Pull-MASTER

THE LOGICAL CHOICE

INSTRUCTION AND PARTS MANUAL

MODEL M6

PLANETARY HYDRAULIC WINCH

TWG

POWER to Move the World™

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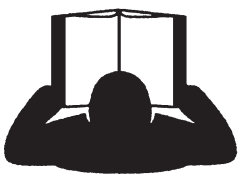
A DOVER COMPANY



READ THIS MANUAL BEFORE INSTALLING, OPERATING OR SERVICING THIS PRODUCT. THIS MANUAL CONTAINS IMPORTANT INFORMATION. MAKE THIS MANUAL AVAILABLE TO ALL PERSONS RESPONSIBLE FOR THE OPERATION, INSTALLATION, SERVICING AND MAINTENANCE OF THIS PRODUCT.

Effective 2011/10/01
SUPERSEDES ALL PRIOR WARRANTIES

LIMITED WARRANTY

50130-0

Seller warrants that each article (whether Gear Drive Products, Brake Products and/or Winch Products, all of which are covered hereunder) sold under this order shall at the time of shipment (i) conform to applicable specifications, and (ii) be free from defects in material and workmanship during normal and ordinary use and service (the "Warranty").

Buyer's exclusive remedy and Seller's sole obligation under this Warranty shall be, at Seller's option, to repair or replace any article or part thereof which has proven to be defective, or to refund the purchase price of such article or part thereof. Buyer acknowledges that Buyer is knowledgeable concerning the articles covered by this Warranty and sold in connection therewith which are being purchased, that Buyer has reviewed this Warranty and that the remedies provided hereunder are adequate and acceptable to Buyer.

This Warranty shall expire one (1) year from the date the article is first shipped by Seller. Notice of claimed breach of this Warranty must be given by Buyer to Seller within the applicable period. Such notice shall include an explanation of the claimed warranty defect and proof of date of purchase of the article or part thereof for which warranty coverage is sought. No allowances shall be made by Seller for any transportation, labor charges, parts, "in and out" costs, adjustments or repairs, or any other work, unless such items are authorized in writing and in advance by Seller. Nor shall Seller have any obligation to repair or replace items which by their nature are expendable.

If an article is claimed to be defective in material or workmanship, or not to conform to the applicable specifications, Seller will either examine the article at Buyer's site or issue shipping instructions for return to Seller. This Warranty shall not extend to any articles or parts thereof which have been installed, used, or serviced otherwise than in conformity with Seller's applicable specifications, manuals, bulletins, or instructions, or which shall have been subjected to improper installation, operation, or usage, misapplication, neglect, incorrect installation, overloading, or employment for other than normal and ordinary use and service. This Warranty shall not apply to any article which has been repaired, altered or disassembled, or assembled by personnel other than those of Seller. This Warranty shall not apply to any article upon which repairs or alterations have been made (unless authorized in writing and in advance by Seller). This Warranty shall not apply to any articles or parts thereof furnished by Seller to Buyer's specifications and/or furnished by Buyer or acquired from others at Buyer's request.

SELLER MAKES NO EXPRESS WARRANTIES AND NO IMPLIED WARRANTIES OF ANY KIND, OTHER THAN THE WARRANTY EXPRESSLY SET FORTH ABOVE. SUCH WARRANTY IS EXCLUSIVE AND IS MADE AND ACCEPTED IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Buyer expressly agrees that Seller is not responsible to perform any work or investigation related in any way to torsional vibration issues and is not responsible for the detection or remedy of Natural Frequency Vibration of the mechanical system in which the unit is installed. Buyer acknowledges, understands and agrees that this Warranty does not cover failures of the unit which result in any manner from the operation of the machine or unit at vibration frequencies at or near the natural frequency vibration of the machine in such a way that damage may result. Buyer expressly agrees that Seller is not responsible for failure damage or accelerated wear caused by machine or ambient vibration. Further, Buyer acknowledges and agrees that Buyer is always solely responsible for determination and final approval of the “application factor” which may be used in Seller’s calculations and this application factor is 1.0 unless otherwise stated in Seller’s quotation specifications.

The remedies for this Warranty shall be only those expressly set forth above, to the exclusion of any and all other remedies of whatsoever kind. The limited remedies set forth above shall be deemed exclusive, even though they may fail their essential purpose. No agreement varying or extending the foregoing Warranty, remedies, exclusions, or limitations shall be effective unless in writing signed by an executive officer of Seller and Buyer. This Warranty is non-transferable. If a party who had purchased articles from Buyer, or from persons in privity with Buyer, brings any action or proceeding against Seller for remedies other than those set forth in this Warranty, Buyer agrees to defend Seller against the claims asserted in such action or proceeding at Buyer’s expense, including the payment of attorneys’ fees and costs, and indemnify Seller and hold Seller harmless of, from and against all such claims, actions, proceedings or judgments therein. Buyer also agrees to defend and indemnify Seller of, from and against any loss, cost, damage, claim, debt or expenses, including attorneys’ fees, resulting from any claims by Buyer or third parties to property or injury to persons resulting from faulty installation, repair or modification of the article and misuse or negligent operation or use of the article, whether or not such damage to property or injury to persons may be caused by defective material, workmanship, or construction.

ADVISORY: *Winches and hoists are not approved for lifting or handling personnel or persons unless specifically approved in writing from Seller for the specific intended application.*

Under no circumstances shall Seller be liable (i) for any damage or loss to any property other than the warranted article or part thereof, or (ii) for any special, indirect, incidental, or consequential damage or loss, even though such expenses, damages, or losses may be foreseeable.

The foregoing limitations on Seller's liability in the event of breach of warranty shall also be the absolute limit of Seller's liability in the event of Seller's negligence in manufacture, installation, or otherwise, with regard to the articles covered by this Warranty, and at the expiration of the Warranty period as above stated, all such liabilities shall terminate. Buyer’s purchase of any article(s) covered by this Warranty shall constitute acceptance of the terms and conditions hereof and shall be binding upon Buyer and Buyer’s representatives, heirs and assigns. The laws of the Province of British Columbia shall govern Buyer’s rights and responsibilities in regard to this Warranty and the transaction(s) subject thereto, and the Province of British Columbia shall be the exclusive forum and jurisdiction for any action or proceedings brought by Buyer in connection herewith or any dispute hereunder. If any of the terms and conditions contained within this Warranty are void, the remaining provisions thereof are and shall remain valid and enforceable.

SAFETY RECOMMENDATIONS

DANGER

FAILURE TO COMPLY WITH THE FOLLOWING SAFETY RECOMMENDATIONS AND LOCAL RULES AND REGULATIONS WILL RESULT IN PROPERTY DAMAGE, SEVERE INJURY OR DEATH.

Definition: **Caution** indicates a potentially hazardous situation which, if not avoided may result in minor or moderate injury.

Definition: **Warning** indicates a potentially hazardous situation which, if not avoided could result in death or serious injury.

Definition: **Danger** indicates a potentially hazardous situation which, if not avoided will result in death or serious injury.

The planetary hydraulic winches are made for hoisting and lowering loads and to be operated by trained and professional personnel. They are not designed for operations involving lifting or moving personnel. The winches are powered by hydraulic power. The ropes / cables for hoisting operations are not supplied by PULLMASTER. The winches are always assembled in an application, they do not function as an independent machine and it is not allowed to use them as such.

The winches are to be used within the specifications as listed in the manual under "SPECIFICATIONS". Other use as foreseen in the functional description of the hydraulic winch is not allowed without written permission from PULLMASTER.

1. Do not install, operate or service winch before reading and understanding manufacturer's instructions.
2. The winch described herein is not designed for operations involving lifting or moving personnel.
3. Do not lift or carry loads over people.
4. Do not exceed recommended operating pressure (psi) and operating volume (gpm).
5. Do not jerk the winch. Always smoothly accelerate and decelerate load.
6. Do not operate a damaged, noisy or malfunctioning winch.
7. Do not leave a load suspended for any extended period of time.
8. Never leave a suspended load unattended.
9. Winch should be maintained and operated by qualified personnel.
10. Inspect winch, rigging, mounting bolts and hoses before each shift.
11. Warm-up equipment before operating winch, particularly at low ambient temperatures.
12. Verify winch function by raising and lowering a full test load to a safe height before each shift.
13. Do not weld any part of the winch.
14. Verify gear lubrication and brake circulation supply and return before operating winch.
15. Be sure of equipment stability before operating winch.
16. Wear proper clothing to avoid entanglement in rotating machinery.
17. Always stand clear of the load.
18. Use only recommended hydraulic oil and gear lubricant.
19. Keep hydraulic system clean and free from contamination at all times.
20. Maintain winch and equipment in good operating condition. Perform scheduled maintenance regularly.
21. Keep hands clear when winding wire rope onto the winch drum.
22. Do not use the wire rope as a ground for welding.
23. Rig the winch carefully. Ensure that the wire rope is properly anchored to the correct cable anchor slot at the cable drum.
24. Do not lift a load with a twisted, kinked or damaged wire rope.
25. Consult wire rope manufacturer for size, type and maintenance of wire rope.
26. Maintain five wraps of wire rope on the cable drum at all times.
27. In case of a power failure or breakdown leading to an unexpected stop of the hydraulic power circuit, stand clear of the area and the load being hoisted, take the necessary precautions to prevent access to area where the load is halted.
28. The noise level of the winch is 86 dBA measured on a distance of 1.00 meter, 1.60 meters high. The measuring equipment used was: Realistic #42-3019.
29. Clean up any oil spillage immediately.
30. Wear proper clothing and personal protection equipment such as, footwear, safety goggles and a hard hat. Read manual first.

DESCRIPTION OF THE MODEL M6

GENERAL DESCRIPTION:

The PULLMASTER Model M6 is a planetary, hydraulic winch having equal speed in both directions and an automatic disc brake. The main components of this unit are:

- high torque, low speed hydraulic motor
- multi-disc brake with over-running clutch
- planetary reduction
- brake housing
- cable drum
- final drive housing

FUNCTION IN FORWARD ROTATION (HOISTING):

In forward rotation, the output torque and rpm of the hydraulic motor are transmitted through the brake shaft to the final sungear. The planet gears are driven by the final sungear and cause the planet hub to drive the cable drum at a reduction of 9.25:1. When a load is raised, an over-running clutch which connects the motor drive shaft to the automatic brake assembly, permits free rotation of the sungear, without effecting the brake. When the winch rotation is stopped, the load on the cable drum causes the over-running clutch to lock and the load is held safely by the disc brake.

FUNCTION IN REVERSE ROTATION (LOWERING):

In reverse rotation, hydraulic pressure from the reverse side of the hydraulic motor is channelled to the brake piston, causing the brake piston to release the multi-disc brake. The over-running clutch, connecting the motor drive shaft to the brake assembly, locks, causing the brake discs to rotate between stationary divider plates. If the load on the cable drum increases the pay out speed, the resulting pressure drop in the brake piston increases friction between the friction plates and slows the drum. In this way, a completely smooth pay out speed can be achieved in a stepless operation by modulation of the winch control valve. When the control valve is returned to neutral position, rotation stops and the disc brake applies automatically.

During lowering operations of the winch, the friction created by the brake discs results in heat. This heat is dissipated by the circulation of hydraulic fluid from the brake housing, supplied internally through the hydraulic motor. This circulation flow is internally vented to the return line through a check valve arrangement inside the specially modified motor. The circulation flow is supplied only when lowering a load. A separate vent line connecting the PULLMASTER Model M6 with the hydraulic reservoir is not required (see TYPICAL HYDRAULIC CIRCUIT).

IMPORTANT: **SAFETY VALVE**

The PULLMASTER Model M6 winch does not require a drain line up to 100 psi permissible back pressure in the brake housing. To indicate excessive pressure and potential damage to the hydraulic motor or to the oil seal in the brake housing, a safety valve is installed on the motor adaptor.

BREATHER RELIEF VALVE

Excessive pressure in the brake housing will damage the oil seal separating the brake housing from the drum interior. Damage to this seal will cause the drum to fill up with hydraulic fluid. To prevent damage to the drum seal and end cover of the final drive if the cable drum fills up with hydraulic fluid, a breather relief (PARTS REFERENCE item 130) is installed on the end cover. The breather relief does not prevent oil seal failure but serves as an indicator or warning that the seals between brake housing and the cable drum interior have failed and must be replaced immediately.

EXPLANATION OF MODEL CODING

M 6 X - XX - XX - X X - X XXXX

BASIC UNIT SERIES
M = Equal speed in both directions

SIZE OF UNIT

OPTIONAL REDUCTION RATIO

TYPE OF BRAKE

-12 Automatic brake, counterclockwise drum rotation, intravent

-13 External brake release, automatic brake, counterclockwise drum rotation, intravent

-14 External brake release, automatic brake, clockwise drum rotation, intravent

-15 Automatic brake, clockwise drum rotation, intravent

HYDRAULIC MOTOR
-70 NICHOLS, 12.9 cubic inch displacement
(Other displacements are optional)

DRUM SIZE
-2 7 1/2 inch drum diameter X 11 3/8 inch flange diameter X 9 inch - STANDARD
(For other drum sizes refer to APPENDIX A)

OPTIONS

DESIGN REVISION

SPECIFICATION NUMBER
Describes features not identified by preceding codes

NOTE: Clockwise and counterclockwise drum rotation is the direction of rotation for pulling or hoisting, established by looking at the hydraulic motor.

OPTIONS

CLOCKWISE ROTATION:

The drum rotation of the standard PULLMASTER Model M6 planetary winch is counterclockwise for hoisting, when looking at the hydraulic motor of the winch. Drum rotation for clockwise hoisting direction is available as an option.

EXTERNAL BRAKE RELEASE:

PULLMASTER planetary winches can be supplied with an **external brake release** which permits release of the automatic disc brake from an external pressure source.

DANGER

FAILURE TO PROPERLY VENT EXTERNAL BRAKE RELEASE PORT WILL TRAP BRAKE PRESSURE AND ALLOW THE LOAD TO DROP, CAUSING PROPERTY DAMAGE, SEVERE INJURY OR DEATH. WINCHES SUPPLIED WITH EXTERNAL RELEASE OPTION MUST BE CONNECTED ACCORDING TO TYPICAL HYDRAULIC CIRCUIT.

CABLE DRUM SIZES:

Aside from the standard drum sizes listed in APPENDIX A, the PULLMASTER Model M6 planetary winch can be supplied with optional drums to accommodate large wire rope storage capacity.

DRUM GROOVING:

Cable drums for the PULLMASTER Model M6 planetary winch can be grooved. Where this option is a requirement, it is necessary to state the size of wire rope which is to be used with the winch.

OPTIONAL HYDRAULIC MOTORS:

The performance of the standard PULLMASTER Model M6 planetary winch may be changed by using a different displacement motor. (Contact the factory for performance information.)

The PULLMASTER WINCH CORPORATION will consider other options for quantity requirements.

SPECIFICATIONS

Performance specifications are based on standard hydraulic motor, gear ratio and cable drum (drum code -2) with 1/2 inch diameter wire rope. For other cable drums refer to APPENDIX A. Performance specifications for winches supplied with optional motors are provided in attached supplement.

CABLE DRUM DIMENSIONS (STANDARD DRUM):

Barrel diameter	7.50 in	191 mm
Flange diameter	11.38 in	289 mm
Barrel length	9.00 in	229 mm

CABLE STORAGE CAPACITY:

(Size of wire rope)		
3/16 in	932 ft	284 m
1/4 in	484 ft	148 m
5/16 in	363 ft	111 m
3/8 in	218 ft	67 m
7/16 in	198 ft	60 m
1/2 in	139 ft	42 m
9/16 in	93 ft	28 m

MAXIMUM OPERATING PRESSURE: 2000 psi 138 bar

MAXIMUM OPERATING VOLUME: 15 (US) gpm 57 l/min

MINIMUM OPERATING VOLUME: 5 (US) gpm 19 l/min

DRUM TORQUE AT MAXIMUM PRESSURE: 26,448 lb-in 2,988 Nm

DRUM RPM AT MAXIMUM VOLUME: 26 rpm

LINE PULL AT MAXIMUM PRESSURE:

Bare drum	6,612 lb	29.4 kN
Full drum	4,864 lb	21.6 kN

LINE SPEED AT MAXIMUM VOLUME:

Bare drum	54 fpm	17 m/min
Full drum	74 fpm	23 m/min

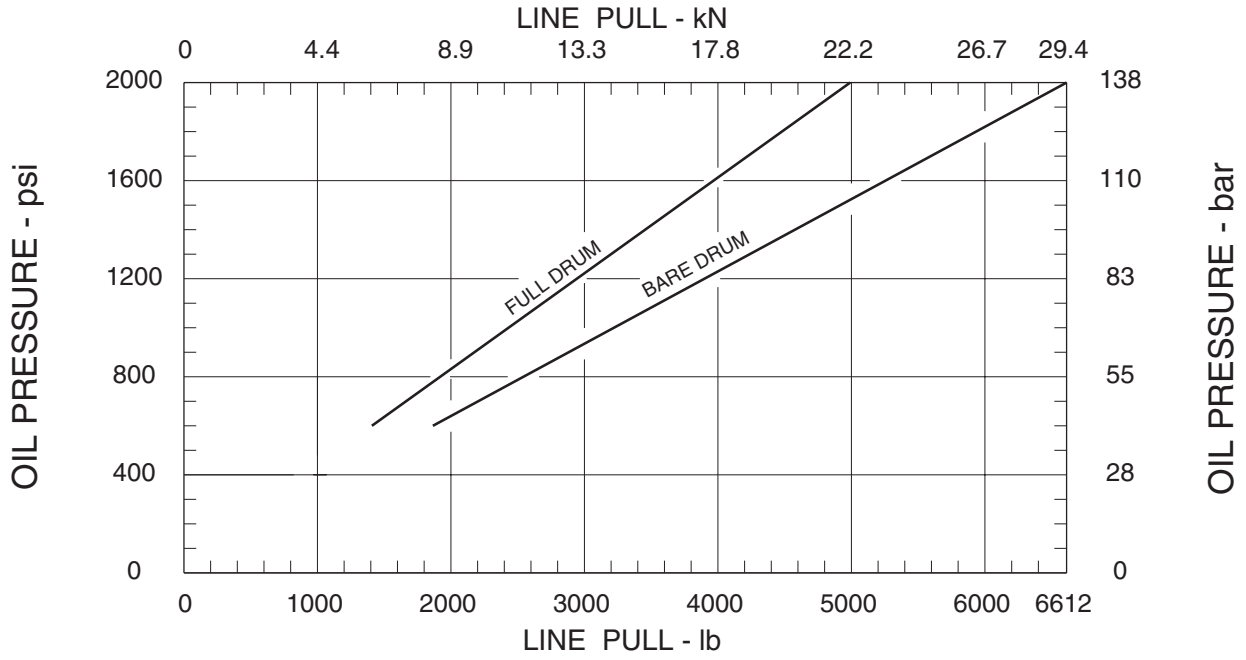
PERMISSIBLE SYSTEM BACK PRESSURE AT MOTOR RETURN PORT: 65 psi 4.5 bar

LUBRICATING OIL: Refer to RECOMMENDATIONS for viscosity and instructions. Refer to APPENDIX A for oil volume required.

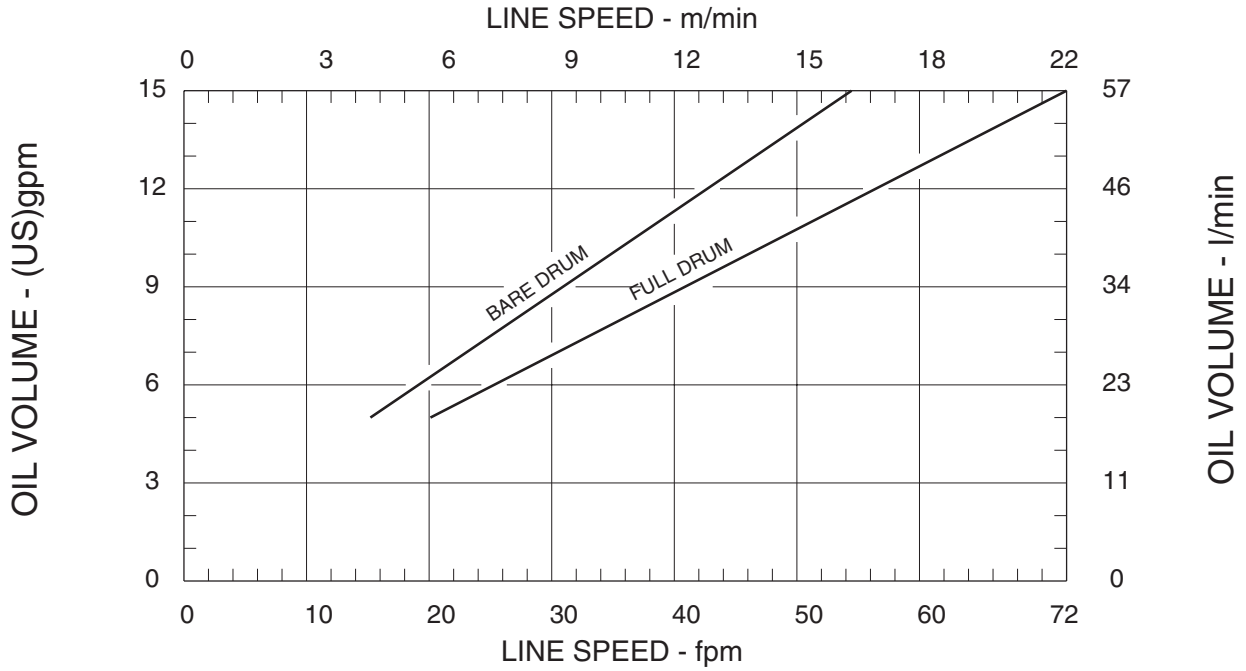
PERFORMANCE GRAPHS

PG-M6-B

LINE PULL VS. OIL PRESSURE:



LINE SPEED VS. OIL VOLUME:

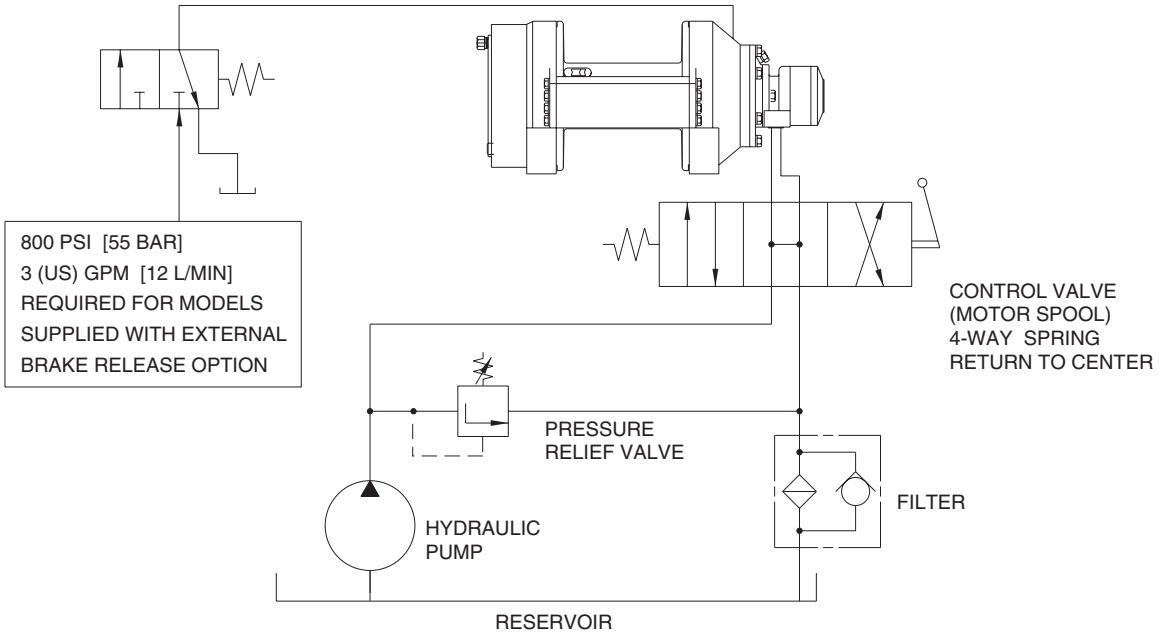


Performance graphs are based on standard hydraulic motor and cable drum with 1/2 inch diameter wire rope.

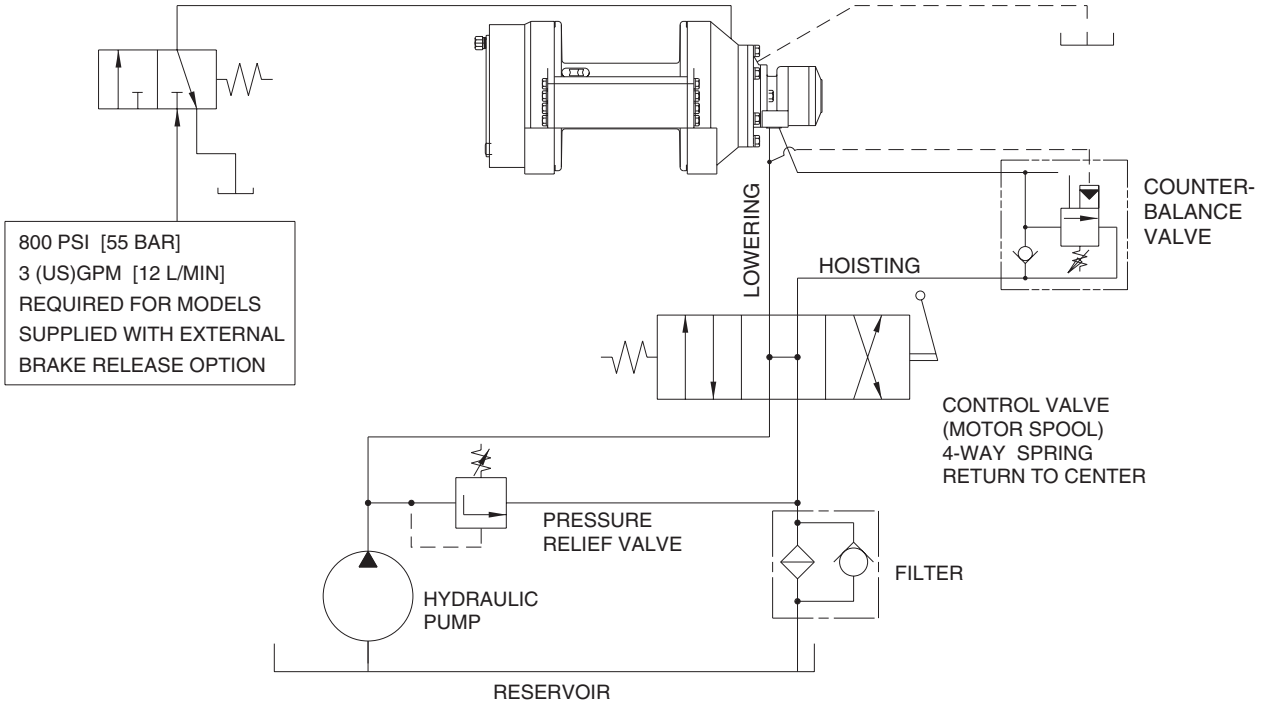
TYPICAL HYDRAULIC CIRCUITS

HC-M6-B

PULLING APPLICATIONS:



HOISTING APPLICATIONS:



RECOMMENDATIONS

HYDRAULIC FLUID:

The hydraulic fluid selected for use with PULLMASTER planetary winches should be a high grade, petroleum based fluid, with rust, oxidation and wear resistance. Fluid cleanliness and operating viscosity are critical to winch reliability, efficiency and service life.

For optimum performance, the recommended viscosity range at operating temperature is 81 - 167 SUS (16 - 36 CS). For extreme operating conditions of short duration, the maximum viscosity range of 58 - 4635 SUS (10 - 1000 CS) should not be exceeded.

For optimum performance, the winch recommended hydraulic fluid temperature operating range is 80 - 150F (27 - 66 C). For extreme operating conditions of short duration, the maximum temperature range of -5 - 180F (-21 - 82 C) should not be exceeded.

LUBRICATION:

The winch gear train requires oil bath lubrication. The winch is shipped from the factory without lubricating oil.

IMPORTANT: ADD LUBRICATING OIL BEFORE RUNNING WINCH.

Refer to INSTALLATION DIMENSIONS for location of lubricating oil fill port. Refer to APPENDIX A for quantity of oil required. For normal operating temperature use SAE 90 lubricating oil. For temperature beyond normal operating range, consult lubricating oil supplier or factory.

HYDRAULIC PUMP:

For maximum performance of the PULLMASTER planetary winch, the hydraulic pump must supply the maximum flow of hydraulic fluid at the hydraulic pressure stated in SPECIFICATIONS.

HYDRAULIC CONTROL VALVE:

The standard control valve used for operation of the PULLMASTER planetary winch must have a four-way, spring return to neutral feature, which provides for open flow from the pressure ports of the winch to the reservoir in neutral position of the control (motor spool). It is important to point out that good speed control, especially when lowering a load, depends on the "metering" characteristics of the control valve. The better the oil flow is "metered" the better will be the speed control.

HYDRAULIC PRESSURE RELIEF:

The hydraulic circuit for the PULLMASTER planetary winch requires a pressure relief set at the operating pressure (see SPECIFICATIONS). Usually, a pressure relief is part of the hydraulic control valve. Where this is not the case, a separate pressure relief valve must be installed and set at the recommended maximum pressure.

HYDRAULIC RESERVOIR:

It is recommended that the hydraulic reservoir has sufficient capacity to provide good heat dissipation in order to prevent over-heating of the hydraulic fluid. The hydraulic reservoir should be made from clean and scale-free material to prevent contamination of the hydraulic fluid. In order to prevent air from being mixed with the hydraulic fluid, the reservoir should have an over-flow baffle separating the return lines from the suction line and all return lines should enter the reservoir below the fluid level. The reservoir should be mounted close to and above the hydraulic pump in a location which provides for free air circulation around the reservoir.

HYDRAULIC HOSES:

The following hydraulic hoses are recommended for maximum efficiency of the PULLMASTER Model M6 planetary winch:

Pressure lines: Equivalent to SAE 100R12-12

It is recommended that a larger size of hydraulic hose is installed where the pressure lines or the circulation lines are excessively long.

HYDRAULIC FILTER:

Hydraulic filter recommendations for the hydraulic circuit of the PULLMASTER planetary winch, based on a return line filter, are given as follows:

Average Atmosphere:	10 microns
Dusty Atmosphere:	5 microns

In order to prevent accidental stoppage of the return line flow, the oil filter should have a by-pass feature.

USE OF AN E STOP:

(FOR EUROPEAN MACHINERY DIRECTIVE APPLICATIONS)

The use of an E stop (emergency) is mandatory in the controls circuit. The E stop is to be placed in the operator's control panel. The E stop must be designed and placed in line with EN 60204 and EN 418.

INSTALLATION INSTRUCTIONS

DANGER

FAILURE TO FOLLOW INSTALLATION INSTRUCTIONS WILL RESULT IN PROPERTY DAMAGE, SEVERE INJURY OR DEATH.

The initial installation or mounting of a PULLMASTER planetary winch is critically important for proper operation and performance. If the winch is mounted to an uneven surface, the centre line of the unit can be distorted to a point where the winch will not operate in either direction. It is therefore very important that the following instructions are observed when a PULLMASTER planetary winch is installed:

1) Make certain that the mounting platform is sufficiently strong in order to avoid deflection when a load is lifted.

2) Set the winch on the mounting platform and check for surface contact on all mounting pads of the winch.

3) If there is a space between the mounting surface and one of the mounting pads, the mounting surface is not even and the space below the mounting pad must be shimmed. If this condition exists, proceed as follows:

   a) Install mounting bolts snug tight on the three mounting pads which are in contact with the mounting surface. (For mounting bolt size and grade see INSTALLATION DIMENSIONS.)

   b) Measure the space underneath the fourth mounting pad with a feeler gauge and use shim stock of equivalent thickness in the space between the mounting pad and the mounting surface.

   c) Only after this procedure should the fourth mounting bolt be installed. Tighten all four bolts per BOLT TORQUE CHART.

4) Fill the winch with lubricating oil. (See APPENDIX A for oil volume required.)

5) Use recommended circuit components and hydraulic hoses.

6) The circulation return line of the winch should be plumbed in such a manner that the brake housing remains full of oil at all times. Connect the return line directly to reservoir. Do not connect to a common return line.

7) Verify that breather relief, item 130, is in place on end cover above oil level. Rotate end cover if breather relief is below oil level.

IMPORTANT: Do not replace breather relief or safety valve with a pipe plug. The breather relief does not prevent oil seal failure but serves as an indicator or warning that the oil seals between brake housing and the cable drum interior have failed and must be replaced immediately. The safety valve acts as a warning that excessive pressure is present in the brake housing and must be rectified immediately.

OPERATING INSTRUCTIONS

DANGER

FAILURE TO FOLLOW OPERATING INSTRUCTIONS WILL RESULT IN PROPERTY DAMAGE, SEVERE INJURY OR DEATH.

After the PULLMASTER planetary winch has been installed in accordance with the INSTALLATION INSTRUCTIONS, the wire rope can be fastened to the cable drum.

IMPORTANT: The ropes, chains, slings, etc. are not part of the winch and are not covered by this manual. Refer to manufacturer's handling, inspection and maintenance recommendations to avoid potential accidents. For selection of ropes, etc. please check following product standards: DIN 15020, prEN818-1/9, prEN 1492-1/2, prEN 1677-1/3 and other relevant product standards.

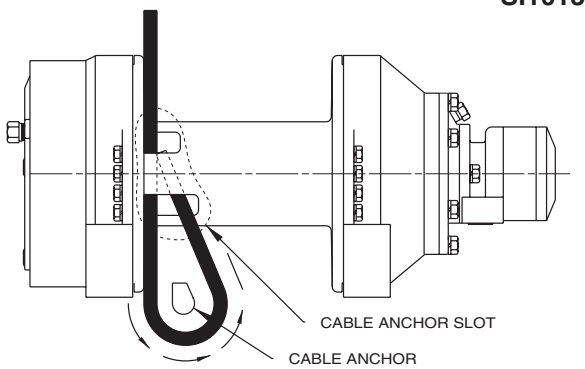
1) The cable drum of the PULLMASTER planetary winch has two cable anchor slots, one for clockwise and one for counterclockwise pulling. Standard rotation for pulling is counterclockwise when looking at the hydraulic motor of the unit. It is critical to select the cable anchor slot which will permit winding of the wire rope on the drum in the correct direction of rotation. If the wire rope is wound on the cable drum in the wrong direction of rotation, the winch will have no braking capacity. Each winch is shipped from the factory with a label on the drum indicating the correct cable anchor slot.

SI1013 - M6

WIRE ROPE INSTALLATION

Counterclockwise pulling winch shown. (Use cable anchor slot on opposite side of drum for clockwise pulling winch.)

Feed the wire rope through the cable anchor slot. Loop rope back into slot as shown. Insert cable anchor into slot, small end first and long side nearest the drum flange. Pull rope tight to wedge rope in slot.



2) On wire rope installation, care must be taken that the wire rope is wrapped completely around the cable anchor and properly pulled into the cable anchor slot in the cable drum. The cable drum requires 5 wraps of wire rope for safety.

3) The winch operation is controlled by a single control valve lever which has a **forward**, a **reverse** and a **neutral** position. Speed control in either direction is obtained by modulation of the control valve lever. Maximum line speed in either direction is obtained when the control valve lever is moved as far as it can go. The disc brake of the winch will come on automatically when the winch control lever is returned to **neutral**.

4) Always warm up equipment prior to operating winch, particularly in low ambient temperature. Circulate hydraulic oil through the winch control valve for several minutes to warm the hydraulic system. To prime the winch with warm oil, operate the winch at slow speed, forward and reverse, several times.

5) Prevent corrosion damage to winch interior. If not used regularly, run winch up and down at least once every two weeks.

6) To ensure proper winch installation and function, raise and lower a full test load to a safe height before using winch for regular operation at the start of each shift.

   If, after a new installation, the winch does not function properly, refer to the TROUBLESHOOTING section of this manual.

TROUBLE SHOOTING

GENERAL:

In most cases, when the hydraulic winch does not perform satisfactorily, the cause of malfunction is found somewhere in the hydraulic circuit. Before the winch is removed from its mounting and disassembled, all of the hydraulic circuit components should be checked for proper function.

IMPORTANT:

The hydraulic oil volume relates to the line speed or rpm of the winch.
Therefore, if the winch does not produce the maximum rated line speed, a loss of hydraulic flow somewhere in the hydraulic circuit system can be analysed. If this condition exists, install a flow meter into the hydraulic circuit to check the volume supplied to the motor ports when the winch control is completely opened. The flow meter should indicate the maximum operating volume. If the test described indicates a loss of hydraulic flow, check the hydraulic pump, the relief valve and the control valve.

The hydraulic pressure relates to the line pull or lifting capacity of the winch.
If the winch will not pull the maximum rated load, install a pressure gauge into the pressure line leading to the pulling port on the hydraulic winch motor. Stall the winch to prevent rotation of the drum and then open the control valve and check the hydraulic pressure reading of the installed pressure gauge. If the pressure reads below the specified maximum operating pressure, look for trouble in the hydraulic pump, the relief valve and the control valve. When checking oil pressure of oil volume anywhere in the hydraulic system, make certain that the hydraulic pump is running at maximum operating rpm. Installations using a belt drive for hydraulic pump must be checked for belt slippage. Verify that hydraulic reservoir is filled to the top level.

Only if the hydraulic system has been checked and found to be in order, use the following indications for probable causes of failure in the winch:

FAILURE	PROBABLE CAUSE
Winch will not produce line pull at maximum pressure as listed in SPECIFICATIONS.	a) Winch is mounted to an uneven surface (see INSTALLATION INSTRUCTIONS). b) Cable sheaves or block purchase operated with the winch are not turning freely. c) Damage or wear in the hydraulic motor. d) Excessive back pressure in the hydraulic system. e) Relief valve may be set too low.
Winch will not produce line speed at maximum volume as listed in SPECIFICATIONS.	a) Winch is mounted to an uneven surface (see INSTALLATION INSTRUCTIONS). b) Cable sheaves or block purchase operated with the winch are not turning freely. c) Damage or wear in the hydraulic motor d) Excessive back pressure in the hydraulic circuit.
Winch will not reverse.	a) Leakage out of the brake piston prevents the brake from being released against the brake springs. This is caused by damaged O-ring seals on the brake piston. b) The O-ring seals, on the brake release channel between the motor adaptor and the brake housing is damaged. If this failure occurs there will be substantial leakage from between the motor adaptor and brake housing. c) Insufficient hydraulic pressure (see SPECIFICATIONS for minimum operating pressure). d) Winch is mounted to an uneven surface (see INSTALLATION INSTRUCTIONS). e) Hydraulic pressure is not reaching the brake piston (plugged brake release orifice in the brake housing).

TROUBLE SHOOTING

FAILURE	PROBABLE CAUSE
Brake will not hold.	a) Friction plates or divider plates have been damaged by contamination in the hydraulic fluid, or lack of circulation flow in the brake housing. b) Brake piston is seized in the brake housing because of contamination in the hydraulic fluid. c) Excessive back pressure in the return line causes the brake to be released. d) Control valve has incorrect spool, which traps hydraulic pressure in the brake piston when the control valve handle is returned to neutral position. For proper function of the automatic brake, both pressure ports of the winch must be open to the reservoir in neutral position of the control valve. e) Wire rope is fastened to the incorrect cable anchor slot. f) Sprag clutch is damaged or surfaces where sprag clutch engages on brake shaft or brake hub are worn or indented. g) Winch supplied with external brake release option is not plumbed per HYDRAULIC CIRCUIT. Failure to vent external brake release port to reservoir may trap pressure and cause winch brake to slip.
Brake vibrates when lowering a load.	a) Pump is too slow. Pump rpm must be maintained at normal operating speed when a load is lowered. b) Brake is running too hot. This is caused by a complete lack of, or insufficient circulation flow. To check circulation flow, remove safety valve from motor adaptor. When winch is reversed, oil flow should be approximately 2.5 (US) gpm (9 litre/min). c) Control valve has poor metering characteristics. d) Damaged brake plates or divider plates. e) The over-running clutch, which connects the motor shaft with the brake assembly, is damaged. f) Air mixed with hydraulic oil (foamy oil).
Oil leaks.	a) Oil leaks from the hydraulic motor flange and the motor adaptor are caused by damaged O-ring seals. b) Oil leaks occurring between the cable drum flanges and housings are caused by excessive pressure in the brake housing. Excessive pressure will damage the oil seal which separates the brake housing from the cable drum interior. c) If the breather relief on the end cover leaks, the seal between the drum interior and the brake housing is damaged and must be replaced. This condition is caused by excessive pressure in the brake housing of the winch, operation with the incorrect hydraulic fluid during cold weather, or a restriction in the circulation return line leading back to tank.

Refer to the SERVICE INSTRUCTIONS if it becomes necessary to disassemble the Model M6 winch.

SERVICE INSTRUCTIONS

GENERAL:

Before attempting disassembly of the PULLMASTER Model M6 planetary winch, the following instructions should be read and understood.

It is suggested that all expendable parts, such as O-rings and oil seals are not reused on reassembly. It is therefore important to have a winch seal kit (Part No. 23119) and, providing the hydraulic motor has to be serviced, a motor seal kit (Part No. 23118) on hand.

NOTE: Backup washers may be included with seal kit. Install with oil seals as per instructions. If not present in seal kit, the oil seals supplied do not require backup washers.

A clean working area is of prime importance, similar to conditions used for service work on any other hydraulic components.

All parts, as they are removed from the winch assembly, should be inspected for wear and damage. Thoroughly clean parts before reassembly, however, do not use solvent to clean friction plates.

During reassembly, lubricate all O-rings and oil seals with grease.

In the following service instructions, reference to parts is made by numbers and shown on the applicable group drawings.

DISASSEMBLY

The majority of service or repair work is accomplished by disassembling the brake housing of the PULLMASTER Model M6 planetary winch. There are no special tools, adjustments or calibrations necessary to service or repair the winch.

REMOVAL OF HYDRAULIC MOTOR ASSEMBLY:

1) Remove two capscrews, item 815, and lockwashers, item 817. Pull the hydraulic motor, item 850, out of the winch assembly.
2) Remove and discard O-ring, item 811.
3) Remove connecting tube, item 830. Remove and discard two O-rings, item 831.
4) Remove two check valves, item 832. Remove and discard two O-rings, item 833.

The standard motor of the Model M6 is a *NICHOLS* hydraulic motor with 12.9 cubic inch displacement. If a problem is analysed to be in the hydraulic motor, we recommend that a NICHOLS dealer be contacted for parts and service.

If the hydraulic motor is disassembled, the original flange section of the motor must be re-used in order to provide the required porting to operate the automatic brake and for the circulation flow.

DISASSEMBLY OF BRAKE HOUSING ASSEMBLY:

Disassemble brake housing assembly as follows:

1) Remove motor adaptor, item 800, by removing six capscrews, item 821, and lockwashers, item 823. Allow brake springs, item 752, to expand safely by unscrewing capscrews one turn at a time.
2) Remove and discard O-ring, item 707.
3) Remove eight brake springs, item 752. Examine brake springs for damage and measure overall length. Overall spring length should be 1.54 inch. If any spring measures less than 1.48 inch, replace all springs as a set.
4) Pull the brake piston, item 750, out of the brake housing using two 1/2 - 13NC bolts screwed into the two puller holes in the piston and discard O-rings, item 751 and item 753.

5) Remove pipe plug, item 755, and verify that circulation hole in piston is clear and unobstructed. Re-install pipe plug, item 755.

6) Thoroughly inspect the brake piston outer diameters and brake housing inner bores for scoring caused by hydraulic fluid contamination. Minor surface damage may be repaired by polishing with a fine emery cloth.

7) Pull the brake shaft, item 730, and complete brake hub assembly from the brake housing.

8) Disassemble brake hub assembly by removing circlip, item 727, from brake shaft, item 730. Remove brake shaft from brake hub assembly. Remove sprag clutch aligners, item 722 and item 724, and sprag clutch, item 723, from brake hub.

DANGER

MINOR SURFACE DEFECTS WHERE THE SPRAG CLUTCH ENGAGES THE BRAKE SHAFT AND BRAKE HUB, WILL RESULT IN BRAKE FAILURE AND ALLOW THE LOAD TO DROP, CAUSING PROPERTY DAMAGE, SEVERE INJURY OR DEATH. THOROUGHLY INSPECT THESE AREAS AND, IF NECESSARY, REPLACE BRAKE SHAFT, SPRAG CLUTCH AND BRAKE HUB AS A SET.

9) Thoroughly inspect brake shaft, item 730, and brake hub, item 720, particularly the surfaces where the sprag clutch, item 723, engages. If any indentation or surface damage is detected, replace brake hub, sprag clutch and brake shaft as a set.

10) Remove the 14 divider plates, item 713, together with 13 brake plates, item 715, and inspect for damage or wear. Plates should not show heat discoloration. Paper material on friction plates should be intact and smooth. If any damage is detected, replace friction and divider plates as a set. Check oil for contamination if plates are in poor condition.

DANGER

DAMAGED FRICTION OR DIVIDER PLATES WILL REDUCE BRAKING CAPACITY AND ALLOW THE LOAD TO DROP CAUSING PROPERTY DAMAGE, SEVERE INJURY OR DEATH. DO NOT USE SOLVENT TO CLEAN THE FRICTION PLATES. PERFORM THOROUGH INSPECTION AND, IF NECESSARY, REPLACE FRICTION AND DIVIDER PLATES AS A SET.

11) Remove brake spacer, item 712, two thrust washers, item 615, and thrust bearing, item 617.

12) Remove bronze washer, item 706. Remove and discard oil seal, item 711, and backup washer, item 710.

All parts have now been removed from the brake housing and there is no need for further disassembly unless a failure has been analysed in the final drive of the Model M6.

DISASSEMBLY OF FINAL DRIVE ASSEMBLY:

If a failure occurs in the mechanism located inside the final drive housing, or the winch has to be disassembled beyond the point described in the preceding chapter, proceed as follows:

1) Remove the drain plug, item 121, from the end cover, item 120, and drain the lubricating oil from the final drive assembly and the cable drum interior. In order to drain all of the oil out of the cable drum interior, the winch should be tipped to an angle and the filler plug, item 503, removed.

2) Remove retaining ring, item 124, and pull end cover, item 120, out of final housing, item 100.

3) Discard O-ring, item 123, and inspect planet hub stopper, item 126, and sungear stopper, item 122, for excessive wear. Replace sungear stopper if less than .35 inch thick and planet hub stopper if less than .14 inch thick.

4) Remove final planet hub assembly from final housing, item 100.

5) Inspect three planet gears, item 320, for damage or wear. If it is necessary to remove planet gears, remove circlip, item 311, and press planet pin, item 310, out of planet hub, item 300. Inspect needle bearing, item 323, and two thrust washers, item 321, and replace if damaged.

6) Remove final sungear, item 340, from cable drum, item 500. Remove O-ring, item 293, from final sungear and discard.

All parts have now been removed from the final drive assembly. If further disassembly is required, proceed as follows:

DISASSEMBLY OF CABLE DRUM ASSEMBLY:

To separate brake housing, item 700, and final housing, item 100, from cable drum, item 500, proceed as follows:

1) Remove 16 capscrews, item 971, and lockwashers, item 973. Remove two tie bars, item 970. Stand the winch upright on its end housing.

2) Insert two heel bars between the flange of the cable drum, item 500, and the brake housing, item 700, and gently pry the brake housing out of spherical roller bearing, item 507.

3) Remove and discard oil seal, item 515.

4) Inspect spherical roller bearing, item 507, and replace if damaged.

5) Turn winch over to stand upright on the drum flange. Remove circlip, item 513, from splined hub of cable drum, item 500.

6) Insert two heel bars between the drum flange and the final housing and carefully pry the cable drum out of ball bearing, item 103.

7) Remove and discard oil seal, item 105. If removal of ball bearing, item 103, is necessary, first remove circlip, item 109.

The PULLMASTER Model M6 winch has now been completely disassembled.

REASSEMBLY

Thoroughly clean and lubricate all parts. Use only new, well-greased O-rings and oil seals. Unless otherwise specified, torque fasteners per BOLT TORQUE CHART at back of manual.

REASSEMBLY OF CABLE DRUM ASSEMBLY:

Reassemble cable drum assembly by reversing the disassembly procedure.

1) Press ball bearing, item 109, into final housing, item 100, and fasten with circlip, item 109.

2) Press new, well-greased oil seal, item 105, into other side of final drive housing.

3) Press final housing, item 100, onto hub of cable drum, item 500, and fasten with circlip, item 513.

4) Turn winch over so it stands on final housing end. Press spherical roller bearing, item 507, into cable drum, item 500.

5) Press new, well-greased oil seal, item 515, into cable drum, item 500.

REASSEMBLY OF FINAL DRIVE ASSEMBLY:

Reassemble final drive assembly by reversing the disassembly procedure.

1) Return winch to a horizontal position, standing on its mounting feet.
2) Install new, well-greased O-ring, item 293, on end of final sungear, item 340, and slide sungear through opening in cable drum, item 500.
3) Reassemble final planet hub assembly. Press pre-greased needle bearing, item 323, midway into planet gear, item 320. Position thrust washers, item 321, on either side of planet gear and press planet pin, item 310, into the planet hub, item 300. Retain with circlip, item 311.
4) Insert final planet hub assembly into final housing, so that spline interlocks with cable drum, and planet gears mesh with final sungear.
5) Install new, well-greased O-ring, item 123, into end cover, item 120. Verify that planet hub stopper, item 126, and sungear stopper, item 122, are installed into end cover.
6) Gently insert end cover into final housing, item 100, and fasten with retaining ring, item 124.
7) Temporarily remove breather relief valve, item 130, from end cover. Turn winch up on end with cable drum opening upwards.
8) Install new backup washer, item 710, and new, well-greased oil seal, item 711, in the bore of the brake housing.
9) Place brake housing, item 700, into cable drum, item 500, guiding it over final sungear, item 340. Use 16 capscrews, item 971, and lockwashers, item 973, to secure tie bars, item 970.

REASSEMBLY OF BRAKE HOUSING ASSEMBLY:

Reassemble brake housing assembly by reversing the disassembly procedure.

1) Install bronze washer, item 706. Place thrust bearing, item 617, in between two thrust washers, item 615, on top of bronze washer, item 706.
2) Install sprag clutch, item 723, in bore of brake hub, item 720. Insert sprag clutch aligner, item 722, into one side of the brake hub. Insert the other sprag clutch aligner, item 724, into the other side of the brake hub. Carefully slide the brake shaft, item 730, through the sprag clutch aligner, item 724, into the brake hub assembly and fasten into place by installing circlip, item 727.

IMPORTANT: For proper brake function, ensure that the brake hub rotation is correct. When viewed from the motor end, the brake shaft of a counterclockwise hoisting winch must turn freely counterclockwise and lock in the clockwise direction.

3) Install brake hub assembly through thrust washers, item 615, and engage spline with final sungear, item 340.

DANGER

INCORRECT ASSEMBLY OF THE FRICTION PLATE AND DIVIDER PLATE STACK WILL REDUCE BRAKING CAPACITY AND ALLOW THE LOAD TO DROP, CAUSING PROPERTY DAMAGE, SEVERE INJURY OR DEATH. REASSEMBLE PER INSTRUCTIONS.

4) Install brake spacer, item 712, into brake housing. Starting and finishing with a divider plate, alternately install 14 divider plates, item 713, and 13 friction plates, item 715.
5) Liberally grease O-ring, item 751, and O-ring, item 753, and install on the brake piston, item 750.

6) Carefully insert the brake piston into the brake housing and turn the piston to line up the bore for the connecting tube, item 830, with the bore in the motor, item 850.

7) Install the eight brake springs, item 752.

8) Install new, well-greased O-ring, item 707, on motor adaptor pilot, item 800.

9) Position motor adaptor with hydraulic motor mounting holes horizontal and the connecting tube holes of the piston aligned with motor adaptor. Tighten six capscrews, item 821, and lockwashers, item 823, one turn at a time to evenly compress springs.

REPLACEMENT OF HYDRAULIC MOTOR ASSEMBLY:

1) Install new O-rings, item 831, on each end of the connecting tube, item 830, and apply grease liberally. Insert the long end of the connecting tube into motor adaptor, item 800.

2) Install new, well-greased O-ring, item 811, on flange of the hydraulic motor, and two new, well-greased O-rings, item 834, on check valves, item 832.

3) Insert check valves in face of motor and fasten motor to motor adaptor using two capscrews, item 815, and lockwashers, item 817.

IMPORTANT: Before operating the winch, add lubricating oil up to the oil level fill port on the end cover. Refer to INSTALLATION INSTRUCTIONS for location of fill port. Refer to APPENDIX A for oil volume required. Ensure all pipe plugs are securely tightened and breather relief, item 130, is in place.

To ensure proper reassembly, run the winch in both directions without load.

DANGER

PULLING A LOAD WITH A NEWLY SERVICED WINCH WILL ENABLE AN INSTALLATION OR SERVICE PROBLEM TO GO UNDETECTED AND ALLOW THE LOAD TO DROP CAUSING PROPERTY DAMAGE, SEVERE INJURY OR DEATH. TO ENSURE PROPER REINSTALLATION, REFER TO PROCEDURES AND TESTS DESCRIBED IN "INSTALLATION" AND "OPERATING INSTRUCTIONS".

RECOMMENDED MAINTENANCE

Winch gear train lubricating oil should be changed after the initial six months or 50 hours of operation, whichever comes first. Lubricating oil should then be changed every 12 months or 500 operating hours, whichever comes first.

Hydraulic system fluid should be changed at least once every 12 months.

For optimum performance over an extended period of time, the following preventative maintenance service should be done every 12 months or 500 hours, whichever comes first:

1) Disconnect all hydraulic hoses and remove the winch from its mounting.

2) Disassemble the winch as per instructions.

3) Discard and replace all O-rings and oil seals.

4) Inspect all parts for wear and replace if necessary.

5) Clean all parts and inspect for wear and damage as per instructions. Replace worn or damaged parts as required.

6) Follow INSTALLATION and OPERATING INSTRUCTIONS when returning winch to its mounting.

When ordering parts for the PULLMASTER Model M6 planetary winch, always quote the complete model and serial number of the unit.

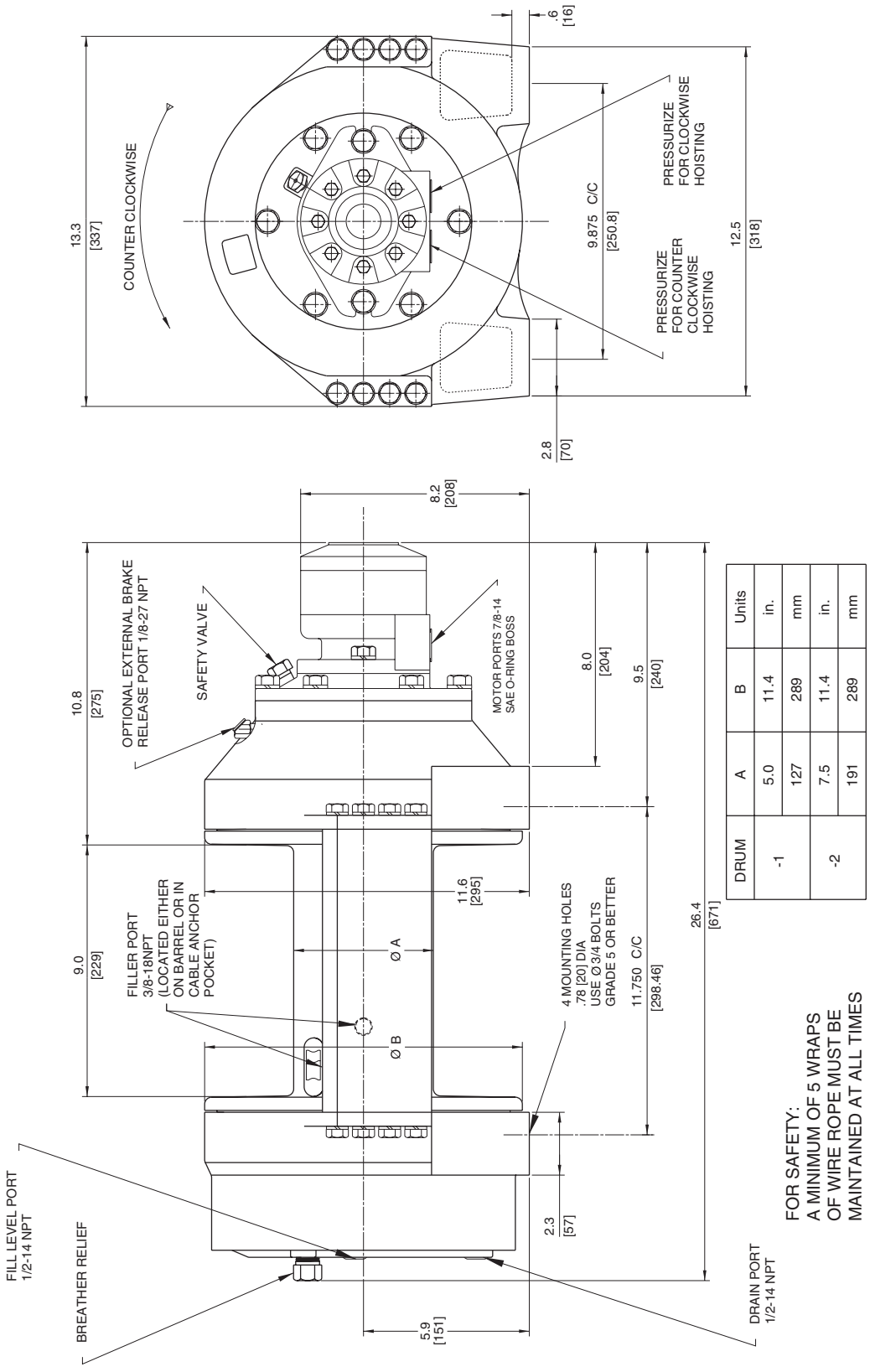
MODEL NO. _____

SERIAL NO. _____

PULLMASTER WINCH CORPORATION reserves the right to change specifications and the design of PULLMASTER planetary winches at any time without prior notice and without incurring any obligations.

INSTALLATION DIMENSIONS

I1062-A



DRUM	A	B	Units
-1	5.0	11.4	in.
	127	289	mm
-2	7.5	11.4	in.
	191	289	mm

PARTS REFERENCE - FINAL DRIVE

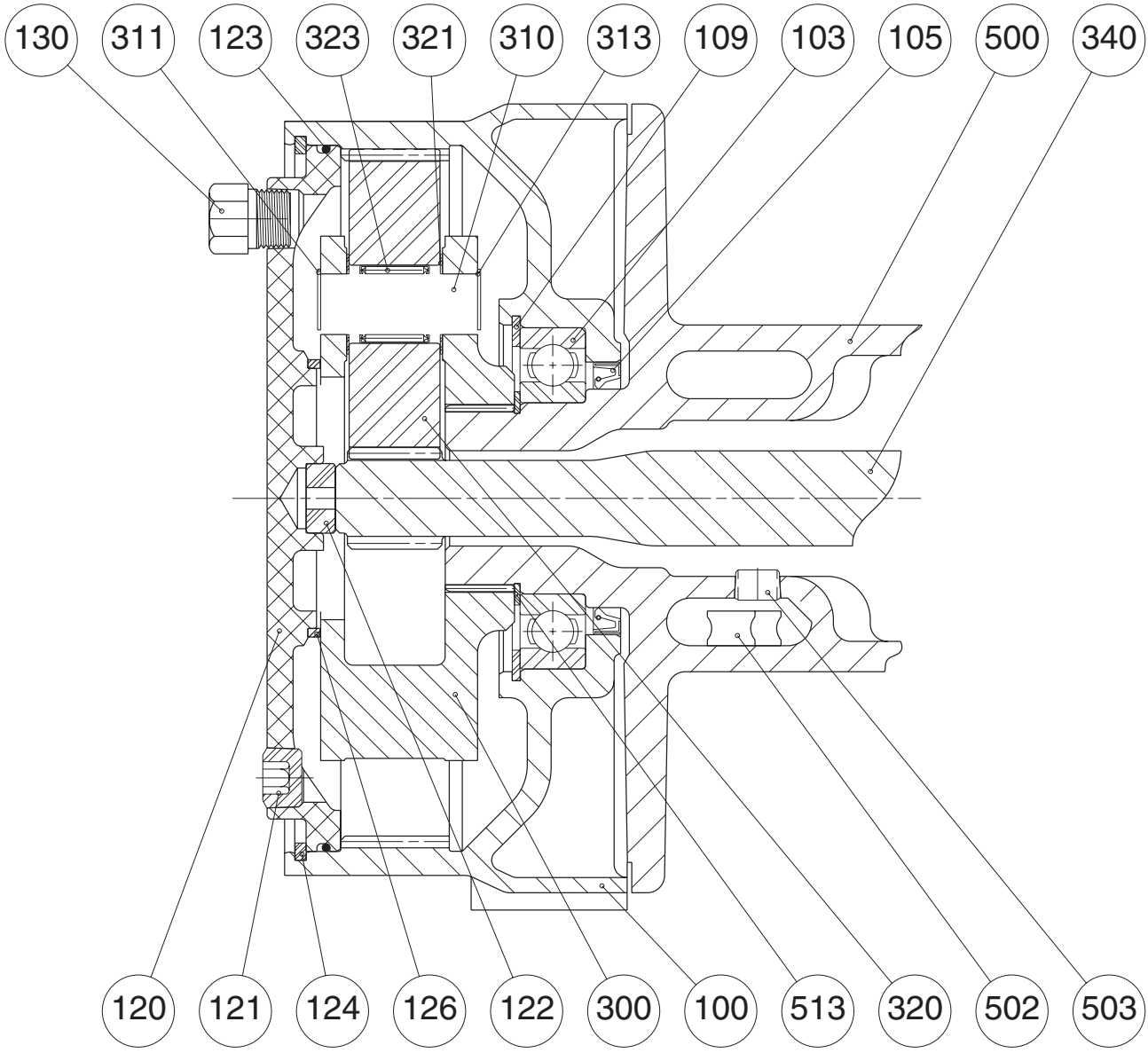
ITEM NO.	QTY.	PART NO.	DESCRIPTION
100	1	20868	FINAL HOUSING
103	1	25087	BALL BEARING 070 X 125 X 24 # 6214
105	1	25933	OIL SEAL 80 X 100 X 7
109	1	25086	CIRCLIP ROTOR CLIP HO-500
120	1	21149	END COVER
121	2	25032	PIPE PLUG 1/2 NPT SOCKET HEAD
122	1	20063	SUNGEAR STOPPER
123	1	25104	O-RING -273 9-3/4"ID 1/8" CS
124	1	20898	RETAINING RING
126	1	20899	PLANET HUB STOPPER
130	1	20458	BREATHER RELIEF ASSEMBLY
300	1	20877	PLANET HUB
310	3	20900	PLANET PIN
311	3	25091	CIRCLIP ROTOR CLIP SH-87
313	3	25091	CIRCLIP ROTOR CLIP SH-87
320	3	20113	PLANET GEAR
321	6	25068	THRUST WASHER TORRINGTON # TRA 1423
323	3	25005	NEEDLE BEARING TORRINGTON # B1416
500	1	*	CABLE DRUM
502	1	20085	CABLE ANCHOR
503	2	25085	PIPE PLUG 3/8 NPT SOCKET HEAD
513	1	25055	CIRCLIP ROTOR CLIP SH-262
		23119	WINCH SEAL KIT, CONSISTS OF ITEMS: 105, 123, 293, 515, 710, 711, 751, 753, 811, 831 AND 834

* This part varies according to drum code.
Refer to APPENDIX A.

Refer to PAGE 22 for motor seal kit and PAGE 24 for ASSEMBLY DRAWING.

FINAL DRIVE GROUP

G1134



Groups drawings may reference more parts than are actually present in a specific assembly. Parts that are referenced on the drawing but are not on the PARTS REFERENCE list should be ignored.

PARTS REFERENCE - BRAKE GROUP

ITEM NO.	QTY.	PART NO.	DESCRIPTION
293	1	25584	O-RING - 016 5/8 "ID 1/16" CS
340	1	21121	FINAL SUNGEAR
507	1	25664	SPHERICAL ROLLER BEARING SKF # 22211CC
515	1	25665	OIL SEAL 3.375 X 4.000 X .500
615	2	26229	THRUST WASHER TORRINGTON # FTRA 4060
617	1	25667	THRUST BEARING TORRINGTON # FNT 4060
700	1	*	BRAKE HOUSING
706	1	21048	BRONZE WASHER
707	1	25061	O-RING - 163 6" ID 3/32" CS
708	1	*	CHECK VALVE
709	1	*	PLASTIC CAPLUG 1/8 NPT
710	1	20896	BACK-UP WASHER
711	1	25666	OIL SEAL**
712	1	20874	BRAKE SPACER
713	14	25624	DIVIDER PLATE
715	13	25623	FRICTION PLATE
720	1	20890	BRAKE HUB
722	1	20421	SPRAG CLUTCH ALIGNER
723	1	25303	SPRAG CLUTCH BORG WARNER # 140373 "B"
724	1	20421	SPRAG CLUTCH ALIGNER
727	1	25335	CIRCLIP ROTOR CLIP SH-196
730	1	20891	BRAKE SHAFT
750	1	*	PISTON
751	1	25629	O-RING - 90 DURO - 253 5-3/8" ID 1/8" CS
752	8	20859	BRAKE SPRING
753	1	25630	O-RING - 90 DURO - 256 5-3/4" ID 1/8" CS
755	1	*	*
759	1	*	STEEL BALL 5/32 DIAMETER
762	1	*	BALL STOPPER
800	1	*	MOTOR ADAPTOR
811	1	26624	O-RING 100 MM ID x 2 MM CS
815	2	25013	CAPSCREW - HEX HEAD 1/2 - 13NC X 1.25 GR 5
817	2	25014	LOCKWASHER 1/2"
821	6	25013	CAPSCREW - HEX HEAD 1/2 - 13NC X 1.25 GR 5
823	6	25014	LOCKWASHER 1/2"
830	1	20902	CONNECTING TUBE
831	2	25018	O-RING - 010 1/4" ID 1/16" CS
832	2	21524	CHECK VALVE
834	2	25738	O-RING .306 ID X .034 C/S
840	1	20870	SAFETY VALVE
850	1	*	MOTOR - 070 HIGH TORQUE LOW SPEED 12.9 CID
955	2	25687	PLASTIC CAPLUG SAE # 10 ORB
970	2	20892	TIE BAR
971	16	25265	CAPSCREW - HEX HEAD 7/16 - 14NC X 1.25 GR 5
973	16	25328	LOCKWASHER 7/16"
		23118	MOTOR SEAL KIT

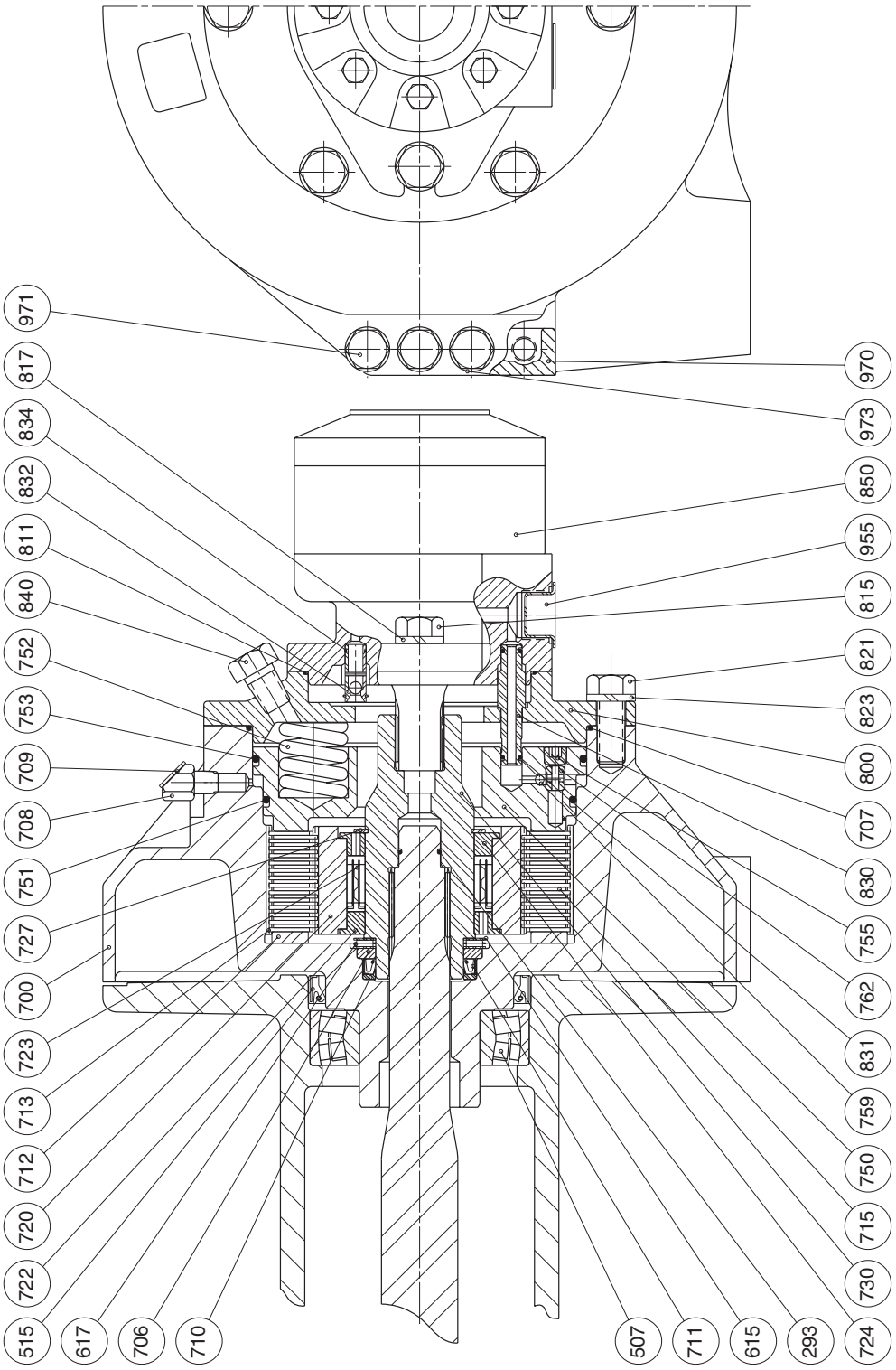
* These part numbers and descriptions vary according to brake code. Refer to APPENDIX B.

** Do not substitute. Available from PULLMASTER or Authorized Dealer only.

Refer to PAGE 20 for winch seal kit and PAGE 24 for ASSEMBLY DRAWING.

BRAKE GROUP

G1133



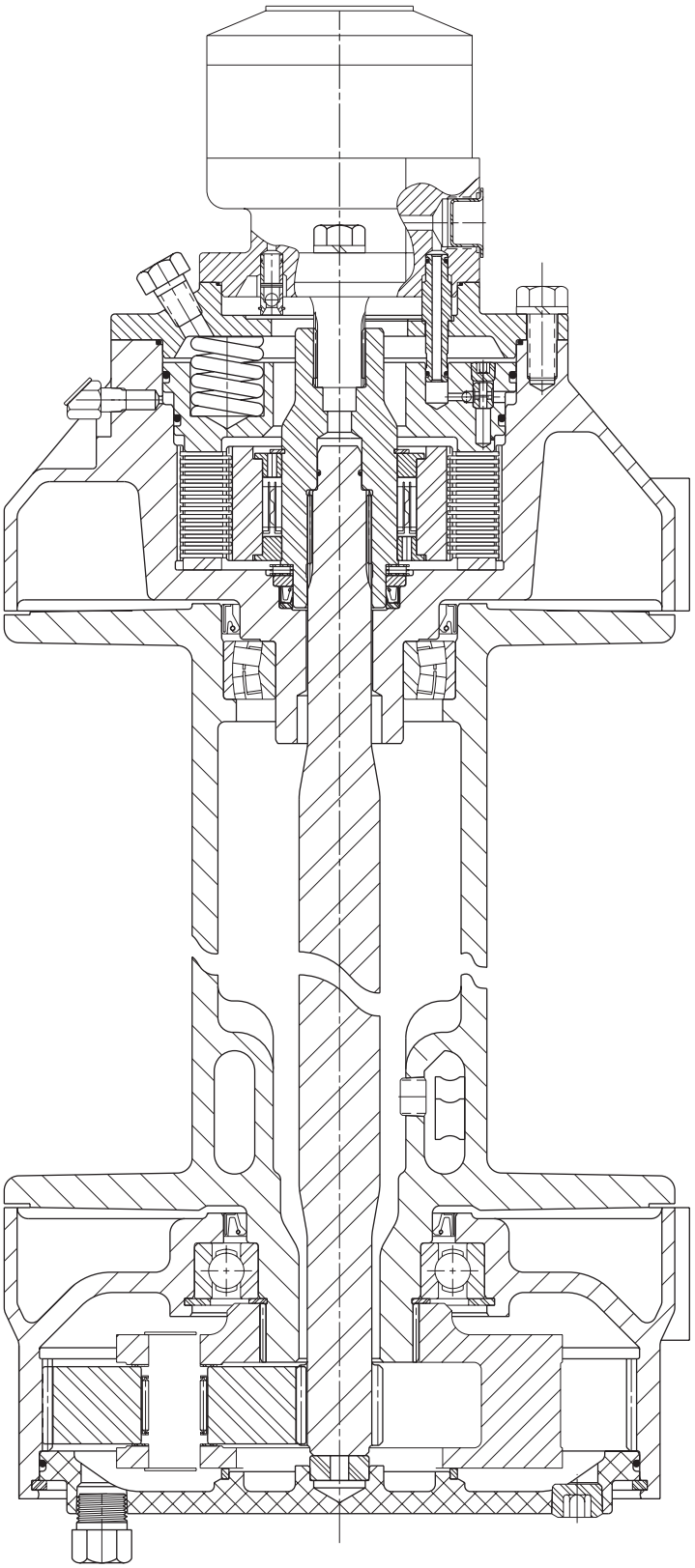
Group drawings may reference more parts than are actually present in a specific assembly. Parts that are referenced on the drawing but are not on the PARTS REFERENCE list should be ignored.

NOTE: **PRIOR TO SERIAL # 38771**

For Item No. 615 use:
TORRINGTON THRUST WASHER # FTA 4060
PART NO. 25668
QTY. - 2

ASSEMBLY DRAWING

G1133 & G1134



APPENDIX A

DRUM CODE	PART N0.	CABLE DRUM SIZES INCHES (MILLIMETERS)			WIRE ROPE STORAGE FEET (METERS)			LINE PULL AT MAXIMUM PRESSURE* POUNDS (KILONEWTONS)		LINE SPEED AT MAXIMUM VOLUME* FEET/MINUTE (METERS/MINUTE)		LUBRICATING OIL VOLUME REQUIRED U.S. GALLONS
		BARREL	FLANGE	LENGTH	5/8 in	9/16 in	1/2 in	BARE DRUM	FULL DRUM	BARE DRUM	FULL DRUM	
-1	20873	5.0 (127)	11.4 (289)	9.0 (229)	119 (36)	160 (49)	209 (64)	9617 (42.8)	4945 (22.0)	37 (11)	73 (22)	.5 (1.9)
-2	21147	7.5 (191)	11.4 (289)	9.0 (229)	86 (26)	93 (28)	139 (42)	6612 (29.4)	4991 (22.2)	54 (16)	72 (22)	.8 (3.0)

* Performance specifications are based on standard hydraulic motor with 1/2 inch diameter rope.

APPENDIX B

ITEM NO.	PART DESCRIPTION	BRAKE CODE - 12	- 13	- 14	- 15
		PART NUMBERS			
700	BRAKE HOUSING	20869	21432	21432	20869
708	CHECK VALVE	N/A	21530	21530	N/A
709	CAPLUG 1/8 NPT	N/A	25374	25374	N/A
750	PISTON	21153	21402	21402	21153
755	PIPE PLUG 1/16 NPT	25370	N/A	N/A	25370
755	PIPE PLUG 1/8 NPT	N/A	25040	25040	N/A
759	STEEL BALL 5/32" DIAMETER	N/A	25533	25533	N/A
762	BALL STOPPER	N/A	21406	21406	N/A
800	MOTOR ADAPTOR	20876	20876	21403	21403
850	MOTOR (-70 STANDARD)	20906	20906	21508	21508

BOLT TORQUE CHART

BOLT DIAMETER Inches	TORQUE lb-ft	TORQUE Nm
1/4	9	12
5/16	18	24
3/8	32	43
7/16	50	68
1/2	75	102
9/16	110	149
5/8	150	203
3/4	265	359
7/8	420	569
1	640	868
1 1/8	800	1085
1 1/4	1000	1356
1 3/8	1200	1627
1 1/2	1500	2034

NOTE: Unless otherwise specified, torque bolts per above chart.