE 1-1. D6E TOWING WINCH (Sheet 1 of 2)

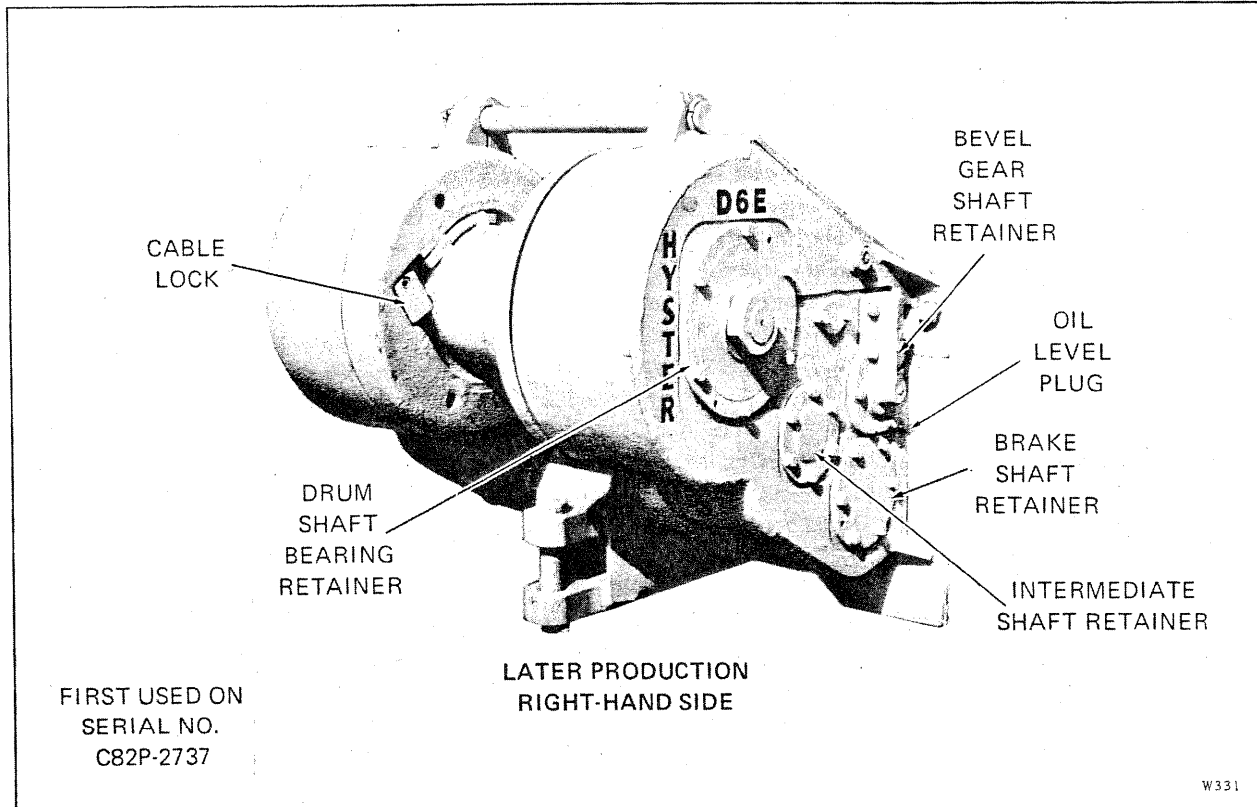
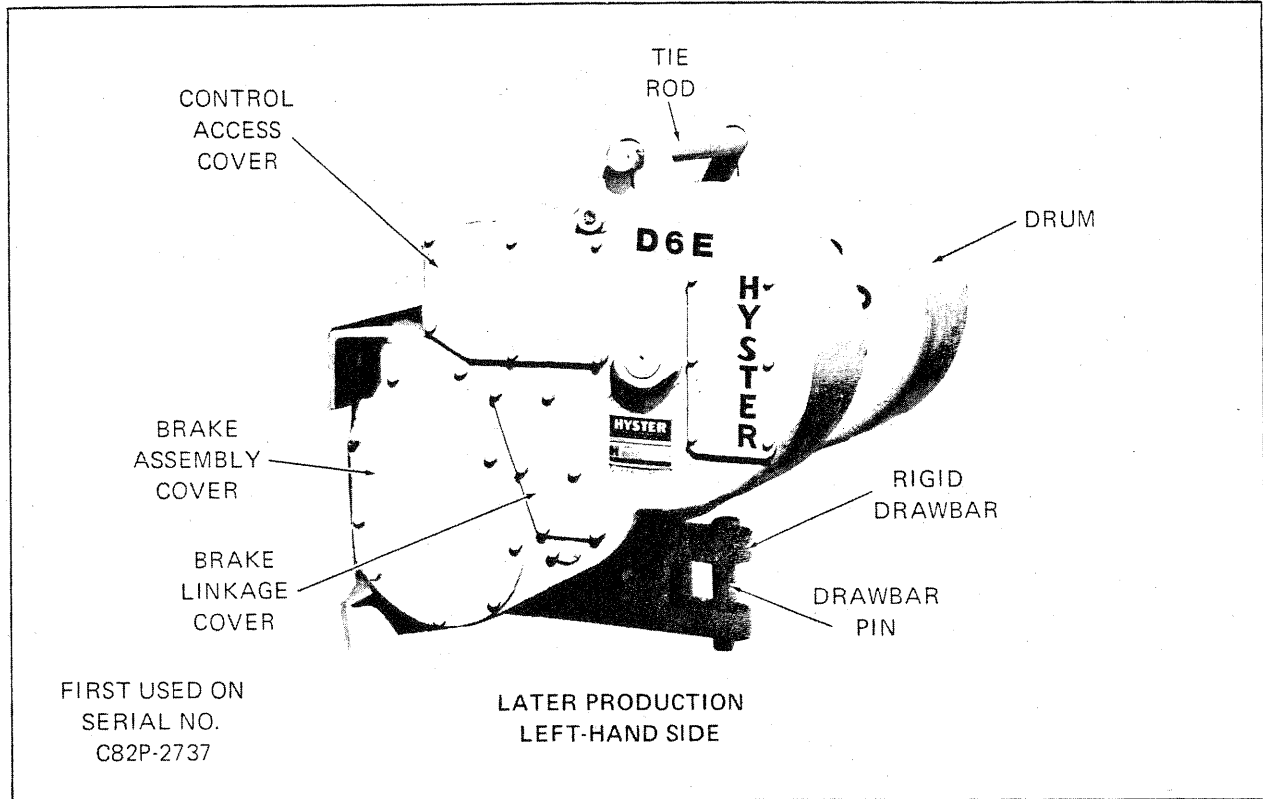


FIGURE 1-1. D6E TOWING WINCH (Sheet 2 of 2)

## Specifications and Descriptions

clutch assembly are mounted in the right-hand section of the weldment. These components are accessible by removing the top, right-hand cover and the right-hand bearing retainers. A control valve, cooling oil relief valve and related hydraulic hoses serve as the control mechanism on the Power Controlled winch. The control valve is mounted at the top, left-hand section of the weldment. Mechanical linkage is used to control the operation of the Direct Drive winch.

1-10. DIRECT DRIVE GEAR TRAIN. (See Figure 1-2.) The gear train used in the Direct Drive winch consists primarily of a PTO shaft assembly, bevel gear shaft assembly, brake shaft assembly, intermediate shaft assembly and drum shaft assembly. The PTO shaft assembly on the Lo-, and Slo-Speed winches is an integral assembly. On the Standard Speed winch, the bevel pinion is splined and locked to the PTO shaft by means of a lock ring. The bevel gear shaft assembly contains two straight-cut pinion gears, two dental clutches, four spacers, two single taper roller bearings (one on each end of the shaft) and one ball bearing for shaft center support. 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 brake is 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. This shaft transfers input torque to the drum gear mounted on the drum shaft. The drum shaft assembly is aligned between two matched, double taper roller bearings. The drum shaft is secured to the winch weldment 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 and drum gear to rotate around the drum shaft. All drive train gears are heat-treated to provide maximum service life.

1-11. POWER CONTROLLED GEAR TRAIN. (See figure 1-3.) The gear train used in the Power Controlled winch is essentially the same as the Direct Drive winch gear train, except that multiple disc oil clutch assemblies are used in place of the dental clutches. Manufacturing differences between the Direct Drive and Power Controlled weldments are great enough that interchangeability of components should not be attempted. The bevel gear shaft used on the Power Controlled winch is center-drilled on each end and cross drilled at the clutch assembly locations to allow oil under pressure to flow to the clutches. A cast-iron seal ring on each end of the bevel gear 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 bevel gear shaft assembly used on the Power Controlled winch is preloaded between two taper roller bearings as opposed to an endplay condition on the Direct Drive bevel gear shaft assembly.

1-12. DRY BRAKE ASSEMBLY (DIRECT DRIVE WINCH). (See Figure 1-4.) The dry brake assembly consists of a brake wheel, band assembly, lever assembly, crank assembly and connecting linkage. The cast iron brake wheel is splined to the left-hand side of the brake shaft and is held in place by a snap ring. A segmented lining is riveted to the brake band. The lever assembly is connected to the connecting linkage by means of two roll pins. Pre-lubricated bushings are installed in the pin bores of the lever assembly to prevent wear. When the control cable is pulled, the crank assembly rotates and forces the lever assembly against the brake band. This pulls the brake band against the brake wheel, applying the brake.

1-13. AUTOMATIC BRAKE (OPTIONAL, DIRECT DRIVE WINCH). (See Figure 1-5.) The automatic brake assembly consists primarily of a brake wheel, hub, pawl assembly, drag rings, oil seals, bearings and cover. The hub is splined to the left-hand side of the brake shaft and is held in place by a snap ring. The brake wheel is designed with an internal ratchet ring and rotates on two roller bearings. The pawl assembly ratchets toward the hub as the winch drum is turning. When the drum stops, the pawl immediately engages into the brake wheel ratchet.

1-14. HYDRAULIC BRAKE ASSEMBLY (POWER CONTROLLED WINCH). (See figure 1-6.) The hydraulic brake assembly consists primarily of a brake wheel, band assembly, crank assembly, adjustment link assembly, two brake springs, hydraulic brake cylinder and related hydraulic hoses. The hydraulic brake assembly used in the Power Controlled winch is essentially the same as the dry brake assembly used in the Direct Drive winch, except that the brake springs and hydraulic cylinder are connected to the crank assembly to spring-apply and hydraulically-release the brake band from the brake wheel. The brake wheel is splined to the left-hand end of the brake shaft and is held in place by a snap ring. The brake band is mounted over the brake wheel and is attached to the adjustment link by two brake pins. Pre-lubricated bushings are pressed into the pin bores of the link assembly to allow the brake pins to pivot smoothly. The hydraulic cylinder is connected to the crank assembly by means of an adjustable rod end. The brake is normally applied when hydraulic oil is not being pumped through the control valve to the brake hydraulic cylinder; in this condition, the cylinder rod is retracted, allowing the brake spring to rotate the crank assembly in a direction that will

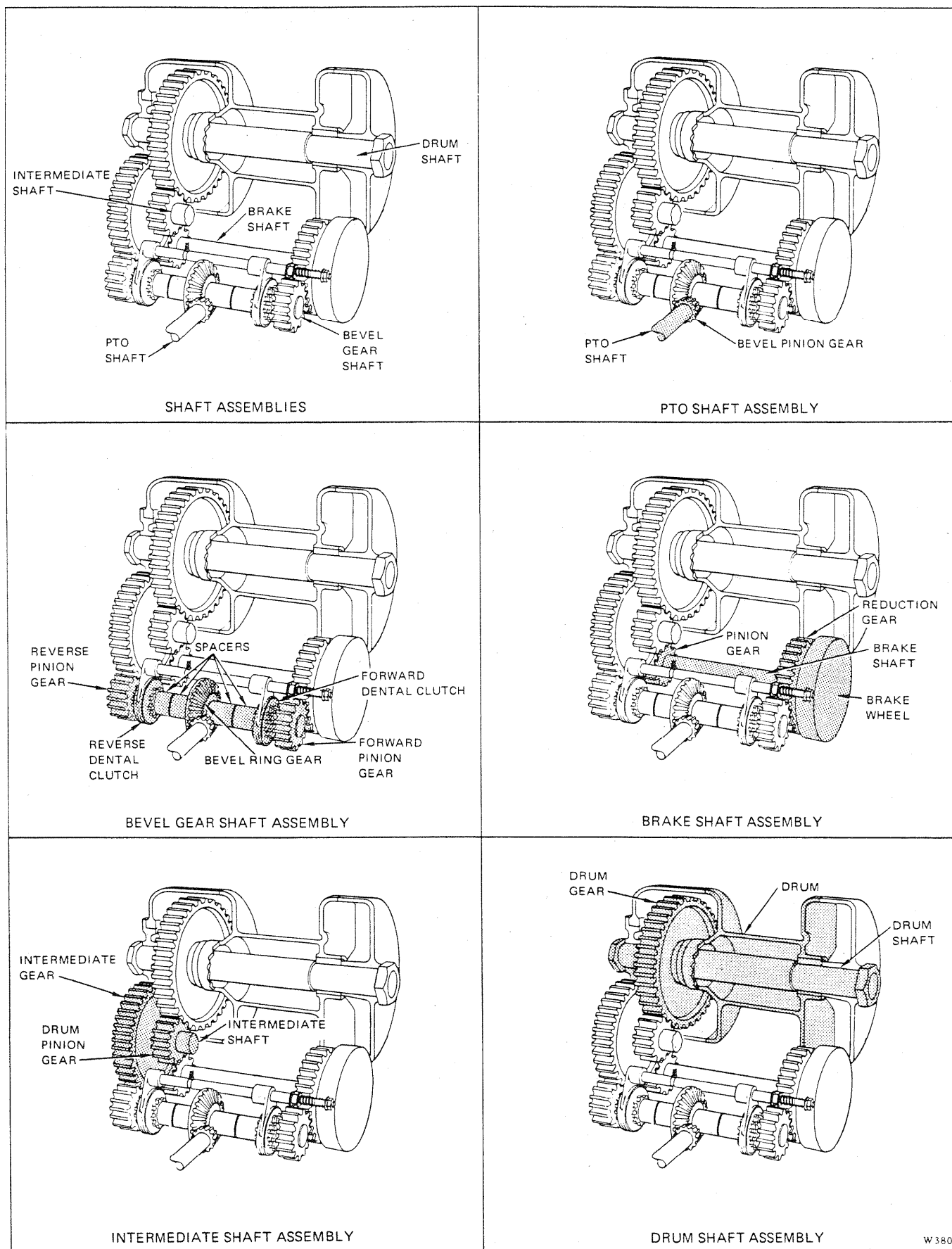


FIGURE 1-2. DIRECT DRIVE GEAR TRAIN

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# Specifications and Descriptions

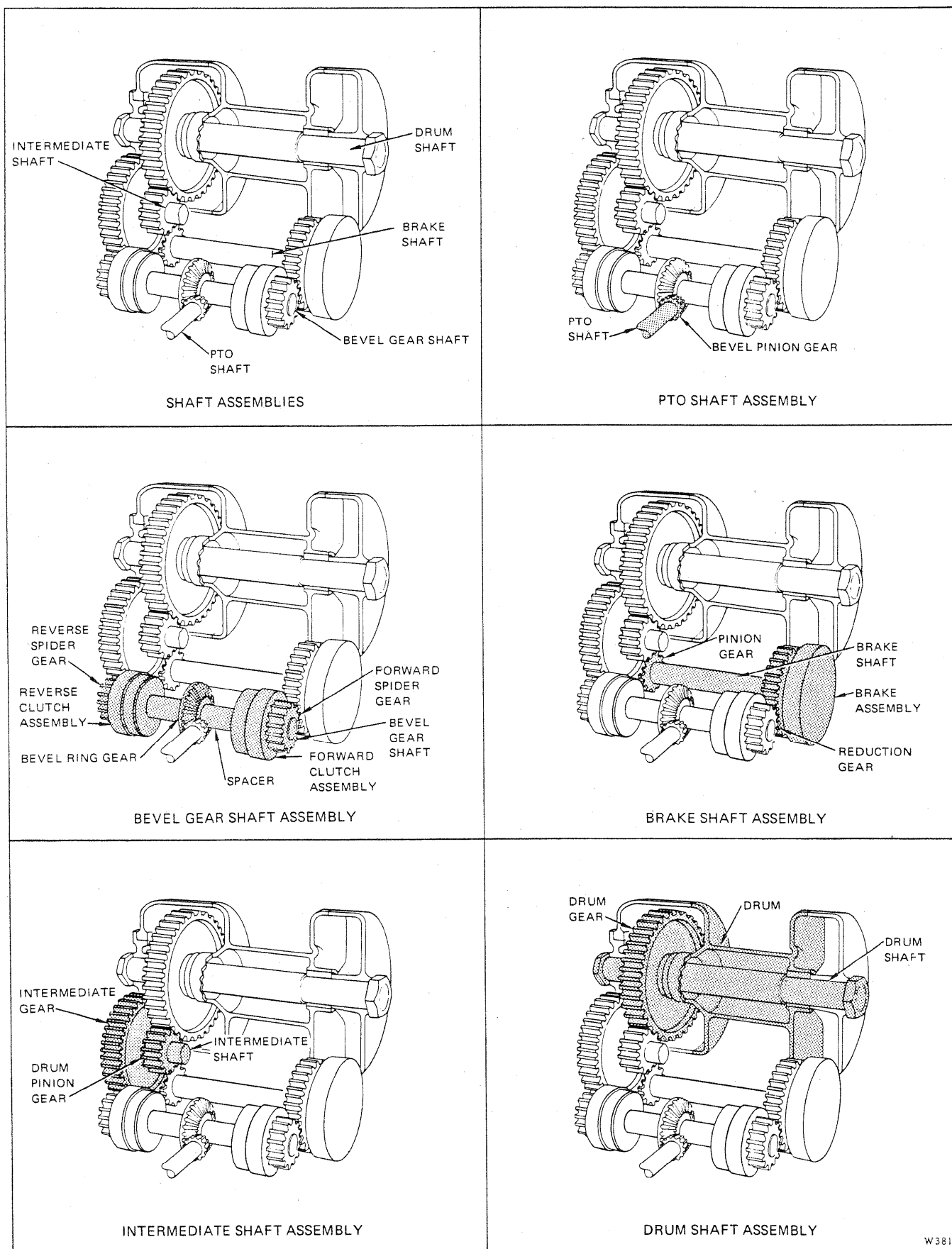


FIGURE 1-3. POWER CONTROLLED GEAR TRAIN



## Specifications and Descriptions

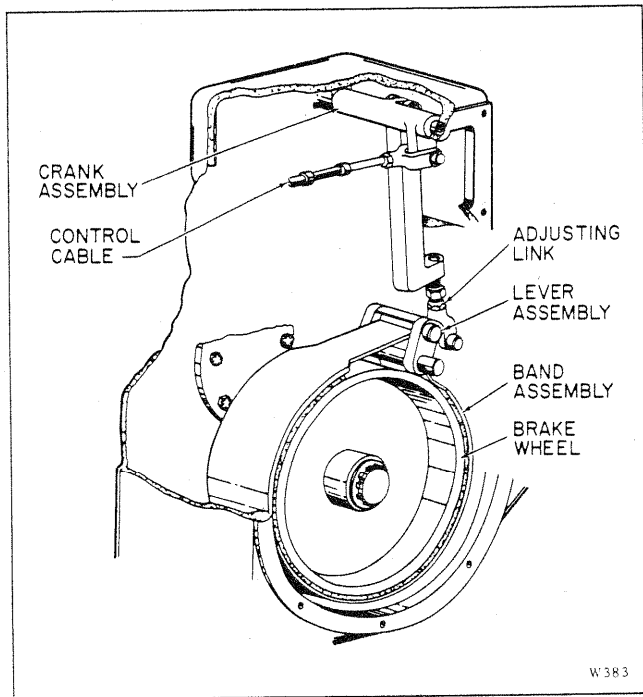


FIGURE 1-4. DRY BRAKE ASSEMBLY, DIRECT DRIVE WINCH

pull the brake band against the brake wheel. This applies the brake. When hydraulic pressure is applied to the brake cylinder, the cylinder rod extends and rotates the crank assembly against the two brake springs. This compresses the springs and allows the brake band to retract away from the brake wheel, thus releasing the brake. Hydraulic oil, which normally leaks by the brake cylinder piston, is discharged out of the cylinder to the winch center compartment through a dump line. This occurs whenever the piston moves outward during brake release. The dump line is equipped with two check valves: (1) a lower valve in series and (2) an upper valve in parallel with the dump line outlet. The lower check valve closes during piston return movement to prevent any hydraulic oil from being drawn into the dump line. The upper check valve opens during the same piston movement to prevent hydraulic lockup in the brake cylinder. Only air can enter through the upper check valve which speeds piston return.

1-15. DENTAL CLUTCH ASSEMBLY (DIRECT DRIVE WINCH). (See Figure 1-7.) The dental clutch assembly used in the Direct Drive winch consists primarily of a reverse dental clutch, forward dental

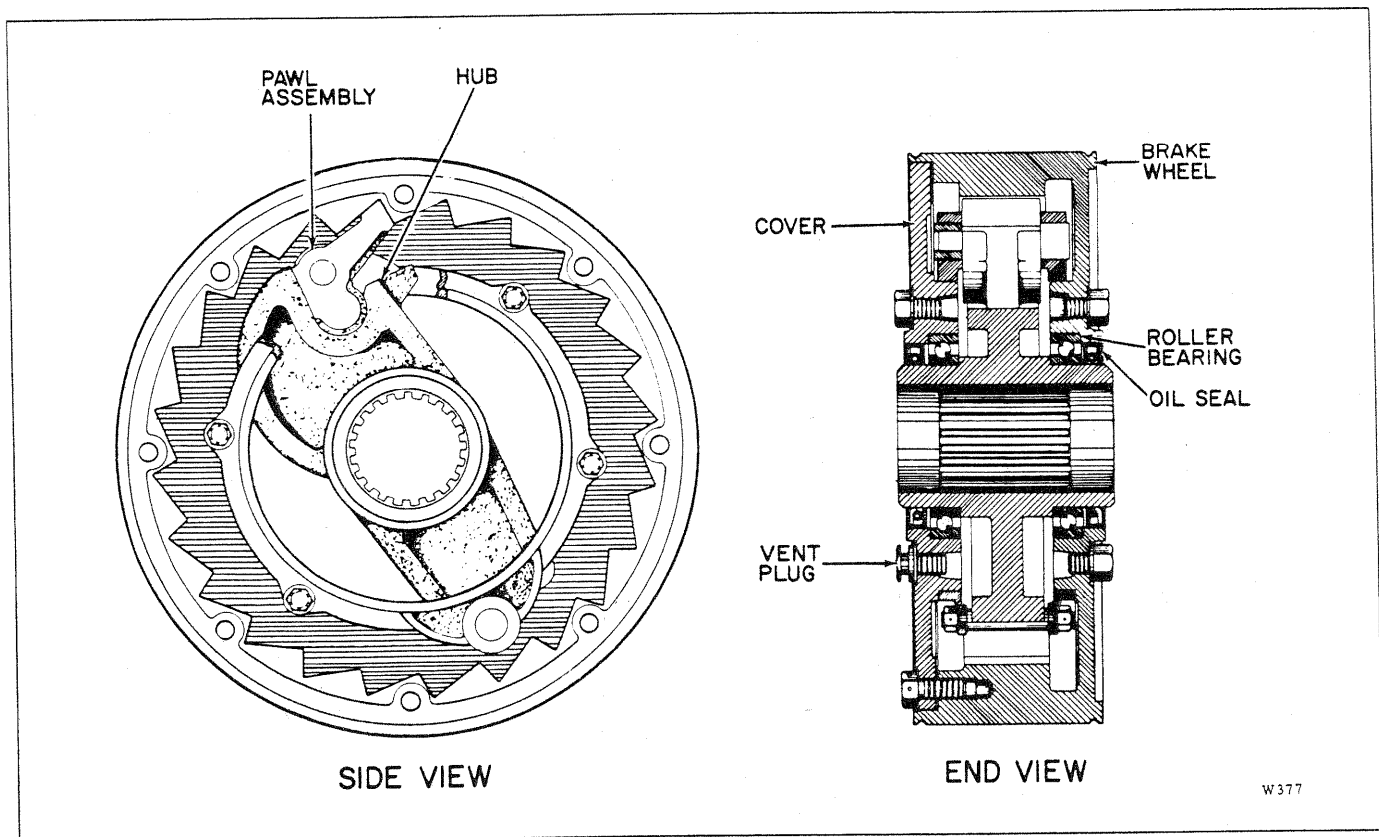


FIGURE 1-5. AUTOMATIC BRAKE, OPTIONAL, DIRECT DRIVE WINCH

## Specifications and Descriptions

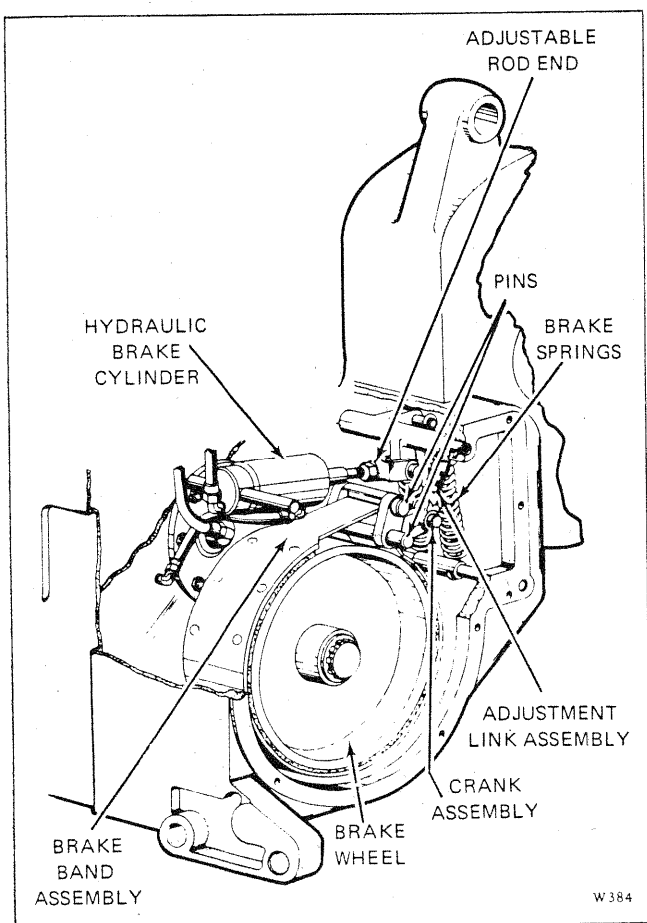


FIGURE 1-6. HYDRAULIC BRAKE ASSEMBLY, POWER CONTROLLED WINCH

clutch, two dental clutch hubs, right-hand shifter fork, left-hand shifter fork, shifter shaft, detent ball and a detent spring. The shifter forks are secured to the shifter shaft by means of a lock screw and lock-

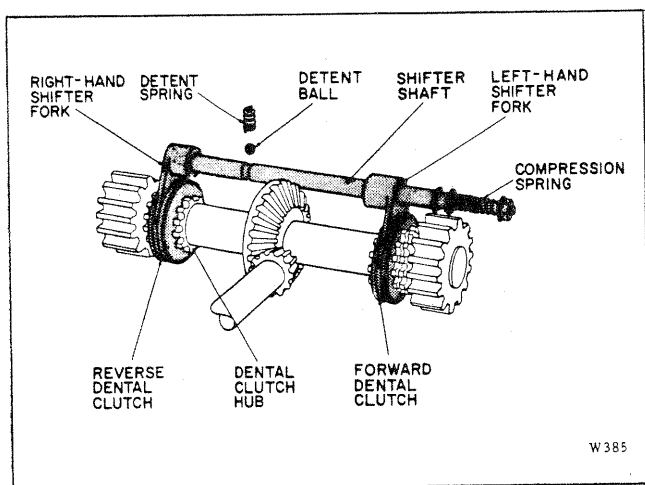


FIGURE 1-7. DENTAL CLUTCH ASSEMBLY, DIRECT DRIVE WINCH

wire. The shifter shaft is connected through a shifter crank assembly to the clutch control cable. The detent ball and spring hold the shifter forks in the Forward, Neutral or Reverse position. A compression spring absorbs the shifting force until the external teeth of the dental clutch hub align with the external teeth of the pinion gear. When the teeth are aligned, the dental clutch slides onto the dental teeth of the pinion gear. This completely engages the bevel gear shaft to the pinion gear.

1-16. OIL CLUTCH ASSEMBLY (POWER CONTROLLED WINCH). (See Figures 1-8 and 5-8.) The oil clutch assembly used in the Power Controlled winch consists of a piston retainer plate, clutch piston, six friction discs, six separator plates, cooling oil valve assembly, clutch hub, six 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 screwed into one of the retainer bores. 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 six separator plates. The six 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 of the clutch. The friction discs rotate with the spider gear. The six release springs are installed into the six bores in the clutch hub. During clutch operation, pressurized oil flows into a cavity between the clutch piston and retainer plate. This 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.

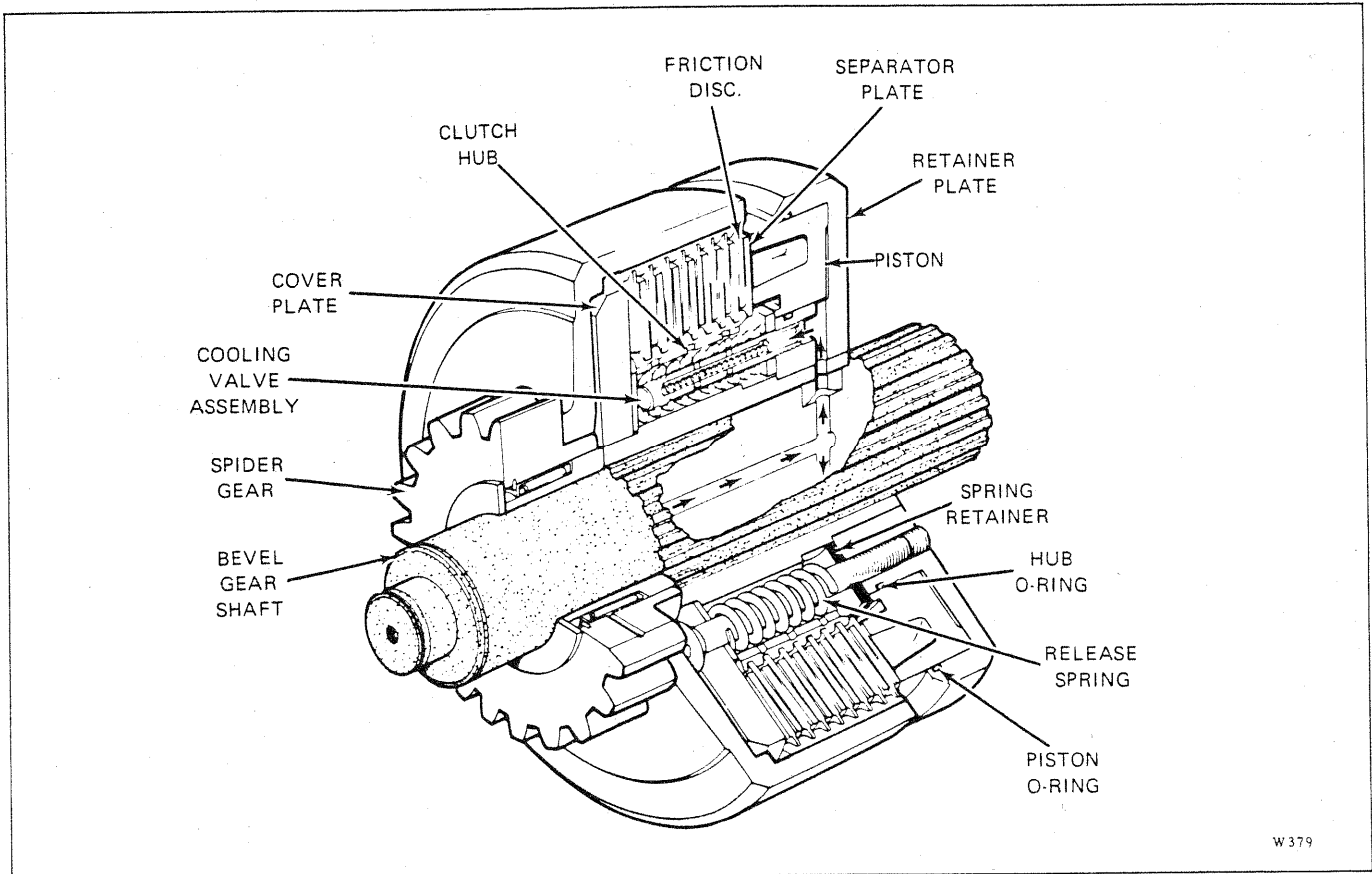


FIGURE 1-8. OIL CLUTCH ASSEMBLY, POWER CONTROLLED WINCH

1-17. CONTROL VALVE ASSEMBLY (POWER CONTROLLED WINCH.) (See Figure 1-9.) 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 center 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 1-37). 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 used on later production units. These spool assemblies ARE interchangeable; however, the spools cannot be interchanged without cable adjustment (refer to Section 4).

1-18. COOLING OIL RELIEF VALVE ASSEMBLY (POWER CONTROLLED WINCH). (Last Used on Serial No. C82P-2736.) (See Figure 1-10.) The cooling oil relief valve assembly is attached to the bottom side of the control valve assembly (Figure 1-16). The relief valve consists of a valve body, valve cap, O-ring, spring, and poppet. The valve is a simple poppet and spring-type valve which regulates the hydraulic system cooling oil pressure.

1-19. COOLING OIL RELIEF VALVE ASSEMBLY (POWER CONTROLLED WINCH). (First Used on Serial No. C82P-2737.) (See Figure 1-10.) The cooling oil relief valve is contained in a block housing

## Specifications and Descriptions

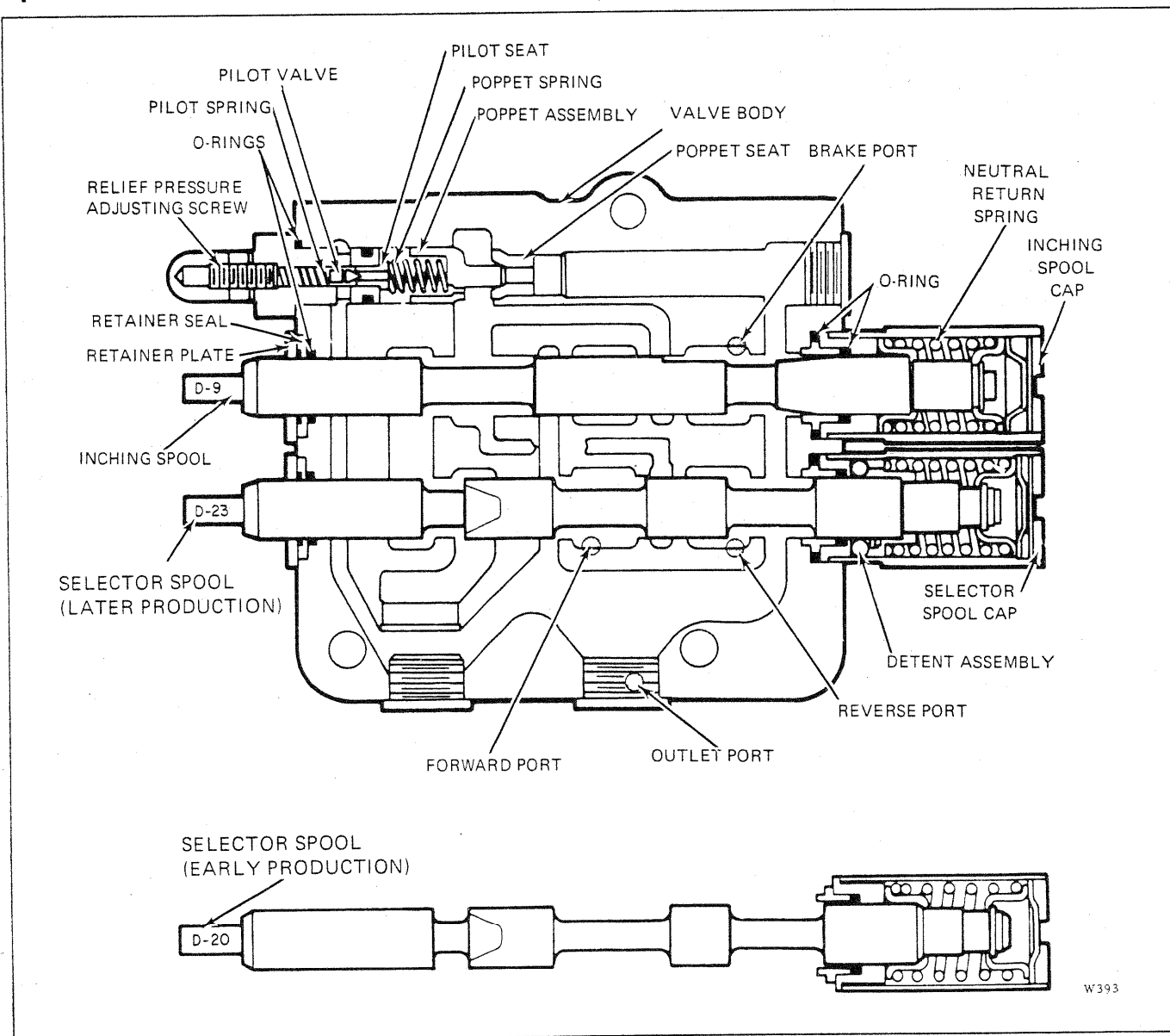


FIGURE 1-9. CONTROL VALVE ASSEMBLY, POWER CONTROLLED WINCH

mounted on the left-hand side of the compartment wall which separates the center and left-hand weldment compartments. A tube assembly connects the inlet of the relief valve with the dump port of the control valve assembly (see Figure 1-16). The relief valve consists of a valve housing, spool (poppet), spring, plug, and O-ring seal. A gasket is used to seal the valve housing mounting surface to the compartment wall. A hole drilled through the forward portion of the valve housing block routes oil to the reverse clutch pressure line. The valve is a simple poppet and spring-type valve which regulates the hydraulic system cooling oil pressure.

### 1-20. HYDRAULIC PUMP ASSEMBLY (POWER CONTROL WINCH). (See Figure 1-11.)

1-21. D5 AND TRAXCAVATOR, D6 UP THROUGH WINCH SERIAL NO. C82P-1872. The hydraulic pump assembly is a positive displacement, external gear pump that supplies the hydraulic energy necessary for operation of the Power Controlled 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

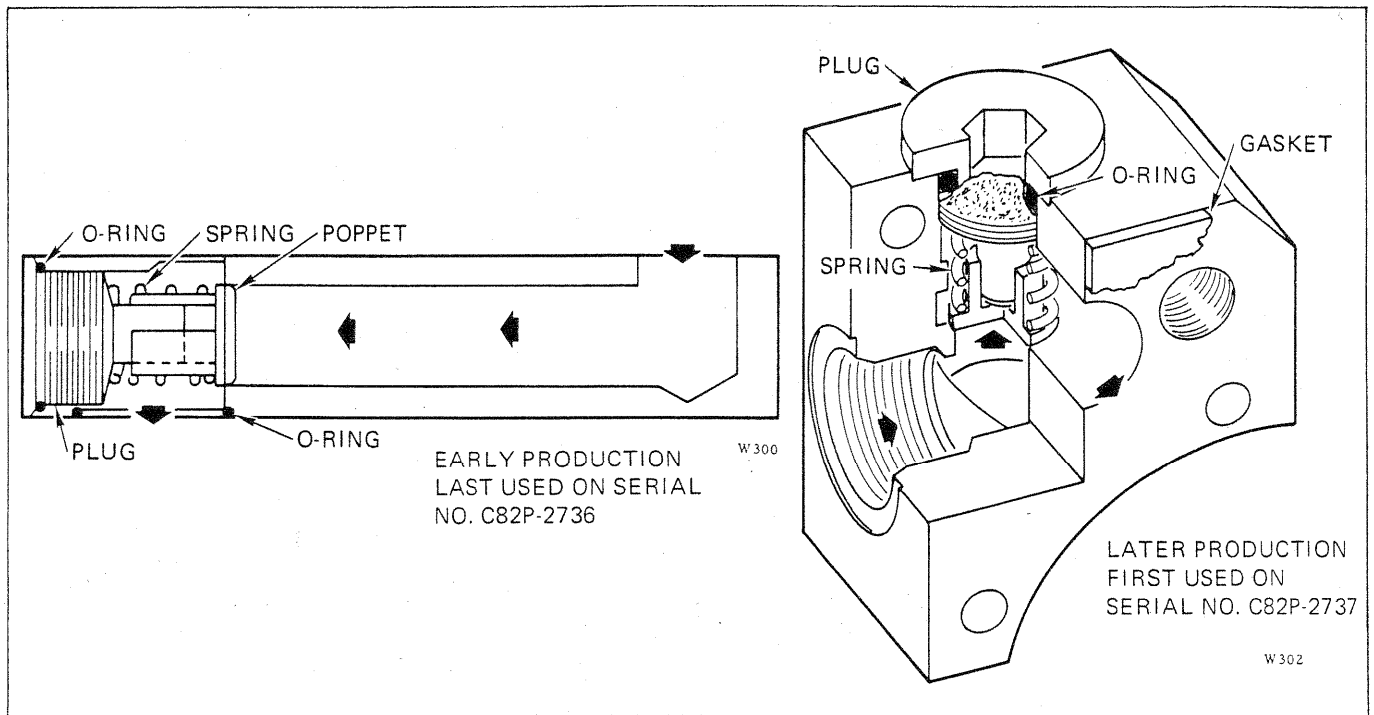


FIGURE 1-10. COOLING OIL RELIEF VALVE ASSEMBLY, POWER CONTROLLED WINCH

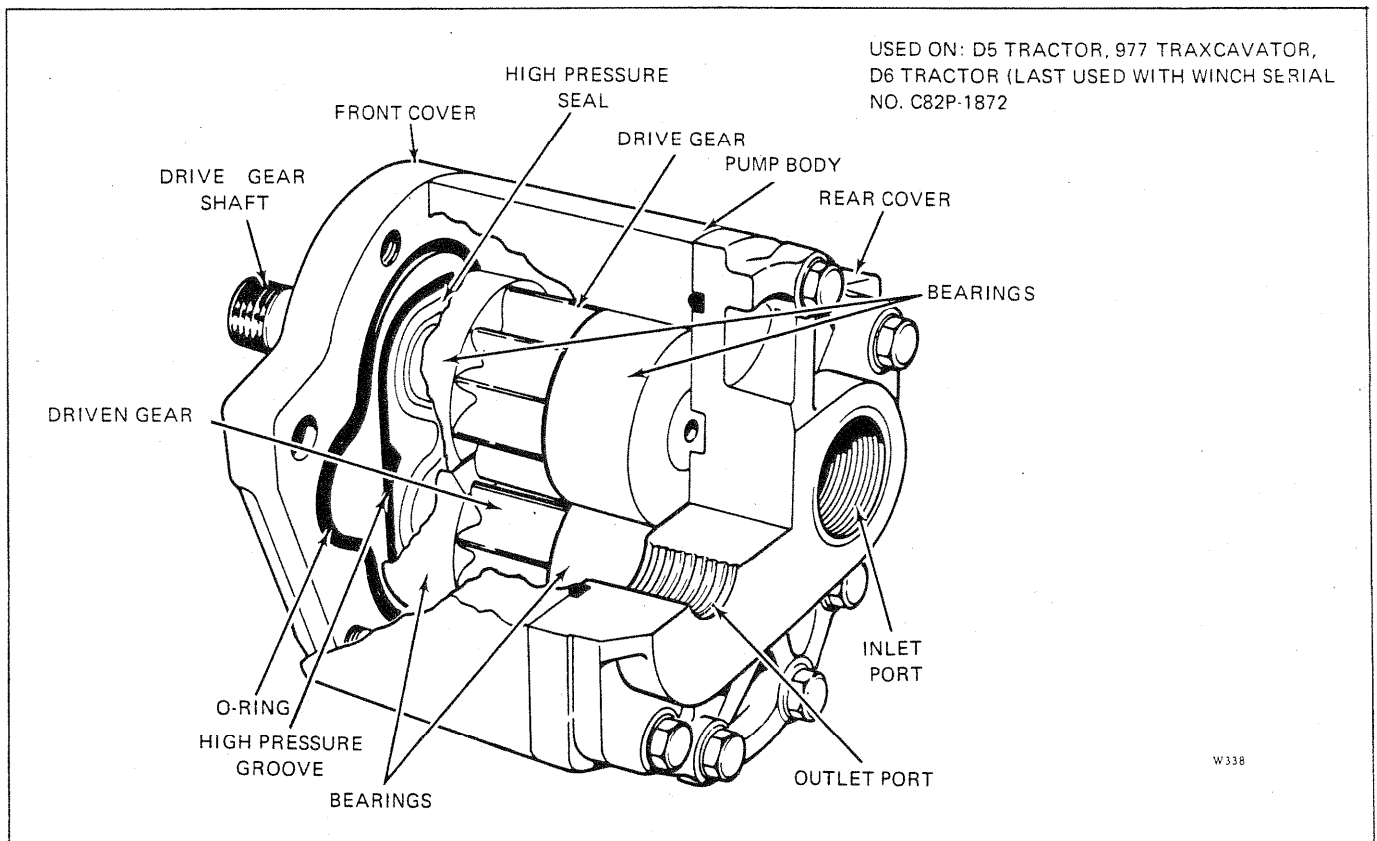


FIGURE 1-11. HYDRAULIC PUMP ASSEMBLY (Sheet 1 of 2)

## Specifications and Descriptions

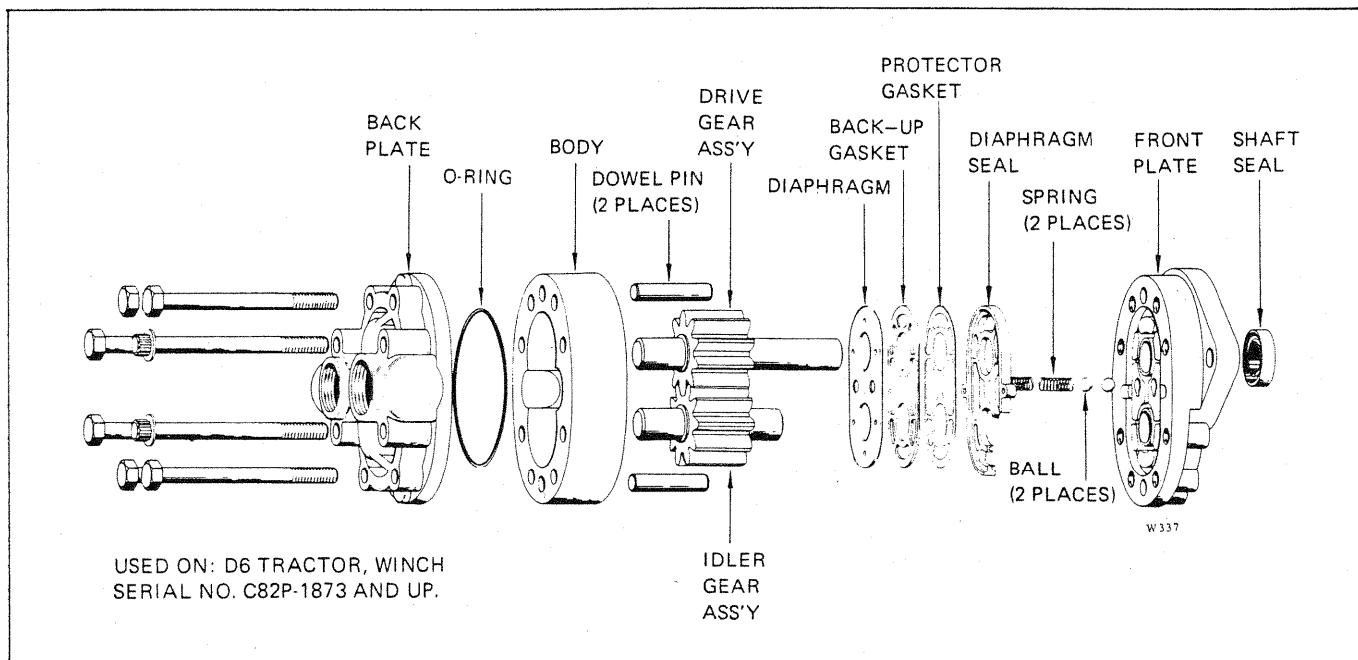


FIGURE 1-11. HYDRAULIC PUMP ASSEMBLY (Sheet 2 of 2)

operation. Each of the two pump gears is 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 in the cover bore. The teeth of the drive gear mate with the teeth of the driven gear. The drive gear is driven externally by the tractor auxiliary PTO shaft in most applications. However, on Traxcavators, the gear is driven through drive belts. The pump inlet and outlet ports are located in the rear cover. 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 winch control valve assembly on earlier models, or to the winch pressure inlet on later production models. Oil drawn into the inlet port is carried to the outlet port in pumping chambers 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.

1-22. D6 TRACTORS WITH WINCH SERIAL NO. C82P-1873 AND UP. The hydraulic pump assembly is a positive-displacement, external gear pump that supplies the hydraulic energy necessary for operation of the power controlled winch. The hydraulic pump consists primarily of a helical-cut drive and driven gear which mesh and revolve in a close fitting

body casting enclosed by a front and back end plate. The two end plates contain gearshaft support bushings that are pressure-balanced during pump operation. A diaphragm seal system prevents high pressure oil from flowing toward the front end of the pump where it may leak by the drive shaft seal. When the drive shaft rotates, oil from the inlet port is trapped between the unmeshing gear teeth and carried around to the outlet port where it is forced out by the remeshing gear teeth. The pump drive shaft is driven externally by the tractor auxiliary PTO shaft through a splined coupling. The pump inlet and outlet ports are located in the rear-end plate. The inlet port is connected to the winch intake manifold by a large diameter hose. The outlet port is connected either directly to the winch control valve assembly or, on later production models, to the winch pressure inlet by a smaller diameter hose.

### 1-23. HANDLING GEAR.

1-24. DIRECT DRIVE WINCH. (See Figure 1-12.) The handling gear used to control the operation of the Direct Drive winch consists of a clutch handlever, brake handlever assembly and mounting bracket with an attached quadrant bar. The handling gear is mounted at the front, left-hand side of the operator's seat. The clutch handlever controls the dental clutches through a control cable attached to the bottom of the handlever. The brake handlever can be positioned and locked at various positions along the quadrant bar. The position of the handlever along the quadrant bar determines the extent that the brake is applied or

## Specifications and Descriptions

released. A release button at the top of the brake handlever must be depressed before the handlever can be moved forward to release the brake.

### 1-25. Power Controlled Winch. (See Figure 1-13.)

1-26. EARLY PRODUCTION HANDLING GEAR.  
(Last Used on Serial No. C82P-1899.) The handling gear used to control earlier production winches consists of a housing, control lever, selector lever, oil

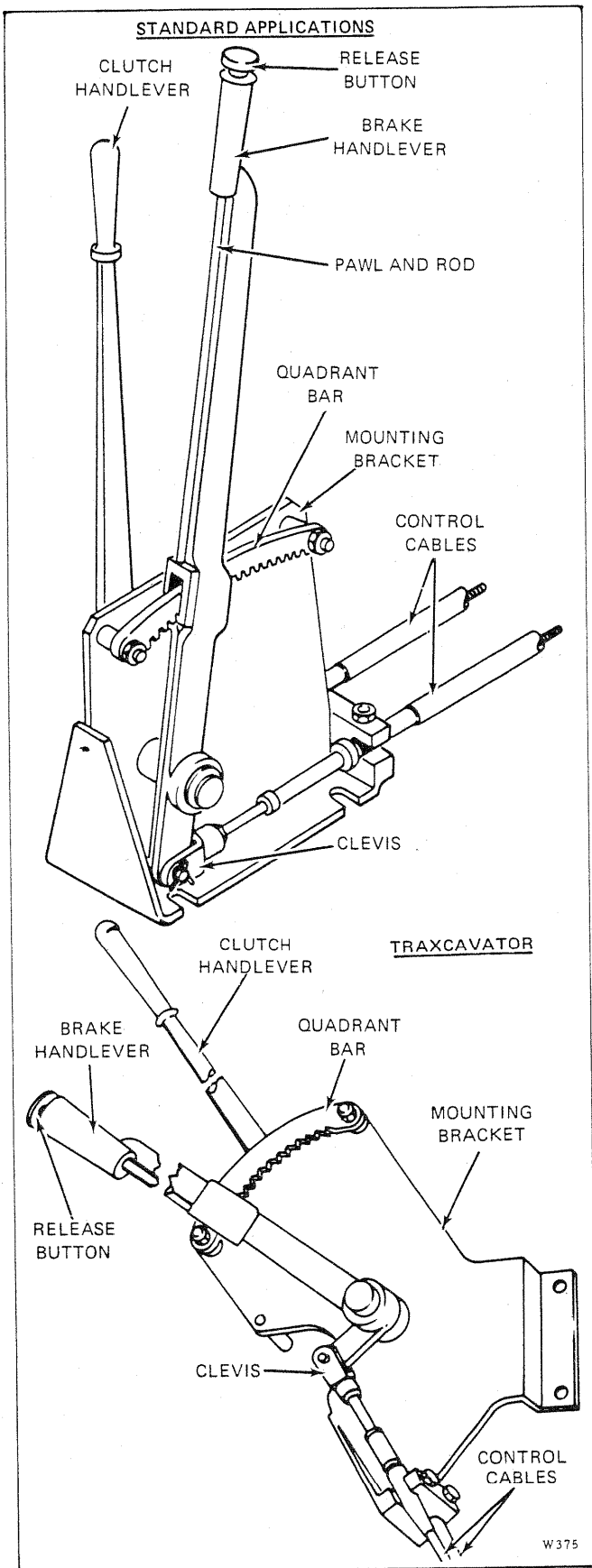


FIGURE 1-12. HANDLING GEAR FOR DIRECT DRIVE WINCH

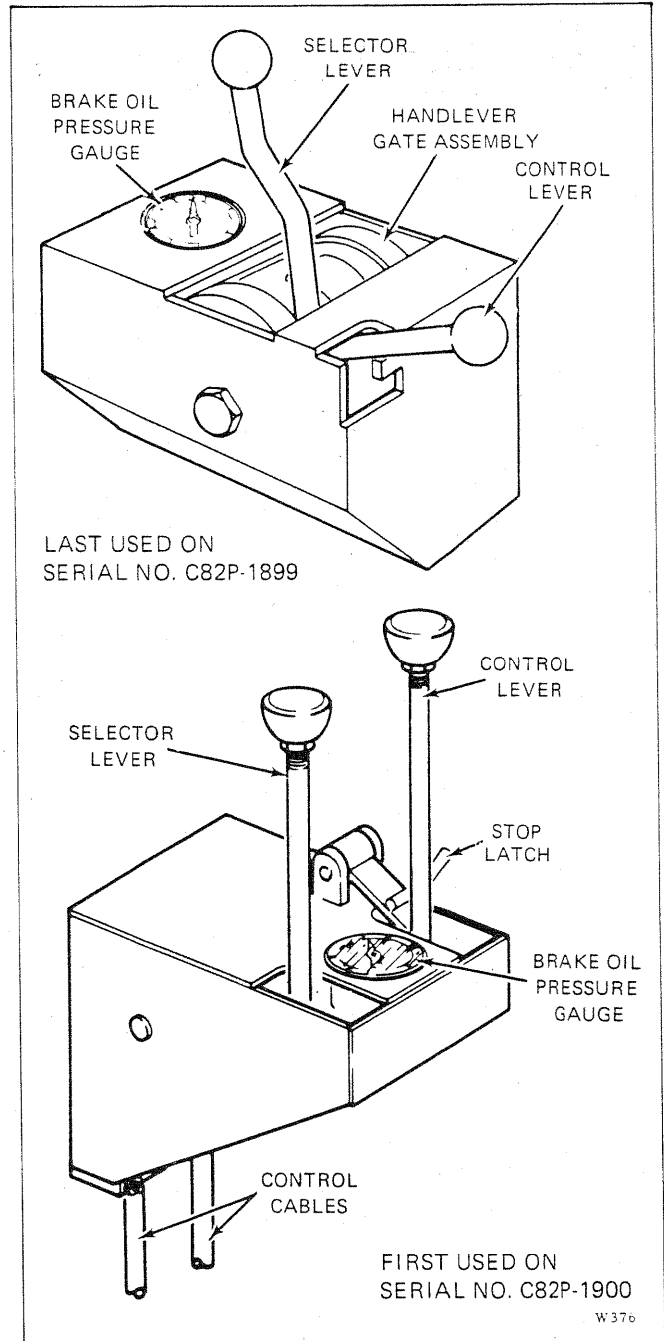


FIGURE 1-13. HANDLING GEAR FOR POWER CONTROLLED WINCH

## Specifications and Descriptions

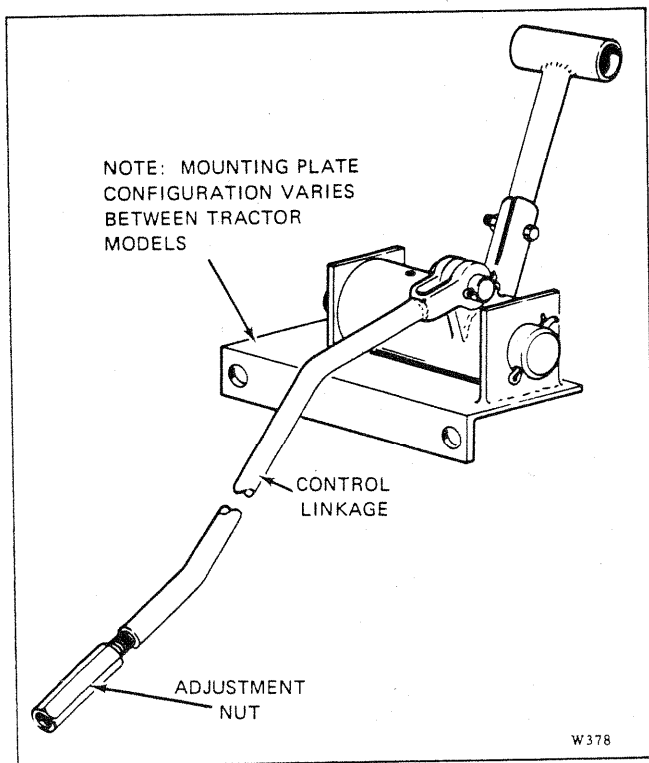


FIGURE 1-14. HANDLING GEAR FOR FREE-SPOOLING OPERATION, OPTIONAL

pressure gauge and handlever gate assembly. The handling gear is mounted on the right-hand side of the operator's seat and is connected to the 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.

1-27. LATER PRODUCTION HANDLING GEAR. (First Used on Serial No. C82P-1900.) The handling gear used to control later 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 operations. The handling gear is normally mounted at the right-hand side of the operator's seat.

However, on Traxcavators, the handling gear is mounted at the left-hand side of the operator's seat.

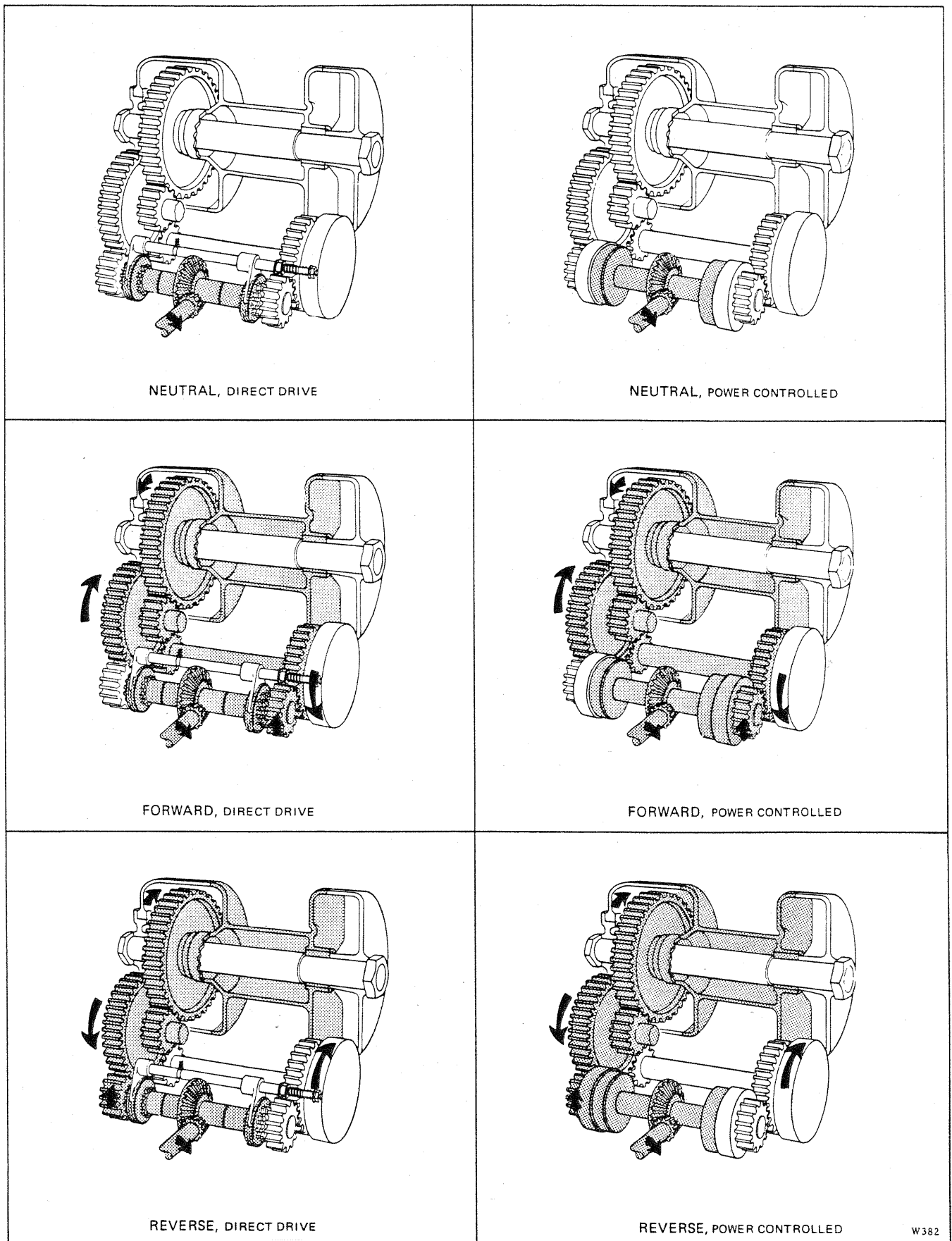
1-28. FREE-SPOOLING HANDLING GEAR. (OPTIONAL.) (See Figure 1-14.) The optional free-spool arrangement is used on Direct Drive and Power Controlled winches to allow cable to be payed out by hand. This is accomplished by disengaging the drum pinion gear from the remainder of the winch gear train, allowing the drum to rotate freely. A bracket-mounted handlever assembly is used in addition to the handling gear described in paragraphs 1-24 through 1-26. The free-spool handlever assembly is normally mounted under the operator's seat and controls free-spool operation. The control linkage from the handlever assembly extends through the right-hand drum gear cover and connects to a ball-stud fitted into the bore of a shifter fork. The shifter fork is independently mounted on a shaft located directly above the drum pinion gear. A detent ball and spring fitted into the shaft detents the shifter fork in the normal or free-spool position. The pads of the shifter fork are fitted into an internal-tooth dental clutch that rides between the intermediate gear and drum pinion. As the shifter fork is moved to the free-spool position, the dental clutch disengages from the drum pinion. At this time, the drum pinion is not driven by the intermediate gear and stops rotating. The drum pinion drives the drum gear, therefore, the drum gear is disconnected from the remaining sections of the winch drive train and can rotate freely. As the shifter fork is moved to the normal position, the dental clutch is moved so that it engages with the intermediate gear and drum pinion. This causes the intermediate gear to rotate the drum pinion which in turn rotates the drum gear. At this time, the drum gear is mechanically connected to the remaining sections of the winch gear train. When in the normal position, the winch gear train controls the operation of the drum gear and drum.

### 1-29. FUNCTIONAL DESCRIPTION.

#### 1-30. Direct Drive Gear Train. (See Figure 1-15.)

1-31. 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 ring gear. This causes the bevel gear shaft, bevel ring gear, two spacers and the dental clutches to rotate, but the associated pinion gears do not. This is because neither clutch is engaged. In Forward, the left-hand dental clutch is moved toward the left-hand side of the unit to engage the forward pinion gear. This will cause torque to be transferred from the forward pinion gear to the brakeshaft reduction gear, forcing the brakeshaft assembly to





W382

FIGURE 1-15. TORQUE TRANSFER, DIRECT DRIVE AND POWER CONTROLLED WINCH

## Specifications and Descriptions

rotate counterclockwise. The brakeshaft pinion gear will 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 dental clutch is moved toward the right-hand side of the unit to engage the reverse pinion gear. This will cause torque to be transferred from the reverse pinion 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.

### 1-32. Power Controlled Gear Train. (See Figure 1-15.)

1-33. 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 gearshaft ring gear. This causes the bevel gearshaft to rotate clockwise as viewed from the left-

hand side of the winch. In Neutral, the bevel gearshaft, bevel ring gear, two spacers and 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.

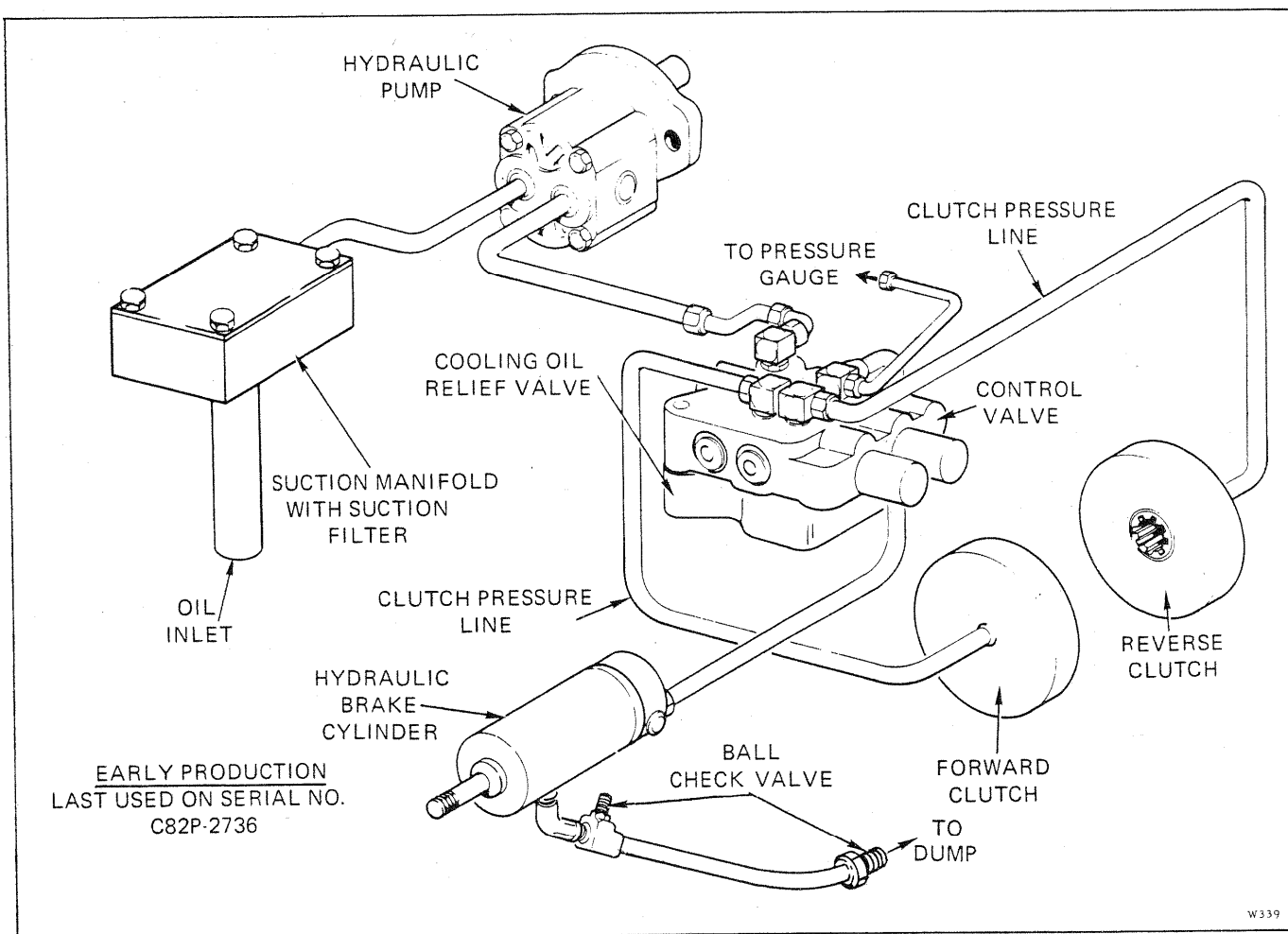


FIGURE 1-16. HYDRAULIC SYSTEM INTERCONNECTION DIAGRAM (Sheet 1 of 2)

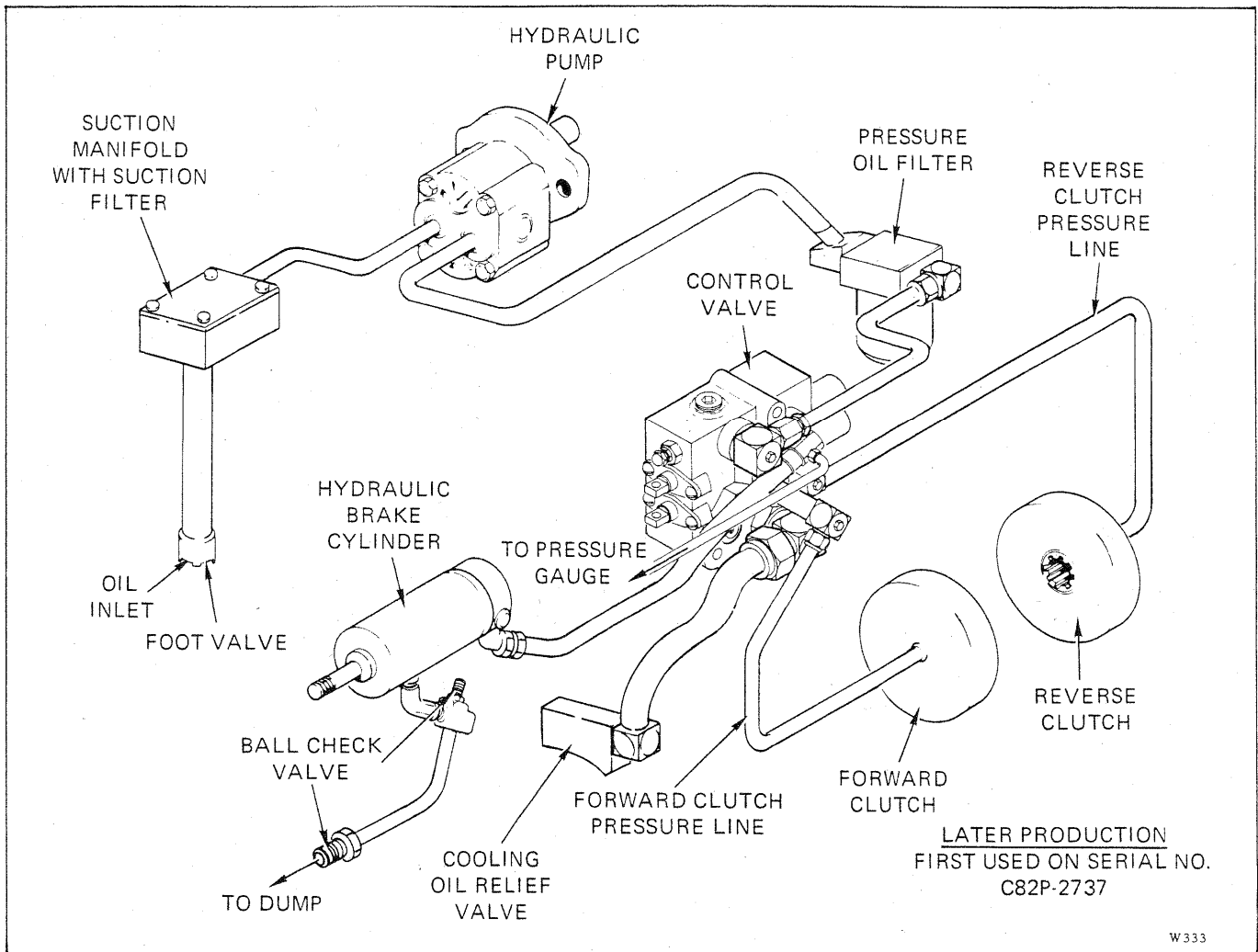


FIGURE 1-16. HYDRAULIC SYSTEM INTERCONNECTION DIAGRAM (Sheet 2 of 2)

## 1-34. Hydraulic System (Power Controlled Winch Only). (See Figure 1-16.)

1-35. **EARLY PRODUCTION.** (Last Used on Serial No. C82P-2736.) The hydraulic system used for the Power Controlled winch consists primarily of a suction filter, hydraulic pump assembly, control valve assembly, cooling oil relief valve assembly, pressure gauge, two oil clutch assemblies, hydraulic brake cylinder and associated 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 filter removes contaminants from the oil. The cooling oil valve maintains the proper oil flow to the oil clutch assemblies. The pressure gauge is mounted on the handling gear and indicates brake release pressure. The dump line on the brake cylinder includes an upper and lower ball check valve. The upper valve allows air to be drawn in, during retraction of the brake cylinder

piston, to prevent a suction pressure lock. The lower valve prevents oil being drawn up into the line when the discharge end is below the sump oil level, such as when the tractor is nosed down a steep incline.

1-36. **LATER PRODUCTION.** (First Used on Serial No. C82P-2737.) In addition to the hydraulic system components previously mentioned for the early units, the later production power controlled winch contains a pressure filter and a suction inlet foot valve. The pressure filter is located inside the winch housing and is used to protect the control valve from contaminants. The foot valve is located on the suction inlet to the suction filter and is used to prevent oil drain-back and pump loss of prime, especially during cold weather.

1-37. **OPERATIONAL MODES.** There are eight modes of winch operation. These modes are as follows (refer to paragraphs 1-38 through 1-45):

1. **NEUTRAL, Normal Operation**

## Specifications and Descriptions

2. FORWARD, Normal Operation
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)

1-38. HYDRAULIC SYSTEM IN NEUTRAL, NORMAL OPERATION. (See Figure 1-17.) On Early 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 the later Production Handling Gear, this is accomplished by: (1) Locking the Inching Lever in BRAKE OFF and (2) Shifting the Selector Lever to NEUTRAL. 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

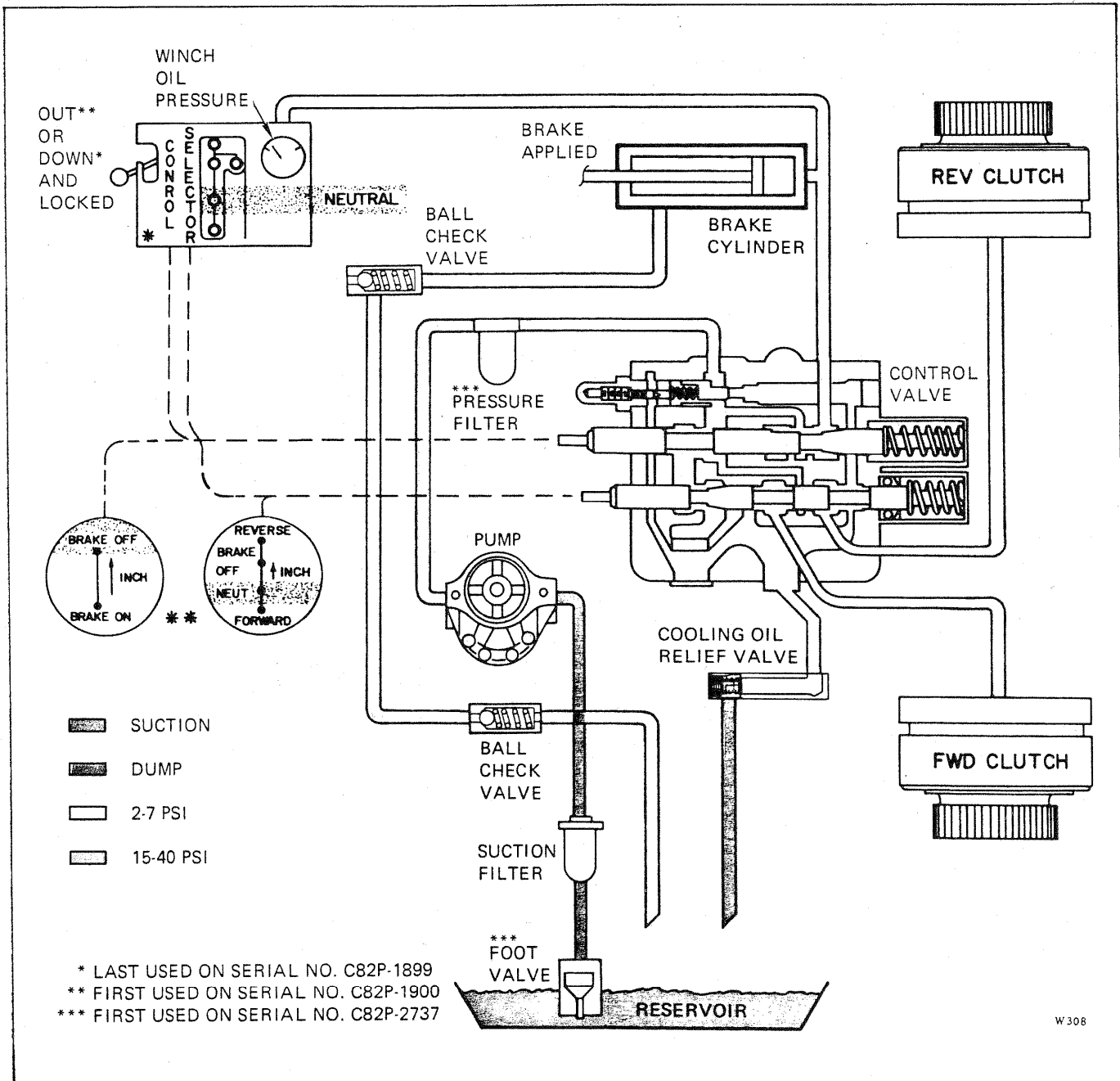


FIGURE 1-17. HYDRAULIC FLOW DIAGRAM, NEUTRAL, NORMAL OPERATION

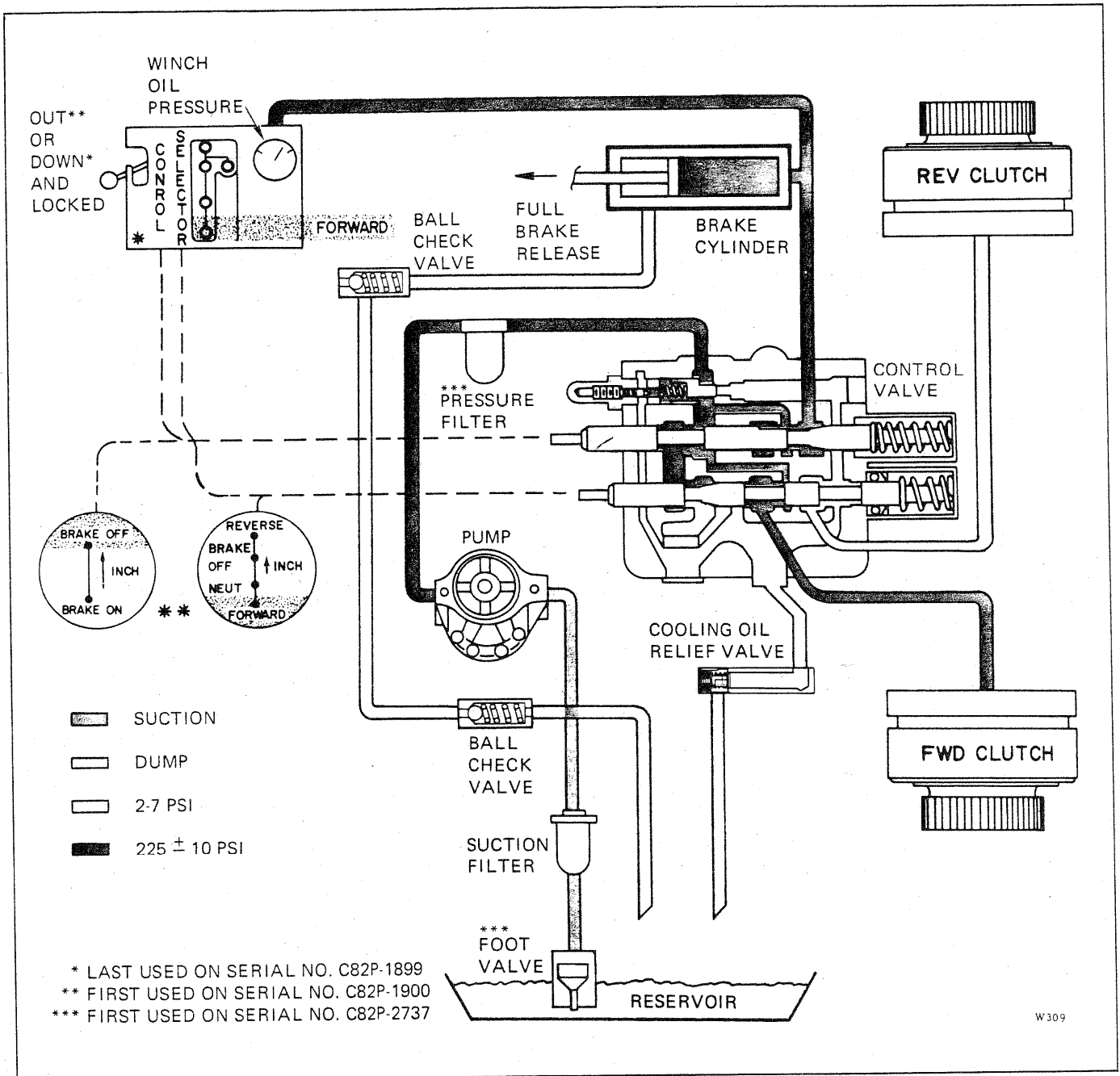


FIGURE 1-18. HYDRAULIC FLOW DIAGRAM, FORWARD, NORMAL OPERATION

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 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 clutches.

1-39. HYDRAULIC SYSTEM IN FORWARD, NORMAL OPERATION. (See Figure 1-18.) On Early 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 FORWARD. On the later Production Handling Gear, this is accomplished by: (1) Locking the Inching Lever in the BRAKE OFF position and (2) Shifting the Selector Lever to NEU-

## Specifications and Descriptions

TRAL. 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 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.

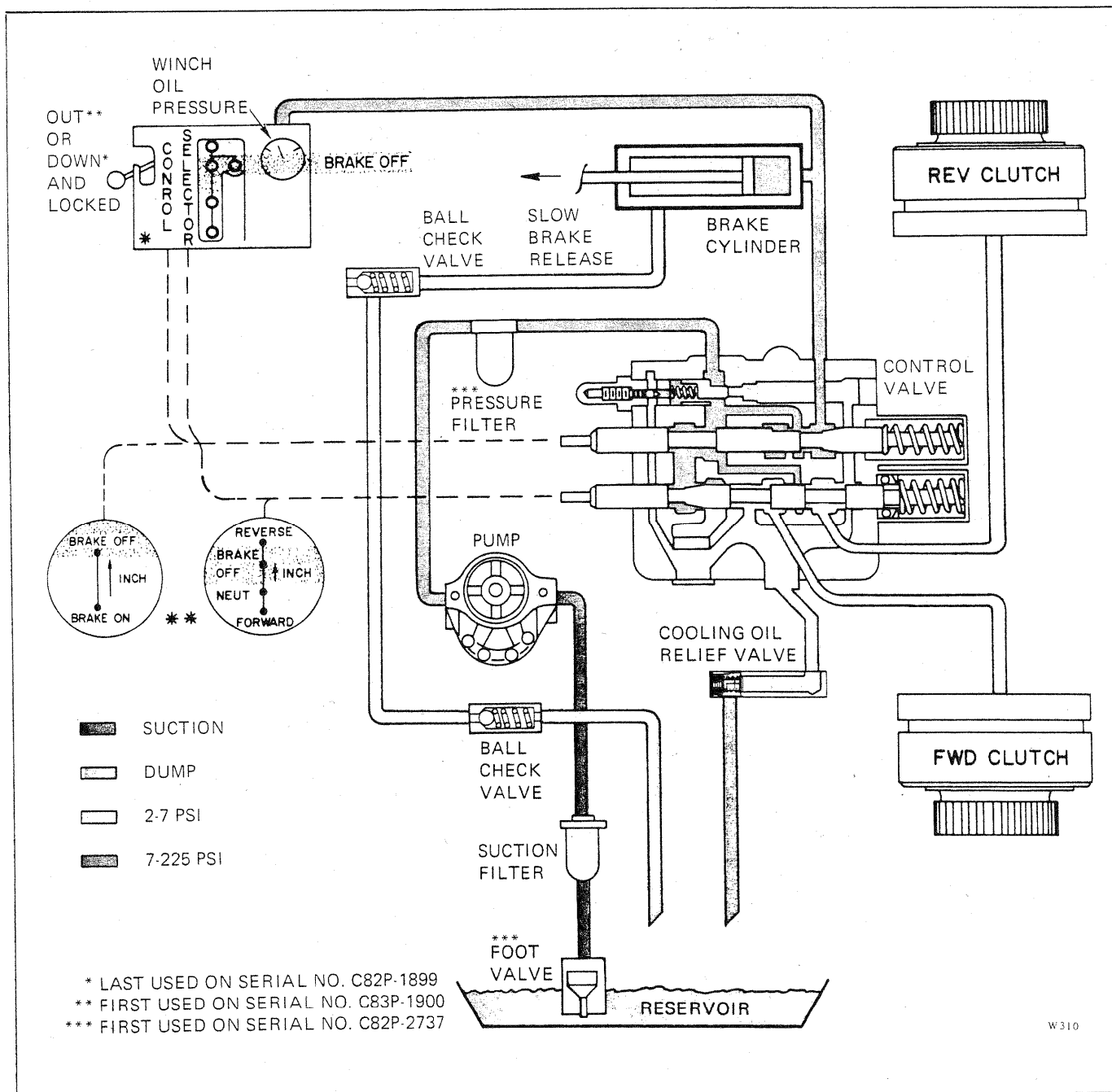


FIGURE 1-19. HYDRAULIC FLOW DIAGRAM, GRADUAL BRAKE RELEASE, NORMAL OPERATION

## Specifications and Descriptions

1-40. HYDRAULIC SYSTEM IN GRADUAL BRAKE RELEASE, NORMAL OPERATION. (See Figure 1-19.) On Early 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 INCH. On later Production Handling Gear, this is accomplished by: (1) Locking the Inching Lever in BRAKE OFF and (2) Shifting the Selector Lever to INCH. 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, 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 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.

1-41. HYDRAULIC SYSTEM IN REVERSE, NORMAL OPERATION. (See Figure 1-20.) On Early 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 REVERSE. On the later Production Handling Gear, this is accomplished by: Locking the Inching Lever in BRAKE OFF and (2) Shifting the Selector Lever to REVERSE. 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 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.

1-42. HYDRAULIC SYSTEM IN FORWARD INCHING, BRAKE APPLIED. (See Figure 1-21.) On Early 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 FORWARD. On later 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 BRAKE ON and (2) Holding the Selector Lever in FORWARD. 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 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 1-21, 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.

1-43. HYDRAULIC SYSTEM IN FORWARD INCHING, BRAKE SLIPPING. (See Figure 1-22.) On Early

# Specifications and Descriptions

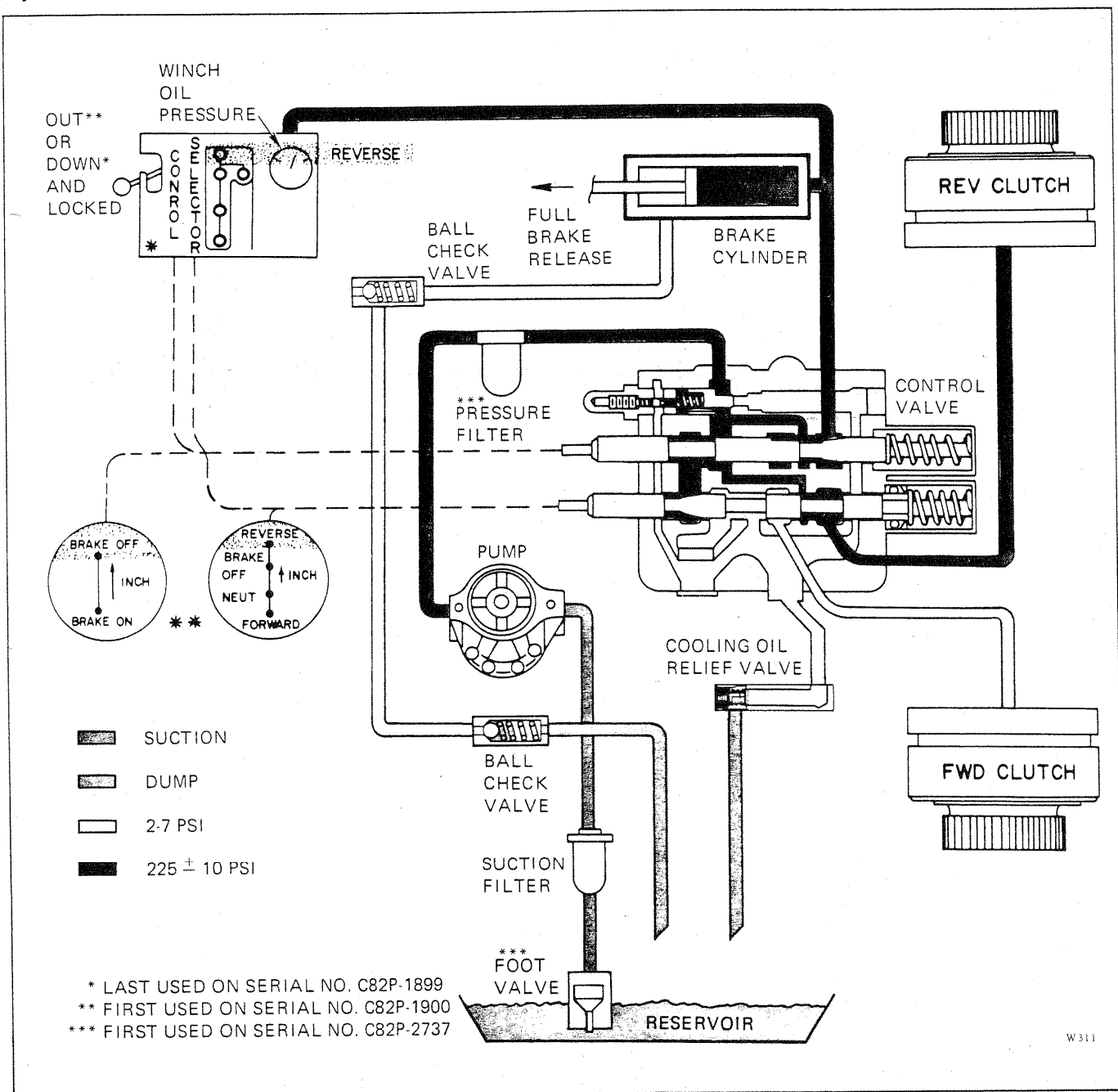


FIGURE 1-20. HYDRAULIC FLOW DIAGRAM, REVERSE, NORMAL OPERATION

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 later Production Handling Gear, this is accomplished by: (1) Holding the Selector Lever in FORWARD and (2) Moving the Inching Lever toward BRAKE OFF. When the Selector Lever (early production) is moved toward the front of the handlever housing or the Inching Lever (later 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.



## Specifications and Descriptions

1-44. HYDRAULIC SYSTEM IN REVERSE INCHING, BRAKE APPLIED. (See Figure 1-23.) On Early 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 REVERSE. On the later 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 BRAKE ON and (2) Holding the Selector Lever in REVERSE. 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 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

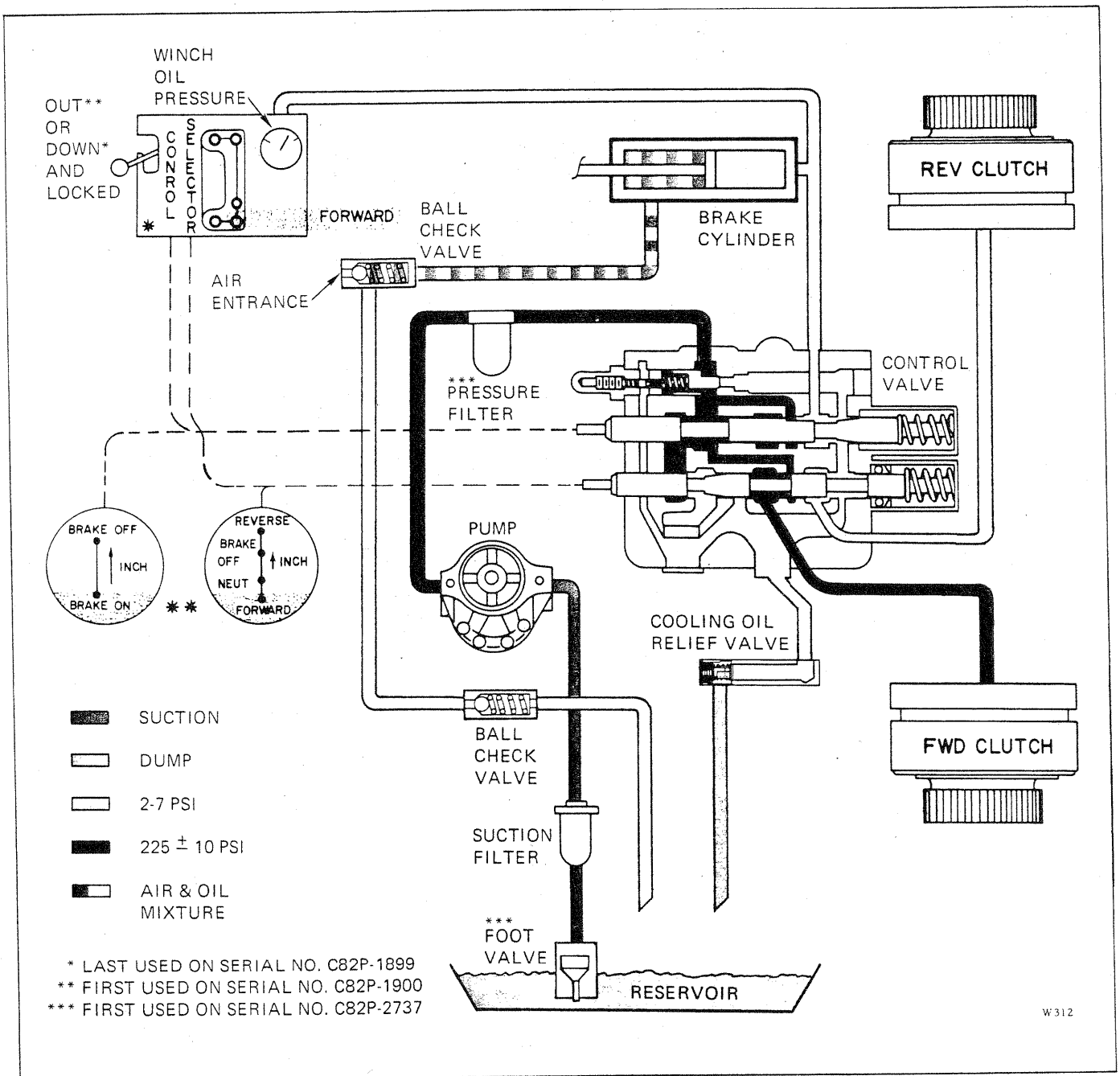


FIGURE 1-21. HYDRAULIC FLOW DIAGRAM, FORWARD INCHING, BRAKE APPLIED

## Specifications and Descriptions

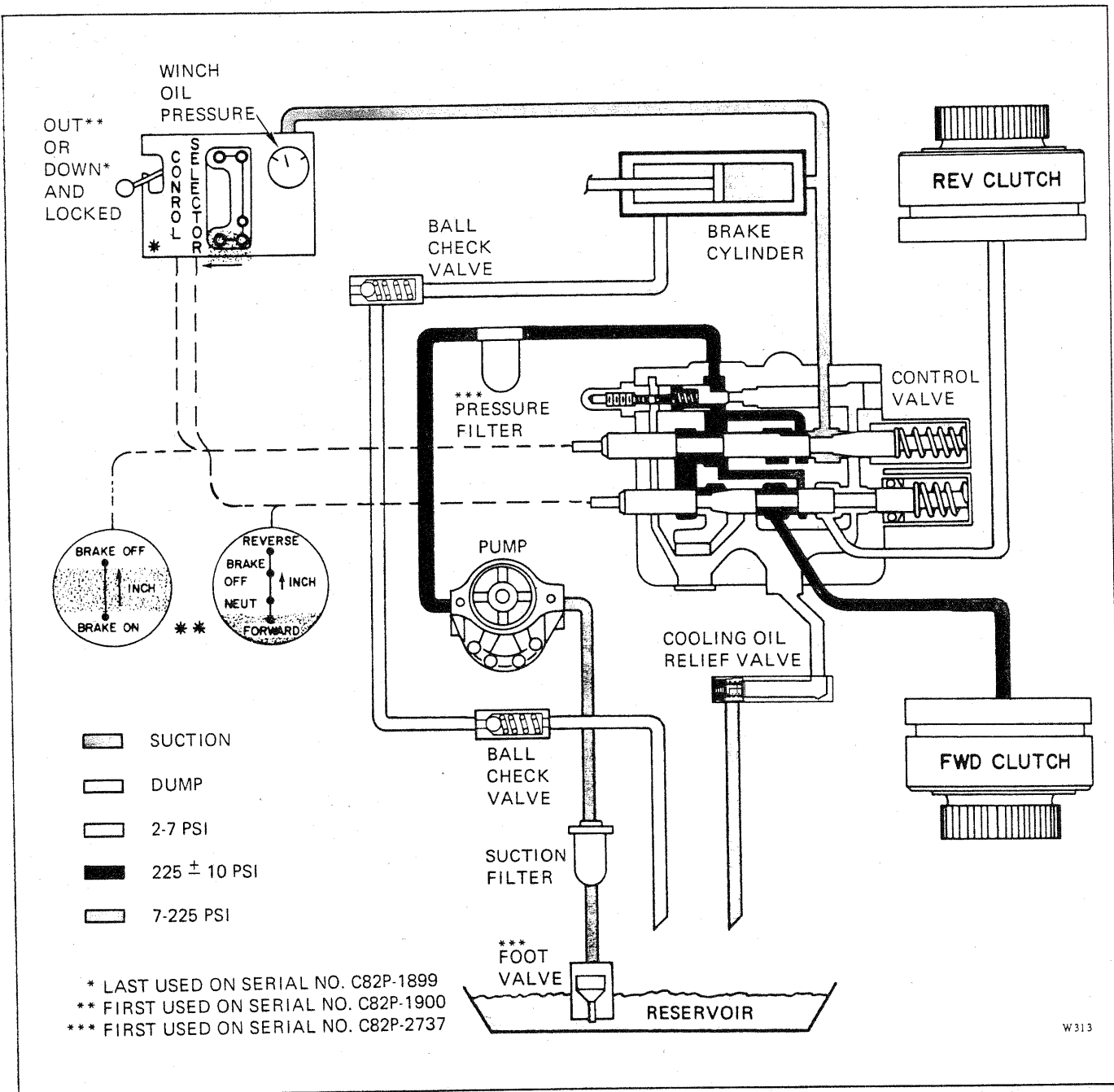


FIGURE 1-22. HYDRAULIC FLOW DIAGRAM, FORWARD INCHING, BRAKE SLIPPING

and fill the cavities leading to the reverse clutch assembly and the brake cylinder. As shown in Figure 1-23, 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.

1-45. HYDRAULIC SYSTEM IN REVERSE INCHING, BRAKE SLIPPING. (See Figure 1-24.) On Early 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)

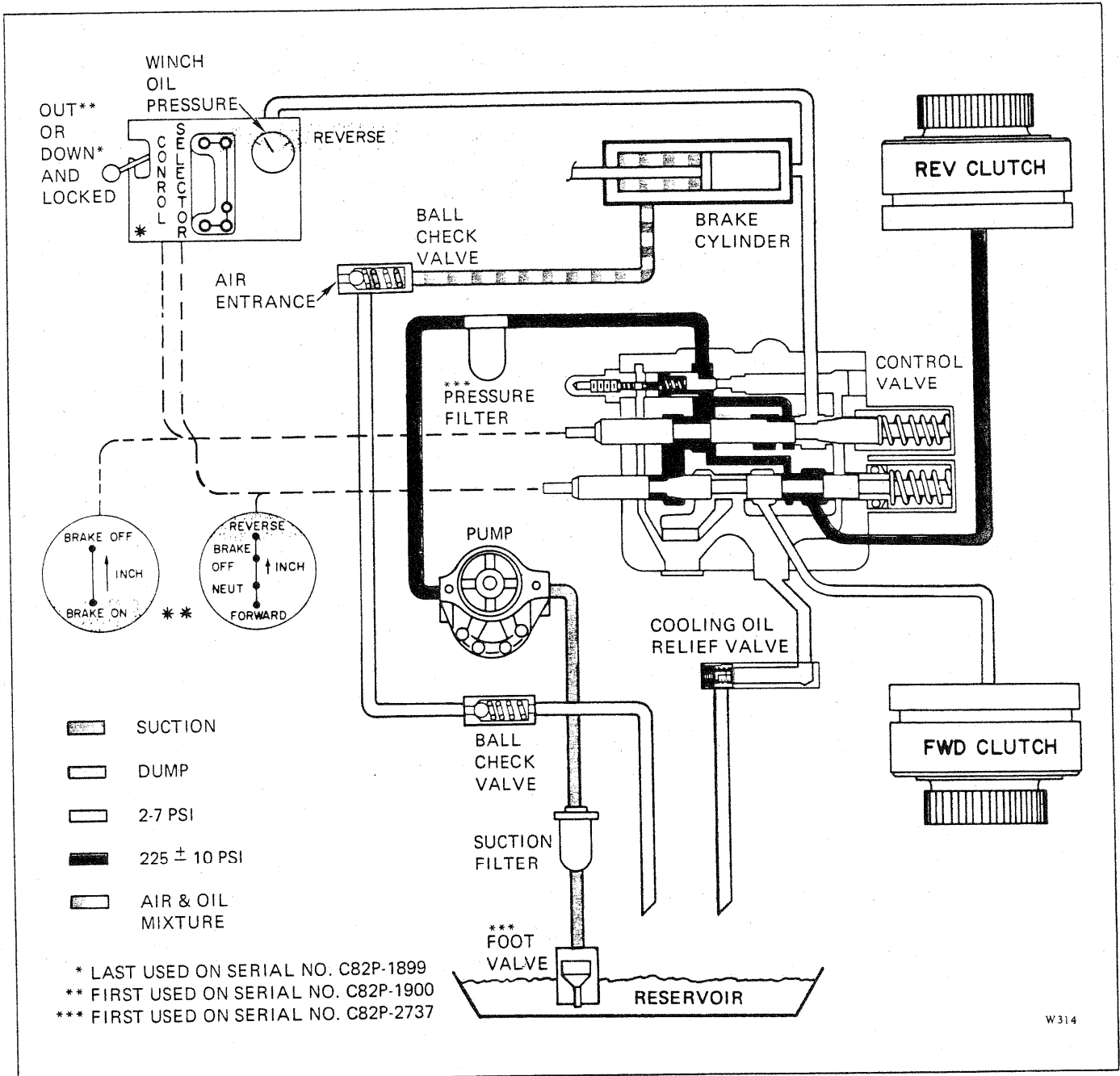


FIGURE 1-23. HYDRAULIC FLOW DIAGRAM, REVERSE INCHING, BRAKE APPLIED

Moving the Selector Lever toward the front of the handlever housing. On the later Production Handling Gear, this is accomplished by (1) Holding the Selector Lever in REVERSE and (2) Moving the Inching Lever toward BRAKE OFF. When the Selector Lever (early production) is moved toward the front of the handlever housing, or the Inching Lever (later production) is moved toward 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.

# Specifications and Descriptions

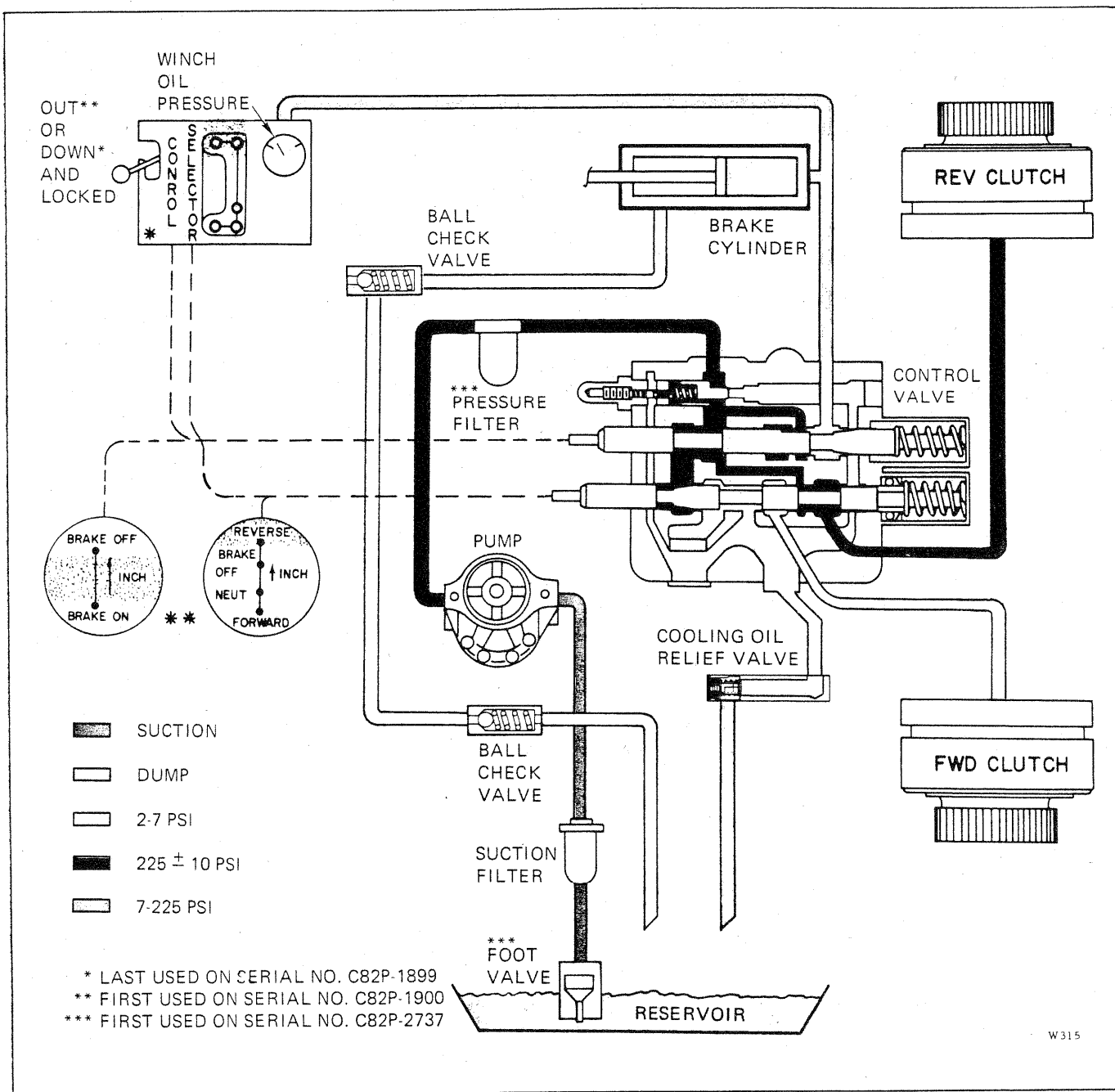


FIGURE 1-24. HYDRAULIC FLOW DIAGRAM, REVERSE INCHING, BRAKE SLIPPING



### 2-1. GENERAL.

2-2. The D6E Direct Drive and Power Controlled winches use tractor mounted controls. These controls allow the operator to either pay-out or pull-in line easily without leaving the tractor. Every operator must know the exact operating procedure of these controls prior to operating the winch.

### 2-3. OPERATIONAL PRECAUTIONS.

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

- a. Report damage or erratic operation of 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, lunchpails, 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 load.
- 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 line 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. Direct Drive Winch. (See Figure 2-1.)

2-7. SETTING THE BRAKE. To set the brake, pull back on the Brake Handlever. The brake will remain in BRAKE APPLIED until manually moved.

2-8. RELEASING THE BRAKE. To release the brake, proceed as follows:

- a. Pull back slightly on the Brake Handlever.
- b. Depress the release button.
- c. Push the Brake Handlever forward.

**NOTE** If the winch is equipped with the optional automatic brake (see Figure 1-5), the winch may haul-in line with the mechanical brake set, but the brake must be released to pay-out line.

2-9. HAULING-IN LINE. To haul-in line, proceed as follows:

- a. Disengage the tractor master clutch.
- b. Place the tractor transmission in NEUTRAL.
- c. Pull the Clutch Handlever all the way back to the FORWARD position.
- d. Release the brake (refer to paragraph 2-8).
- e. Engage the tractor master clutch.

**NOTE** Line speed is varied by throttling the tractor engine.

2-10. STOPPING THE WINCH. To stop the winch, proceed as follows:

- a. Throttle down the engine.

## Operation

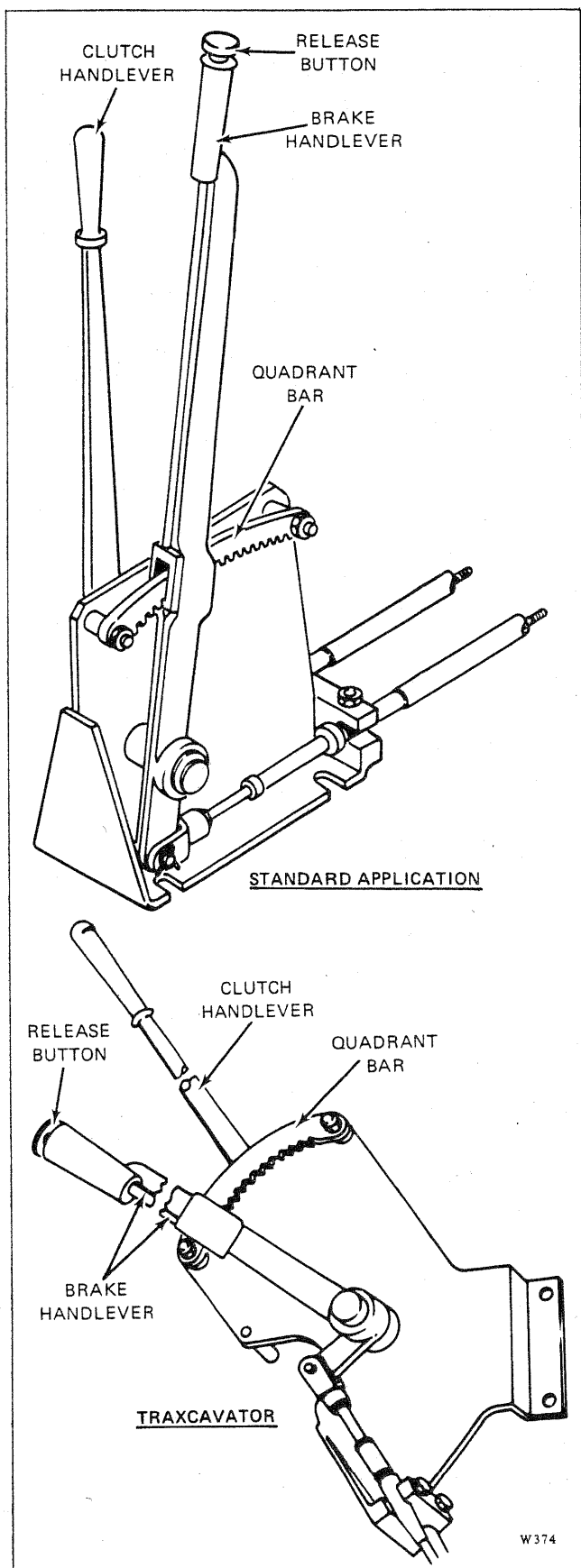


FIGURE 2-1. OPERATING CONTROLS FOR DIRECT DRIVE WINCH

b. Disengage the tractor master clutch and apply the brake at the same time.

**NOTE** The brake may be set before the tractor master clutch is disengaged if the winch is equipped with an automatic brake.

2-11. PAYING-OUT LINE UNDER POWER. To pay-out line under power, proceed as follows:

- Disengage the tractor master clutch.
- Push the winch Clutch Handlever past NEUTRAL and into REVERSE.
- Release the brake (refer to paragraph 2-8).
- Engage the master clutch.

**NOTE** Line speed is varied by throttling the engine.

2-12. SHIFTING TO NEUTRAL. To shift to NEUTRAL, proceed as follows:

- Disengage the tractor master clutch.
- Move the Clutch Handlever to NEUTRAL (straight up).

**CAUTION** Do not operate the winch while the tractor is in motion.

### 2-13. Power Controlled Winch.

2-14. There are two different handling gear designs on the Power Controlled Winch. These will be referred to as Early Production and later Production. Although the winch is the same, the operational procedure of these two handling gear designs are different. (Refer to paragraphs 2-15 and 2-18.)

2-15. EARLY PRODUCTION HANDLING GEAR. (See Figure 2-2.) 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, raising, lowering, towing, yo-yo operation and rescue work. Operating procedures for Normal Control and Fine Inching Control are given in paragraphs 2-16 and 2-17.

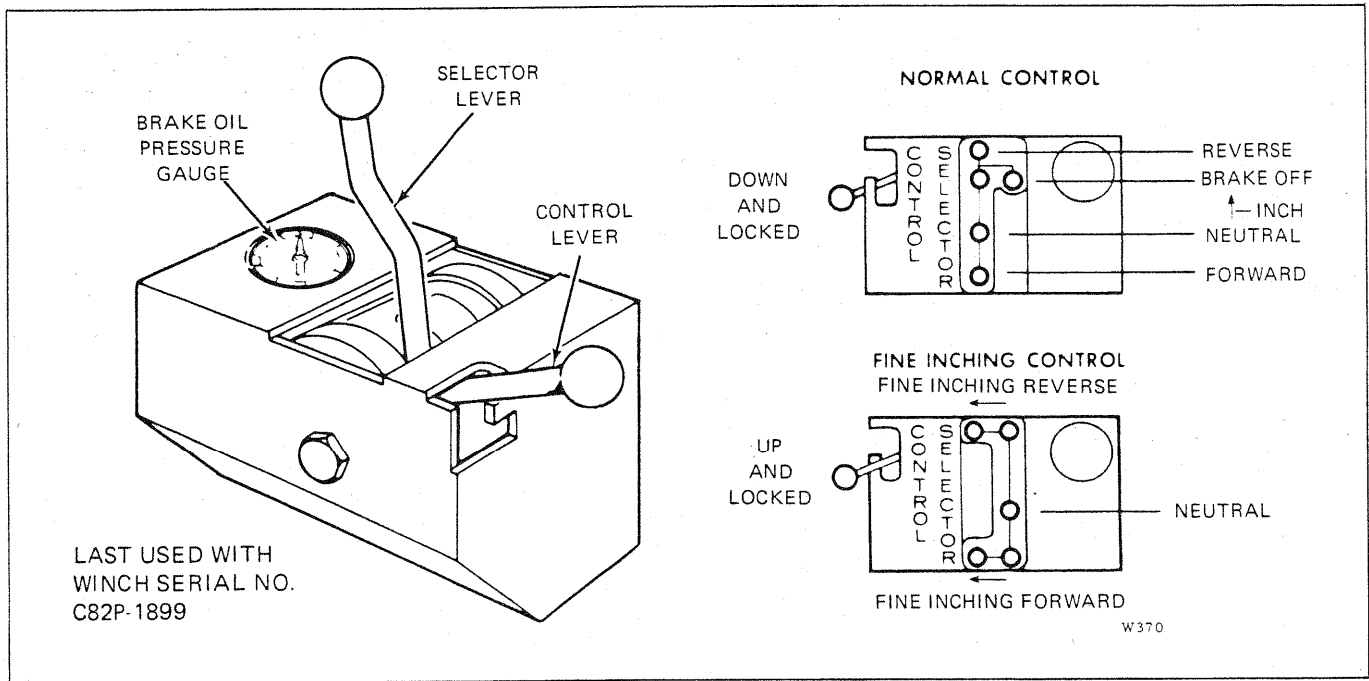


FIGURE 2-2. OPERATING CONTROLS, EARLY PRODUCTION POWER CONTROLLED WINCH

2-16. 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 NEUTRAL. In NEUTRAL, brake is applied. The winch brake oil pressure gauge will be in the lower green zone.

b. For Forward, hold the Selector Lever in FORWARD. In FORWARD, brake is completely released and drum will haul-in line. The winch Brake Oil Pressure Gauge should be in the upper green zone.

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

d. For Brake Off, shift the Selector Lever to BRAKE OFF. In BRAKE OFF, the brake is completely released, which allows the drum to free-wheel. The Brake Oil Pressure Gauge should be 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 early production winches to maintain a Brake-Off condition. On later production winches (equipped with early production handling gear), the Selector Lever linkage is detented to the BRAKE OFF position.

**CAUTION** Do not operate the winch for extended periods in BRAKE OFF.

e. For Reverse, hold the Selector Lever in REVERSE. In REVERSE, the brake is completely released and the drum will pay-out line under power. The winch Brake Oil Pressure Gauge will be in the upper green zone.

2-17. 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 NEUTRAL. 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 FORWARD. In FORWARD, the winch brake

## Operation

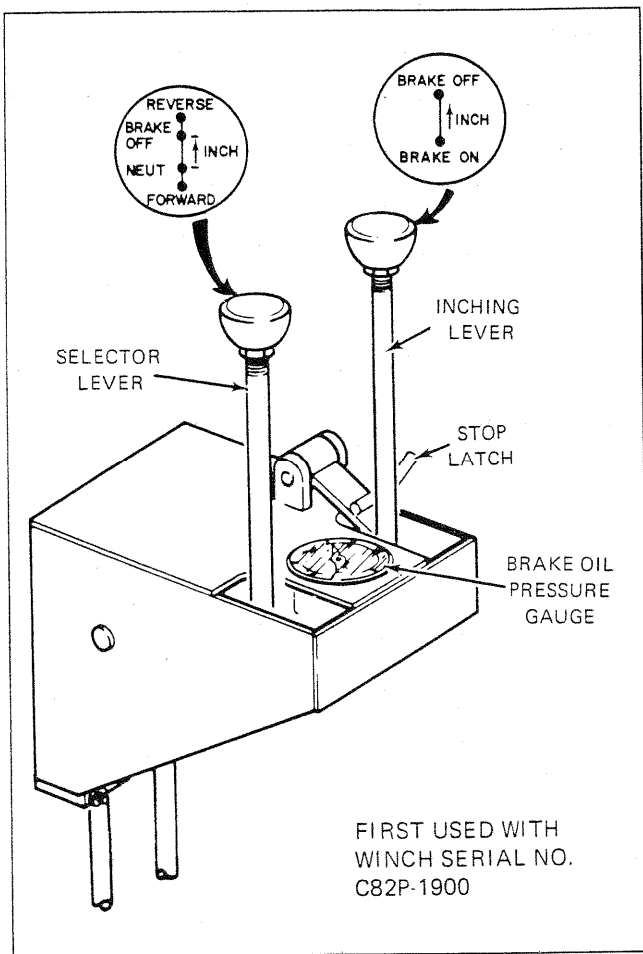


FIGURE 2-3. OPERATING CONTROLS, LATER PRODUCTION POWER CONTROLLED WINCH

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 be in the red zone, close to the lower green zone.

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

c. For Forward (Brake Slipping), slowly move the Selector Lever from FORWARD 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 will assume control of the load to inch IN under power. The winch Brake Oil Pressure gauge will be 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 be 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 REVERSE. In REVERSE, 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 be in the red zone close to the lower green zone.

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

e. For Reverse (Brake Slipping), slowly move the Selector Lever from REVERSE toward 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 reverse clutch will assume control of the load to inch OUT under power. The winch Brake Oil Pressure Gauge will be 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 be in the upper green zone.

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

2-18. LATER PRODUCTION HANDLING GEAR. (See Figure 2-3.) 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, raising, lowering, towing, yo-yo operations and rescue work. Operating procedures for Normal Control and Fine Inching Control on later production handling gear are contained in paragraphs 2-17 and 2-20.

2-19. OPERATING IN NORMAL CONTROL. To operate later production handling gear in Normal Control, lock the Inching Lever in BRAKE OFF. This will allow the Selector Lever to be shifted as follows:

a. For Neutral, shift the Selector Lever to NEUTRAL. 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 FORWARD. In FORWARD, the brake is completely released and the drum will haul-in line. The winch Brake Oil Pressure Gauge should be in the upper green zone.



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

d. For Brake Off, shift the Selector Lever to BRAKE OFF. In BRAKE OFF, the brake is completely released, which allows the drum to free-wheel. The Brake Oil Pressure Gauge should be 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 in BRAKE OFF.

2-20. 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 BRAKE ON. 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 NEUTRAL. 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 FORWARD. In FORWARD, 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 be in the red zone close to the lower green zone.

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

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

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

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

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

## 2-21. Free-Spooling.

2-22. The optional free-spooling arrangement is used on Direct Drive and Power Controlled winches to allow cable to be payed-out by hand. This is accomplished by disengaging the drum pinion gear from the remainder of the winch gear train, thus allowing the drum to rotate freely. A bracket-mounted handle assembly (see Figure 1-14) is used in addition to the handling gear shown in Figures 2-1 through 2-3. The handle assembly used for controlling free-spooling operation is normally mounted under the operator's seat. The winch is placed in free-spooling by removing tension from the winch cable and pushing the free-spool handle forward. This disengages the drum pinion gear from the winch gear train. To return to normal operation, remove tension from the winch cable, release the winch brake as described in paragraph 2-8 or 2-19 and pull the free-spool handle back toward the operator's seat.

**NOTE** For Direct Drive Winches, it may be necessary to engage the winch clutch and temporarily engage and disengage the tractor master clutch to align the winch gear teeth for shifting out of free-spool. The gear train in the Power Controlled winch normally rotates slowly even though the controls are in neutral with the brake released.





## 3-1. GENERAL.

3-2. Tables 3-1 through 3-3 are trouble analysis check charts that include the most common troubles that may be encountered, the probable cause of the trouble, and the corrective action that should be taken

to restore the winch to normal operating condition. The information contained in Table 3-1 applies to the Direct Drive winch. The information contained in Table 3-2 applies to the Power Controlled winch. Table 3-3 applies to both the Direct Drive and Power Controlled winches equipped with optional free-spool.

TABLE 3-1. TROUBLE ANALYSIS CHECK CHART FOR DIRECT DRIVE WINCH (Sheet 1 of 2)

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Hard to Shift into Forward or Reverse	Control cable damaged.	Check for pinched, rusted, or broken cable housing. Replace if found defective.
	Control cable improperly adjusted.	Check and adjust as necessary. Refer to paragraph 4-9.
	Linkage binding or rusted.	Clean, straighten, repair or replace parts as necessary.
	Shifting collar too tight on splines or splines rough.	Remove shifting collar, dress splines with fine stone, and replace parts if necessary.
Will not Stay in NEUTRAL Position	Detent ball and spring damaged or sticking.	Replace spring if broken. Check that ball is free in the bore. Lubricate ball, spring and bore.
	Annular groove on shifter shaft elongated.	Replace shifter shaft.
	Dental clutches installed backwards.	Install the dental clutch so chamfered ramp will face pinion gear.
Jumps Out of Gear	Dental teeth worn.	Check for dental teeth wear on: a. Dental Clutch, b. Dental Clutch hub, c. Forward pinion gear, d. Reverse pinion gear. Replace above components if teeth are rounded.
	Shifter fork improperly positioned on the shifter shaft.	Check for loose anchor screw on: a. Forward shifter fork, b. Reverse shifter fork. Tighten securely and lock with lockwire.
	Dental clutches installed backwards.	Install the dental clutch so chamfered ramp will face pinion gear.
	Shifter forks installed backwards.	Install the shifter fork so anchored end faces toward the center of the winch.

# Troubleshooting

TABLE 3-1. TROUBLE ANALYSIS CHECK CHART FOR DIRECT DRIVE WINCH (Sheet 2 of 2)

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Brake Not Holding or Hard to Apply	Water in brake compartment resulting from condensation or marine use.	Drain water from brake compartment each day if necessary.
	Improper clearance between brake band assembly and brake wheel.	Check that clearance is approximately 1/32-inch. Refer to paragraph 4-13.
	Worn brake lining.	Replace with new lining.
	Brake cable improperly adjusted.	Adjust cable ends so Brake Handlever applies brake before it reaches end of travel. Refer to paragraph 4-14.
	Brake control cable assembly not anchored securely.	Check for loose connection of control cable housing to the: <ul style="list-style-type: none"> <li>a. Handling Gear mounting bracket.</li> <li>b. Winch control housing bracket.</li> </ul> Tighten securely and lock with jam nut.
	Control cable damaged.	Check for pinched, rusted, or broken cable housing. Replace if found defective.
	Brake linkage set for overwind operation and winch is used for underwind operation.	Change linkage for underwind operation. Refer to paragraph 4-19.
	Brake linkage set for underwind operation and winch is used for overwind operation.	Change linkage for overwind operation. Refer to paragraph 4-15.

TABLE 3-2. TROUBLE ANALYSIS CHECK CHART FOR POWER CONTROLLED WINCH (Sheet 1 of 5)

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Erratic Operation	Low oil level.	Add oil as necessary. Refer to Table 4-1.
	Pump cavitating due to air leaks in hydraulic system.	Check the following for air leaks: <ul style="list-style-type: none"> <li>a. Suction manifold cover gasket.</li> <li>b. Suction manifold cover screw tightness.</li> <li>c. Suction hose to manifold connection.</li> <li>d. Suction hose to pump connection.</li> <li>e. Suction hose for cracks or collapsed condition.</li> <li>f. Suction manifold pick-up tube weld connection to manifold.</li> <li>g. Pump shaft seal.</li> </ul> <p><b>CAUTION</b> Use only Hyster approved gaskets and hoses.</p>
	Stuck or clogged suction foot valve, if used.	Clean or replace foot valve, as necessary, to remove restriction.

# Troubleshooting

TABLE 3-2. TROUBLE ANALYSIS CHECK CHART FOR POWER CONTROLLED WINCH (Sheet 2 of 5)

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Erratic Operation (Cont.)	Push-pull cables out of adjustment.	Check for proper adjustment as outlined in paragraph 4-26. 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.
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 4-25. Replace Relief Valve Assembly if defective.  <b>NOTE</b> Do not rely on brake release pressure gauge when adjusting relief pressure. Always use a calibrated gauge.
	Brake Oil Pressure Gauge defective.	Check gauge reading against a calibrated gauge. Replace if gauge is faulty.
	Internal slippage (leakage) in hydraulic 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 5-26.
Brake Not Releasing	Refer to LOW OIL PRESSURE troubleshooting procedure.	
	Cover plate capscrew too long. (These capscrews will jam against brake lever assembly.)	Remove and replace with correct capscrew.
	Rusted or corroded linkage and pins.	Clean and replace as necessary.
	Brake cylinder damaged or piston ring worn.	Repair or replace as necessary.

# Troubleshooting

TABLE 3-2. TROUBLE ANALYSIS CHECK CHART FOR POWER CONTROLLED WINCH (Sheet 3 of 5)

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Brake Slipping	Water in brake compartment resulting from condensation or marine use.	Drain water from brake compartment each day if necessary.
	Brake lining saturated with oil.	Replace lining, clean brake wheel and brake compartment, locate source of oil leakage and repair leak. Refer to OIL IN BRAKE COMPARTMENT trouble.
	Broken springs.	Replace with new springs. See Figure 5-4.
	Hydraulic brake cylinder incorrectly adjusted.	Adjust as necessary. Refer to paragraph 4-30.
	Improper clearance between brake band assembly and brake wheel.	Check that clearance is approximately 1/32-inch. Refer to paragraph 4-31.
	Worn brake lining.	Replace with new lining.
	Brake linkage set for overwind operation and winch is used for underwind operation.	Change linkage for underwind operation. Refer to paragraph 4-19.
Oil in Brake Compartment	Brake linkage set for underwind operation and winch is used for overwind operation.	Change linkage for overwind operation. Refer to paragraph 4-15.
	Worn brake shaft seal.	Replace seal and check brake shaft preload to prevent re-occurrence.
	Bevel gear shaft or brake shaft retainer capscrews leaking.	Remove capscrews and coat with sealing compound.
	Ball check connectors (valves) are malfunctioning.	Replace valves as necessary.  <b>CAUTION</b> Upper ball check must point up with pipe thread end installed in fitting and straight thread end out.
	Brake cylinder piston rod packing worn or damaged.	Replace packing as necessary.
Overheating	Oil leaking from control valve, pressure filter (later production only), cooling oil relief valve, brake cylinder, or associated fittings and hoses.	Repair leaks or replace components as necessary.  <b>CAUTION</b> On early production version, do not plug vent in control valve mounting plate.
	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.

TABLE 3-2. TROUBLE ANALYSIS CHECK CHART FOR POWER CONTROLLED WINCH (Sheet 4 of 5)

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Overheating (Cont.)	Inching spool or control cable travel improperly adjusted.	Check and adjust as necessary. Refer to paragraph 4-23.
	Excessive inching.	Allow oil to cool periodically.  <b>NOTE</b> Install heat exchanger if excessive inching is necessary.
	Defective clutch cooling oil valves.	Replace valve. See Figure 5-8, step 6.
	Plugged suction filter.	Remove suction filter, clean, and replace. See Figure 5-29.
	High cooling oil pressure.	Check cooling oil pressure. Replace cooling oil relief valve assembly if reading is over 7 PSI at the forward or reverse port. See Figure 5-17.
	Insufficient Clutch Assembly clearance.	Adjust to correct clearance. See Figure 5-21, 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 4-27.
	Broken cast iron seal ring on the bevel gear shaft.	Replace: a. Left-hand seal ring if low pressure is indicated when Selector Lever is shifted to FORWARD. b. Right-hand seal ring if low pressure is indicated when Selector Lever is shifted to REVERSE.  <b>NOTE</b> 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 5-26.
	Damaged bevel gear shaft seal ring grooves.	Check grooves for taper, scoring, and rust. Replace or rebuild shaft if 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 5-26, step 7.

# Troubleshooting

TABLE 3-2. TROUBLE ANALYSIS CHECK CHART FOR POWER CONTROLLED WINCH (Sheet 5 of 5)

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Variation of Pressure Between Ports (Cont.)	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 5-21, step 1.
Instant Shifting from BRAKE-OFF to REVERSE	D-20 Selector spool.	Replace with D-23 Selector spool. Adjust cables.
High Oil Level	Engine oil transferring past pump shaft seal into winch hydraulic system.	Replace pump shaft seal. Refer to paragraph 5-26.

TABLE 3-3. TROUBLE ANALYSIS CHECK CHART FOR OPTIONAL FREE-SPOOL WINCHES

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Hard to Shift	Linkage binding or rusted.	Clean, straighten, repair or replace parts as necessary.
	Shifting collar too tight on splines or splines rough.	Remove shifting collar, dress splines with fine stone, and replace parts if necessary.
	Dental clutch installed backwards.	Install clutch so that chamfered ramp will face drum pinion gear. See Figure 5-23.
Jumps Out of Gear	Control linkage improperly adjusted.	Check and adjust as necessary.
	Worn shifter fork.	Replace shifter fork and related parts as necessary.
	Worn drum pinion gear bushing.	Replace bushing and related parts as necessary.
	Detent ball and spring loose, damaged, or sticking.	Clean or replace as necessary.
Winch Will Not Free-Spool	Linkage improperly adjusted.	Check and adjust as necessary.
	Intermediate shaft assembly damaged, rusted, or preloaded.	Adjust or repair as necessary.
	Drum shaft assembly damaged, rusted, or binding.	Adjust or repair as necessary.





# Section 4

## SERVICE INSTRUCTIONS

### 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 cor-

related 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 eight hours per day, the hourly schedule should be followed. If the unit is operated eight hours or less per day, the periodic schedule should be followed.

TABLE 4-1. SafeGuard MAINTENANCE AND SERVICE INSPECTION SCHEDULE (Sheet 1 of 3)

REFER TO FIG. NO.	ITEM	SCHEDULE (Hour/Period)					QUAN.	TYPE	PROCEDURE
		8/ dy	50/ wk	500/ 3 mo	1000/ 6 mo	2000/ 1 yr			
4-1	Transmission Oil Level (Direct Drive)		✓		C H A N G E		10 Gals.	SAE 90, MIL-L-2105B.  <b>NOTE</b> In freezing temperatures it may be necessary to use a lighter oil to make shifting easier.	Check winch oil at level plug <b>A</b> on right side of winch. Add oil as required at plug <b>B</b> . Drain oil at plug <b>C</b> .  <b>NOTE</b> When checking winch oil level on winches mounted on powershift tractors, stop engine to obtain correct reading. For winches mounted on direct drive tractors, disengage tractor master clutch to obtain correct reading.
4-1	Transmission Oil Level (Power Controlled)		✓		C H A N G E		12 Gals.	SAE 10, MIL-L-2104B.  <b>NOTE</b> Series 3 oil may be substituted for 2104B. In temperatures -10°F and lower, dilute oil with kerosene so 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	<b>CAUTION</b> If winch is new, drain after 50 hours of operation, then flush and refill. Replace pressure filter element on later production winches.

# Service Instructions

TABLE 4-1. SafeGuard MAINTENANCE AND SERVICE INSPECTION SCHEDULE (Sheet 2 of 3)

REFER TO FIG. NO.	ITEM	SCHEDULE (Hour/Period)					QUAN.	TYPE	PROCEDURE
		8/ dy	50/ wk	500/ 3 mo	1000 6 mo	2000/ 1 yr			
	Transmission Oil Level (Power Controlled) (Cont.)							reservoir under steady operation may make it necessary to again add kero- sene to maintain proper fluidity.	
4-1	Brake and Transmission Compartments		✓				Variable	Water and/or oil.	Loosen plug <b>C</b> and drain any accumulation of water in transmission compartment. Tighten plug <b>C</b> when oil appears.
2-1 2-2 2-3	Handling Gear	✓					Few Drops	SAE 30.	Lubricate fulcrum pin connections and other moving parts at end of each eight hour shift.
4-1 4-2	Suction Filter (Power Controlled Only)			S E R V I C E			One	Refer to Parts Manual.	Remove suction filter <b>D</b> , clean thoroughly, and reinstall.  <b>CAUTION</b> Suction manifold cover gasket must be in good condi- tion to prevent air leaks. Replace with Hyster approved gasket.
5-2 5-28	Suction Hose Clamps (Power Con- trolled Only)		✓						Check both ends of suction hose to see that hose clamps are <b>TIGHT</b> . Retighten hose clamps as necessary.
5-2	Control Cables		✓						Check both ends of each cable housing to see that they are securely anchored. Retighten set screw as necessary.
4-1	Automatic Brake (Optional, Direct Drive Only)				S E R V I C E			High tempera- ture grease as follows:  Atlantic Richfield (Thermogrease)  Mobil Oil (Mobil- temp Grease #1)	Remove automatic brake assembly. Dis- assemble and clean automatic brake assem- bly components <b>G</b> . Pack the two bearings <b>G</b> with a high tempera- ture grease. Put a

# Service Instructions

TABLE 4-1. SafeGuard MAINTENANCE AND SERVICE INSPECTION SCHEDULE (Sheet 3 of 3)

REFER TO FIG. NO.	ITEM	SCHEDULE (Hour/Period)					QUAN.	TYPE	PROCEDURE
		8/ dy	50/ wk	500/ 3 mo	1000/ 6 mo	2000/ 1 yr			
	Automatic Brake (Optional, Direct Drive Only) (Cont.)							Shell Oil (Darina Grease 1) Standard Oil (Chevron Industrial Grease) Texaco (Thermatex EP #1) Union Oil (Strona HT-1) Sun Oil (Sunaplex 991 EP) BP Australia (Energ grease HTB2)	heavy film of high temperature grease on ratchet ring, pawl assembly, and hub. DO NOT completely fill automatic brake assembly with grease or attempt to grease brake through the vent plug. <b>CAUTION</b> Always install oil seals so that lips of both seals are pointing inward.
4-1	Cable Guide Rolls (Optional)	✓						Multi-purpose Grease	Lubricate two grease fittings <b>E</b> .
4-1	Fairlead (Optional)	✓						Multi-purpose Grease	Lubricate six grease fittings <b>F</b> .
4-1	Swiveling Drawbar (Optional)	✓						Multi-purpose Grease	Lubricate one grease fitting <b>H</b> .
4-1	Pressure Filter (Later Production Power Controlled Only)			C H A N G E			One	Refer to Parts Manual	Replace with Hyster approved filter element <b>J</b> . Coat O-ring and backup ring with film of multi-purpose grease to ensure a leak-proof seal between filter and case.
5-25 (Setp 17)	Bevel Gear Shaft Locknut					✓		Refer to Parts Manual if necessary to replace tabbed lockwasher.	Pry lockwasher tangs away from locknut flats and retighten locknut to 200 ft-lbs torque. Bend lockwasher tangs over locknut flats.

Service Instructions

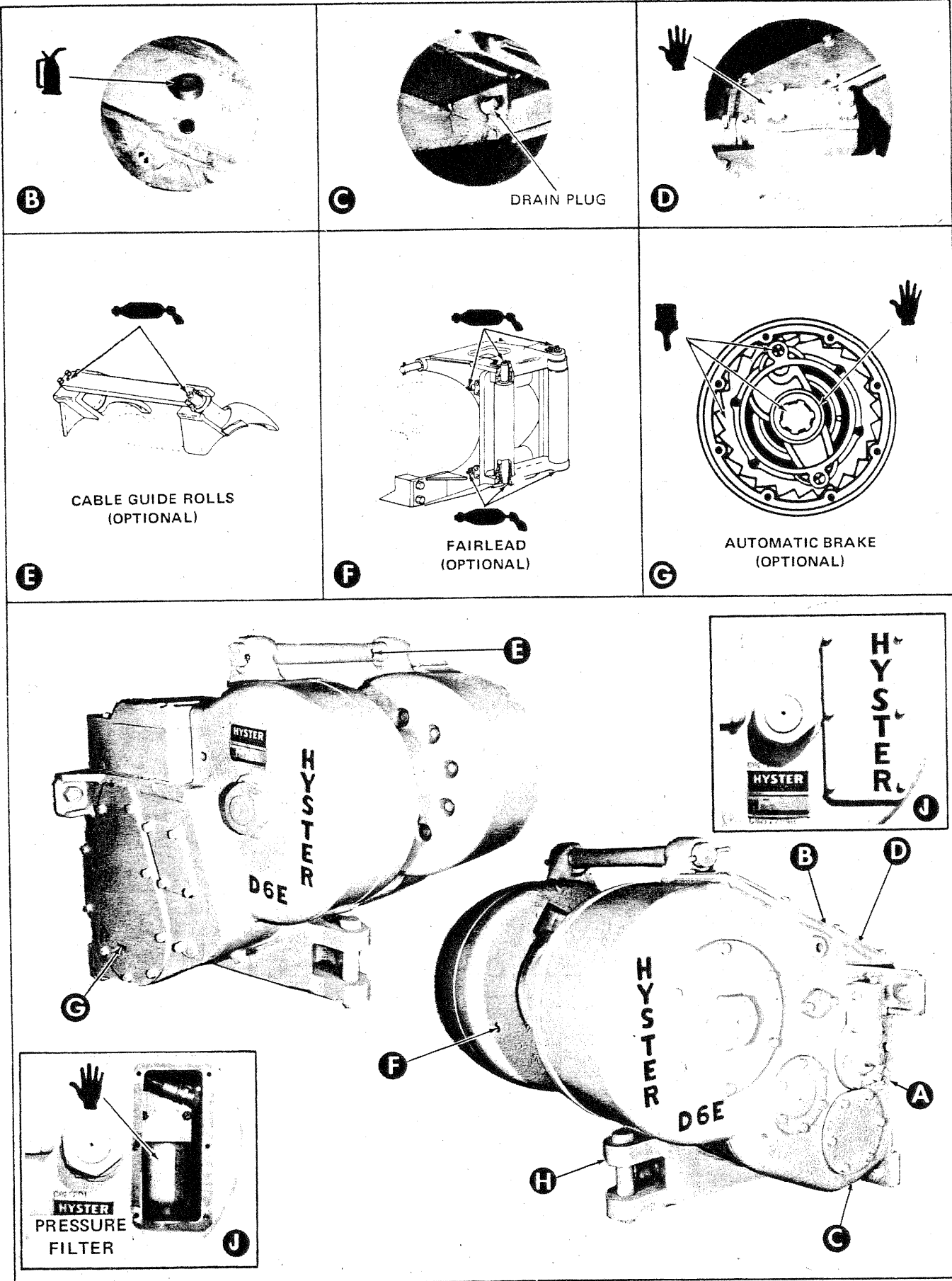


FIGURE 4-1. SafeGuard MAINTENANCE DIAGRAM

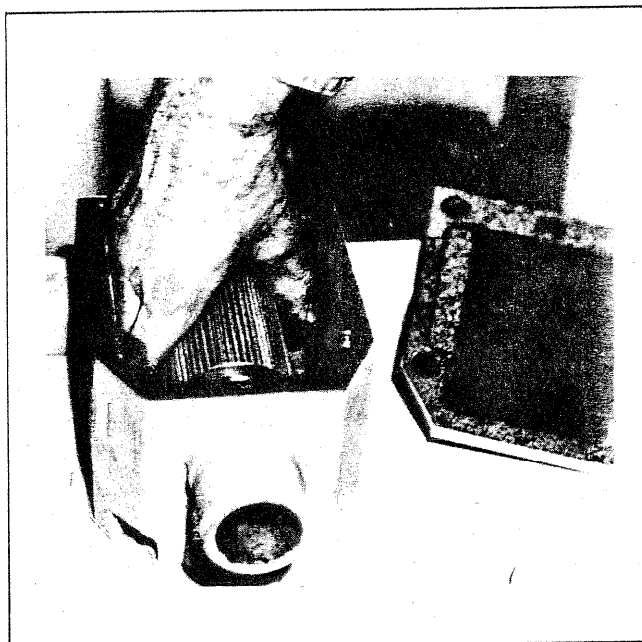


FIGURE 4-2. SUCTION FILTER, POWER CONTROLLED WINCH

## 4-7. ADJUSTMENT PROCEDURES.

4-8. Adjustment procedures for the Direct Drive Winch are limited to minor mechanical linkage adjustments. The Power Controlled Winch requires mechanical adjustments plus hydraulic system adjustments.

### 4-9. Direct Drive Winch Adjustments.

4-10. The handling gear that controls the operation of the Direct Drive Winch is mounted to the floor plate at the front, left-hand side of the operator's seat. The linkage connecting the levers to the clutches and brake will periodically require minor adjustments.

4-11. ADJUSTING CLUTCH HANDLEVER. The Clutch Handlever (see figure 2-1) controls the dental clutches through a plastic-lined control cable. The shifter assembly will shift the dental clutches into Forward, Neutral and Reverse positions when the control cable-to-clutch handlever is properly adjusted. To adjust the position of the clutch handlever, proceed as follows:

a. Remove the manifold cover and place the shifter assembly in Neutral (see Figure 4-3). The shifter linkage will positively detent to this position.

b. Adjust the control cable rod ends as necessary to place the Clutch Handlever vertical and in the center of travel when shifter assembly is in Neutral.

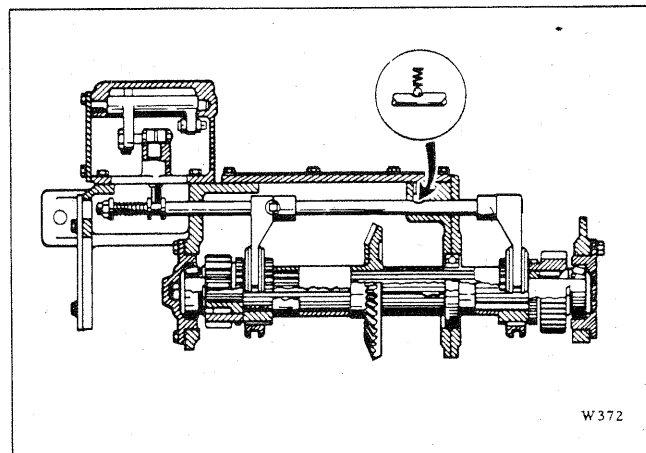


FIGURE 4-3. ADJUSTMENT OF CLUTCH LINKAGE, DIRECT DRIVE WINCH

c. Make sure that Forward, Neutral and Reverse can be selected by moving the Clutch Handlever to the corresponding position.

4-12. ADJUSTING THE BRAKE. The Brake Handlever (see Figure 2-1) controls the brake through a plastic-lined control cable (identical to the clutch control cable). Two adjustments are required to properly adjust the brake. Refer to paragraphs 4-13 and 4-14.

4-13. BRAKE BAND ADJUSTMENT. (See Figure 4-4.) To adjust the brake band, proceed as follows:

a. Remove the small brake cover from the left-hand side of the winch.

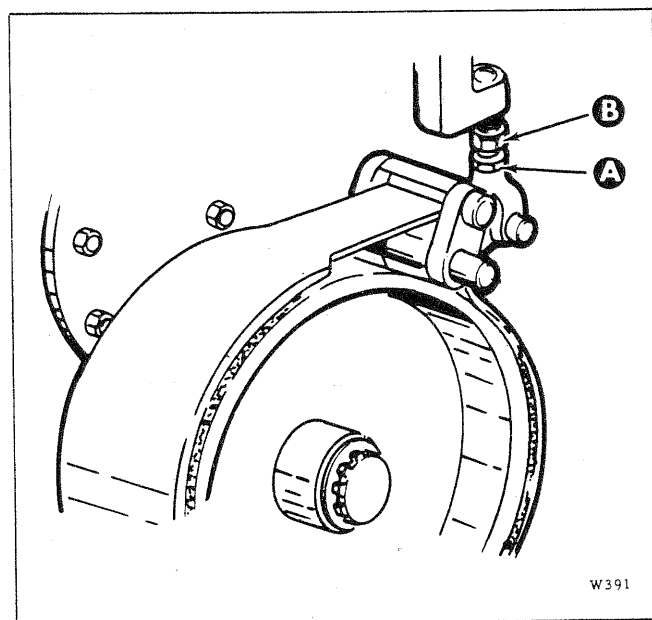


FIGURE 4-4. BRAKE BAND ADJUSTMENT DIAGRAM, DIRECT DRIVE WINCH

## Service Instructions

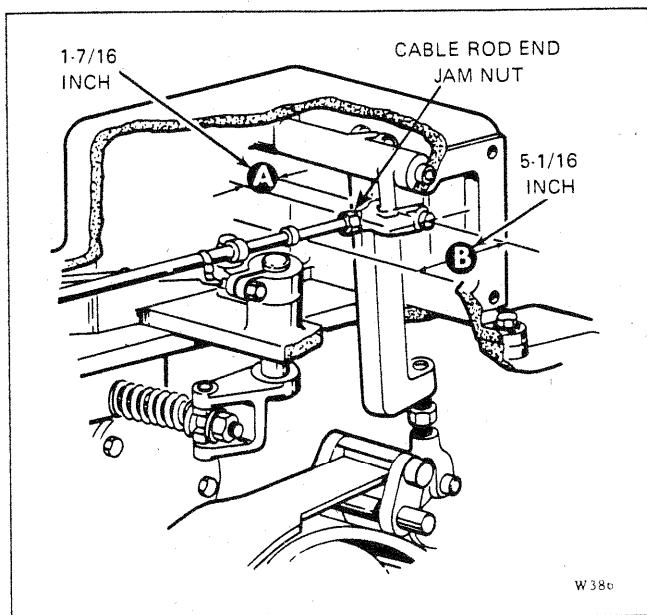


FIGURE 4-5. ADJUSTMENT OF BRAKE LINKAGE, DIRECT DRIVE WINCH

b. Push the brake handlever to its full release position.

c. Loosen jam nut **A**.

d. Turn adjusting link **B** until there is approximately 1/32-inch clearance between the brake band and brake wheel or until there is just enough clearance to prevent "brake drag".

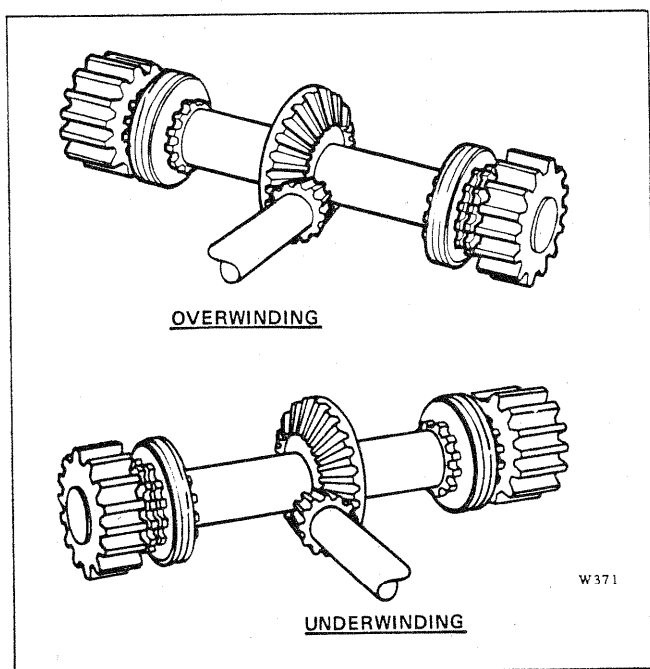


FIGURE 4-6. BEVEL GEAR SHAFT OVERWIND AND UNDERWIND ARRANGEMENT

e. Tighten jam nut **A**.

f. Replace the brake cover.

4-14. BRAKE HANDLEVER ADJUSTMENT. (See Figure 4-5.) To adjust the positioning of the Brake Handlever, proceed as follows:

a. Adjust the brake band. (Refer to paragraph 4-13.)

b. Loosen cable rod end jam nut.

c. Adjust the control cable at the winch control housing end until dimension **A** is obtained (distance between the cable end and the centerline of the rod end pin).

d. Tighten the jam nut.

e. Push the Brake Handlever to the full release position.

f. Adjust the push-pull cable at the Brake Handlever end (see Figure 2-1) until dimension **B**, Figure 4-5, is obtained.

4-15. OVERWIND ADJUSTMENT PROCEDURE. When the cable passes over the top of the drum during forward rotation, the drum is said to be overwinding. Unless otherwise specified, the winch is set to overwind at the factory. The bevel gear shaft assembly, brake assembly, and drum assembly must be rearranged when using an original underwind winch for overwind operation (refer to paragraphs 4-16 through 4-18).

4-16. BEVEL GEAR SHAFT ARRANGEMENT. (See Figure 4-6.) To arrange the bevel gear shaft for overwind operation, proceed as follows:

a. Pull the bevel gear shaft from the right-hand side of the winch (see figure 5-7) far enough to enable switching of the bevel gear and the spacer.

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

c. Install bevel gear shaft.

**NOTE** This change in operation may affect gear lash, but should not affect the shaft endplay. However, both should be checked and adjusted if necessary.

4-17. BRAKE ASSEMBLY ARRANGEMENT. If the winch is equipped with a standard brake band, follow procedure a. Follow procedure a and b if the winch is equipped with an optional automatic brake.

a. Brake Band. (See Figure 4-7.) Change the anchoring end of the brake band by changing the positions of pins **A** and **B**.

**NOTE** Pin **A** connects the moveable end of the band to the crank. This pin is 4-5/8 inches long and has a cotter pin hole in the center. Pin **B** is 6-3/8 inches long and has a tapped hole in the end. It anchors the band and provides a pivot for the crank.

b. Automatic Brake (Optional). (See Figure 4-8.) Remove the automatic brake assembly and reinstall so that the word **OVERWINDING** is facing to the outside.

4-18. DRUM ASSEMBLY ARRANGEMENT. (See Figure 4-9.) The cable on the drum must be anchored and wound in the opposite direction for overwind operation. To setup the drum assembly for overwind operation, proceed as follows:

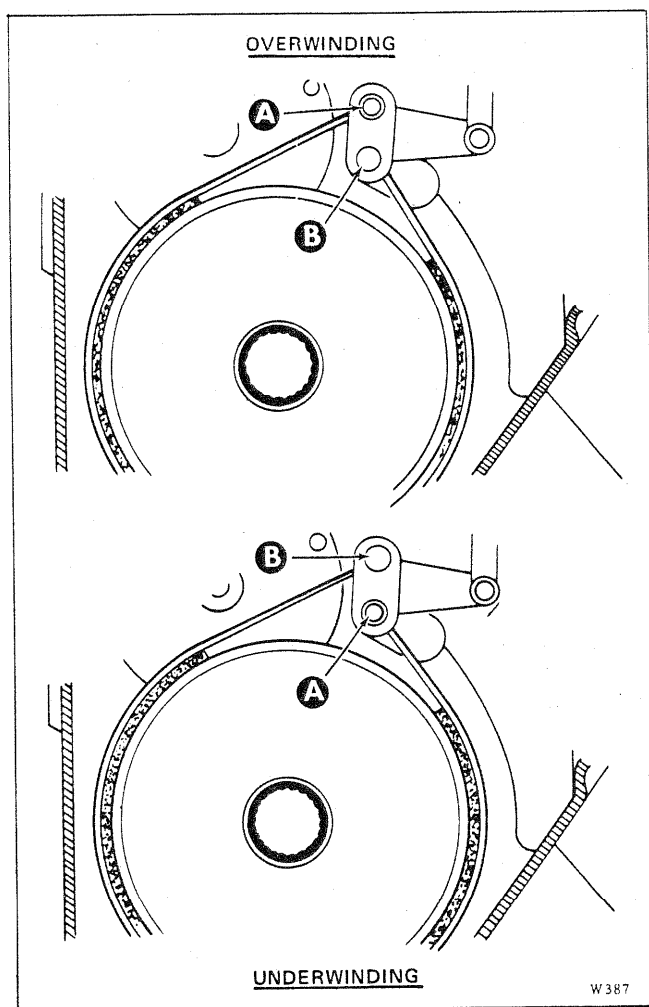


FIGURE 4-7. BRAKE BAND OVERWIND AND UNDERWIND ARRANGEMENT

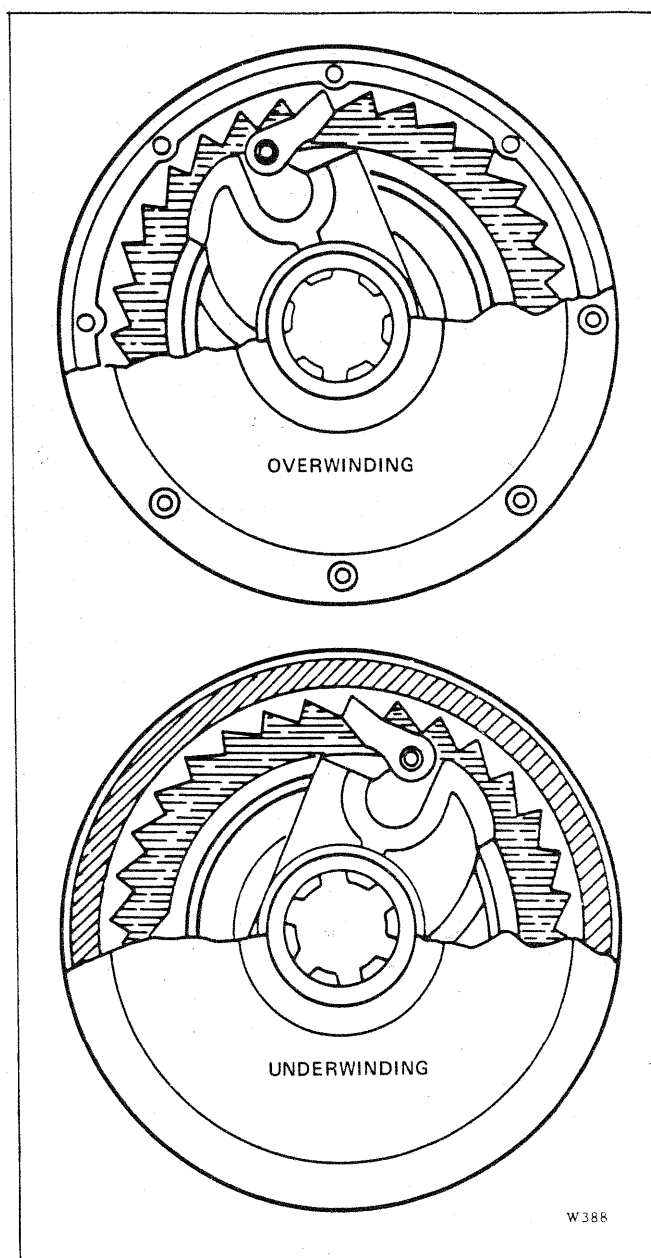


FIGURE 4-8. AUTOMATIC BRAKE OVERWIND AND UNDERWIND ARRANGEMENT

- Unwind the cable.
- Unscrew capscrew (4).
- Remove ferrule lock (3) and ferrule (2).
- Break or cut the tack welds securing the filler (1). Smooth the ragged edges of filler and groove by grinding.
- Tack weld the filler in the overwind position.
- Lock ferrule (2) in overwind position with ferrule lock (3) and capscrew (4).

# Service Instructions

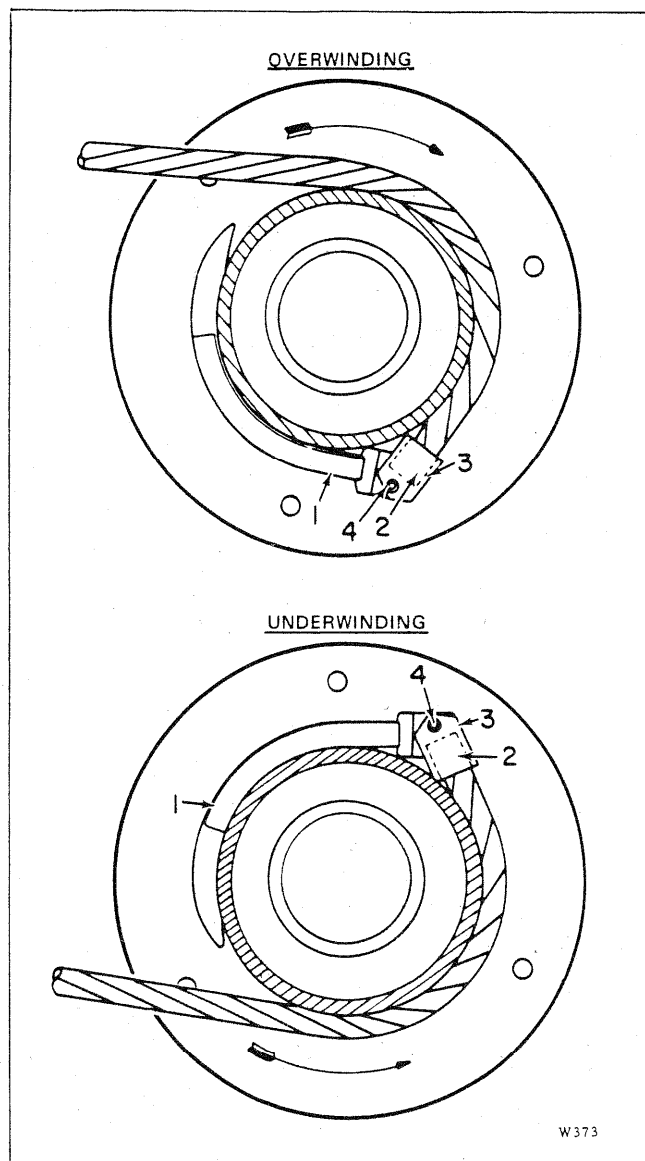


FIGURE 4-9. WINCH DRUM OVERWIND AND UNDERWIND ARRANGEMENT

4-19. **UNDERWIND ADJUSTMENT PROCEDURE.** When the cable is pulled under the drum during forward rotation, the drum is said to be UNDERWINDING. Unless otherwise specified, the winch is set for overwind at the factory. The bevel gear shaft assembly, brake assembly, and drum assembly must be rearranged when using an original overwind winch for underwind operation (refer to paragraphs 4-20 through 4-22).

4-20. **BEVEL GEAR SHAFT ARRANGEMENT.** (See Figure 4-6.) To arrange the bevel gear shaft for underwind operation, proceed as follows:

- a. Pull the bevel gear shaft from the right-hand side of the winch (see Figure 5-7) 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 left-hand side of the PTO shaft assembly.

- c. Install bevel gear shaft (see Figure 5-25).

**NOTE** This change in operation may affect gear lash, but it should not affect the shaft end-play. However, both should be checked and adjusted if necessary.

4-21. **BRAKE ASSEMBLY ARRANGEMENT.** If the winch is equipped with a standard brake band, follow procedure a. Follow procedure a and b if the winch is equipped with an optional automatic brake.

- a. **Brake Band.** (See Figure 4-7.) Change the anchoring end of the brake band by changing the positions of pins **A** and **B**.

**NOTE** Pin **A** connects the moveable end of the band to the crank. This pin is 4-5/8 inches long and has a cotter pin hole in the center. Pin **B** is 6-3/8 inches long and has a tapped hole in the end. It anchors the band and provides a pivot for the crank.

- b. **Automatic Brake (Optional).** (See Figure 4-8.) Remove the automatic brake assembly and reinstall so that the word UNDERWINDING is facing to the outside.

4-22. **DRUM ASSEMBLY ARRANGEMENT.** (See Figure 4-9.) The cable on the drum must be anchored and wound in the opposite direction for UNDERWIND operation. To setup the drum for underwind operation, proceed as follows:

- a. Unwind the cable.
- b. Unscrew capscrew (4).
- c. Remove ferrule lock (3) and ferrule (2).
- d. Break or cut the tack welds securing the filler (1). Smooth the ragged edges of filler and groove by grinding.
- e. Tack weld the filler in the underwind position.
- f. Lock ferrule (2) in underwind position with ferrule lock (3) and capscrew (4).

## 4-23. Power Controlled Winch Adjustments.

4-24. The handling gear assembly that controls the Power Controlled Winch is manufactured in two different designs: Early production and later production



PRESSURE PORT	FORWARD	NEUTRAL	BRAKE OFF	REVERSE
A	225 ± 10	3-7	225 ± 10	225 ± 10
B	225 ± 10	3-7	3-7	3-7
C	3-7	3-7	3-7	225 ± 10
D	225 ± 10	25 MAX.	225 ± 10	225 ± 10

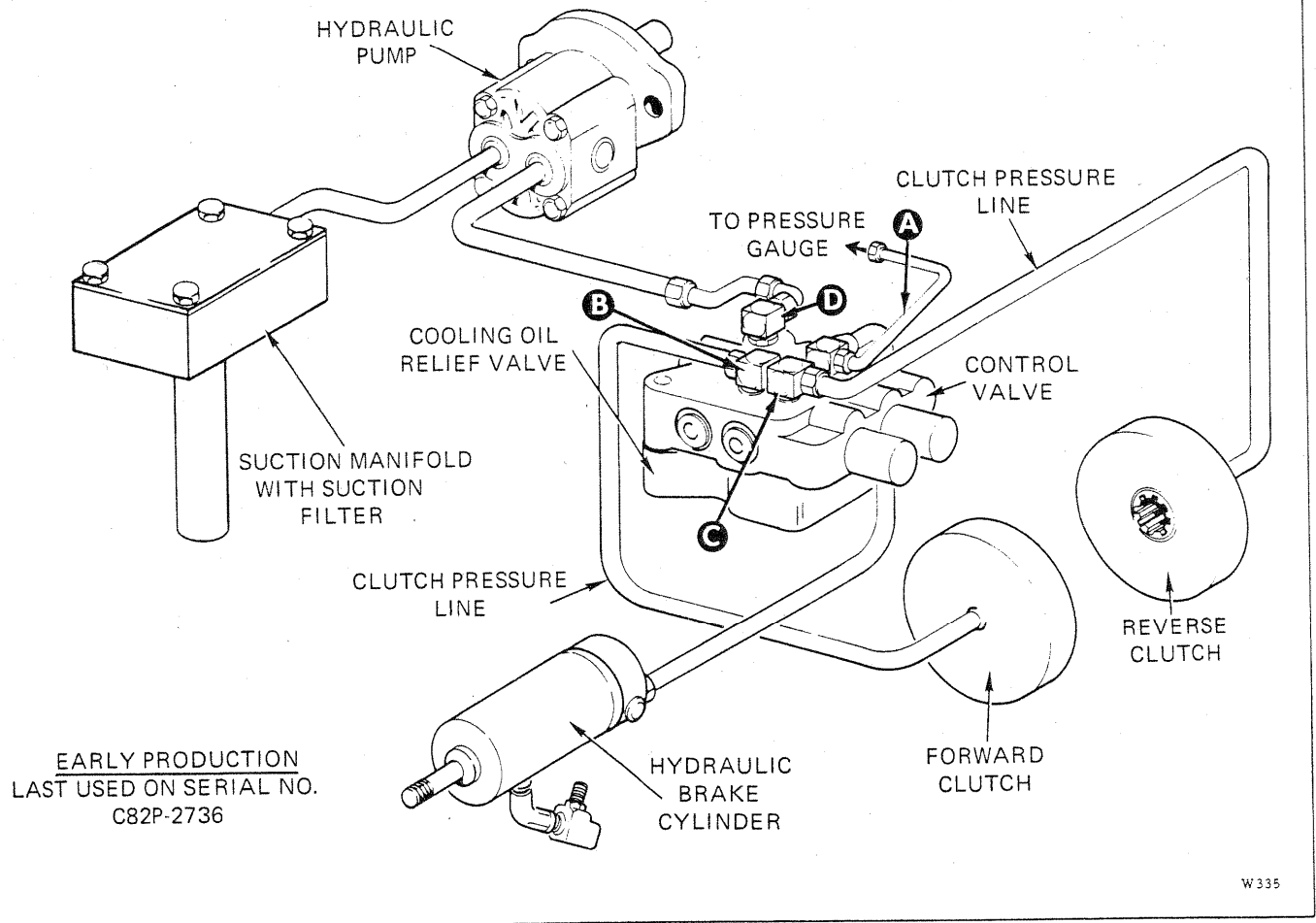


FIGURE 4-10. HYDRAULIC SYSTEM PRESSURE CHECKS (Sheet 1 of 2)

(refer to paragraphs 1-26 and 1-27). Perform the adjustment procedure outlined in paragraphs 4-26 through 4-31 for both the early production and the later production handling gear.

**4-25. HYDRAULIC SYSTEM PRESSURE CHECKS.** (See Figure 4-10.) The later production winch, having an all-fabricated housing (see Figure 1-1), has a different control valve installation and access arrangement than the early production version with the cast/fabricated housing. Access to the control valve for the early production is through a removable top

cover; for the later production, a left side cover plate is removed. To check hydraulic system pressures, proceed as follows:

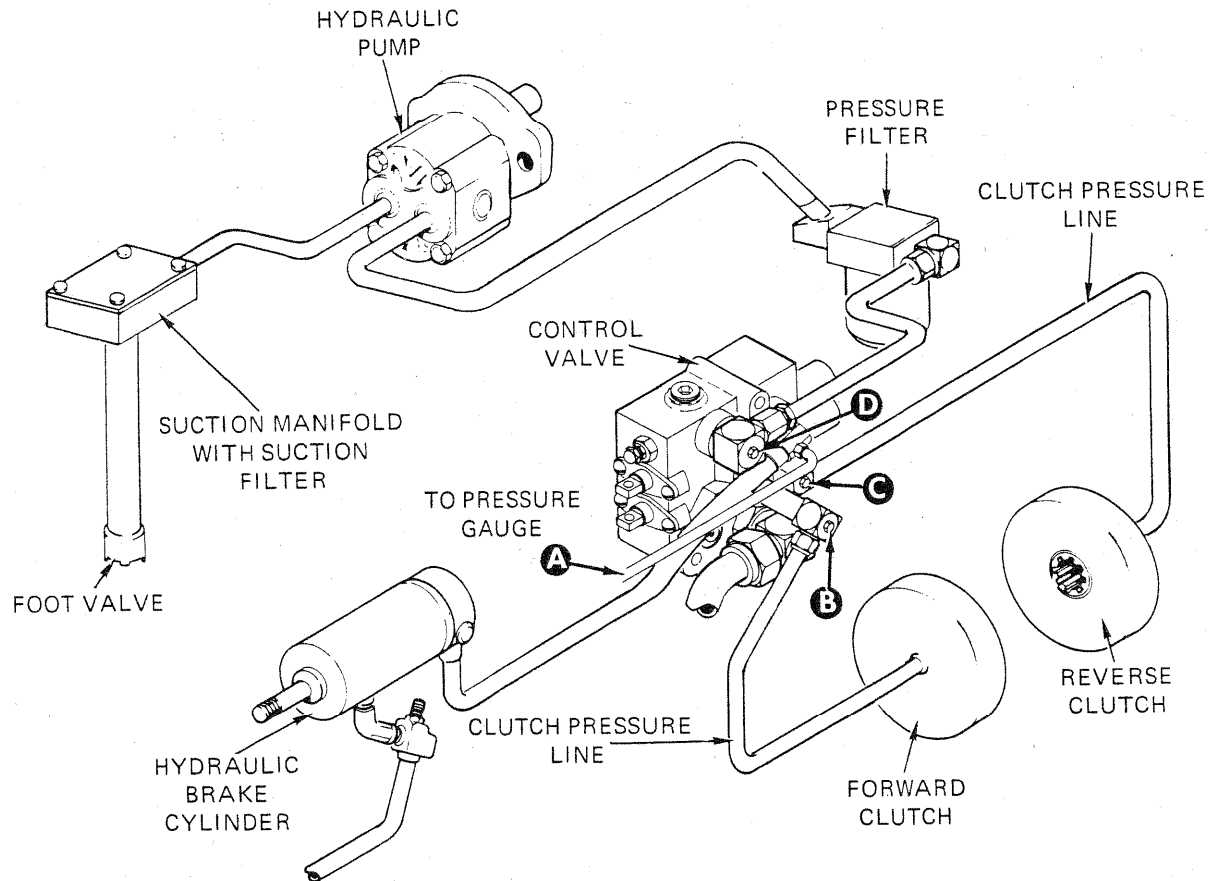
**NOTE** Winch oil should be at least 70°F before making pressure checks.

a. Remove the cable from the drum to prevent entanglement during pressure checks.

**WARNING** Tractor engine must be OFF before disconnecting pressure line.

# Service Instructions

PRESSURE PORT	FORWARD	NEUTRAL	BRAKE OFF	REVERSE
A	225 ± 10	2-5	225 ± 10	225 ± 10
B	225 ± 10	2-5	2-5	2-5
C	2-5	2-5	2-5	225 ± 10
D	225 ± 10	15-35	225 ± 10	225 ± 10



LATER PRODUCTION  
FIRST USED ON SERIAL NO.  
C82P-2737

W336

FIGURE 4-10. HYDRAULIC SYSTEM PRESSURE CHECKS (Sheet 2 of 2)

b. Disconnect, at the winch housing bulkhead fitting, the small-diameter pressure line connecting the control valve brake port fitting and the bulkhead fitting in front of the control valve. Connect a 400 psi pressure test gauge to the end **A** of the pressure line.

**NOTE** Use of a test gauge will eliminate the possibility of inaccurate readings from a faulty winch pressure gauge. If accessible, make test gauge connection on outside of winch housing by removing line from gauge to winch.

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

d. Place the hydraulic system in NORMAL CONTROL. On the earlier production handling gear, this is accomplished by moving the control lever to the Down position. On the later production handling gear, this is accomplished by locking the inching lever in the BRAKE OFF position.

e. Check the pressure readings when the Selector lever is moved to the FORWARD, BRAKE-OFF,

## Service Instructions

and REVERSE positions. These pressures should be 225 ( $\pm 10$ ) PSI.

1. If these three pressure readings ARE WITHIN 7 PSI of each other, but not 225 ( $\pm 10$ ) PSI, then:

- Remove the access cover or plate from control valve housing.
- Remove protective acorn nut from relief valve adjusting screw (Figure 4-11).
- Change the relief pressure by turning the relief pressure adjusting screw IN to increase pressure or OUT to decrease pressure.

2. 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 4-26).

h. To check the COOLING OIL pressure (regulated by a nonadjustable relief valve), engage the FORWARD clutch and note the pressure indicated at the REVERSE pressure port. It should be 3-7 PSI, for early production, or 2-5 PSI for later production.

**CAUTION** Do not engage the reverse clutch with low pressure gauge in reverse port.

i. Engage the REVERSE clutch with low pressure gauge in forward pressure port and note the pressure indicated. Pressure should be 3-7 or 2-5 PSI.

**NOTE** The high pressure (225  $\pm 10$  PSI) is clutch lock-up pressure and the low (3-7 or 2-5 PSI) is cooling oil pressure.

4-26. ADJUSTING THE CONTROL CABLES. (See Figure 4-11.) Two teflon lined control cables connect the handling gear assembly to the winch control valve. Be 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.

4-27. MEASURING SPOOL TRAVEL. Adjust the cable ends of the control cable 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 retainer plate.

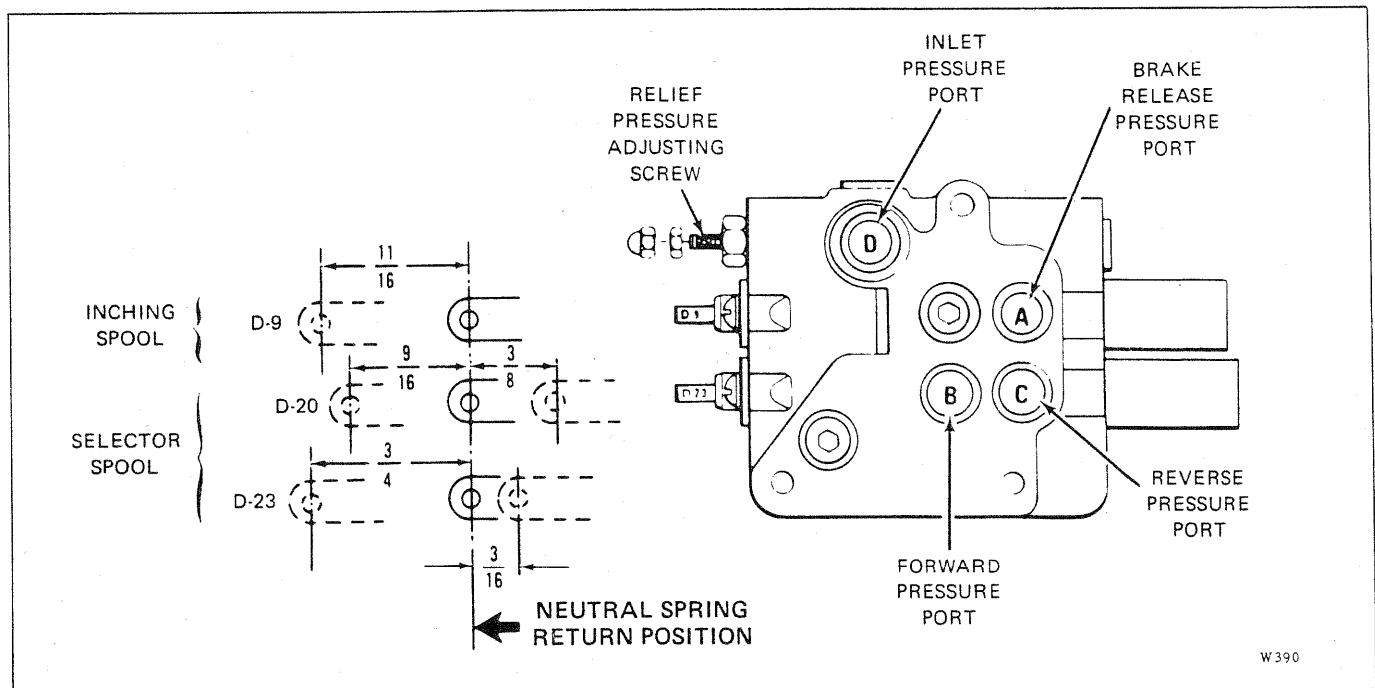


FIGURE 4-11. CONTROL CABLE ADJUSTMENT DIAGRAM

## Service Instructions

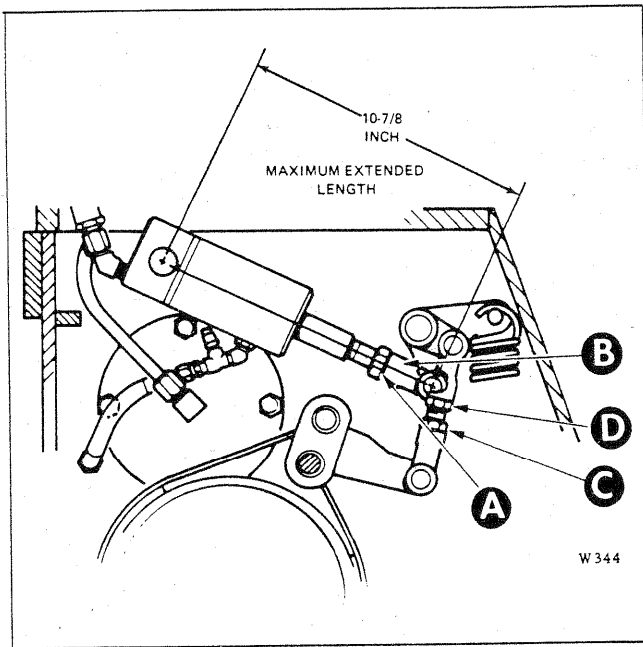


FIGURE 4-12. HYDRAULIC BRAKE CYLINDER AND BAND ADJUSTMENT DIAGRAM, POWER CONTROLLED WINCH

a. The inching spool (D-9) should move OUT  $11/16$ -inch from its neutral position when the Control Lever (early production) is moved down and locked or when the Inching Lever (later production) is moved from the BRAKE-ON position to the BRAKE-OFF position.

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

b. The selector spool should move IN  $3/16$ -inch (D-23) or  $3/8$ -inch (D-20) from 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 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.

4-28. 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 (early production) must be down and locked or the Inching Lever (later production) must be in the Brake-Off position.

a. In FORWARD, the pressure should be 225 ( $\pm 10$ ) PSI at forward, inlet, and brake release ports.

b. In NEUTRAL, the pressure should NOT be greater than 25 PSI for early production or 35 PSI for later production.

c. In BRAKE-OFF, the pressure should be 225 ( $\pm 10$ ) PSI at the brake and inlet pressure ports.

d. In REVERSE, the pressure should be 225 ( $\pm 10$ ) PSI at the reverse, inlet and brake release ports.

4-29. ADJUSTING THE BRAKE. The brake is spring-applied and hydraulically-released. Two adjustments are required to properly adjust the brake. (Refer to paragraphs 4-30 and 4-31.)

4-30. BRAKE CYLINDER ADJUSTMENT. (See Figure 4-12.) To adjust the brake cylinder, proceed as follows:

a. Fully extend the cylinder rod.

b. Loosen jam nut **A**. Adjust rod end **B** to maximum extended cylinder length of  $10-7/8$  inches.

c. Tighten jam nut **A**.

4-31. BRAKE BAND ADJUSTMENT. (See Figure 4-12.) To adjust the brake band, proceed as follows:

a. Release the brake (refer to paragraph 2-16 or 2-19).

b. Loosen jam nut **C**.

c. Turn adjusting link **D** to achieve  $1/32$ -inch clearance between the brake band and drum.

d. Tighten jam nut **C**.

4-32. OVERWIND AND UNDERWIND ADJUSTMENT PROCEDURE. Follow the same procedure as listed for the Direct Drive Winches. (Refer to paragraph 4-15.)

### 4-33. Free-Spooling Adjustments.

4-34. The only adjustment necessary is to position the handlever so that it allows the linkage to shift the free spool mechanism into normal and free-spool positions (both positions detented).

### 4-35. UNIT PAINTING.

4-36. Upon completion of unit overhaul or major repairs, paint the exterior sections of the winch as follows:

- a. Remove any corrosion or peeling paint using a stiff wire brush or coarse sandpaper. Scrape off any deteriorated decals.

- 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 or grease.

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

- e. Touch-up the D6E Model Designation and HYSTER letters using black enamel on early production models.

### 4-37. DECAL AND NAMEPLATE INSTALLATION.

4-38. A Caution Decal is located on the drum gear cover, near the oil filler plug, as shown in Figure

4-13. Make sure that all markings on the decal (Part No. 145781) 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, close to the oil filler plug.

4-39. The unit Nameplate is located on the left-hand side of the winch housing above or below the drum shaft nut as shown in Figure 4-13. Data contained on the nameplate is given in paragraph 1-5. If the nameplate has been damaged, install a new nameplate in the location shown in Figure 4-13. Use drive screws for nameplate installation.

4-40. On later production models with an internal pressure filter, a filter service plate is located on the left-hand side of the winch housing above the drum shaft nut as shown in Figure 4-13. If the service plate has been damaged, install a new service plate in the location shown in Figure 4-13. Use drive screws to retain plate on housing.

4-41. On later production models, the winch model designation and HYSTER letters are in the form of decals. Replace as necessary using location information shown in Figure 4-13.

## Service Instructions

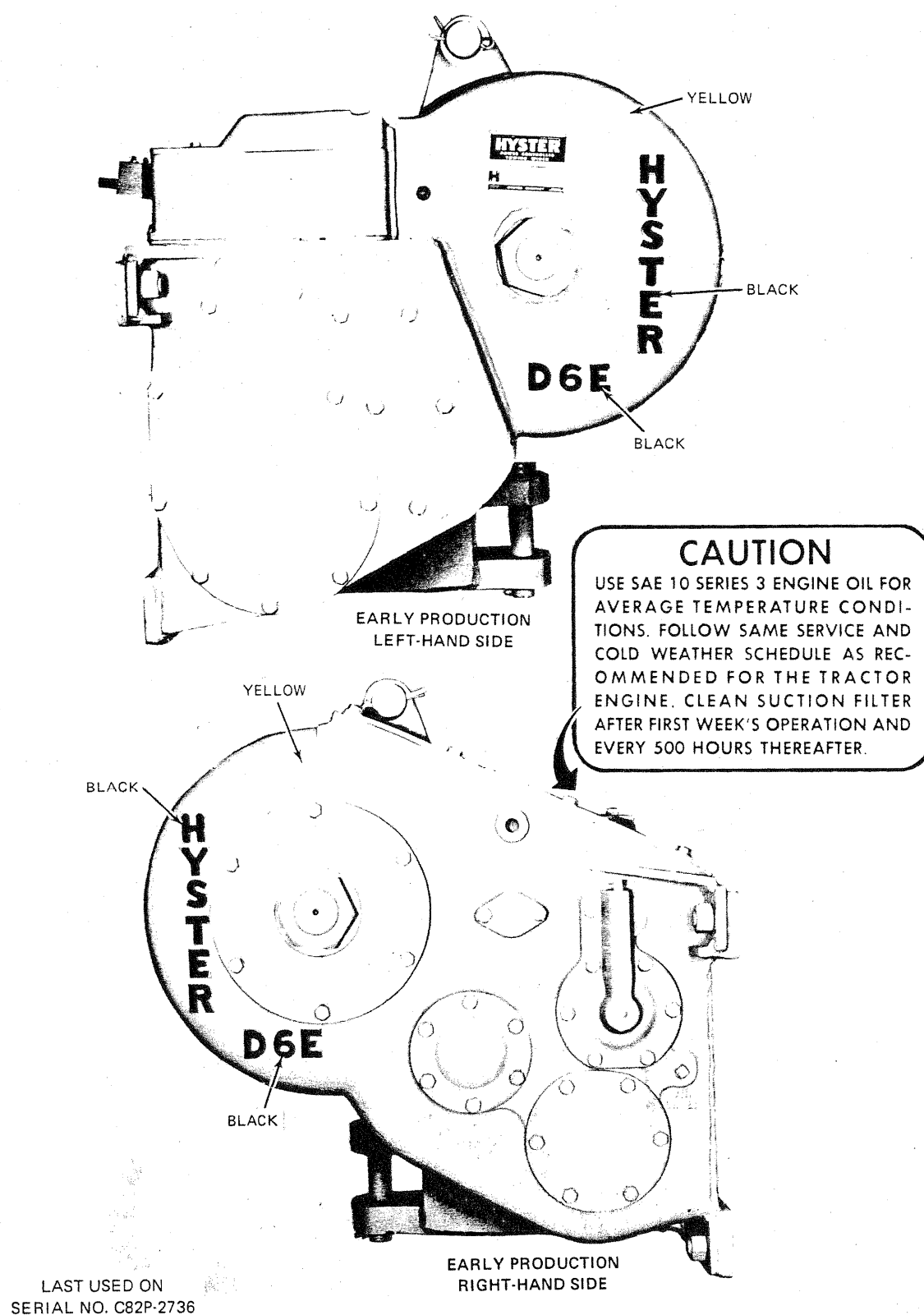
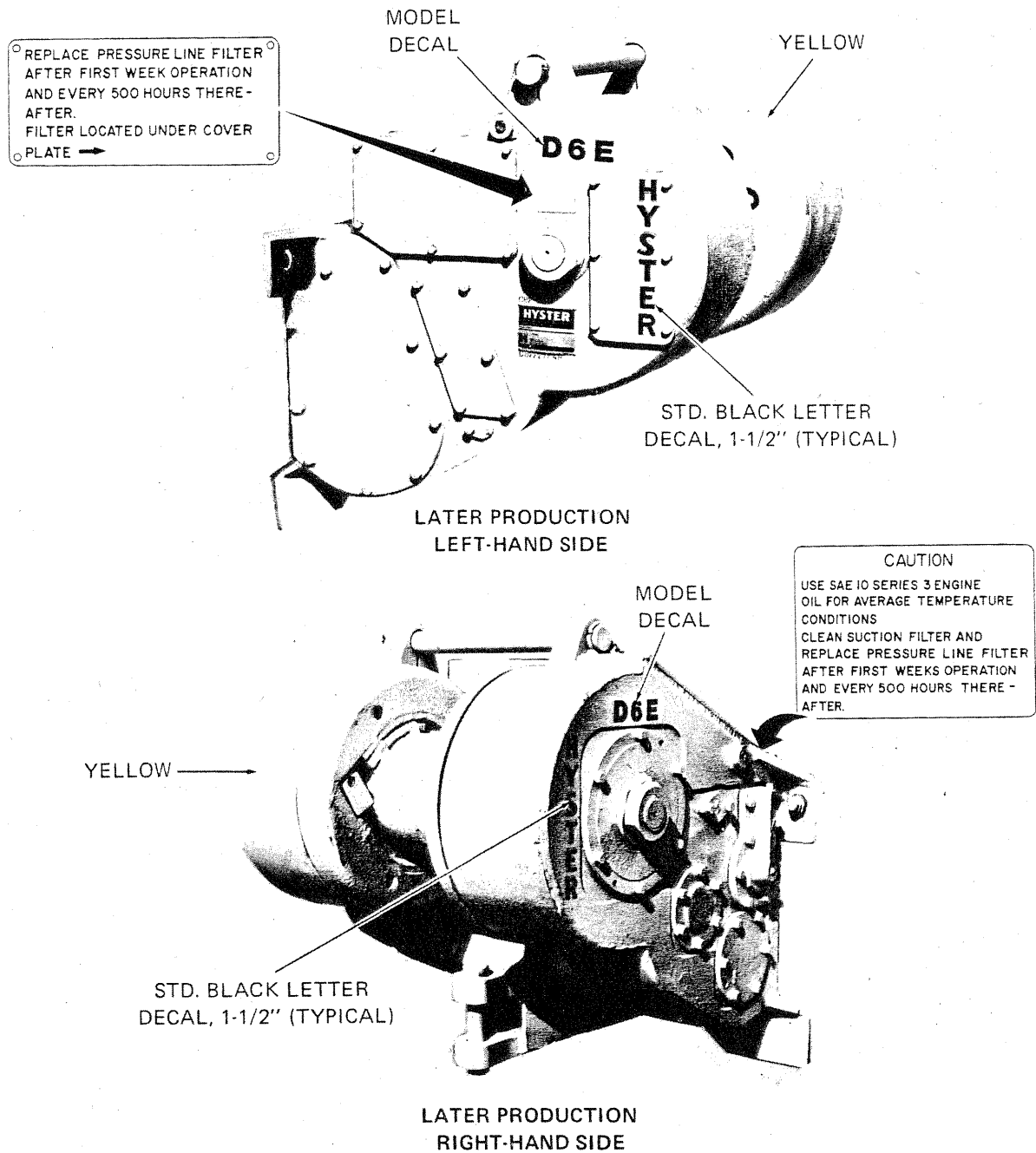


FIGURE 4-13. PAINTING AND DECAL INSTALLATION (Sheet 1 of 2)



FIRST USED ON SERIAL NO.  
C82P-2737

FIGURE 4-13. PAINTING AND DECAL INSTALLATION (Sheet 2 of 2)








# Section 5

## OVERHAUL INSTRUCTIONS

### 5-1. GENERAL.

5-2. This section contains overhaul instructions for the D6E Direct Drive and Power Controlled Winches. 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 the 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 troubleshooting 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 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.

5-6. REMOVAL OF DIRECT DRIVE WINCH. Removal of the Direct Drive winch is shown in Figure 5-1. Make sure that the two control cables between the handling gear and winch are removed before separating the winch from the mounting pad.

**WARNING** Make sure that the lifting device has a minimum capacity of 3,000 pounds before lifting the winch off of the mounting pad.

5-7. REMOVAL OF POWER CONTROLLED WINCH. Removal of the Power Controlled winch is shown in Figure 5-2. 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 3,000 pounds before lifting the winch off of the mounting pad.

#### 5-8. Removal and Disassembly of PTO Shaft Assembly (Direct Drive and Power Controlled Winches).

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 or 5-2.

#### 5-10. Removal and Disassembly of Hydraulic Brake Assembly (Power Controlled Winch Only).

5-11. Removal and disassembly of the hydraulic brake assembly used in the Power Controlled winch is shown in Figure 5-4. Removal and disassembly of the 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 of Dry Brake and Automatic Brake (Direct Drive Winch Only).

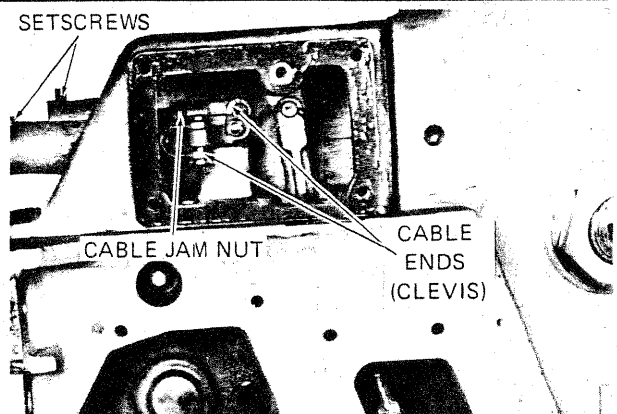
5-13. Removal of the dry brake (or optional automatic brake) used in the Direct Drive winch is shown in Figure 5-5. Removal of the dry brake can be accomplished with the winch mounted on the tractor. During disassembly, check all parts for damage and wear.

#### 5-14. Removal and Disassembly of Bevel Gear Shaft Assembly.

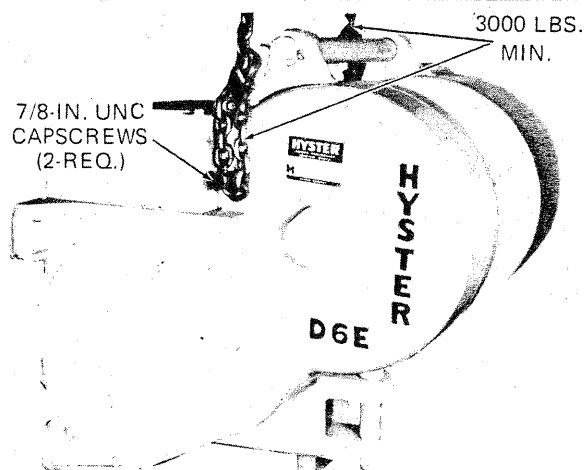
5-15. Removal and disassembly of the bevel gear shaft assembly is shown in Figure 5-7. Removal of the bevel gear shaft and associated components can be accomplished with the winch mounted on the tractor. Prior to removal of the bevel gear shaft, perform the following:

- Drain oil from winch (see Figure 4-1).
- Remove all brake components as shown in Figures 5-4 or 5-5, depending upon the winch model.

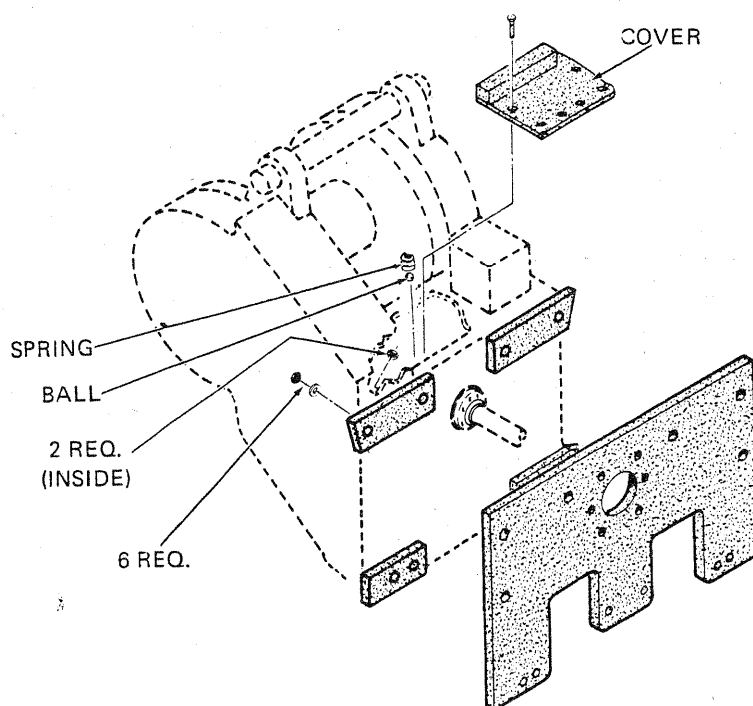
# Overhaul Instructions



STEP 1. Loosen the two setscrews on the cable anchor block. Remove the control housing cover, then disconnect the cable end (clevis) at end of each cable.



STEP 2. Connect lifting device to winch. Winch will be balanced when connected as shown.



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. Remove transmission cover. Be careful not to lose detent ball and spring. Remove the eight nuts and lockwashers attaching winch to mounting pad.

FIGURE 5-1. REMOVAL OF DIRECT DRIVE WINCH FROM TRACTOR

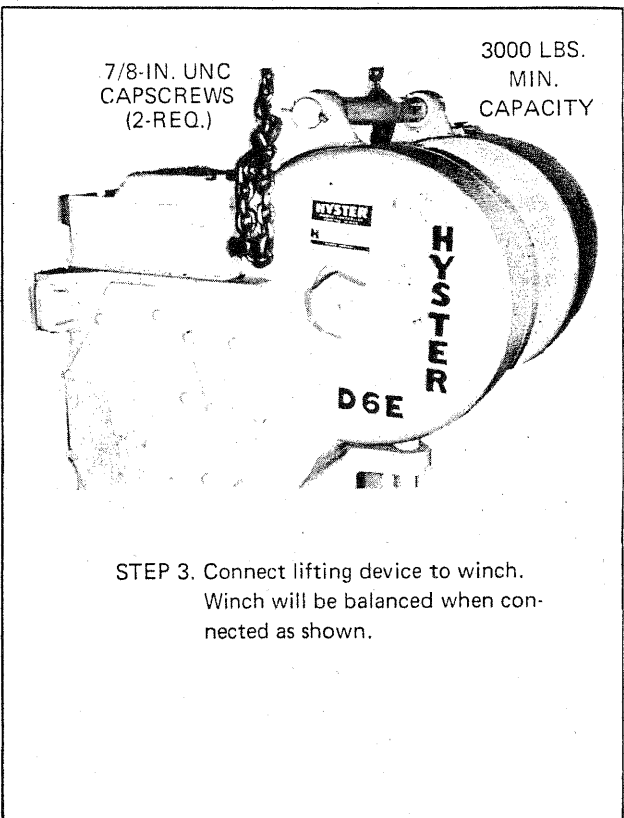
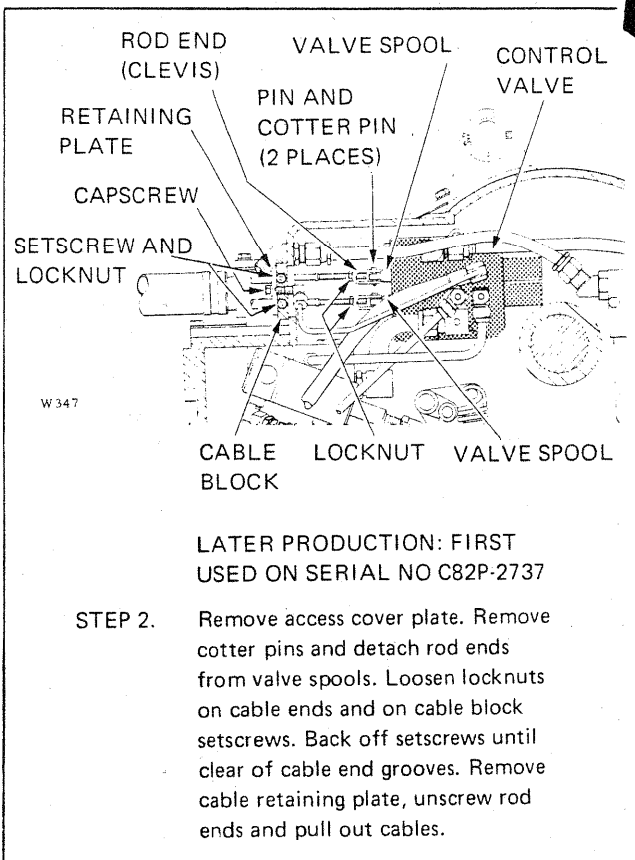
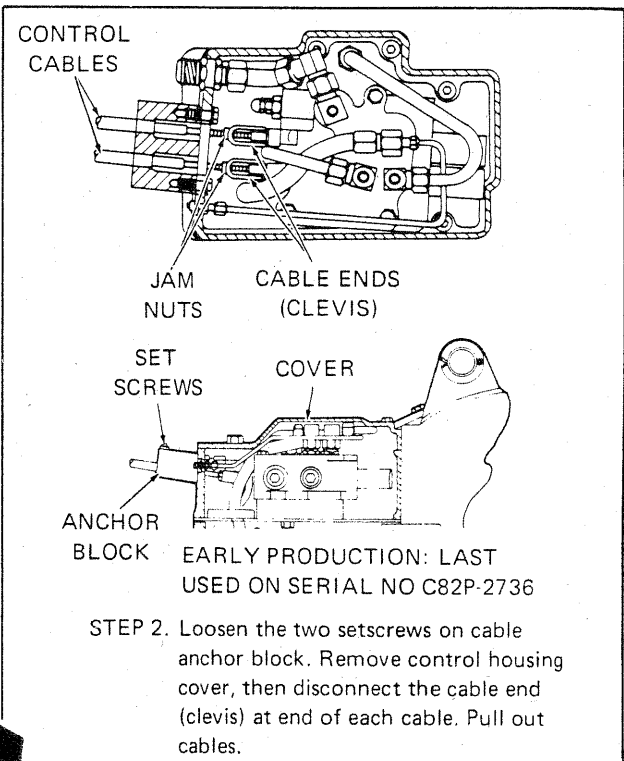
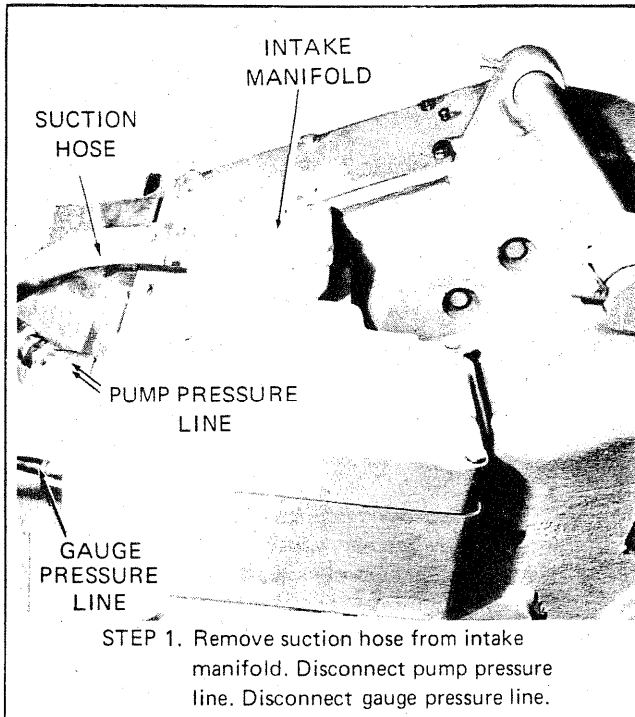


FIGURE 5-2. REMOVAL OF POWER CONTROLLED WINCH FROM TRACTOR (Sheet 1 of 2)

# Overhaul Instructions

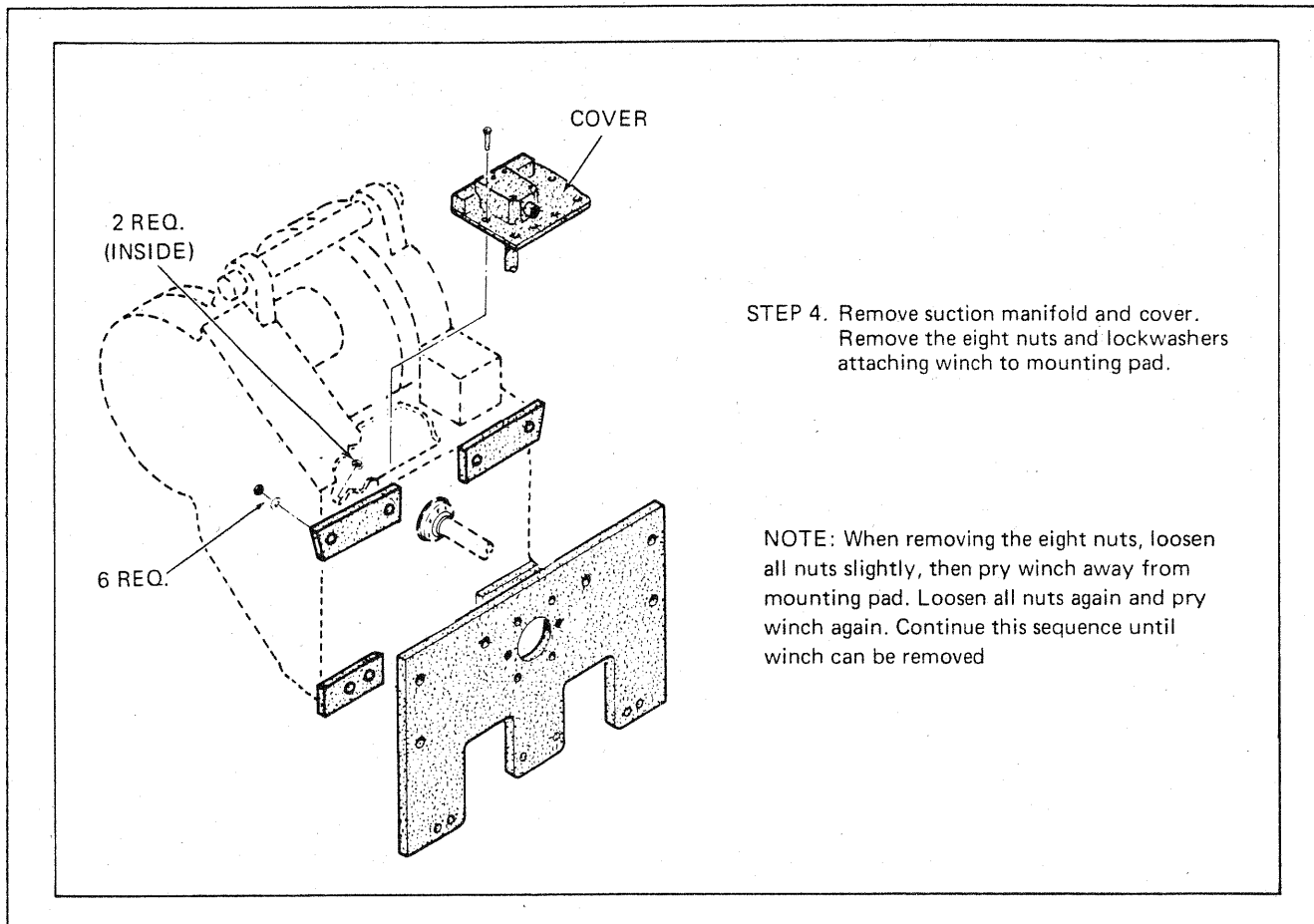


FIGURE 5-2. REMOVAL OF POWER CONTROLLED WINCH FROM TRACTOR (Sheet 2 of 2)

c. Remove the hydraulic fitting from the bearing retainer at each end of the bevel gear shaft (Power Controlled winches only).

d. Remove the brake connecting linkage (Direct Drive winch only).

e. Slowly unscrew to relieve spring compression, and remove the nut from the left-hand end of the shifter shaft. Cut the lockwire retaining the shifter forks lockscrews and loosen lockscrews (Direct Drive winch only). Pull out shifter shaft being careful not to drop the forks (see Figure 1-7).

**WARNING** Compression force of spring when installed is equal to 60 pounds.

**NOTE** Procedures given in Figure 5-7 are for the bevel gear shaft used in Power Controlled winches. These procedures can be used for Direct Drive winches by omitting all references to hydraulic components. Figure 5-6 shows the bevel gear shaft assemblies used

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

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

in both the Power Controlled and Direct Drive winches.

## 5-16. Disassembly of Clutch Assemblies (Power Controlled Winch Only).

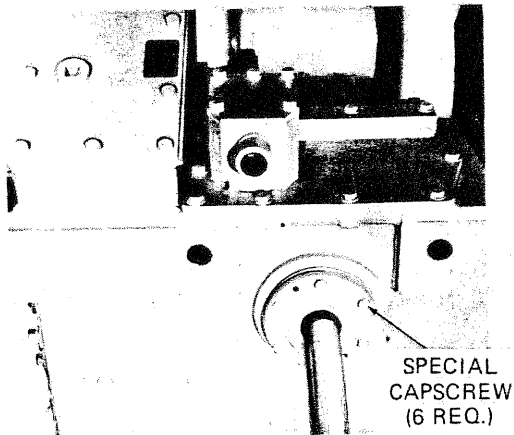
5-17. Disassembly of the clutch assemblies used in the Power Controlled winch is shown in Figure 5-8. Removal of the clutch assemblies is shown in Figure 5-7.

## 5-18. Removal of Brake Shaft Assembly.

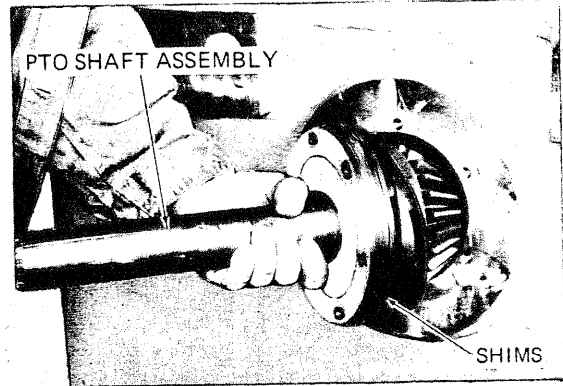
5-19. Removal of the brake shaft assembly is shown in Figure 5-9. The brake shaft cannot be removed when the winch is mounted on the tractor. Prior to removal of the brake shaft assembly, perform the following:

a. Remove the winch from the tractor (see Figure 5-1 or 5-2).

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

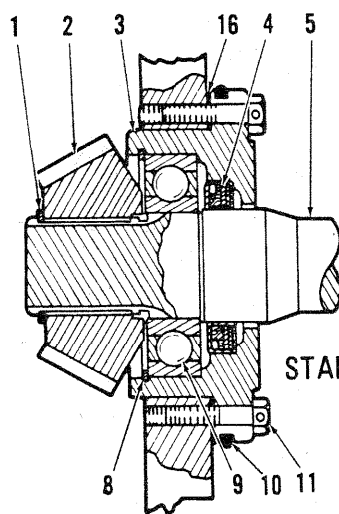


STEP 1. Remove the wire locking the six special cap screws, then remove the cap screws

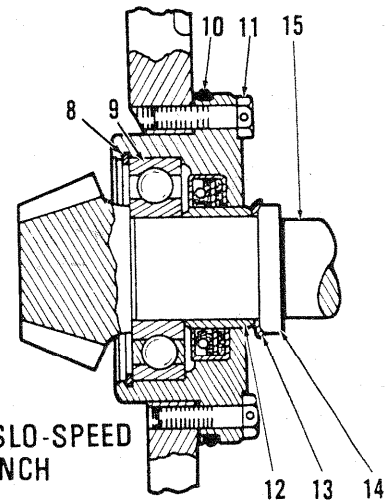
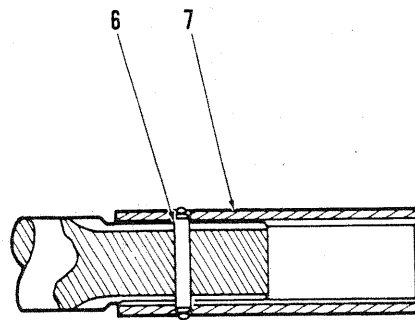


STEP 2. Pull PTO shaft assembly straight out.

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



STANDARD SPEED WINCH



LO AND SLO-SPEED WINCH

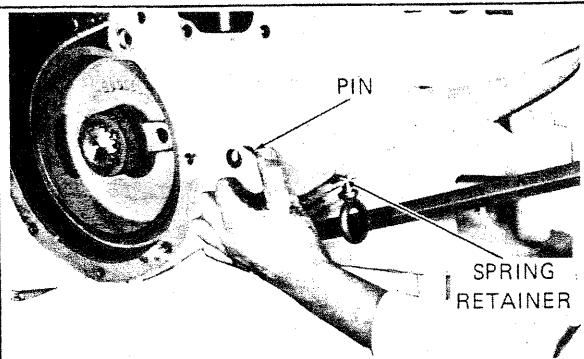
STEP 3. Disassemble PTO shaft as required

- |                                  |                            |
|----------------------------------|----------------------------|
| 1. Snap ring                     | 9. Ball bearing            |
| 2. Bevel pinion gear             | 10. O-ring                 |
| 3. Bearing carrier               | 11. Drilled head cap screw |
| 4. Oil seal                      | 12. Spacer                 |
| 5. PTO shaft (Std and Slo-speed) | 13. Lockwasher             |
| 6. Pin and lock ring             | 14. Locknut                |
| 7. Coupling                      | 15. PTO shaft (Lo-speed)   |
| 8. Snap ring                     | 16. Shim pack              |

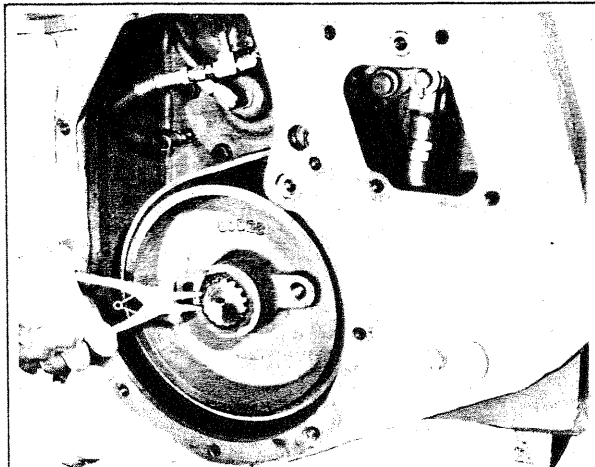
NOTE: On Lo and Slo-speed winches the PTO shaft and pinion are integral. On Standard speed winches, pinion gear is splined on the shaft and locked in place by a snap ring.

FIGURE 5-3. REMOVAL AND DISASSEMBLY OF PTO SHAFT ASSEMBLY

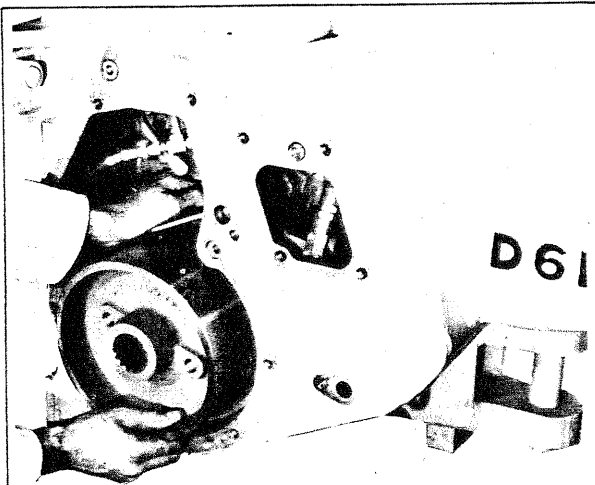
## Overhaul Instructions



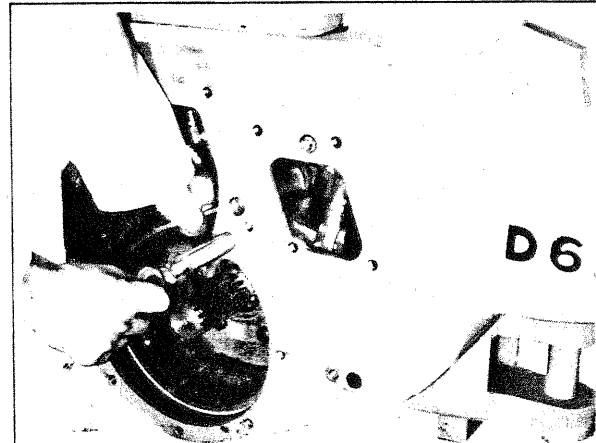
STEP 1. Remove the access plug and install a 1/2 UNF eyebolt into the spring retainer. Pull down on the eyebolt to release the pin, then remove pin. This releases the brake.



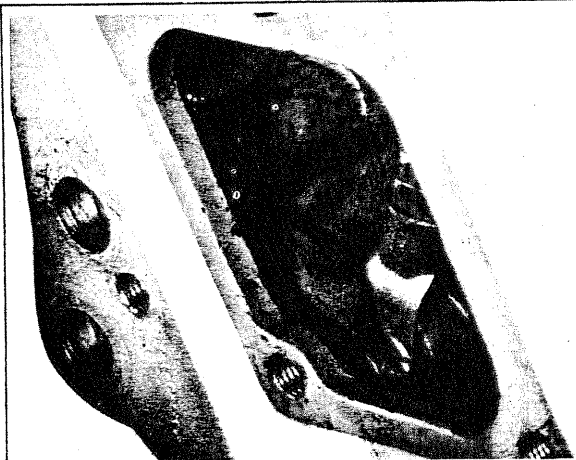
STEP 2. Remove snap ring.



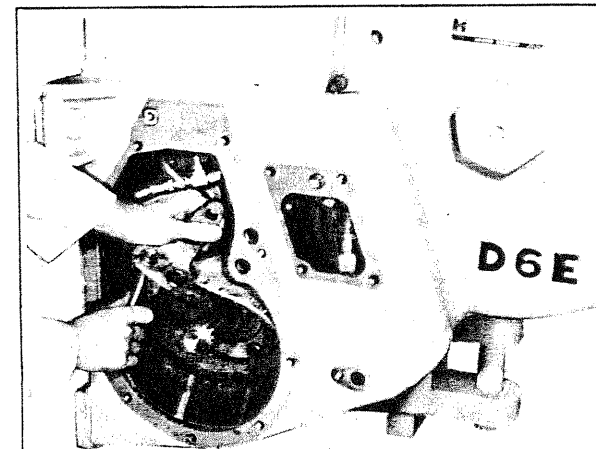
STEP 3. Remove brake wheel.



STEP 4. Remove brake pin using eyebolt as shown.



STEP 5. Remove cotter key and pin from adjustment link assembly.



STEP 6. Pull out band assembly as shown.

FIGURE 5-4. REMOVAL OF HYDRAULIC BRAKE ASSEMBLY, POWER CONTROLLED WINCH (Sheet 1 of 2)

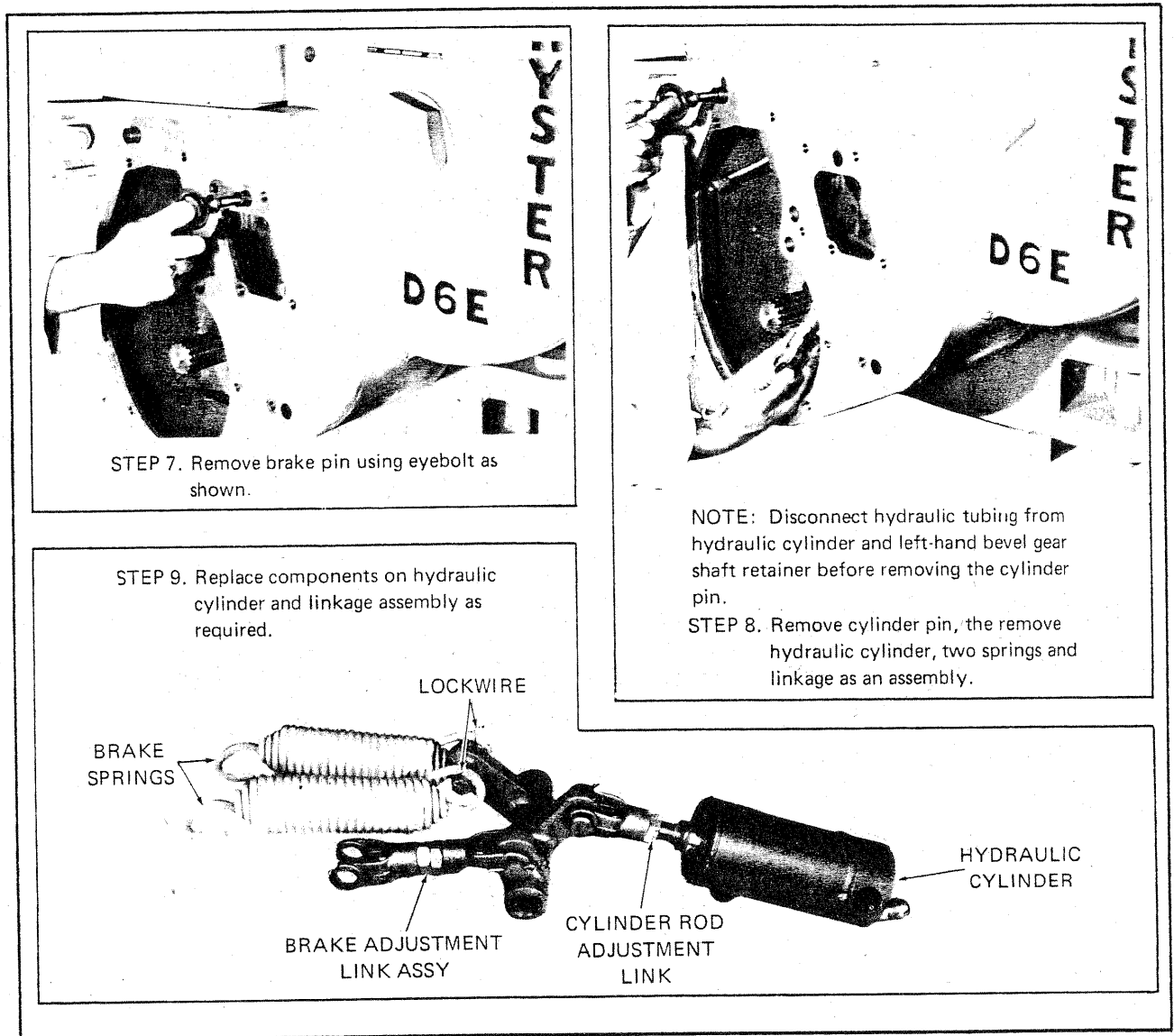


FIGURE 5-4. REMOVAL OF HYDRAULIC BRAKE ASSEMBLY, POWER CONTROLLED WINCH (Sheet 2 of 2)

c. Remove all brake components as shown in Figure 5-4 or 5-5, depending upon the winch model.

**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 5-7.

## 5-20. Removal of Intermediate Shaft Assembly.

5-21. Removal of the intermediate shaft and associated components is shown in Figure 5-10. 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, suf-

ficient clearance can be obtained by removing the drum shaft bearing retainer as shown in Figure 5-11, step 3.

**NOTE** Figure 5-10 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.

## 5-22. Removal of Drum Shaft and Drum.

5-23. Removal of the drum shaft and drum is shown in Figure 5-11. The winch should be removed from the tractor before the drum shaft and drum are removed. During removal of the drum shaft and drum, see the

## Overhaul Instructions

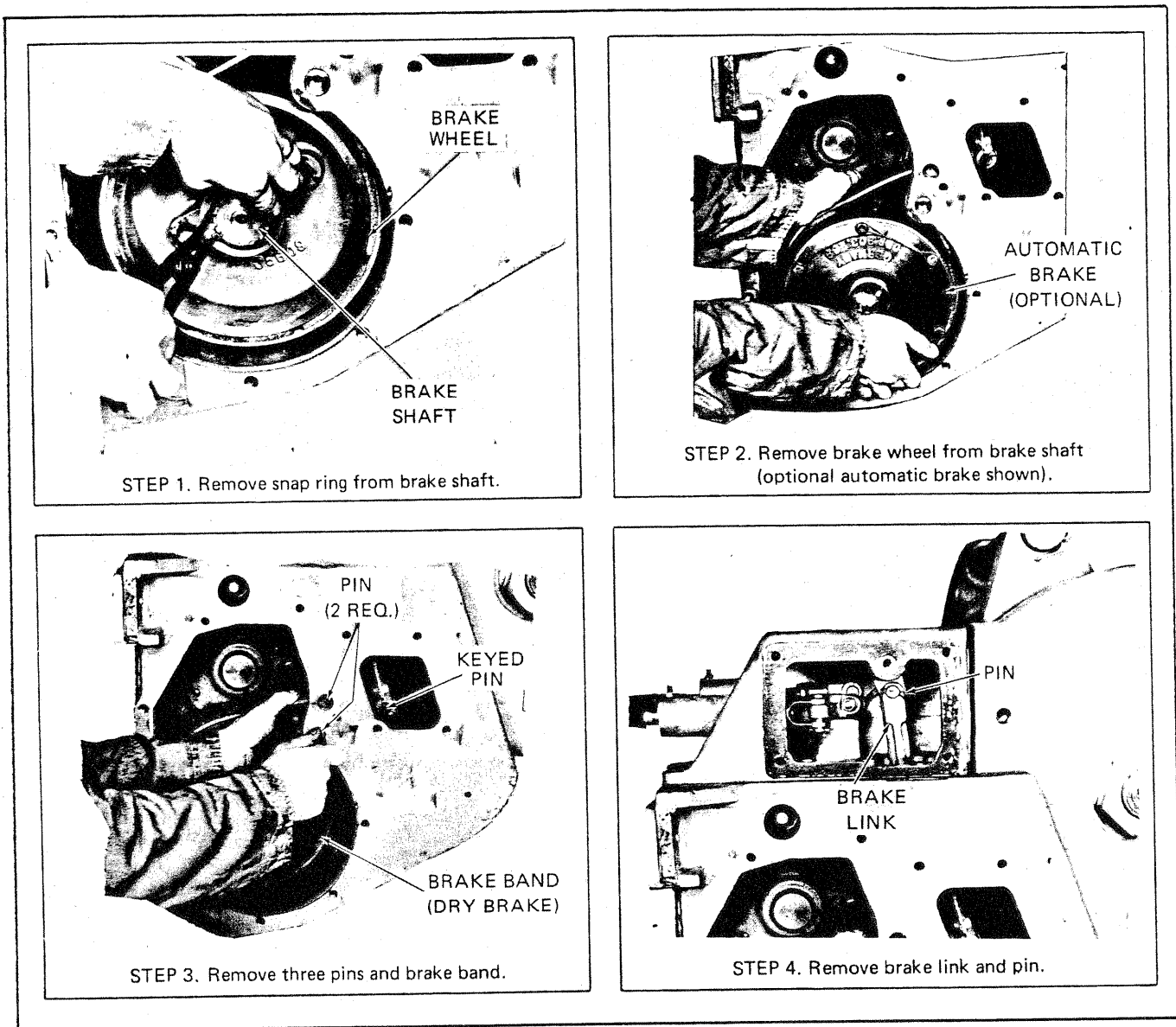


FIGURE 5-5. REMOVAL OF DRY BRAKE AND AUTOMATIC BRAKE, DIRECT DRIVE WINCH

illustration of special tools (Figure 5-30) 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 5-10) and the reverse clutch assembly (see Figure 5-7) is required prior to removal of the drum shaft and drum.

### 5-24. Removal of Control Valve (Power Controlled Winch Only).

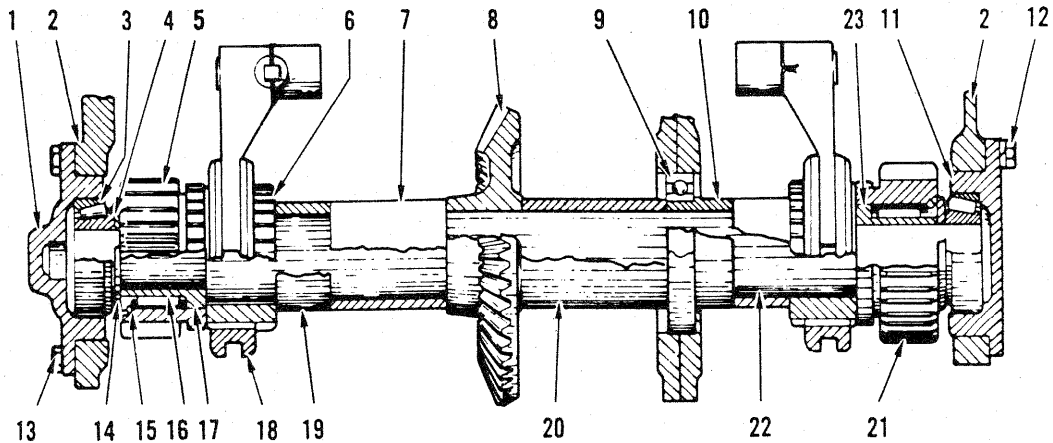
5-25. Access to the control valve may be obtained by removing the top control housing cover, on early production models; or the control valve access cover plate on upper, forward portion of left side of winch housing on later production models. When removing

the control valve on early production models, the brake cover plate must also be removed. On later production models, improved access to adjacent hydraulic fittings is gained by removal of the brake cover plate. Remove the control valve as follows (see Figures 5-2 and 5-17):

- Disconnect the cable end (clevis) at the end of each control cable.
- Disconnect the inlet pressure line, brake pressure line, two clutch pressure lines, pressure gauge line, and, on later production models, line to cooling oil relief valve.
- Remove the cooling oil relief valve on early production models.

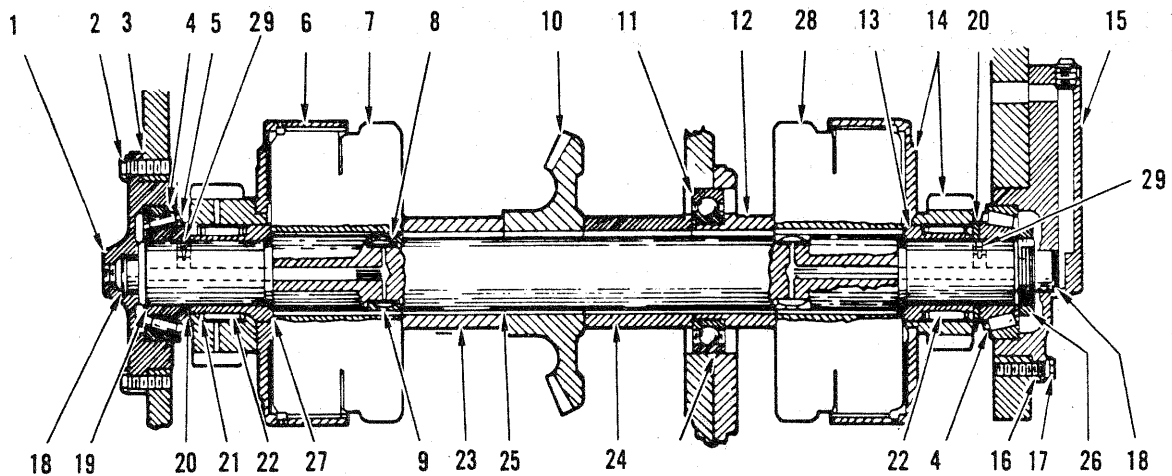


## FOR DIRECT DRIVE WINCH



- |                          |                         |                         |
|--------------------------|-------------------------|-------------------------|
| 1. L.H. BEARING RETAINER | 9. BALL BEARING         | 17. BEARING CARRIER     |
| 2. SHIM                  | 10. BEARING CARRIER     | 18. DENTAL CLUTCH       |
| 3. BEARING CUP           | 11. BEARING RETAINER    | 19. SPACER              |
| 4. BEARING CONE          | 12. CAPSCREW-LOCKWASHER | 20. SPACER              |
| 5. FORWARD PINION        | 13. CAPSCREW-LOCKWASHER | 21. REVERSE PINION GEAR |
| 6. DENTAL CLUTCH HUB     | 14. THRUST WASHER       | 22. BEVEL GEAR SHAFT    |
| 7. SPACER                | 15. SNAP RING           | 23. BEARING CARRIER     |
| 8. BEVEL RING GEAR       | 16. ROLLER BEARING      |                         |

## FOR POWER CONTROLLED WINCH



- |                            |                           |                         |                             |
|----------------------------|---------------------------|-------------------------|-----------------------------|
| 1. L.H. BEARING RETAINER   | 8. SEAL (THREE TEETH)     | 16. SHIM                | 24. SPACER                  |
| 2. CAPSCREW-LOCKWASHER     | 9. SEAL (TWO TEETH)       | 17. CAPSCREW-LOCKWASHER | 25. BEVEL GEAR SHAFT        |
| 3. SHIM                    | 10. BEVEL GEAR            | 18. SEAL RING           | 26. LOCKWASHER-LOCKNUT      |
| 4. BEARING CUP             | 11. BALL BEARING          | 19. SNAP RING           | 27. BEARING CARRIER         |
| 5. BEARING CONE            | 12. BEARING CARRIER       | 20. THRUST WASHER       | 28. REVERSE CLUTCH ASSEMBLY |
| 6. FORWARD SPIDER GEAR     | 13. BEARING CARRIER       | 21. SNAP RING           | 29. ORIFICE PLUG*           |
| 7. FORWARD CLUTCH ASSEMBLY | 14. REVERSE SPIDER GEAR   | 22. ROLLER BEARING      |                             |
|                            | 15. R.H. BEARING RETAINER | 23. SPACER              |                             |

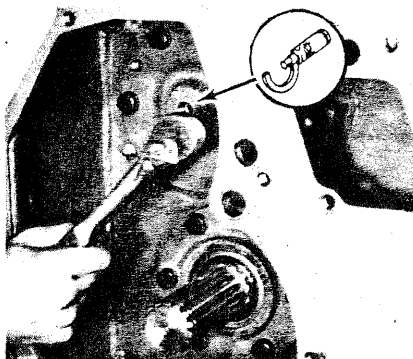
\* FIRST USED ON SERIAL NO. C82P-2417 AND C82S-1539  
(EARLIER PRODUCTION MODELS ARE UNDRILLED)

W351

FIGURE 5-6. BEVEL GEAR SHAFT, LOCATION OF COMPONENTS

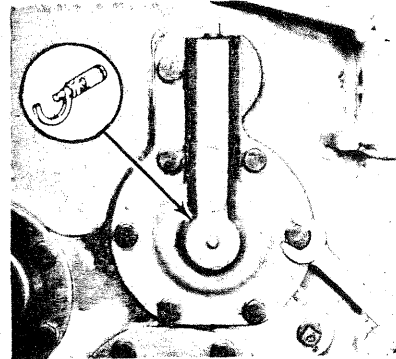
# Overhaul Instructions

NOTE: Prior to removal and disassembly of the bevel gear shaft assembly, perform the procedures given in paragraph 5-14.



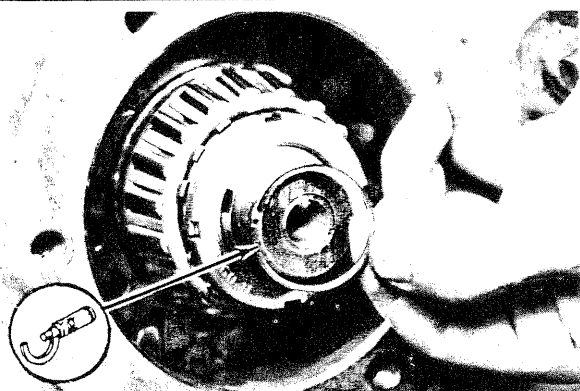
STEP 1. Remove left-hand bearing retainer with shims by removing the five cap screws.

NOTE: Keep shim pack with the retainer

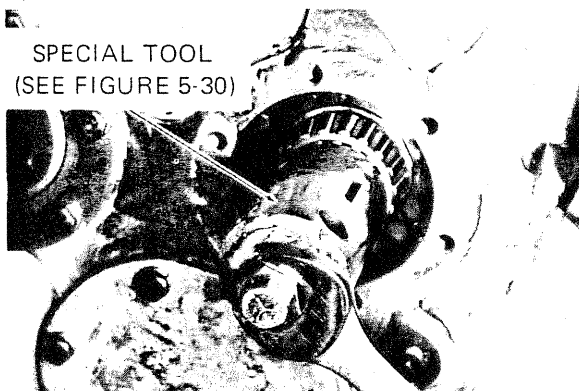


STEP 2. Remove right hand bearing retainer with shims by removing the seven cap screws.

NOTE: Keep shim pack with the retainer.

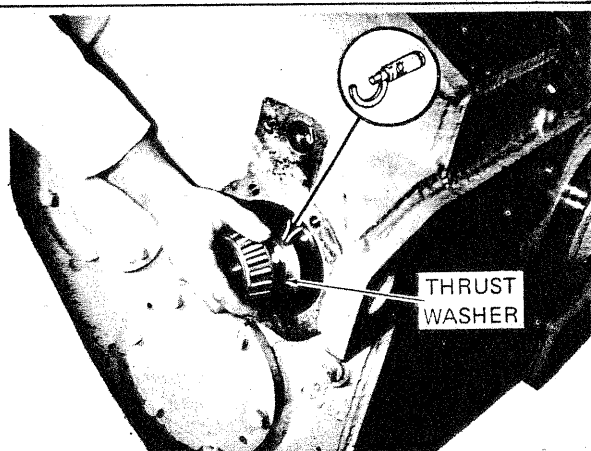


STEP 3. Remove cast-iron seal rings (one on each end of bevel gear shaft). Expand seal rings just enough to slip over the end of the shaft.

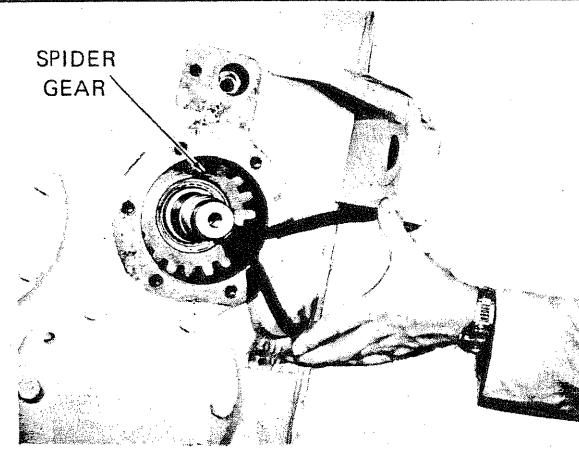


SPECIAL TOOL  
(SEE FIGURE 5-30)

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

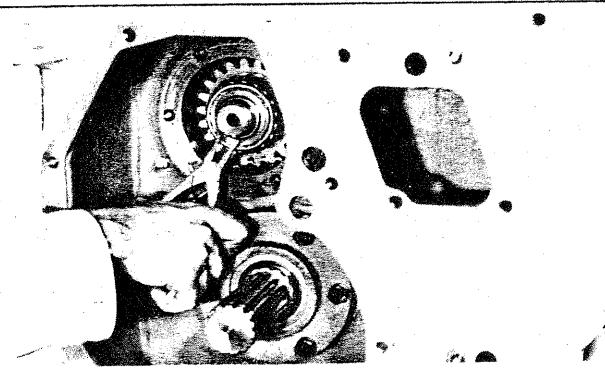


STEP 5. Remove taper roller bearing and thrust washer.

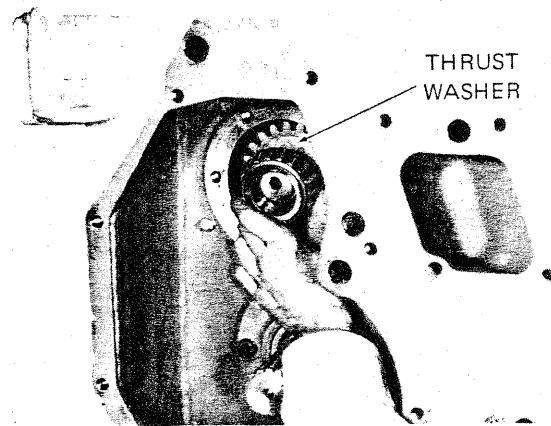


STEP 6. Remove the internal snap ring from the reverse spider gear bore.

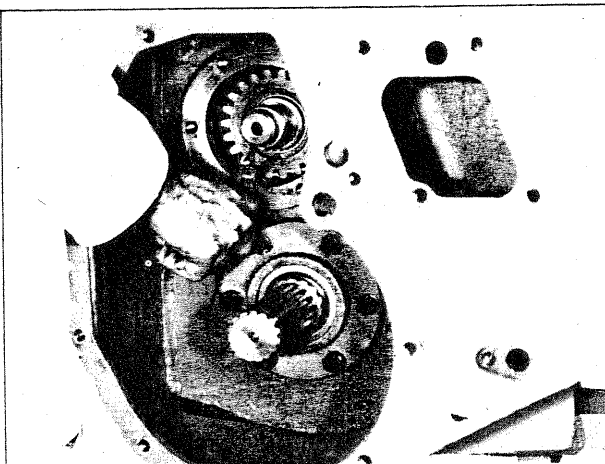
FIGURE 5-7. REMOVAL AND DISASSEMBLY OF BEVEL GEAR SHAFT ASSEMBLY (Sheet 1 of 3)



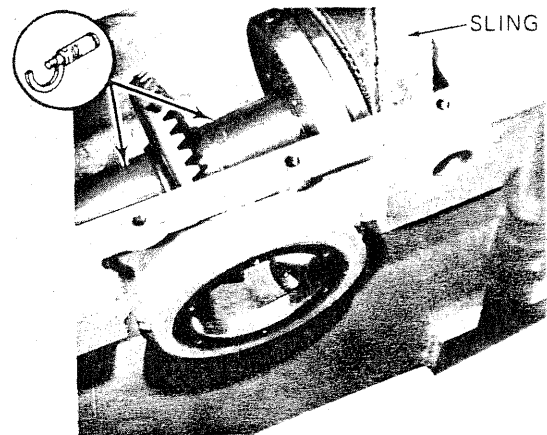
STEP 7. Remove external snap ring from left-hand end of the bevel gear shaft. It may be necessary to tap right-hand end of bevel gear shaft to relieve pressure on snap ring.



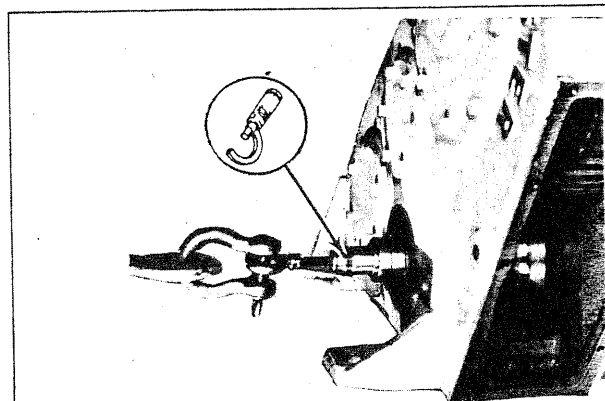
STEP 8. Remove taper roller bearing and thrust washer.



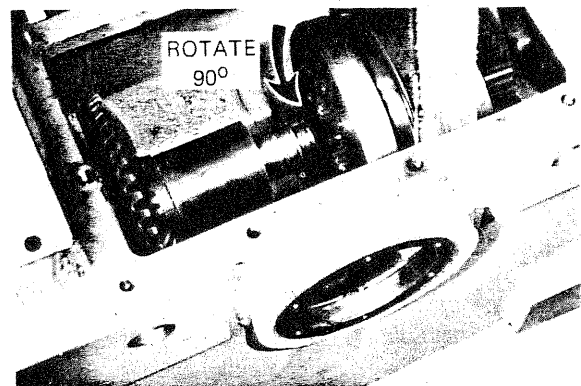
STEP 9. Remove the internal snap ring from the forward spider gear bore.



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



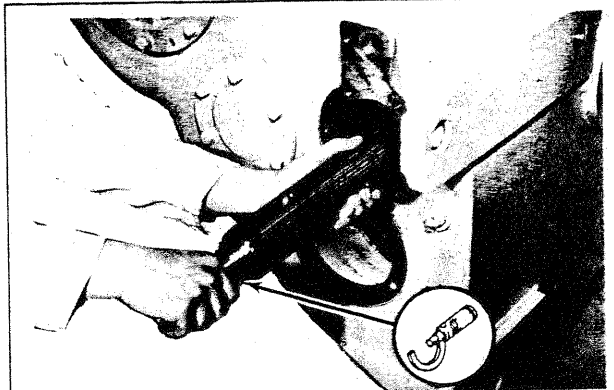
STEP 11. Pull bevel gear shaft straight out. CAUTION: Pull out just far enough for removal of forward clutch assembly.



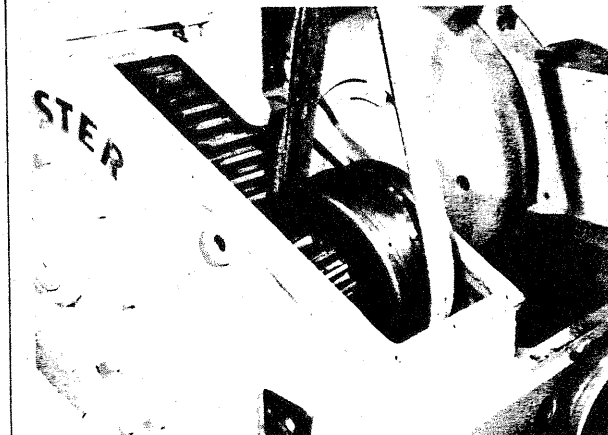
STEP 12. Remove forward clutch pack by rotating 90° from position shown. Lift straight out after rotating. Remove bevel gear and two spacers.

FIGURE 5-7. REMOVAL AND DISASSEMBLY OF BEVEL GEAR SHAFT ASSEMBLY (Sheet 2 of 3)

## Overhaul Instructions



**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.

FIGURE 5-7. REMOVAL AND DISASSEMBLY OF BEVEL GEAR SHAFT ASSEMBLY (Sheet 3 of 3)

d. Remove the three capscrews securing the control valve to the control housing.

**NOTE** Control valve repairs are given in paragraph 5-38.

### 5-26. Removal of Hydraulic Pump Assembly (Power Controlled Winch Only).

5-27. Location of the hydraulic pump assembly varies between tractor models. Pump locations for specific tractor series are given in the following paragraphs. Before removing the hydraulic pump, thoroughly clean all surfaces around the pump. Place all removed parts in a clean container to prevent loss or damage. Repair procedures for the hydraulic pump assembly are given in paragraph 5-42.

5-28. FOR D5 TRACTOR SERIAL NUMBER 81H1 THRU 84H1 AND UP. On this tractor series, the hydraulic pump assembly is mounted on the forward, right-hand side of the tractor frame adjacent to the engine crank shaft pulley. The pump is belt-driven from the crank shaft pulley. Belt tension can be adjusted by means of the adjustment screw shown in Figure 5-12.

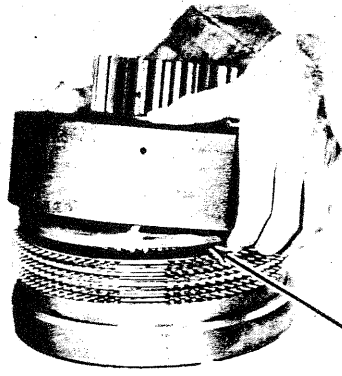
5-29. FOR D5 TRACTOR SERIAL NUMBER 95J1 AND UP AND 96J1 AND UP. On this tractor series,

the hydraulic pump assembly is mounted on the right-hand side of the tractor converter housing. The pump is gear driven by the converter gear train. (See Figure 5-13.)

5-30. FOR D6 TRACTOR SERIAL NUMBER 74A THRU 76A AND UP, 99J1 AND UP, AND 10K1 AND UP. On this tractor series, the hydraulic pump assembly is located under the floor plates at the operator's compartment. The pump is mounted on the tractor pump group. A special coupling is mounted on the pump drive shaft and mates with the tractor pump drive linkage. (See Figure 5-14.)

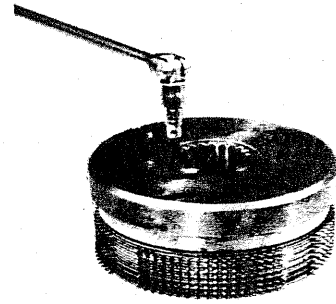
5-31. FOR 977 TRAXCAVATOR SERIAL NUMBER 53A1 AND UP. On this tractor series, the hydraulic pump assembly is mounted on the tractor timing gear housing at the right-hand side of the tractor engine. The pump is belt-driven by the engine fan belts. Belt tension can be adjusted by means of the adjustment screw shown in Figure 5-15.

5-32. FOR 977K TRAXCAVATOR SERIAL NUMBER 46H1 AND UP. On this tractor series, the hydraulic pump assembly is mounted at the left-hand side of the tractor converter housing. The pump is gear-driven through a special coupling mounted on the pump drive shaft as shown in Figure 5-16.

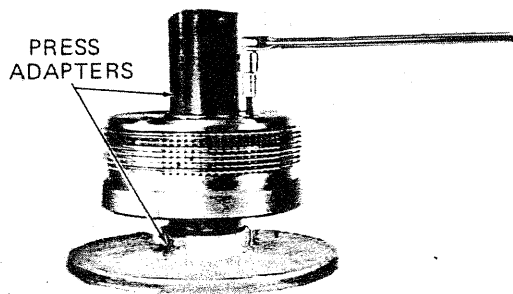


NOTE: Two feeler gauges placed 180° apart are required to obtain an accurate measurement. (See Step 10 figure 5-21.)

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

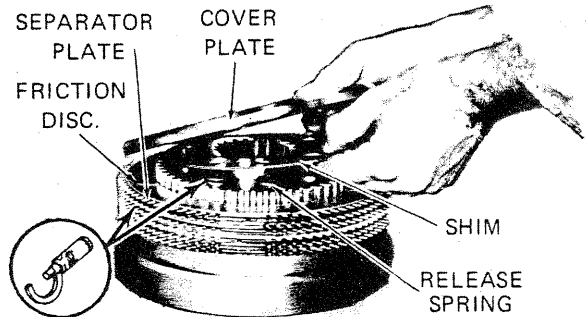


STEP 2. Remove six set screws that lock the special capscrews on opposite end of clutch.



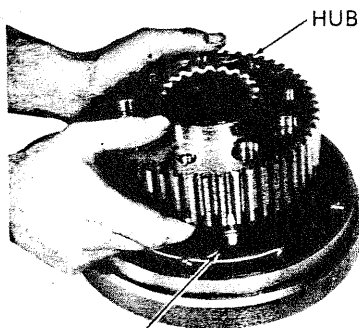
STEP 3. Remove six special capscrews. Hold assembly in press as shown.

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



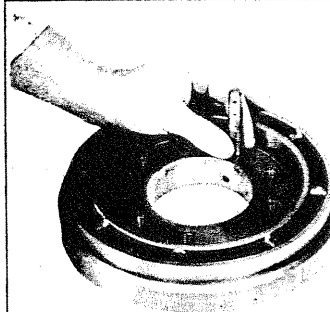
STEP 4. Lift cover plate, shim, six release springs, six friction discs, and six separator plates from clutch hub.

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



SPRING  
RETAINER

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



STEP 6. Remove clutch cooling oil valve. Use special tool (See figure 5-30 )

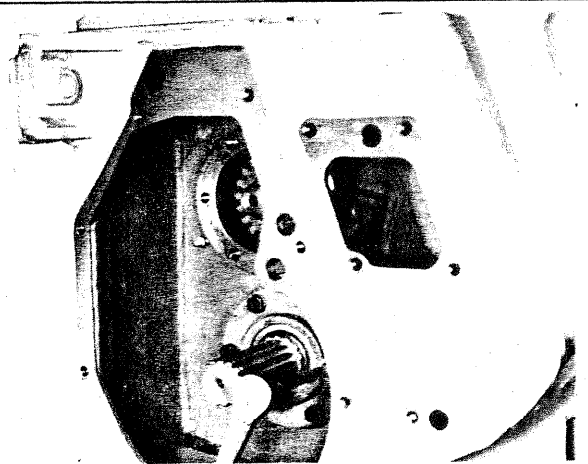
**CAUTION:** Do not insert any tool through valve body.



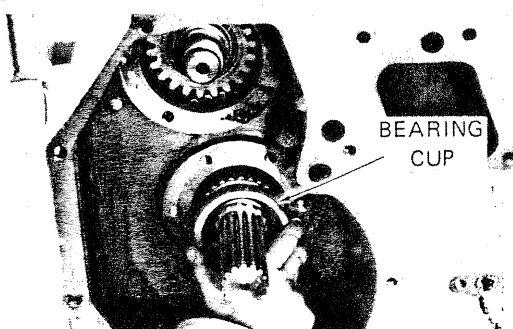
STEP 7. Remove clutch piston from piston retainer by applying compressed air at the cooling oil valve port. Then remove two o-rings.

FIGURE 5-8. DISASSEMBLY OF CLUTCH ASSEMBLY, POWER CONTROLLED WINCH

## Overhaul Instructions

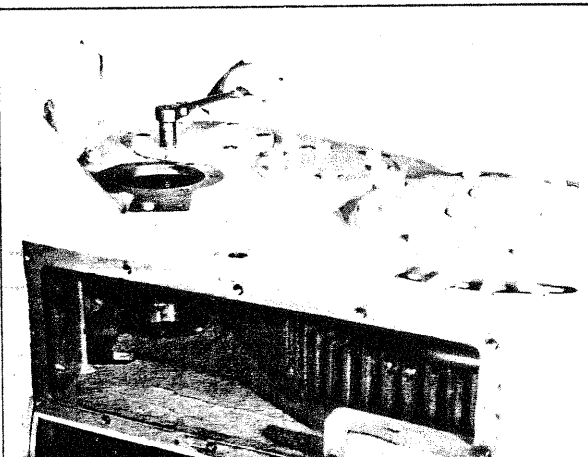


STEP 1. Remove left-hand bearing retainer. Tag shims for reference during reassembly.

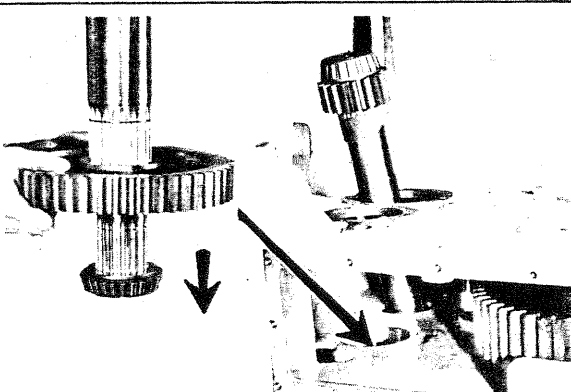


NOTE: Prior to removal and disassembly of the brake shaft, perform the procedures given in paragraph 5-18.

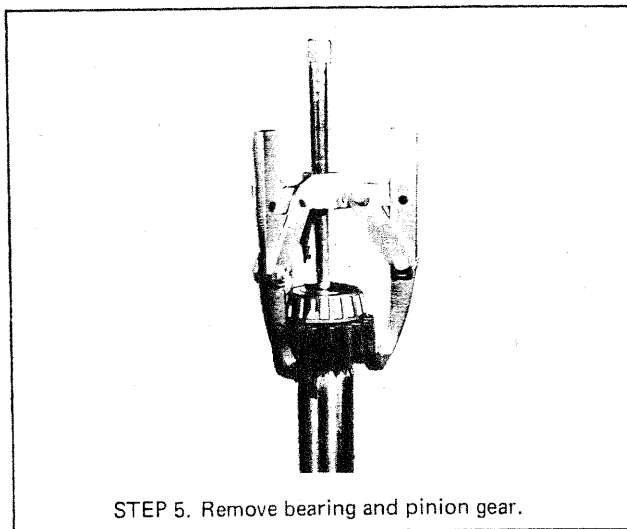
STEP 2. Remove left-hand bearing cup (outer race). Tag cup for reference during reassembly.



STEP 3. Position winch with right-hand side facing upward. Remove bearing retainer.



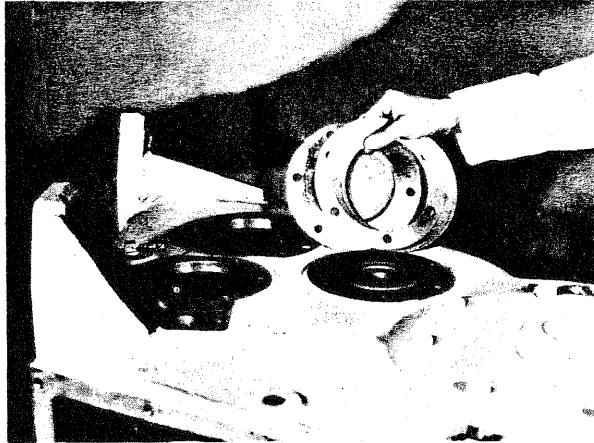
STEP 4. Pull brake shaft out of winch housing to approximate position shown. Tap bearing off of shaft using reduction gear as driver.



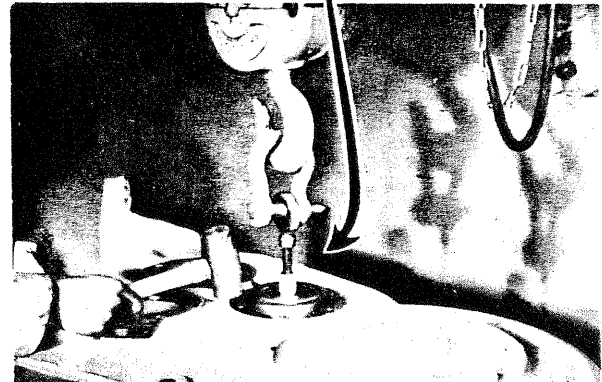
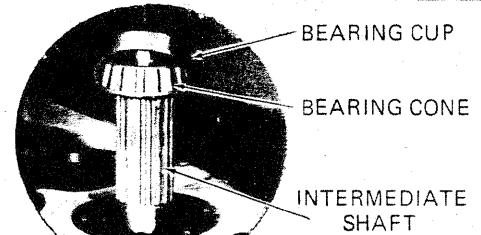
STEP 5. Remove bearing and pinion gear.

FIGURE 5-9. REMOVAL OF BRAKE SHAFT ASSEMBLY

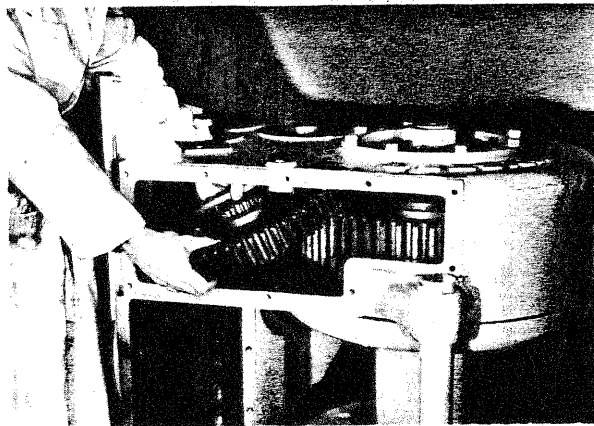
NOTE: The following illustrations show the winch removed from the tractor and positioned on its side with the brake shaft and bevel gear shaft removed. Removal of these shafts is not necessary for ON TRACTOR REPAIR of the intermediate shaft. Remove the drum shaft bearing retainer (see figure 5-11) to obtain the necessary clearance for removal of the intermediate shaft gears.



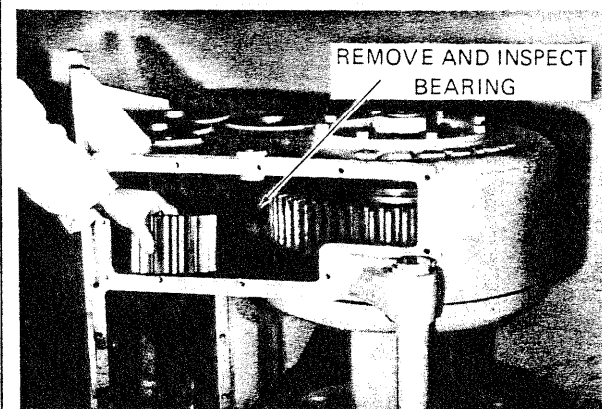
STEP 1. Remove the right-hand bearing retainer with shims. Tag shims for reference during reassembly.



STEP 2. Screw a 5/8-inch 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.

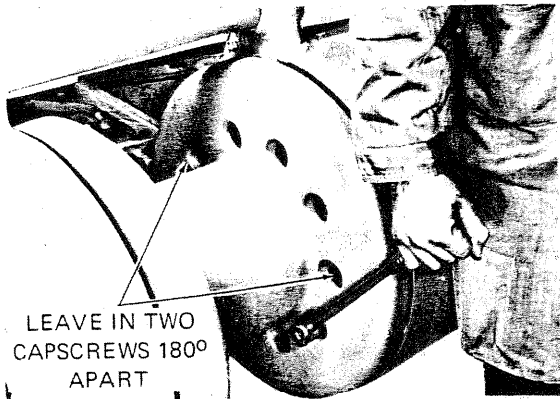


STEP 4. Remove drum pinion and bearing.

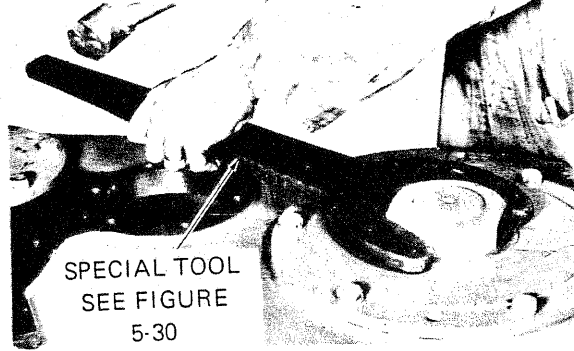
FIGURE 5-10. REMOVAL OF INTERMEDIATE SHAFT ASSEMBLY



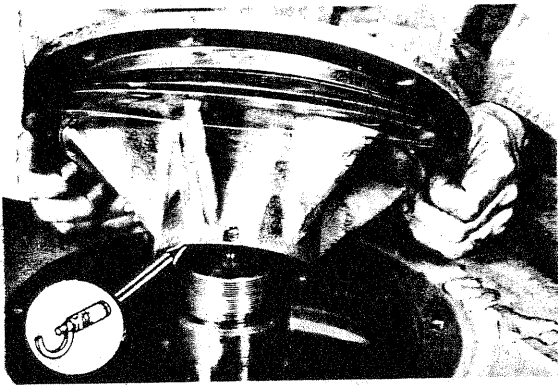
# Overhaul Instructions



STEP 1. Loosen the 12 drum cap screws, then remove 10 cap screws leaving two located 180 degrees apart.

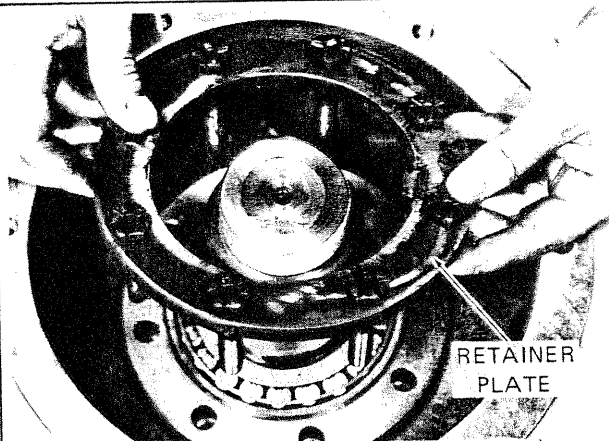


STEP 2. Remove left-hand drum shaft locknut, then turn winch so that right-hand side faces upward. Remove second drum shaft locknut.

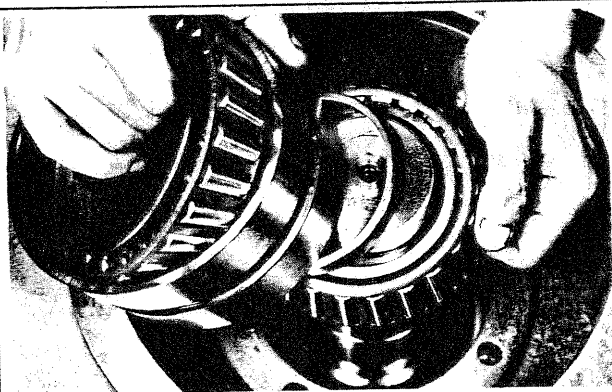


STEP 3. Remove bearing retainer and shim pack.

NOTE: Tag shim pack for reference during reassembly.

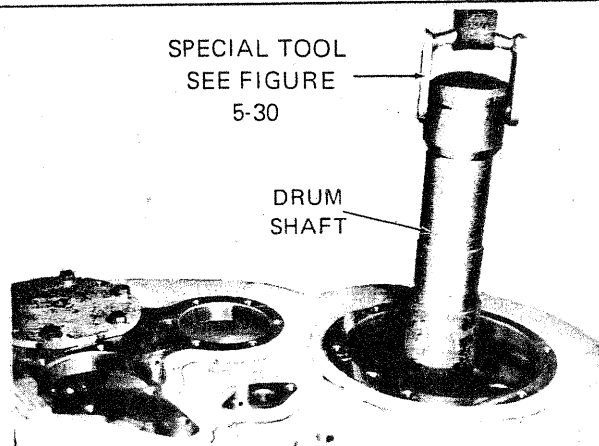


STEP 4. Remove retainer plate by removing the eight special cap screws.



STEP 5. Remove double taper roller bearing assembly.

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



STEP 6. Remove drum shaft using special attachment.

FIGURE 5-11. REMOVAL OF DRUM SHAFT AND DRUM (Sheet 1 of 2)



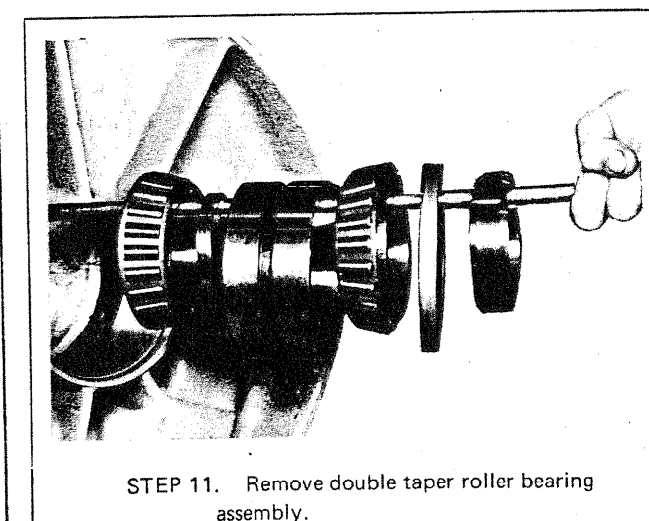
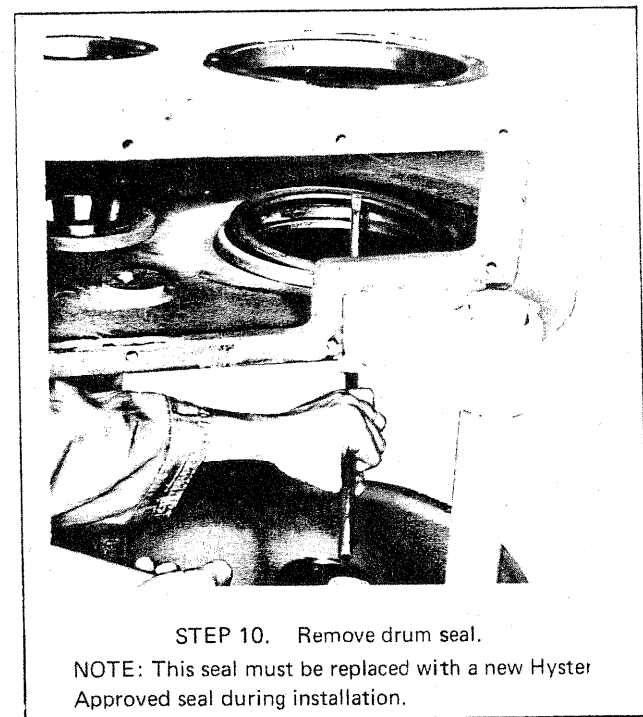
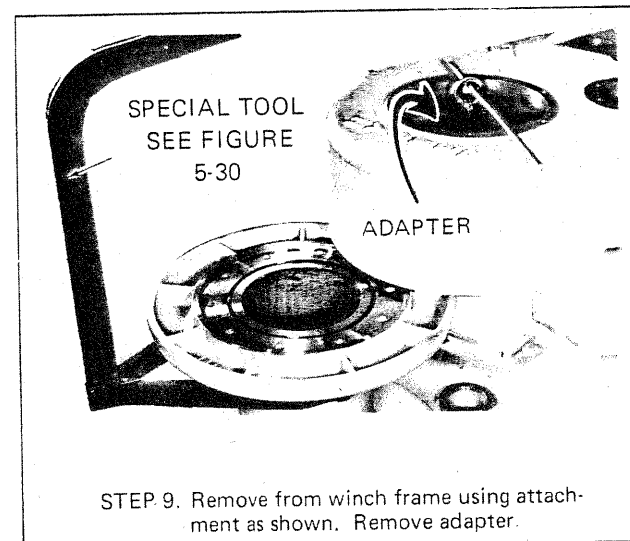
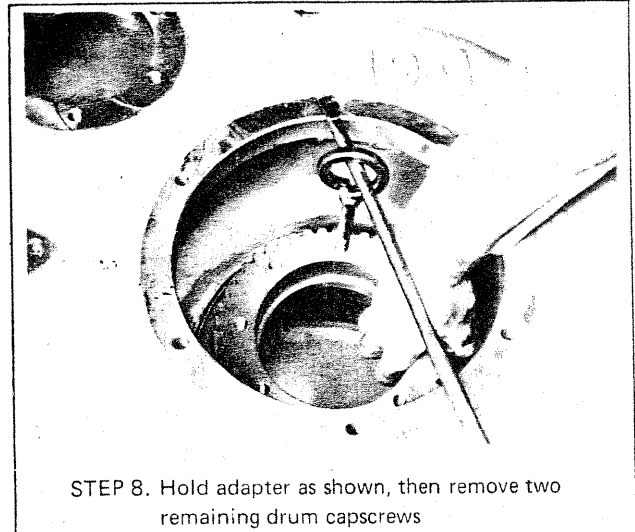
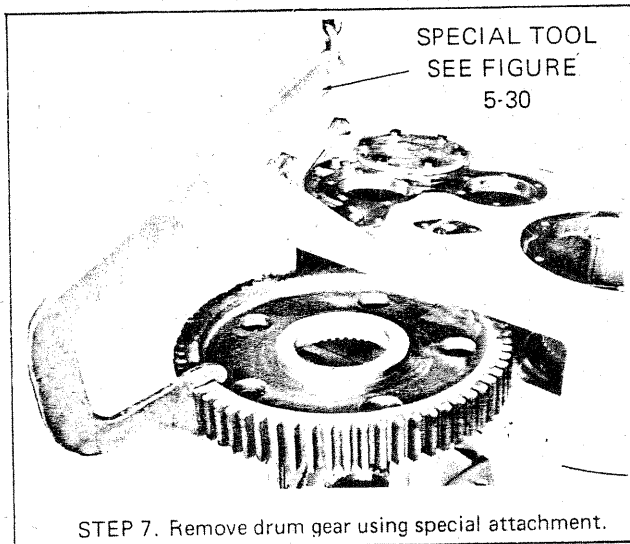


FIGURE 5-11. REMOVAL OF DRUM SHAFT AND DRUM (Sheet 2 of 2)

# Overhaul Instructions

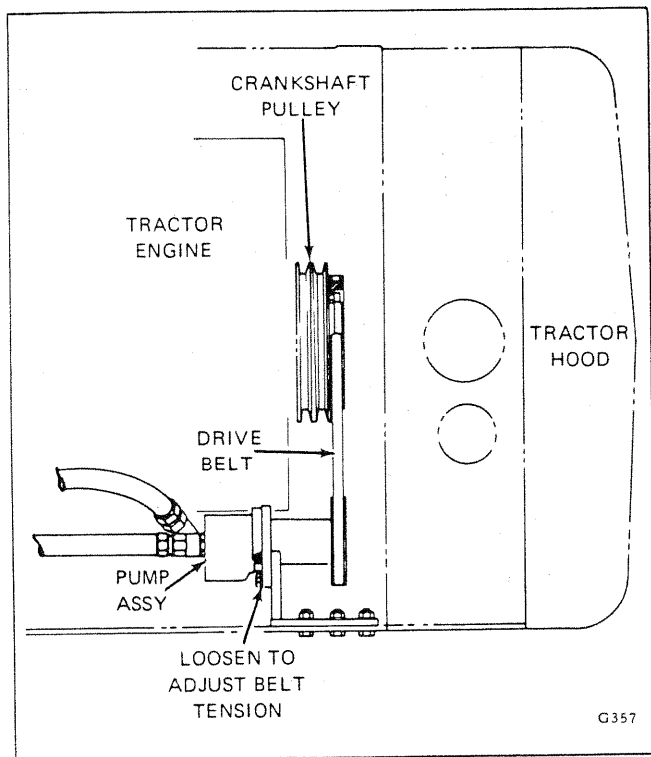


FIGURE 5-12. REMOVAL OF HYDRAULIC PUMP ASSEMBLY (D5 TRACTOR SERIAL NUMBER 81H1 THROUGH 84H1 AND UP)

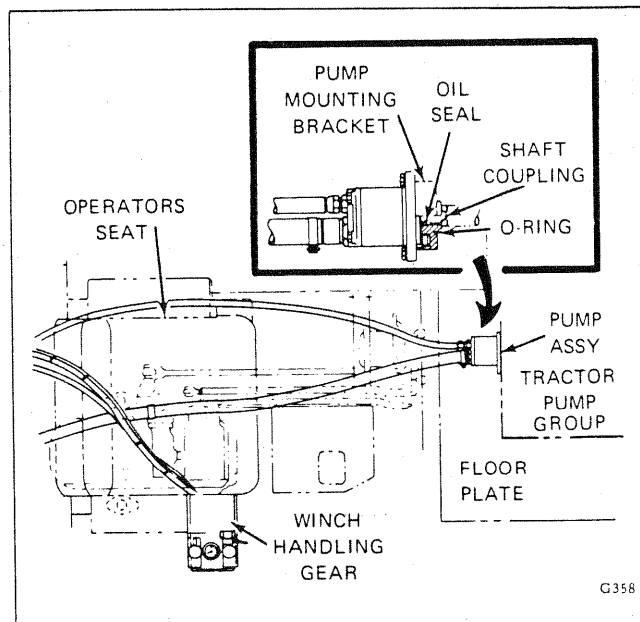


FIGURE 5-14. REMOVAL OF HYDRAULIC PUMP ASSEMBLY (D6 TRACTOR SERIAL NUMBER 74A THROUGH 76A AND UP, AND 10K1 AND UP)

## 5-33. CLEANING.

5-34. 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

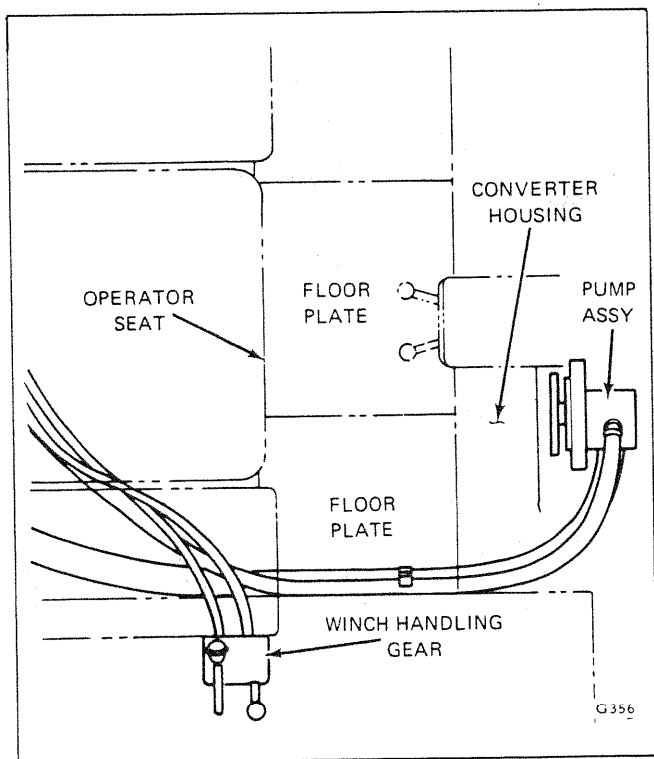


FIGURE 5-13. REMOVAL OF HYDRAULIC PUMP ASSEMBLY (D5 TRACTOR SERIAL NUMBER 95J1 AND UP AND 96J1 AND UP)

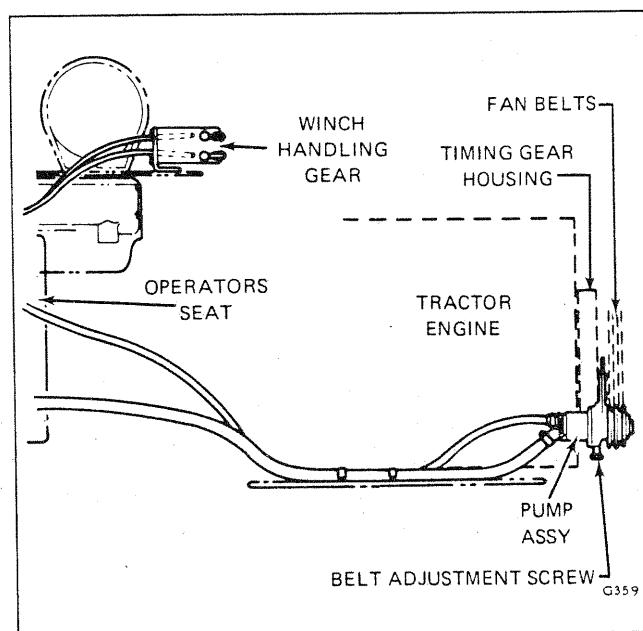


FIGURE 5-15. REMOVAL OF HYDRAULIC PUMP ASSEMBLY (977H TRAXCAVATOR SERIAL NUMBER 53A1 AND UP)

# Overhaul Instructions

or dirt. Damage to a part may not be obvious unless thoroughly cleaned. Steam clean all external surfaces of the winch prior to reassembly.

**CAUTION** Do not use oily (dirty) solvents to clean the brake band used in the direct drive or power controlled winch. Use only clean solvents to remove grease or oil from the brake lining.

5-35. BEVEL GEAR SHAFT OIL PASSAGES. Ensure that oil passage in each end of bevel gear shaft is clean. To aid in cleaning passages, remove four seals from shaft inboard holes and, on winches starting with Serial Numbers C82P-2417 and C825-1539, remove two orifice plugs from shaft outboard holes. Use air to blow out any accumulated dirt.

## 5-36. VISUAL INSPECTION.

5-37. Table 5-1 contains procedures for visual inspection of all critical parts of the winch assembly.

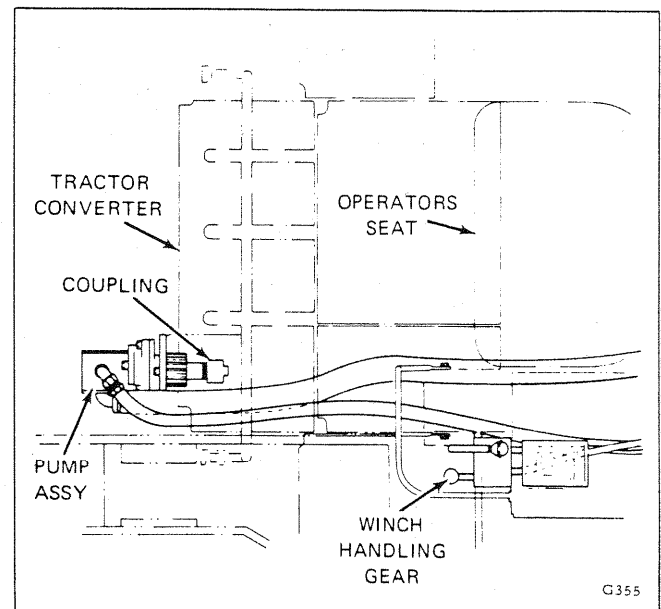


FIGURE 5-16. REMOVAL OF HYDRAULIC PUMP ASSEMBLY (977K TRAXCAVATOR SERIAL NUMBER 46H1 AND UP)

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

ITEM	INSPECTION REQUIREMENTS	CORRECTIVE ACTION
PTO Shaft, Lo-Speed and Slo-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, Direct Drive	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.
Bevel Gear Shaft, Power Controlled Winch	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).	Dress threads with a thread chaser.

# Overhaul Instructions

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

ITEM	INSPECTION REQUIREMENTS	CORRECTIVE ACTION
Bevel Gear Shaft, Power Controlled Winch (Cont.)	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.
	Check for damaged or enlarged orifice plugs (first used on Serial Numbers C82P-2417 and C82S-1539).	Replace plugs if damaged or if orifice hole diameter is not within specifications (see Table 1-1).
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.
Dental Clutch, Direct Drive Winch	Check for broken or worn teeth.	Replace dental clutch if teeth are broken or severely worn.
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 Shaft Pinion Gears, Direct Drive Winch	Check for broken or worn teeth.	Replace pinion gears if teeth are broken or severely worn.
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.  <b>NOTE</b> Do not machine gear faces. Overall length of components is critical.
Clutch Assembly, Power Controlled Winch	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 5-21, 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 see if surfaces are conical (dished).	Replace separator plate if any surface is flat, warped, or scored.  <b>NOTE</b> 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.

# Overhaul Instructions

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

ITEM	INSPECTION REQUIREMENTS	CORRECTIVE ACTION
Clutch Assembly, Power Controlled Winch (Cont.)	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.
Hydraulic Brake Cylinder, Power Controlled Winch Only	Check cylinder housing for damaged internal threads.	Dress threads using thread chaser. Replace housing if threads are severely damaged.
	Carefully check cylinder housing bore for deep scratches.	Replace cylinder housing.
	Check piston and rod assembly for deep scratches, scoring or excessive wear.	Replace piston and rod as an assembly.
Brakeshaft	Check for deep scratches or scoring on bearing journals at each end of shaft, and oil seal surface on Direct Drive winch.	Machine bearing journal as required but do not exceed minimum dimensions given 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 given 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 crossthreaded 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 quad-ring groove for burrs, scoring, and rust.	Replace drum or rebuild drum groove if a new quad-ring will not seat properly.
Drum Adapter	Carefully inspect double seal contact surface for deep scratches, burrs, and rust.	Replace if damaged.

# Overhaul Instructions

## 5-38. MINOR REPAIRS.

## 5-39. Control Valve Repairs (Power Controlled Winch Only).

5-40. Repair of the control valve is limited to removal and replacement of individual components as shown in Figure 5-17. 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 reinstalled in the correct ports.

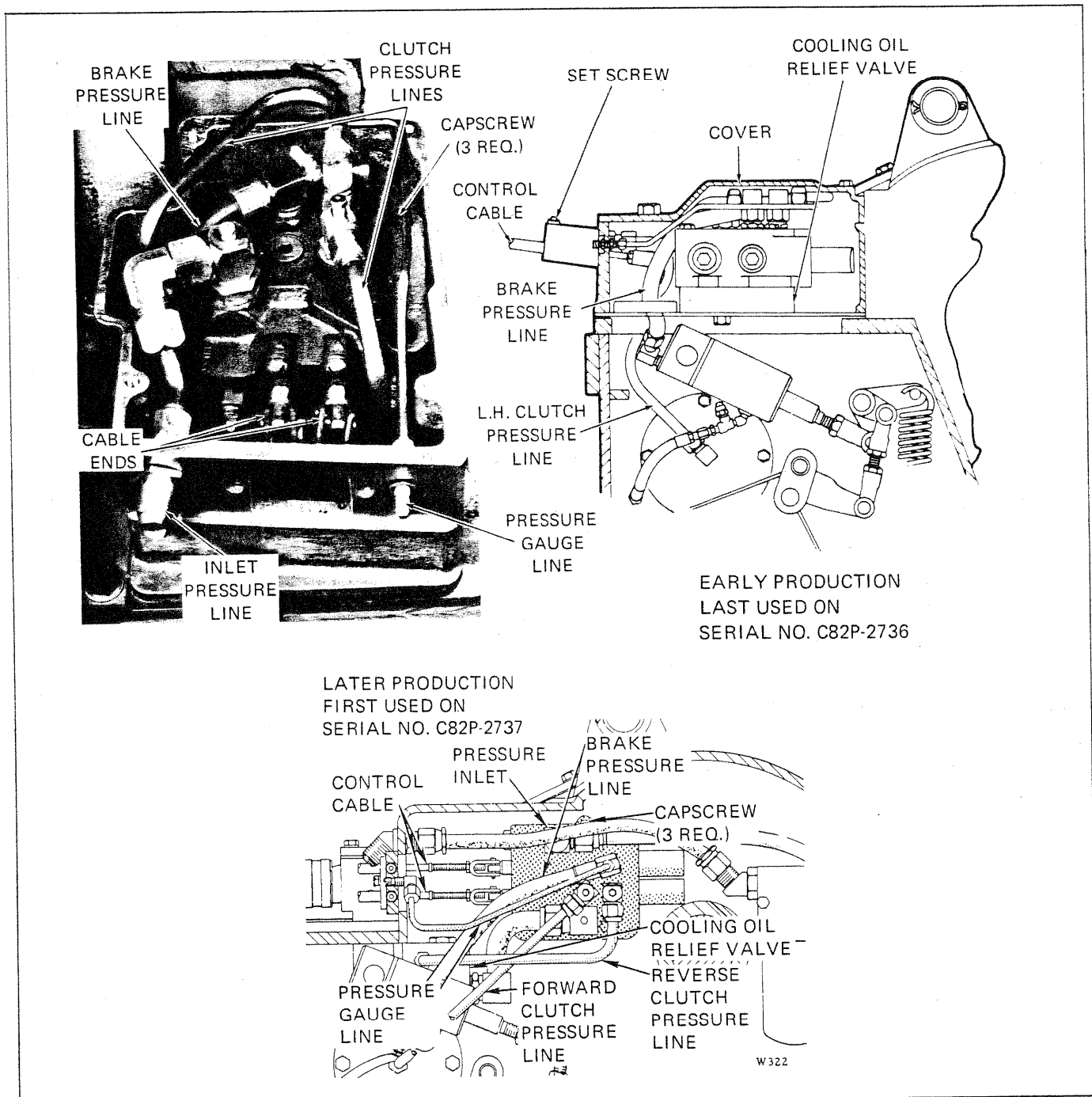


FIGURE 5-17. CONTROL VALVE REPAIR, POWER CONTROLLED WINCH (Sheet 1 of 2)

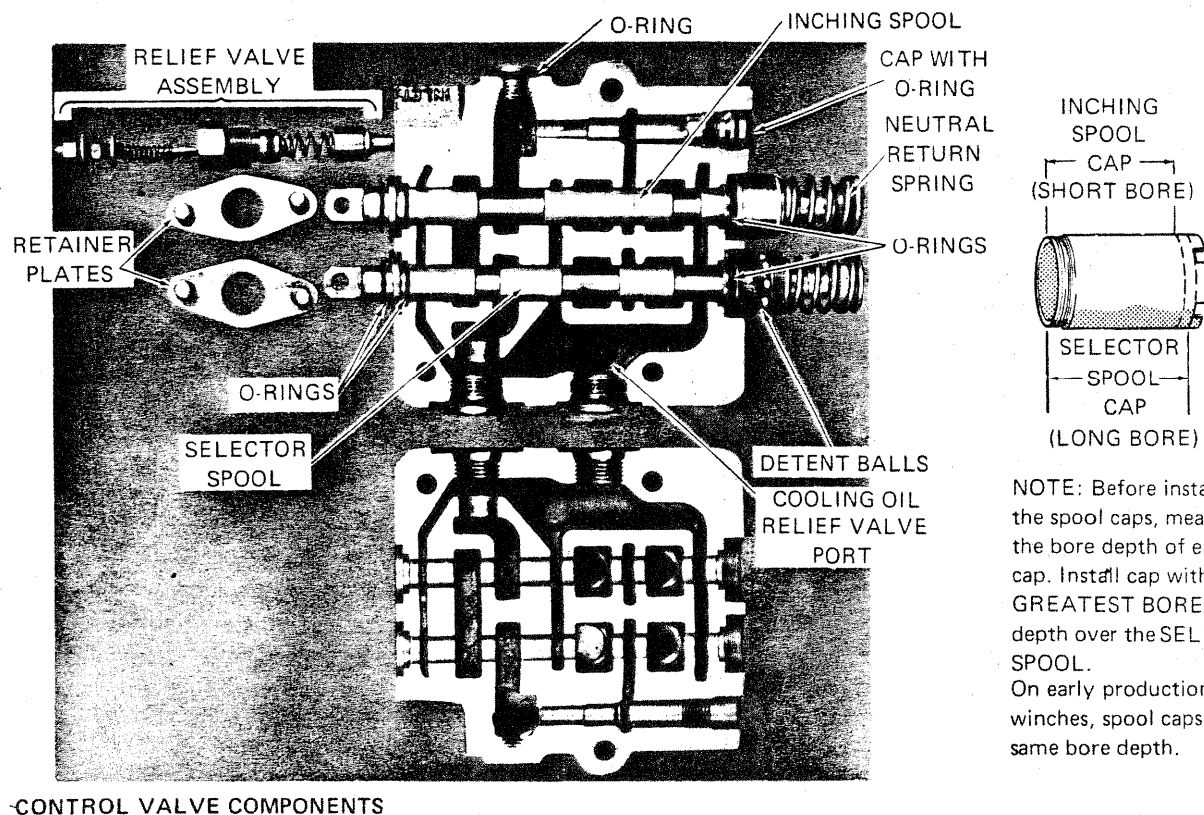


FIGURE 5-17. CONTROL VALVE REPAIR, POWER CONTROLLED WINCH (Sheet 2 of 2)

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

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

## 5-41. Hydraulic Brake Cylinder Repairs (Power Controlled Winch Only).

5-42. Repair of the hydraulic brake cylinder is limited to removal and replacement of individual components shown in Figure 5-18. Replace defective components as required, observing the following:

**CAUTION** Do not attempt to machine any part of the brake cylinder. If parts are found to be defective, replace the part. Do not hone the cylinder housing bore or attempt to machine the piston and rod assembly.

a. Lubricate all O-rings with hydraulic oil prior to installation.

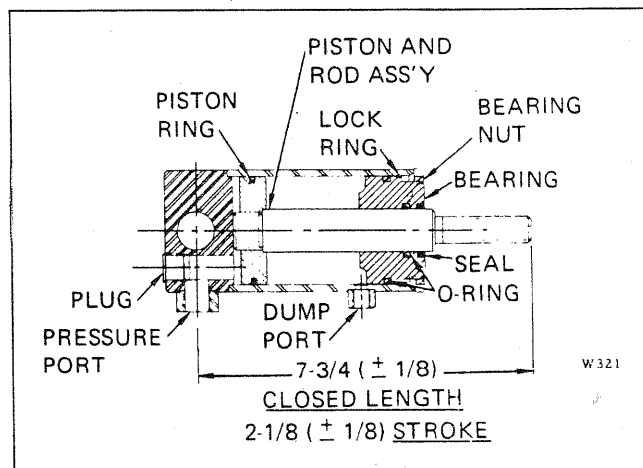


FIGURE 5-18. HYDRAULIC BRAKE CYLINDER REPAIRS, POWER CONTROLLED WINCH ONLY

## Overhaul Instructions

b. Check all threads in the cylinder housing. If threads are damaged, rethread using same size tap. Make sure that all metal chips are removed from the cylinder bore.

c. Lubricate the interior section of the cylinder housing with hydraulic oil prior to installing the piston and rod assembly.

### 5-43. Hydraulic Pump Repairs (Power Controlled Winch Only).

5-44. Seal wear or deterioration are the most common failures 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.

5-45. PUMP DISASSEMBLY, CATCO D5 AND TRAXCAVATOR, CATCO D6 UP THROUGH WINCH SERIAL NO. C82P-1872. (See Figure 5-19, View A.) Disassemble the pump as required, observing the following:

- 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 prussian 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).

5-46. INSPECTION AND REPAIR OF PUMP PARTS, CATCO D5 AND TRAXCAVATOR, CATCO D6 UP THROUGH WINCH SERIAL NO. C82P-1872. (See Figure 5-19.) 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 Figure 5-19, 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.

5-47. PUMP REASSEMBLY, CATCO D5 AND TRAXCAVATOR, CATCO D6 UP THROUGH WINCH SERIAL NO. C82P-1872. (See Figure 5-19.) 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 (see View C) are aligned.

**CAUTION** Do not attempt to straighten the high-pressure seal (View B) during installation. Be careful not to distort the seal.

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.

5-48. PUMP DISASSEMBLY, CATCO D6 TRACTOR (First Used With Winch Serial No. C82P-1873). (See Figure 5-20.) Disassemble hydraulic pump as follows:

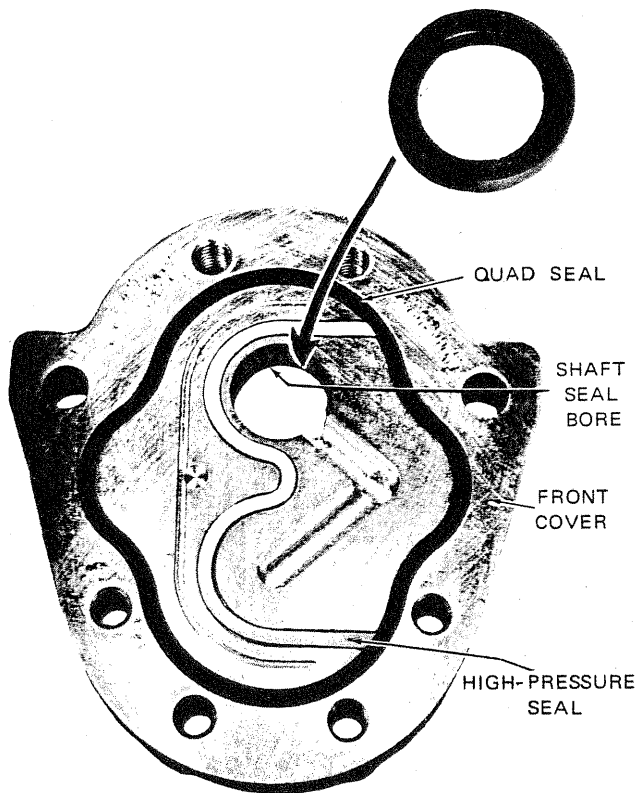
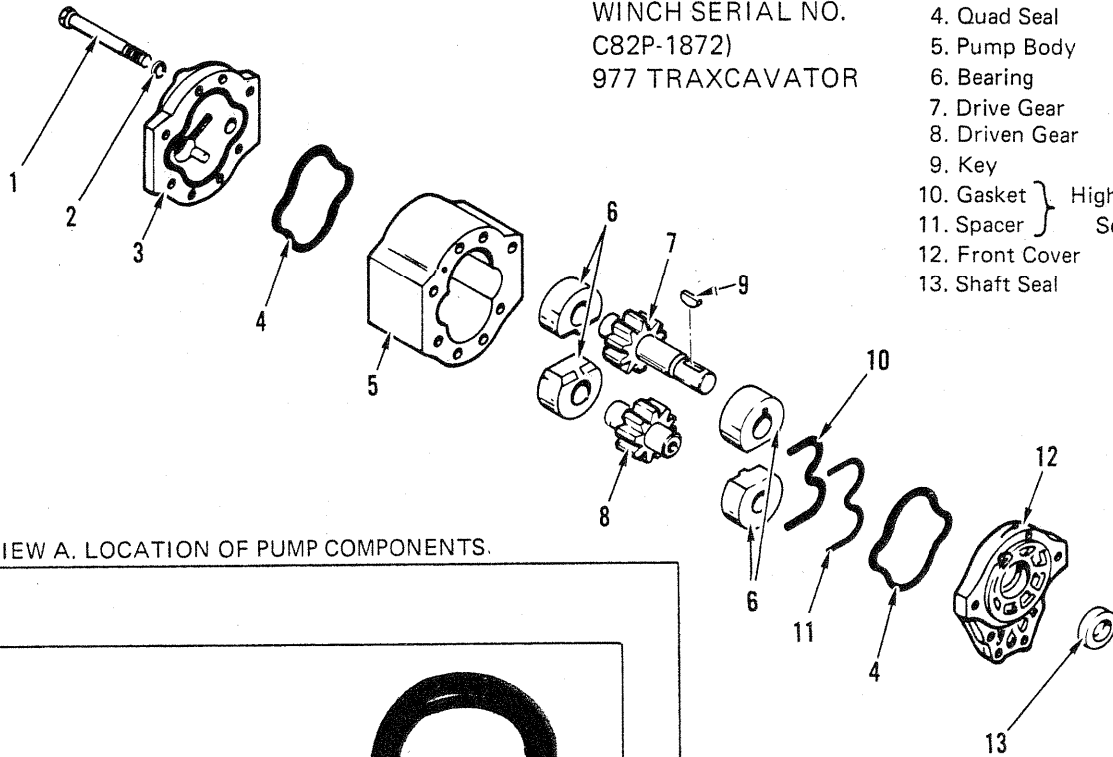
- a. Clean the outside of the pump thoroughly.
- b. Scribe a line across each end plate and the body to aid alignment during reassembly.
- c. Clamp the pump in a vise, shaft down. Remove the four hex-head capscrews farthest from the center of the pump.
- d. Remove the remaining two hex-head and two 12-point capscrews.



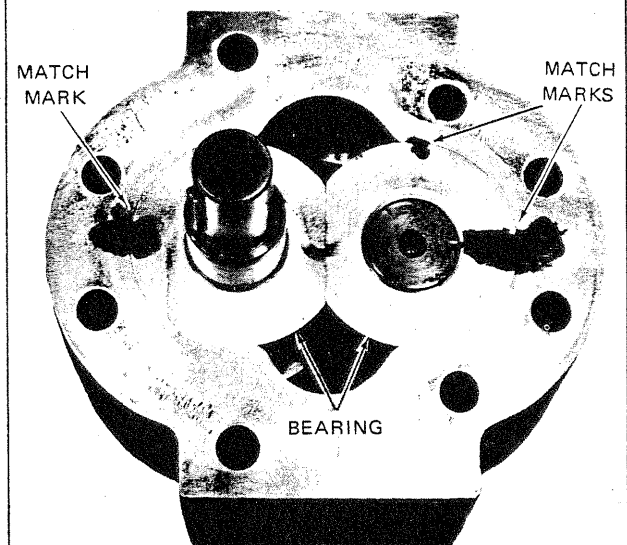
# Overhaul Instructions

USED ON: D5 TRACTOR  
D6 TRACTOR  
(LAST USED ON  
WINCH SERIAL NO.  
C82P-1872)  
977 TRAXCAVATOR

1. Capscrew
2. Lockwasher
3. Rear Cover
4. Quad Seal
5. Pump Body
6. Bearing
7. Drive Gear
8. Driven Gear
9. Key
10. Gasket } High Pressure
11. Spacer } Seal
12. Front Cover
13. Shaft Seal



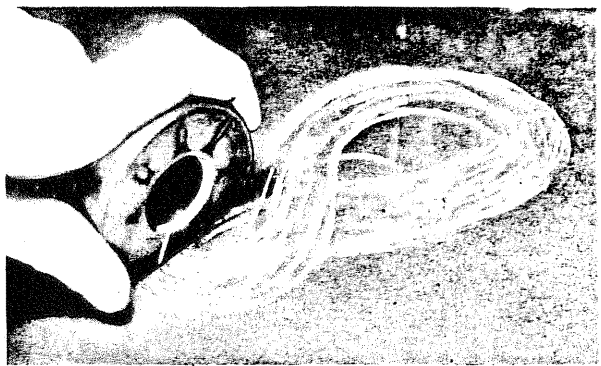
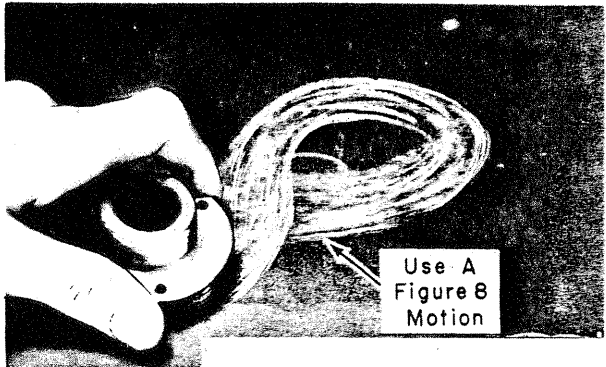
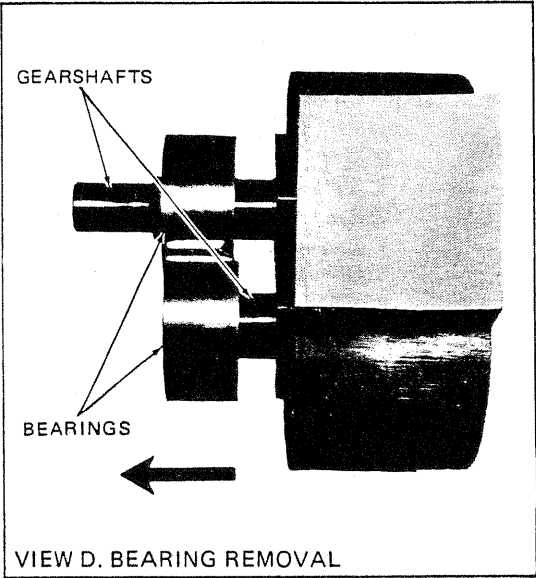
VIEW B. FRONT COVER



VIEW C. BEARING MATCH MARKS

FIGURE 5-19. HYDRAULIC PUMP REPAIRS (Sheet 1 of 2)

Overhaul Instructions



VIEW E. DRESSING BEARING FACES

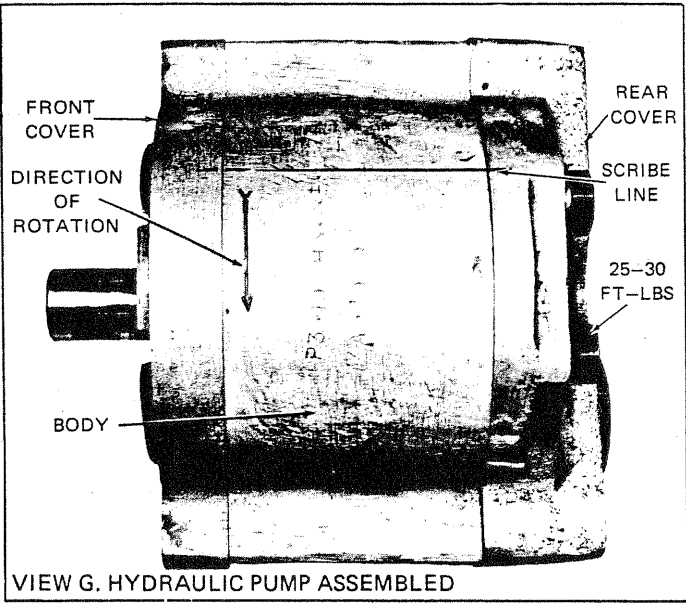
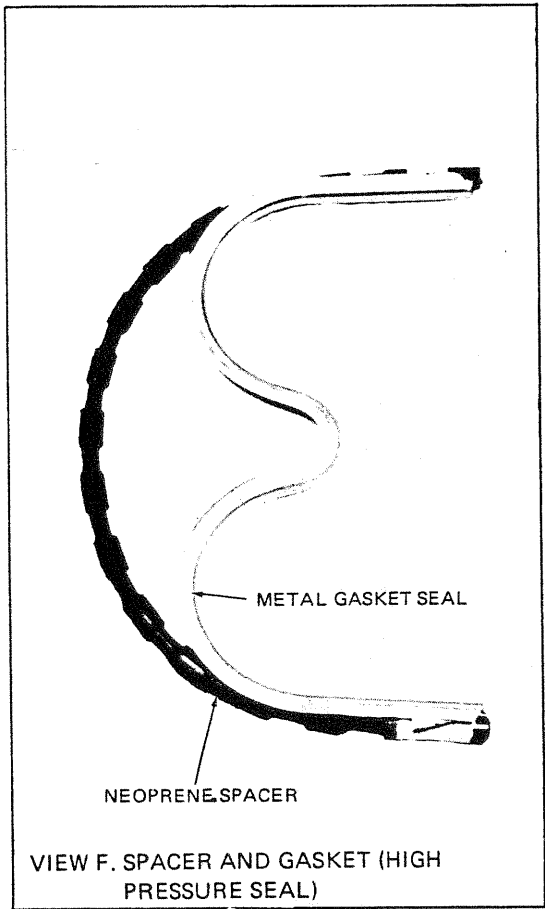
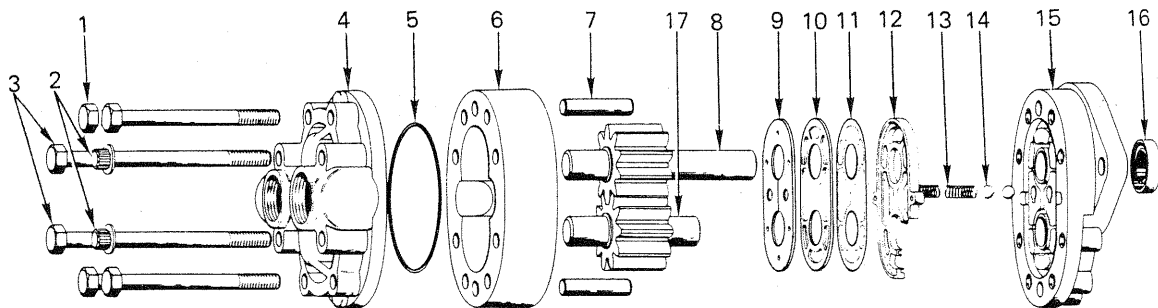


FIGURE 5-19. HYDRAULIC PUMP REPAIRS (Sheet 2 of 2)

USED ON D6 TRACTOR  
FIRST USED ON WINCH  
SERIAL NO. C82P-1873.



1. CAPSCREW (3 INCHES LONG, 4 PLACES).
2. 12-POINT CAPSCREW
3. CAPSCREW (3-1/4 INCHES LONG, 2 PLACES).
4. BACK PLATE ASS'Y.
5. O-RING.
6. BODY.
7. DOWEL PIN (2 REQ'D.)

8. DRIVE GEAR ASS'Y.
9. DIAPHRAGM
10. BACK-UP GASKET
11. PROTECTOR GASKET
12. DIAPHRAGM SEAL
13. SPRING (2 REQ'D.)
14. BALL (2 REQ'D.)
15. FRONT PLATE ASS'Y.
16. SHAFT SEAL
17. IDLER GEAR ASS'Y.

W342

FIGURE 5-20. HYDRAULIC PUMP REPAIRS

e. Hold the pump and bump drive shaft against wooden block to separate front plate from back plate. If back plate separates first, remove the idler gear assembly but leave drive gear assembly in place.

**NOTE** The body casting will usually remain fixed to one of the two end plates.

f. Separate the remaining end plate from the body by tapping the protruding end of the drive gear shaft with a plastic hammer. Remove the two dowel pins from the body.

g. Remove the O-ring seal from the back plate assembly and discard.

h. Remove the diaphragm from the front plate, by prying with a sharp tool. Discard the diaphragm.

i. Lift the two springs and steel balls from the holes in the front plate. Separate the back-up gasket, protector gasket, diaphragm seal and shaft seal from the front plate. Discard all gaskets and seals.

5-49. INSPECTION AND REPAIR OF PUMP PARTS, CATCO D6 TRACTOR (First Used With Winch Serial No. C82P-1873). (See Figure 5-20.) Inspect and repair pump parts as follows:

a. Clean and dry all parts. Remove nicks and burrs from all parts with fine abrasive cloth or paper. If edge of gear teeth are sharp, break edge using same type of abrasive.

b. Inspect the drive gear and idler gear shafts at the bearing points and seal areas for rough surfaces and excessive wear. If shaft diameters measure less than 0.6850 in bearing area, replace the whole gear assembly.

**NOTE** One gear assembly may be replaced separately if the other gear assembly is okay. Shafts and gears are available as assemblies only.

c. Inspect the gear faces and ends for scoring and excessive wear and replace gear assembly, if necessary. Replace the gear assembly if the gear width is less than 1.330. Check snap rings for proper fit in grooves.

d. Inspect ID of end plate bearings and replace entire end plate assembly if ID exceeds 0.691 inch.

**NOTE** Bearings are not available separately.

## Overhaul Instructions

e. Check that the oil grooves in the bearings, in both end plates, are in line with the dowel pin holes and 180 degrees apart to assure optimum closeness of oil groove to respective dowel pin hole. The bearings in the front plate should be flush with the islands in the groove pattern.

f. Inspect the inner face of the back plate for scoring and replace the plate assembly if rough, or if wear exceeds 0.0015 inch.

g. Inspect the gear pockets in body for excessive scoring or wear. Replace the body if ID of gear pocket exceeds 1.719 inches.

5-50. PUMP REASSEMBLY, CATCO D6 TRACTOR (First Used With Winch Serial No. C82P-1873). (See Figure 5-20.) Reassemble the pump as follows:

a. Obtain a new diaphragm, back-up gasket, diaphragm seal, protector gasket, O-ring and shaft seal before starting reassembly.

b. Tuck the diaphragm seal into the grooves in the front plate with the open part of the "V" section down (use dull tool). Press the protector gasket and back-up gasket into the diaphragm seal.

c. Drop the two steel balls into their respective seats in the front plate and place the springs over the balls. Place the diaphragm on top of the back-up gasket with the bronze face up and positioned so that the entire diaphragm fits inside of the raised rim of the diaphragm seal.

d. Dip the gear assemblies in clean hydraulic oil and slip into their respective front plate bearings.

e. Insert the two dowel pins in the body. Apply a thin coat of heavy grease to both milled faces of the body. Position the scribe line on the body with the matching line on the front plate. Slip the body over the gears onto the front plate. Half moon port cavities in the body must face away from front plate. Note small drilled hole in one of cavities which must be located on the pressure side of the pump.

f. Place an O-ring seal in the groove in the back plate. Slide the back plate over the gear shafts with the scribe line on the back plate positioned to match the scribe line on the body. Engage dowel pins in holes and hand press assemblies firmly together.

g. Insert two 3-1/4-inch long 12-point, two 3-1/4-inch long hex-head, and four 3-inch long capscrews

in positions shown in Figure 5-20. Tighten all capscrews evenly to 23 ft.-lbs. torque.

h. Apply a liberal coating of hydraulic oil to the shaft seal. Work the seal carefully over the drive gear shaft taking care not to cut the rubber sealing lip. Seat the seal in the cavity by tapping with a plastic hammer.

i. Check for drive shaft freedom of rotation by rotating the shaft by hand. Pump should have a slight amount of drag but should turn freely after a short period of use.

j. Cap the suction and pressure ports to prevent entrance of dirt until the pump is installed on tractor.

### 5-51. REASSEMBLY AND INSTALLATION.

5-52. 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 retainers and cover plate capscrews.

### 5-53. Reassembly of Clutch Assemblies (Power Controlled Winch Only).

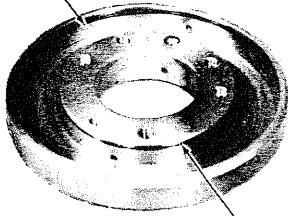
5-54. Reassembly of the clutch assemblies used in the Power Controlled winch is shown in Figure 5-21.

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

### 5-55. Installation of Drum and Drum Shaft.

5-56. Reassembly and installation of the drum and drum shaft is shown in Figure 5-22. During installation of the drum and drum shaft, see the illustration of special tools (Figure 5-30) 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.

LARGE O-RING

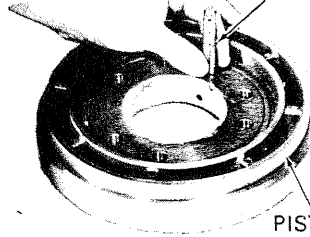


SMALL O-RING

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.

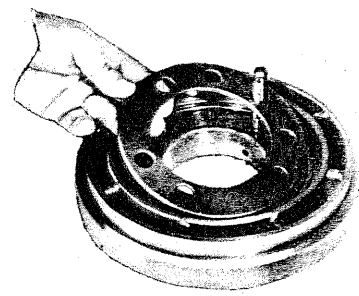
COOLING OIL VALVE



PISTON

STEP 2. Install piston and cooling oil valve. Tighten valve with special tool (See figure 5-30).

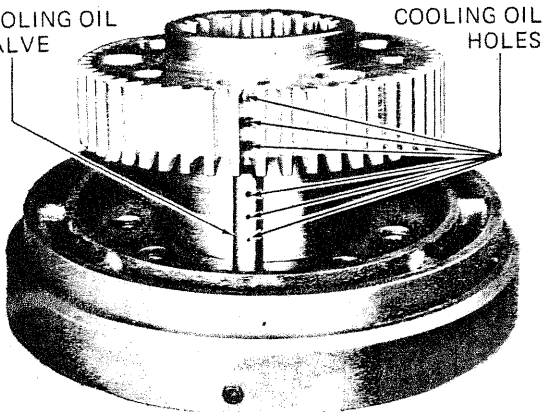
CAUTION: Do not insert any tool through valve body. It will damage spring.



STEP 3. Install spring retainer with smooth side up.

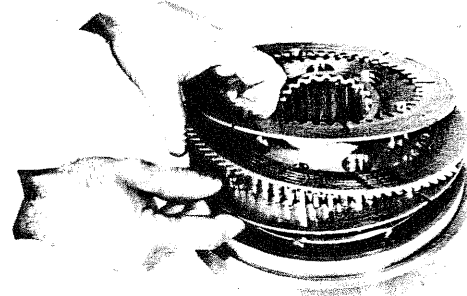
NOTE: Holes are sequenced so spring retainer can only be installed as shown.

COOLING OIL VALVE



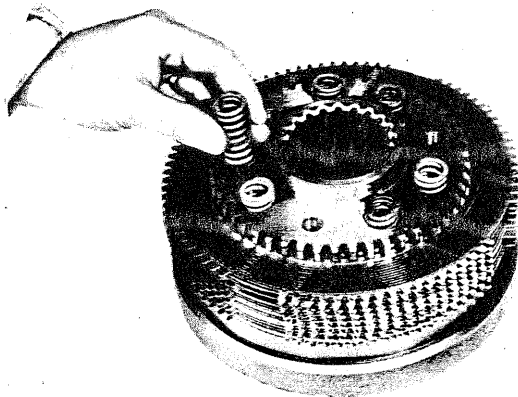
STEP 4. Install clutch hub.

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

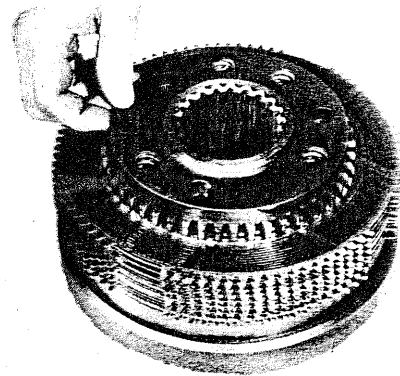


STEP 5. Place six separator plates and six friction discs ALTERNATELY on clutch hub.

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 six release springs.

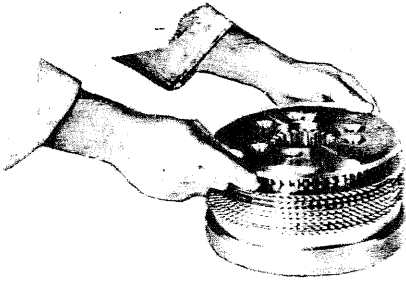


STEP 7. Install shim if required (See STEP 10.)

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

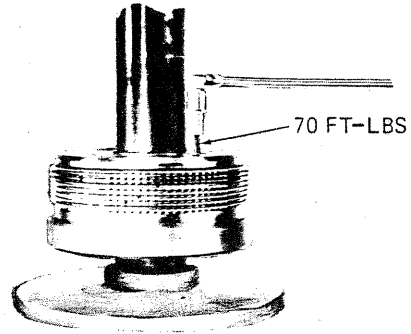
FIGURE 5-21. REASSEMBLY OF CLUTCH ASSEMBLY, POWER CONTROLLED WINCH (Sheet 1 of 2)

## Overhaul Instructions



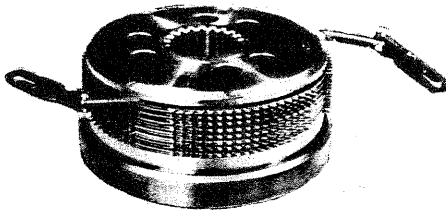
STEP 8. Install cover plate.

**CAUTION:** Holes are sequenced so cover plate can only be installed as shown.



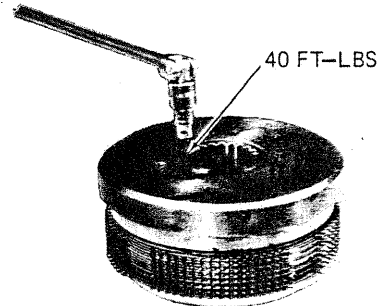
STEP 9. Install and tighten six special cap screws.

**CAUTION:** The press adapters should contact the hub only. Apply only enough pressure to prevent assembly from turning when cap screws are tightened.

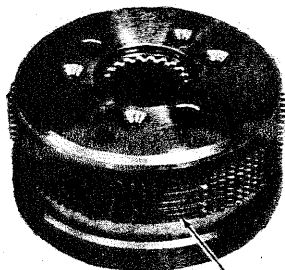


STEP 10 Measure distance between cover plate and top friction disc with two feeler gauges placed 180° apart as shown. Gap should be 0.065 to 0.125 inch. Add or delete shims as required, to obtain correct clearance (see Step 7).

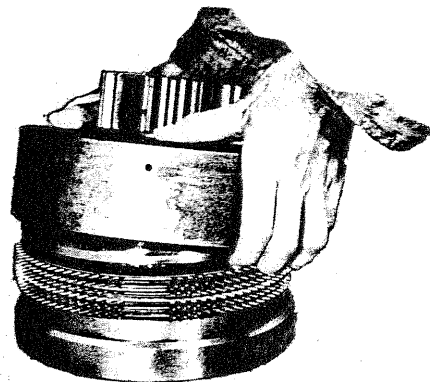
**CAUTION:** When only one feeler gauge is used, friction disc will tip slightly giving false clearance.



STEP 11. Tighten six set screws that lock the special cap screws.



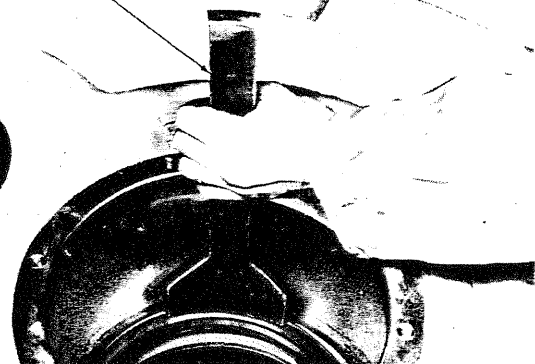
STEP 12. Align friction discs as shown.



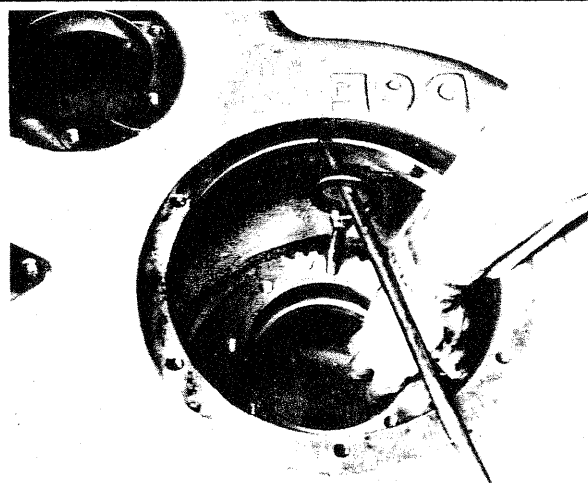
STEP 13. Carefully slide spider gear over clutch pack.

FIGURE 5-21. REASSEMBLY OF CLUTCH ASSEMBLY, POWER CONTROLLED WINCH (Sheet 2 of 2)

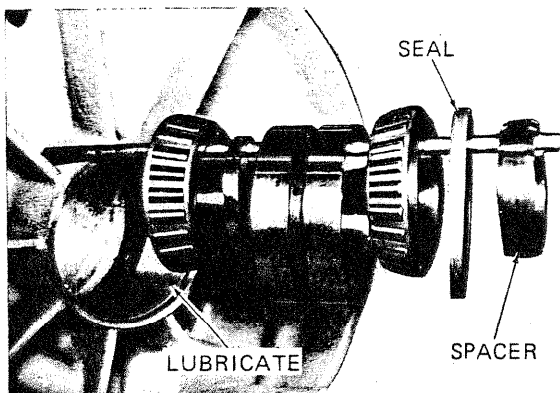
SPECIAL TOOL  
SEE FIGURE  
5-30



STEP 1. Lubricate seal bore with petrolatum or other suitable lubricant. Install double-lip seal with smooth side down. Use seal driver as shown to prevent seal distortion.

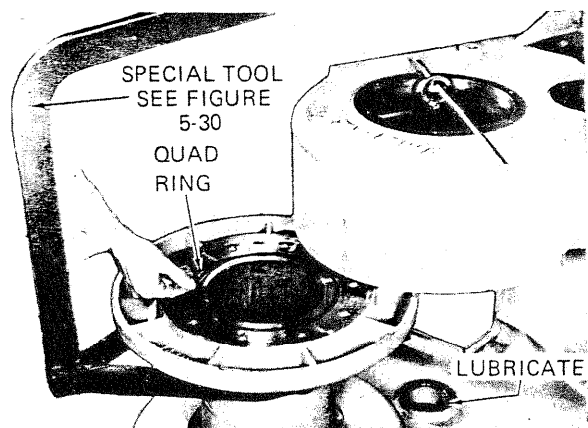


STEP 2. Install drum adapter by lifting it up through double-lip seal. Hold in place with bar and eyebolt as shown.



STEP 3. Lubricate drum bore with petrolatum, then install double-taper roller bearing, seal, and spacer as shown.

NOTE: Smooth side of seal must face inward.



STEP 4. Lubricate left-hand drum shaft bore. Coat quad ring and groove with permatex or other suitable compound. Install quad ring, then place drum in position using special attachment.

STEP 5. Align adapter and drum holes, then install the 12 locking dowels and capscrews. Tighten securely to prevent quad ring from shifting.

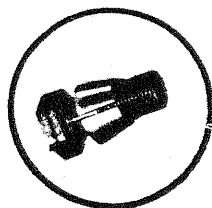
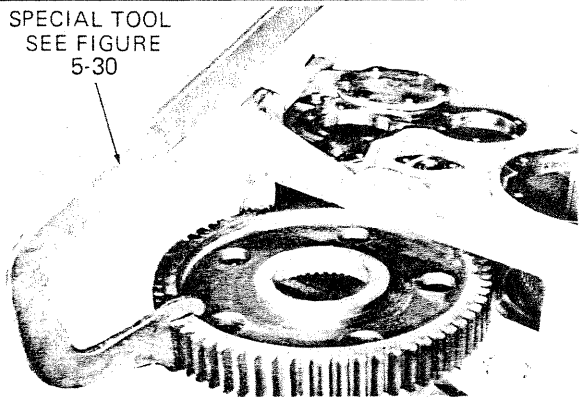


FIGURE 5-22. INSTALLATION OF DRUM AND DRUM SHAFT (Sheet 1 of 3)

# Overhaul Instructions

SPECIAL TOOL  
SEE FIGURE  
5-30

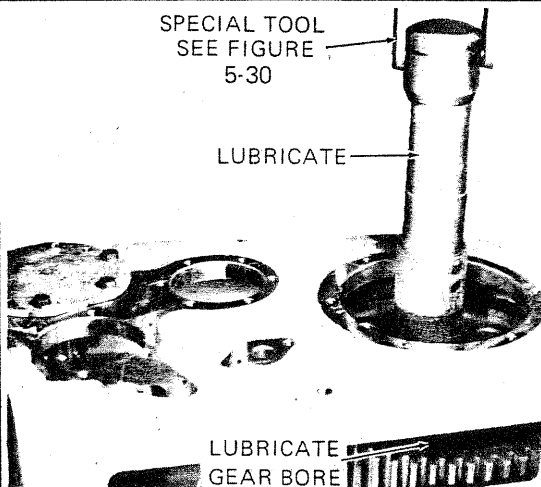


NOTE: If intermediate shaft bearing cup has been removed install cup as shown in Figure 5-24

STEP 6. Install drum gear using special attachment as shown.

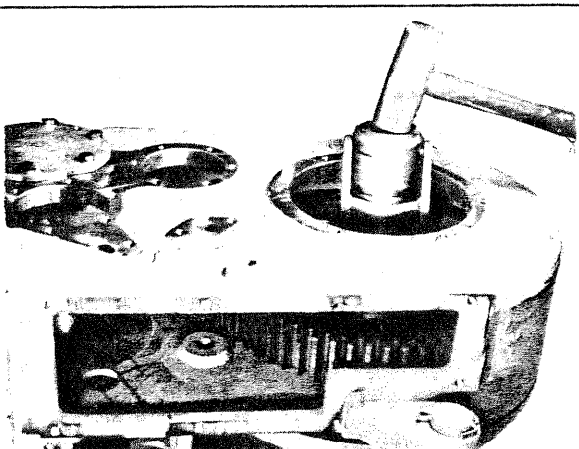
SPECIAL TOOL  
SEE FIGURE  
5-30

LUBRICATE



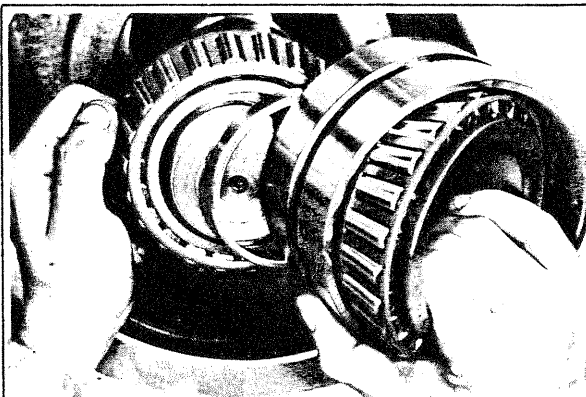
LUBRICATE  
GEAR BORE

STEP 7. Make sure that double taper roller bearing, seal and spacer are properly seated in drum (see step 3). Lubricate drum shaft and drum gear bore, then install drum shaft using special attachment as shown.



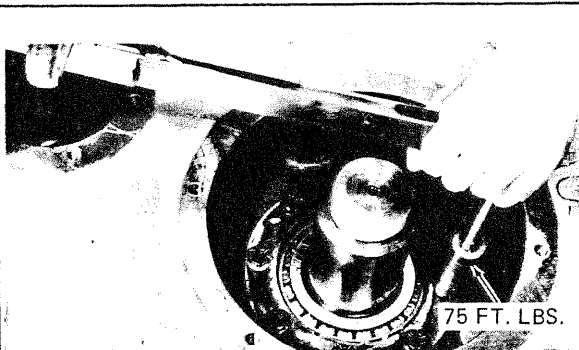
STEP 8. Drive shaft down through drum gear until shaft bottoms solidly against lower taper roller bearing.

CAUTION: Hammer on special attachment only. Do not hammer on drum shaft surface.



CAUTION: Prior to installing bearing, pour 2 quarts SAE 90 oil over drum shaft. This will provide initial lubrication for the lower bearing.

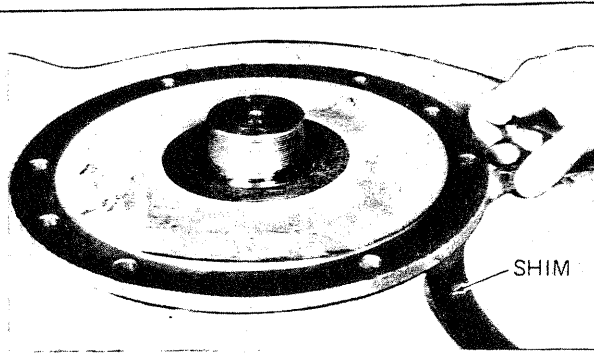
STEP 9. Install bearing assembly. Install bearing parts in sequence shown. Tap into place.



STEP 10 Install retainer plate using the eight special capscrews. Tighten capscrews to 75 ft-lbs.

FIGURE 5-22. INSTALLATION OF DRUM AND DRUM SHAFT (Sheet 2 of 3)

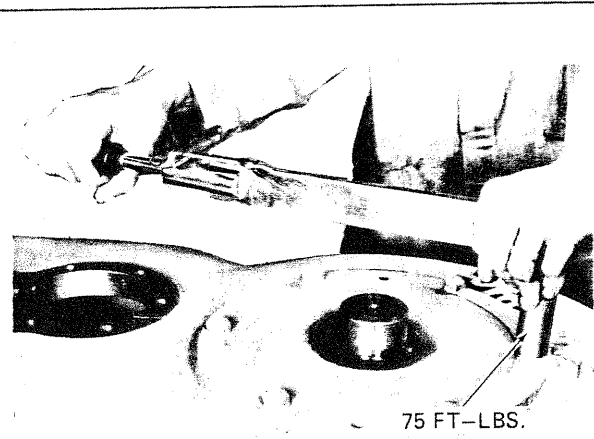




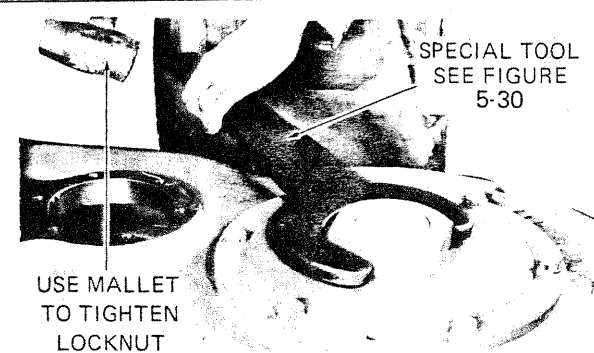
STEP 11. Set bearing retainer into place. Determine shim pack by sliding segment of shim between retainer and winch frame. Add shims until slight drag is felt. Remove retainer.



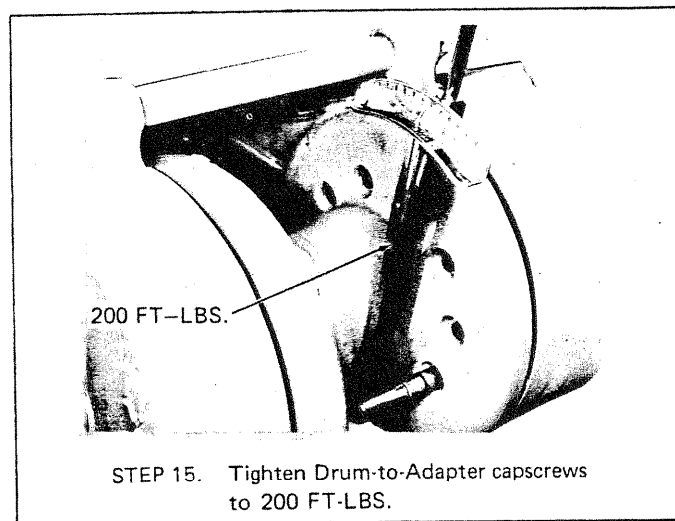
STEP 12. Coat winch frame and bearing retainer flange with permatex or other suitable sealing compound. Install shim pack (determined in Step 10).



STEP 13. Secure retainer using eight capscrews and lockwashers. Tighten capscrews to 75 ft.-lbs.



STEP 14. Coat locknut threads with permatex or other suitable sealing compound. Install nut and tighten securely as shown. Place winch in normal operating position and install locknut on opposite end of drum shaft.



STEP 15. Tighten Drum-to-Adapter capscrews to 200 FT-LBS.

FIGURE 5-22. INSTALLATION OF DRUM AND DRUM SHAFT (Sheet 3 of 3)

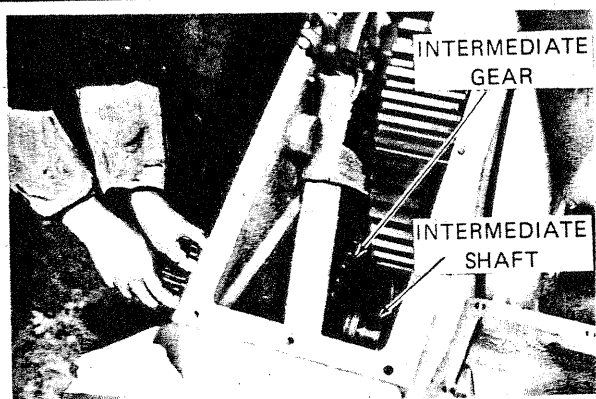
## Overhaul Instructions

### 5-57. Installation of Intermediate Shaft Assembly.

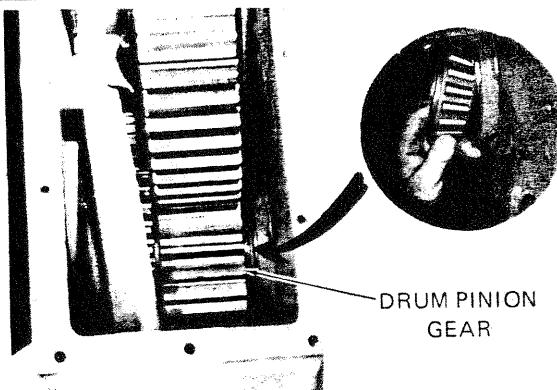
5-58. Installation of the intermediate shaft and associated components is shown in Figures 5-23 and 5-24. Figures 5-23 and 5-24 show the winch removed from the tractor with the bevel gear shaft and brake shaft removed. However, the intermediate shaft can be installed with the winch mounted on the tractor and with only the drum shaft bearing retainer removed for the necessary clearance.

### 5-59. Installation of Brake Shaft Assembly.

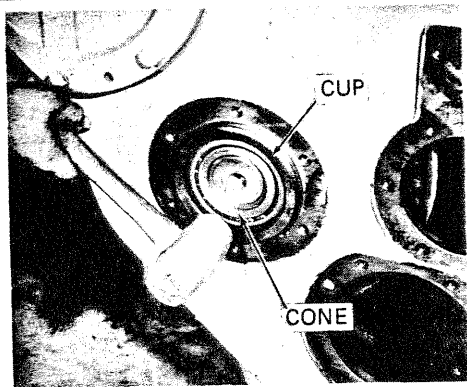
5-60. Installation of the brake shaft and associated components is shown in Figure 5-25. The brake shaft and reduction gear must be installed before installation of the bevel gear shaft assembly. The brake shaft cannot be installed when the winch is mounted on the tractor unless the tractor tracks are removed or disconnected. The brake shaft installation must be adjusted for 0.000- to 0.004-inch preload.



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 5-23. INSTALLATION OF INTERMEDIATE SHAFT ASSEMBLY

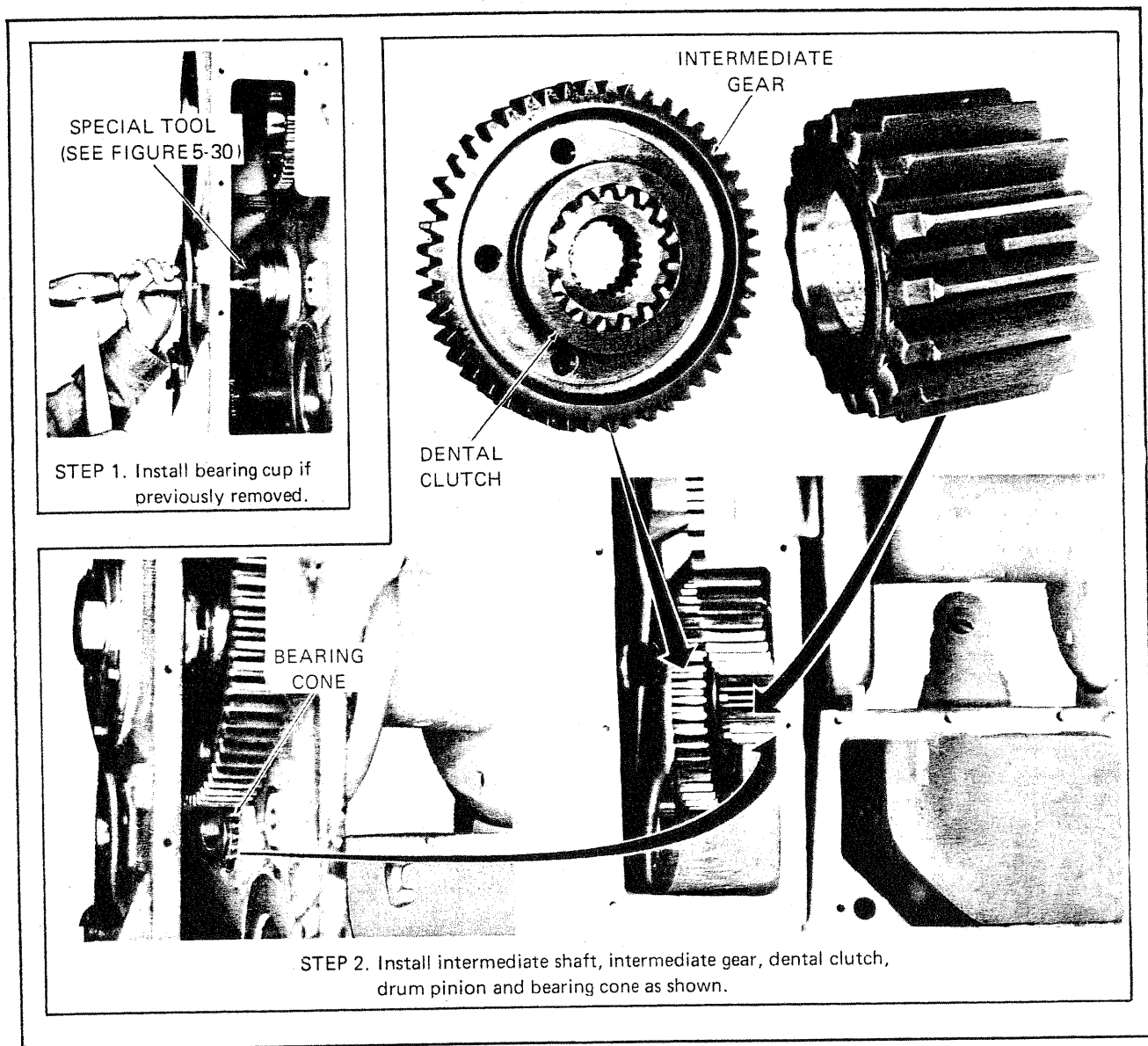


FIGURE 5-24. INSTALLATION OF INTERMEDIATE SHAFT ASSEMBLY FOR WINCH WITH FREE SPOOLING  
(Sheet 1 of 2)

# Overhaul Instructions

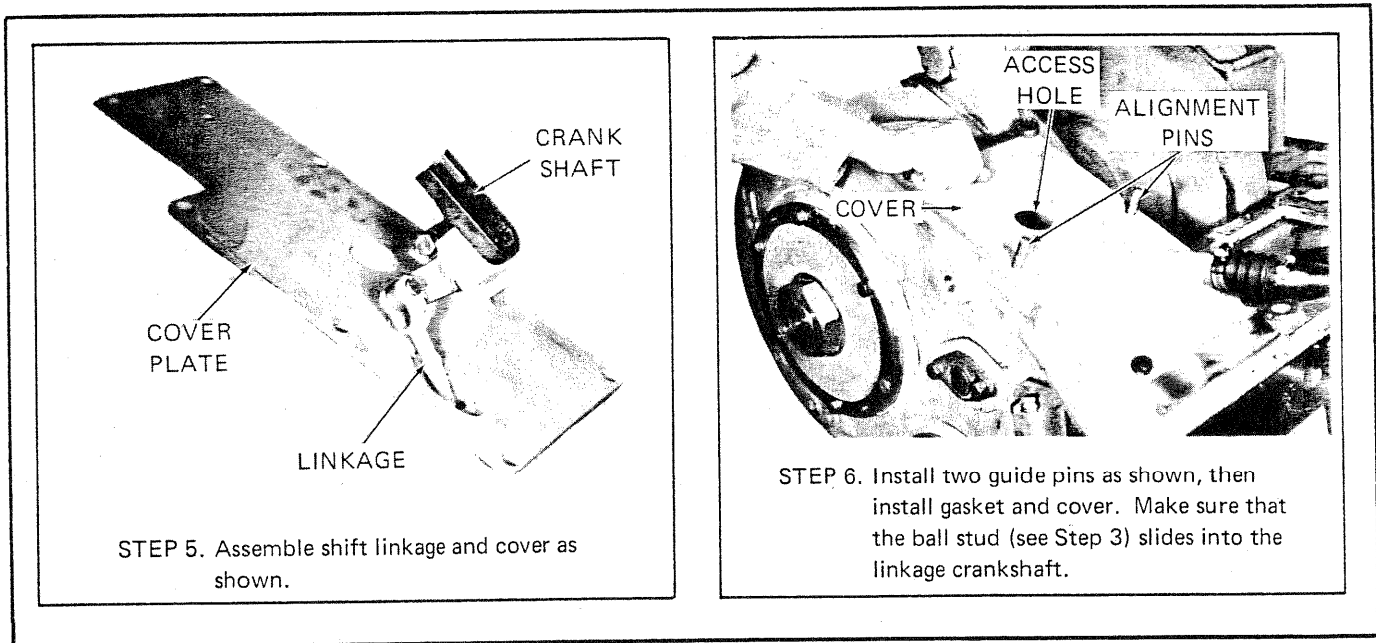


FIGURE 5-24. INSTALLATION OF INTERMEDIATE SHAFT ASSEMBLY FOR WINCH WITH FREE SPOOLING  
(Sheet 2 of 2)

## 5-61. Reassembly and Installation of Bevel Gear Shaft Assembly (Power Controlled Winch).

5-62. Reassembly and installation of the bevel gear shaft assembly used in the Power Controlled winch is shown in Figure 5-26. Installation of the bevel gear shaft can be accomplished with the winch mounted on the tractor.

**NOTE** The reduction gear (see Figure 5-25) 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.

## 5-63. Reassembly and Installation of Bevel Gear Shaft Assembly (Direct Drive Winch).

5-64. Reassembly and installation of the bevel gear shaft assembly used in the Direct Drive winch is essentially the same as for the bevel gear shaft used in the Power Controlled winch (see Figure 5-26). Reassemble and install the bevel gear shaft as shown in Figure 5-26, observing the following:

a. See Figure 5-6 for location of bevel gear shaft components.

b. The Direct Drive winch is equipped with dental clutches. Install the dental clutch so that the chamfered ramp faces toward the pinion gear.

c. Install the bevel gear and two spacers for either Underwind or Overwind operation. Refer to paragraph 4-15 or 4-19.

d. The bevel gear shaft must be adjusted for 0.006 to 0.009 inch endplay. This adjustment requires a different procedure than that used for preload adjustment for the power controlled winch (see Figure 5-26).

## 5-65. Reassembly and Installation of Hydraulic Brake Assembly (Power Controlled Winch Only).

5-66. Installation of the hydraulic brake assembly used in the Power Controlled winch is shown in Figure 5-27. Reassembly and installation of the hydraulic brake can be accomplished with the winch mounted on the tractor. Make sure that the bevel gear shaft has been installed prior to installation of the brake assembly.

## 5-67. Installation of Dry Brake and Automatic Brake (Direct Drive Winch Only).

5-68. Installation of dry brake (or optional automatic brake) used in the Direct Drive winch is shown in Figure 5-28. Installation procedures shown in Figure 5-28 apply to both the dry brake and optional automatic brake.

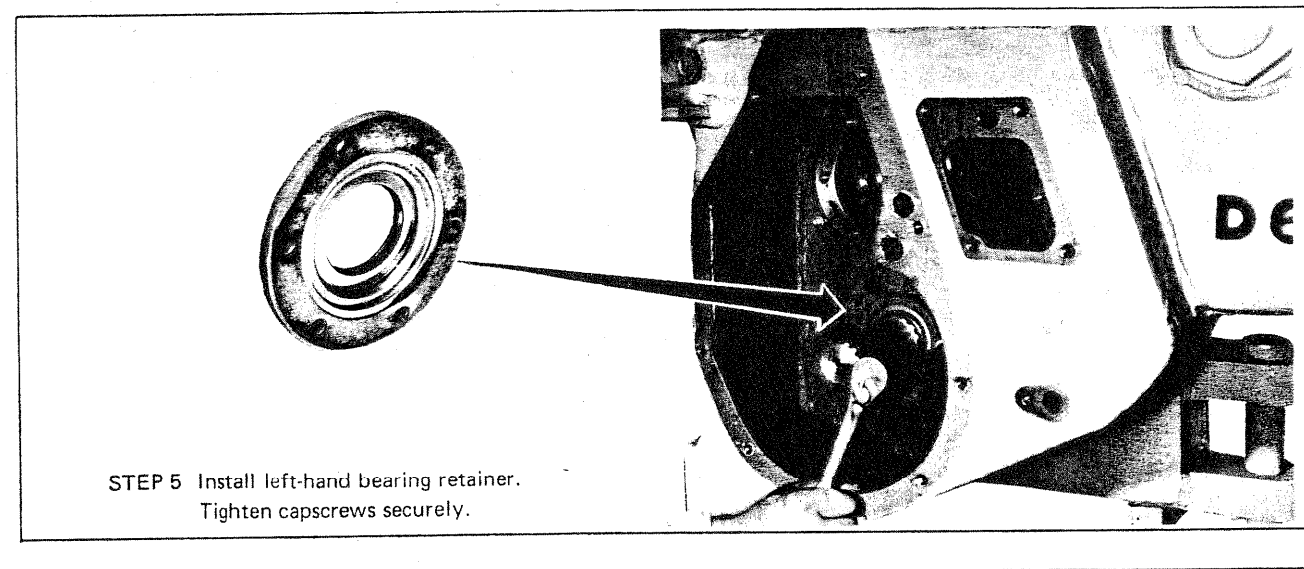
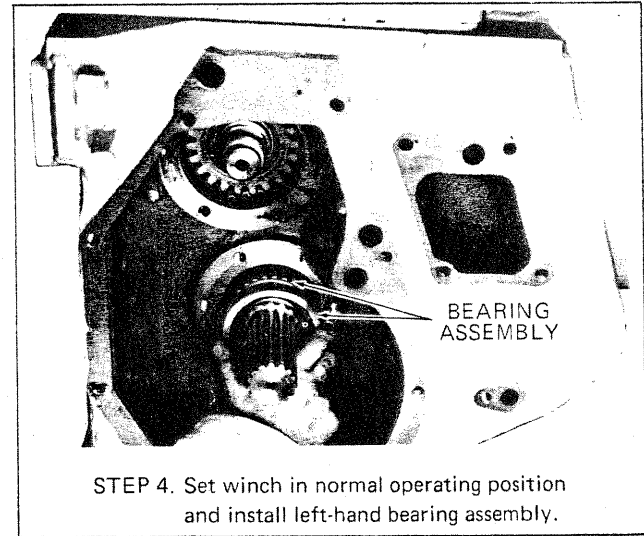
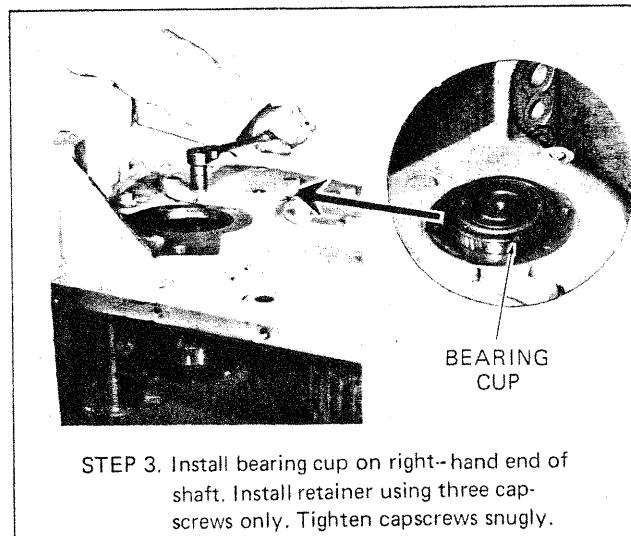
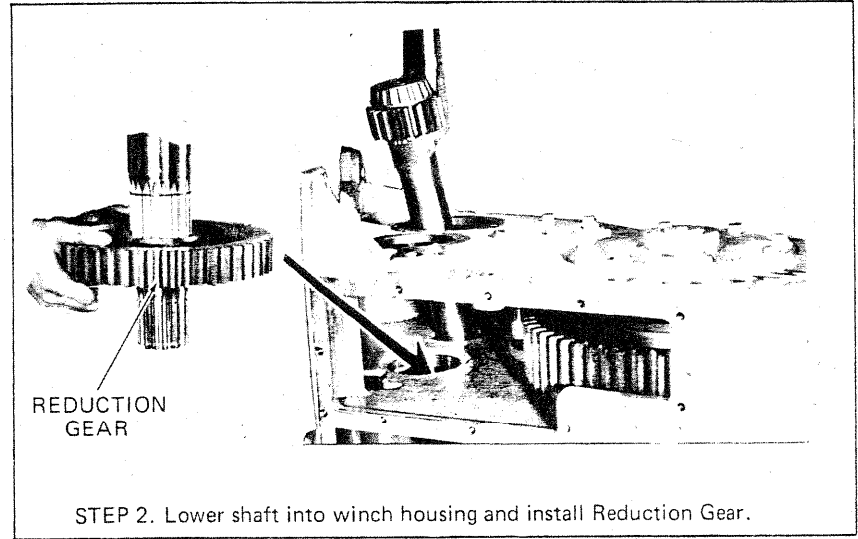
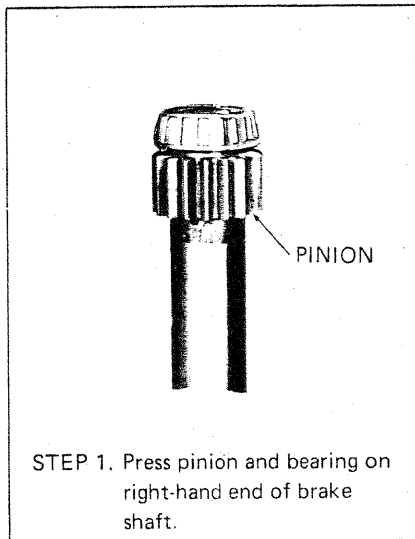


FIGURE 5-25. INSTALLATION OF BRAKE SHAFT (Sheet 1 of 2)

# Overhaul Instructions

## 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 0.000 to 0.004 inch less than average gap. This will place the desired preload on the brake shaft bearings.

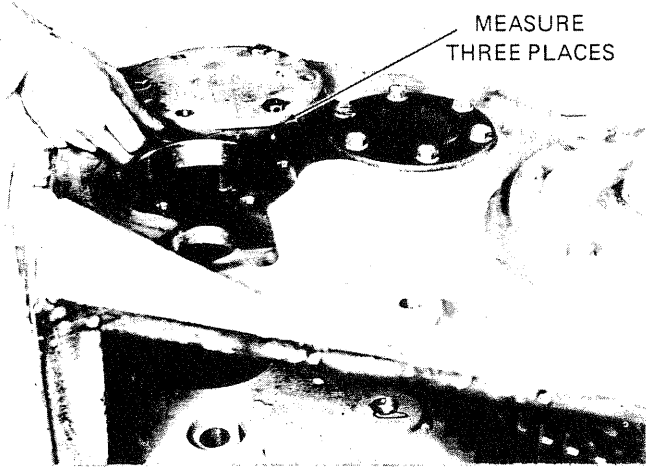


FIGURE 5-25. INSTALLATION OF BRAKE SHAFT (Sheet 2 of 2)

## 5-69. Installation of Winch on Tractor.

5-70. The D6E winch is attached to the tractor by eight studs. A single 1-inch diameter stud attaches at each of the two upper winch corners while two 1-inch diameter studs are used for attachment at each lower corner. Two 1-1/4-inch diameter studs, inboard of the upper corner studs, protrude into the winch housing and are drilled for use with castellated nuts and cotter pins. The corner studs are all out in the open and use lockwashers and nuts. The following checks and procedures should be made and followed during installation:

- a. Ensure that all shipping plugs are removed from winch before mounting on the tractor.
- b. Check the condition of the studs on the tractor before installing the winch. Replace any bent studs or ones with damaged threads. Minor thread damage may be dressed with a file.
- c. Clean all mounting surfaces on the winch and tractor before installation.
- d. Carefully check all hydraulic hoses and hose fittings for damage and general condition (power controlled winch only).
- e. Carefully check the push-pull mechanical cables for damage and general condition.
- f. Remove the suction manifold on power controlled winch and transmission cover on all winches before

installation to provide access for the upper, inboard stud nuts and cotter pins.

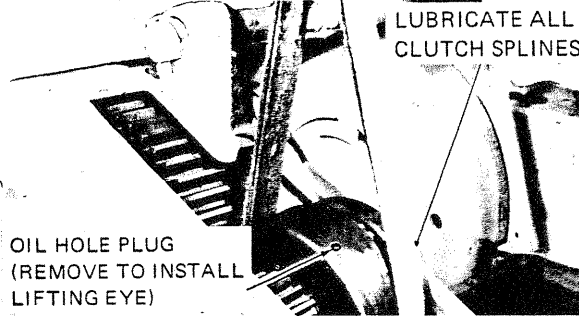
g. Place a new O-ring seal on each of the two upper, inboard studs and position the seal against the rear face of the tractor before the winch is raised in place.

h. Before raising the winch into place, ensure that the lifting device is in a safe operating condition and has a rating of at least 3000 pounds. Carefully check the cable or chain for damage.

**WARNING** Injury to personnel and damage to equipment may result from using too low a capacity lifting device, or one in poor condition.

i. Raise the winch to the proper height and move toward the tractor. Line up the splines on the tractor PTO with the coupling splines on the winch PTO shaft. Align the studs with the housing mounting holes. On direct drive models, route the push-pull control cables to the handling gear housing. Install loosely the two top, inboard nuts before the winch is fully seated.


j. Install the remaining six nuts with lockwashers. Tighten all nuts alternately at each side of the winch to pull the winch evenly against the tractor. Tighten the top, inboard castellated stud nuts to 170 ( $\pm 20$ ) ft.-lbs. torque and install 1/4 x 3-inch cotter pins. Tighten all six corner bolts to 110 ( $\pm 15$ ) ft.-lbs. torque.



**OIL HOLE PLUG**  
(REMOVE TO INSTALL LIFTING EYE)

**LUBRICATE ALL CLUTCH SPLINES**

**STEP 1.** Use sling around clutch, or cable attached to lifting eye installed in oil hole, to lower reverse clutch assembly into housing. Position clutch so that oil hole is up as shown. Replace plug, if removed.

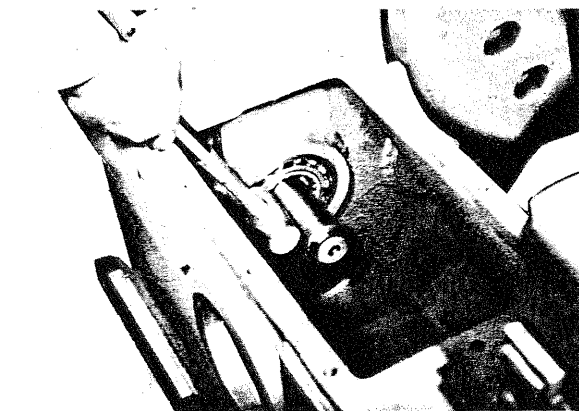


**SCRIBE LINE**

**SPLINED SEAL BORE**

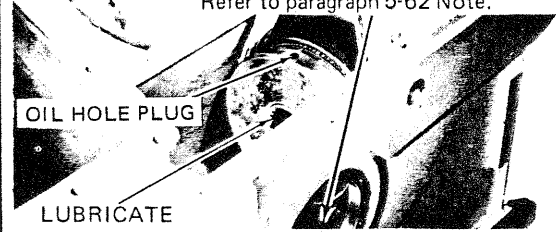
**STEP 2.** Position bevel gear shaft so that splined seal bore is directly in line with the set-screw at the top of reverse clutch assembly, then insert shaft. Make sure that scribe line on spline faces up. Lubricate entire shaft.

**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. Make sure that bearing face is flush with winch frame.

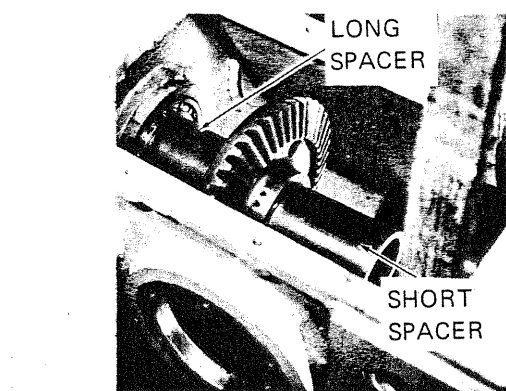
**NOTE:** If brake shaft has not been installed, make sure that brake reduction gear is installed in housing at this time. Refer to paragraph 5-62 Note.



**OIL HOLE PLUG**

**LUBRICATE**

**STEP 4.** Use sling around clutch, or cable attached to lifting eye installed in oil hole, to lower forward clutch assembly into housing. Position clutch so that oil hole is up as shown. Replace plug, if removed.

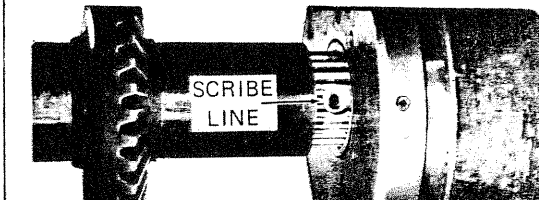


**LONG SPACER**

**SHORT SPACER**

**STEP 5.** Install the two spacers and bevel gear.

**NOTE:** Bevel gear and spacers are shown in overwind position. Refer to Paragraph 4-19. for underwind.



**SCRIBE LINE**

**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 5-26. REASSEMBLY AND INSTALLATION OF BEVEL GEAR SHAFT ASSEMBLY (Sheet 1 of 4)

# Overhaul Instructions

(PART A)

INSTALL TWO SEALS  
ON BOTTOM OF SHAFT.



NOTE: SEAL  
CONFIGURATION

(PART B)

INSTALL TWO SEALS  
ON TOP OF SHAFT.



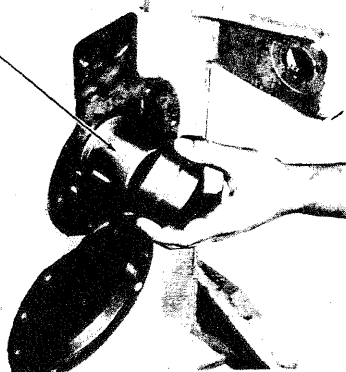
SCRIBE  
LINE

NOTE: SEAL  
CONFIGURATION

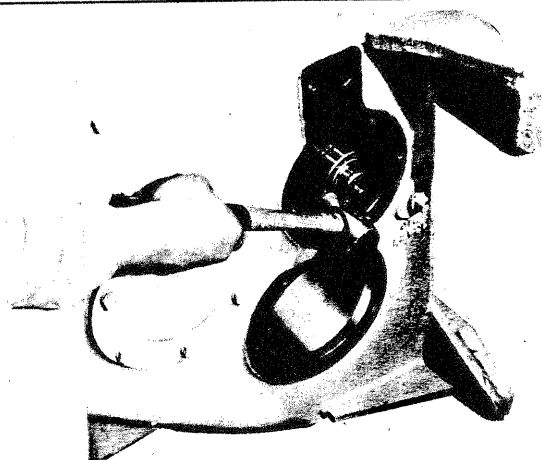
STEP 7. Carefully insert the four splined seals.

CAUTION: Lubricate spline seals prior to installation.

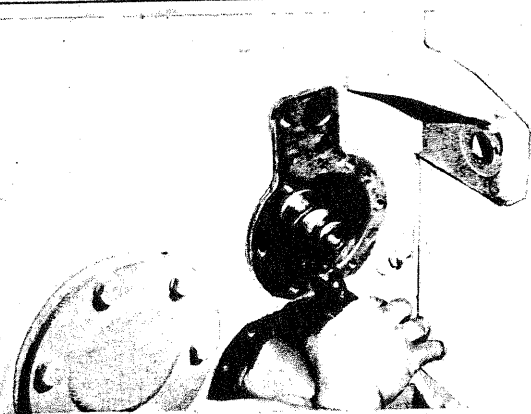
BEARING  
CARRIER



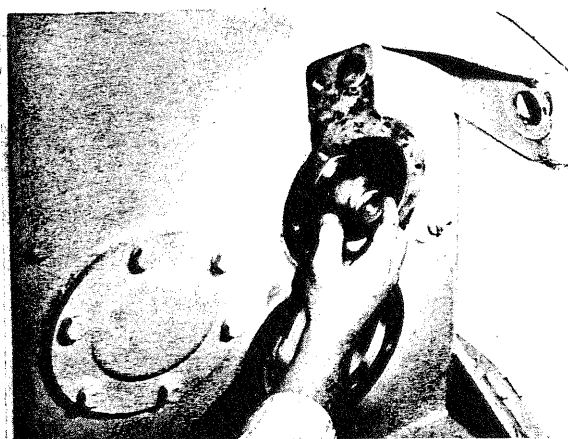
STEP 8. Carefully tap bevel gear shaft through the  
clutch assemblies. Install bearing assembly on  
right-hand end of gear shaft.



STEP 9. Tap bearing assembly into reverse clutch pack.



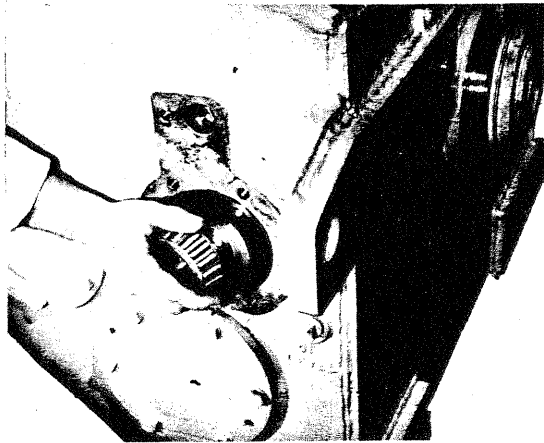
STEP 10. Install snap ring, making sure that it  
is properly seated in the clutch  
assembly groove.



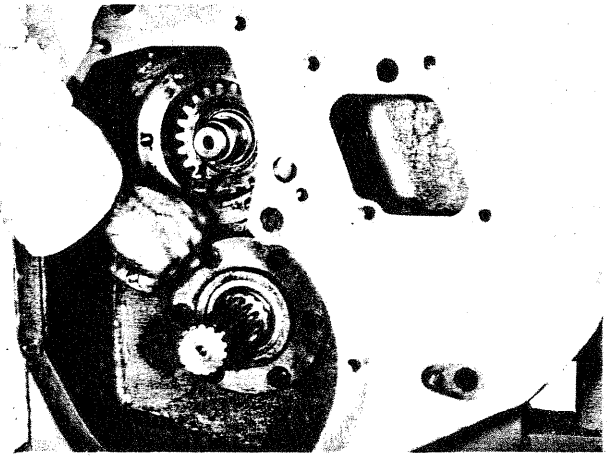
STEP 11. Install washer.

FIGURE 5-26. REASSEMBLY AND INSTALLATION OF BEVEL GEAR SHAFT ASSEMBLY (Sheet 2 of 4)





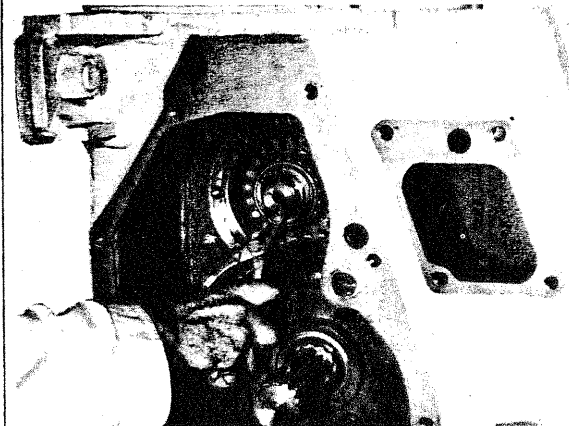
STEP 12. Install bearing.



STEP 13. Install bearing assembly on left-hand end of shaft, then install snap ring.



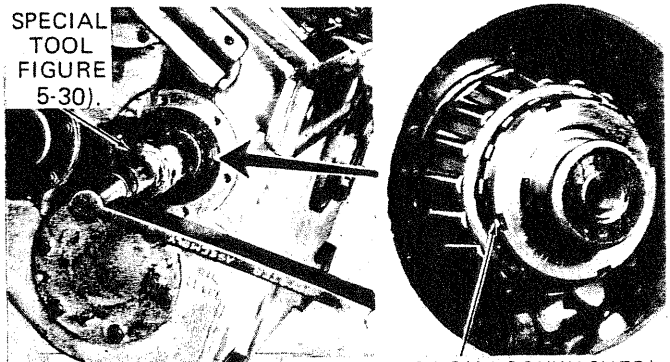
STEP 14. Install washer and bearing.



STEP 15. Tap bearing against clutch assembly, then install snap ring.

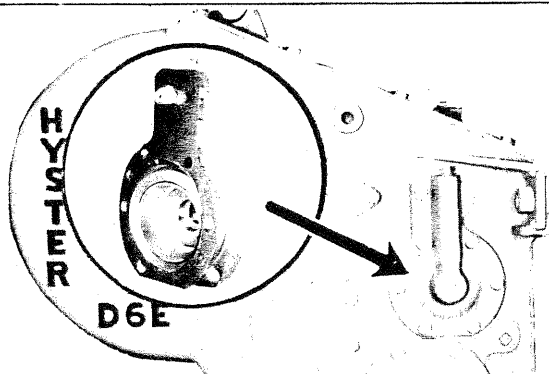


STEP 16. Install approximately 0.025 inch shim pack on left-hand bearing retainer, then install retainer. Tighten capscrews securely. Final torque at this time is not necessary.

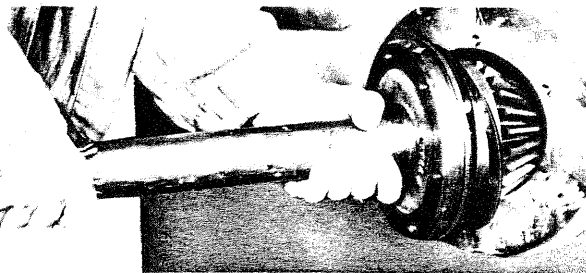


STEP 17. Install lockwasher and locknut on right-hand end of gear shaft. Tighten locknut to 200 ft-lbs. Bend lockwasher tangs over flats of locknut.

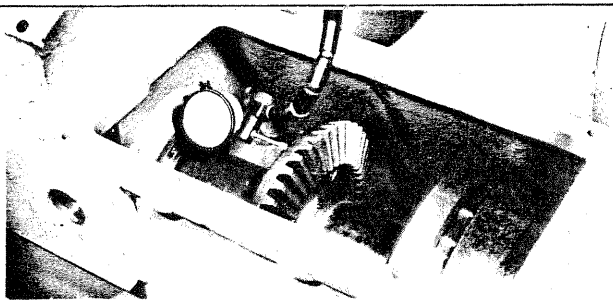
## Overhaul Instructions



STEP 18. 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.

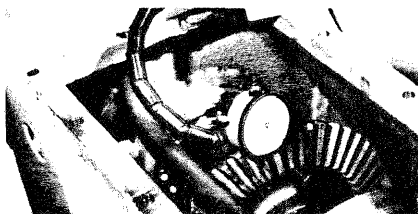


STEP 19. Install approximately 0.025 inch shim pack on PTO shaft and install shaft. Tighten capscrews securely. Check that PTO pinion teeth are positioned in the center of bevel gear teeth. Add or subtract shims at PTO shaft to center gear teeth. Tighten capscrews to 75 ft-lbs.



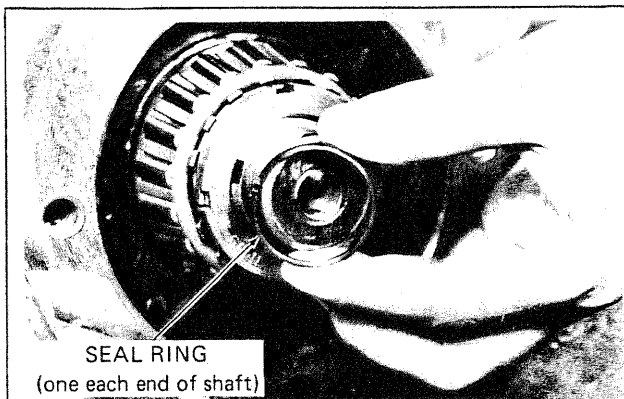
STEP 20. Connect dial indicator as shown to check bevel gear shaft preload. Add or subtract shims from the two bearing retainers to obtain zero endplay as indicated on dial indicator. When zero endplay is obtained, subtract 0.004 inch shim from either the right-hand or left-hand bearing retainer.

NOTE: Adding or subtracting shims from these retainers will effect pinion-to-bevel gear backlash. See step 21.



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 21. 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.



STEP 22. 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.

FIGURE 5-26. REASSEMBLY AND INSTALLATION OF BEVEL GEAR SHAFT ASSEMBLY (Sheet 4 of 4)

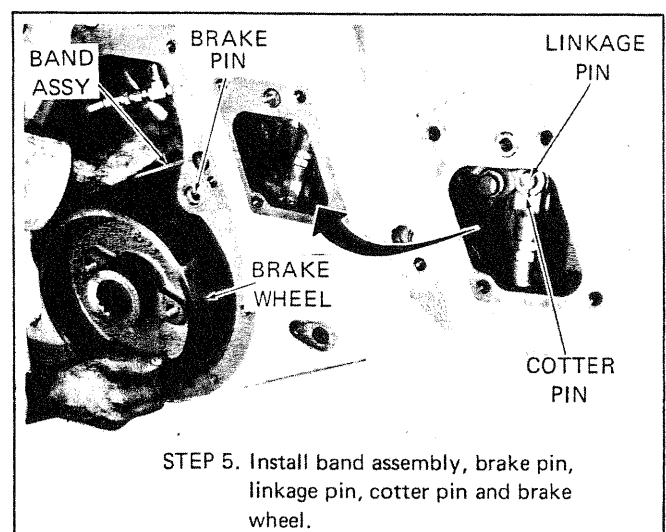
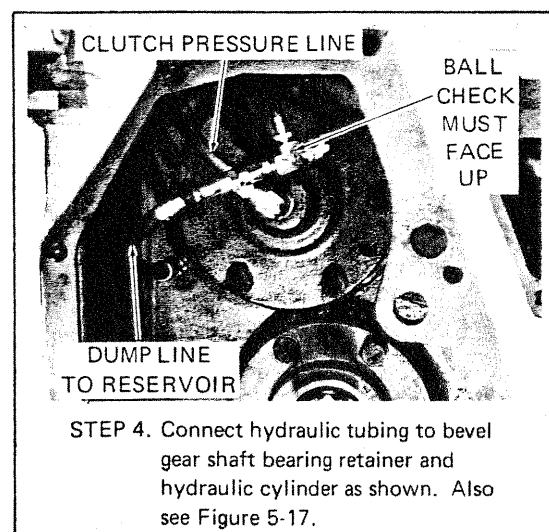
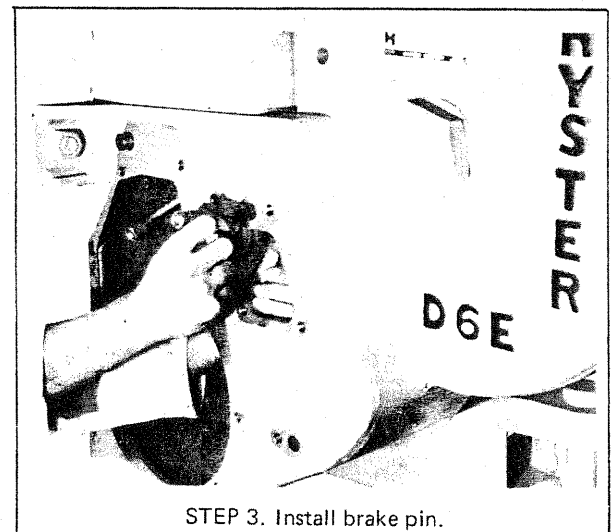
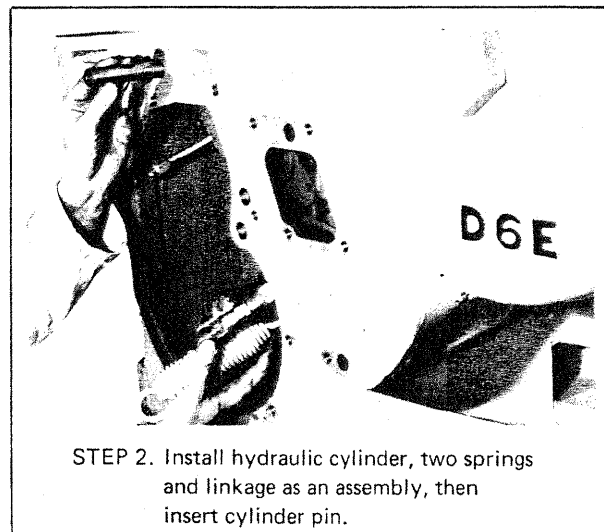
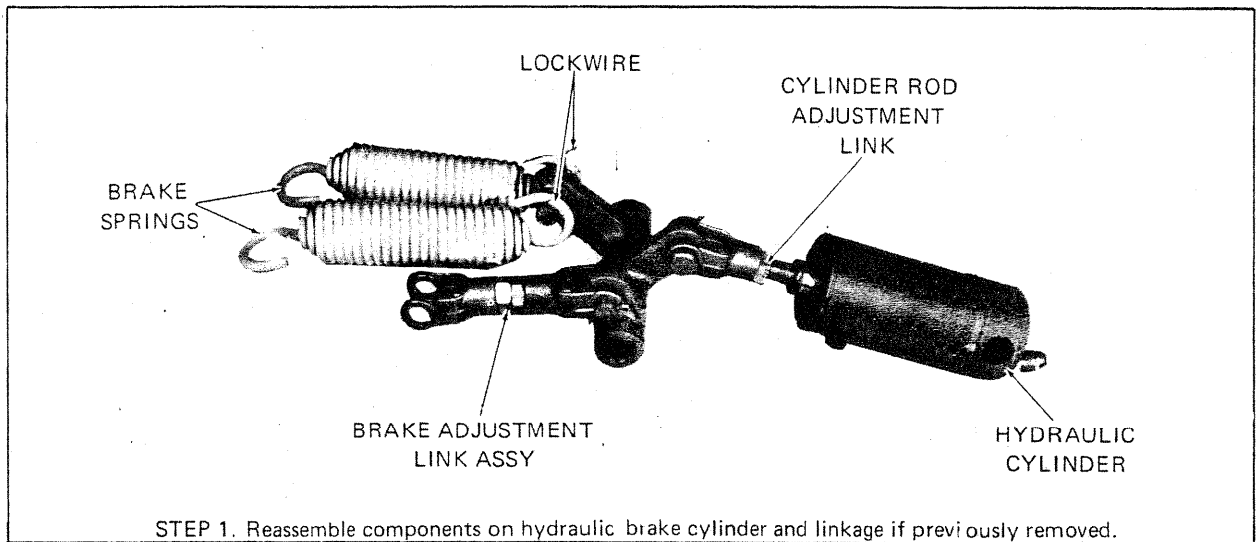
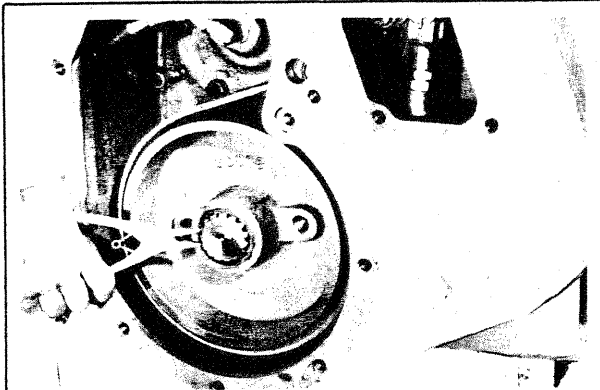


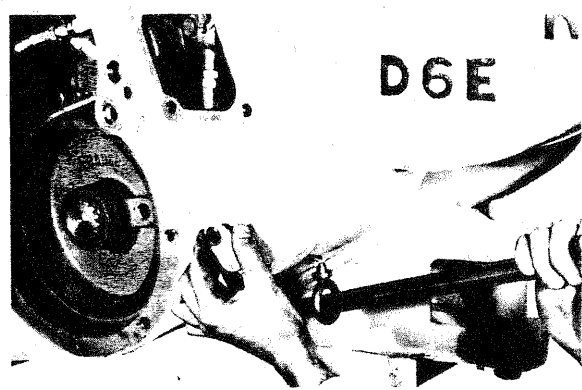
FIGURE 5-27. INSTALLATION OF HYDRAULIC BRAKE ASSEMBLY, POWER CONTROLLED WINCH (Sheet 1 of 2)

## Overhaul Instructions



NOTE: Refer to Paragraph 4-15 or 4-19 for correct pin and band arrangement (Overwind or Underwind).

STEP 6. Install snap ring.



STEP 7. Insert an eyebolt into spring retainer, then attach the end-loop on each brake spring to the retainer. Pull down on the eyebolt, then insert retainer pin through the retainer. This pulls the brake band against the brake wheel. Adjust brake linkage as described in Paragraph 4-29.

FIGURE 5-27. INSTALLATION OF HYDRAULIC BRAKE ASSEMBLY, POWER CONTROLLED WINCH (Sheet 2 of 2)

k. Recheck the bevel gear backlash and readjust if necessary (see Figure 5-26).

l. Replace the transmission cover using a new gasket, if necessary. For the power controlled winch, replace the suction manifold and cover, using new gaskets (see Figure 5-29).

m. On the power controlled winch:

(1) Connect the hydraulic suction line to the fitting on the suction manifold (see Figure 5-2).

(2) Connect the hydraulic pressure line to the fitting on the upper, left-hand side of the winch (see Figure 5-2).

**WARNING** Ensure that all hydraulic connecting clamps and fittings on the winch and tractor are tightened securely.

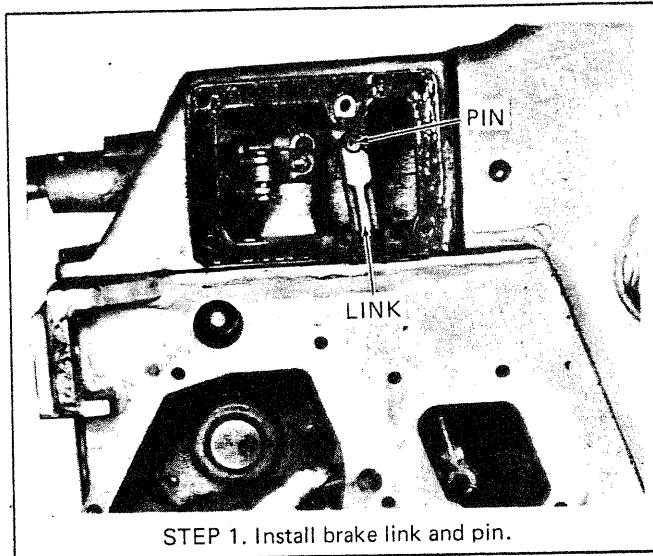
(3) Connect the winch oil pressure line to the fitting close to the hydraulic pressure line fitting (see Figure 5-2).

(4) If the control cables are disconnected, remove the top housing cover or, on later production models, remove the side access cover plate. Loosen the two setscrews on the cable anchor block and insert the cables through the block until the grooves in the cable sheathing ends are aligned with the setscrew. Tighten the setscrews and locknuts and install the retaining plate with capscrew. Connect the rod ends on the cables with the respective control valve spools using pins secured with cotter pins (see Figure 5-2). Adjust the cables per Adjustment Procedures, Section 4. Replace the top housing cover or access cover plate.

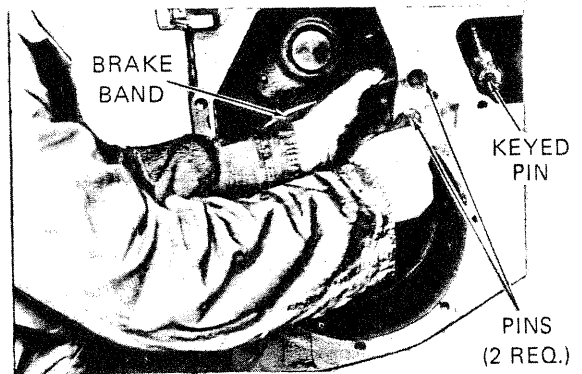
n. On the direct drive winch, adjust the push-pull control cables per Adjustment Procedures, Section 4.

### 5-71. SPECIAL TOOLS.

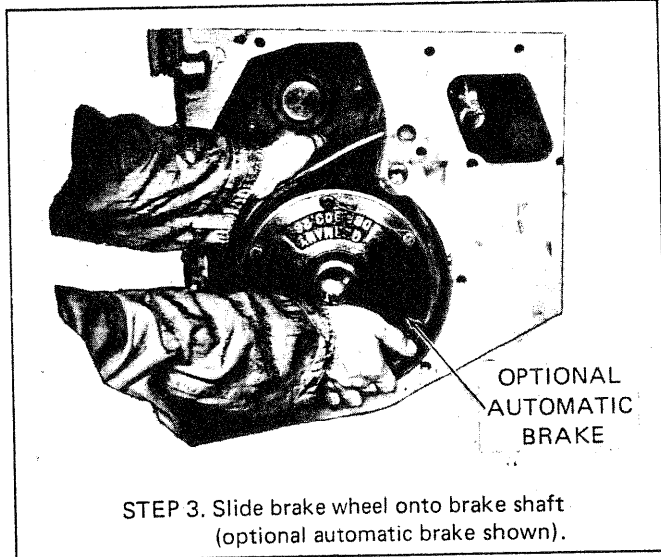
5-72. Figure 5-30 contains a listing of tools required during repair of the winch.



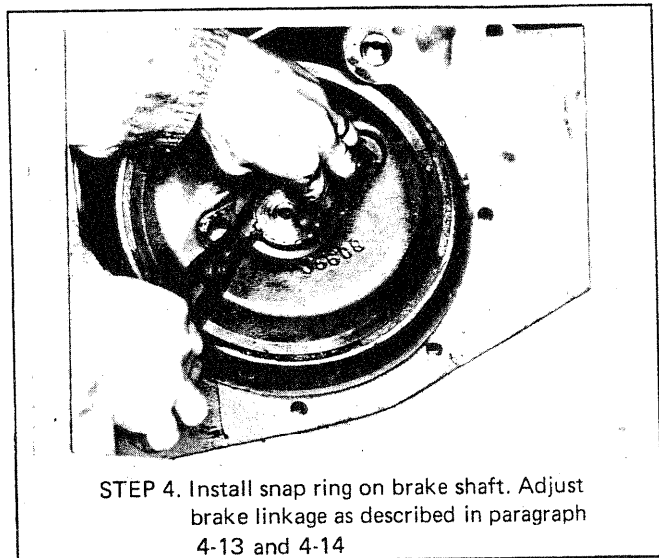
STEP 1. Install brake link and pin.



STEP 2. Install brake band and the three pins.  
CAUTION: Refer to paragraph 4-15 or 4-19 for correct pin and band arrangement (overwind or underwind)



STEP 3. Slide brake wheel onto brake shaft (optional automatic brake shown).



STEP 4. Install snap ring on brake shaft. Adjust brake linkage as described in paragraph 4-13 and 4-14

FIGURE 5-28. INSTALLATION OF DRY BRAKE AND AUTOMATIC BRAKE, DIRECT DRIVE WINCH

## Overhaul Instructions

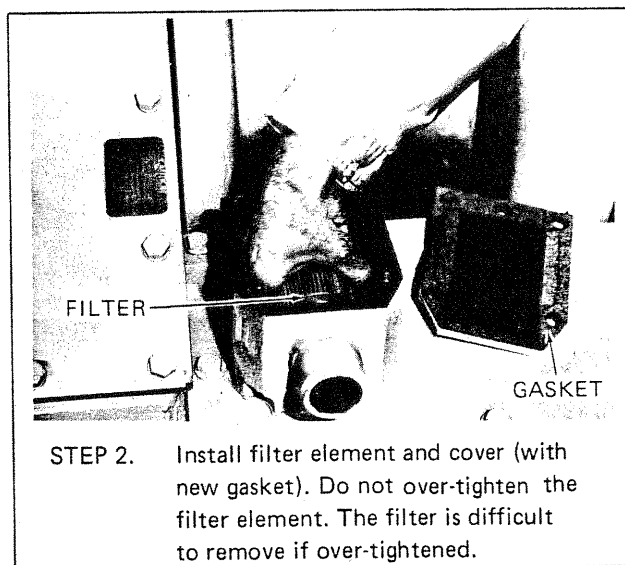
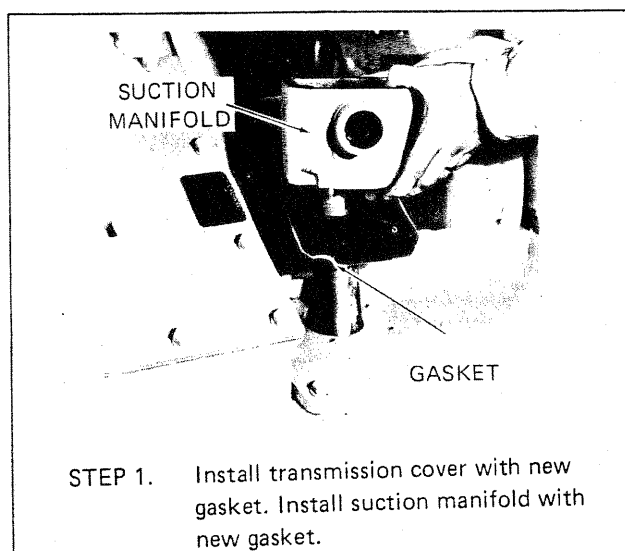
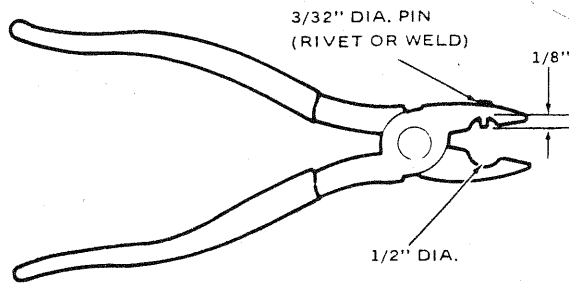


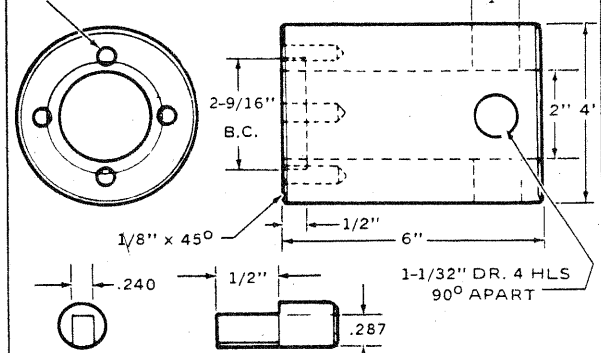
FIGURE 5-29. INSTALLATION OF SUCTION MANIFOLD, POWER CONTROLLED WINCH

Note: Modify Lineman's Plier As Shown.



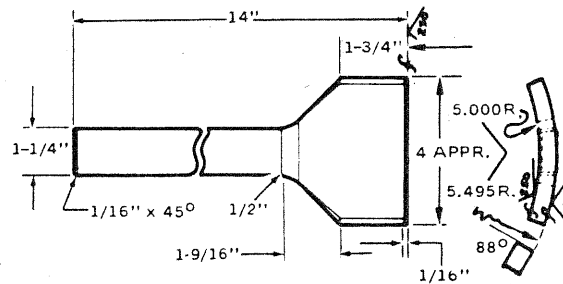
**CLUTCH COOLING OIL VALVE REMOVAL AND INSTALLATION (Power Controlled Only)**

3/8 RM. P.F. 4HLS On 2-9/16" B.C.



4 Req. Alter 3/8" Dia. x 1-1/4" Dowel

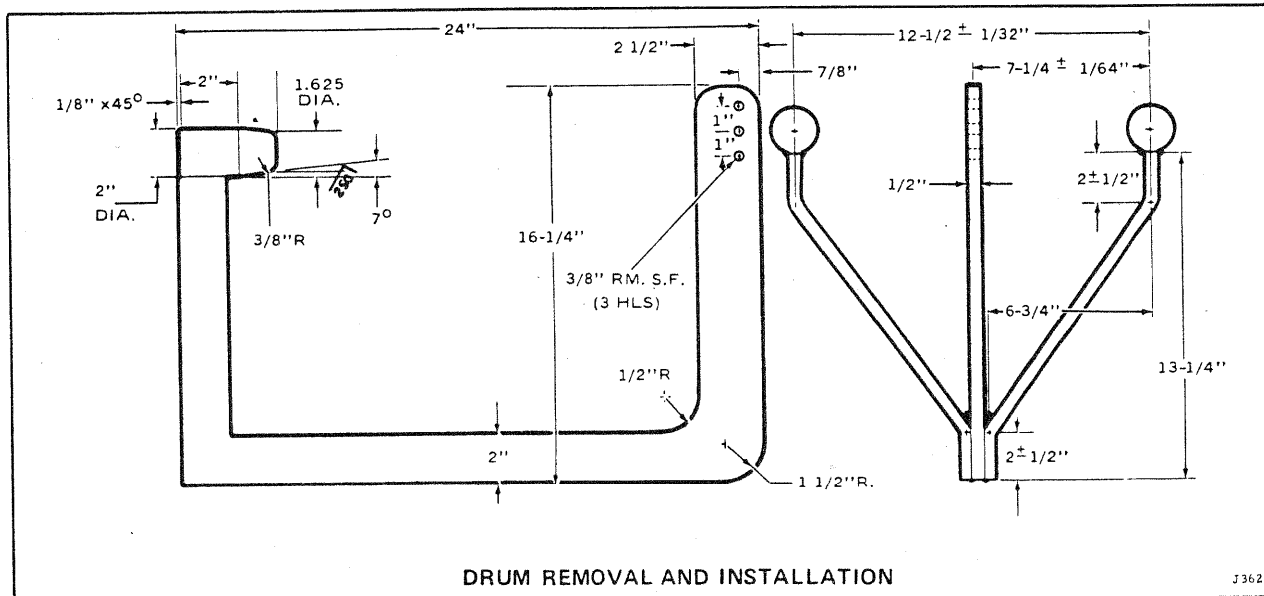
**BEVEL GEAR SHAFT LOCKNUT REMOVAL AND INSTALLATION (Power Controlled Only)**



Note: Break All Edges - 1/32"

One Req'd 1" x 4" x 14-1/8" H.C. No. 17 HF.

**DRUM OIL SEAL INSTALLATION**

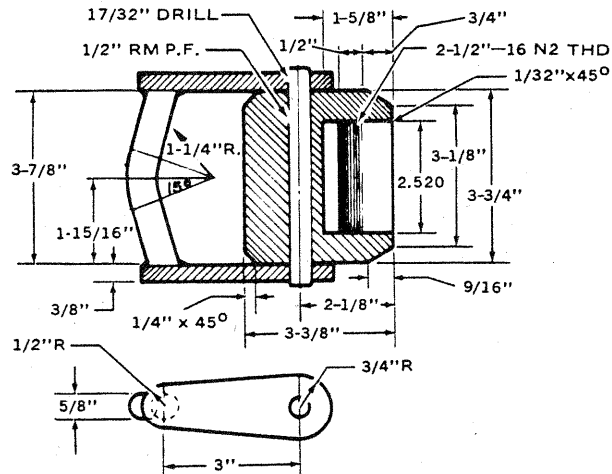


**DRUM REMOVAL AND INSTALLATION**

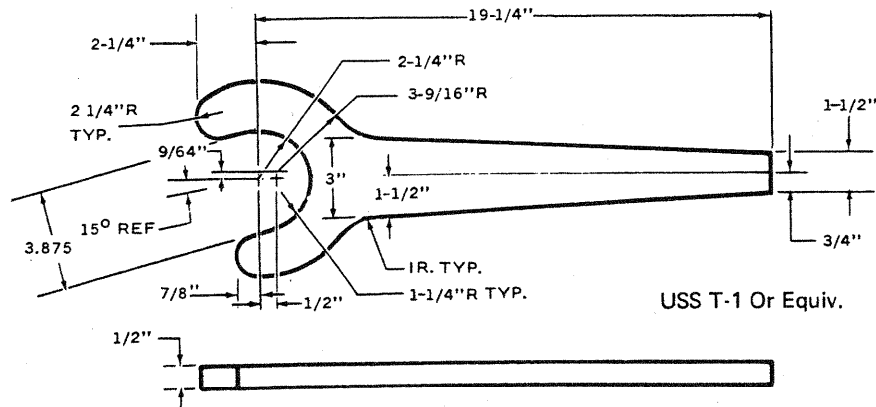
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FIGURE 5-30. SPECIAL TOOLS (Sheet 1 of 2)

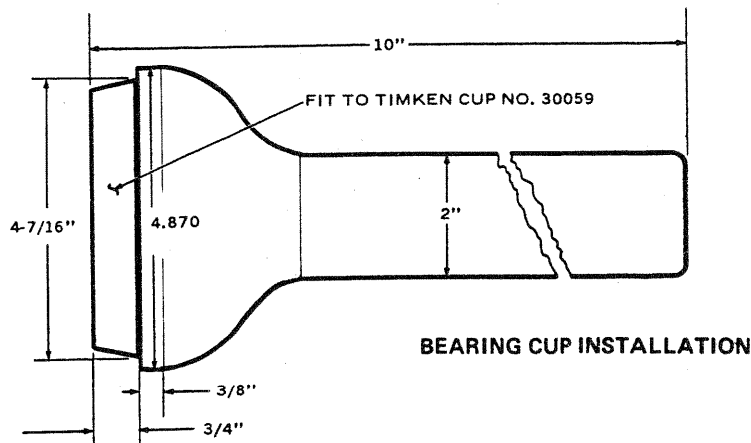
# Overhaul Instructions



DRUM SHAFT REMOVAL AND INSTALLATION



DRUM SHAFT NUT REMOVAL AND INSTALLATION



BEARING CUP INSTALLATION

J363

FIGURE 5-30. SPECIAL TOOLS (Sheet 2 of 2)