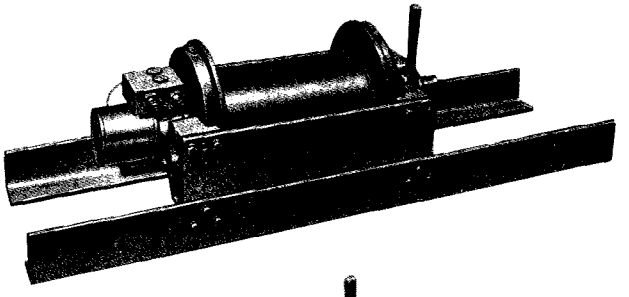
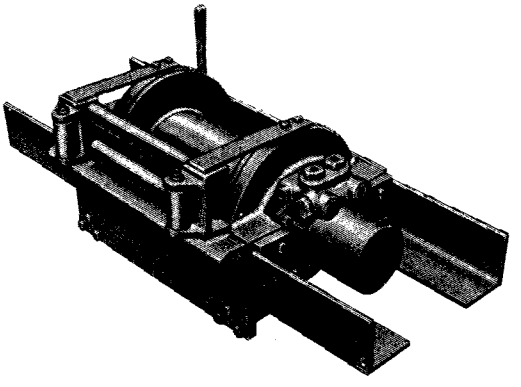
INSTALLATION, MAINTENANCE AND SERVICE

BRADEN SERIES

PD18





BRADEN WINCH
DIVISION OF BRADEN INDUSTRIES, INC.
PHONE: 918 — 251-8511 • BROKEN ARROW, OKLAHOMA 74012

11-7512-9

DESCRIPTION OF WINCH

The winch has three basic component parts:

1. Tie Plates and Side Frames
2. Hydraulic Motor and Brake Valve
3. Cable Drum Assembly

The Cable Drum Assembly is made up of five basic assemblies:

1. Cable Drum
2. Brake Assembly
3. Primary Planetary Reducer
4. Final Planetary Reducer and Output Shaft
5. Manual Clutch

The hydraulic motor is bolted directly to the side frame. The brake assembly housing is bolted and doweled to the side frame. The ring gear of both planetary reducers is splined to the brake housing. The cable drum is supported by the brake housing through a large bushing. A quad ring is used to prevent oil leakage.

The cable drum is supported on the other end by the final planet carrier through a large bushing. The carrier is supported by the output shaft through a bushing. The output shaft is supported, through two bushings, by the shaft support sleeve which is secured to the clutch housing side frame by two bearing locknuts. A lip type oil seal is used to prevent leakage around the output shaft.

The manually actuated jaw clutch is splined into the cable drum barrel and engages clutch jaw recesses in the planet carrier.

HOW IT OPERATES

The hydraulic motor drives the sun gear of the primary planetary reducer. The output is transmitted, by the planet carrier, to the output shaft and the sun gear of the final planetary reducer.

The output of the final planetary reducer is transmitted to the cable drum through the jaw clutch which is splined to it.

The output shaft turns any time the motor is running at one-sixth motor speed since it is connected directly to the final sun gear.

THE BRAKE SYSTEM

The automatic braking system consists of a dynamic braking sub-system and a static braking sub-system.

The dynamic braking sub-system has two operating component parts:

1. Brake Valve Assembly
2. Hydraulic Motor

The brake valve is basically a counterbalance valve. It contains a check valve to allow free flow of oil to the motor in a hoisting direction of rotation, and a pilot operated check valve that prevents flow of oil out of the motor when the operating valve is placed in neutral. When the operating valve is placed in the reverse or lowering position the check valve remains closed until sufficient pressure is present for the pilot piston to open the check valve. After the check valve cracks open, the pilot pressure becomes flow-dependent and modulates the check valve opening which controls the rate of descent of the load. The brake valve also contains a small pressure relief valve set to prevent excessive shocks on the motor when a lowering operation is stopped abruptly.

The static sub-system has three operating component parts:

1. Spring Applied, Multiple Disc Friction Brake
2. Over-riding Cam Clutch
3. Hydraulic Piston and Cylinder (Brake Release and Balance)

The static brake is released by the brake valve pilot pressure at a pressure lower than that required to open the pilot operated check valve. This sequence assures that dynamic braking takes place in the brake valve and that little, if any, heat is generated by the friction brake.

The friction brake is a load holding brake only and has nothing to do with dynamic braking or rate of descent of a load.

The over-riding clutch is splined to the input sun gear shaft between the hydraulic motor and the primary sun gear. It will allow this shaft to turn freely in a rotation to raise a load and force the brake discs to turn with the shaft in rotation to lower a load.

The hydraulic cylinder, when pressurized, will release the spring pressure on the brake discs.

HOW IT OPERATES

When the winch is powered in a hoisting direction, the drive from the motor to the primary sun gear runs free. The over-riding clutch between the primary sun gear shaft and the brake discs allows complete freedom of rotation in this direction. The brake remains fully engaged by the spring pressure on the brake piston.

When the lifting operation is stopped, the brake, being fully engaged, prevents the load from lowering.

When the winch is powered to reverse, the motor cannot rotate until sufficient pressure is present to open the brake valve. The friction brake within the winch will completely release at a pressure lower than that required to open the brake valve. The extent to which the valve opens will determine the amount of oil that can flow through it and the speed at which the load will be lowered. Increasing the flow of oil to the winch motor will cause the pressure to rise and the opening in the brake valve to enlarge, speeding up the descent of the load. Decreasing this flow causes the pressure to lower, the opening in the brake valve to decrease, slowing down the descent of the load.

When the operating valve is shifted to neutral the pressure will drop, the brake valve will close, stopping the load. The friction brake will engage after the valve has closed and hold the load.

When lowering a load very slowly for precise positioning, no oil flow actually occurs through the winch motor. The pressure will build up to a point where the brake will release sufficiently to allow the load to rotate the motor through its own leakage. This feature results in a very slow speed and extremely accurate positioning.

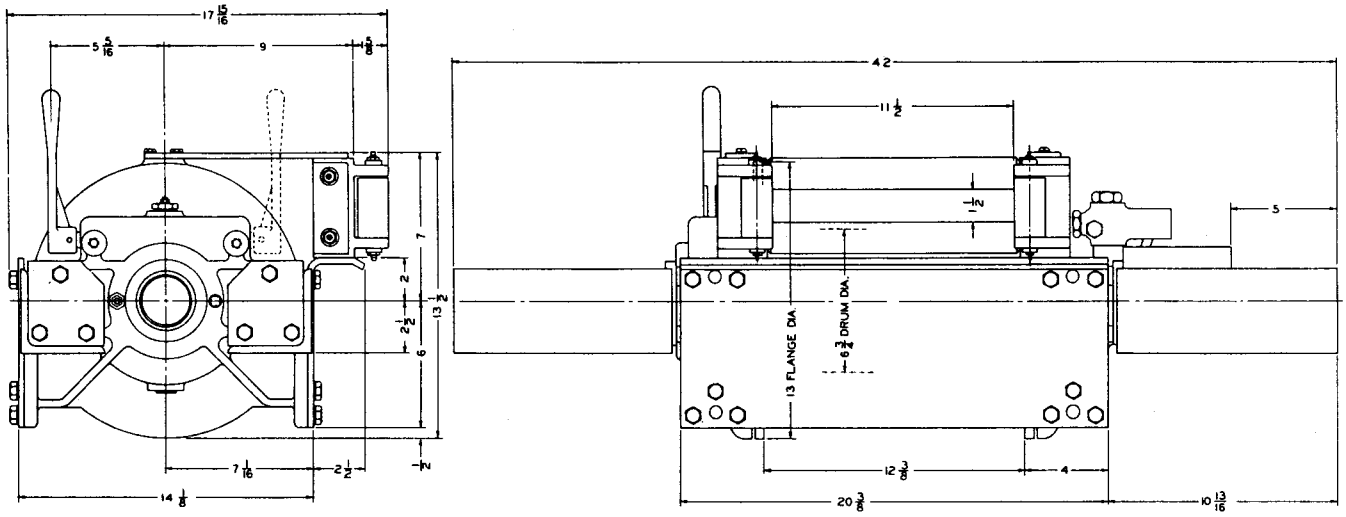
SUMMARY

The winch, in raising a load, is not affected by any braking action. When lowering a load the brake valve has complete control of the speed at which it is lowered. When the winch is stopped by returning the control lever to neutral — the brake valve restricts the flow of oil through the motor, stopping the load. The friction brake engages, after the valve is closed, holding the load.

Thus the brake receives very little wear in lowering operations. All of the heat generated by the lowering and stopping of a load is absorbed by the hydraulic oil where it can be readily dissipated. The only heat absorbed by the winch in either hoisting or lowering is due to the efficiency losses within the winch itself.

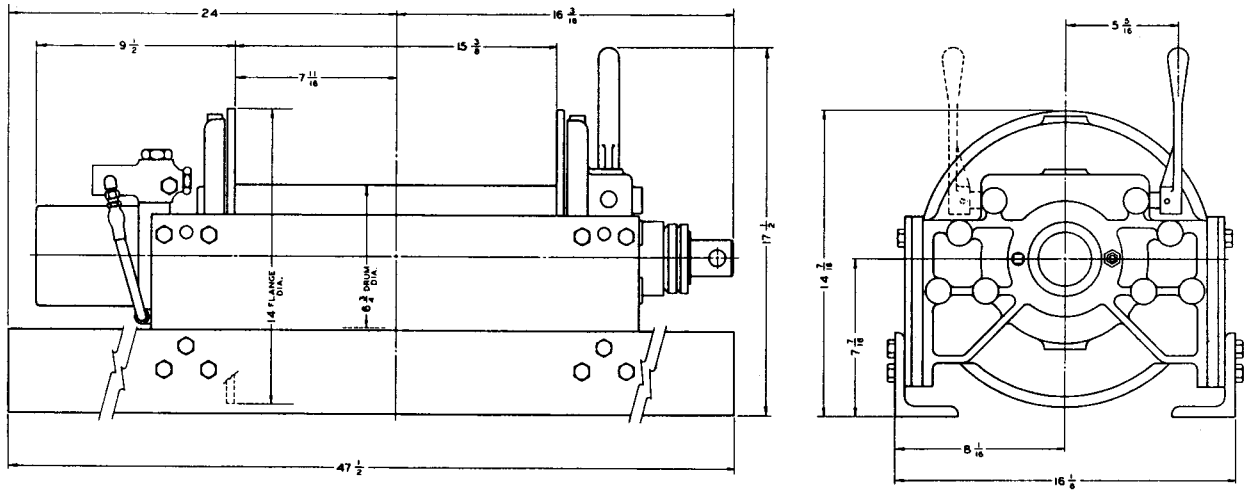
DIMENSIONAL DATA
PD18 Winches

FRONT MOUNT UNITS — 12″ DRUM WIDTH
(Extension Shafts To Curbside Only)



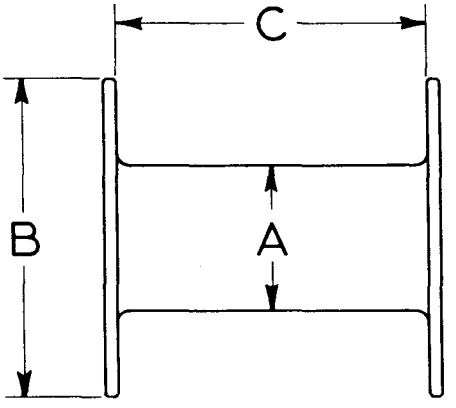
MODEL PD18-12F

REAR MOUNT UNITS — 15⅜″ DRUM WIDTH
(Extension Shafts To Curbside Only)



MODEL PD18-15

PERFORMANCE DATA



MODEL	DRUM DIMENSIONS (INCHES)			CABLE SIZE	CABLE CAPACITY (FEET)	LINE PULL (POUNDS), LINE SPEED (FPM), DRUM CAPACITY (FEET) 30 G.P.M. @ 2200 P.S.I.																							
						1st LAYER				2nd LAYER (TOTAL)				3rd LAYER (TOTAL)				4th LAYER (TOTAL)				5th LAYER (TOTAL)				6th LAYER (TOTAL)				7th LAYER (TOTAL)			
						POUNDS		FPM	FT.	POUNDS		FPM	FT.	POUNDS		FPM	FT.	POUNDS		FPM	FT.	POUNDS		FPM	FT.	POUNDS		FPM	FT.	POUNDS		FPM	FT.
	A	B	C			Dy-namic	Hoist-ing			Dy-namic	Hoist-ing			Dy-namic	Hoist-ing			Dy-namic	Hoist-ing			Dy-namic	Hoist-ing			Dy-namic	Hoist-ing			Dy-namic	Hoist-ing		
PD18-12F	6¾	13	12⅜	5/8	230	18,000	12,000	38	35	15,400	10,300	45	75	13,400	8,900	51	120	11,900	7,900	58	175	10,700	7,100	65	230	—	—	—	—	—	—	—	—
&				9/16	250	18,000	12,000	38	38	15,600	10,400	44	82	13,700	9,100	50	130	12,300	8,200	56	190	11,100	7,400	62	250	—	—	—	—	—	—	—	—
PD18-12FEB				½	340	18,000	12,000	38	43	15,800	10,500	43	91	14,100	9,300	48	145	12,700	8,400	54	210	11,600	7,700	59	270	10,600	7,100	64	340	—	—	—	—
PD18-15	6¾	14	15⅜	5/8	285	18,000	12,000	38	40	15,400	10,300	45	95	13,400	8,900	51	150	11,900	7,900	58	220	10,700	7,100	65	285	—	—	—	—	—	—	—	—
&				9/16	390	18,000	12,000	38	47	15,600	10,400	44	100	13,700	9,100	50	160	12,300	8,200	56	235	11,100	7,400	62	310	10,100	6,700	68	390	—	—	—	—
PD18-15EB				½	520	18,000	12,000	38	53	15,800	10,500	43	110	14,100	9,300	48	180	12,700	8,400	54	260	11,600	7,700	59	335	10,600	7,100	64	420	9,900	6,600	69	520

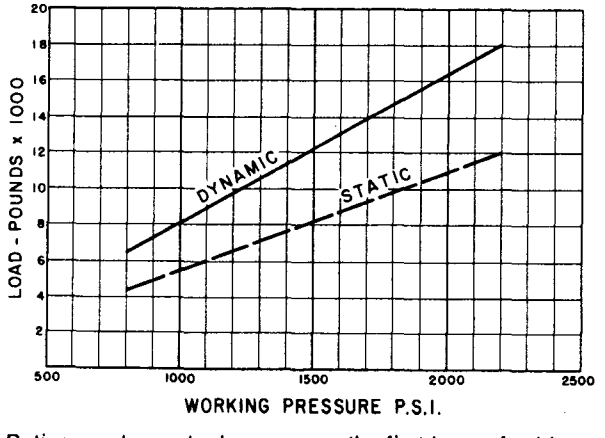
Recommended cable size is 5/8"

EXTENSION SHAFT PERFORMANCE DATA

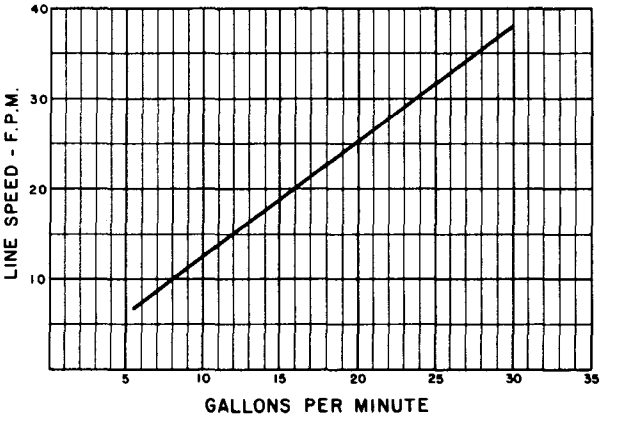
Flow in G.P.M.	6	10	18	30
Full Load R.P.M.	17	29	52	85
No Load R.P.M.	20	33	60	100

Maximum allowable load on extension shaft:
3000 pounds on 7" diameter capstan.
1000 pounds on 24" diameter C. R. Reel.

CABLE PULL

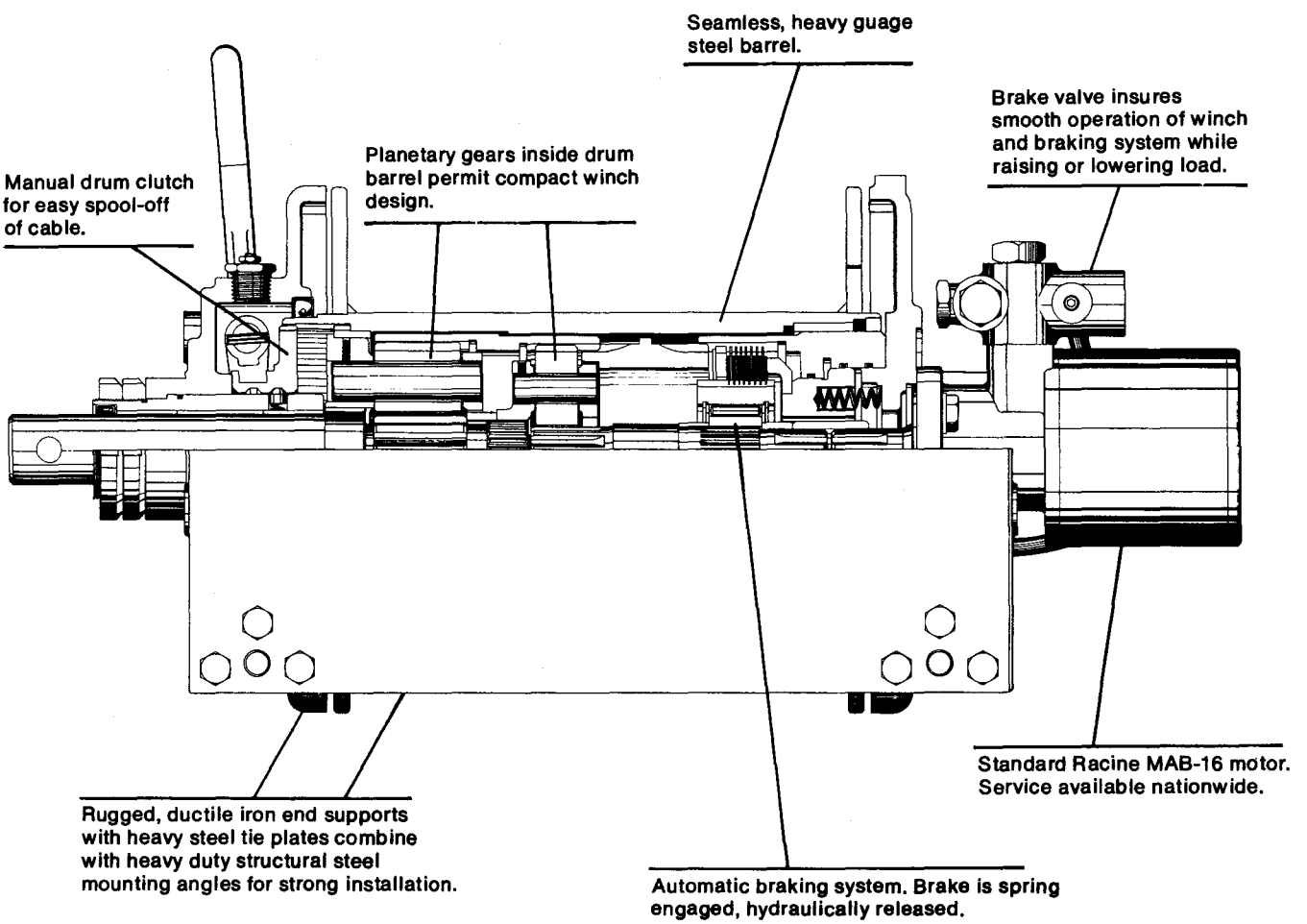


CABLE SPEED

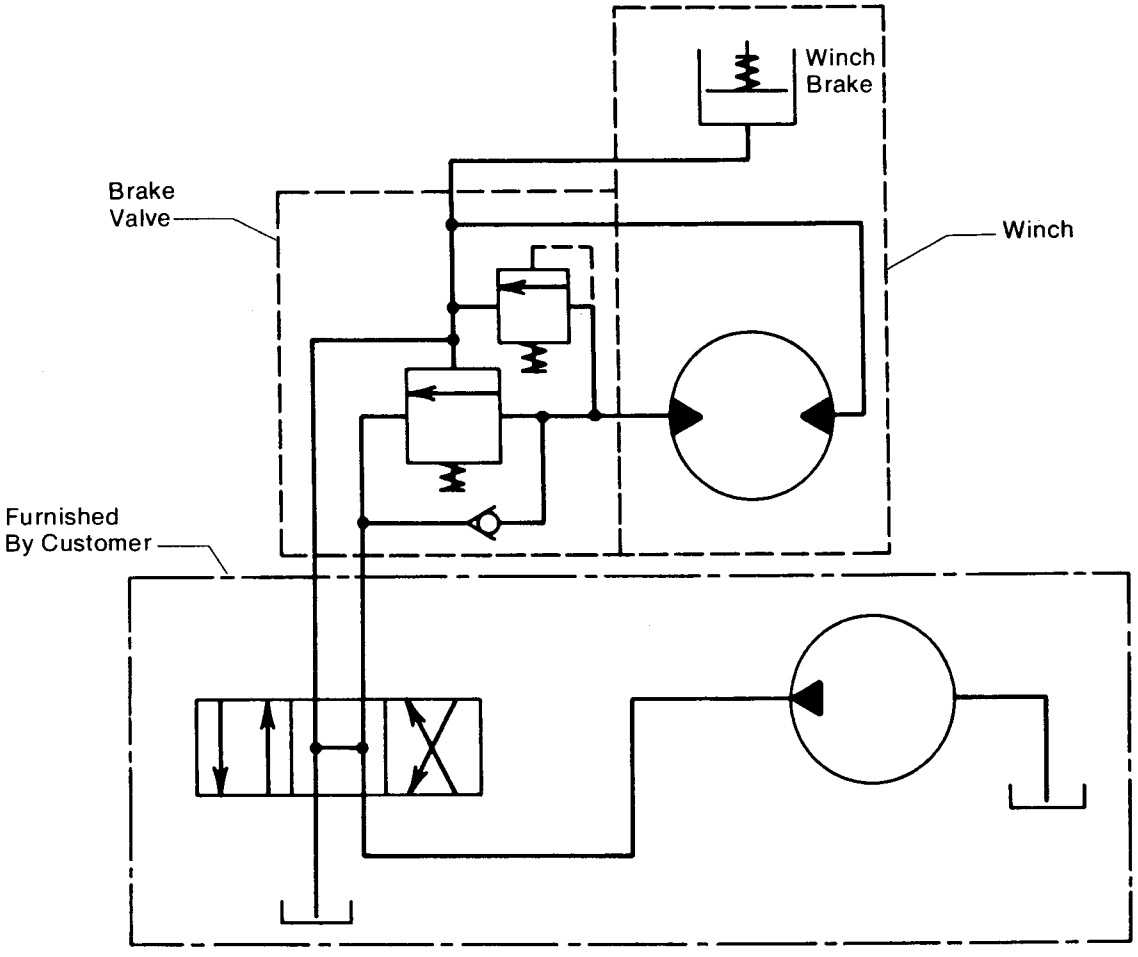


Ratings and speeds shown are on the first layer of cable.

CROSS-SECTIONAL VIEW



WINCH CONTROL CIRCUIT



A regular program of preventive maintenance will tend to eliminate the need for much emergency servicing and insure a long life and trouble-free service from your planetary winch.

SOME THINGS TO REMEMBER IN YOUR SERVICING OPERATONS:

- Work in a clean, dust free area, as cleanliness is of utmost important when servicing any hydraulic equipment.
- Inspect all replacement parts, prior to installation, to detect any damage which might have occurred in shipment.
- Use only certified replacement parts for optimum results. Never re-use expendable parts such as oil seals, O-rings and quad rings. Although they may appear to be in good condition, many times they are not.
- Clean all parts and inspect all machined surfaces for excessive wear or damage . . . before reassembly operations are begun.
- Lubricate all O-rings and oil seals with oil prior to installation.

INSTALLATION SUGGESTIONS

1. The winch should be mounted with the centerline of the cable drum in a horizontal position. The clutch shifter shaft should also be in a horizontal centerline.
2. Hydraulic lines that operate the winch should be of sufficient diameter to assure that back pressure at the winch will not exceed 150 P.S.I.
3. The winch directional control valve must be 4-way, 3 position, parallel circuit with motor type spool. Work ports must open directly into tank in neutral position.
4. Hydraulic oil filter should have 10 micron rating and be a full flow type.

MAINTENANCE SUGGESTIONS

I. CHECKING OIL LEVEL

There is a ⅛" pipe plug in the end of the clutch housing side plate. Oil should be level with this plug. Add approved 90 weight gear oil through the filler hole in the top of clutch housing side plate.

II. OIL CHANGE INFORMATION

1. Oil should be drained after first two (2) months operating time.
2. Fill winch with clean kerosene and run for 15 minutes in each direction. Drain kerosene and add proper amount of approved 90 weight gear oil. Oil should then be changed every six (6) months.

III. OIL CAPACITY RECOMMENDATION

MODEL	CAPACITY (PINTS)	MODEL	CAPACITY (PINTS)
PD18-12F	2	PD18-15	2 ½
PD18-12FEB	2	PD18-15EB	2 ½

IV. APPROVED GEAR OIL

BRAND	DESCRIPTION	SAE-90
Humble	Pen-O-Led EP	#3
Phillips	Phillips Worm Gear Oil	9332
Sinclair	Pennant EP	#3
Standard	Stanogear	#3
Texaco	Maropa	#3

MODEL PD18 MANUAL CLUTCH INSTRUCTIONS

PROCEDURE FOR SHIFTING THE CLUTCH

A. To engage the clutch

With the hydraulic motor turning, move the clutch handle in the direction (as shown on the adjacent metal label) to engage the clutch. If the clutch lugs are aligned with the mating recesses in the output carrier, the clutch will immediately engage. If the lugs and recesses are not aligned, the clutch handle will move a short distance and stop. In this event, continue to hold light pressure on the handle in the direction to engage the clutch. When the output carrier rotates to a position where the recesses are aligned with the lugs, the clutch will engage.

B. To disengage the clutch.

1. With the hydraulic motor turning, hold light pressure against the clutch handle in the direction (as shown on the adjacent metal label) to disengage the clutch.
2. Reverse the motor direction and the clutch will disengage.

C. Do not attempt to move the clutch handle with a load on the cable.

D. Do not use "cheaters" to extend the handle length or other means to apply undue force on the handle as damage to the Spirol pins may result. Heavy pressure on the handle is self-defeating in that it tends to bind the clutch, making it difficult to shift.

THE CLUTCH INDICATOR ASSEMBLY

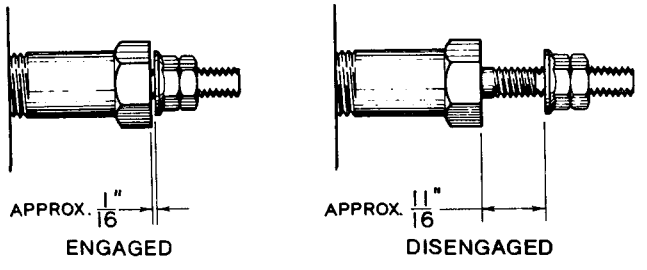
Since the clutch in this winch is inside the clutch housing side frame and out of view, an indicator assembly has been provided to give the operator a visual check of whether or not the clutch is fully engaged. This assembly can be installed in either of two threaded holes located in the clutch housing side frame near the output shaft. The installation can be made without disassembling the winch.

HOW IT OPERATES

The indicator plunger is spring loaded against the shifter fork and moves in when the clutch is engaged and out when the clutch is disengaged. The plunger extends through the indicator housing, and is threaded on its outer end to accept a flange nut and a jam nut. After initial adjustment, the position of the flange nut relative to the housing tells the operator whether or not the clutch is fully engaged. Note that the direction of movement of the plunger is opposite to that of the clutch handle.

ADJUSTMENT PROCEDURE

1. Back off the jam nut and the flange nut to the end of the plunger.
2. Engage the clutch (see procedure for shifting the clutch). Check for full engagement by moving the handle in the direction to disengage until the plunger moves about 1/8", then release the handle. The plunger should move back to the original position. This is due to the action of the spring loaded poppets on the "engage" detent groove.
3. Adjust the flange nut until there is about 1/16" gap between the nut and the indicator housing, then lock it into place with the jam nut.



PROCEDURE FOR DETERMINING CONDITION OF CLUTCH LUGS

There is a 7 1/2% angle on the load bearing faces of the clutch lugs and final planet carrier recesses to prevent disengagement of the clutch under load. Since these surfaces cannot be visually inspected without disassembling the winch, the following procedure was devised to insure that their condition is such that the clutch cannot disengage under load:

1. Fully engage clutch (See Step 2 under Adjustment Procedure above).
2. Power about 4 feet of cable off the drum.
3. Power in slowly while holding 5-10 # of tension on the cable. This tension must be maintained throughout the balance of this procedure. The purpose of this step is to take up the slack in the power train and maintain a no-slack condition.
4. Stop the winch, leaving the clutch engaged.
5. Mark one line on or near the outside diameter of the drum flange and another on the clutch housing side frame adjacent to the first line.
6. Disengage the clutch slowly while observing the lines. The drum flange line should move 1/16" to 5/16" in the direction that spools cable onto the drum. If less than 1/16" travel occurs, or if the travel is in the opposite direction, the clutch should be visually inspected for possible replacement.

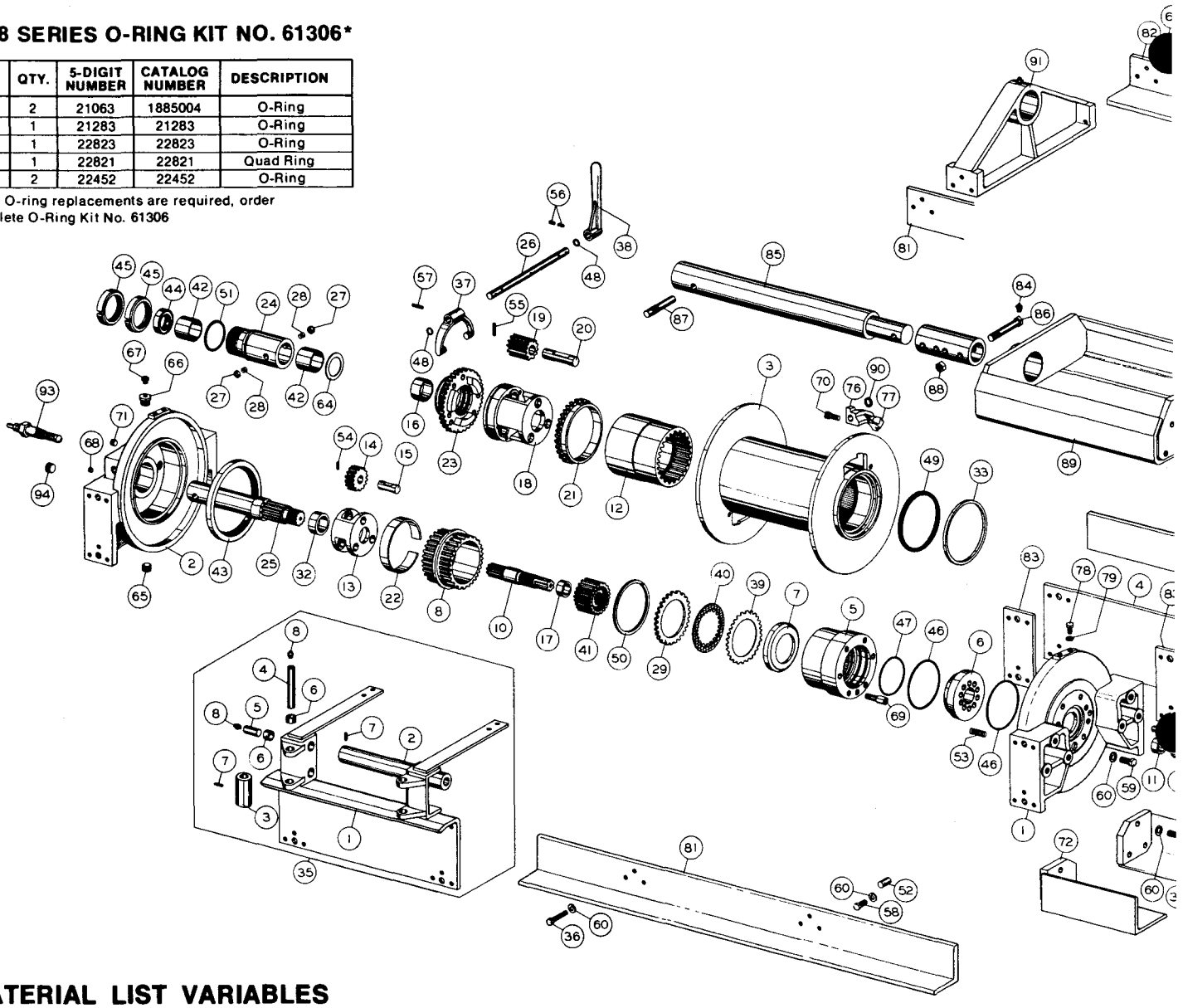
The clutch should be inspected periodically using the above procedure.

COMPONENTS — MODEL PD18

PD18 SERIES O-RING KIT NO. 61306*

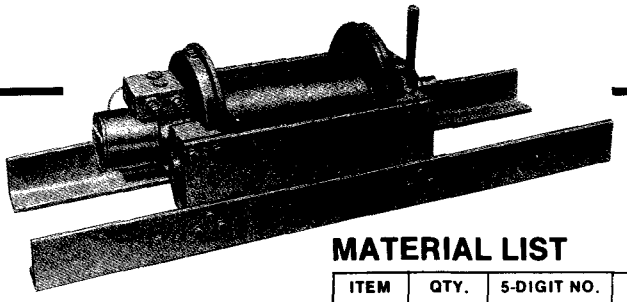
ITEM NO.	QTY.	5-DIGIT NUMBER	CATALOG NUMBER	DESCRIPTION
1	2	21063	1885004	O-Ring
2	1	21283	21283	O-Ring
3	1	22823	22823	O-Ring
4	1	22821	22821	Quad Ring
5	2	22452	22452	O-Ring

*When O-ring replacements are required, order complete O-Ring Kit No. 61306



MATERIAL LIST VARIABLES

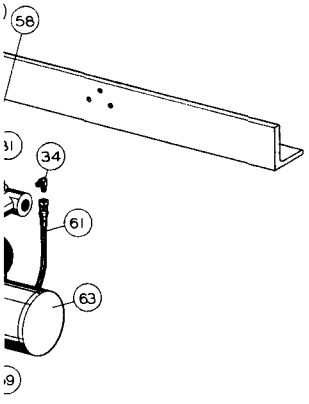
ITEM NO.	DESCRIPTION	PD18-12F			PD18-12FEB			PD18-15			PD18-15EB		
		QTY.	5-DIGIT NO.	CATALOG NO.	QTY.	5-DIGIT NO.	CATALOG NO.	QTY.	5-DIGIT NO.	CATALOG NO.	QTY.	5-DIGIT NO.	CATALOG NO.
3	Cable Drum Assembly	1	81465	81465	1	81465	81465	1	81466	84166	1	81466	81466
4	Tie Plate	1	22787	22787	1	22787	22787	2	22832	22832	2	22832	22832
8	Ring Gear Coupling	1	22791	22791	1	22791	22791	1	22833	22833	1	22833	22833
10	Input Sun Gear	1	22793	22793	1	22793	22793	1	22834	22834	1	22834	22834
35	Roller Bracket Assembly	1	81488	81488	1	81488	81488	-	—	—	-	—	—
36	Capscrew	12	13413	S050-15PH5	14	13413	S050-15PH5	12	13421	S050-20PH5	12	13421	S050-20PH5
52	Dowel Pin	8	21112	2085001	8	21112	2085001	8	10472	10472	8	10472	10472
58	Capscrew	20	22697	S050-10PH5	20	22697	S050-10PH5	8	13413	S050-15PH5	8	13413	S050-15PH5
59	Capscrew	8	13938	S050-12PH5	8	13938	S050-12PH5	8	13938	S050-12PH5	14	13938	S050-12PH5
60	Lockwasher	40	11026	A050	42	11026	A050	28	11026	A050	34	11026	A050
72	Front Support	2	22839	22839	1	22839	22839	-	—	—	-	—	—
73	Rear Support	2	22838	22838	1	22838	22838	-	—	—	-	—	—
78	Capscrew	4	11763	S031-07PH5	4	11763	S031-07PH5	-	—	—	-	—	—
79	Lockwasher	4	11024	A031	4	11024	A031	-	—	—	-	—	—
81	Front Base Angle	-	—	—	-	—	—	1	22859	22859	1	22863	22863
82	Rear Base Angle	-	—	—	-	—	—	1	22860	22860	1	22864	22864
83	Spacer	-	—	—	-	—	—	4	22831	22831	4	22831	22831
84	Grease Fitting	-	—	—	1	18047	Z525	-	—	—	-	—	—
85	Extension Shaft	-	—	—	1	23211	23211	-	—	—	1	23211	23211
86	Capscrew	-	—	—	2	23578	B062-32PH8	-	—	—	2	23578	B062-32PH8
87	Capstan Pin	-	—	—	1	11980	20-272P	-	—	—	1	11980	20-272P
88	Jam Nut	-	—	—	2	23577	B062JH8	-	—	—	2	23577	B062JH8
89	Extension Shaft Bracket	-	—	—	1	81470	81470	-	—	—	-	—	—
91	Bearing Leg Assembly	-	—	—	-	—	—	-	—	—	1	81472	81472
92	Coupling	-	—	—	1	23210	23210	-	—	—	1	23210	23210



MATERIAL LIST

ITEM	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
1	1	23117	23117	Side Frame — Motor Support
2	1	22784	22784	Side Frame — Clutch Housing
5	1	23118	23118	Brake Cylinder
6	1	22789	22789	Brake Piston
7	1	22790	22790	Brake Pressure Plate
9	1	22792	22792	Motor Coupling
11	1	22794	22794	Coupling Spacer
12	1	22795	22795	Ring Gear
13	1	22796	22796	Primary Planet Carrier
14	3	22797	22797	Planet Gear
15	3	22798	22798	Planet Gear Shaft
16	1	23107	23107	Planet Carrier Bushing
17	1	22800	22800	Input Shaft Spacer
18	1	23105	23105	Final Planet Carrier
19	3	22802	22802	Planet Gear
20	3	22803	22803	Planet Gear Shaft
21	1	22804	22804	Cable Drum Bushing
22	1	22805	22805	Ring Gear Spacer
23	1	22806	22806	Sliding Clutch
24	1	22807	22807	Shaft Support Sleeve
25	1	23106	23106	Output Shaft
26	1	22809	22809	Shifter Shaft
27	2	23511	23511	Clutch Poppet
28	2	22811	22811	Clutch Poppet Spring
29	1	22812	22812	Brake Backup Plate
30	1	22813	22813	Motor Gasket
31	1	22814	22814	Brake Valve
32	1	22815	22815	Sun Gear Spacer
33	1	22816	22816	Quad Ring Retainer
34	1	21163	2685008	Elbow
37	1	23519	23519	Clutch Shifter Fork
38	1	12716	700300	Shifter Lever
39	8	10189	570520	Clutch Disc
40	8	21036	850170	Friction Disc
41	1	81324	851040	Brake Clutch Assembly
42	2	22817	22817	Output Shaft Bushing
43	1	22818	22818	Oil Seal
44	1	22819	22819	Oil Seal
45	2	22820	22820	Locknut
46	2	21063	1885004	O-Ring
47	1	21283	21283	O-Ring
48	2	22452	22452	O-Ring
49	1	22821	22821	Quad Ring
50	1	22822	22822	Retaining Ring
51	1	22823	22823	O-Ring
53	10	21037	850190	Brake Spring
54	3	22824	R18-062	Rollpin
55	3	12005	R18-087	Rollpin
56	2	23520	23520	Spirol Pin
57	1	23521	23521	Spirol Pin
61	1	13710	13710	Hose Assembly
62	2	22828	22828	Dowel Pin
63	1	22826	22826	Hydraulic Motor
64	1	22827	22827	Thrust Bearing
65	1	11085	E075WC	Pipe Plug
66	1	21973	58-TJD-1	Reducer Bushing
67	1	10074	2558001	Relief Valve
68	1	22374	E012A	Pipe Plug
69	1	22350	22350	Nipple
70	1	13567	S037-10A	Bolt
71	1	18063	E025W	Pipe Plug
76	1	22842	22842	Cable Clamp
77	1	51917	51917	Cable Clamp Stop
80	1	13708	13708	Elbow
90	1	22488	850480	Bushing
93	1	81529	81529	Indicator Assembly
94	1	23377	E037T	Pipe Plug

NOTE: Refer to "Material List Variables" for items not shown in basic material list.



FOR BEST RESULTS, USE ONLY FACTORY CERTIFIED REPLACEMENT PARTS.

PROCEDURE FOR DISASSEMBLY OF THE BRADEN MODEL PD18 WINCH

Disassembly of winch may be done from either end. Remove the winch from the equipment on which it is mounted.

For complete disassembly, place the winch in a horizontal position, drain oil and flush.

For partial disassembly, from either end, the oil need not be drained.

DISASSEMBLY FROM THE MOTOR END

Begin disassembly by following the specific instructions given below for the particular model of PD18 winch you are working with.

Model PD18-12F — Remove two (2) front supports, Item 72, and two (2) rear supports, Item 73, by removing twelve (12) capscrews and lockwashers, Items 36 and 60. Remove tie plate, Item 4, by removing ten (10) capscrews and lockwashers, Items 58 and 60. A few taps with a plastic hammer may be needed to free the tie plate from dowel pins, Item 52. Remove roller bracket assembly, Item 35, by removing ten (10) capscrews and lockwashers, Items 58 and 60, and four (4) capscrews and lockwashers, Items 78 and 79. A few taps with a plastic hammer may be needed to free roller bracket from dowel pins, Item 52.

Model PD18-12FEB — Remove front support, Item 72, and rear support, Item 73, by removing six (6) capscrews and lockwashers, Items 36 and 60. Remove two (2) hex nuts, Item 88, and two (2) capscrews, Item 86. Remove extension shaft, Item 85. Remove coupling, Item 92. Remove extension shaft bracket, Item 89, by removing eight (8) capscrews and lockwashers, Items 36 and 60. Remove tie plate, Item 4, by removing ten (10) capscrews and lockwashers, Items 58 and 60. A few taps with a plastic hammer may be needed to free tie plate from dowel pins, Item 52. Remove roller bracket assembly, Item 35, by removing ten (10) capscrews and lockwashers, Items 58 and 60, and four (4) capscrews and lockwashers, Items 78 and 79. A few taps with a plastic hammer may be needed to free roller bracket from dowel pins, Item 52.

Model PD18-15 — Remove front base angle, Item 81, by removing six (6) capscrews and lockwashers, Items 36 and 60. Remove rear base angle, Item 82, by removing six (6) capscrews and lockwashers, Items 36 and 60. Remove two (2) tie plates, Item 4, and four (4) spacers, Item 83, by removing eight (8) capscrews and lockwashers, Items 58 and 60.

Model PD18-15EB — Remove two (2) hex nuts and capscrews, Items 88 and 86. Remove extension shaft, Item 85. Remove coupling, Item 92. Remove six (6) capscrews and lockwashers, Items 59 and 60. Remove bearing leg assembly, Item 91. Remove front base angle, Item 81, by removing six (6) capscrews and lockwashers, Items 36 and 60. Remove rear base angle, Item 82, by removing six (6) capscrews and lockwashers, Items 36 and 60. Remove two (2) tie plates, Item 4, and four (4) spacers, Item 83, by removing eight (8) capscrews and lockwashers, Items 58 and 60.

The following instructions apply to all models:

Stand winch in vertical position with side frame, Item 2, resting on blocks high enough from the work surface to allow clearance for the output shaft, Item 25.

Disconnect hose assembly, Item 61, from elbow, Item 34.

Remove four (4) capscrews and lockwashers, Items 59 and 60. Remove hydraulic motor, Item 63, and brake valve, Item 31.

Remove hose assembly, Item 61, elbow, Item 80, and nipple, Item 69.

Remove motor coupling, Item 9.

Now carefully turn winch over and stand on side frame, Item 1.

Continue disassembly according to the instructions in the following section.

DISASSEMBLY FROM THE CLUTCH HOUSING END

Stand winch in a vertical position on motor end with side frame, Item 1, resting on blocks high enough from the work surface to allow clearance for the hydraulic motor and brake valve. If complete disassembly was started on the other end, the blocks will not be needed.

Pull straight up on side frame, Item 2, removing it, and the parts assembled into it, from the output shaft, Item 25. The assembly just removed will consist of: Items 2, 23, 24, 26, 27, 28, 37, 38, 42, 43, 44, 45, 48, 51, 56, 57 and 93. For disassembly of the clutch housing side frame see next section.

Remove output shaft, Item 25.

Remove thrust washer, Item 64.

Remove final planet carrier as an assembly consisting of: Items 18, 19, 20 and 55.

Remove cable drum bushing, Item 21.

Remove ring gear, Item 12.

Remove sun gear spacer, Item 32.

Remove primary planet carrier as an assembly consisting of: Items 13, 14, 15 and 54.

This completes partial disassembly from the clutch housing end. If complete disassembly is being done continue with next instruction.

Remove cable drum assembly, Item 3.

Remove ring gear coupling, Item 8, and ring gear spacer, Item 22.

Remove input sun gear, Item 10, and input shaft spacer, Item 17.

Remove brake clutch assembly, Item 41.

Turn side frame, Item 1, over and set on end of brake cylinder, Item 5. Coupling spacer, Item 11, will be on the work surface where it had fallen when input sun gear, Item 10, was removed.

Remove four (4) capscrews and lockwashers,

Items 59 and 60. Remove side frame, Item 1, from brake cylinder, Item 5. A few taps with a plastic hammer may be needed to free the side frame from the dowel pins, Item 62.

For disassembly of brake cylinder, refer to page 17.

PROCEDURE FOR DISASSEMBLY OF CLUTCH HOUSING SIDE FRAME

Remove two (2) locknuts, Item 45.

Remove shaft support sleeve, Item 24, as an assembly including Items 23, 27, 28, 42, 44 and 51.

Remove sliding clutch, Item 23, being careful to catch the poppets, Item 27, and poppet springs, Item 28, when they are released.

Use a ¼" diameter punch to drive rollpin, Item 57, out of clutch shifter fork, Item 37, and shifter shaft, Item 26.

Pull shifter lever, Item 38, and shifter shaft, Item 26, out of housing.

Shifter lever, Item 38, may be removed from shifter shaft, Item 26, by driving two (2) rollpins, Item 56, out with a ¼" diameter punch.

PROCEDURE FOR REMOVAL OF BRAKE CYLINDER ONLY

If the brake cylinder only is to be removed for inspection or replacement, place winch in a vertical position with motor end up.

Disconnect hose assembly, Item 61, from elbow, Item 34.

Remove four (4) capscrews and lockwashers, Items 59 and 60. Remove hydraulic motor, Item 63, and brake valve, Item 31.

Remove hose assembly, Item 61, elbow, Item 80, and nipple, Item 69.

Remove four (4) capscrews and lockwashers, Items 59 and 60. Remove side frame, Item 1, by tapping with a plastic hammer to loosen from brake cylinder dowel pins, Item 62.

Secure with two (2) capscrews, a short length of chain, or similar lifting device, to brake cylinder, Item 5. Lift brake cylinder assembly from cable drum, Item 3, being careful to pull straight to avoid damaging the bronze bushing in the cable drum.

For disassembly of brake cylinder, refer to page 17.

PROCEDURE FOR REASSEMBLY OF THE BRADEN MODEL PD18 WINCH

Assemble brake cylinder assembly per instructions on page 17.

Assemble brake clutch assembly per instructions on page 16.

Assemble final planet carrier assembly per instructions on page 16.

Assemble primary planet carrier assembly per instructions on page 15.

Assemble roller bracket assembly per instructions on page 18.

Using a hand operated arbor press, install oil seal, Item 43, in side frame, Item 2.

Place two (2) O-rings, Item 48, in grooves in shifter shaft, Item 26, after coating lightly with oil.

Hold clutch shifter fork, Item 37, in approximate position in housing and pass shifter shaft through hole in housing, through hole in shifter fork and into other hole in housing. Align rollpin holes in shifter fork and shifter shaft and drive rollpin, Item 57, into place.

Press two (2) output shaft bushings, Item 42, into shaft support sleeve, Item 24. Press oil seal, Item 44, into shaft support sleeve.

Lightly oil O-ring, Item 51, and install in groove in shaft support sleeve.

Insert clutch poppet springs, Item 28, and clutch poppets, Item 27, in holes in shaft support sleeve, Item 24. Depress the poppets with the thumb and forefinger of one hand while slipping the sliding clutch onto the shaft support sleeve. Move the sliding clutch far enough for the poppets to engage one of the grooves.

Swing the shifter fork out and insert the shaft support sleeve, Item 24, into the side frame, Item 2. While sliding this assembly into place be sure the clutch shifter fork engages the groove in the sliding clutch. Install and tighten the two (2) locknuts, Item 45.

Install pipe plugs, Items 65, 68, 71 and 94.

Install clutch indicator assembly, Item 93.

Set brake cylinder assembly down on work surface with brake springs up. Be sure all ten (10) springs are in place.

Set side frame, Item 1, on brake cylinder, being sure to align holes so that clearance hole in side frame aligns with hole in brake cylinder which has pipe threads.

Install four (4) capscrews and lockwashers, Items 59 and 60, and two (2) dowel pins, Item 62.

Turn this assembly over and set it on the side frame, Item 1, with brake cylinder assembly up.

IMPORTANT: Check the rotation of the brake clutch assembly, Item 41.

Hold the brake clutch in the left hand. Insert the input sun gear, Item 10, into the brake clutch and rotate the shaft in a counter-clockwise direction. If the rotor of the brake clutch turns in this direction, install it in place. If it will not turn in this direction, turn it over and insert the shaft in the other side.

If the brake clutch is installed opposite to the above procedure, the winch will be working against the brake, the brake will not release and there will be no forward rotation of the winch.

Insert the brake clutch assembly, Item 4, into the brake cylinder housing, Item 5.

Smear a small amount of grease inside spacer, Item 17, and slide onto input sun gear, Item 10.

Insert input sun gear into rotor of brake clutch engaging the splines until the spacer seats against the rotor.

Install ring gear coupling, Item 8.

Install ring gear spacer, Item 22, on ring gear coupling.

Install primary planet carrier assembly, Items 13,

14, 15 and 54, engaging teeth of planet gears with input sun gear, Item 10.

Coat quad-ring, Item 49, with oil and install in groove in cable drum assembly, Item 3.

Install cable drum assembly, Item 3, using care to avoid damaging the quad-ring.

Install ring gear, Item 12.

Install cable drum bushing, Item 21.

Press planet carrier bushing, Item 16, into final planet carrier, Item 18. Slide final planet carrier assembly onto output shaft, Item 25, engaging planet gears with sun gear.

Smear a small amount of grease inside sun gear spacer, Item 32, and slide onto output shaft, Item 25.

Carefully install this assembly in winch, aligning planet gear teeth with ring gear and spline on output shaft with spline in primary planet carrier.

Slip thrust bearing, Item 64, over end of output shaft.

Oil the lip of oil seals, Items 43 and 44, in side frame assembly. Install this assembly, carefully engaging the teeth on sliding clutch, Item 23, with teeth in cable drum assembly, Item 3, and oil seal, Item 43, onto cable drum barrel. Be sure lip of oil seal, Item 44, does not get rolled when passing output shaft through it.

Drive eight (8) dowel pins, Item 52, into holes in side frames, Items 1 and 2.

The following sets of instructions apply to specific models of the PD18 winch.

Model PD18-12F — Install tie plate, Item 4, securing it with ten (10) capscrews and lockwashers, Items 58 and 60. A few taps with a plastic hammer may be needed to seat the tie plate on dowel pins, Item 52.

Install roller bracket assembly, Item 35, securing with ten (10) capscrews and lockwashers, Items 58 and 60, and four (4) capscrews and lockwashers, Items 78 and 79.

Place coupling spacer, Item 11, on input sun gear, Item 10. Slip motor coupling, Item 9, onto spline of input sun gear.

Install nipple, Item 69, into hole in brake cylinder, Item 5, after coating threads with a good grade of thread compound with Teflon. Install elbow, Item 80, into nipple. Attach hose assembly, Item 61, to elbow.

Coat motor gasket, Item 30, with gasket cement and place in position on side frame, Item 1.

Install hydraulic motor, Item 63, in place on the side frame, Item 1. Secure with four (4) capscrews and lockwashers, Items 59 and 60.

If the brake valve, Item 31, was removed from the motor it should be replaced at this time. Engage the threads on the valve spools with the threads in the motor ports. Tighten with a ½" Allen wrench. Pull the body of the brake valve down securely by tightening the jam nuts.

Install elbow, Item 34, in brake valve.

Connect hose assembly, Item 61, to elbow.

Attach two (2) front supports, Item 72, and two (2) rear supports, Item 73, using twelve (12) capscrews and lockwashers, Items 36 and 60.

Refill winch with two (2) pints of approved 90 weight gear oil through the top of the clutch housing side frame, Item 2.

After filling the winch with oil, replace reducer bushing, Item 66, and relief valve, Item 67.

Model PD18-12FEB — Install tie plate, Item 4, securing it with ten (10) capscrews and lockwashers, Items 58 and 60. A few taps with a plastic hammer may be needed to seat the tie plate on dowel pins, Item 52.

Install roller bracket assembly, Item 35, securing with ten (10) capscrews and lockwashers, Items 58 and 60, and four (4) capscrews and lockwashers, Items 78 and 79. A few taps with a plastic hammer may be needed to seat the roller bracket on dowel pins, Item 52.

Place coupling spacer, Item 11, on input sun gear, Item 10. Slip motor coupling, Item 9, onto spline of the input sun gear.

Install nipple, Item 69, into hole in brake cylinder, Item 5, after coating threads with a good grade of thread compound with Teflon. Install elbow, Item 80, into nipple. Attach hose assembly, Item 61, to elbow.

Coat motor gasket, Item 30, with gasket cement and place in position on side frame, Item 1.

Install hydraulic motor, Item 63, in place on the side frame. Item 1. Secure with four (4) capscrews and lockwashers, Items 59 and 60.

If the brake valve, Item 31, was removed from the motor it should be replaced at this time. Engage the threads on the valve spools with the threads in the motor ports. Tighten with a ½" Allen wrench. Pull the body of the brake valve down securely by tightening the jam nuts.

Install elbow, Item 34, in brake valve.

Connect hose assembly, Item 61, to elbow.

Install front support, Item 72, and rear support, Item 73, to motor end side frame with six (6) capscrews and lockwashers, Items 36 and 60.

Install extension shaft bracket, Item 89, to clutch housing side frame, Item 2, with (6) capscrews and lockwashers, Items 36 and 60.

Install extension shaft coupling, Item 92, securing to output shaft, Item 25, with capscrew and hex nut, Items 86 and 88. Install extension shaft, Item 85, securing to coupling with capscrew and hex nut, Items 86 and 88.

Refill winch with two (2) pints of approved 90 weight gear oil through the top of the clutch housing side frame, Item 2.

After filling the winch with oil, replace reducer bushing, Item 66, and relief valve, Item 67.

Model PD18-15 — Install two (2) tie plates, Item 4, and four (4) spacers, Item 83, securing them with eight (8) capscrews and lockwashers, Items 58 and 60. A few taps with a plastic hammer may be needed to seat the tie plates on dowel pins, Item 52.

Place coupling spacer, Item 11, on input sun gear, Item 10.

Slip motor coupling, Item 9, onto spline of input sun gear.

Install nipple, Item 69, into hole in brake cylinder, Item 5, after coating threads with a good grade of thread compound with Teflon. Install elbow, Item 80, into nipple. Attach hose assembly, Item 61, to elbow.

Coat motor gasket, Item 30, with gasket cement and place in position on side frame, Item 1.

Install hydraulic motor, Item 63, in place on the side frame, Item 1. Secure with four (4) capscrews and lockwashers, Items 59 and 60.

If the brake valve, Item 31, was removed from the motor it should be replaced at this time. Engage the threads on the valve spools with the threads in the motor ports. Tighten with a ½" Allen wrench. Pull the body of the brake valve down securely by tightening the jam nuts.

Install elbow, Item 34, in brake valve.

Connect hose assembly, Item 61, to elbow.

Install front base angle, Item 81, and rear base angle, Item 82, securing with twelve (12) capscrews and lockwashers, Items 36 and 60.

Refill winch with two and one-half (2½) pints of approved 90 weight gear oil through the top of the clutch housing side frame, Item 2.

After filling the winch with oil, replace reducer bushing, Item 66, and relief valve, Item 67.

Model PD18-15EB — Install two (2) tie plates, Item 4, and four (4) spacers, Item 83, securing them with eight (8) capscrews and lockwashers, Items 58 and 60. A few taps with a plastic hammer may be needed to seat the tie plates on dowel pins, Item 52.

Place coupling spacer, Item 11, on input sun gear, Item 10.

Slip motor coupling, Item 9, onto spline of input sun gear.

Install nipple, Item 69, into hole in brake cylinder, Item 5, after coating threads with a good grade of thread compound with Teflon. Install elbow, Item 80, into nipple. Attach hose assembly, Item 61, to elbow.

Coat motor gasket, Item 30, with gasket cement and place in position on side frame, Item 1.

Install hydraulic motor, Item 63, in place on the side frame, Item 1. Secure with four (4) capscrews and lockwashers, Items 59 and 60.

If the brake valve, Item 31, was removed from the motor it should be replaced at this time. Engage the threads on the valve spools with the threads in the motor ports. Tighten with a ½" Allen wrench. Pull the body of the brake valve down securely by tightening the jam nuts.

Install elbow, Item 34, in brake valve.

Connect hose assembly, Item 61, to elbow.

Install front base angle, Item 81, and rear base angle, Item 82, securing with twelve (12) capscrews and lockwashers, Items 36 and 60.

Install bearing leg assembly, Item 91, securing with six (6) capscrews and lockwashers, Items 59 and 60. Install extension shaft coupling, Item 92, securing to output shaft, Item 25, with capscrew and hex nut, Items 86 and 88. Install extension shaft, Item 85, securing to coupling with capscrew and lockwasher, Items 86 and 88.

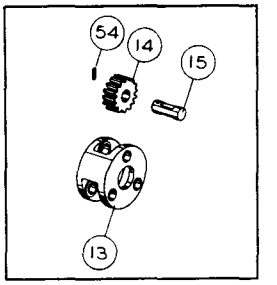
Refill winch with two and one-half (2½) pints of approved 90 weight gear oil through the top of the clutch housing side frame, Item 2.

After filling the winch with oil, replace reducer bushing, Item 66, and relief valve, Item 67.

BRAKE VALVE INFORMATION

The brake valve assembly, Item 31, is a purchased component, manufactured to exacting Braden specifications. Should a failure occur, or repairs be needed in this assembly, it is suggested that the entire part be removed from the winch and forwarded to the Braden factory for inspection and repair or replacement.

PRIMARY PLANET CARRIER ASSEMBLY, PART NO. 81501 — MATERIAL LIST AND ASSEMBLY INSTRUCTIONS



ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
13	1	22796	22796	Planet Carrier
14	3	22797	22797	Planet Gear
15	3	22798	22798	Planet Gear Shaft
54	3	22824	R18-062	Rollpin

DISASSEMBLY PROCEDURE

Remove rollpin, Item 54, by inserting a 3/16" punch into hole provided in planet carrier, Item 13. A few taps on the punch will drive the rollpin into the planet gear shaft, Item 15, thus allowing removal of the shaft and planet gear, Item 14, for inspection.

Drive old rollpin completely from the shaft and use new rollpin, 3/16" x 5/8", for reassembly.

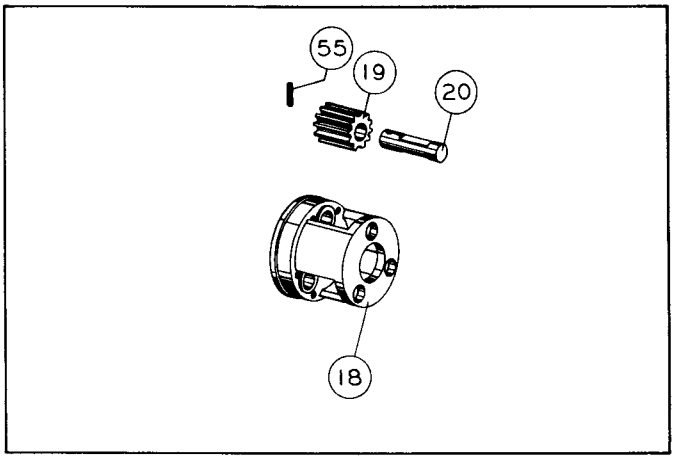
REASSEMBLY PROCEDURE

Install planet gear, Item 14, into planet carrier, Item 13. Insert planet gear shaft, Item 15, into planet carrier through hole provided, passing it through planet gear and into planet carrier. Align rollpin holes. Install new rollpin, Item 54. This pin should be countersunk to 3/16" below the surface of the planet carrier. With a centerpunch, dimple the edge of the rollpin hole to keep the pin from backing out.

Install remainder of gears, shafts and pins in the manner described.

FINAL PLANET CARRIER ASSEMBLY, PART NO. 81502 — MATERIAL LIST AND ASSEMBLY INSTRUCTIONS

ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
18	1	23105	23105	Planet Carrier
19	3	22802	22802	Planet Gear
20	3	22803	22803	Planet Gear Shaft
55	3	12005	R18-087	Rollpin



DISASSEMBLY PROCEDURE

Remove rollpin, Item 55, by inserting a 3/16" punch into hole provided in planet carrier, Item 18. A few taps on the punch will drive the rollpin into the planet gear shaft, Item 20, thus allowing removal of the shaft and planet gear, Item 19, for inspection.

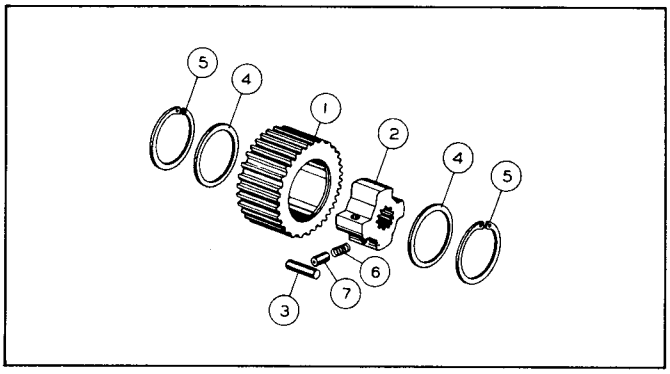
Drive old rollpin completely from the shaft and use new rollpin, 3/16" x 7/8", for reassembly.

REASSEMBLY PROCEDURE

Install planet gear, Item 19, into planet carrier, Item 18. Insert planet gear shaft, Item 20, into planet carrier through hole provided, passing it through planet gear and into planet carrier. Align rollpin holes. Install new rollpin, Item 55. This pin should be countersunk to 3/16" below the surface of the planet carrier. With a centerpunch, dimple the edge of the rollpin hole to keep the pin from backing out.

Install remainder of gears, shafts and pins in the manner described.

BRAKE CLUTCH ASSEMBLY, PART NO. 81324 — MATERIAL LIST AND ASSEMBLY INSTRUCTIONS



ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
1	1	21094	850690	Brake Race
2	1	21093	850670	Brake Cam
3	4	21097	850730	Brake Roller
4	2	12592	630300	Brake Roller Retainer
5	2	12913	MU7-121	Retaining Ring
6	4	12050	238-148-5	Spring
7	4	12049	238-148-4	Plunger

DISASSEMBLY PROCEDURE

Remove retaining rings, Item 5.

Remove brake roller retainers, Item 4.

This will release the brake cam, Item 2, brake rollers, Item 3, plungers, Item 7, and springs, Item 6, from the brake race, Item 1.

Check for wear on race and rollers.

REASSEMBLY PROCEDURE

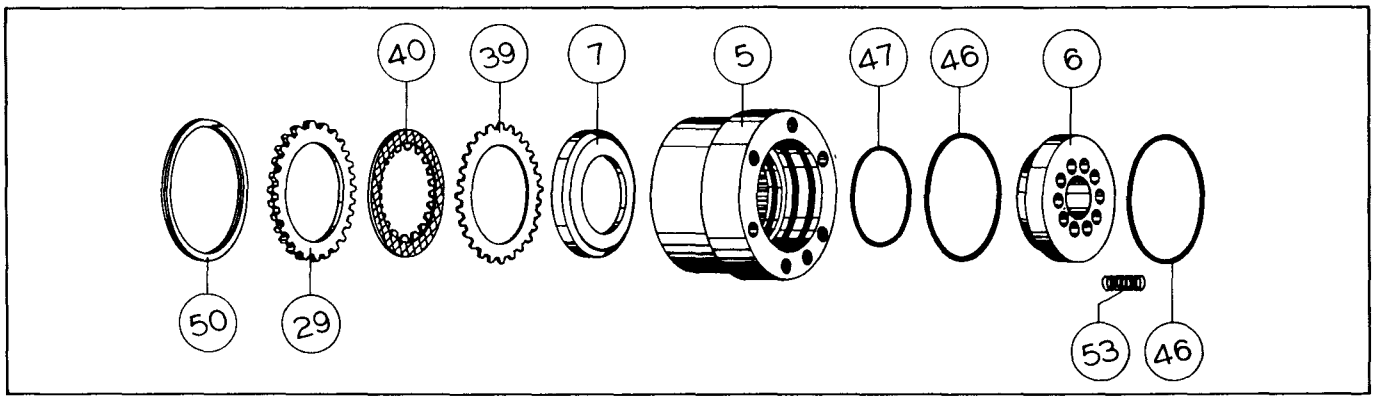
Insert brake cam, Item 2, into brake race, Item 1, just far enough to insert springs, Item 6, plungers, Item 7, and rollers, Item 3.

By using the secondary sun gear shaft (Item 9 on Basic Material List, Page 11,) to hold the cam, the springs, plungers and rollers can be inserted with the aid of a small screwdriver.

After the springs, plungers and rollers are installed and the cam is in place, install the brake roller retainers, Item 4, and secure with retaining rings, Item 5.

After all parts have been installed, rotate the brake cam with the aid of the secondary sun gear shaft. It should turn in one direction.

BRAKE CYLINDER ASSEMBLY, PART NO. 81500 — MATERIAL LIST AND ASSEMBLY INSTRUCTIONS



ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
5	1	23118	23118	Brake Cylinder
6	1	22789	22789	Brake Piston
7	1	22790	22790	Brake Pressure Plate
29	1	22812	22812	Brake Backup Plate
39	8	10189	570520	Brake Disc

ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
40	8	21036	850170	Friction Disc
46	2	21063	1885004	O-Ring
47	1	21283	21283	O-Ring
50	1	22822	22822	Retaining Ring
53	10	21037	850190	Brake Spring

DISASSEMBLY PROCEDURE

Remove ten (10) brake springs, Item 53.

Carefully push the brake piston, Item 6, out of the brake cylinder, Item 5.

Remove retaining ring, Item 50, with retaining ring pliers.

Remove as an assembly: brake backup plate, Item 29, clutch discs, Item 39, friction discs, Item 40, and brake pressure plate, Item 7, by inserting the fingers through the bore of the pressure plate and lifting straight up on the flange.

Remove two (2) O-rings, Item 46, and one (1) O-ring, Item 47. Discard O-rings.

REASSEMBLY PROCEDURE

Prior to reassembly of parts, clean brake cylinder, Item 5, by applying air pressure to all grooves and oil passages.

Use new O-rings throughout when reassembling brake cylinder. Lightly coat all O-rings with oil before installing.

Install O-ring, Item 47, in groove in small bore of brake cylinder, Item 5. Install two (2) O-rings, Item 46, in grooves of larger bore.

Lightly coat the sealing surfaces of the brake piston, Item 6, with oil and carefully insert it into the brake cylinder.

Turn the brake cylinder over and set it on a flat surface with a spacer about ¾" thick under the piston to assure that the pilot diameter on which the pressure plate, Item 7, fits will be standing above the bottom of the bore.

Install pressure plate, Item 7, into bore and on its seat on the brake piston. Insert brake disc, Item 39, and friction disc, Item 40. Continue to alternate discs until eight (8) each of brake discs and friction discs are in place. Insert brake backup plate, Item 29. Install retaining ring, Item 50, with retaining ring pliers.

To test the assembly for leaks it is necessary to mount it on the side frame, Item 1.

Set the brake cylinder assembly down with the large end up. Insert ten (10) brake springs, Item 53, into holes in piston.

Install side frame, carefully engaging support into brake cylinder bore. A few taps with a plastic hammer may be necessary to seat the side frame. Secure with four (4) capscrews and lockwashers, Items 59 and 60.

Install nipple, Item 69, in brake cylinder port.

Connect a hydraulic pump which is equipped with a dial guage that reads to 600 P.S.I. or more.

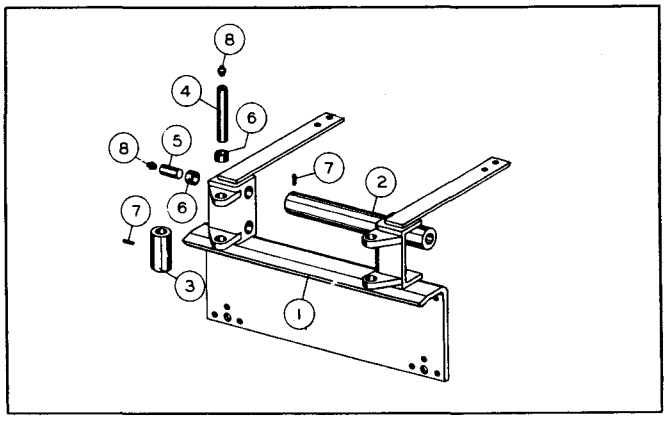
Apply 600 lbs. pressure into brake cylinder and hold for about five minutes. If the pressure holds, the installation of the brake piston is proper. A slight drop in pressure may be evident; but, after the brake is operated a few times, the O-ring will seat and the pressure will hold.

If the piston assembly does not hold pressure and the gauge returns to zero, check the hose and fittings from the pump to the brake cylinder for leaks. If no leaks are visible, the brake cylinder must be disassembled and the O-rings and all parts checked for damage where leakage could occur.

During the time that pressure is applied, check the brake friction discs. There should be no tension on the discs. Centering and aligning the discs with the brake clutch assembly is recommended and will be helpful in the final assembly of the winch.

ROLLER BRACKET ASSEMBLY
PART NO. 81488 — MATERIAL LIST AND ASSEMBLY INSTRUCTIONS

ITEM NO.	QTY.	5-DIGIT NO.	CATALOG NO.	DESCRIPTION
1	1	81482	81482	Front Plate and Roller Support
2	2	22840	22840	Cable Roller
3	2	22850	22850	Vertical Cable Roller
4	2	22851	22851	Cable Roller Pin
5	4	22841	22841	Cable Roller Pin
6	8	22470	22470	Bushing
7	6	22824	R18-062	Rollpin
8	8	18047	Z525	Grease Fitting



DISASSEMBLY PROCEDURE

Using a 3/16" diameter punch, drive rollpin, Item 7, into cable roller pin, Item 4 and 5.

Remove cable roller pins, Item 4, and vertical cable rollers, Item 3.

Remove cable roller pins, Item 5, and cable rollers, Item 2.

Drive rollpins out of cable roller pins.

Bushing, Item 6, may be driven out of roller support, Item 1, if they are damaged and need replacing.

REASSEMBLY PROCEDURE

Press bushings, Item 6, into front plate and roller support, Item 1.

Insert cable roller pin, Item 5, through bushing in roller support and into cable roller, Item 2. Align rollpin holes and drive rollpin, Item 7, through cable roller and into cable roller pin until flush with cable roller surface. Repeat with three remaining cable roller pins, Item 5.

Insert cable roller pin, Item 4, through hole in roller support, through vertical cable roller, Item 3, and into other hole in support. Align rollpin holes and drive rollpin in place until flush with cable roller surface. Repeat with other vertical cable roller and pin.

Install eight (8) grease fittings, Item 8, in ends of cable roller pins. Grease all fittings.

PROCEDURE FOR DISASSEMBLY OF OLDER BRADEN MODEL PD18 WINCHES WITH LOW SPEED OUTPUT SHAFT

Proceed with standard disassembly instructions, starting on page 12, to and including removal of clutch housing side frame assembly.

In these winches the output shaft is separate from the output sun gear.

Remove the output shaft with thrust washer, Item 64.

Remove final planet carrier as an assembly consisting of Items 18, 19, 20 and 55.

Remove cable drum bushing, Item 21.

Remove ring gear, Item 12.

Remove output sun gear.

Remove sun gear spacer, Item 32.

Remove primary planet carrier as an assembly consisting of Items 13, 14, 15 and 54.

Return to standard disassembly instructions on page 12.

PROCEDURE FOR REASSEMBLY OF OLDER BRADEN MODEL PD18 WINCHES WITH LOW SPEED OUTPUT SHAFT

Proceed with standard reassembly instructions, starting on page 13, to and including installation of primary planet carrier assembly.

Smear a small amount of grease inside sun gear spacer, Item 32, and slide onto output sun gear.

Insert spline of output sun gear into spline of primary planet carrier, Item 13.

Coat quad-ring, Item 49, with oil and install in groove in cable drum assembly, Item 3.

Install cable drum assembly, Item 3, using care not to damage the quad-ring.

Install ring gear, Item 12.

Install cable drum bushing, Item 21.

Install final planet carrier assembly in winch, aligning planet gear teeth with ring gear, Item 12, and output sun gear.

Install output shaft by engaging its spline with spline in output planet carrier, Item 18.

Slip thrust bearing, Item 64, over end of output shaft.

Return to standard reassembly instructions on page 14.