Installation and Maintenance Instructions

AH90 Series
Hydramotor® Actuators
Model B & Model B1

WARNING!

Pressure and electrical hazards. To prevent the possibility of severe personal injury or property damage, the hydramotor ® Actuator must be installed and serviced only by a trained, certified service technician.

Notice:

These instructions supersede all previous instructions for AH90 Series Hydramotor ® Actuators

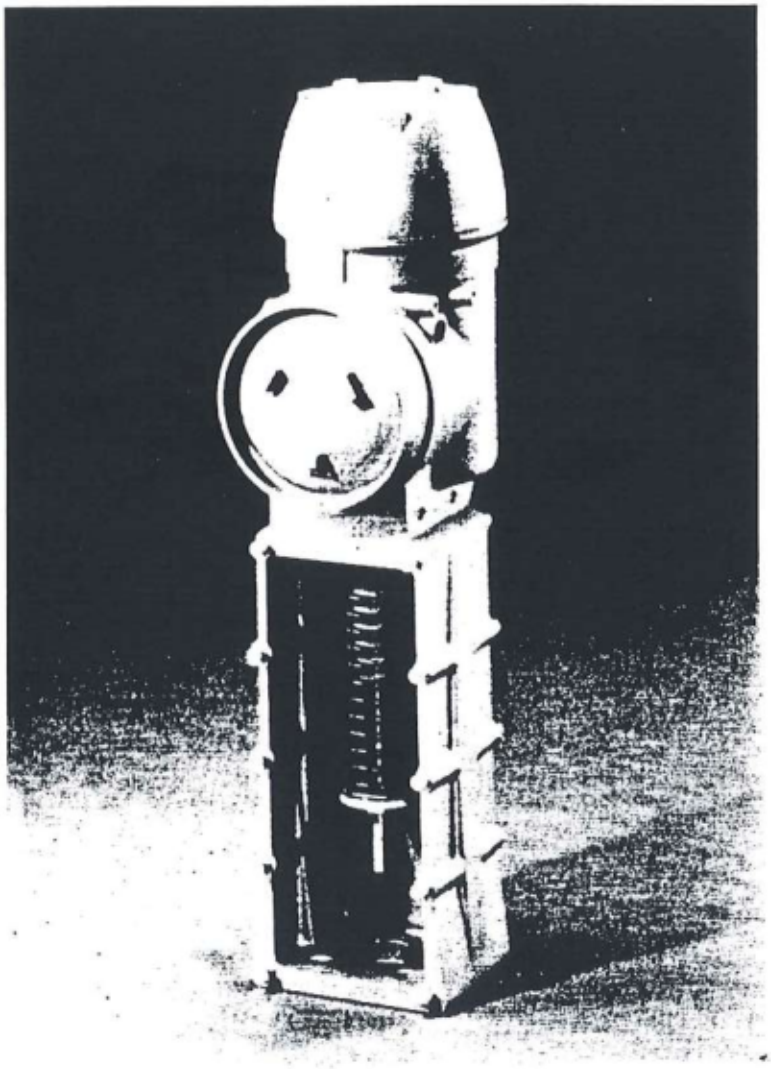
INSTALLATION & MAINTENANCE INSTRUCTIONS

FOR

AH90 SERIES HYDRAMOTOR ACTUATORS

MODELS B and B-1

AH91 AH93 AH95 AH97
AH92 AH94 AH96 AH98



SPECIFICATIONS

INSTALLATION

CALIBRATION

ADJUSTMENT

OPERATION

OVERHAUL

TROUBLESHOOTING

PREFACE

AH90 Series Hydramotor® Actuators will hereinafter be referred to as the Hydramotor. Beginning in section 2, Hydramotors are identified by their model number(s). The Hydramotor is a result of over 45 years of experience in electrohydraulic actuator engineering, design and production. Designed for high reliability in critical applications, ASCO General Controls has established the performance standards by which other Hydramotors are mesaured. Thousands of units currently in operation throughout the world attest to this fact.

Experience in the field, on going in-house R&D, and advances in materials technology have all been in incorporated into product design improvements. Durable as the original Hydramotors were when first introduced, today's models are even more durable. Most of these improvements can be retrofitted on the earlier Hydramotor models.

How To Use This Manual

This manual has been prepared to assist trained and experienced technical personnel in repairing units or replacing parts. Its content includes maintenance information, descriptions, principles of operation, installation, adjustment and calibration, periodic maintenance, troubleshooting, overhaul, and maintenance/repair kit part numbers.

It is organized for easy reference. The manual is divided into seven sections, identified by tabs. Each section is further divided, with progressive subsections separated by periods.

Example: 5.1.1=	Section 5-	Model AH96
	Subsection-1-	Principle of Operation
	Topic-1-	Model B

Refer to the LIST OF EFFECTIVE PAGES for subject breakdown and the TABLE OF CONTENTS for a more detailed description of subject matter and page number. A LIST OF ILLUSTRATIONS and a LIST OF TABLES are also included for your reference.

A Note Before You Start

Proper functioning and long-term, trouble-free operation require careful adherence to these instructions. Perform all procedures carefully and in the specified order. This will provide for the safety of personnel and property and insure that all repair work is properly carried out.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Continued)

LIST OF ILLUSTRATIONS (Continued)

LIST OF ILLUSTRATIONS (Continued)

LIST OF ILLUSTRATIONS (Continued)

LIST OF ILLUSTRATIONS (Continued)

LIST OF TABLES

1 GENERAL INFORMATION

1.1 HYDRAMOTORS, MODELS B AND B-1

Model B Hydramotors are units produced prior to February 1987. Model B-1 Hydramotors are our current design. This improved variation of the actuator has been produced since February, 1987.

1). AH91 Proportional, Pull Type: Shaft retracts on increase of control signal; spring return on power interruption.
2). AH92 Proportional, Push Type: Shaft extends on increase of control signal; spring return on power interruption.
3). AH93 Proportional, Pull Type: Shaft retracts on increase of control signal; lock- in-last position on power interruption.
4). AH94 Proportional, Push Type: Shaft extends on increase of control signal; lock-in-last position on power interruption.
5). AH95 Two Position, Pull Type: Shaft retracts on application of power; spring return on power interruption.
6). AH96 Two Position, Push Type; Shaft extends on application of power; spring return on power interruption.
7). AH97 Power Extend-Power Retract, Pull Type; Shaft retracts on application of power; lock-in-last position on power interruption; DC dump valve (normally closed) wired independently of motor circuit.
8). AH98 Power Extend-Power Retract, Pull Type: Shaft retracts on application of power; lock-in-last position on power interruption; AC dump valve (normally closed) wired independently of motor circuit.

•Training programs and repair courses are available on site or off site as needed (see section 8 (MISCELLANEOUS INFORMATION)).

1.2 GENERAL DESCRIPTION

The Hydramotor® is an electrohydraulic actuator consisting of an input and control mechanism, a hydraulic power source, and a yoke assembly with return spring(s). The control mechanism and electrical terminals are readily accessible by removing the control cover and electrical cover.

These exceptionally efficient Hydramotors provide precise two-position or proportional control of valves, dampers, louvers, shutters, proportional pumps, and a wide variety of other devices requiring a gross hydraulic force output up to 1,500 lbs. (680 kg.), 3,000 lbs. (1,360 kg.) or 4,000 lbs. (1,800 kg.)

The Hydramotor, available in push type and pull type models, features a positive, hard -positioning power stroke. It is not dependent on load for position, and position will not vary with load changes.

The Hydramotor employs a completely self-contained hydraulic power system coupled with a fail-safe spring return. Depending on the model selected, the Hydramotor shaft will return to its original position or its lock-in-last signaled position. These uniquely built-in "safety" modes, combined with the self-containment concept, make the Hydramotor ideal for use in remote locations.

Careful attention to design details has made the Hydramotor reliable and serviceable. Its housing and yoke are cast of heavy duty aluminum. Its shaft is made of hard chrome-plated carbon steel. Sensitive parts such as pistons, etc..., are anodized. The pump is a dual-cylinder, reciprocating type with heat-treated steel alloy pistons and steel cylinders. The pump, motor, dump valve, and high pressure relief valves are completely immersed in oil for continuous lubrication. The elimination of gears, the reduction of moving parts, and the availability of heat resistant Viton seals allow for minimum repair and extended service life.

To provide continuous peak output without overheating, the Hydramotor utilizes a rugged 100% duty cycle, single or three phase electric motor. Single phase motors are of the permanent split capacitor type. Hydramotors will operate in temperatures from -40°F (-40°C) to +150°F (+66°C) for Model B and intermittently up to +200°F (+93°C) for Model B-1.

Standard enclosures are designed to meet NEMA 4 (watertight) requirements. Explosion-proof enclosures, designed to meet the requirements of NEMA 4 and 7, Class I, Groups C and D (hazardous locations), Division 1, are also available.

A variety of electrical enclosures, power units, yoke and spring combinations, dump valves, stem adapters, and split coupling assemblies are available (see Tables 1-4 through 1-6). Section 7 outlines options for auxlilary switches, manual override, and shaft position feedback potentiometer.

In 1987, ASCO General Controls introduced an improved Hydramotor, the Model B-1, which is comprised of long-life Viton sealing materials and an improved pump/motor and dump valve design.

Specific operational characteristics of the various Hydramotors are discussed in subsections 2.1, 3.1, 4.1, and 5.1 (PRINCIPLES OF OPERATION)

1.3 FEATURES OF THE HYDRAMOTOR

1.3.1 The following is a list of features which comprise the Hydramotor:

(a). Electrohydraulic operation.
(b). In the event of power interruption, the fail-safe options (spring return or lock-in-last position) is available.
(c). Pull or push type linear force output.
(d). Proportional or On/Off models.
(e). Gross hydraulic force output up to 4,000 lbs.(1,800 kg.).
(f). Adjustable stroke up to 3.5 inches or 4 inches.depending on the model used.
(g). 100% duty cycle motor.
(h). Completely sealed and self-contained, no interconnecting piping required.
(i). Hard positioning.
(i). Operating Temperature Model B -40°F (-40°C) to +150°F (+66°C) and Model B-1 intermittently up to +200°F (+93°C).
(k). Designed and built with generous safety and performance margins.
(l). Responds to two-wire control, 4-20 mA or 10-50 mA.
(m). Watertight enclosures (NEMA 4) are standard.
(n). Explosion-proof enclosures (NEMA 4 & 7) are available.
(o). Standard two-wire power wiring.
(p). Open and shut position indicators are standard.
(q). Available with 6 DPDT auxiliary switches.
(r). Available with manual override.
(s). Available with independent feedback potentiometer (0-1,000 ohm).

1.4 SPECIFICATIONS OF HYDRAMOTORS

1.4.1 The following is a list of **enclosure** specifications:

(a). Heavy duty Cast Aluminum with four 3/4 "-12 NPT conduit connections.
(b). Standard housings designed to meet NEMA 4 (Watertight) standards.
(c). Optional housings designed to meet both NEMA 4 and NEMA 7 Class 1, Group C and D (hazardous locations), Division 1 standards.

1.4.2 The following is a list of **hydraulic system** (Integral) specifications:

(a). Hydraulic Oil: Mobil SHC824 (MIL-H-5606B is available for special low-temperature applications below -20°F (-7°C)
(b). Capacity 3.26 quarts (3.08 liters)
(c). Pump 2 Cylinders, positive displacement
(d). Filters (2) Thru-put 10 times pump capacity

1.4.3 The following is a list of **electric motor** specifications:
(a). Type: Heavy duty: 1- Phase, split capacitor, 4 pole, or 3 phase
(b). Duty: Continuous (100%)
(c). Power Rating: 1/6 HP

1.4.4 The following is a list of **power input** (225 VA) specifications:
(a). **Single Phase** options: (b). **Three Phase** options:

110V/50Hz	240V/60Hz
120V/60Hz	380V/50Hz
240V/60Hz	440V/50Hz
220V/50Hz	460V/60Hz
240V/50Hz	480V/60Hz

• Consult factory for other power options.

1.4.5 The following is a list of **control signal input** specifications:
(a). 4-20 mAdc (400 ohm)
(b). 10-50 mAdc (100 ohm)

1.4.6 The following is a list of **mode of operations** specifications:
1). Proportional Types:
(a). **AH91 Pull Type**: Shaft retracts on increase of control signal. Spring return on power interruption.
(b). **AH92 Push Type**: Shaft extends on increase of control signal. Spring return on power interruption.
(c). **AH93 Pull Type**: Shaft retracts on increase of control signal. Lock-in-last position on power interruption.
(d). **AH94 Push Type**: Shaft extends on increase of control signal. Lock-in-last position on power interruption.
2). Two Position (On-Off) Types:
(a). **AH95 Pull Type**: Spring return on power interruption. Adjustable travel limit switch.
(b). **AH96 Push Type**: Spring return on power interruption. Pre-set force limited (Model B); travel limit switch (Model B-1 only).
(c). **AH97 Pull Type**: Lock-in-last position on power interruption. Adjustable travel limit switch.
(d). **AH98 Pull Type**: Lock-in-last position on power interruption. Adjustable travel limit switch.

1.4.7 The following is a description of various specifications:
1). **Maximum Stroke** (adjustable)
(a). 1,500 lb. (680 kg.) and 3,000 lb.(1,360 kg.) units 3.5 " (89 mm)
(b). 4,000 lb.(1,800 kg.) units 4 " (102 mm)

2). **Force Output** (gross)
(a). 1,500 lb. (680 kg.)
(b). 3,000 lb. (1,360 kg.)
(c). 4,000 lb. (1,800 kg.)

3). **Power Stroke Speed** (hydraulic)
(a). 1,500 lb.(680 kg.) units- 0.376"/sec (9.5mm/sec)
(b). 3,000 lb.(1,360 kg.) units- 0.188"/sec (4.8mm/sec)
(c). 4,000 lb.(1,800 kg.) units- 0.141 "/sec (3.6mm/sec)

4). **Spring Return Speed** (Adjustable)
(a). 1,500 lb.(680 kg.)-4 seconds maximum
(b). 3,000 lb.(1,360 kg.)-7 seconds maximum
(c). 4,000 lb.(1,800 kg.)-10 seconds maximum

1.4.8 The following is a list of **storage temperature range** (crated) specifications:

1). **Short Term** (up to 3 months)
(a). Model B: -40°F (-40°C) to +150°F (+66°C)
(b). Model B-1: -40°F (-40°C) to +200°F (+93°C)

2). **Long Term** (as per specified maintenance schedule) (up to 2 years)
(a) -20°F (-29°C) to +120°F (+49°C)

1.4.9 The following is a list of **operating environment** specifications:

(a). **Temperature**: Mobil SHC824: -20°F (+29°C) to +150°F (+66°C)
MIL H-5606B: -40°F (-40°C) to +150°F (+66°C)
(b). **Sub 0°F (-18°C) Ambient Start-Up**: The Hydramotor must be powered for 30 minutes prior to application of control signal.
(c). **Humidity**: 0 to 100%
(d). **Atmosphere**: Industrial, including hazardous (see enclosure specifications)
(e). **Shock**: Meets Air Force MIL-T- 4807A and Navy MIL-S-901C
(f). **Load Sensitivity**: Within 0.1% of stroke per 100 lb. (45.5 kg.) load.
(g). **Mounting**: Any position where the power frame is above the horizontal axis.

1.4.10 The following is a list of **functional characteristics** (% of stroke) specifications:

(a).	Accuracy (overall)	Within 1.5%
(b).	Linearity (absolute)	Within 1.0%
(c).	Hysteresis	Within 0.5%
(d).	Repeatability	Within 0.2%
(e).	Dead band	Within 0.1%
(f).	Drift (24 hours)	Within 0.2%

1.5 DEFINITIONS

1.5.1 Age Control: The designation of a specific maximum period of time after cure date or assembly date that will assure desired conformance characteristics of an elastomer. Age control is based on the premise that elastomers deteriorate upon exposure to ozone, heat, sunlight, rain, dust, and other similar environmental factors.

Age Sensitive: That characteristic of an elastomer which makes it subject to deterioration by ozone ,oxygen, heat, sunlight, rain, dust, and similar factors experienced in the normal course of manufacture, storage and use.

Cure Date: The date the compounded, uncured high molecular weight elastomer is crosslinked to produce an elastomeric product. (Cross-linking is defined as the tying together of large molecules, changing the physical properties of a material).

Elastomer: A synthetic material which possesses elastic properties very similar to those of natural rubber. Elastomers are used in AH90 Hydramotors for O-rings, seals, diaphragms, and insulating materials.

Failsafe: Refers to the Hydramotor's ability to spring return or lock-in last position upon power interruption or loss of control signal.

PCD: Process Control Device refers to the mechanism driven by the AH90 Hydramotor, typically a valve or a damper.

Pre-Service Life: The sum total of shelf life and storage life prior to field installation.

Shelf Life: The amount of time an uninstalled component or subassembly remains usable, when properly stored. Shelf life is measured from the cure date of the component.

Spring Return Refers to the Hydramotor's ability to go to the de-energized position on power interruption.

Storage LIfe:

The amount of time a component remains fully usable following installation in a Hydramotor, provided that the Hydramotor itself is stored in accordance with conditions set forth by ASCO General Controls . Storage life is measured from the final acceptance test date of the Hydramotor.

If the recommended storage life is not exceede there is no effect on the service life of the Hydramotor. If storage life is exceeded, qualified (service) life is taken to have begun at the end of the recommended storage life. (Storage life of a component or Hydramotor en and service life begins when the Hydramotor a its driven PCD are installed in their final in-plar service location.

1.6 STORAGE AND SHIPPING

1.6.1 Refer to Table 1-1 for reference to material pre-service life

Table 1-1. Pre-Service Life (Shelf Life Plus Storage Life)

Item	Material	Part No.	Pre-Service Life
O-ring Seal	Buna-N 70 Shore	16606A56	5 years (2 yr.shelf) (3 yr. storage)
O-ring Seal	Buna-N 75 Shore	16606A83	5 years (2 yr.shelf,) (3 yr. storage)
Piston Ring	Polymyte Nitrile	19009A/B/C (Parker)	unlimited 10 years
Dynamic Seal	Polyurethane	65417B	10 years
Wiper Ring	Polyurethane	64476A	10 years
Dynamic Seal	Polyurethane 90 Shore	65418B	10 years
Capacitor	Phthalate Ester	104857AE (Malory)	unlimited
Capacitor		104857A (Maxwell)	unlimited
Switch	Durez 18441	10BS212 (Microswitch)	unlimited
Coil Assembly	Polythermaleze Vulkene Epoxy	CK501F__A8	20 years
Coil Insulation	Nyleze	E34609 (Phelps-Dodge)	20 years
Motor Assembly	Kapton Polyamide-Imide Silicon Resin	38304-00-200-111 (Motronics)	unlimited

Table 1-1. Pre-Service Life (Shelf Life Plus Storage Life) (Continued)

Item	Material	Part No.	Pre-Service Life
Terminal Block	Durez 15528	106942C/P	unlimited
Terminal Block	XP Phenolic	64641B	unlimited
Terminal Insulation	Vulcanized Fiber	65253A	10 years
Switch Insulation	Varnished Glass Cloth	107023E	15 years
Shrinkable Sleeving	Viton	57202	10 years
Epoxy Filler	Epoxy	R313	unlimited
Isolation Barrier	Fish Paper	--	10 years
Gasket	Nitrile/Cork	N.C.711 (Armstrong)	10 years
Diaphragm	Buna-N Coated Nylon	Spec. 6334 (Chem. Prod. Inc.)	10 years
Cover	Plexiglass	65795+Var.	unlimited
•Hydraulic Fluid	Synthetic Hydracarbon	SHC 824 (Mobil)	unlimited
O-Ring Seal	Viton	16606A84	10 years
Wiper Ring	Viton	68039A	10 years
Dymanic Seal	Viton	69035A, 68037A, 68036A, 68038A,	10 years
Hydraulic Fluid	Hydra Carbon	MIL-H-5606B	unlimited

•Source: Mobil Oil Corp., Research & Development Center, Princeton, NJ.

1.6.2 Storage options for the Hydramotor are as follows:

(a). Store in a dry area away from active electrical equipment

(b). The storage area should have a steady-state temperature below +120°F (+49°C) and above -20°F (-29°C). (Intermittent, **short-term** exposure to temperatures up to but not exceeding, +150°F (+66°C) should not affect the installed life).

(c). **The Hydramotor must be electrically powered and operated for a minimum of 10 full cycles every 3 months during storage.**

(d). Upon removing a Hydramotor from storage, and prior to installing it on the PCD, perform the following steps:

1). Remove the control cover, the electrical cover, and protective pads (see Figure 1-1).

2). Visually inspect the top control plate and around the electrical terminal blocks for evidence of leakage.

3). If there is leakage, replace seals or O-rings as required. (Refer to the relevant Hydramotor section).

4). Preheat the Hydramotor by electrically running the motor for a minimum of one-half hour before applying the control signal.

5). Cycle the Hydramotor several times while checking for external leakage between the main bushing and the shaft. Slight wetting of the shaft is normal and acceptable, however, no drops of oil should form on the shaft.

6). After the above steps have been satisfactorily completed , the Hydramotor is ready for installation, refer to subsection 1.7 (MOUNTING/INSTALLATION).

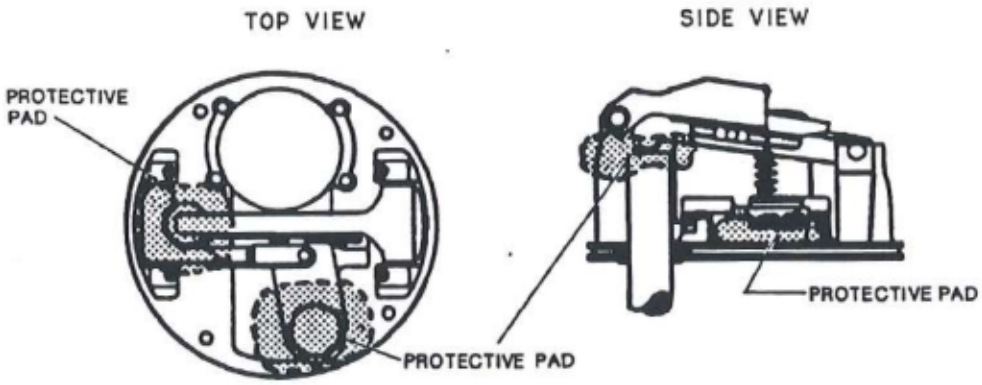


Figure 1-1 Location of Protective Pads
(Models AH91, AH92, AH93, and AH94)

1.6.3 Remove the Hydramotor from the PCD as follows:

1). Pull Type Hydramotors

(a). Depressurize and remove fluid from all interconnected piping.

(b). Reduce the control signal or disengage power to fully extend the Hydramotor shaft.

(c). Disconnect electrical and power control signal leads (refer to the corresponding wiring diagrams).

(d). Remove the two Allen screws from the split coupling assembly..

(e). Remove the split coupling assembly from the stem adapter and PCD.

(f). Remove the four mounting bolts or the PCD lock nut securing the yoke to the PCD.

(g). Remove the Hydramotor from the PCD.

(h). Reinstall the split coupling assembly on the stem adapter.

2). Push Type Hydramotors

(a). Depressurize and remove fluid from all interconnected piping.

(b). Energize the Hydramotor until the shaft reaches the extreme end of its stroke (shaft fully extended).

(c). Remove the two Allen screws from the split coupling assembly per Figure 1-7. Remove the split coupling assembly from the PCD stem and the Hydramotor stem adapter.

(d). Retract the Hydramotor shaft by reducing the control signal or by turning power off.

(e). Disconnect all electrical power and control signal leads from the Hydramotor (refer to the corresponding wiring diagram.)

(f). Remove the four mounting bolts or the PCD lock nut , whichever is securing the yoke to the PCD.

(g). Remove the Hydramotor unit from the PCD.

(h). Reinstall the split coupling assembly on the stem adapter.

1.6.4 The shipping procedures are as follows:

1). For Modulating Hydramotors (Models AH91, AH92, AH93, and AH94), continue with the following steps; otherwise, proceed to step 2:

(a). Remove the control cover.

(b). Place one of the two foam rubber damping pads (approximately 3"X3"X1/4") between the beam and the control plate.

(c). Place the second pad between the end of the shaft and the arm assembly of the control plate (see Figure 1-1).

2). If the Hydramotor is being shipped to the factory for a failure analysis, **do not drain oil from the Hydramotor** and proceed to step 3; otherwise, continue:
   (a). Drain the hydraulic oil (see subsection 1.9 (HYDRAULIC OIL CHANGE)).
   (b). Replace the drain and filler plugs, control cover and electrical cover.

3). Prepare a wooden crate suitable for transporting the Hydramotor or reuse the original shipping container with foam packing.

4). Assure that the crate is strong enough to withstand normal shipping and handling.

1.7 MOUNTING/INSTALLATION

1.7.1 The instructions for unpacking and mounting a Hydramotor on a valve, damper, or other PCD are as follows:

1). Unpacking: Hydramotors are packaged in accordance with ANSI N45.2.2, Level C.
   (a). Carefully uncrate the Hydramotor and position it with the control compartment uppermost as seen in Figure 1-2.
   (b). Visually check for any sign of oil leakage or shipping damage.
   (c). Read all warning labels and attached tags thoroughly.
   (d). On the modulating Hydramotors only (AH91, AH92, AH93, and AH94), remove the threaded control cover from the top of the Hydramotor and carefully remove all protective pads (usually 2) from the control beam and arms, before operating the Hydramotor.

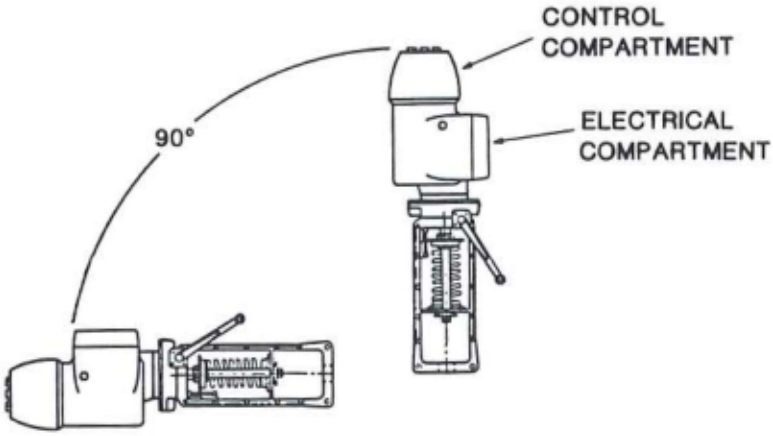


Figure 1-2. Hydramotor Mounting Positions

1.7.2 The recommended tools for installation, calibration and overhauling the Hydramotor are as follows:

1). Installation and verification of voltage supply, control signal,and tools used for stroke adjustment and Hydramotor mounting:

(a). Appropriate Power Supply (see Hydramotor nameplate).

(b). AH91 through AH94, Control Signal, 4-20 mAdc or 10-50 mAdc (see Hydramotor nameplate).

(c). Meter, 0-50 milliampere, accurate to within 1.5% of full scale.

(d). Hand tools as follows:
6" steel rule, graduated in 1/32"
Screwdriver for slotted screws
10" adjustable wrench
1/4" Allen wrench
1/2" open wrench (thin type, 1/8")

(e). Appropriate wrenches to attach the Hydramotor to the PCD.

2). Overhaul:
(The "AH90 Special Tools" Brochure (see subsection 6.5 (SPECIAL TOOLS)) describes a family of tools designed to facilitate field servicing, transport, disassembly, reassembly, and testing. These tools are referred to in the overhaul instructions.

Overhaul will require a standard mechanic's tool kit: standard SAE socket set with ratchet drive, nut driver and a 6" extension; a selection of pliers, including 90° offset split ring (external) and 10" locking (curved jaws); SAE Allen wrenches (hex keys). A crimping tool (such as a Hollingsworth H-18) is required for connecting pump wiring. A 5 quart drain pan and clean rags will be required as well.

Refer to Table 1-2 which contains the expendable items and their identification numbers and descriptions.

1.7.3 Mounting Positions

1). The Hydramotor may be mounted in horizontal, vertical or intermediate planes as seen in Figure 1-2.

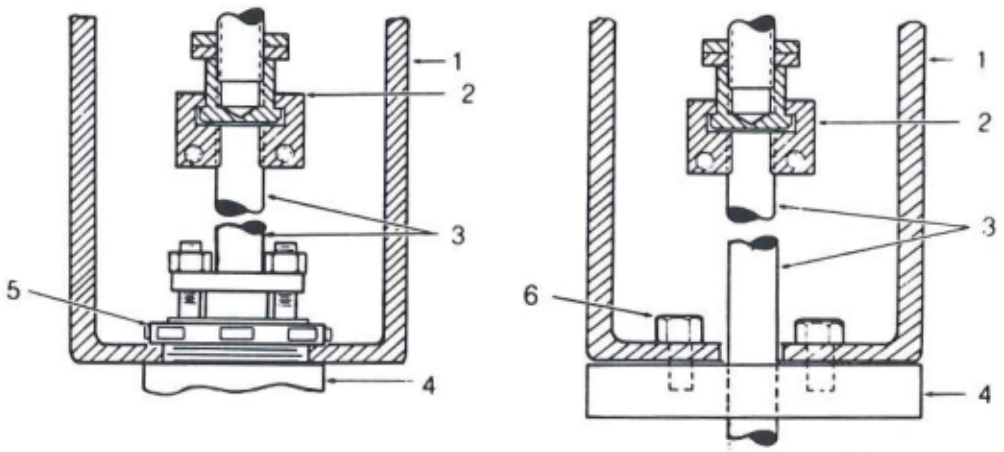
(a). For vertical mounting, the control compartment must face upward.

(b). When mounting in a horizontal or an intermediate plane, the electrical compartment must face upward.

Table 1-2. Expendable Items-Overhaul

Product	Number	Description
Chemical Film (Alodine)	MIL-C-5541	Military Specification
Dry Cleaning Solvent	P-D-680	Federal Specification
Aluminum Oxide Abrasive Cloth	P-D-451	Federal Specification
Crocus Cloth	P-D-458	Federal Specification
Hydraulic Oil	MIL-H-5606B	Military Specification
Anti-Seize Lubricant	Generic	
Locitite (red)	Generic	
Naptha	Generic	
Solder (electrical)	Generic	
Trichloroethane III Solvent	Generic	
White Petroleum Jelly	Generic	

1.7.4 Hydramotor/PCD Connections:
Standard Hydramotor assemblies are supplied with a four-bolt mount consisting of four 5/8" holes on a 5" bolt circle as seen in Figure 1-3 in addition to various bonnet openings. A bonnet opening at the base of the yoke must match the PCD mounting pad. Other yoke configurations may be available; contact factory for details.



A. Bonnet B. Bolt

1. Yoke
2. Split coupling
3. PCD Shaft
4. PCD Mounting
5. PCD Lock nut
6. PCD Mounting Bolts (4)

Figure 1-3A/B. Typical Hydramotor Bonnet/Bolt Mounting

1.7.5 Matching Temperature, Force Output and Stroke:
Hydramotors are not designed to operate with process fluid temperatures above +400°F (+200°C). Subjecting the Hydramotor to excessive temperature may cause premature seal failure and leakage. For high temperature media applications, a protective shield should be used between the Hydramotor yoke and the PCD. A suitable extension bonnet may also be used, in which case please consult the factory for details.

Before installing a Hydramotor, assure that the stroke length and gross shaft force output are compatible with the PCD as described in Table 1-3.

Table 1-3. Stroke and Force Output

Power Unit	Max. Stroke (Adjustable)	Gross Shaft Force Output
20, 21, 26, 40, 41, 46	3 1/2" (89mm)	1,500 lb. (680 kg.)
60, 61, 66	3 1/2" (89mm)	3,000 lb. (1,300 kg.)
80, 81, 86	4" (102mm)	4,000 lb. (1,800 kg.)

Hydramotors are designed for linear applications. Therefore, proper positioning of the shaft to the PCD is critical. **Misalignment of the Hydramotor shaft will cause side loading on the shaft. This will shorten the life of the shaft seals and result in premature leakage.**

1.7.6 Rotary Applications:
The linear motion component (of a linear to rotary conversion device) that connects to the Hydramotor output shaft must be supported in a way that will eliminate induced side loading from being transferred to the Hydramotor output shaft. Consult factory for further information on this matter.

1.7.7 Initial Testing

1). The Hydramotor is normally factory adjusted for maximum stroke (see Table 1-3). Therefore, the stroke will probably have to be adjusted to match the PCD requirements. This should be accomplished as follows:

(a). **AH91 & AH93**: Adjust the mechanical stroke limit stop nut as required by PCD instructions, referring to subsection 2.3 (ADJUSTMENT AND CALIBRATION).

(b). **AH92 & AH94**: Adjust the mechanical stroke limit stop nut as required by PCD instructions, referring to subsection 3.3 (ADJUSTMENT AND CALIBRATION)..

(c). **AH95, AH97 and AH98** : Adjust the travel limit switch as defined in subsection 4.3 (LIMIT SWITCH AND STROKE ADJUSTMENT).

(d). **AH96 Model B**: Adjust the mechanical stroke limit adjustment stop nut as required by the PCD requirements as defined in 5.3.1.

AH96 Model B-1: Adjust the mechanical stroke limit adjustment stop nut as required by the PCD requirements as defined in 5.3.1, and adjust the travel limit switch as required to satisfy PCD requirements per 5.3.2.

2). Operate the Hydramotor through four or five complete cycles and assure that the required stroke (as described above) is reached. If proper stroking in not maintained, repeat applicable step in 1.7.7 steps 1a through 1d.

3). Once the Hydramotor stroke and function have been verified to be correct, the position indicators on the yoke should be adjusted to coincide with the actual Hydramotor stroke.

1.7.8 Mounting Procedure

WARNING

THE HYDRAMOTOR AND ITS VALVE ASSEMBLY MUST BE INSTALLED OR SERVICED BY A TRAINED OR EXPERIENCED TECHNICIAN.

WARNING

PRIOR TO INSTALLATION OR SERVICE, TURN OFF ALL POWER TO THE HYDRAMOTOR AND WHERE APPLICABLE, DEPRESSURIZE THE PROCESS PIPING.

1). Check the nameplate to verify that the correct Hydramotor is ready for application.Verify conformance to PCD manufacturer's instructions and all applicable local and national codes and ordinances.

A. Install only where ambient temperatures remain between:
   (a). Model B -40°F (-40°C) and +150°F (+60°C)
   (b). Model B-1 -40°F (-40°C) and +150°F (+60°C)

B. Test all functions and verify operation of the complete system after installing the Hydramotor as follows:
   1). Turn off electrical power to the Hydramotor and remove the plastic dust cover from the yoke.
   2). Loosen the two Allen cap screws (see Figure 1-4 or 1-5) from the Stem Adapter and remove the split coupling.

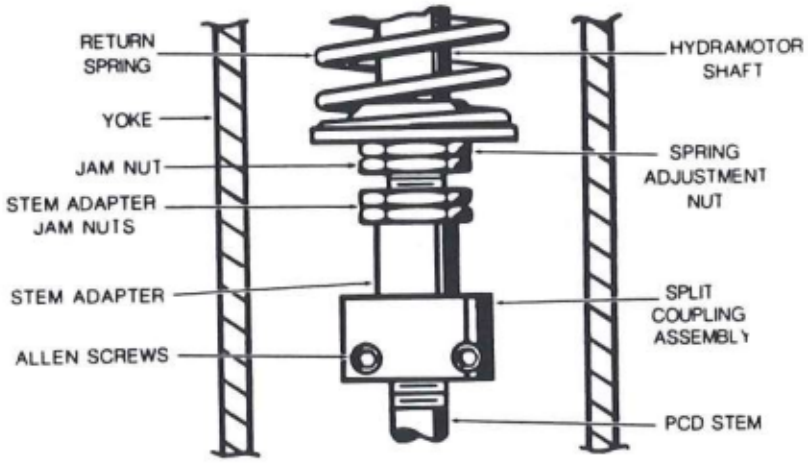


Figure 1-4. Shaft Connection for Pull Type Hydramotors

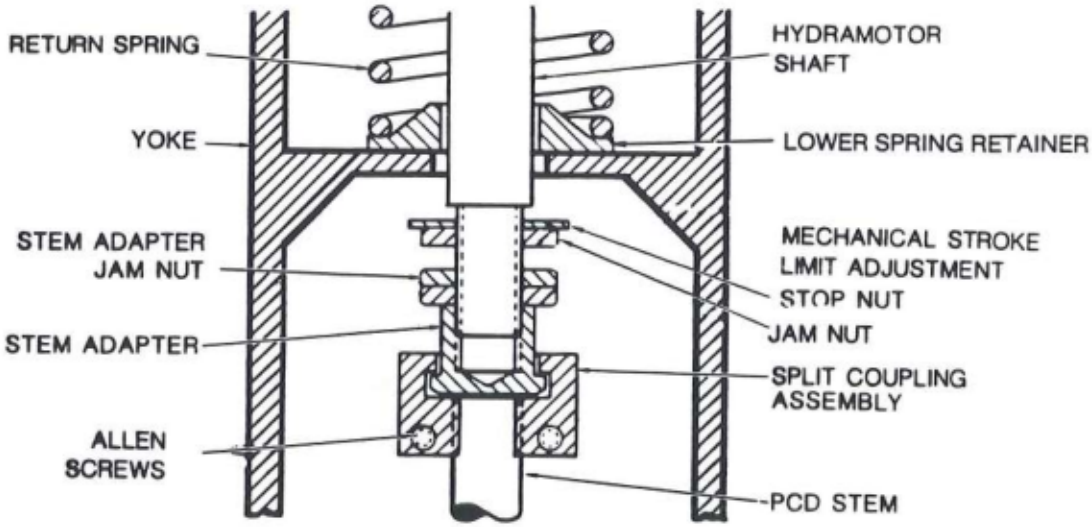


Figure 1-5. Shaft/PCD Stem Connection for Push Type Hydramotors

3).a. Pull Type Hydramotors :Thread two stem adapter jam nuts on the Hydramotor shaft to the upper end of the shaft threads (see Figure 1-4).

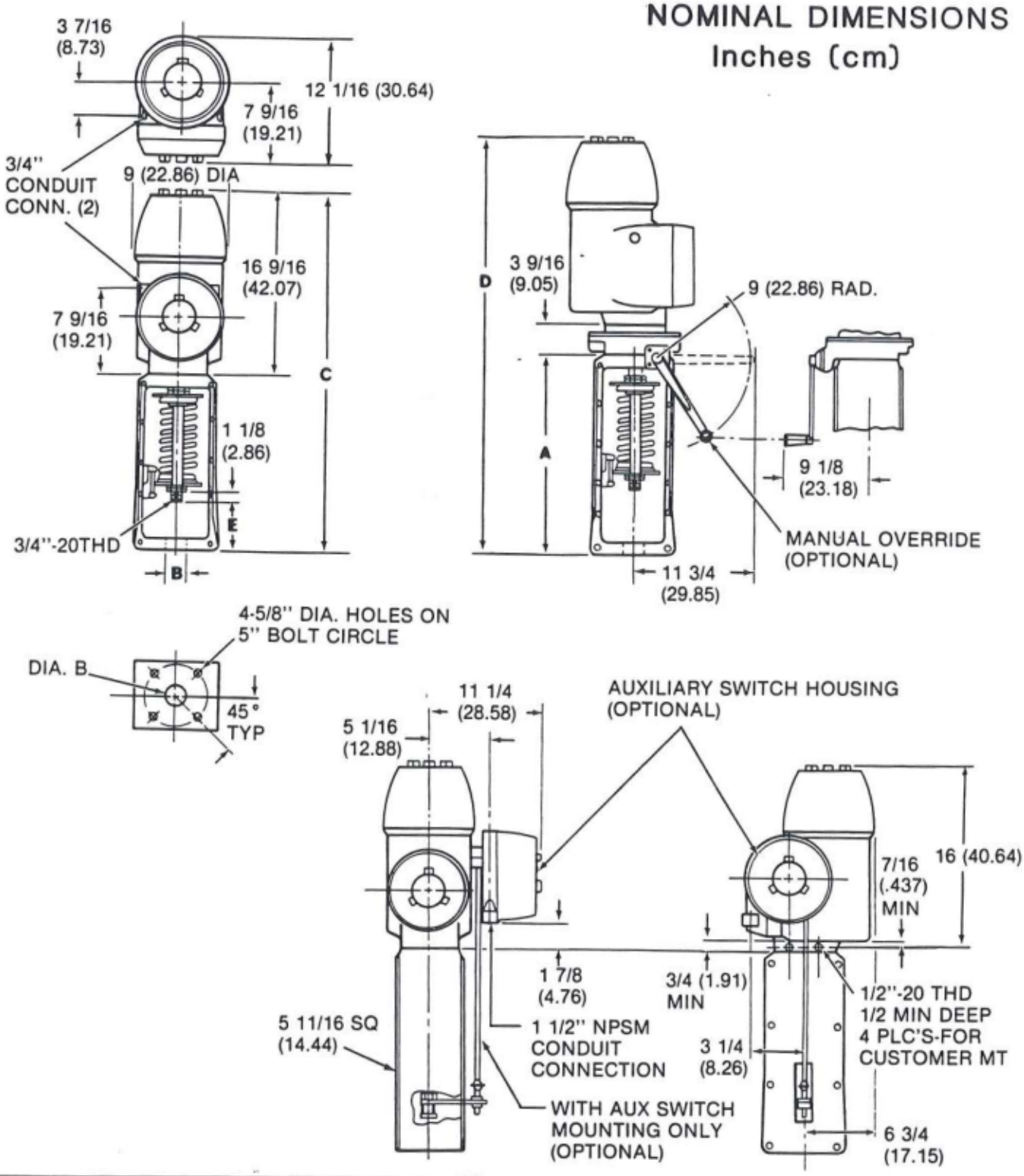
b. Push Type Hydramotors: Thread the mechanical stroke limit adjustment stop nut (see Figure 1-5) on the Hydramotor shaft, then screw the jam nut and stem adapter jam nut to the upper end of the shaft threads.

4). Thread the appropriate stem adapter (see Table 1-12) onto the Hydramotor shaft. (For bonnet mounting only, remove the lock nut (see Figure 1-3A) from the valve bonnet.)

5). For wiring, perform the following steps and refer to the specific model wiring diagrams as defined in subsection 2.2 (WIRING DIAGRAMS).

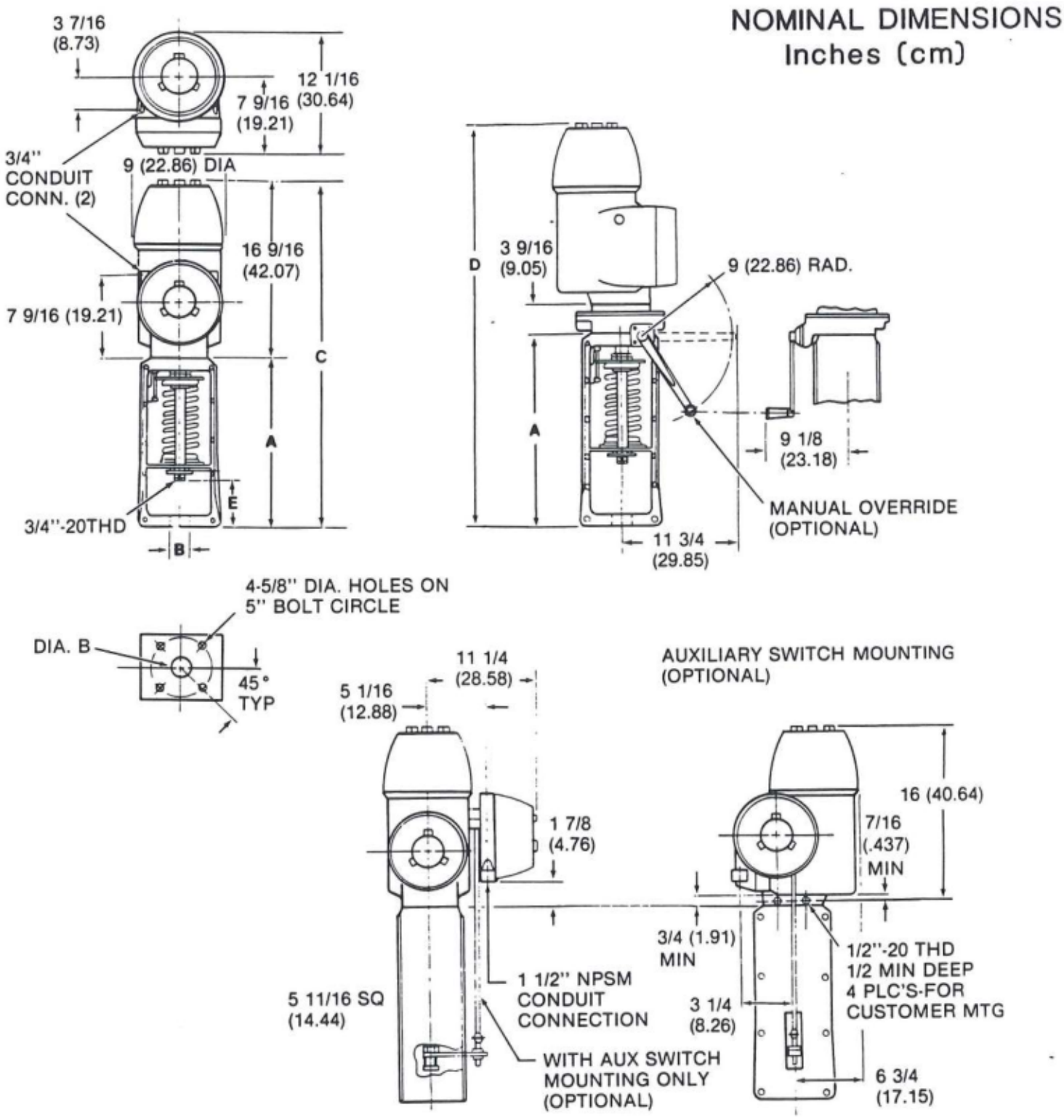
(a). Unscrew the electrical housing cover and O-Ring (see Figure 1-2).
(b). Install the appropriate fittings.
(c). Route the control and power wiring through one of the 3/4" NPT conduit connections, unless it is equipped with an auxiliary switch box, in which case, route the wiring through the 1 1/2 " NPSM conduit connection beneath the switch box (see Figure 1-8 or 1-9).
(d). Connect the ground wire to the green ground screw.
(e). Connect the power wires to Terminal Block No. 1.
(f). Connect the mA control wires to Terminal Block No. 3 (Models AH91, AH92, AH93, and AH94 only).
(g). Reinstall the O-ring and electrical cover.
(h). Turn on electrical power and operate the Hydramotor to assure proper connections.

NOMINAL DIMENSIONS
Inches (cm)



YOKE LENGTH	BONNET MOUNT DIAMETER	OVERALL HEIGHT	HEIGHT WITH MANUAL OVERRIDE	STEM MID POSITION
A	B	C	D	E
20 (50.80)	2 1/8 (5.40), 2 1/4 (5.72), 2 5/16 (5.87), 2 3/8 (6.03), 2 1/2 (6.35), 2 5/8 (6.67),	36 9/16 (92.87)	40 1/8 (101.92)	8.32 (21.13)
17 1/2 (44.45)	2 13/16 (7.14), 3 (7.62), 3 1/4 (8.26), 3 9/16 (9.05), 4 (10.16)	34 1/16 (86.52)	37 5/8 (95.57)	5.82 (14.78)

Figure 1-6. Dimensions for Pull Type Hydramotors



YOKE LENGTH	BONNET MOUNT DIAMETER	OVERALL HEIGHT	HEIGHT WITH MANUAL OVERRIDE	STEM MID POSITION
A	B	C	D	E
26 1/2 (67.31)	2 1/8 (5.40), 2 1/4 (5.72), 2 5/16 (5.87), 2 3/8 (6.03), 2 1/2 (6.35), 2 5/8 (6.67), 2 13/16 (7.14), 3 (7.62), 3 1/4 (8.26), 3 9/16 (9.05), 4 (10.16)	43 1/16 (109.38)	46 5/8 (118.43)	8.31 (21.11)
22 (55.88)		38 9/16 (97.95)	42 1/8 (107.00)	5.31 (13.49)

Figure 1-7. Dimensions for Push Type Hydramotors

WARNING

DO NOT PUT FINGERS IN THE SPRINGS OR BETWEEN THE HYDRAMOTOR OUTPUT SHAFT AND ANY UNYIELDING SURFACE WHEN ENERGIZING OR DE-ENERGIZING THE HYDRAMOTOR.

6). Pull Type Hydramotors- Energize the Hydramotor to retract the shaft before mounting it onto the PCD.

7). Mount the Hydramotor yoke to the PCD, according to the PCD manufacturer's instructions.

8). Secure with the lock nut or 4-bolt mountings (see Figure 1-3) and torque per PCD specifications.

9).a. Pull Type Hydramotors:
De-energize the Hydramotor allowing the spring return to extend the shaft until it meets with the top of the PCD stem.

b. Push Type Hydramotors:
Using the electric power or manual override option (if so equipped), carefully extend the Hydramotor shaft until it just touches the top of the PCD stem.

10). When the Hydramotor shaft touches the top of the PCD stem, mount the two halves of the split coupling (see Figure 1-4 or 1-5) over the PCD stem adapter and join them by tightening the two Allen cap screws.

11). Secure the stem adapter jam nut to the stem adapter.

12). Return the manual override to its de-energized position, as required.

1.8 MAINTENANCE

The following are the instructions for the general maintenance, physical inspection, periodic calibration, and other maintenance procedures.

1.8.1 General Maintenance Checks: Qualified Hydramotor life and maintenance intervals are dependent upon service usage (frequency of operation, etc...) and ambient environmental conditions (temperature, humidity, etc...).

Periodic Maintenance should include inspection and cleaning. Develop a maintenance schedule based on the environment and frequency of use.

1). Cycling:
   (a). Cycle the Hydramotor several times and listen for unusual motor and pump noises.
   (b). Refer to subsection 4.5 (TROUBLESHOOTING) as a guide to address problems which may occur over a prolonged operating period.

2). Visual Check:
   (a). Check for oil leakages at the main bushing and the shaft, paying particular attention to shaft seals.
   (b). Slight wetting of the shaft is normal, but no drops of oil are permissible. If excessive leakage occurs, remove and overhaul the Hydramotor as described in the overhaul subsection within the applicable model section.

3). Control Compartment Cover:
   (a). Remove the cover and check for evidence of oil in the compartment, discoloration or burned wires or burned electrical components.
   (b). If damaged components are found, remove and overhaul the Hydramotor referring to the section for the corresponding Hydramotor model.

4). Electrical Compartment Cover:
   (a). Remove the cover and check for oil leaks around the terminal blocks.
   (b). Check for loose electrical power or signal leads and tighten any loose connections.
   (c). If excessive oil leakage is found at the terminal blocks, overhaul the Hydramotor referring to the section for the corresponding Hydramotor model.

1.8.2 Periodic Calibration:

1). The Hydramotor is designed to operate without calibration or maintenance for extended periods.

2). Perform the stroke adjustment procedure given for the specific Hydramotor model, every six months or as required, making any necessary repairs or corrections.

3). Perform all adjustment and calibration procedures specified in the relevant Hydramotor model section at intervals of no less than once a year.

1.9 HYDRAULIC OIL CHANGE

(a). Before changing the hydraulic oil, assure that 1.8.1 has been performed to determine if the Hydramotor requires an overhaul.

(b). If there is any evidence of contamination or discoloration, the hydraulic oil should be changed and the system flushed; otherwise, change the oil after 40,000 hours of operation or 96 months, whichever occurs first.

1.9.1 Vertically-Mounted Hydramotors:

1). **Turn off electrical power to the Hydramotor.**
2). Place a 5 quart oil drain pan beneath the Hydramotor.
3). Remove the fill plug and drain plug and their O-rings, allowing several minutes for the oil to drain out.
4). Replace the drain plug and its O-ring.
5). Refill the Hydramotor with hydraulic oil such as P/N S156207A (1 gallon container) to meet the bottom of the full plug opening (approximately 3 1/2 quarts).
6). Replace the fill plug with its O-ring.

1.9.2 Horizontally-Mounted Hydramotors :

1). **Turn off electrical power to the Hydramotor.**
2). Remove the electrical cover and disconnect power input to the Hydramotor.
3). Remove the two screws and lift away Terminal Block No. 2 (see Figure 1-8).
4). Place a 5 quart oil drain pan beneath the Hydramotor.
5). Remove the drain plug and allow several minutes for the oil to drain.
6). Using a funnel, assuring that you do not spill hydraulic oil onto electrical components, fill the Hydramotor with oil. The oil level should be 2-3 inches from the mounting surface of Terminal Block No. 2 (see Figure 1-8).

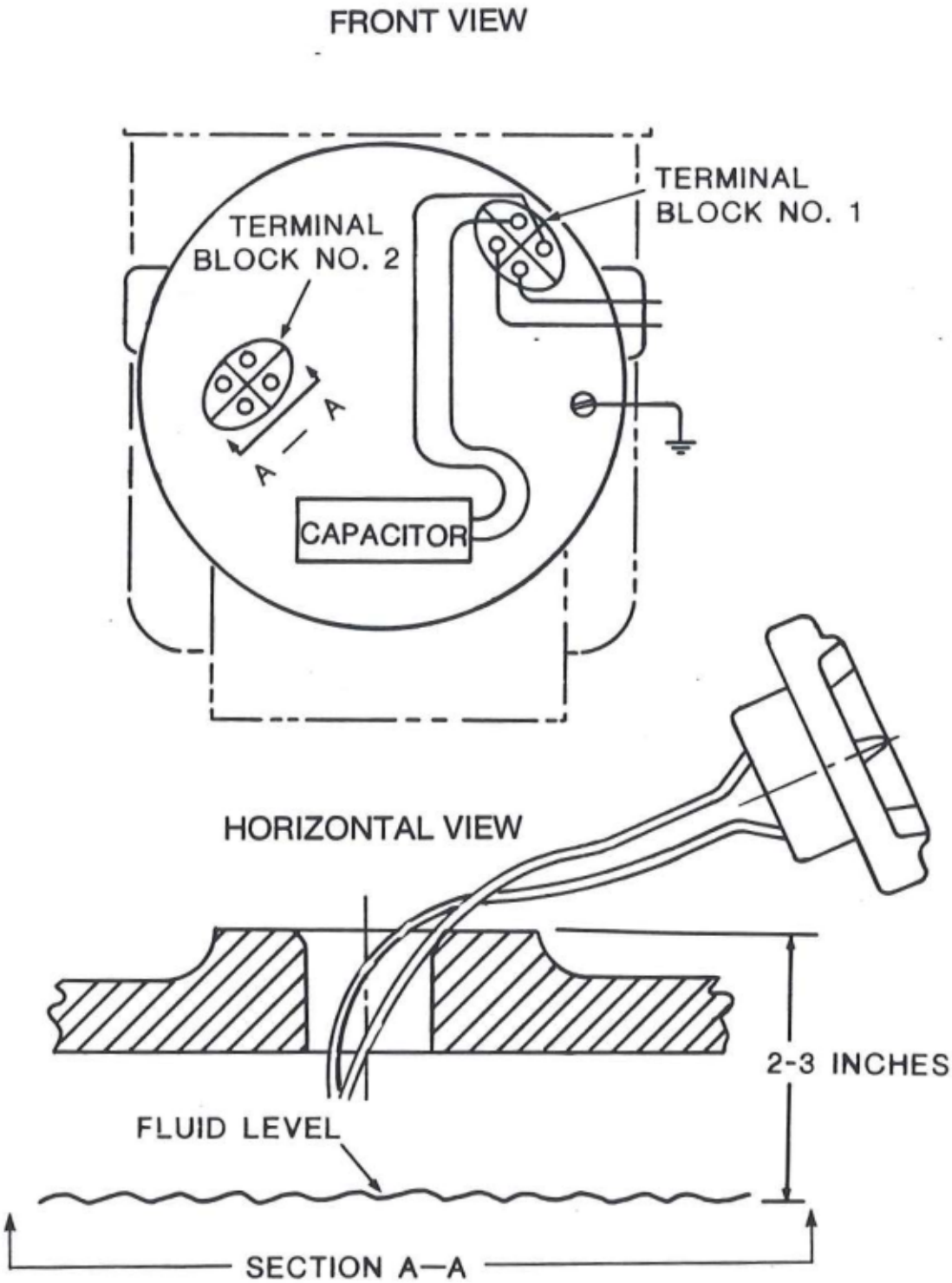


Figure 1-8. Oil Port Access, Horizontal Mounting
(Using Terminal Block 2 Port)

1.9.3 Intermediate Positioned Hydramotors:

1). Remove the Hydramotor from the PCD to change the oil.
2). Place the Hydramotor in the vertical position.
3). **Turn off electrical power to the Hydramotor.**
4). Place an oil drain pan (5 quarts) beneath the Hydramotor.
5). Remove the fill plug and drain plug and their O-rings, allowing several minutes for the oil to drain out.
6). Replace the drain plug and its O-ring.
7). Refill the Hydramotor with hydraulic oil (such as P/N S156207A one gallon container) to meet the bottom of the full plug opening (approximately 3 1/2 quarts).
8). Replace the fill plug and its O-ring.

1.10 CATALOG NUMBERING SYSTEM

Refer to Tables 1-4, 1-5 and 1-6 for the Hydramotor Ordering Table, the Stem Adapter Ordering Table, and the Split Coupling Ordering Table.

1 Proportional, Pull-Type (Spring Return)
2 Proportional, Push-Type (Spring Return)
3 Proportional, Pull-Type (Lock-in-Last Position)
4 Proportional, Push-Type (Lock-in-Last Position)
5 Two-Position, Pull-Type (Spring Return)
6 Two-Position, Push-Type (Spring Return)
7 Power Extend — Power Retract, Pull-Type (Lock-in-Last Position)
8 Power Extend — Power Retract, Pull-Type (Lock-in-Last Position)

ENCLOSURE

*C NEMA 4 (watertight)
*E NEMA 4 & 7 (watertight & explosion-proof)
*L NEMA 4 (with hand crank manual override)
*M NEMA 4 & 7 (with hand crank manual override)
†T NEMA 4 (watertight)
†U NEMA 4 & 7 (watertight & explosion-proof)
†V NEMA 4 (with hand crank manual override)
†W NEMA 4 & 7 (with hand crank manual override)

POWER UNIT

	Gross Shaft Force	Input Signal
40	1500 lbs. (680 kg.)	4-20 mA DC
41	1500 lbs. (680 kg.)	10-50 mA DC
46	1500 lbs. (680 kg.)	None
60	3000 lbs. (1361 kg.)	4-20 mA DC
61	3000 lbs. (1361 kg.)	10-50 mA DC
66	3000 lbs. (1361 kg.)	None
80	4000 lbs. (1814 kg.)	4-20 mA DC
81	4000 lbs. (1814 kg.)	10-50 mA DC
86	4000 lbs. (1814 kg.)	None

VOLTAGE**

02 120 Volts/60 Hz
04 240 Volts/60 Hz
08 110 Volts/50 Hz
09 220 Volts/50 Hz
54 240 Volts/50 Hz

OPTIONS

X0 None
E1 One (1) 0-1000 ohm Feedback Potentiometer
F5 Six (6) DPDT Auxiliary Switches (Explosion-Proof)
F6 Six (6) SPDT Auxiliary Switches (Explosion-Proof)
G1 Low Temperature Oil (AH91 thru AH94)
H2 E1 + F5
H3 E1 + G1 (AH91 thru AH94 only)
H4 F5 + G1 (AH91 thru AH94 only)
H5 E1 + F5 + G1 (AH91 thru AH94 only)

TAGGING

*B With Job Identification Tag, Viton Seals
*C No Tag, Viton Seals
†P With Job Identification Tag, Viton Seals
†R No Tag, Viton Seals

YOKE LENGTH (Overall)††

A 20" (508.0mm) (For Models AH91, 93, 95, 97 & 98)
C 17½" (444.5mm) (For Models AH91, 93, 95, 97 & 98)
K 26½" (673.1mm) (For Models AH92, 94 & 96)
M 22" (558.8mm) (For Models AH92, 94 & 96)

YOKE MOUNT (Diameter)

A 2¼" (57.2mm)
D 2⅛" (54.0mm)
F 2⅜" (60.3mm)
G 2⁹/₁₆" (58.7mm)
H 2⅝" (66.7mm)
J 2½" (63.5mm)
K 2¹³/₁₆" (71.4mm)
L 3" (82.6mm)
N 3¼" (82.6mm)
P 3³/₁₆" (84.1mm)
R 3⁹/₁₆" (90.5mm)
V 4" (101.6mm)

All Yokes have four (4) bolt mount on 5" Bolt Circle

SPRING SIZE

00 No Spring
01 #1 Spring
02 #2 Spring
04 #4 Spring
05 #5 Spring
06 #6 Spring

AH9

* For Model B (For Reference Only).
† For Model B-1.
** Additional Single Phase and Three-Phase voltages are also available, consult factory.
†† If only the power module is required, stop the catalog number after entering the "Tagging" digit.

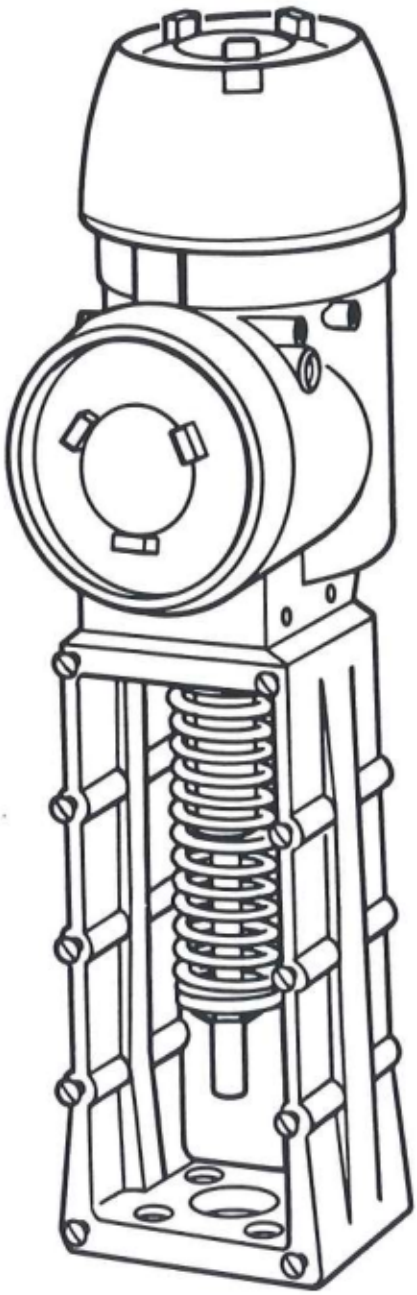
Table 1-5. Stem Adapter Features and Options Tabl

TYPE	SIZE	PART NUMBER
BA	1 5/16" (33.3mm)	64017A
BC	1 9/16" (39.7mm)	64017B
BF	2 1/16" (52.4mm)	64017C
BJ	2 9/16" (65.1mm)	64017D
BM	3 1/16" (77.8mm)	64017E
BQ	3 9/16" (90.5mm)	64017F
BT	4 1/16" (103.2mm)	64017G
BW	4 9/16" (115.9mm)	64017H

Table 1-6. Split Coupling Features and Options Tab

TYPE	SIZE	THREAD	PART NUMBER
C74	5/16" (7.9mm)	24 UNF	108192D
G70	7/16" (11.1mm)	20 UNF	108192F
J70	1/2" (12.7mm)	20 UNF	108192H
N68	5/8" (15.9mm)	18 UNF	108192M
Q66	3/4" (19.0mm)	16 UNF	108192P
S66	7/8" (22.2mm)	16 UNF	108192R
T08	1" (25.4mm)	8 UNC	108192U

AH91 / AH93 HYDRAMOTORS
MODELS B AND B-1



2. AH91 AND AH93 (PULL-TYPE) HYDRAMOTORS

2.1 PRINCIPLE OF OPERATION

AH91 and AH93 Hydramotors are self-contained, electrohydraulic, pull-type linear actuators. An external milliampere (mA) control signal precisely positions the output shaft. The shaft retracts in response to an increase in the mA control signal and extends as the mA signal is reduced. Upon power interruption, the AH91 Hydramotor is returned to its de-energized position by a yoke mounted, fail-safe return spring, while the AH93 Hydramotor locks and holds in its last signalled position.

There are two modes of operation for the AH91 and AH93 Hydramotors, the control mode and failure mode. In the control mode, the position of the shaft is controlled by a mA control signal. The failure modes occur when either the power input or the control signal is interrupted.

2.1.1 Control Mode

An external mA control signal is supplied to the force motor assembly (see Figures 2-1 A and B). The thrust provided by the force motor assembly is proportional to the mA control signal and is opposed by the shaft position feedback spring.

These forces act to position the balance beam with respect to the nozzle. This "force balance mechanism" controls the supply pressure of the hydraulic fluid to the cylinder and piston assembly.

As the control signal is increased, the thrust provided by the force motor assembly becomes greater than the force of the feedback spring. The flapper then moves towards the nozzle, thus restricting the flow of hydraulic fluid out of the pressure reducing valve. The restriction at the pressure reducing valve increases the hydraulic fluid pressure on the piston to retract the shaft. When the shaft has moved to a position where the feedback spring force supplies a thrust equal to that supplied by the force motor assembly, the system reaches a state of equilibrium and a steady shaft position is maintained.

When the mA control signal is decreased, the thrust exerted on the balance beam by the feedback spring exceeds the thrust supplied by the force motor assembly, thereby moving the flapper away from the nozzle. This allows hydraulic fluid to flow through the pressure reducing valve to the reservoir.

As the hydraulic fluid pressure is reduced, the return spring extends the shaft. When the "force balance mechanism" reaches equilibrium, at the point called for by the mA control signal, the shaft maintains a steady position.

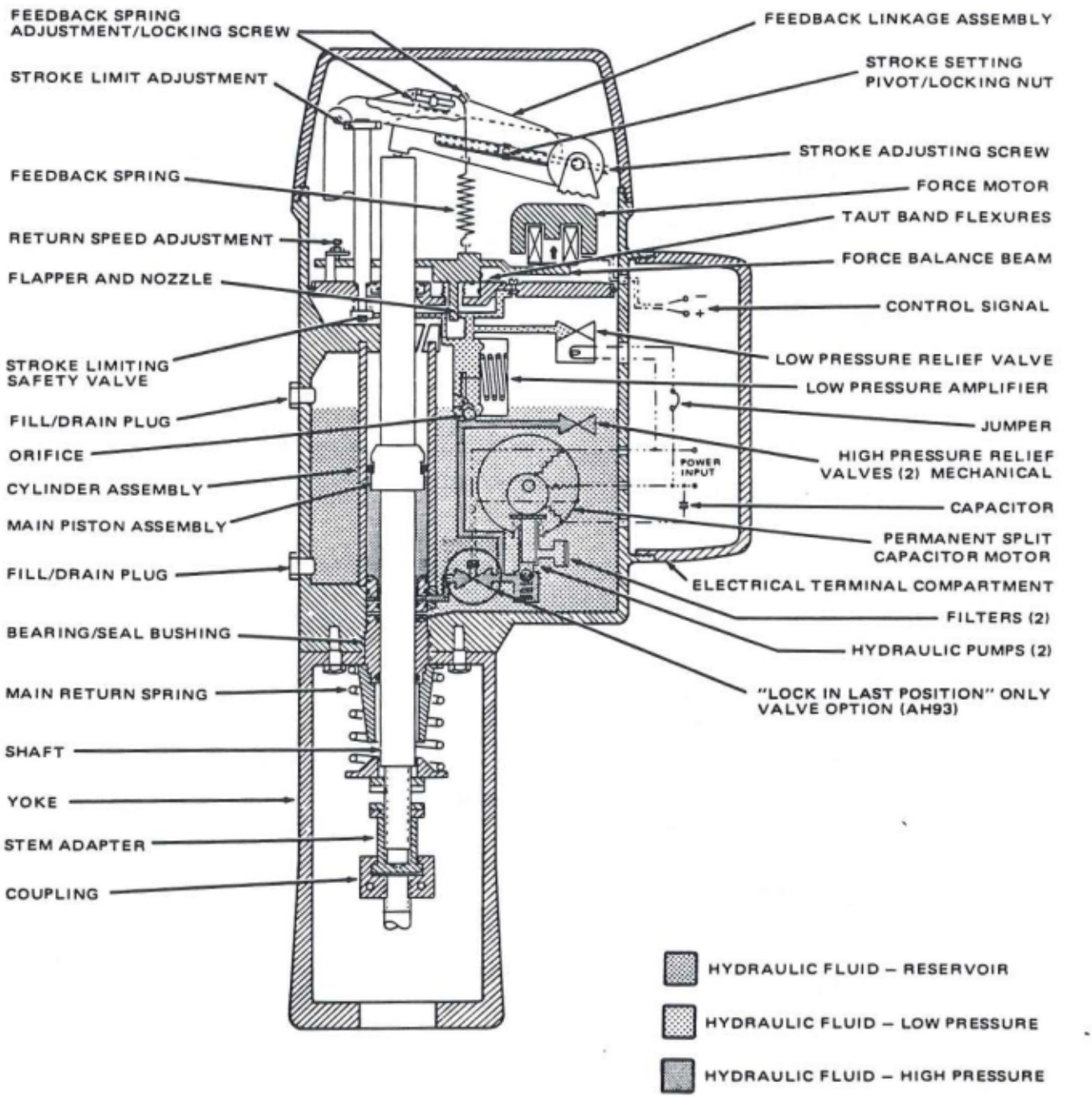


Figure 2-1 A. Hydramotor Assembly Model B

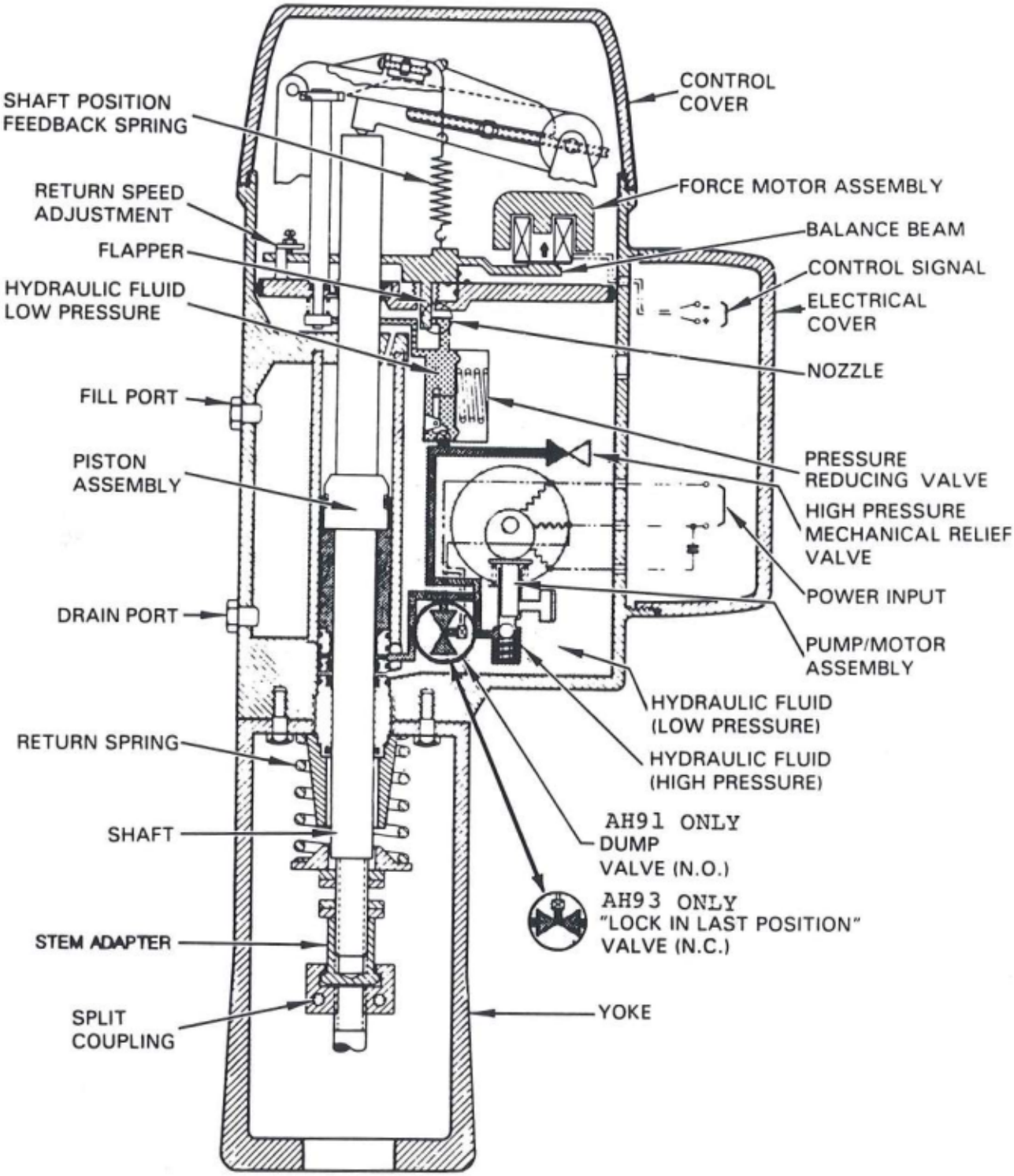


Figure 2-1 B. Hydramotor Assembly Model B-1

2.3 ADJUSTMENT AND CALIBRATION

This subsection defines the adjustment and calibration of a Hydramotor attached to a valve or other PCD. Refer to subsection 1.7 (MOUNTING/INSTALLATION).

(a). Both 1,500 lb. (680 kg.) and 3,000 lb. (1,306 kg.) Hydramotors may be adjusted to a maximum of 3 1/2 inches (89mm) active stroke.
(b). 4,000 lb. (1,800 kg.) Hydramotors may be adjusted to a maximum of 4 inches (102mm) active stroke.

• Before making adjustments, assure that the seventh digit of the nameplate catalog number corresponds to your control signal range (see Table 2-1).

Table 2-1. Control Signal Values*

CONTROL SIGNAL (mAdc)					
CATALOG NUMBER	CONTROL SIGNAL RANGE	BOTTOMING POSITION	MINIMUM POSITION	50 % POSITION	MAXIMUM POSITION
AH9---0	4-20	3.8	4	12	20
AH9---1	10-50	9.5	10	30	50

* Modulating Hydramotors are not designed to respond to control signals below minimum or above maximum.

2.3.1 50% Position Calibration (see Figures 2-8 and 2-9)

1). Remove the control cover using the Cover Removal Tool (P/N S109795Q).
2). Set the mA control signal to the 50% position (see Table 2-1).
3). The top edge of the slot in arm No. 2 and the bottom edge of arm No. 1 (see Figure 2-9) should be visually parallel. If not, loosen the feedback spring lock screw (see Figure 2-9), then turn the feedback spring adjustment screw clockwise or counterclockwise to obtain a parallel condition.
4). Retighten the lock nut. The Hydramotor is now in calibration at the 50% position.

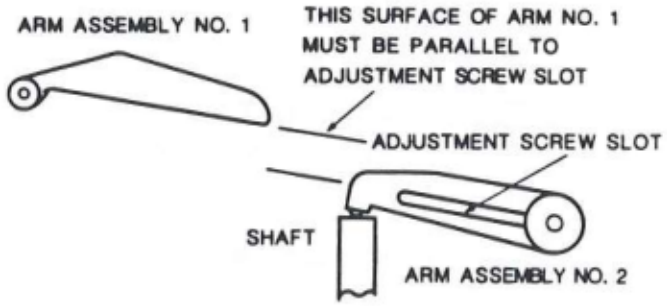


Figure 2-8. Determining Parallelism

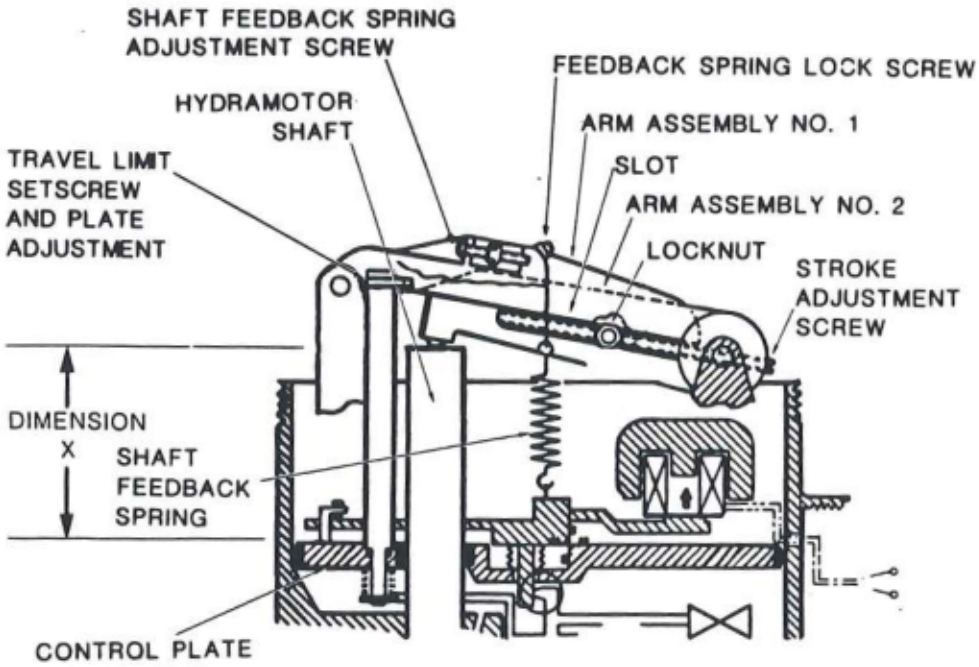


Figure 2-9 Stroke Adjustment for Pull Type

2.3.2 Stoke Adjustment (see Figure 2-9)

1). Set the mA Control Signal to the 50% position (see Table 2-1).
2) Carefully measure dimension "X" (from the controller assembly plate to the top of the shaft) using a 6 inch steel ruler (see Figure 2-9).
3). Determine the required PCD lift from the PCD manufacturer's documentation, or if necessary by careful measurement. (Lift is the total usable stem travel from closed to recommended opened position).
4). Divide the PCD lift (from step 3) by 2 and add this value to dimension "X" (from step 2).
5). Increase the mA control signal to maximum (see Table 2-1).
6). Loosen the lock nut (located between the two arms) using a thin 1/2 inch open end wrench.
7). Turn the stroke adjustment screw clockwise or counterclockwise as necessary to cause the shaft to move to the value determined in step 4, and retighten the lock nut.
8). Decrease the mA Control Signal to minimum (see Table 2-1).
9). Measure dimension "X" (see Figure 2-9), and subtract this value from the value found in step 4. The result should equal the PCD usable lift, as well as the stroke required. If not, repeat the 50% position calibration and stroke adjustment steps 2.3.1 through 2.3.3 above.

CAUTION

TO AVOID EXCESSIVE AND POTENTIALLY DAMAGING FORCE ON THE PCD, THE DIFFERNECE BETWEEN MAXIMUM AND REQUIRED STROKE MUST BE AT LEAST 1/16 INCH. THIS DIFFERENCE PREVENTS THE HYDRAMOTOR SHAFT FROM OVER STRESSING THE PCD WHEN IN THE FULL OPEN POSITION.

10). Set "OPEN" and "SHUT" position indicators (see exploded view Figure 6-12).

2.3.3 Mechanical (Safety)Travel Limit Device

Models AH91 and AH93 are equipped with a mechanical travel limit device (see Figure 2-9), which should be adjusted after stroke adjustments are made and locked. This device will prevent the shaft from exceeding the desired stroke setting.

NOTE

The shaft must not actuate the mechanical safety travel limit device during normal operation.

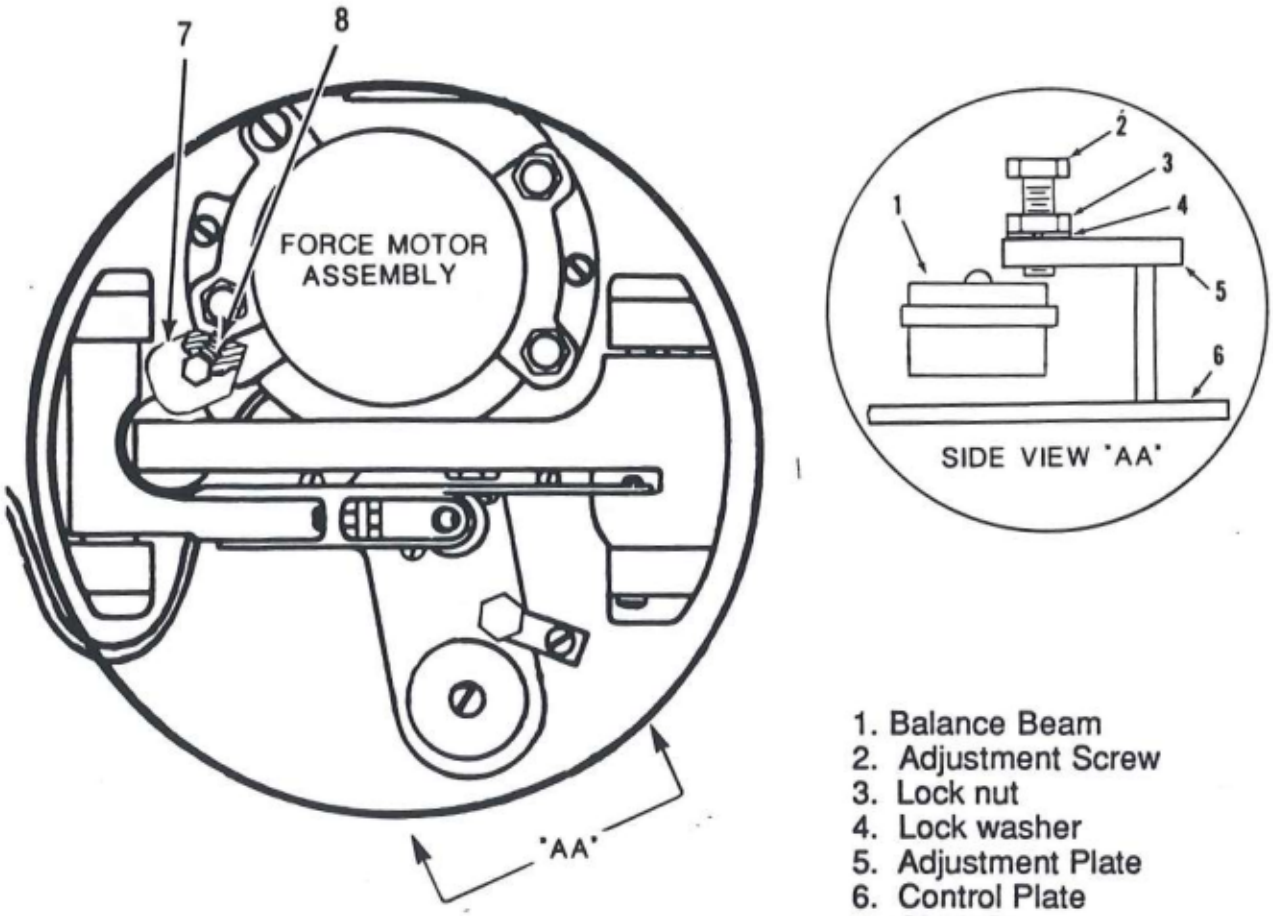
1). Set the mA control signal to the maximum position (see Table 2-1).
2). Loosen the travel limit set screw (see Figure 2-10), then lower the travel limit adjustment plate until it rests on top of the shaft.

CAUTION

DO NOT OVER-TIGHTEN THE ADJUSTMENT SCREW. THE ADJSUTMENT SCREW MUST NOT PREVENT MOVEMENT OF THE BALANCE BEAM.

3). Raise the travel limit adjustment plate approximately 1/32-inch, and lock the adjustment plate arm in this position with the set screw.
4). Operate the Hydramotor past its full stroke a number of times to check travel limit operation.

2.3.4 Return Spring Speed Adjustment



1. Balance Beam
2. Adjustment Screw
3. Lock nut
4. Lock washer
5. Adjustment Plate
6. Control Plate
7. Shaft Stop
8. Set Screw

Figure 2-10. Return Spring Speed Adjustment for Pull Type

NOTE

Return spring speed is factory set at maximum. Resetting the return spring timing may affect low temperature operation.

Return spring speed is adjustable on all variations per Figure 2-10 and as follows:

1). Power the Hydramotor for 30 minutes to bring it up to normal operation temperature.
2). Hold the adjustment screw steady using a screwdriver while loosening the lock nut.
3). Turn the adjustment screw counterclockwise to increase speed of extension or clockwise to reduce speed of extension.
4). Operate the Hydramotor and readjust it until the desired speed of extension is achieved.
5). Hold the adjustment screw in place and tighten its lock nut.
6). Operate the Hydramotor through full stroke several times to assure proper adjustments have been made.

2.4 TROUBLESHOOTING

These charts are intended to assist in isolating and correcting operating problems. Follow the arrows perform each block-solution in sequence, and check the operation of the Hydramotor after each corrective stage.

2.4.1 Figures 2-11A, B and C are flowchart troubleshooting guide examples as follows:

A. The motor runs freely but the Hydramotor will not stroke with milliampere input control signal.

B. The Hydramotor will not stroke when the motor runs.

C. The motor does not run.

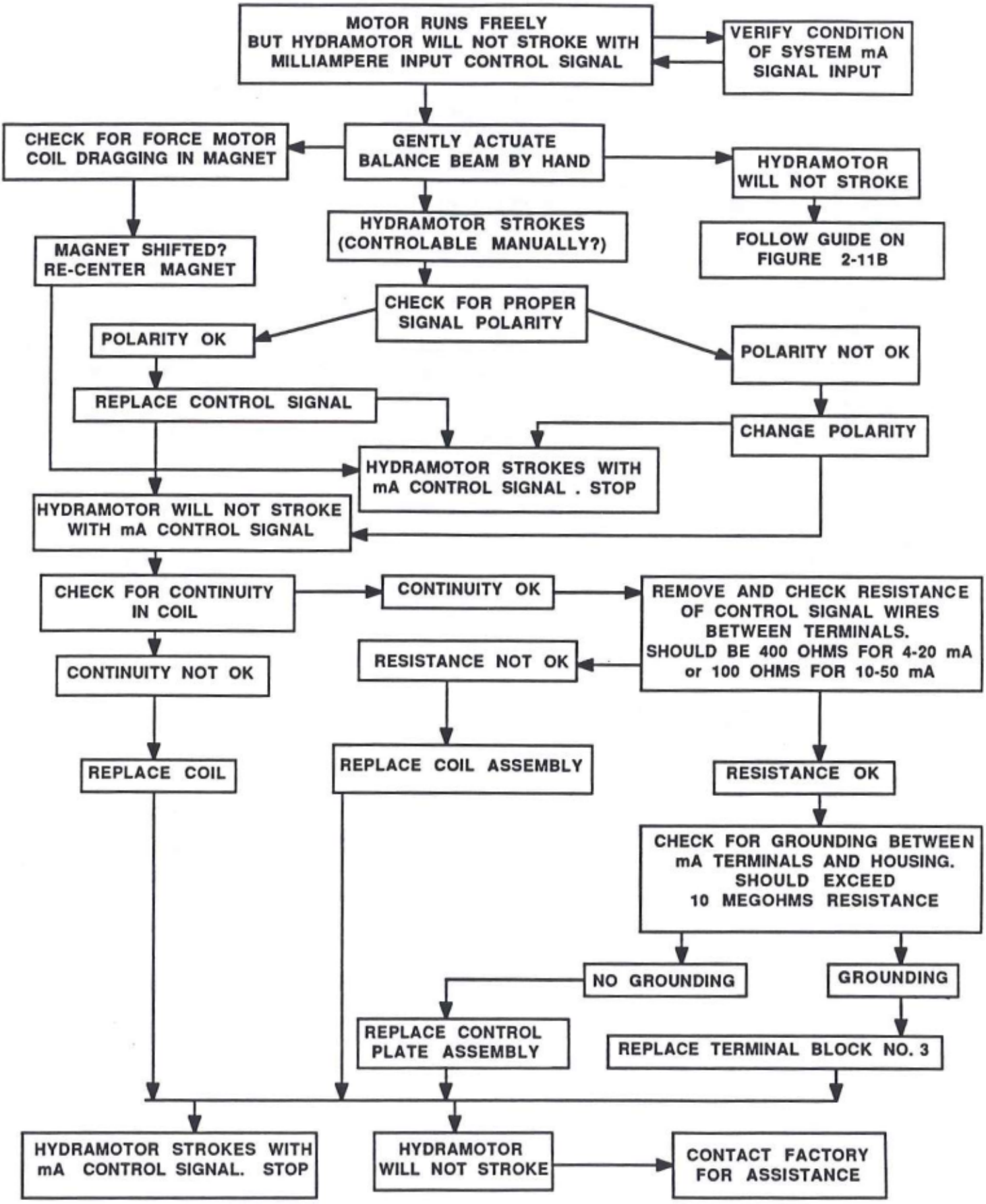


Figure 2-11A. Troubleshooting Guide. Modulating

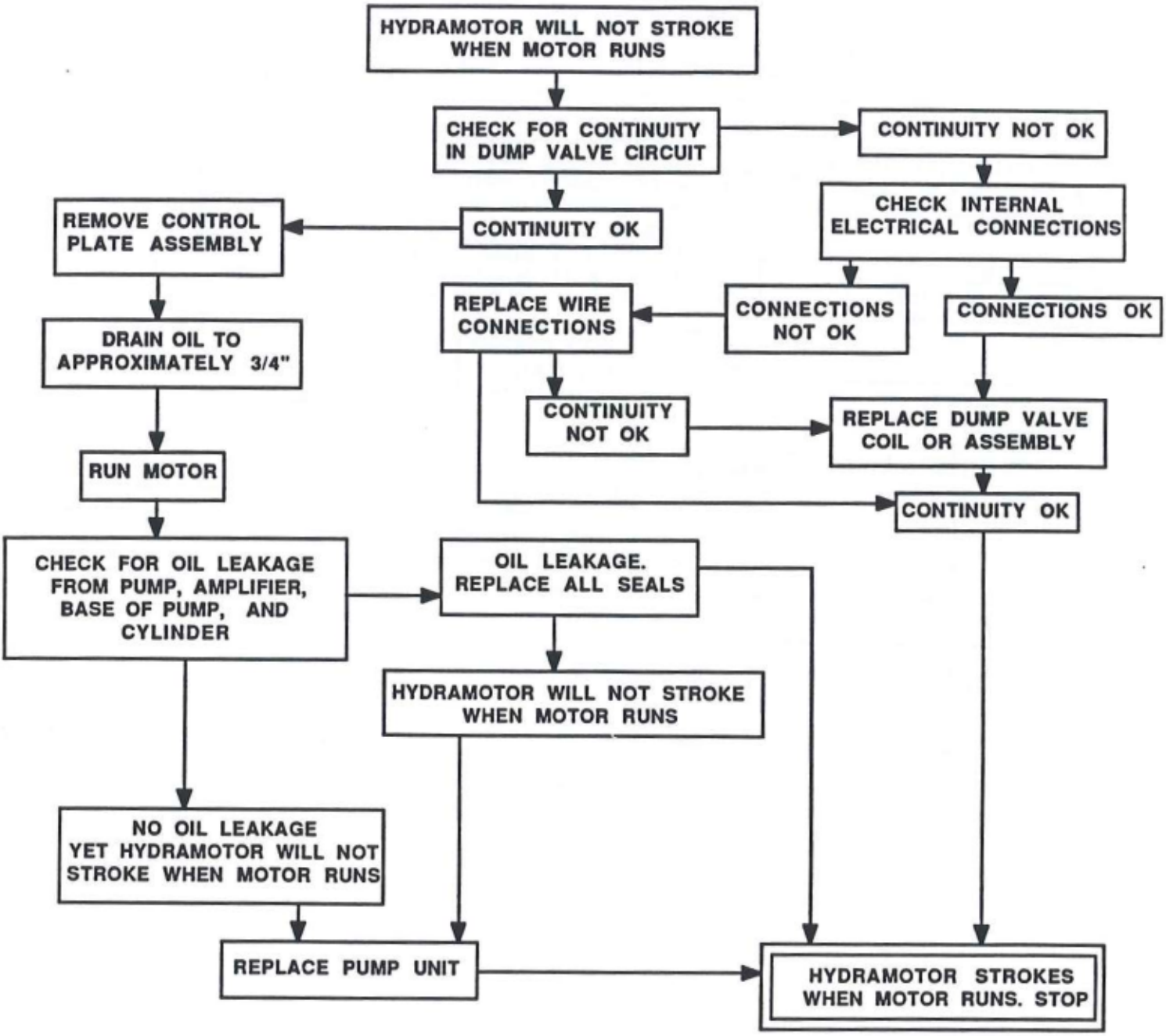


Figure 2-11B. Troubleshooting Guide. Motor Runs Properly.

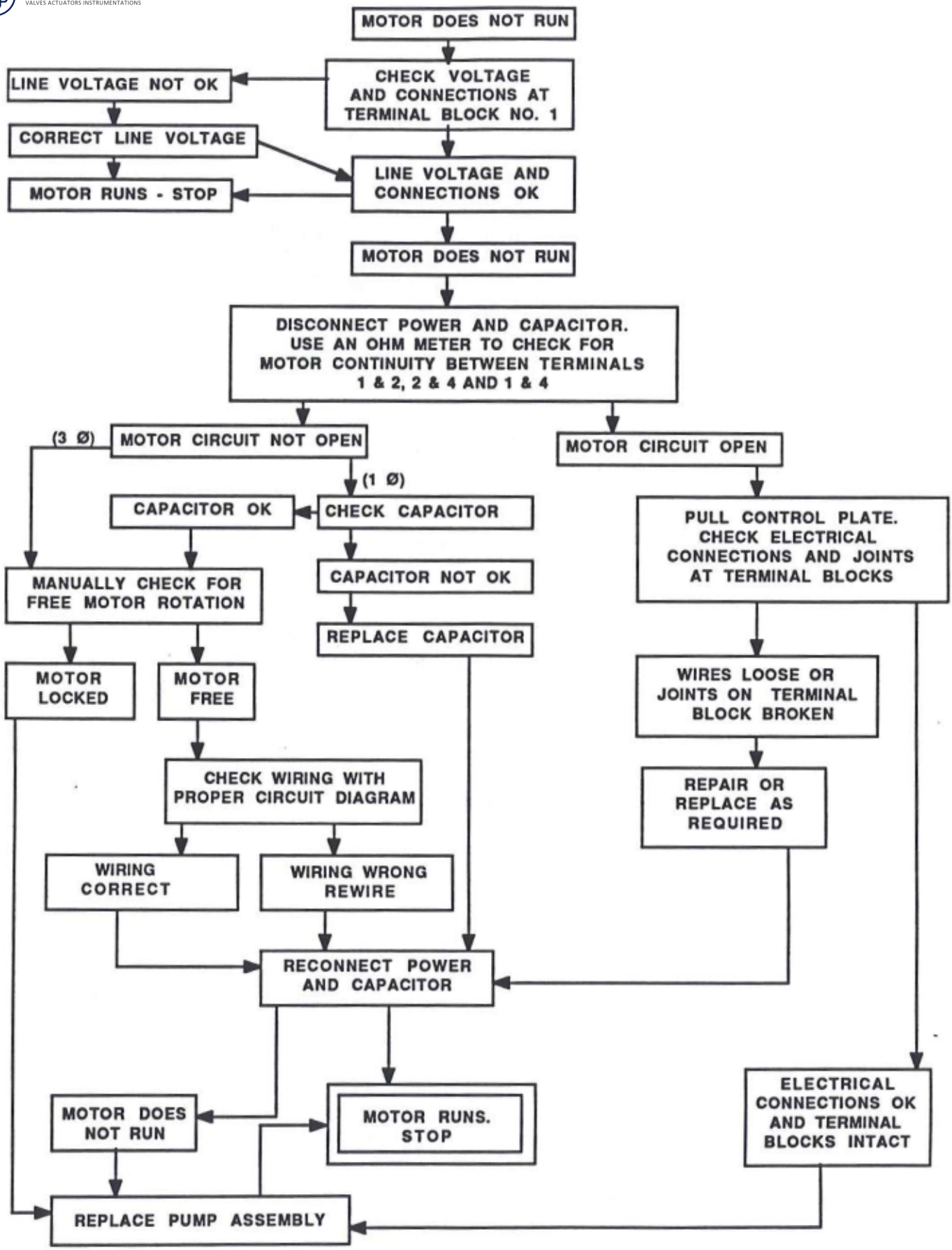


Figure 2-11C. Troubleshooting Guide. Motor Does Not Run Properly.

8). Loosen the two slotted head screws on the top of the pump (201) and install the Pump Removal Tool (P/N S109795-0).
9). Lift the pump (201) straight up, tilt to drain out excess oil, and lift it out of the housing (625).
10). The small nipple (202) that connects the pump to the housing may come out with the pump or stay in the housing. In either case, the nipple must be removed and its O-rings (7) replaced.
11). With a 5 quart container under the Work Table, turn the Hydramotor upside down and set it in the Work Table. The remaining oil in the housing will drain out.

D. Removing the Yoke and Spring Assembly

Refer to 6.3.1.

E. Removing the Shaft Assembly and Bushing

1). Use the Shaft Extension Tools (P/N S109795H) to loosen the shaft extension (613) from the shaft (507).
2). Remove the shaft extension (613).
3). Remove the bushing lock screw (624) if so equipped (no screw is used on 4,000 lb.(1,800 kg.) Hydramotors).
4). Remove the housing (625) from the Work Table and secure in the Power Module Work Stand (P/N S109795A).
5). Rotate the Work Stand 90° and tap the threaded end of the shaft (507) and piston (503) from the cylinder (501) per 6.2.1.
6). Install the bushing socket tool (P/N S109795D for 1,500 lb. (680 kg.) Hydramotors, or P/N S109795L for 3,000 lb. (1,360 kg.) or 4,000 lb. (1,800 kg.) Hydramotors) and unscrew the bushing (101) from the bottom of the housing (625). As the bushing (101) is removed, the cylinder (501) will become free and can be removed from the inside of the housing (625).

F. Final Housing Disassembly

1). Single Phase Only: Remove screws that secure the capacitor wires to Terminal Block No. 1 (see Figure 2-2). Remove and replace the capacitor (641) if bad. Replace the screws in the block.
2). Remove four screws (635) that secure Terminal Blocks No. 1 (630) and No. 2 (634) to the housing (625). Remove the terminal blocks, complete with their O-rings (16) and spacers (628).
3). Remove the housing (625) from the Power Module Work Stand. Remove the oil drain plug and the oil fill plug (619) from the rear of the housing and discard their O-rings (4).

4). Refer to section 6 (OVERHAUL OF COMMON COMPONENTS) for instructions on disassembly of the piston and removal of the seals from the bushing.

G. Removing Seals from the Control Plate

1). Invert the control plate (606).
2). Remove the two slotted head screws and two brass washers that hold the shaft seal bushing to the control plate (see Figure 2-13).
3). Remove the shaft seal bushing and discard its two O-rings.
4). Remove the split retaining ring from the end of the mechanical travel limit stem (see Figure 2-14).
5). Remove the brass washer and spring.
6). Lift the travel limit stem up and out from the top of the control plate.
7). Remove and discard the two travel limit stem O-rings.
8). Thoroughly clean the control plate by solvent de-greasing or similar method.

2.5.2 Assembly of Hydramotors

This procedure is to be followed after all Hydramotor components have been cleaned and inspected. All parts must be free from dirt, impurities, and excessive wear (replace parts as necessary).

CAUTION

THE PRINCIPLE CAUSE OF HYDRAULIC FLUID BYPASS PROBLEMS IS IMPROPER SEALING DUE TO O-RING AND SEAL DAMAGE IN REASSEMBLY. INSPECT AND INSTALL O-RINGS AND SEALS CAREFULLY, ENSURING THAT THEY ARE NOT CUT, ROLLED, ABRADED, OR DISLODGED DURING ASSEMBLY PROCEDURES. PRIOR TO REASSEMBLY, LUBRICATE THOROUGHLY WITH WHITE PETROLEUM JELLY.

A. Preparing the Housing for Assembly

1). Replace the O-rings (4) on the oil fill plug and oil drain plug (619) and assemble in the rear of the housing (625).
2). Place the housing (625) in the Power Module Work Stand (P/N S109795A) and secure.
3). Assemble the bushing per subsection 6.1 (BUSHING AND CYLINDER CAP).
4). Lubricate three lower O-rings (9) with white petroleum jelly and install the bushing (101) into the bottom of the housing (625) with the Bushing Socket Tool (P/N 109795D for 1,500 lb. (680 kg.) Hydramotors and P/N S109795L for 3,000 lb.(1,360 kg.) and

4,000 lb. (1,800 kg.) Hydramotors). Once the socket tool touches the housing, the bushing is tight. Turn the socket tool 1/4 turn ccw.

5). Install the bushing lock screw (624) if required. (No screw is required on 4,000 lb.(1,800 kg.) Hydramotors).

6). Lubricate the two Terminal Block O-rings (16) with petroleum jelly and install on Terminal Blocks No. 1 (630) and No. 2 (634). Fit the spacers (628) onto the terminal blocks and secure them in the housing (625).

7). Reconnect the capacitor to Terminal Block No. 1.

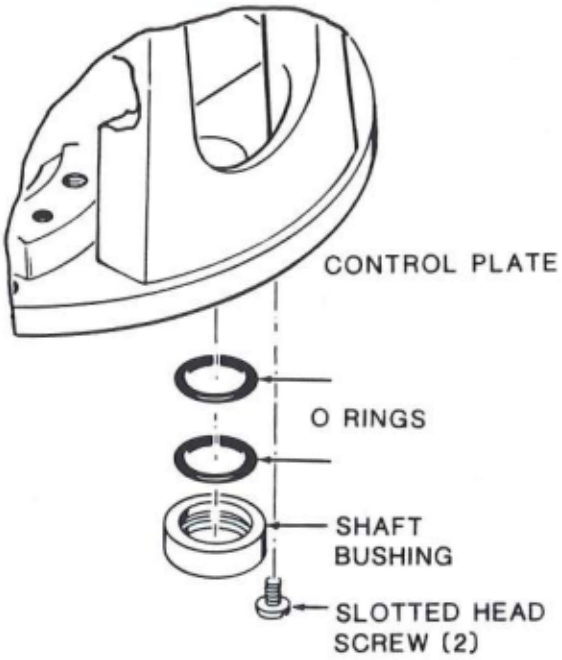


Figure 2-13. Upper Shaft Seals

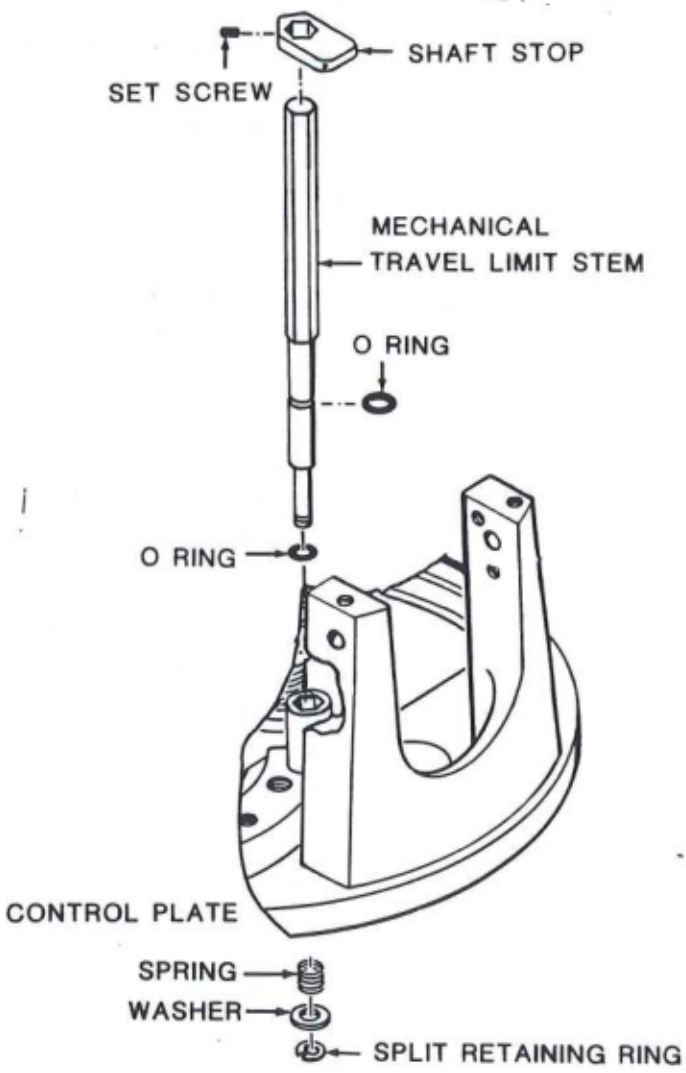


Figure 2-14. Mechanical Travel Limit Device

B. Shaft Assembly

1). Rotate the housing to the upright position.
2). Perform the assembly procedures described in subsection 6.2 (SHAFT AND PISTON ASSEMBLY).
3). Lubricate the fourth bushing O-ring (9) and install it onto the bushing (101) from inside of the housing.
4). Lubricate the tapered end of the shaft (507) with white petroleum jelly and insert it into the bushing (101) from above. Assure that the cylinder (501) slips over the top O-ring (9) on the bushing (101).
5). Push the shaft and piston assembly down smoothly until the piston assembly touches the bushing (101).
6). Install the cylinder cap (102) and two 15/16" hex bolts (614) with both flat washers (616) and lock washers (615) and secure finger tight.
7). Tighten the two hex bolts (614) to hold the cap securely in the housing (625). Remove the Shaft Alignment Tool.
8). Remove the housing from the Power Module Work Stand and turn it upside down in the Work Table (P/N S109795B).
9). Thread the shaft extension (613) onto the shaft (507). Use Shaft Extension Tools (P/N S109795H) to tighten the shaft extension .

C. Yoke and Spring Assembly

Refer to 6.3.2.

D. Pump/Motor Installation

1). Remove the housing and yoke from the Work Table. Stand the yoke on a table or floor.
2). Install new O-rings (7) on the small nipple (202), lubricate with white petroleum jelly and install the nipple assembly into the bottom of the housing. Use care not to bind or cut the O-Rings.
3). Attach the Pump Removal Tool (P/N S109795O) to the pump (201). Carefully set the pump into the housing. Do not rest the pump on the nipple in the bottom of the housing. Place a small screwdriver in one of the rear stud holes to prevent the pump from seating fully, and to allow room for inserting the wiring assembly.
4). Check the appropriate wiring diagram for correct wiring combinations.
5). Place clean padding (rag or towelling) over the pump to prevent any loose wire strands from entering the top of the pump.
6). Connect the wiring by twisting the wire strands together. Use "duck bill" (flat nose) pliers to smooth out the wire twist. Insert into the connector (205). Crimp with a crimping

tool, such as Hollingsworth H-18.

7). After wiring is complete, carefully tuck all wiring down between the cylinder (501) and pump housing (201). Remove the foam padding.

8). Remove the screwdriver and gently lower the pump (201) onto the nipple (202). Do not drop or force the pump down on the nipple. The pump will settle down on the nipple with very little force.

9). Remove the Pump Removal Tool and tighten the two screws on the pump.

10). Install three lock washers (608) and hex nuts (607) onto the bolts (609). **Torque these nuts to approximately 24 in.-lb. (±0%-10%).**

11). Carefully fill the housing to the level of the fill port with oil. (approximately 3 1/2 quarts). Do not allow the oil to enter the large O-ring groove or the four 1/4" threaded holes used to hold down the control plate. As the pump takes in oil, the proper oil level will be maintained.

12). Replace the O-rings (5,6) on the plug (203). Install the spring (204) and plug (203) in the proper port on the top of the pump.

E. Control Plate Assembly

1). Invert the control plate (606). Insert two new O-rings into the shaft seal bushing (see Figure 2-13). Affix the shaft seal bushing assembly to the underside of the control plate with two slotted head screws and two brass washers.

2). Install two new O-rings onto the mechanical travel limit stem (see Figure 2-14). Insert the stem into its receptacle on the control plate. Fit the spring and brass washer onto the stem from the bottom of the control plate and secure with the split retaining ring.

3). Carefully install the large control plate O-ring (2) in the groove at the top of the housing.

4). Place the four small O-rings (3) in the housing bolt holes. Do not get oil on this large O-ring or the four small O-rings (giving the appearance of a leak).

5). Lubricate the large O-ring with white Petroleum jelly.

6). Install the control plate (606) and secure it with four 1/4" hex head cap screws (605).

7). Remove the Control Plate Removal Clamp (P/N 109795P) and replace the screw in the centering ring.

8). Insert a small wire up from the electrical compartment through the small mA force coil wire hole at Terminal Block No. 3 (633). Form a small hook on the end of the wire, then pull the black and white mA wires down through the hole. Before disconnecting the hook, slip the black sleeving* over the wires and push it up into the housing. Disconnect the hooked wire.

and push it up into the housing. Disconnect the hooked wire.

* Black sleeving is not required for Hydramotors equipped with a feedback potentiometer option. Feed two mA wires and three potentiometer wires down through the force coil wire hole at Terminal Block No. 3 (633).

F). Completing the Assembly

1). Replace the rust-colored insulation ring (631).
2). Solder the black and white coil wires to Terminal Block No. 3 (633). Refer to Figures 2-2 through 2-7 as applicable.
3). Install the spacers (632) and secure Terminal Block No. 3 (633) and isolating barrier (636) to the housing (625) with two screws (635).
4). Apply power to the Hydramotor and let its motor run until the oil gets warm (approximately 20 minutes). Apply a mA control signal and check for proper operaton. Check for oil leaks at the control plate and lower shaft extension.
5). Replace the metal stiffener plate and plastic dust cover onto the yoke with mounting screws.
6). The Hydramotor is ready for adjustment and calibration. (see subjection 2.3 (ADJUSTMENT AND CALIBRATION).
7). Replace the control cover O-ring (1) on the top of the housing, apply anti-seizing lubricant to the threads, and screw on the control cover (601).
8). Replace the O-ring (2) on the electrical cover (603), apply anti-seizing lubricant to the threads, and screw in the electrical cover (603).

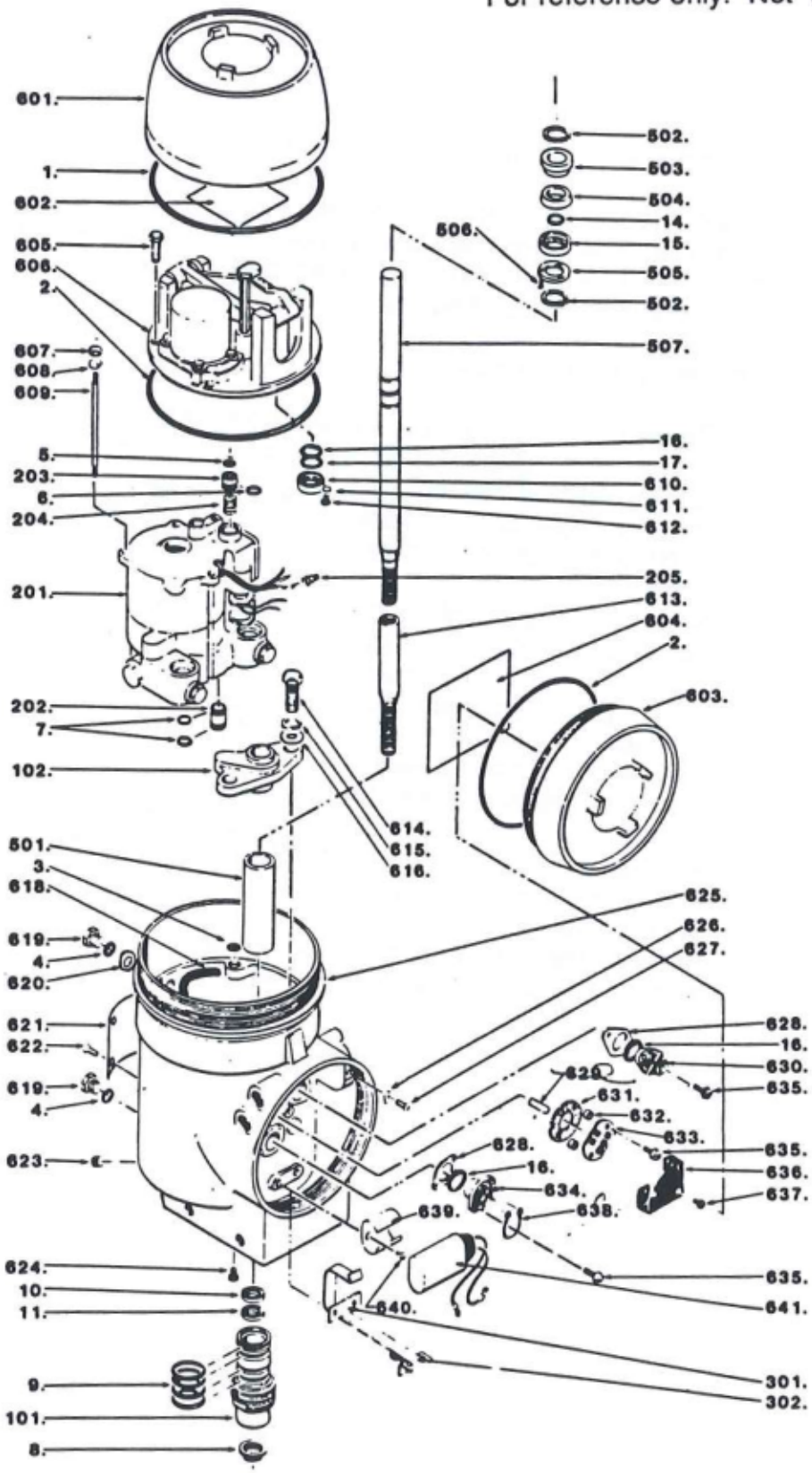


Figure 2-15. Exploded View

For reference only. Not for ordering purposes.

Legend for Figure 2-15
Exploded View

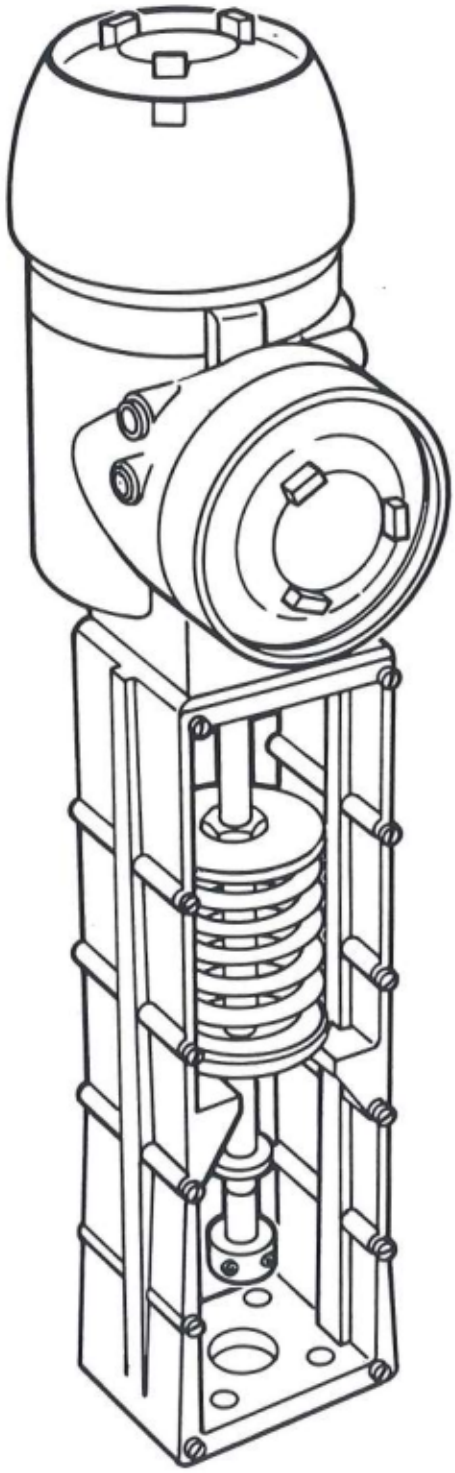
Item No.	Description	No. Required
1	O-ring, Control Cover	1
2	O-ring, Control Plate and Electrical Cover	2
3	O-ring, Control Plate Mounting Bolts	4
4	O- ring, Drain and Fill Plugs	2
5	O-ring, Pump Spring	1
6	O-ring, Pump	1
7	O-ring, Pump Nipple	2
8	Wiper ring	1
9	O-ring, Bushing	4
10	Seal	1
11	Seal	1
12	O-ring	1
14	O-ring	1
15	Polymyte Piston Ring	1
16	O-ring, Seal Retainer, Terminal Blocks	3
17	O-ring. Seal Retainer	1
101	Bushing	1
102	Cylinder Cap	1
201	Pump	1
202	Nipple	1
203	Plug	1
204	Spring	1
205	Connector	5
301	Capacitor Plate	1
302	Capacitor Strap	1
501	Cylinder	1
502	Split Retaining Ring	2
503	Piston	1
504	Spacer (1,500 lb. Hydra. only)	1
505	Retainer	1
506	Set Screw	3
507	Shaft	1
601	Control Cover	1
602	Wiring Diagram	1
603	Electrical Cover	1
604	Wiring Diagram	1
605	Hex Head Screw	4
606	Control Plate	1
607	Hex Nut	3
608	Lock washer	3
609	Bolt Stud	3
610	Seal Retainer	1
611	Flat washer	2

For reference only. Not for ordering purposes.

Legend for Figure 2-15
Exploded View (Continued)

Item No.	Description	No. Required
612	Slot Head Screw	2
613	Shaft Extension	1
614	Bolt	2
615	Lock washer	2
616	Flat washer	2
618	Coil Wire Sleeve	1
619	Oil Fill Plug and Oil Drain Plug	2
620	Plate, Caution	1
621	Nameplate	1
622	Screws, Nameplate	4
623	Plug	1
624	Lock Screw, Bushing	1
625	Housing	1
626	Washer	1
627	Screw	1
628	Spacers, Terminal Blocks	2
630	Terminal Block No. 1	1
631	Insulation Ring	1
632	Spacer	2
633	Terminal Block No. 3	1
634	Terminal Block No. 2	1
635	Screws	6
636	Isolating Barrier (Insulating)	1
637	Screws	3
639	Clip, Capacitor	1
640	Screws, Capacitor Clamp	2
641	Capacitor (Single Phase Only)	1

AH92 / AH94 HYDRAMOTORS
MODELS B AND B-1



3. AH92 AND AH94 (PUSH-TYPE) HYDRAMOTORS

3.1 PRINCIPLE OF OPERATION

The AH92 and AH94 Hydramotors are self contained, electrohydraulic, push-type linear actuators. An external control signal precisely positions the output shaft. The shaft extends or retracts in proportion to the control signal. Upon power interruption, the AH92 will return to the de-energized position by a fail-safe return spring, while the AH94 locks in its last position.

There are two modes of operation for the AH92 and AH94 Hydramotors, the control mode and the failure mode. In the control mode, the position of the shaft is controlled by a mA control signal. The failure mode occurs when either the power input or control signal is interrupted.

3.1.1 Control Mode

Structurally, the push type Hydramotors are identical to the pull type. The AH92 and AH94 control plates have an added bias spring that applies a constant counter-clockwise torque on the balance beam. This bias torque will always try to equal the combined clockwise torques of the feedback spring and force motor.

In the control mode, when the mA control signal is increased to the force motor assembly (see Figure 3-1A and B), the torsional load becomes imbalanced against the bias spring. The flapper on the balance beam moves toward the nozzle thus restricting the flow of hydraulic fluid out of the pressure reducing valve.

The restriction at the pressure reducing valve increases the hydraulic fluid pressure on the piston, extending the shaft against the spring (and the load). When the shaft has moved to a position where the combined forces of the feedback spring and force motor are again equal to the bias spring, the system achieves equilibrium and maintains a steady shaft position.

When the mA control signal is decreased, the combined force of the feedback spring and force motor diminishes allowing the flapper to move away from the nozzle. This opens the pressure reducing valve allowing the oil stored in the cylinder to flow out, causing the shaft to retract driven by the return spring. As the feedback spring is stretched, its force increases until equilibrium with the bias spring is again achieved and the shaft maintains a steady position.

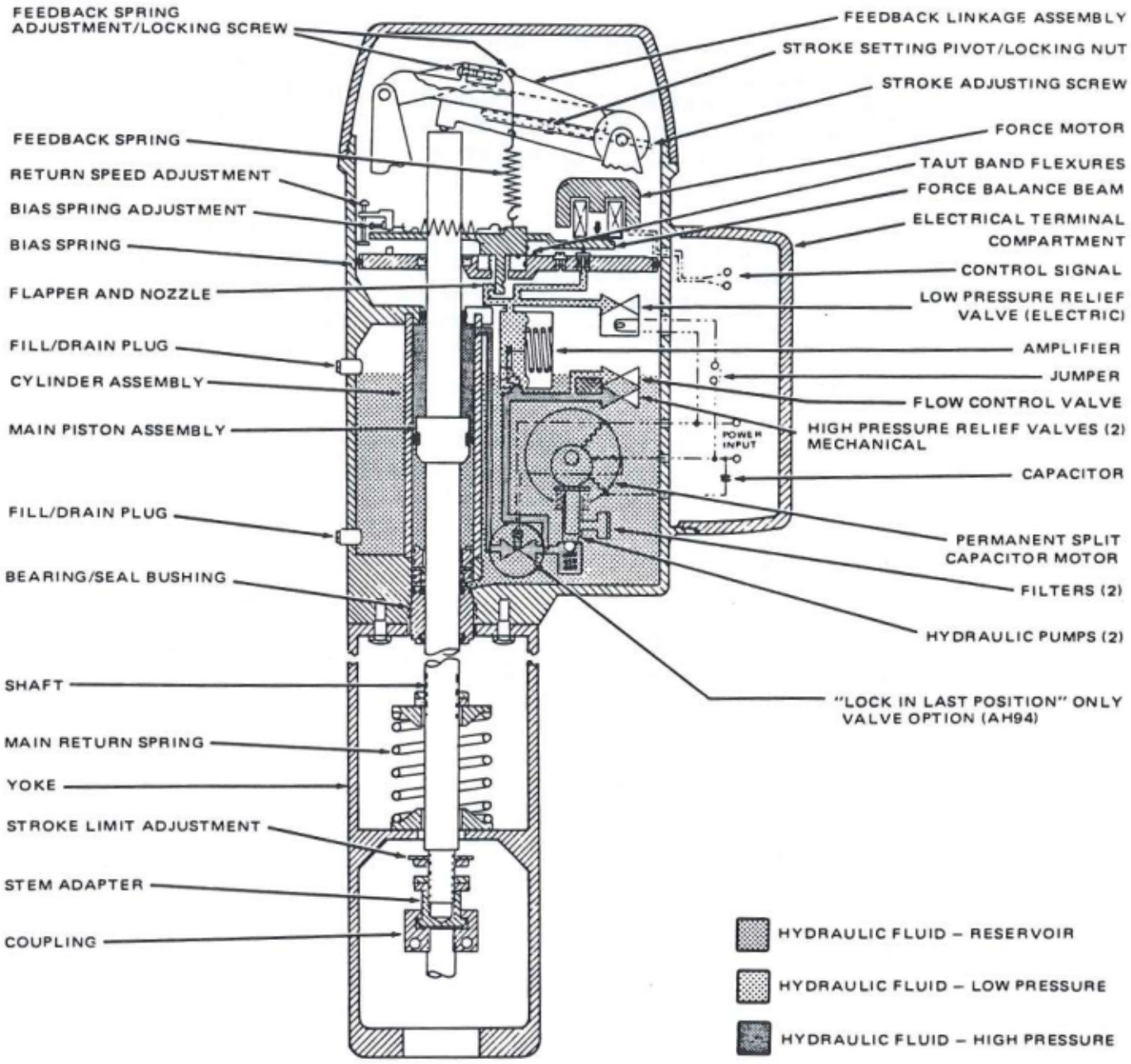


Figure 3-1A. Hydramotor Assembly for Model B

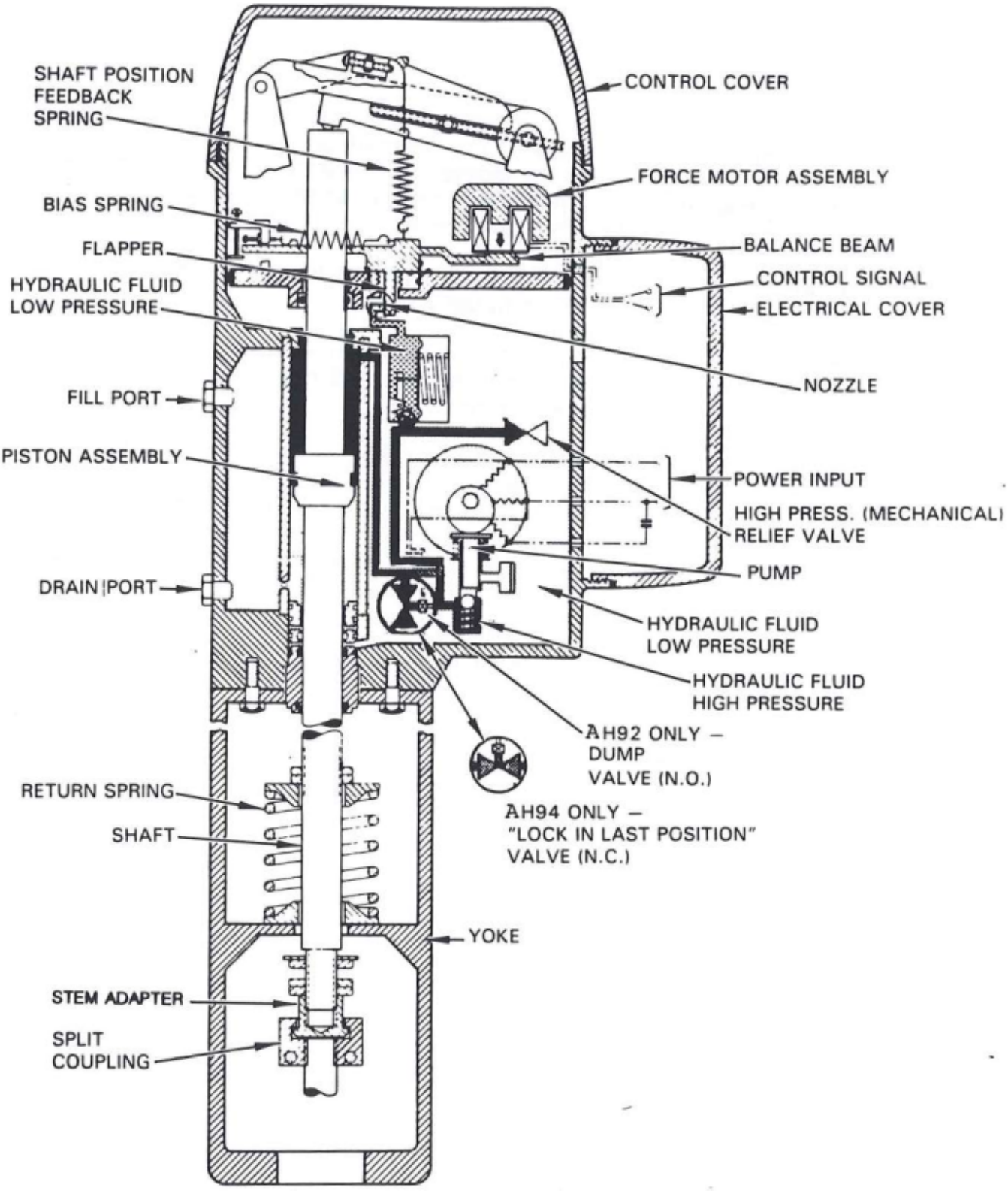


Figure 3-1B. Hydramotor Assembly for Model B-1

3.1.2 Failure Mode

Loss of Control Signal. Loss of control signal causes both AH92 and AH94 Hydramotors to return to the de-energized position. On loss of control signal, the bias spring moves the flapper away from the nozzle, allowing hydraulic fluid to pass from the cylinder into the reservoir. Shaft return is accomplished by the stored energy in the fail-safe return spring.

Interruption of Power. Interruption of power causes the AH92 to retract and the AH94 to lock in its last position.

AH92. On loss of power, the normally open dump valve opens allowing hydraulic fluid to pass from the cylinder into the reservoir. The shaft return is accomplished via stored energy in the return spring.

AH94. The AH94 will lock in its last position at the moment of power interruption. On loss of power the normally closed dump valve closes, trapping hydraulic fluid in the cylinder and locking the position of the shaft at the instant of power interruption. Once the dump valve is re-energized, the shaft will respond proportionally to the control signal.

3.2 WIRING DIAGRAMS

Refer to Figures 3-2 through 3-7 for External and Internal Wiring Diagrams, Single Phase and Three Phase.

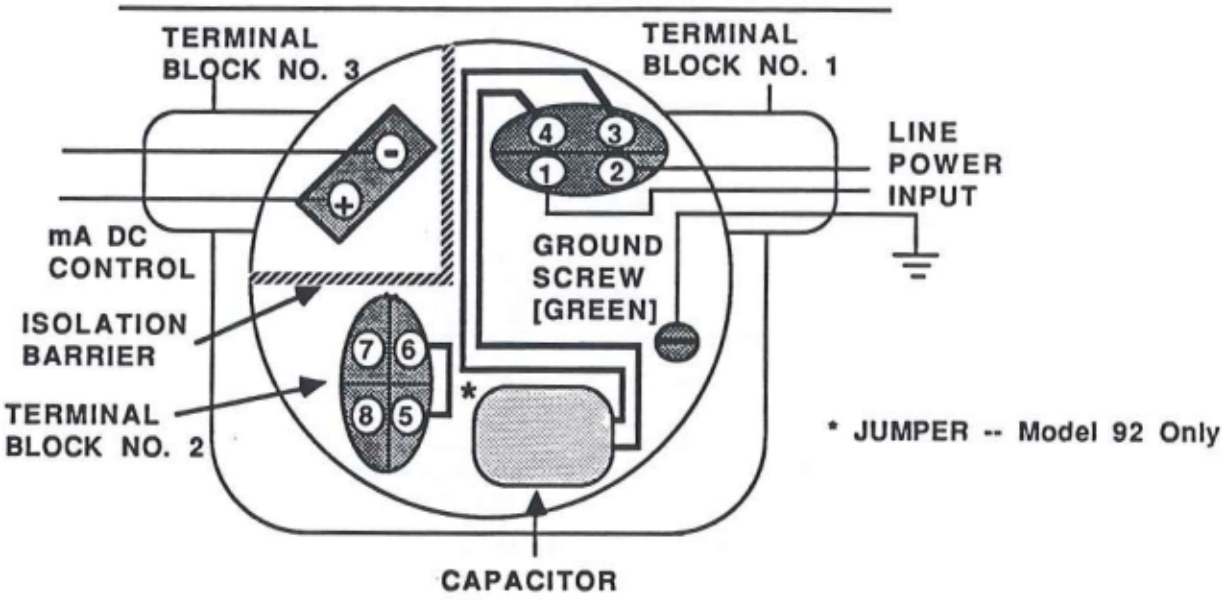


Figure 3-2. Wiring Diagram (External, Single Phase)

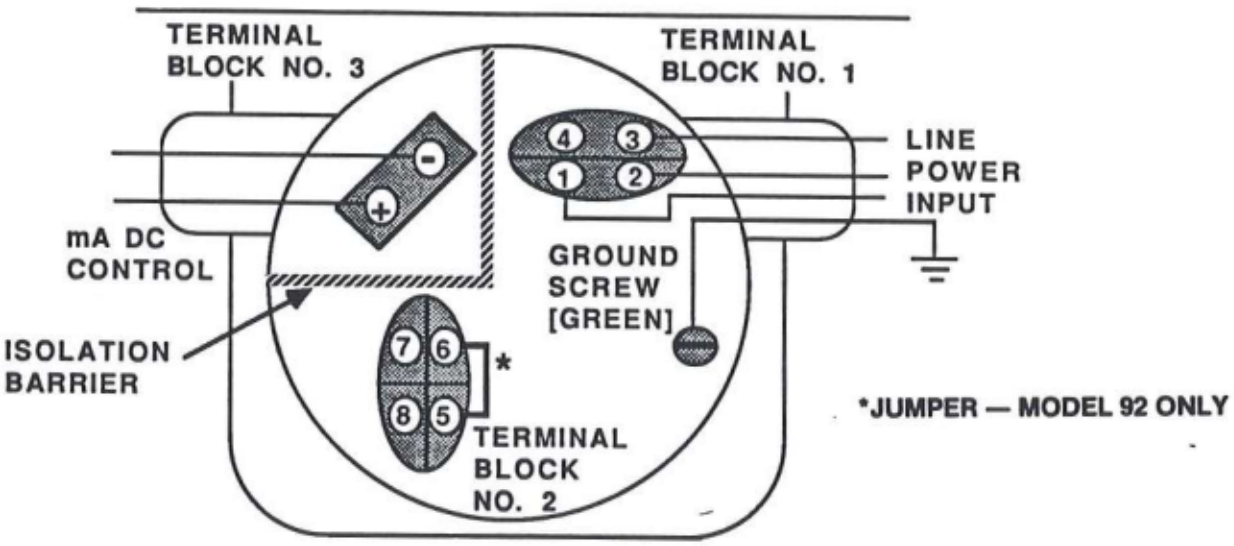


Figure 3-3. Wiring Diagram (External, Three Phase)

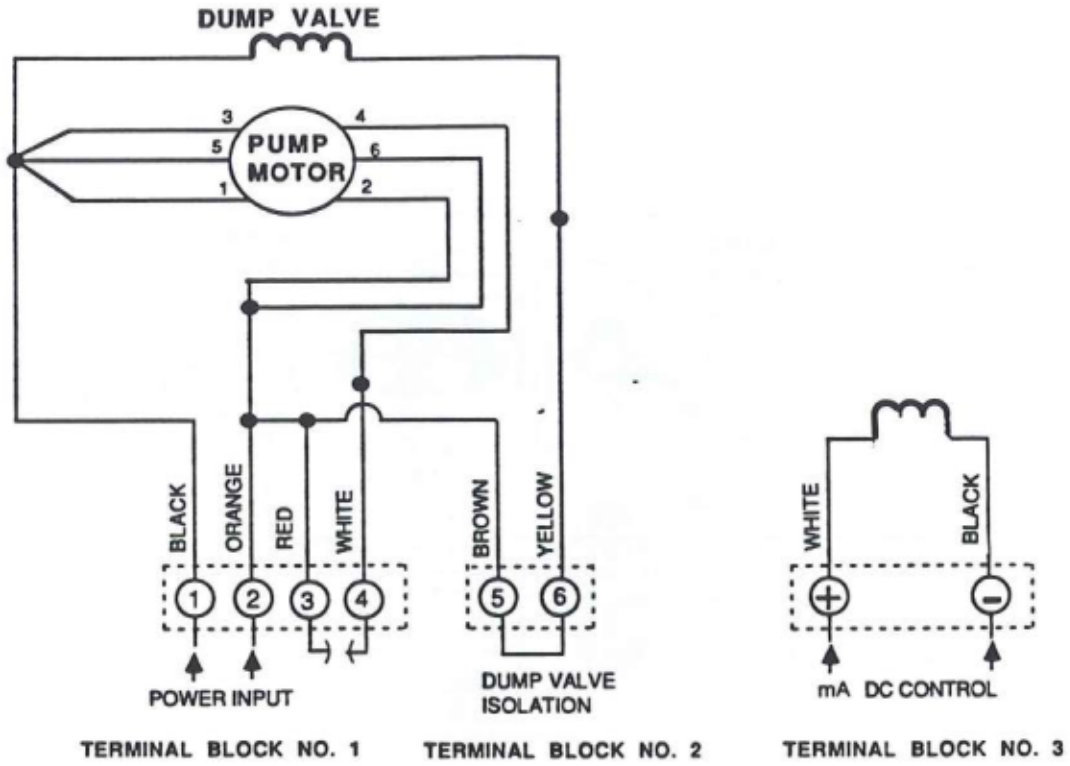


Figure 3-4A. Wiring Diagram (Internal, Single Phase) for Model AH92
120V/60Hz, 110V/50Hz

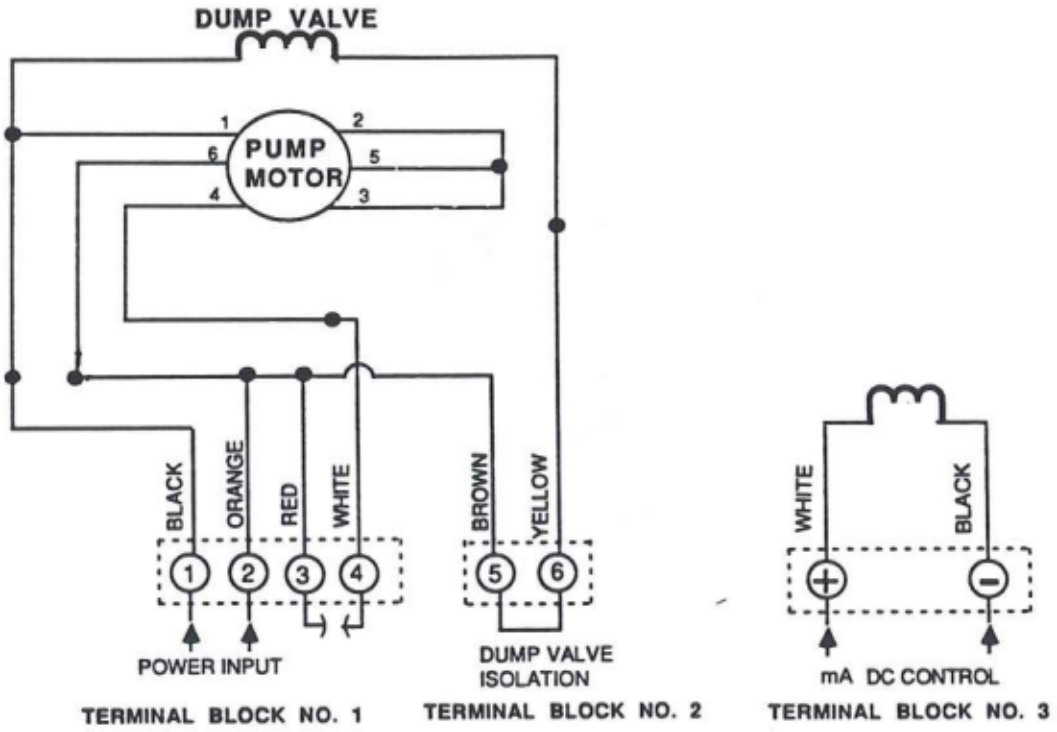


Figure 3-4B. Wiring Diagram (Internal, Single Phase) for Model AH92
220V/50Hz, 240V/50Hz, 240V/60Hz.

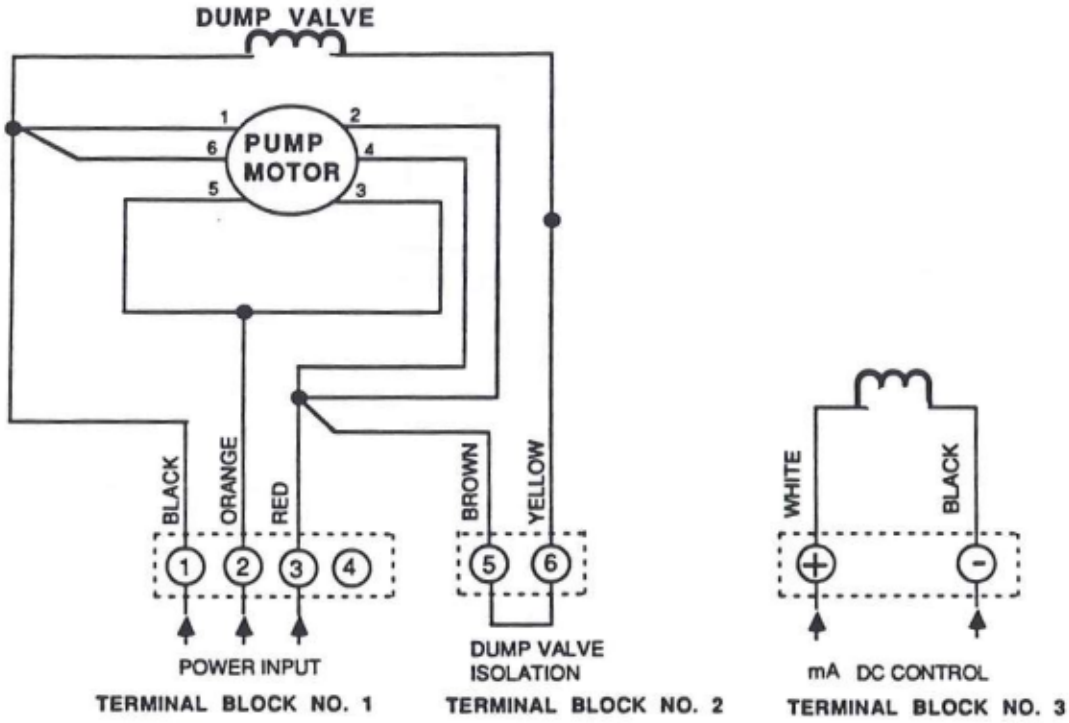


Figure 3-5A. Wiring Diagram (Internal, Three Phase) for Model AH92 240V/60Hz

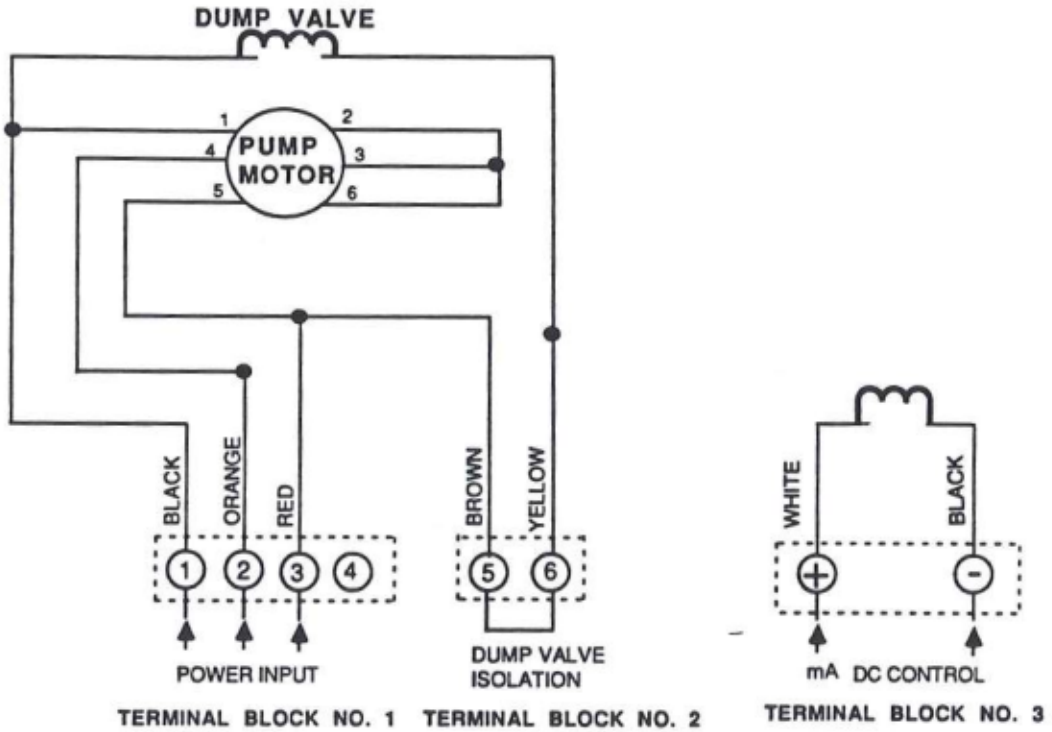


Figure 3-5B. Wiring Diagram (Internal, Three Phase) for Model AH92 380V/50Hz, 440V/50Hz, 460V/60Hz, 480V/60Hz

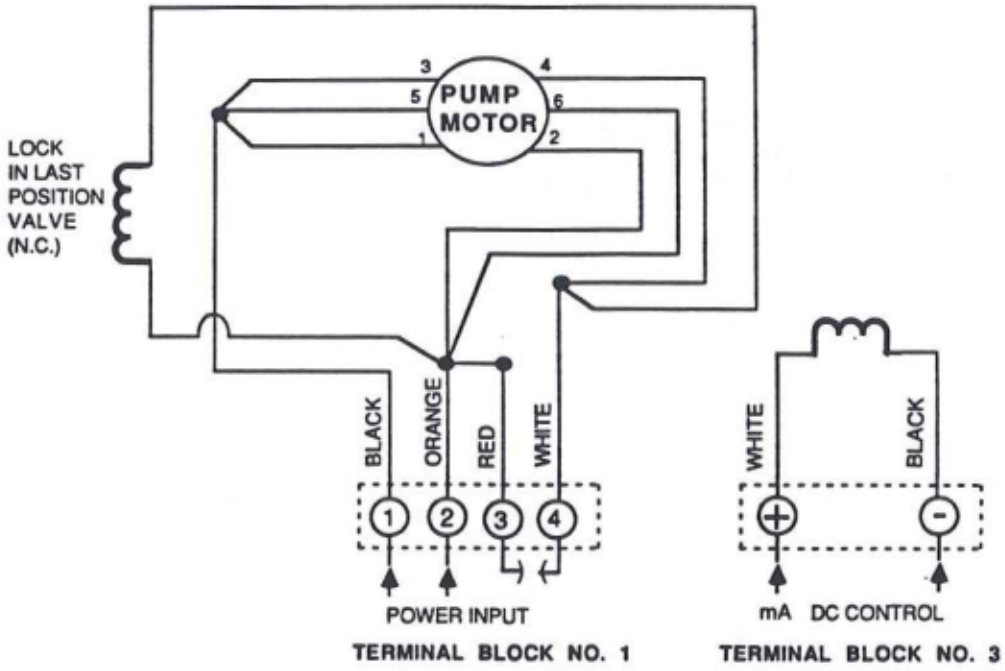


Figure 3-6A. Wiring Diagram (Internal, Single Phase) for Model AH94
120V/60Hz, 110V/50Hz

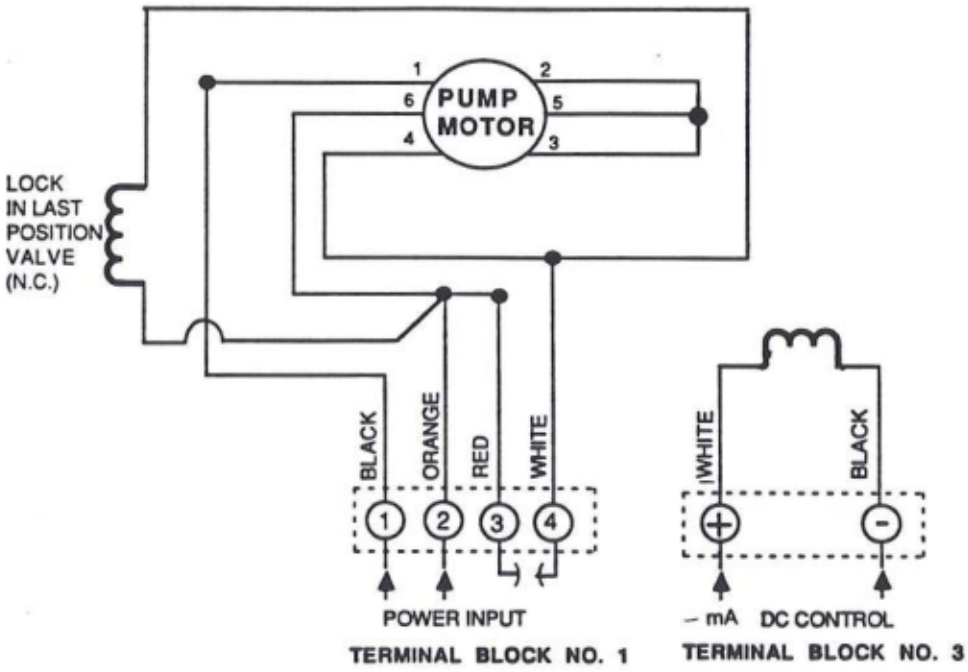


Figure 3-6B. Wiring Diagram (Internal, Single Phase) for Model AH94
220V/50Hz, 240V/50Hz, 240V/60Hz

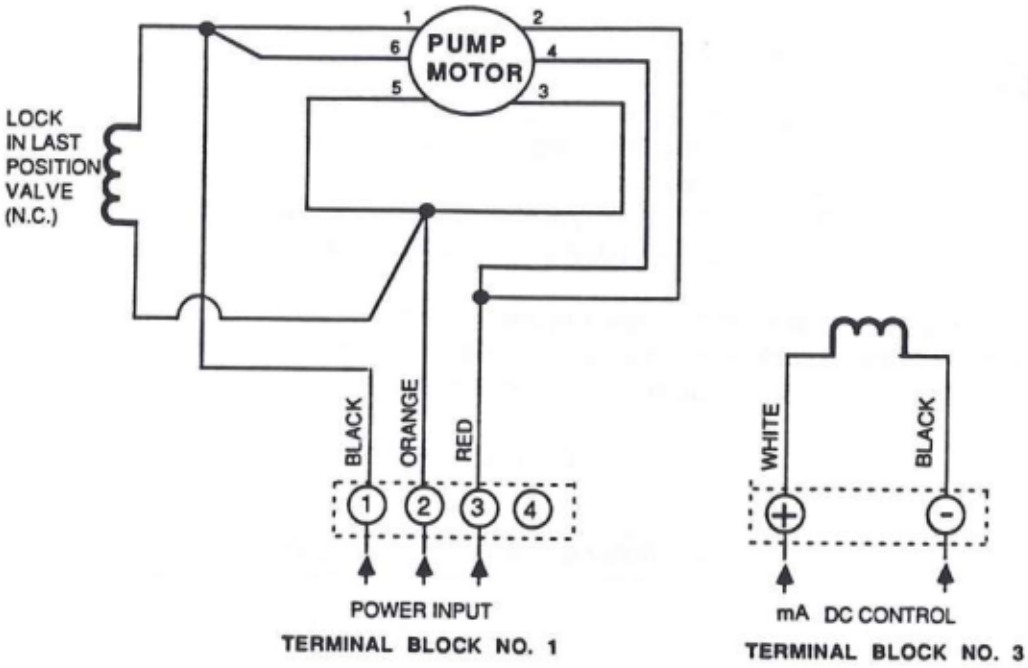


Figure 3-7A. Wiring Diagram (Internal, Three Phase) for Model AH94 240V/60Hz

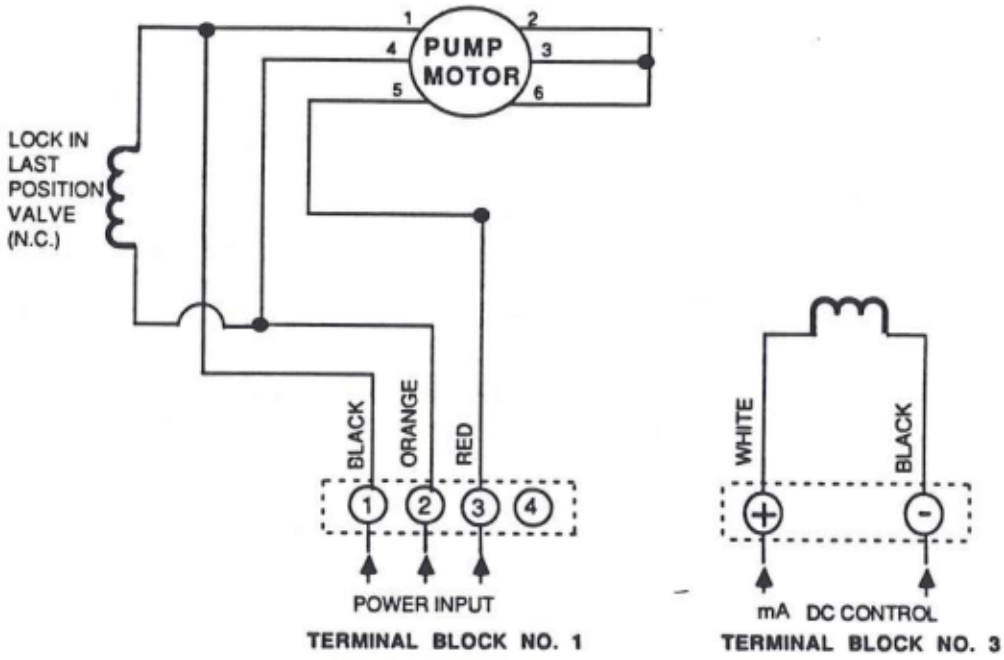


Figure 3-7B. Wiring Diagram (Internal, Three Phase) for Model AH94 380V/50Hz, 440V/50Hz, 460V/60Hz, 480V/60Hz

3.3 ADJUSTMENT AND CALIBRATION

3.3.1 Stroke Adjustment Limits

a). Both 1,500 lb. (680 kg.) and 3,000 lb. (1,360 kg.) Hydramotors may be adjusted up to a maximum of 3 1/2 inches (89mm) active stroke.

b). The 4,000 lb.(1,800 kg.) Hydramotors may be adjusted up to a maximum of 4-inches (102mm) active stroke.

3.3.2 50% Position Calibration (see Figures 3-8 and 3-9).

Before making adjustments, verify that the seventh digit of nameplate catalog number corresponds to the control signal range (Table 3-1).

Table 3-1. Control Signal Values

CATALOG NUMBER	CONTROL SIGNAL [mA DC]				
	CONTROL SIGNAL RANGE	MINIMUM POSITION	BOTTOMING POSITION	50% POSITION	MAXIMUM POSITION
AH9 - - - 0	4 - 20	4	3.8	12	20
AH9 - - - 1	10 - 50	10	9.5	30	50

* Modulating HYDRAMOTORS are not designed to respond to control signals below MINIMUM or above MAXIMUM.

1). Disconnect the shaft from the PCD stem (refer to 1.6.3 step 2). Remove the electrical and control plate covers (Cover Removal Tool P/N S109795Q, will facilitate this step).

2). Verify proper control signal input polarity. If polarity is not correct, terminal No. 3 wires may be reversed due to reversed coil. Temporarily reverse the mA control signal wires and disconnect the bias spring (Figure 3-8).

3). Adjust the mA control signal to the 50% position (Table 3-1). The top edge of the slot in arm assembly No. 2 and the bottom edge of arm assembly No. 1 should be visually parallel (Figure 3-9). If not, loosen the feedback spring lock screw, then turn the feedback spring adjustment screw clockwise or counterclockwise to accomplish a parallel condition. Tighten the feedback spring lock screw (Figure 3-8).

4). Return the control signal wires to their normal position.

5). Reconnect the bias spring and turn the bias spring adjustment screw until the unit reaches the previously adjusted 50% position (visually parallel). **Do not readjust the feedback spring at this time.**

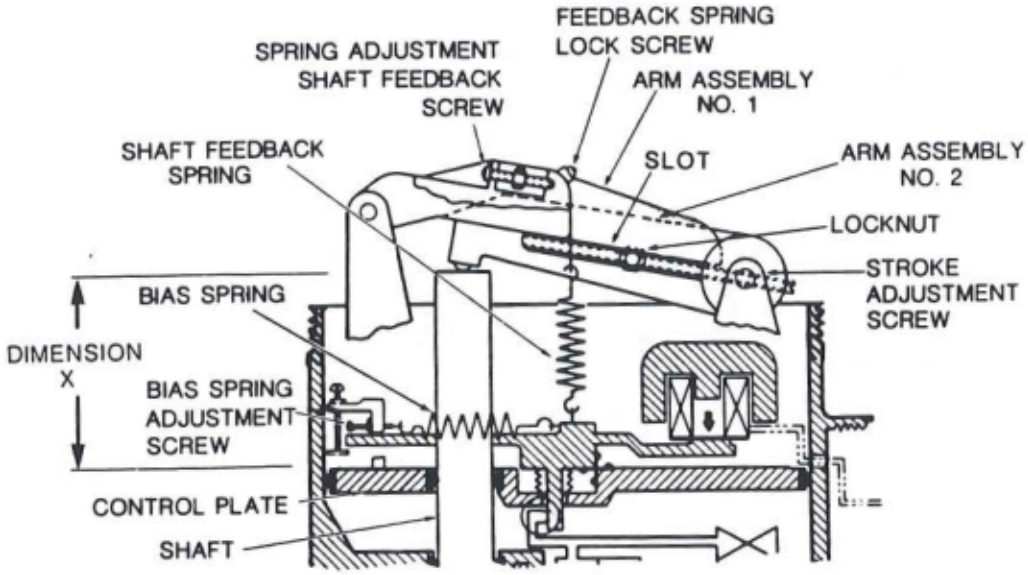


Figure 3-8. Stroke Adjustment for Push Type Models

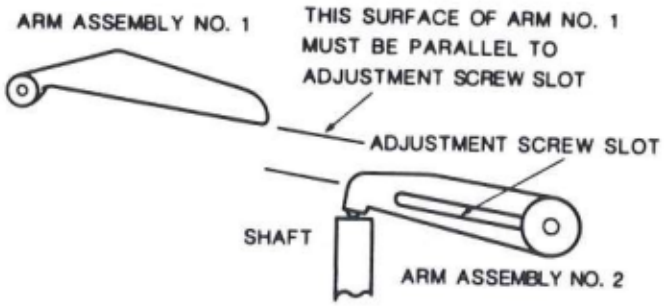


Figure 3-9. Determining Parallelism

3.3.3 Stroke Adjustment

1). Set the control signal to the 50% position (Table 3-1).
2). Carefully measure dimension X from the controller assembly plate to the top of the Hydramotor shaft. Use a 6-inch steel ruler (see Figure 3-9).
3). Determine the required PCD lift from the PCD manufacturer's documentation, or by careful measurement. (Lift is total usable stem travel from open to the closed position).

CAUTION

TO AVOID POTENTIALLY DAMAGING FORCE ON THE PCD, THE DIFFERENCE BETWEEN THE MAXIMUM AND REQUIRED STROKE (LIFT) SHOULD BE AT LEAST 1/16". THIS PREVENTS THE HYDRAMOTOR FROM PUSHING ON THE PCD WHEN IN THE FULLY OPEN POSITION.

4). Divide the PCD lift by 2, and add this value to dimension X (from Step 2).
5). Adjust the control signal to minimum (see Table 3-1).
6). Loosen the lock nut (located between the two arm) using a thin 1/2" open end wrench. Turn the adjustment screw clockwise or counterclockwise as necessary to cause the shaft to move to the value determined in Step 4. Tighten the lock nut. (see Figure 3-8)
7). Adjust the control signal to maximum (Table 3-1). Measure dimension X (see Figure 3-9), then subtract this value from the value determined in Step 4. The result should equal the PCD usable stroke. If not, repeat the above adjustment procedures.
8). Set the "OPEN" and "SHUT" position indicators (refer to exploded view in section 6 (Overhaul of Common Components).

3.3.4 Mechanical Travel Limit Adjustment (see Figure 3-10)

The mechanical safety travel limit stop nut prevents the application of excessive force on the spring return stroke.

1). Mount and wire the Hydramotor (per subsection 1.7 (MOUNTING AND INSTALLATION). Assure that all other stroke adjustments and calibrations have been performed as described in 3.3.2 and 3.3.3.
2). Energize the Hydramotor to extend the shaft. Check its travel to insure that the Hydramotor operates within the desired PCD travel.
3). If stroke adjustment is required, refer to 3.3.3.
4). With the Hydramotor energized and with minimum input signal, loosen the jam nut and adjust the stop nut. Holding the stop nut, tighten the jam nut against the stop nut . **The clearance between the stop nut and the bottom of the yoke web should be at least 1/16 inch.**

5). Operate the Hydramotor through its full travel a number of times to check operation. If proper travel is not maintained, readjust it by repeating Step 4.

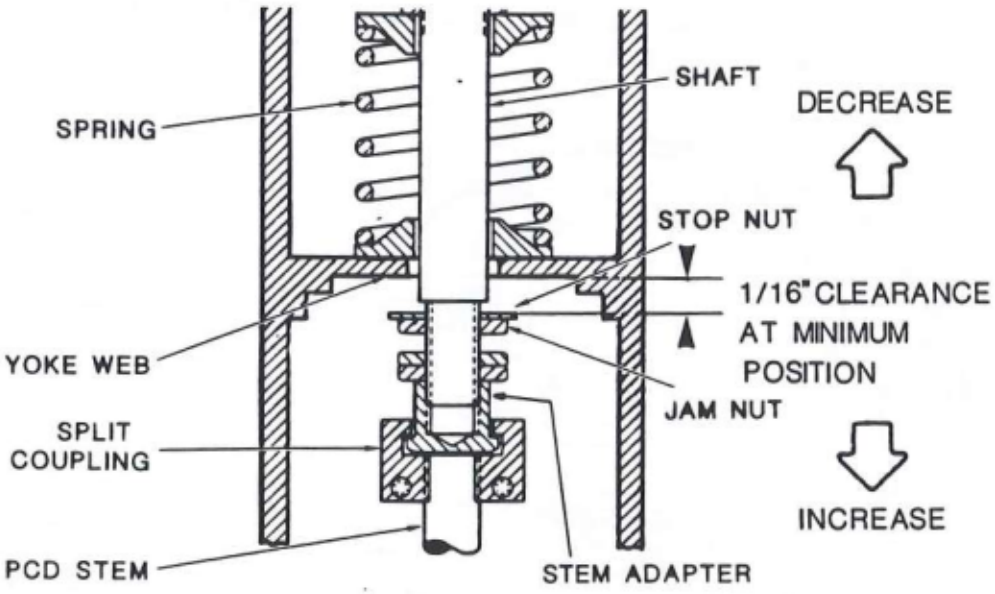


Figure 3-10. Mechanical Travel Limit Adjustment (Push Type)

3.3.5 Spring Return Timing Adjustment

CAUTION

TO PREVENT DAMAGE TO THE FORCE BALANCE MECHANISM, DO NOT OVER-TIGHTEN THE ADJUSTMENT SCREW (SEE FIGURE 3-11).

NOTE

Spring return speed is factory set at maximum. Resetting the return spring timing may affect low temperature operation.

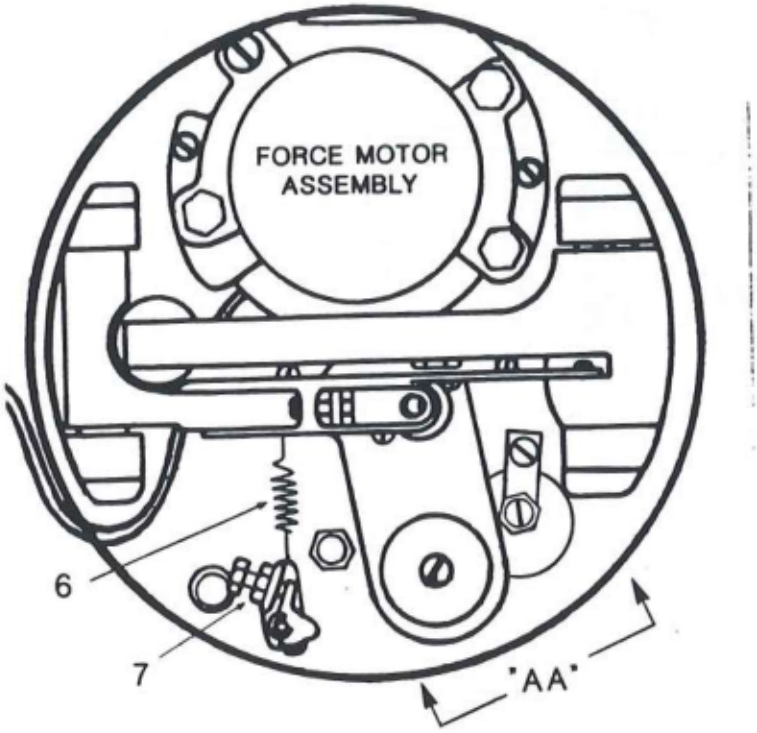
Spring return speed is adjustable on all variations as follows (see Figure 3-11):

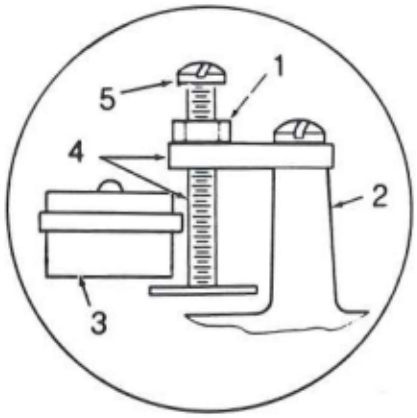
1). Power the Hydramotor for 30 minutes to bring it up to normal operating temperature.
2). Use a screwdriver to hold the spring return speed adjustment screw steady while loosening the lock nut.
3). Turn the adjustment screw clockwise to increase the speed of spring retraction or counterclockwise to reduce the speed of retraction.
4). Operate the Hydramotor and readjust it until the desired retraction speed is achieved.
5). Hold the adjustment screw in place and tighten its lock nut.

6). Operate the Hydramotor through full stoke several times to verify proper adjustment.

NOTE

This is an independent adjustment and will not affect the other calibrations.





SIDEVIEW "AA"

1. Lock nut
2. Control Plate Post
3. Balance Beam
4. Beam Stop Assembly
5. Spring Return Speed Adjustment Screw
6. Bias Spring
7. Bias Spring Adjustment

Figure 3-11. Spring Return Speed Adjustment for Push Type

3.4 TROUBLESHOOTING
These charts are intended to assist in isolating and correcting operating problems. Follow the arrows, perform each block-solution in sequence, and check the operation of the Hydramotor after each corrective stage.

3.4.1 Figures 3-11A, B and C are flowchart troubleshooting guide examples as follows:

A. The motor runs freely but the Hydramotor will not stroke with milliampere input control signal.

B. The Hydramotor will not stroke when the motor runs.

C. The motor does not run.

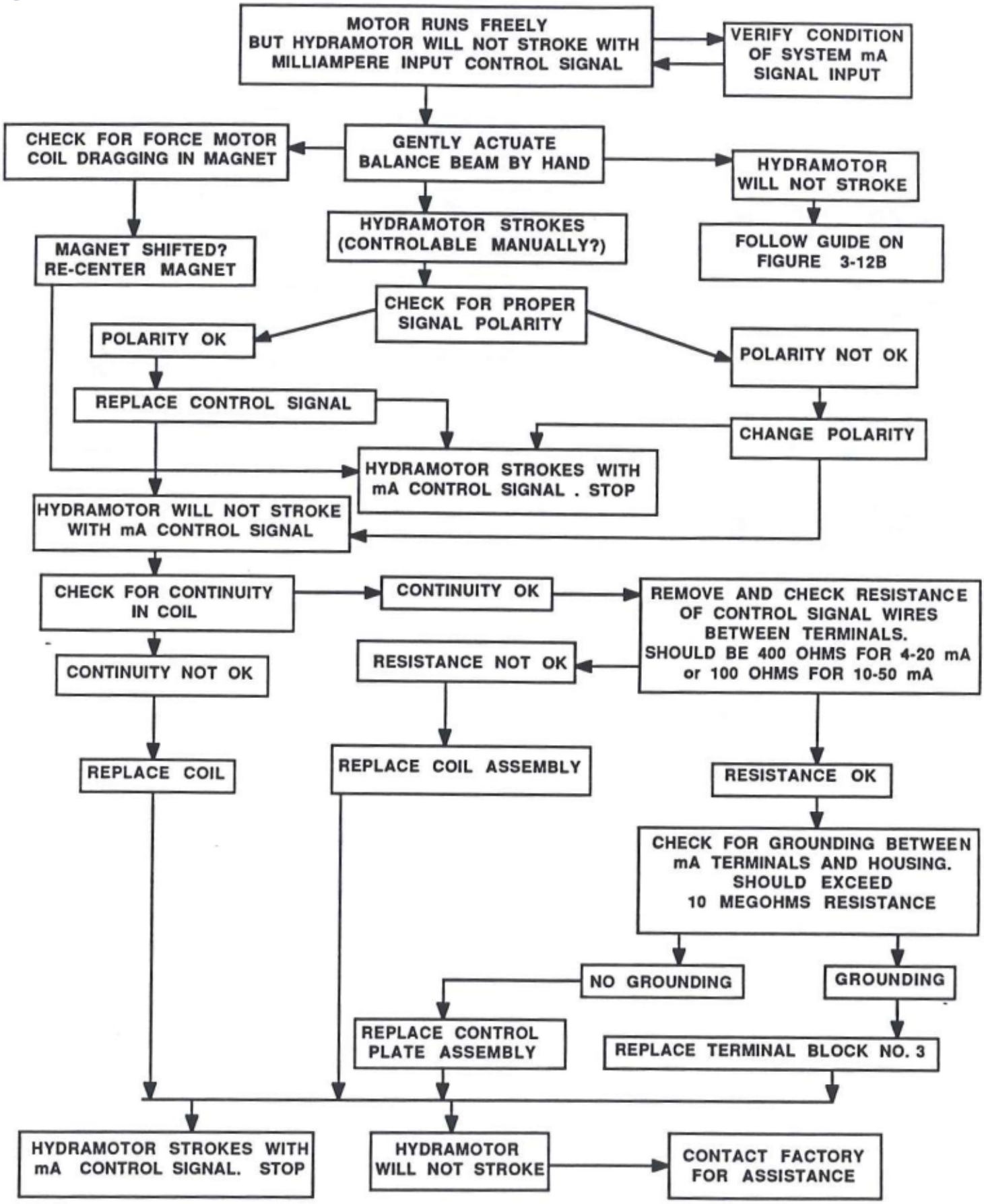


Figure 3-12A. Troubleshooting Guide. Modulating

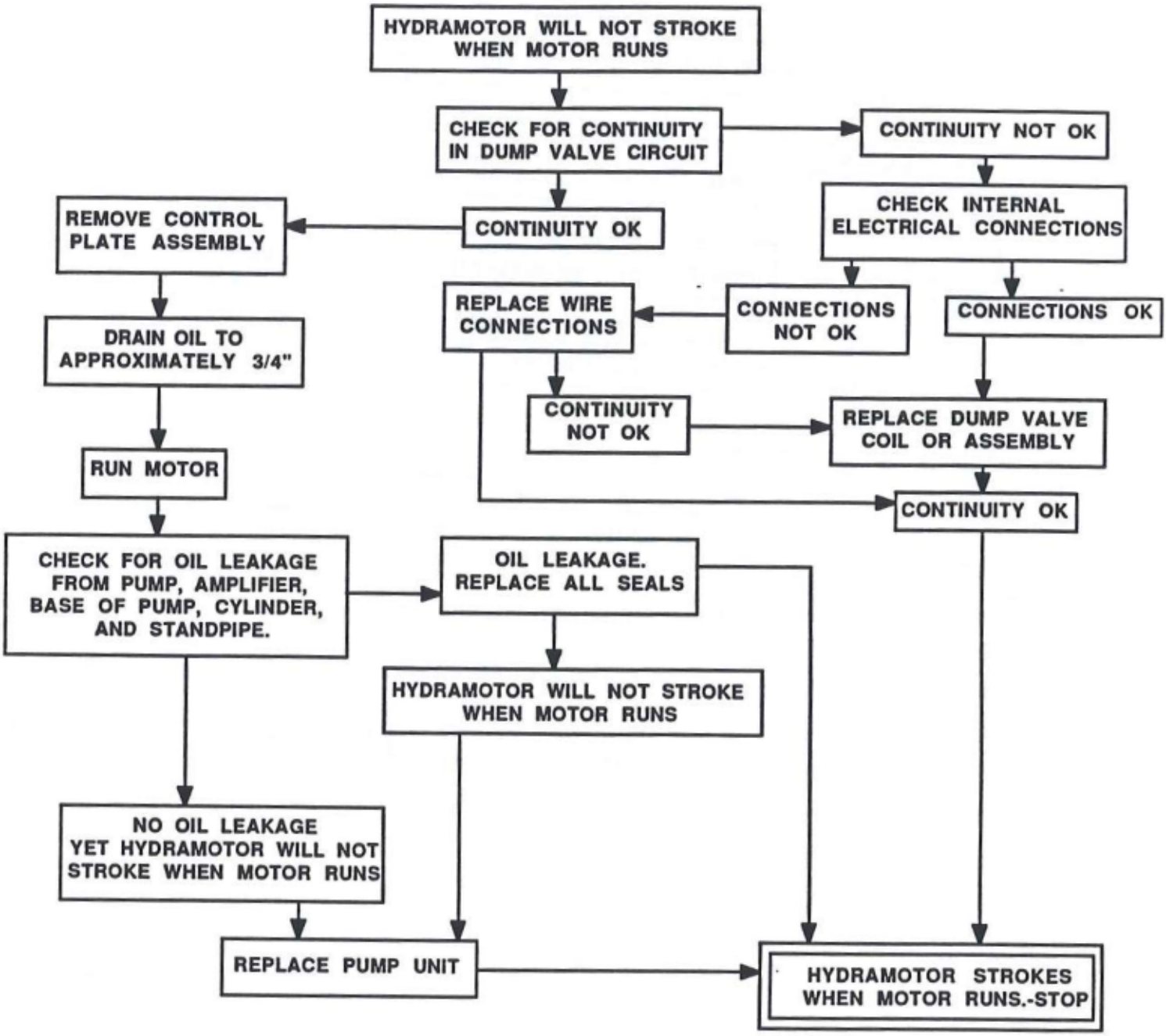


Figure 3-12B. Troubleshooting Guide. Motor Runs Properly

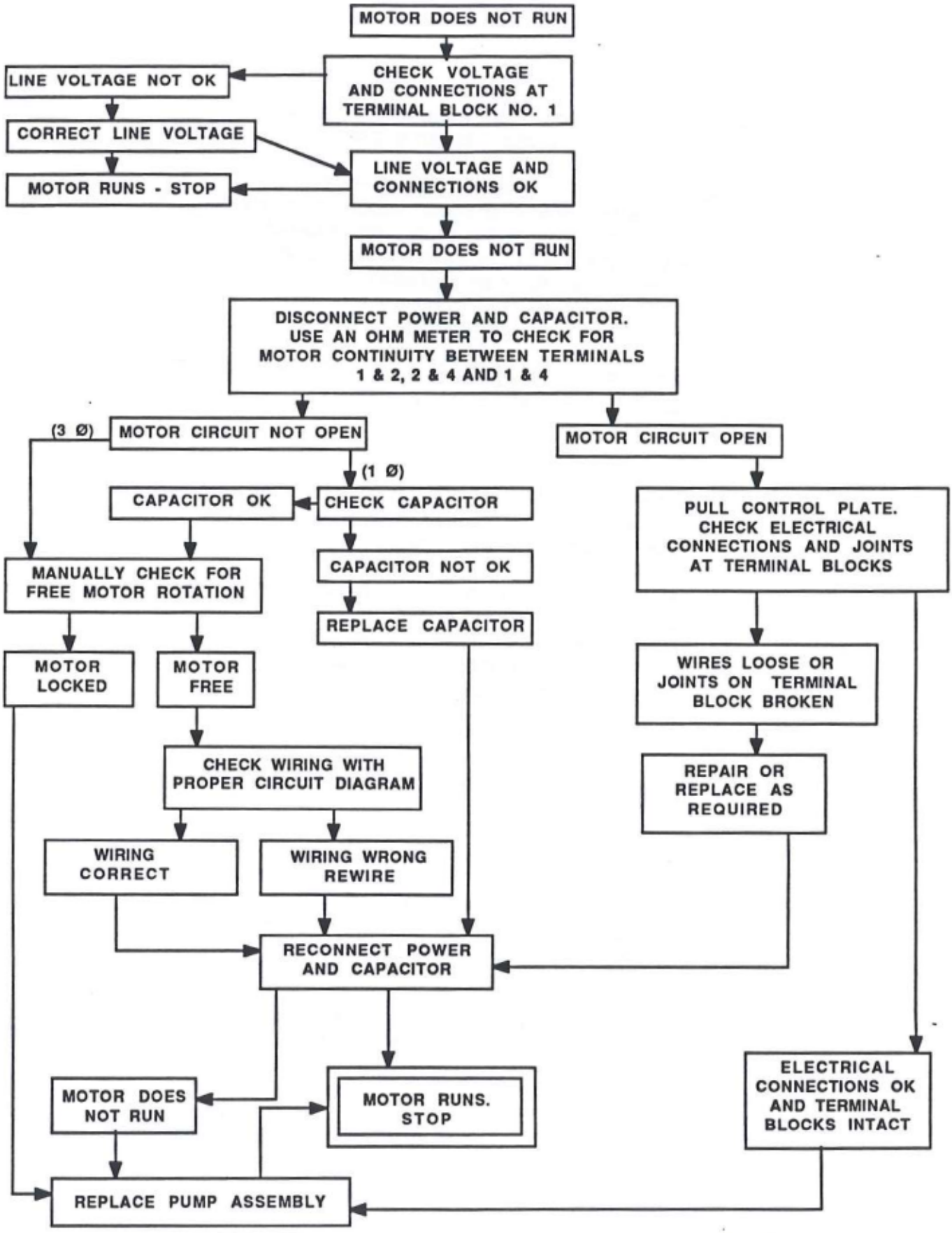


Figure 3-12C. Troubleshooting Guide. Motor Does Not Run Properly

3.5 OVERHAUL

3.5.1 Disassembly of the Hydramotor requires the following steps (see Figure 3-15 (at the end of this section) for an exploded view and legend):

A. Preparing the Hydramotor for Disassembly:

1). Turn off the electrical power supply to the Hydramotor.
2). Drain off the capacitor charge on single phase Hydramotors.
3). Return the shaft to its de-energized position. Disengage the manual override, if so equipped.

WARNING

THE ABOVE THREE STEPS MUST BE PERFORMED TO AVOID ELECTRICAL SHOCK/HYDRAULIC PRESSURE HAZARD.

4). Remove the Hydramotor from the PCD (per 1.6.1).
5). Move the Hydramotor to a clean work place for disassembly.
6). Assure availability of the proper tools per 1.7.2, section 8 and Table 1-2.
7). Remove the electrical and control covers, and remove and discard both O-rings.
8). Remove all slotted head screws from both sides of the yoke.
9). Remove the plastic dust covers (and metal stiffener plate if applicable) from the yoke.

B. Removing the Control Plate Assembly

1). Remove the two screws (635) securing the control signal Terminal Block No. 3 (633) to the housing (625).
2). Remove the nylon spacers (632).
3). Unsolder the black and white coil wires from the positive and negative terminals of Terminal Block No. 3 (633).
4). Unsolder the red, yellow and blue potentiometer wires, if so equipped.
5). Remove the rust-colored insulation ring (631).
6). Carefully pull the black and white coil wires and three potentiometer wires (if so equipped) up through the port under Terminal Block No. 3 (633) to the top of the control plate (606).
7). Remove the black coil wire sleeving from the housing pulling it down through the electrical compartment.
8). Remove the four hex head cap screws (605) from the control plate (606).
9). Remove the slotted head screw closest to the shaft from the coil centering ring (see Figure 3-13).

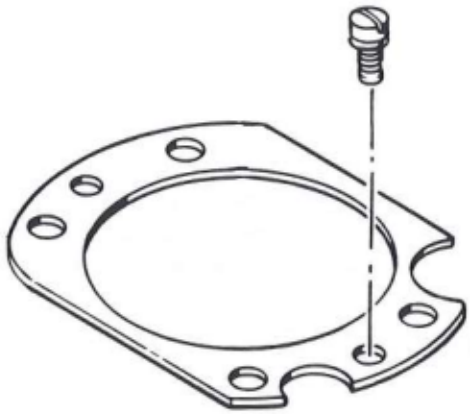


Figure 3-13. Coil Centering Ring

10). Mount theControl PlateRemoval Clamp (P/N S109795P) with the long end of the tool threaded into the centering ring hole and the shorter end threaded into the capped casting hole next to the spring return speed adjustment device.
11). Lift the control plate (606) straight up out of the housing. Discard the four small O-rings (3) and one large O-ring (2) in the housing below the control plate.

C. Removing the Pump

1). Remove the plug (203) and spring (204) from the top of the pump (201).
2). Remove the oil drain plug (619) on the rear of the housing (625) and drain the hydraulic oil into a 5 quart container.
3). After the oil has drained out, install the oil drain plug (619) and secure it finger tight. There will be oil remaining in the cylinder (501) and pump (201).
4). Remove the three hex nuts (607) and the three lock washers (608) that hold the pump (201) in place.
5). Place a blunt tool, such as a large screwdriver, between the cylinder cap (102) and the pump (201) . Carefully pry them apart to allow the pump wires to be pulled up above the pump. This will not require very much leverage. Wires will come up one at a time.
6). Wipe the oil off of the nylon connectors (205). These connectors must be removed before the pump can be lifted out of the housing.
7). Pull the connector off, do not cut the wires. **Locking pliers may be used to reverse the crimp by squeezing the connectors 90° from their original crimped position. Once the connector is removed, separate the wires.**
8). Loosen the two slotted head screws on the top of the pump (201) and install the Pump Removal Tool (P/N S109795-0).
9). Lift the pump (201) straight up and out of the housing (625).
10). Place an oil pan under the Work Table. Turn the Hydromotor upside down and set it in the Work Table. The remaining oil in the housing will drain out.

11). The small nipple (202) that connects the pump to the housing may come out with the pump or stay in the housing. In either case, the nipple must be removed and its O-rings (7) replaced.

D. Removing the Yoke and Spring Assembly

Refer to 6.4.1.

E. Removing the Shaft Assembly and Bushing

1). Remove the housing (625) from the Work Table and secure in the Power Module Work Stand (P/N S109795A).
2). Adjust the socket head screws.
3). Remove the alignment tool and set aside for use in reassembly. Remove the two 5/8" bolts (614) that hold the cylinder cap in place. Remove both the lock washers (615), and the two flat washers (616)
4). Rotate the Power Module Work Stand 90° and tap the threaded end of the shaft (507) with a rubber mallet to remove the shaft, piston assembly, cylinder cap and stand pipe (617)).
5). Remove the bushing lock screw (624) if so equipped (no screw is used on 4,000 lb.(1,800 kg.) Hydramotors).
6). Install the Bushing Socket tool (P/N S109795D for 1,500 lb. (680 kg.) Hydramotors, or P/N S109795L for 3,000 lb. (1,360 kg.) or 4,000 lb.(1,800 kg.) Hydramotors) and unscrew the bushing (101) from the bottom of the housing (625).

F. Final Housing Disassembly

1). Single Phase Only: Remove screws that secure the capacitor wires to Terminal Block No. 1 (see Figure 3-2). Remove and replace the capacitor (641) if bad. Replace the screws in the terminal block.
2). Remove the four screws (635) that secure Terminal Blocks No. 1 (630) and No. 2 (634) to the housing (625). Remove the terminal blocks, complete with their O-rings (16) and spacers (628).
3). Remove the housing (625) from the Power Module Work Stand. Remove the oil drain plug and the oil fill plug (619) from the rear of the housing.
4). Separate the cylinder (501) from the cap (102), remove the shaft (507) and piston assembly from the cylinder and remove the stand pipe (617).
5). The housing, yoke, springs, cylinder, stand pipe and cylinder cap are now ready for cleaning and inspection.

6). Refer to section 6 (OVERHAUL OF COMON COMPONENTS) for instructions on disassembly of the piston and removal of the seals from the bushing.

G. Removing Seals from the Control Plate

1). Invert the control plate (606) so its bottom faces up.
2). Remove the two slotted head screws and two brass washers that hold the shaft seal bushing to the control plate (see Figure 3-14).
3). Remove the bushing and discard its two O-rings.
4). Thoroughly clean the control plate by solvent de-greasing or similar method.

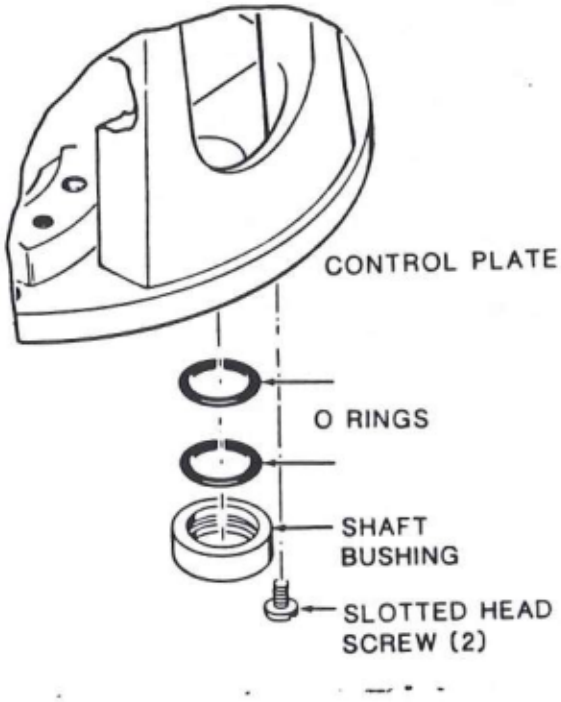


Figure 3-14. Upper Shaft Seals

3.5.2 Assembly of Hydramotors

This procedure is to be followed after all Hydramotor components have been cleaned and inspected. All parts must be free from dirt, impurities, and excessive wear (replace parts as necessary).

CAUTION

THE PRINCIPLE CAUSE OF HYDRAULIC FLUID BYPASS PROBLEMS IS IMPROPER SEALING DUE TO O-RING AND SEAL DAMAGE IN REASSEMBLY. INSPECT AND INSTALL O-RINGS AND SEALS CAREFULLY, ENSURING THAT THEY ARE NOT CUT, ROLLED, ABRAIDED, OR DISLODGED DURING ASSEMBLY PROCEDURES. PRIOR TO REASSEMBLY, LUBRICATE THE O-RINGS THOROUGHLY WITH PETROLEUM JELLY.

A. Preparing the Housing for Assembly

1). Replace the O-rings (4) on the oil fill plug and oil drain plug (619) and assemble in the rear of the housing (625).
2). Place the housing (625) in the Power Module Work Stand (P/N S109795A) and secure.
3). Assemble the bushing per subsection 6.1 (BUSHING AND CYLINDER CAP).
4). Lubricate three lower O-rings (9) with white petroleum jelly and install the bushing (101) into the bottom of the housing (625) with the Bushing Socket Tool (P/N 109795D for 1,500 lb. (680 kg.) Hydramotors and P/N S109795L for 3,000 lb. (1,360 kg.)and 4,000 lb. (1,800 kg.) Hydramotors). Once the Bushing Socket Tool touches the housing, the bushing is tight. Turn the tool 1/4 turn ccw.
5). Install the bushing lock screw (624) if required. (No screw is required on 4,000 lb. (1,800 kg..) Hydramotors).
6). Lubricate the two terminal block O-rings (16) with petroleum jelly and install on Terminal Blocks No. 1 (630) and No. 2 (634). Fit spacers (628) onto the Terminal Blocks and secure them in the housing (625).
7). Reconnect the capacitor to Terminal Block No. 1.

B. Shaft Assembly

1). Rotate the housing to the upright position.
2). Perform the assembly procedures described in subsection 6.2 (SHAFT AND PISTON ASSEMBLY).
3). Lubricate both the seal (12) and its O-ring (13) in the cylinder cap (102) and install it into the cylinder (501).
4). Replace the two O-rings (7) on the stand pipe (617) and insert the assembly into the cylinder cap (102). (The **short machined end** of the stand pipe goes into the cylinder cap.)
5). Lubricate the tapered end of the shaft (507) with white petroleum jelly and insert it into the bushing (101) . Carefully line up the stand pipe (617) with the hole in the bottom of the housing as the cylinder goes over the bushing.

6). Install the cylinder cap with two 5/8" hex bolts (614), two flat washers (616) and two lock washers (615) and secure finger tight.

C. Yoke and Spring Assembly

Refer to 6.4.3.

D. Pump/Motor Installation

1). Remove the housing and yoke from the Work Table. Stand the yoke on a table or floor.
2). Install new O-rings (7) on the small nipple (202), lubricate with white petroleum jelly and install the nipple assembly into the bottom of the housing. Use care not to bind or cut the O-Rings.
3). Attach the Pump Removal Tool (P/N S109795O) to the pump (201). Carefully set the pump into the housing. Do not rest the pump on the nipple in the bottom of the housing. Place a small screwdriver in one of the rear stud holes to prevent the pump from seating fully, and to allow room for inserting the wiring assembly.
4). Remove the two cylinder cap bolts to facilitate wire assembling.
5). Refer to subsection 3.2 (WIRING DIAGRAMS) for the appropriate wiring combinations.
6). Place clean padding (rag or towelling) over the pump to prevent any loose wire strands from entering the top of the pump.
7). Connect the wiring by twisting the wire strands together. Use "duck bill" (flat nose) pliers to smooth out the wire twist. Insert into the proper nylon connector (205). Crimp with a crimping tool such as Hollingsworth H-18.
8). After wiring is complete, carefully tuck all wiring down between the cylinder (501) and pump (201). Remove the protective padding.
9). Remove the screwdriver and gently lower the pump (201) onto the nipple (202). Do not drop or force the pump down on the nipple. The pump will settle down on the nipple with very little force.
10) Install and tighten the two cylinder cap bolts.
11). Remove the pump removal tool and tighten the two screws on the pump.
12). Install three lock washers (608) and hex nuts (607) onto the pump stud bolts (609). **Torque these nuts to approximately 24 in.-lb. (+0%--10%).**
13). Carefully fill the housing to the level of the fill port with oil (approximately 3 1/2 quarts). Do not allow the oil to enter the large O-ring groove or the four 1/4" threaded holes used to hold down the control plate. As the pump takes in oil, the proper oil level will be maintained.
14). Replace the O-rings (5, 6) on the plug (203). Install the spring (204) and small plug (203) in the proper port on the top of the pump (201).

E. Control Plate Assembly

1). Insert a new O-ring (16) and shaft seal (17) into the seal retainer (610) and replace it into the bottom of the control plate (606).
2). Place the four small O-rings (3) over the 1/4" bolt holes in the housing (625).
3). Lubricate the large O-ring with white petroleum jelly.
4). Carefully install the large control plate O-ring (2) in the groove at the top of the housing. **Do not get oil on this large O-ring or the four small O-rings (giving the appearance of a leak).**
5). Install the control plate (606) and secure it with four 1/4" hex head screws (605).
6). Remove the Control Plate Removal Clamp (P/N 109795P) and replace the screw in the centering ring (see Figure 3-13).
7). Insert a small wire up from the electrical compartment through the small force motor coil wire hole at Terminal Block No. 3 (633). Form a small hook on the end of the wire, then pull the black and white control wires down through the hole. Before disconnecting the hook, slip the black sleeving* over the wires and push it up into the housing. Disconnect the hooked wire.

* Black sleeving is not required for Hydramotors equipped with a feedback potentiometer option. Feed two control wires and three potentiometer wires down through the force motor coil wire hole at Terminal Block No. 3 (633).

F). Completing the Assembly

1). Replace the rust-colored insulation ring (631).
2). Solder the black and white coil wires to Terminal Block No. 3 (633). Refer to Figures 3-2 through 3-7 as applicable.
3). Install the two nylon spacers (632) and secure Terminal Block No. 3 (630) and isolating barrier (636) to the housing (625) with two screws (635).
4). Hook up all capacitor wires.
5). Apply power to the Hydramotor and let its motor run until the oil gets warm (approximately 20 minutes). Apply a control signal and check for proper operation. Check for oil leaks at the control plate and shaft extension (613).
6). Install the metal stiffener plate and/or plastic dust covers onto the yoke with mounting screws.
7). The Hydramotor is now ready for adjustment and calibration. (see subjection 3.3 (ADJUSTMENT AND CALIBRATION).
8). Replace the large O-ring (1) on the top of the housing, apply anti-seizing lubricant to the threads, and install control cover (601).
9). Replace the O-ring (2) on the electrical cover (603), apply anti-seizing lubricant to the threads, and screw in the electrical cover (603).

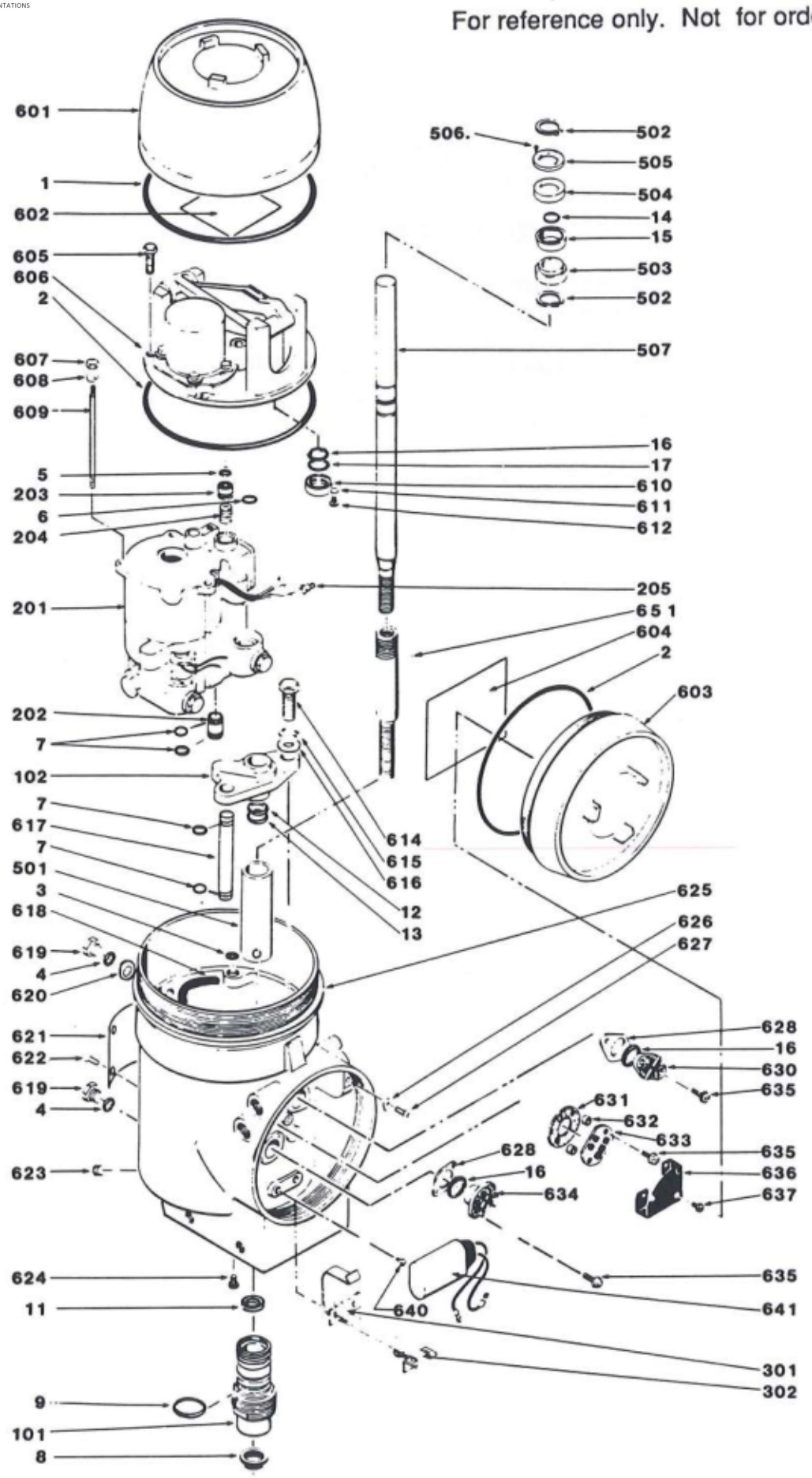


Figure 3-15. Exploded View

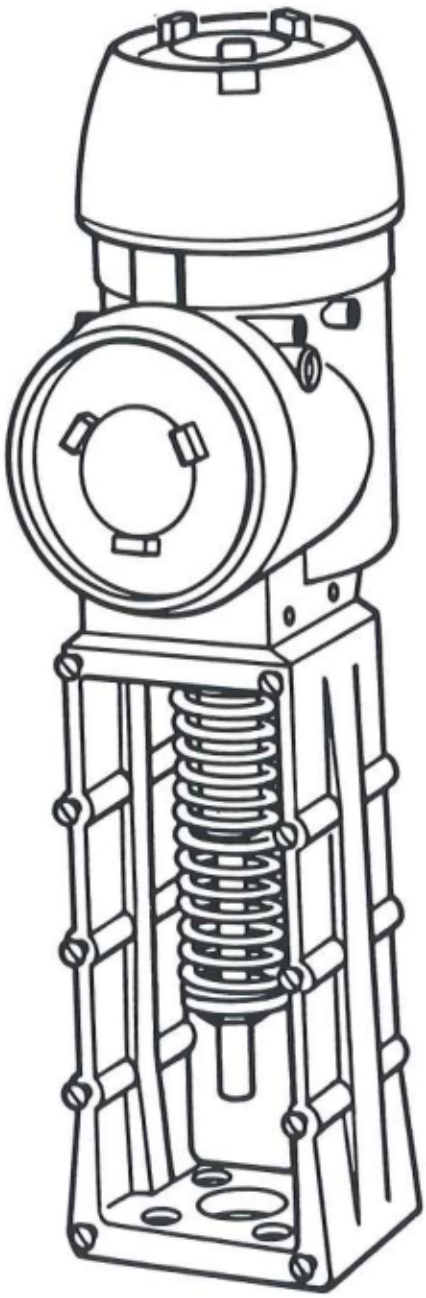
Legend for Figure 3-15
Exploded View

Item No.	Description	No. Required
1	O-ring, Control Cover	1
2	O-ring, Control Plate and Electrical Cover	2
3	O-ring, Control Plate Mounting Bolts	4
4	O- ring, Drain and Fill Plugs	2
5	O-ring, Pump Spring	1
6	O-ring, Pump	1
7	O-ring, Pump Nipple	2
8	Wiper ring	1
9	O-ring, Bushing	4
11	Seal, Hydraulic	1
12	Seal	1
13	O-ring	1
14	O-ring	1
15	Seal	1
16	O-ring, Seal Retainer, Terminal Blocks	3
17	O-ring, Seal Retainer	1
101	Bushing	1
102	Cylinder Cap	1
201	Pump	1
202	Nipple	1
203	Plug	1
204	Spring	1
205	Nylon Connector	5
301	Capacitor Plate	1
302	Capacitor Strap	1
501	Cylinder	1
502	Split Retaining Ring	2
503	Piston	1
504	Spacer (1,500 lb. (680 kg.) Hydra. only)	1
505	Retainer	1
506	Set Screw	3
507	Shaft	1
601	Control Cover	1
602	Wiring Diagram	1
603	Electrical Cover	1
604	Wiring Diagram	1
605	Hex Head Screw	4
606	Control Plate	1
607	Hex Nut	3
608	Lock washer	3
609	Double Ended Stud	3
610	Seal Retainer	1

Legend for Figure 3-15
Exploded View (Continued)

Item No.	Description	No. Required
611	Flat washer	2
612	Slot Head Screw	2
614	Bolts	2
615	Lock washer	2
616	Flat washer	2
617	Stand Pipe	1
618	Coil Wire Sleeve	1
619	Oil Fill Plug and Oil Drain Plug	2
620	Plate, Caution	1
621	Nameplate	1
622	Screws, Nameplate	4
623	Plug	1
624	Lock Screw, Bushing	1
625	Housing	1
626	Washer	1
627	Screw	1
628	Spacers, Terminal Blocks	2
630	Terminal Block No. 1	1
631	Insulation Ring	1
632	Nylon Spacer	2
633	Terminal Block No. 3	1
634	Terminal Block No. 2	1
635	Screws	6
636	Isolating Barrier (Insulating)	1
637	Screws	3
640	Screws, Capacitor Clamp	2
641	Capacitor (Single Phase Only)	1
642	Shaft Extension	1

AH95 / AH97/ AH98 HYDRAMOTORS
MODELS B AND B-1



4. AH95, AH97 AND AH98 (PULL-TYPE) HYDRAMOTORS

4.1 PRINCIPLE OF OPERATION

AH95, AH97 and AH98 Hydramotors are electrohydraulic, pull-type linear Hydramotors, for ON-OFF (two position) applications. Upon power interruption, the AH95 Hydramotor shaft is extended to its de-energized position by a yoke mounted, fail-safe spring return, while the AH97 and AH98 Hydramotors lock and hold in their last signalled position (see Figure 4-1 A and B).

4.1.1 Model AH95

When the Hydramotor's power terminals are energized, a dump valve closes. The pump applies hydraulic pressure to the piston, retracting the shaft.

When the shaft reaches a preset travel, the limit switch will open the pump motor circuit. The dump valve remains closed, holding the shaft in its fully retracted (energized) position until the circuit is broken.

4.1.2 Models AH97 and AH98

The AH97 and the AH98 use an independent two-wire signal to control the **normally closed** dump valve. A DC dump valve control signal is employed in the AH97, while an AC signal is used in the AH98. When electrical power is applied to Terminal Block No. 1, the pump applies hydraulic pressure to the piston assembly, retracting the shaft . When the shaft reaches its full travel, the adjustable limit switch opens the pump motor circuit to stop the pump.

The shaft will maintain its energized position, even if power is interrupted (e.g. power failure), until a control signal is applied to the independent dump valve circuit (Terminal Block No. 2), allowing the return spring to extend the shaft to its de-energized position.

4.1.3 Recycling

Recycle is a characteristic of two-position pull-type Hydramotors,whereby the pump will restart intermittently for a very brief period of time (typically less than 0.5 seconds) in order to maintain the shaft in its energized position.

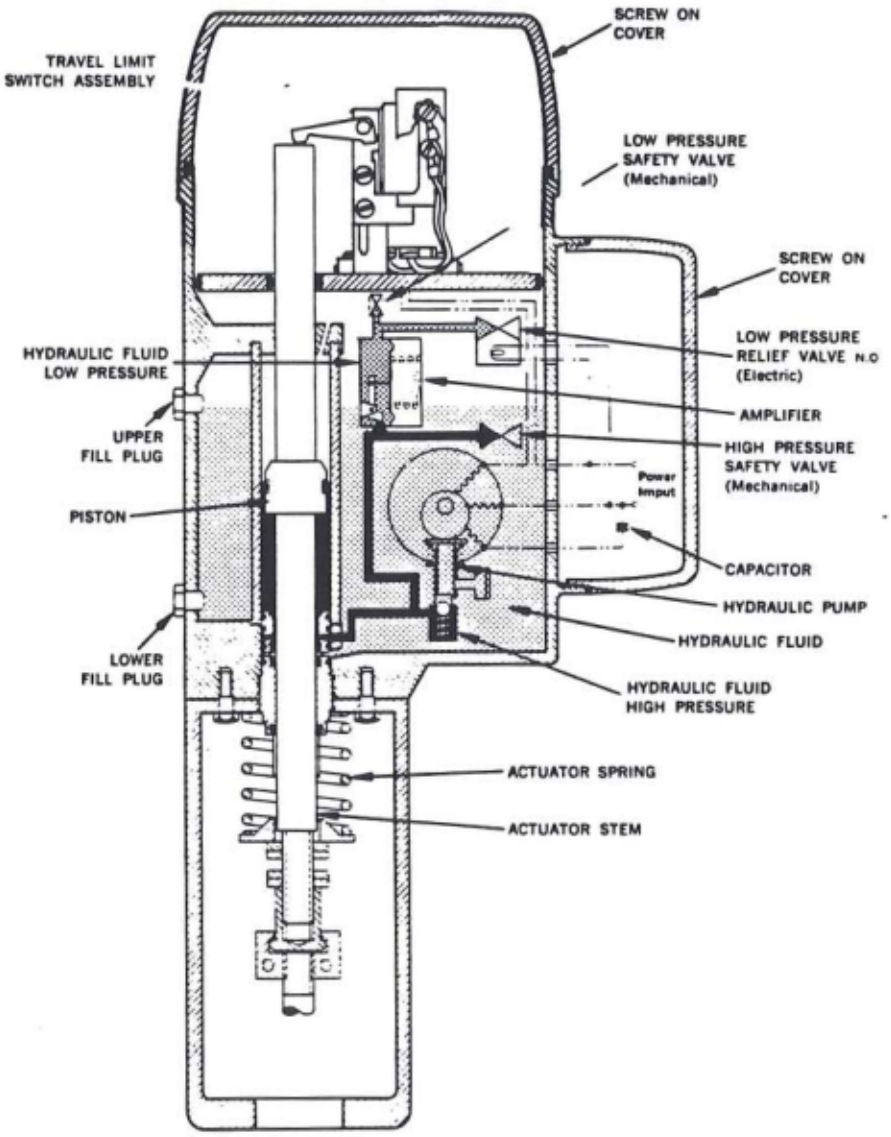


Figure 4-1 A. Hydramotor Assembly Model B

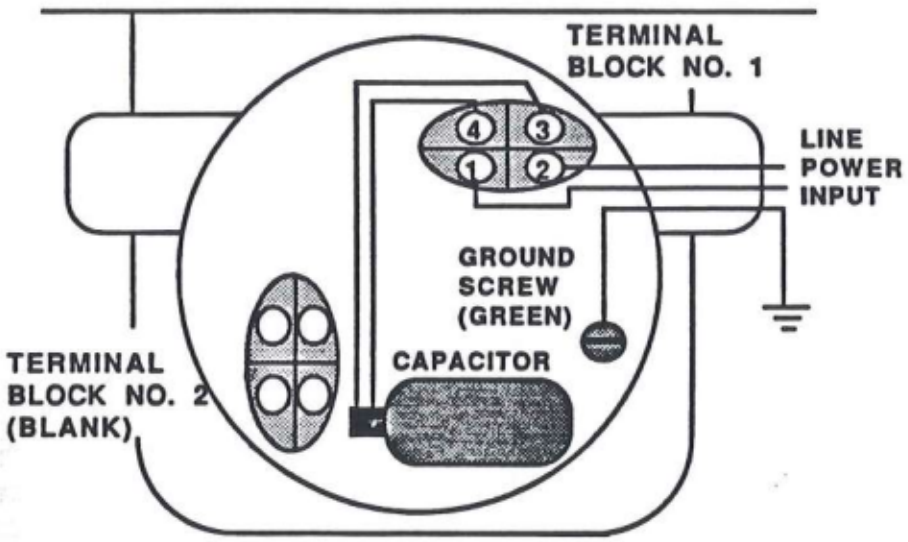


Figure 4-2. Wiring Diagram (External, Single Phase) for Model AH95

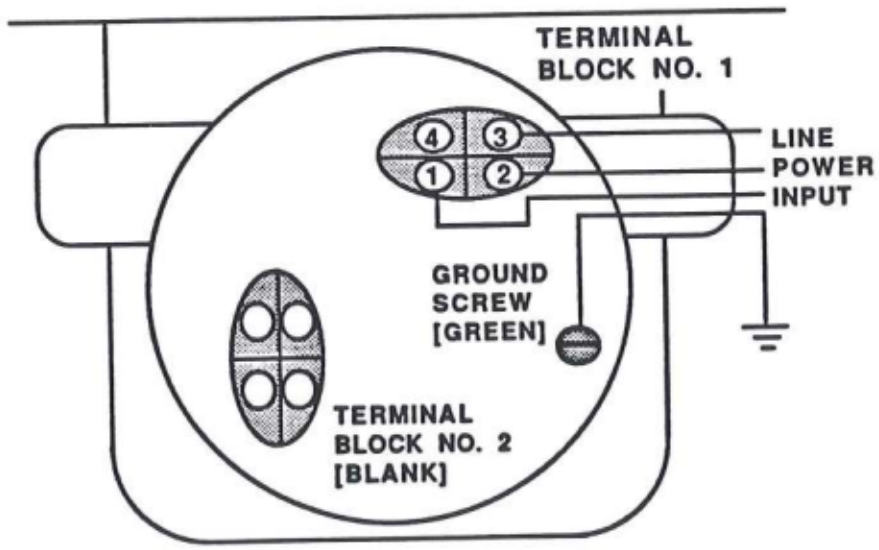


Figure 4-3. Wiring Diagram (External, Three Phase) for Model AH95

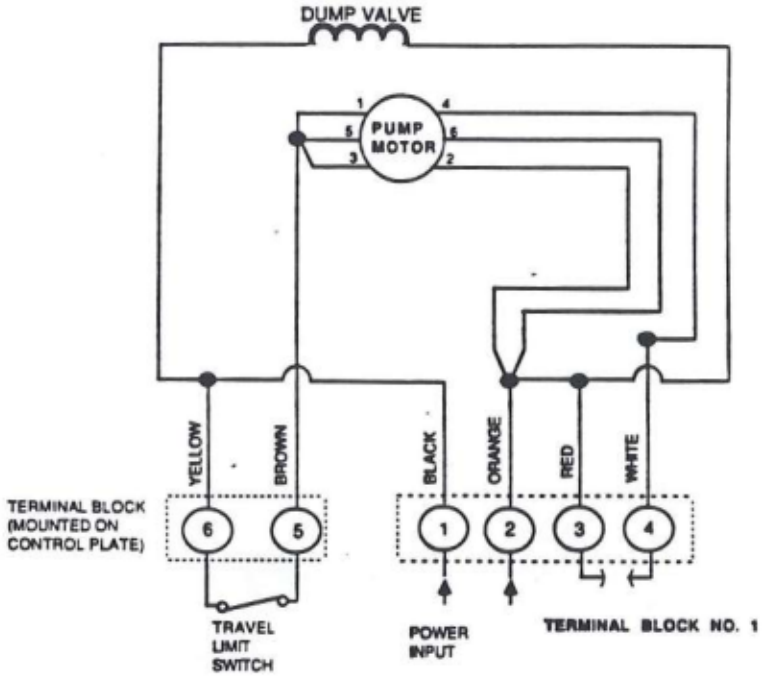


Figure 4-4A. Wiring Diagram (Internal, Single Phase) for Model AH95
120V/60Hz, 110V/50Hz

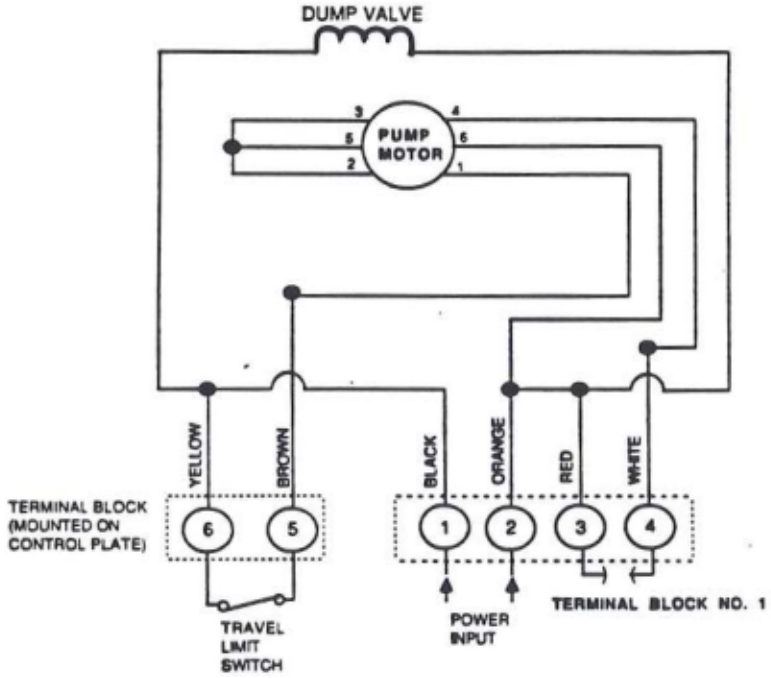


Figure 4-4B. Wiring Diagram (Internal, Single Phase) for Model AH95
220V/50Hz, 240V/50Hz, 240V/60Hz

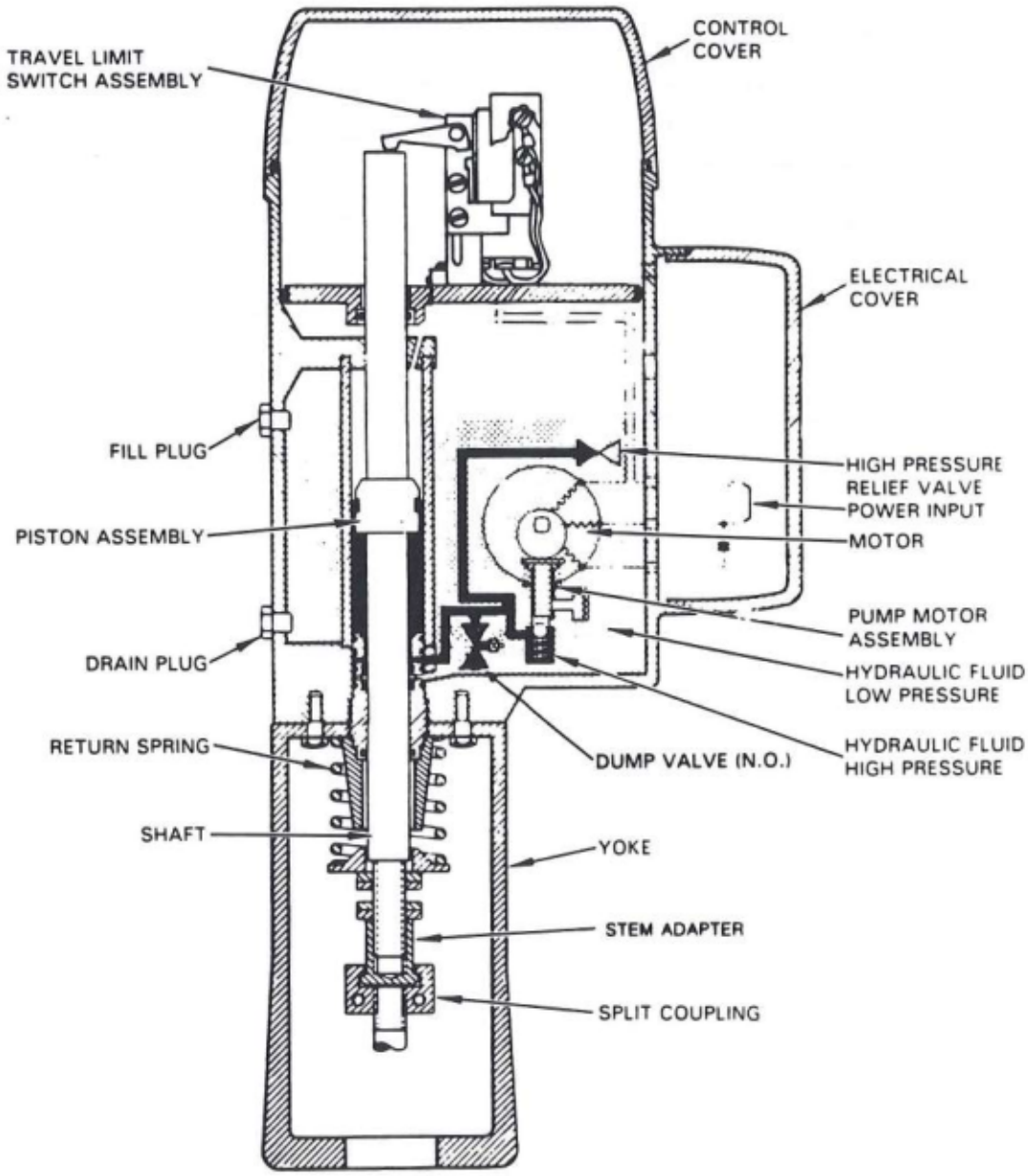


Figure 4-1 B. Hydramotor Assembly for Models AH95
Model B-1

Recycle will occur when sufficient hydraulic fluid is internally bypassed in the Hydramotor for the output shaft to move 0.10 inch off the fully stroked position. At that point, the motor will restart to drive the shaft back to the full stroke position. Because the motor is energized for such a short duration, no measurable heat is added to the fluid. (Regardless of the rate of recycle, the service life of the Hydramotor will not be reduced).

New Hydramotors are allowed a maximum recycle rate of three times every five minutes, but the normal rate is considerably less. When Hydramotors are installed in the field, recycle rates may increase through seal wear or elevated temperatures. For example, if its oil temperature increases to +170°F (+77°C), a Hydramotor that recycles once in five minutes at +70°F (+21°C) may recycle every 30 seconds, yet return to recycling once in five minutes when the temperature returns to +70°F (+21°C).

The following is a "rule of thumb" to consider when determining the Hydramotor's condition. At temperatures below +104°F (+40°C) -- if the Hydramotor recycles less frequently than every 45 seconds it is considered acceptable. If it recycles every thirty seconds or less it must be refurbished. Hydramotors recycling in the 30-45 second range should be judged on an individual basis.

4.2 WIRING DIAGRAMS

Refer to Figures 4-2 through 4-7 for External and Internal Wiring Diagrams, Single Phase and Three Phase.

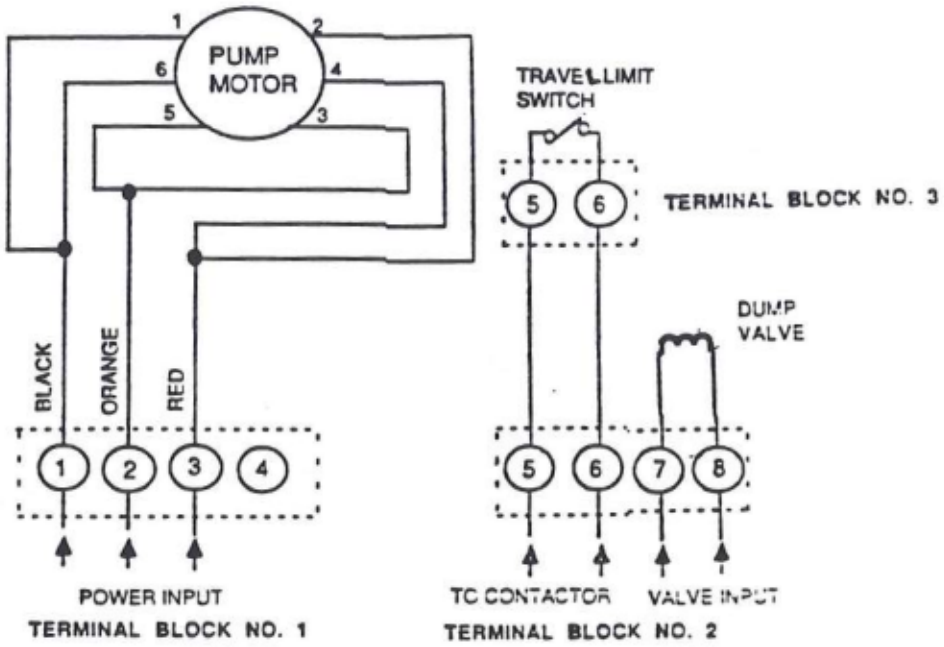


Figure 4-5A. Wiring Diagram (Internal, Three Phase) for Model AH95
220V/50Hz, 230V/50Hz, 240V/60Hz

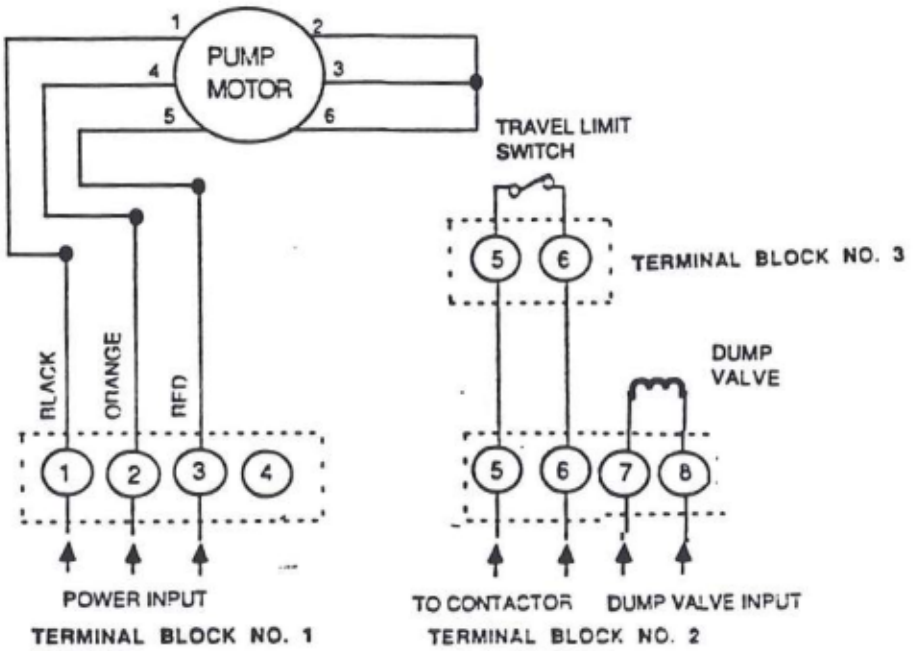


Figure 4-5B. Wiring Diagram (Internal, Three Phase) for Model AH95
380V/50Hz, 440V/50Hz, 460V/60Hz, 480V/60Hz

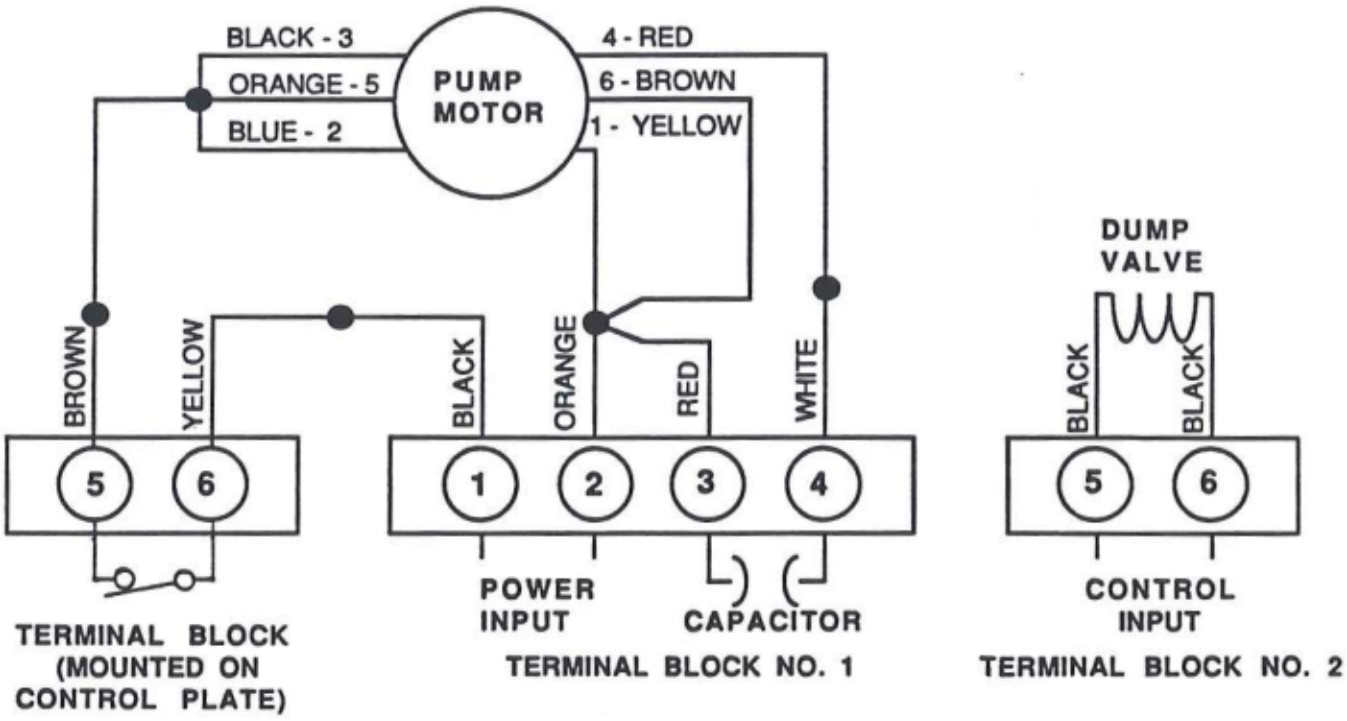


Figure 4-6A. Wiring Diagram (Internal, Single Phase)
for Models AH97 and AH98 120V/60Hz

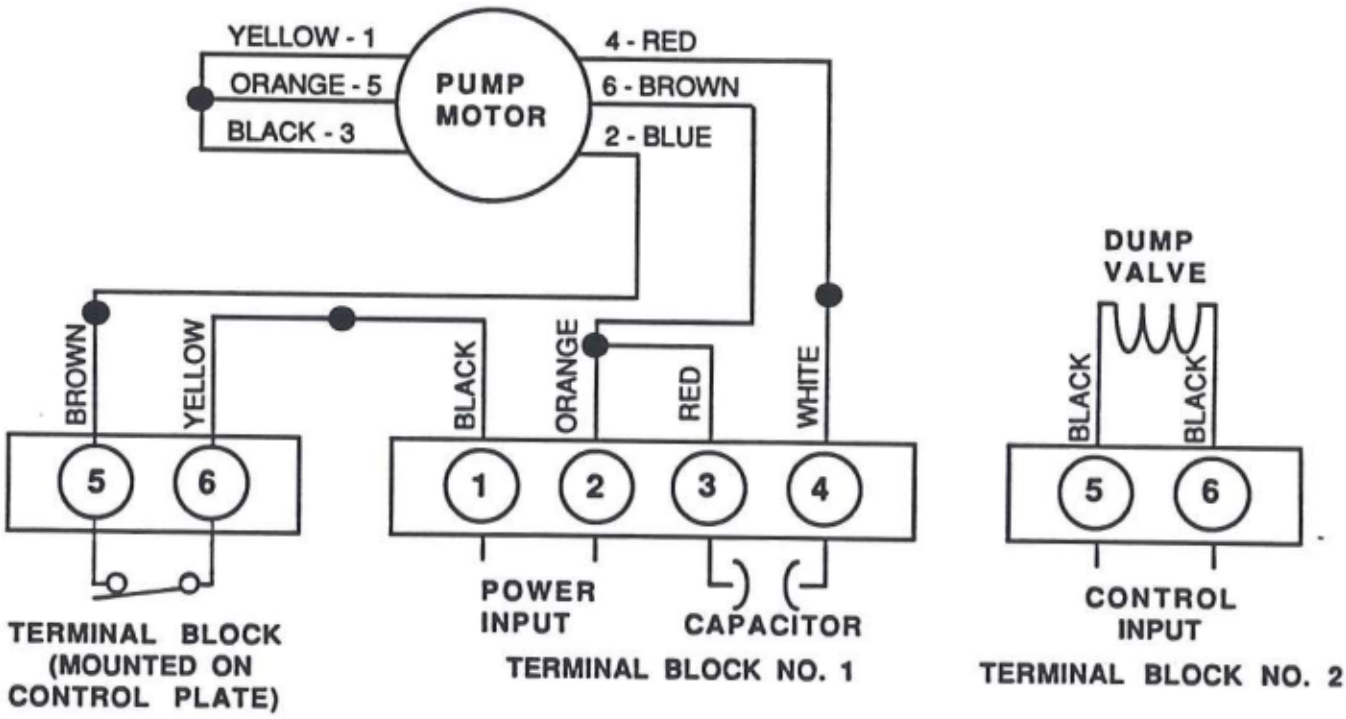


Figure 4-6B. Wiring Diagram (Internal, Single Phase)
for Models AH97 and AH98 220V/50Hz, 240V/50Hz, 240V/60Hz

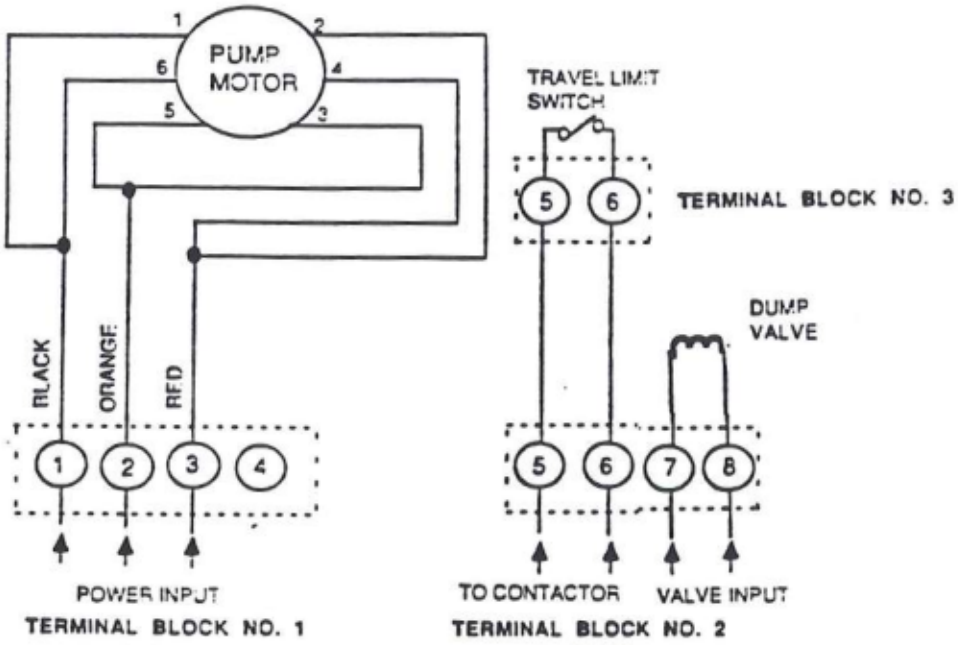


Figure 4-7A. Wiring Diagram (Internal Three Phase)
for Models AH97 and AH98 240V/60Hz

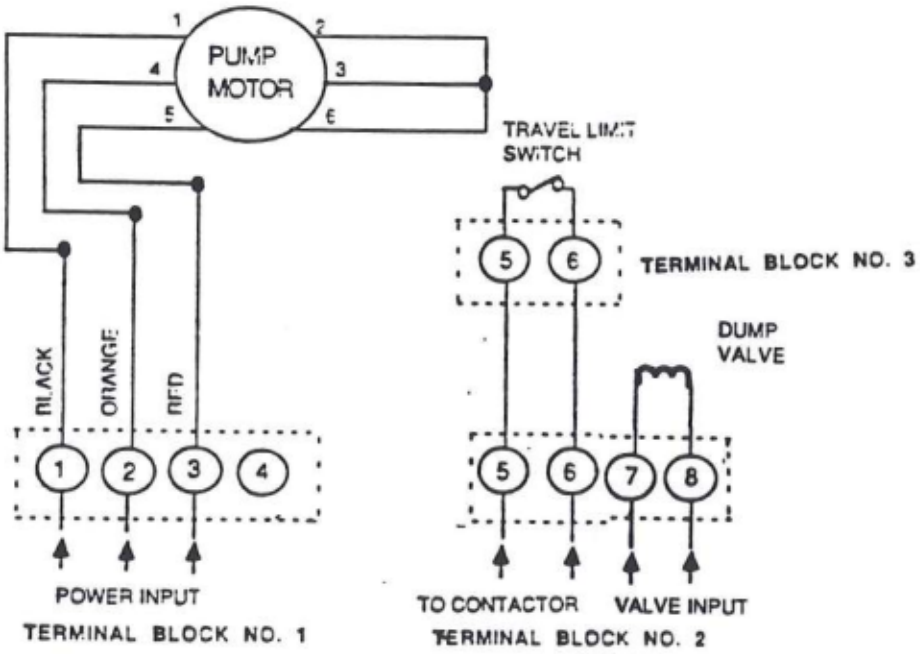


Figure 4-7B. Wiring Diagram (Internal Three Phase)
for Models AH97 and AH98 380V/50Hz, 440V/50Hz, 460V/60Hz, 480V/60Hz

4.3 LIMIT SWITCH AND STROKE ADJUSTMENT

Refer to Figures 4-8 and 4-9 for reference to the Limit Switch Adjustment and Control Plate Assembly viewing.

1). With the Hydramotor shaft connected to the PCD and de-energized (fully extended), raise the switch arm until the switch just clicks, and measure the distance between the top of the shaft and the switch arm (dimension X, Figure 4-8). This distance should be the stroke required for the PCD.

2). If the measured stroke (travel) distance is incorrect, loosen the two adjustment screws Raise the limit switch to increase the stroke or lower the limit switch to decrease the stroke. After the correct stroke is achieved, tighten both adjustment screws securely.

3). Operate the Hydramotor through several cycles and readjust the stroke as necessary.

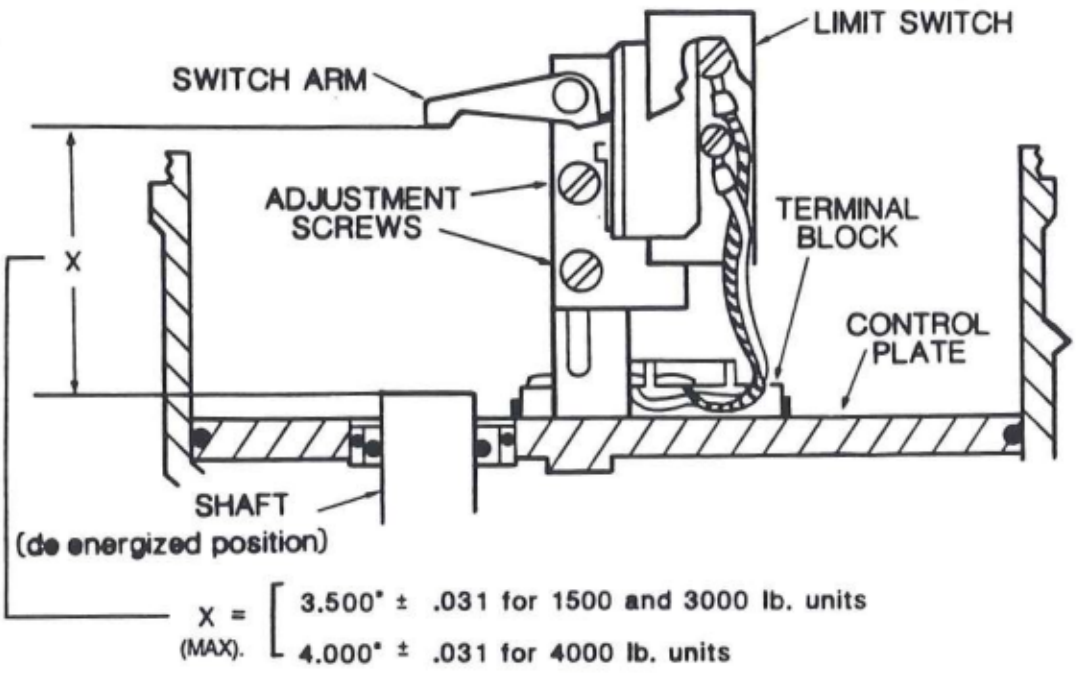


Figure 4-8. Limit Switch Adjustment

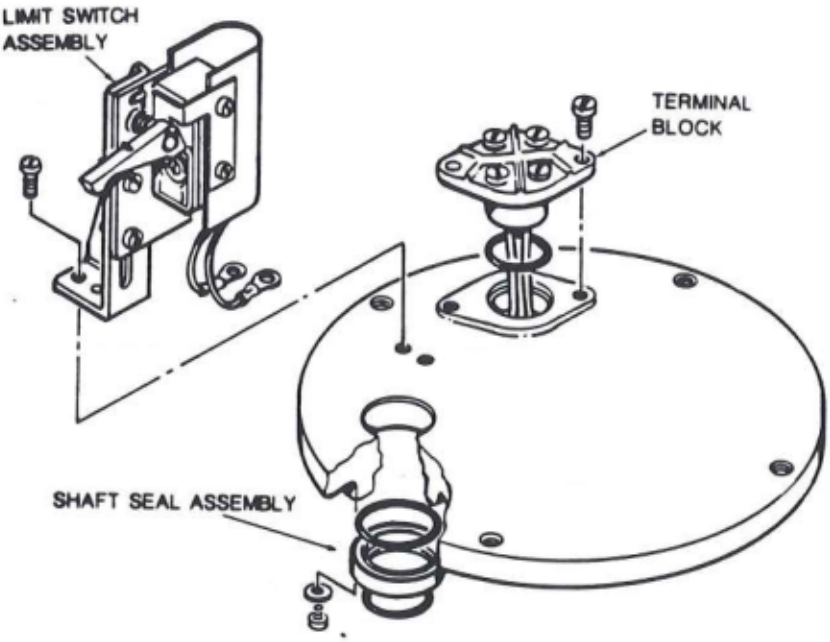


Figure 4-9. Control Plate Assembly

4.4 TROUBLESHOOTING

These charts are intended to assist in isolating and correcting operating problems. Follow the arrows, perform each block-solution in sequence, and check the operation of the Hydramotor after each corrective stage.

4.4.1 Figures 4-10A, B and C are flowchart troubleshooting guide examples as follows:

A. The Hydramotor will not stroke when the motor runs.

B. The motor does not run.

C. Hydramotor recycles more than once per 45 seconds.

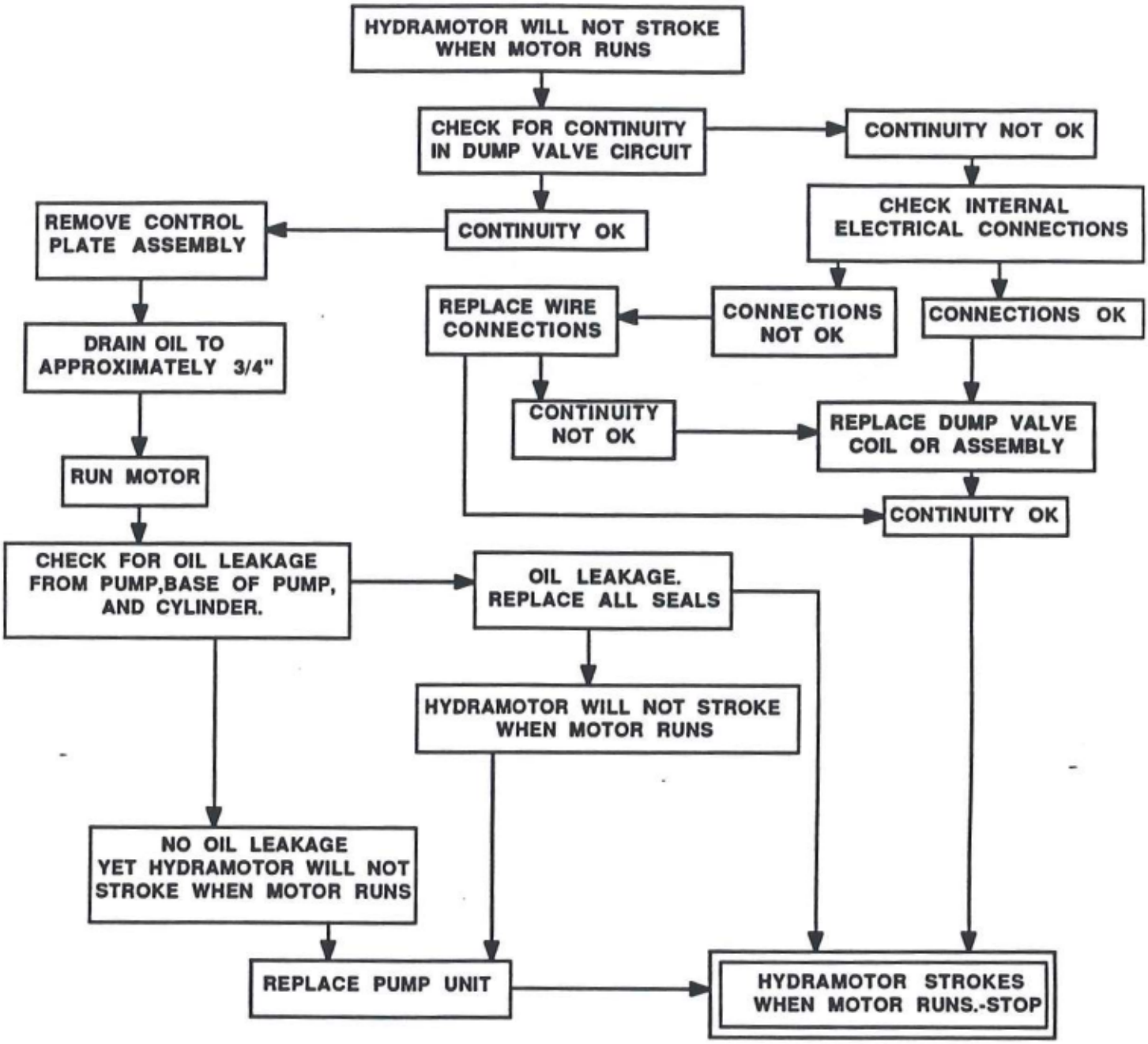


Figure 4-10A. Troubleshooting Guide. Motor Runs Properly

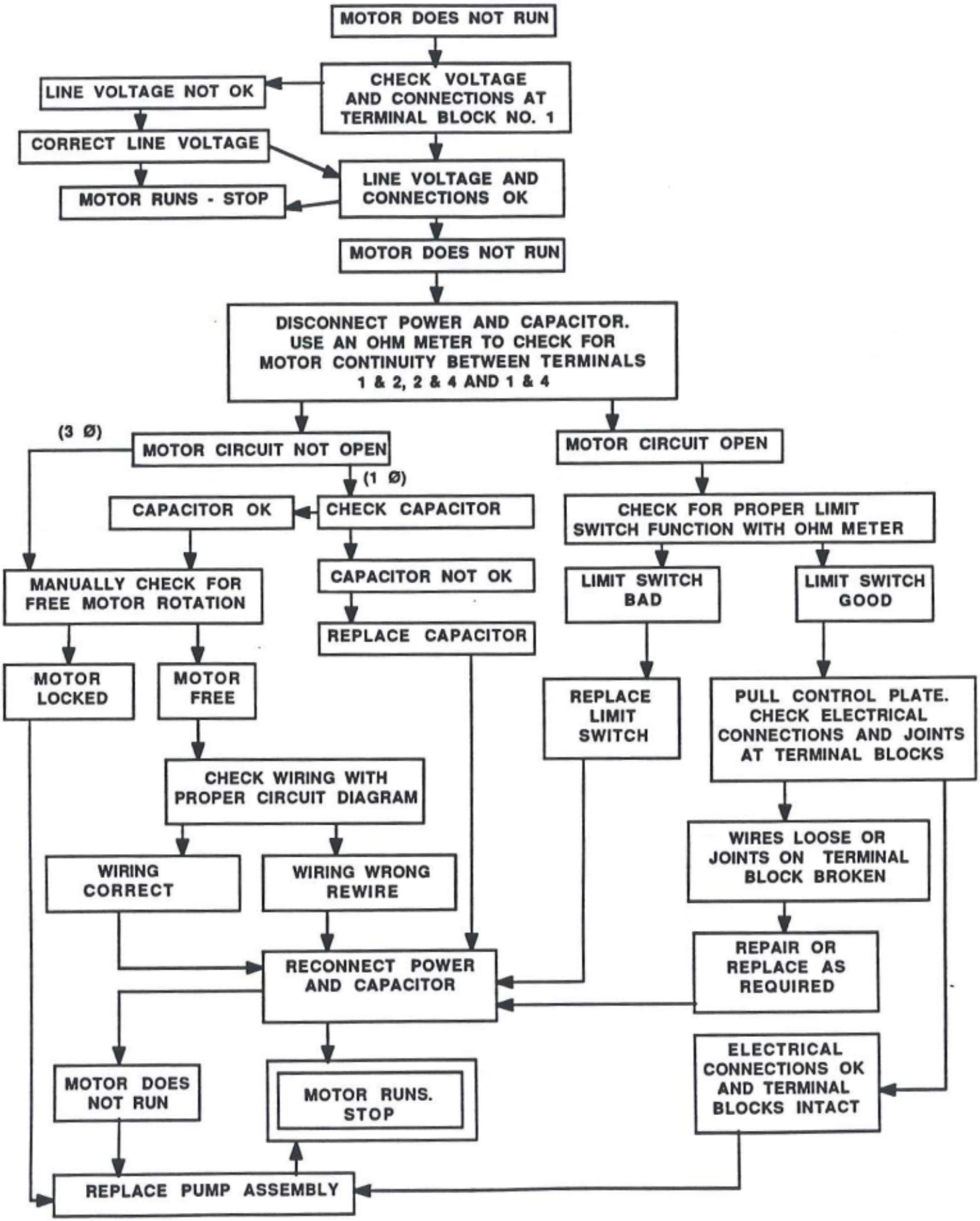
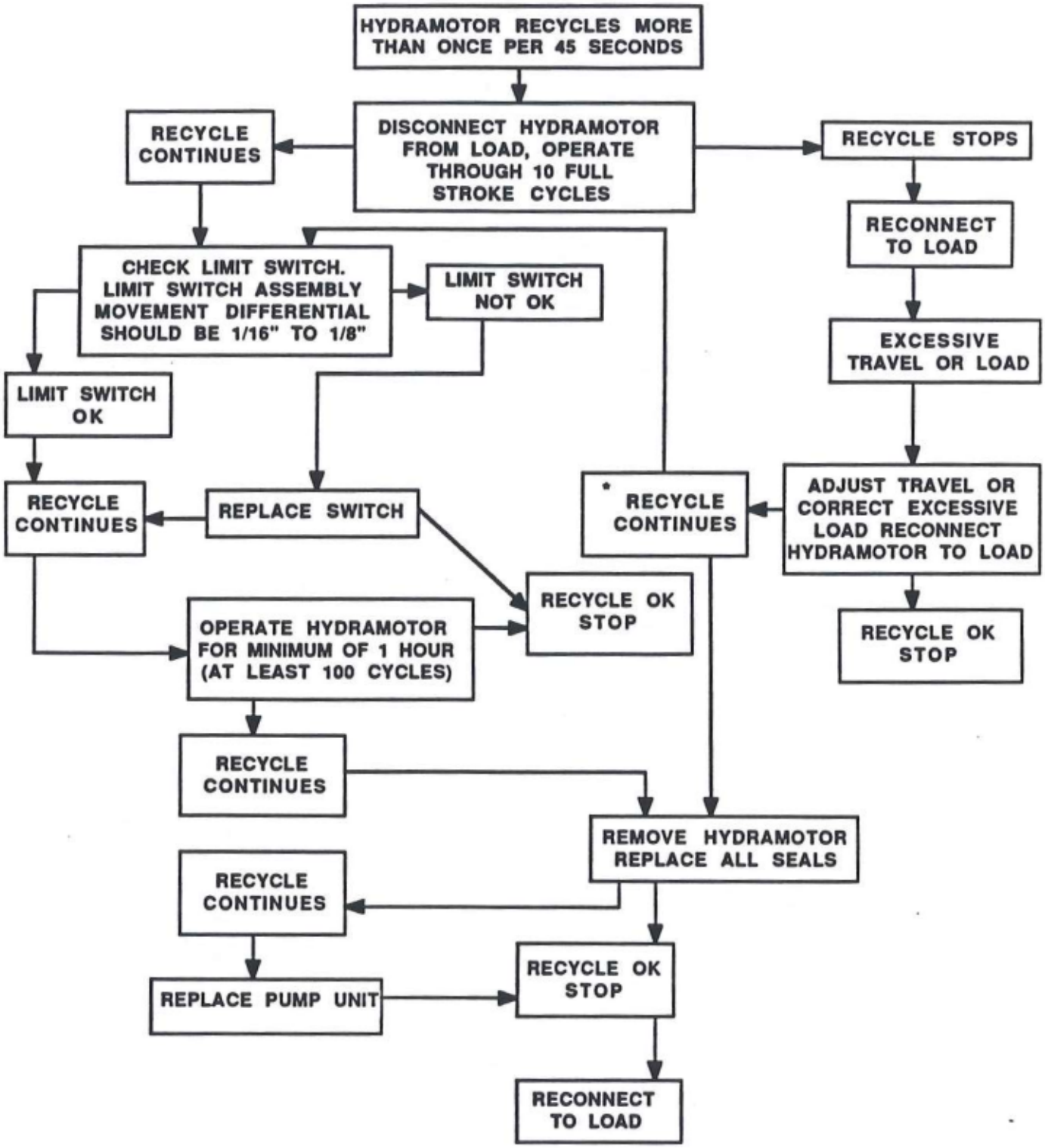


Figure 4-10B. Troubleshooting Guide. Motor Does Not Run Properly.



* If the load travel or force has exceeded the hydramotor rating for a significant period of time, the safety relief valve may have been damaged.

Figure 4-10C. Troubleshooting Guide. Recycle

4.5 OVERHAUL

4.5.1 Disassembly of the Hydramotor requires the following steps (see Figure 4-14 at the end of this section for an exploded view):

A. Preparing the Hydramotor for Disassembly:

1). **Turn off the electrical power supply to the Hydramotor.**
2). Drain off the capacitor charge on single phase Hydramotors.
3). Return the shaft to its de-energized position. Disengage the manual override, if so equipped.

WARNING

THE ABOVE THREE STEPS MUST BE PERFORMED TO AVOID ELECTRICAL SHOCK/HYDRAULIC PRESSURE HAZARD.

4). Remove all slotted head screws from both sides of the yoke.
5). Remove the plastic dust covers (and metal stiffener plate if applicable) from the yoke.
6). Remove the Hydramotor from the PCD (per 1.6.1).
7). Move the Hydramotor to a clean work place for disassembly.
8). Assure availability of the proper tools per 1.7.2 and subsection 6.5 (SPECIAL TOOLS), expendable items (see Table 1-2), and appropriate kits per subsection 7.4 (STANDARD SERVICE KITS).
9). Remove the electrical and control covers, and remove and discard both O-rings.

B. Removing the Control Plate Assembly

1). Remove the two slotted head screws securing the limit switch wires 5 and 6, Terminal Block No. 2, mounted on the control plate.
2). Remove the two limit switch wires and replace the screws in the Terminal Block.
3). Remove the two slotted head screws that secure the limit switch (402) to the control plate. Remove the post and limit switch together (see Figure 4-9).
4). Install the Control Plate Removal Clamp (P/N S109795F) with the same screws removed from the limit switch post (see Figure 4-11).
5). Remove the four 1/4" hex head screws (605) that hold the control plate (606) to the housing (625).
6). Place the table top over the housing (part of the Power Module Work Stand P/N S109795A).
7). Clamp a pair of locking pliers onto the Control Plate Removal Clamp at a slight angle approximately 30° (see Figure 4-12).

8). Place protective padding (a rag or towelling) between the locking pliers and the top of the housing.

9). Strike (with the palm of your hand) the end of the locking pliers in a downward manner. This action will lift the control plate off of the large O-ring seal in the housing. Then slide the control plate up and off the shaft.

NOTE

The control plate cannot be allowed to hang on its wiring outside the housing, rather use the table top.

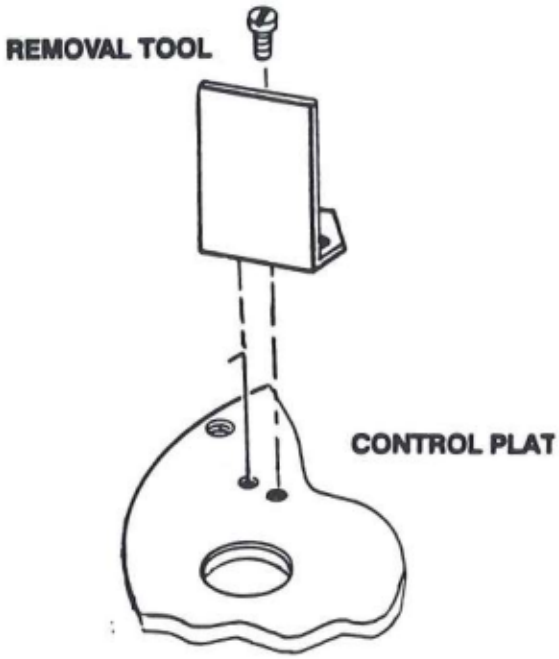


Figure 4-11. Installing the Cover Plate Removal Tool

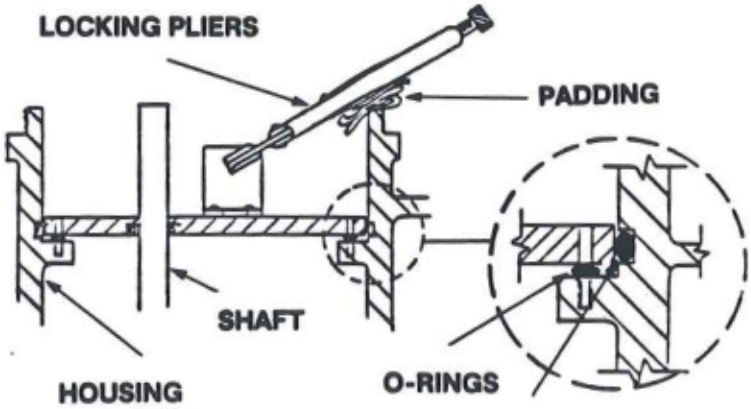


Figure 4-12. Removing the Control Plate

C. Removing the Pump

1). Loosen the drain plug (619), located at the rear of the housing. Drain the hydraulic oil into a 5 quart pan. There will be oil remaining in the pump (201) and the cylinder (501).
2). After most of the oil has drained out, replace the oil drain plug (619) and secure it finger tight.
3). Remove the three hex nuts (607) and the three lock washers (608) that hold the pump (201) in place.
4). Remove the two 15/16" hex bolts (614), two lock washers (615), and two flat washers (616) that secure the cylinder cap (102), then remove the cylinder cap.
5). Wipe the oil off of the nylon connectors (205). These connectors must be removed before the pump can be lifted out of the housing. **Do not cut the wires.**
Locking pliers may be used to reverse the crimp by rotating the connectors 90° from their original crimped position. Once the connector is removed, separate the wires.
6). Loosen the two slotted head screws on the top of the pump (201) and install the Pump Removal Tool (P/N S109795O).
7). Lift the pump (201) straight up, drain out any excess oil and lift it out of the housing (625).
8). The small nipple (202) that connects the pump to the housing may come out with the pump or stay in the housing. In either case, the nipple must be removed and its O-rings (7) replaced.
9). Remove the table top from the top of the housing.
10). Place a drain pan under the Work Table (P/N S109795B). Turn the Hydramotor upside down and set it on the Work Table. Any remaining oil will drain out.

D. Removing the Yoke and Spring Assembly

Refer to 6.3.1.

E. Removing the Shaft Assembly and Bushing

1). Use the Shaft Extensions Tools (P/N S109795H) to loosen the shaft extension (613) from the Hydramotor shaft (507).
2). Remove the shaft extension (613).
3). Remove the housing (625) from the Work Table and secure the Power Module Work Stand (P/N S109795A).
4). Rotate the Power Module Work Stand 90° and tap the threaded end of the shaft (507) and piston (503) from the cylinder (501).

5). Remove the bushing lock screw (624) if so equipped (No bushing lock screw is used on 4,000 lb. (1,800 kg.) Hydramotors).
6). Install the Bushing Socket Tool (P/N S109795D for 1,500 Hydramotors, or P/N S109795L for 3,000 or 4,000 lb. (1,800 kg.) Hydramotors) and unscrew the bushing (101) from the bottom of the housing (625). As the bushing (101) is removed, the cylinder (501) will become free and can be removed from the inside of the housing (625).
7). Use the Bushing Removal Drift (P/N S109795M) to push the bushing (101) out of the housing (625).

F. Removing Electrical Components

1). Single Phase Power Only: Remove screws that secure the capacitor wires to Terminal Block No.1 Remove and replace the capacitor (641) if bad.. Replace the screws in the block.
2). Remove the two screws that secure Terminal Blocks No. 1 (630) to the housing (625). Remove the terminal block complete with its O-rings (16) and spacer(628).
3). Remove the two slotted head screws that secure blank Terminal Block No. 2 (634) to the housing. Remove the Terminal Block, complete with its O-ring (16) and metal spacer (628).
4). Remove the housing (625) from the Power Module Work Stand. Remove the oil drain plug and the oil fill plugs (619) from the rear of the housing.
5). The housing, yoke, spring, cylinder, and cylinder cap are ready for cleaning and inspection.
6). Refer to section 6 (OVERHAUL OF COMMON COMPONENTS) for instructions on disassembly of the piston and removal of the seals from the bushing.

G. Removing Seals from the Control Plate

1). Invert the control plate (606).
2). Remove the two slotted head screws and two brass washers that hold the shaft seal bushing to the control plate (see Figure 4-13).
3). Remove the shaft seal bushing and discard its two O-rings.
4). Remove the two slotted head screws that hold the terminal block to the control plate. Remove the terminal block with its O-ring.
5). Thoroughly clean the control plate by solvent de-greasing or a similar method.

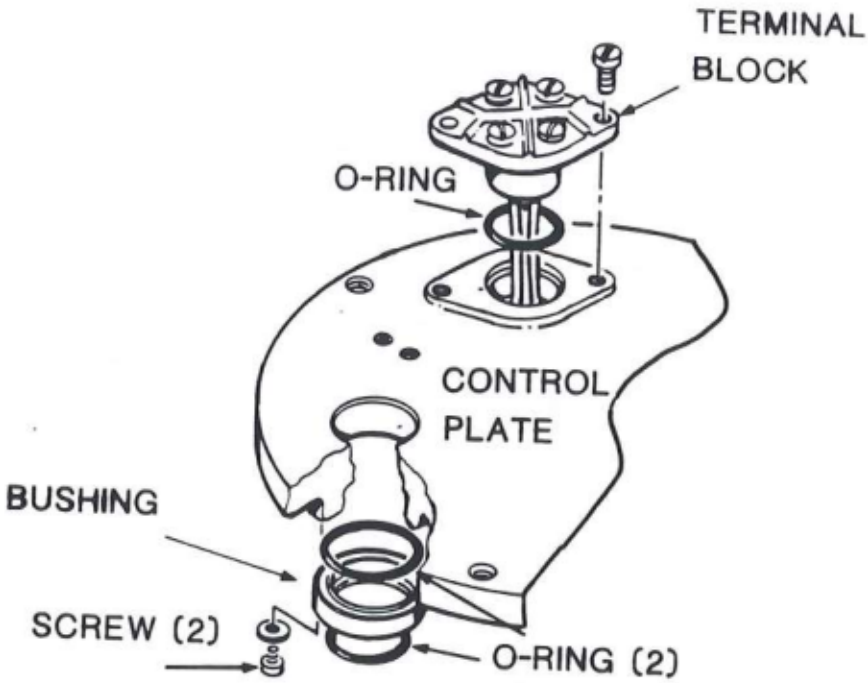


Figure 4-13. Upper Shaft Seals

4.5.2 Assembly of Hydramotors

This procedure is to be followed after all Hydramotor components have been cleaned and inspected. All parts must be free from dirt, impurities, and excessive wear (replace parts as necessary).

NOTE

The principle cause of hydraulic fluid bypass problems is improper sealing due to O-ring and seal damage in reassembly. Inspect and install O-rings and seals carefully, insuring that they are not cut, rolled, abraided, or dislodged during assembly procedures. Prior to reassembly, lubricate thoroughly with petroleum jelly.

A. Preparing the Housing for Assembly

1). Replace the O-rings (4) on the oil fill plug and oil drain plug (619) and assemble in the rear of the housing (625).
2). Place the housing (625) in the Power Module Work Stand (P/N S109795A) and secure.
3). Replace two seals (10, 11) in the bushing (101) per subsection 6.1 (BUSHING AND CYLINDER CAP). Install three new lower O-rings (101, closest to the yoke) on the bushing outside the diameter.
4). Lubricate the O-rings with white petroleum jelly and

install the bushing (101) into the bottom of the housing (625) with the Bushing Socket Tool (P/N 109795D for 1,500 lb. (680 kg.) Hydramotors and P/N S109795L for 3,000 lb. (1,360 kg.) and 4,000 lb. (1,800 kg.) Hydramotors). Once the Bushing Socket Tool touches the housing, the bushing is tight. Turn the Bushing Socket Tool 1/4 turn ccw.

5). Install the bushing lock screw (624) if required. (No screw is required on 4,000 lb. (1,800 kg.) Hydramotors).
6). Lubricate the two Terminal Block O-rings (16) with petroleum jelly and install on Terminal Block No. 1 (630) .
7). Install a new O-ring (16) and metal spacer (628) on the blank Terminal Block No. 2 (634), lubricate the O-ring with petroleum jelly, and secure to the housing.

B. Shaft Assembly

1). Rotate the housing to the upright position.
2). Assemble a new seal on the piston and assemble the piston onto the shaft (refer to subsection 6.2 (SHAFT AND PISTON ASSEMBLY)).
3). Lubricate the piston seal and insert the assembled shaft and piston assembly into the cylinder (501).
4). Lubricate a new fourth O-ring (9) and install it onto the bushing (101) from inside of the housing (625).
5). Lubricate the tapered end of the shaft (507) with white petroleum jelly and insert it into the bushing (101) from above.
6). Assure that the cylinder (501) slips over the last O-ring on the bushing (101).
7). Tighten the two hex bolts (614) to hold the cap securely in the housing (625). Remove the Shaft Alignment Tool.
8). Remove the housing from the Power Module Work Stand and turn it upside down in the Work Table (P/N S109795B).
9). Install the cylinder cap (102) and two 15/16" hex bolts (614) with both flat washers (616) and lock washers (615) and secure finger tight.
10). Thread the extension shaft (613) onto the shaft (507). Use Shaft Extension Tools (P/N S109795H) to tighten the extension shaft.

C. Yoke and Spring Assembly

1). Install the springs onto the yoke. Assemble the yoke and springs onto the shaft and shaft extension.
2). Install four 3/4" hex bolts with their lock washers to secure the yoke to the housing. Torque these bolts to 30 ft.-lbs.
3). Install the spring retainer on the spring.
4). Install the Spring Compression Tool (P/N S108511A) in the yoke and compress the springs enough to start threading the nut onto the extension shaft.

5). Check Table 6-1 or 6-2 to determine compressed spring length.
6). Install the Spring Height Gauge (P/N S109795J) on the yoke (see Figure 6-13).
7). Compress the springs until the proper gauge dimension is reached per Table 6-1 and spin the nut down onto the shaft.
8). Back off the Spring Compression Tool and recheck the spring height with the Gauge. If necessary, compress, adjust the nut, and recheck. When the spring height is properly adjusted, remove the Spring Compression Tool and Spring Height Gauge.
9). Thread the jam nut onto the extension shaft.

D. Pump/Motor Installation

1). Install a new O-ring (16) on the terminal block (642) located in the control compartment , and install onto the top of the control plate (606) with two screws (635).
2). Remove the housing and yoke from the Work Table. Stand the yoke on a table or floor.
3). Place the Power Module Work Stand (P/N S109795A) table top over the housing.
4). Install new O-rings (7) on the small nipple (202), lubricate with white petroleum jelly and install the nipple assembly into the bottom of the housing. **Use care not to bind or cut the O-rings.**
5). Attach the Pump Removal Tool (P/N S109795O) to the pump (201). Carefully set the pump into the housing. Do not rest the pump on the nipple in the bottom of the housing. Place a small screwdriver in one of the rear stud holes to prevent the pump from seating fully, and to allow room for inserting the wiring assembly.
6). Remove the Pump Removal Tool and tighten the two screws on the pump.
7). Place clean padding (rag or towelling) over the pump to prevent any loose wire strands from entering the top of the pump.
8). Refer to subsection 4.2 (WIRING DIAGRAMS) for appropriate wiring combinations.
9). Connect the wiring by twisting the wire strands together. Use "duck bill" (flat nose) pliers to smooth out the wire twist. Insert into the connector (205). Crimp with a crimping tool such as Hollingsworth H-18.
10). After wiring is complete, carefully tuck all wiring down between the cylinder (501) and pump (201). Remove the protective padding.
11). Remove the screwdriver and gently lower the pump (201) onto the nipple (202). Do not drop or force the pump down on the nipple. The pump will settle down on the nipple with very little force.

12). Install three lock washers (608) and hex nuts (607) onto the staff extension (609). **Torque these nuts to 24 in.-lb. (±0%-10%).**
13). Carefully fill the housing to the level of the fill port with oil. (approximately 3 1/2 quarts). Do no allow the oil to enter the large O-ring groove or the four 1/4" threaded holes used to hold down the control plate (giving the appearance of a leak). As the pump takes in oil, the proper oil level will be maintained.
14). Remove Power Module Work Stand (P/N S109795A) from the housing

E). Control Plate Assembly

1). Place the four small O-rings over the 1/4" bolt holes in the housing. **Do not get oil on the large O-ring or four small O-rings (giving the appearance of a leak).**
2). Lubricate the large O-ring with white petroleum jelly and carefully install it in the groove at the top of the housing.
3). Install the control plate and remove the Control Plate Removal tool.
4). Snug down the four 1/4" hex bolts in a diagonal pattern.
5). Install the limit switch assembly, complete with post.
6). Connect its wires to Terminal Blocks Nos. 5 and 6 on the control plate (refer to corresponding wiring diagram.)

F). Completing the Assembly

1). Replace the plastic dust covers (and metal stiffener plate if applicable) onto the yoke with mounting screws.
2). Apply power to the Hydramotor and test for correct operation cycling 3 or 4 times.

NOTE

Assure that recycling does not exceed 3 times per 5 minutes.

3). Replace the control cover O-ring (1) on the top of the housing, apply anti-seizing lubricant to the threads, and screw on the control cover (601).

4). Replace the O-ring (2) on the electrical cover (603), apply anti-seizing lubricant to the threads, clear threads of any wires and screw in the cover (603).

For reference only. Not for ordering purposes.

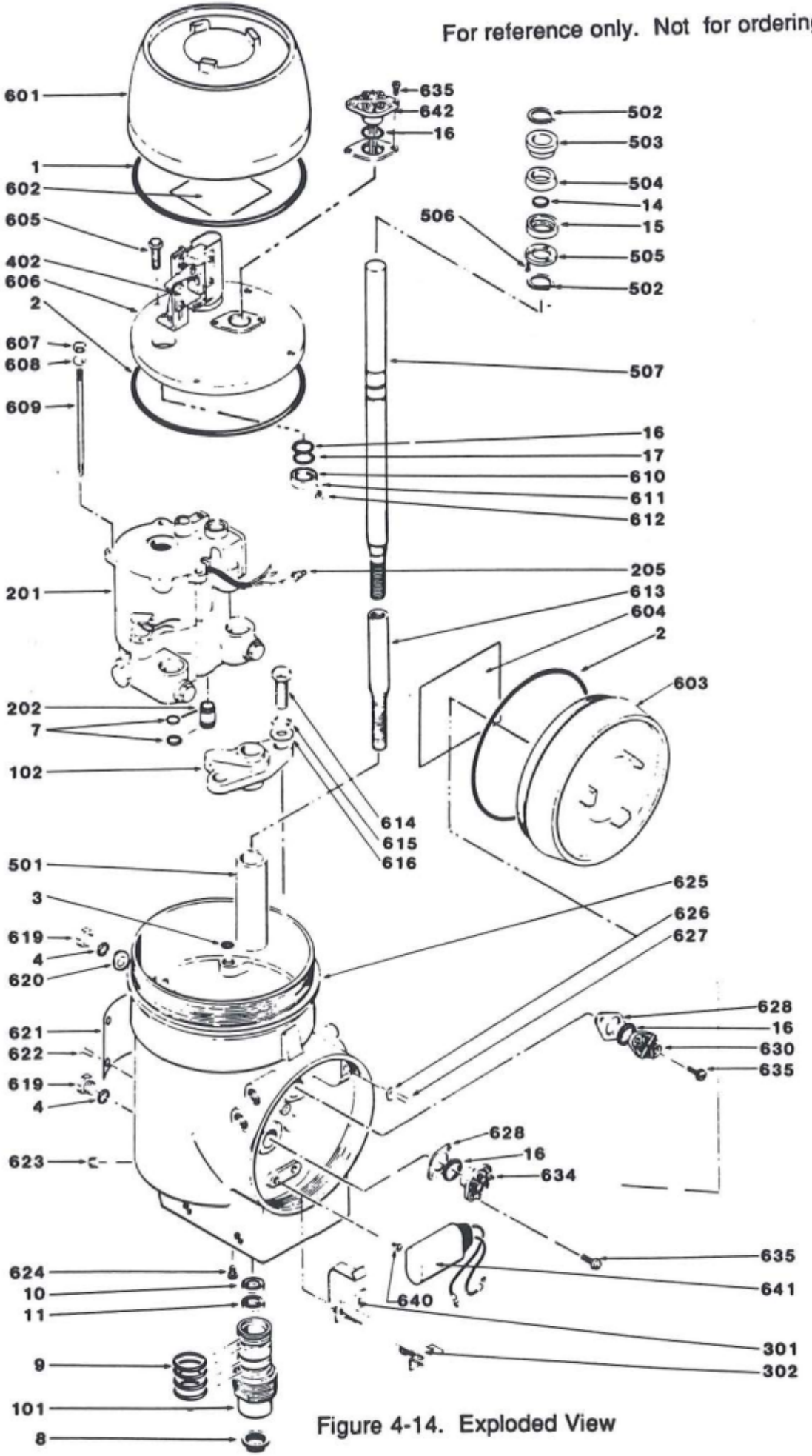


Figure 4-14. Exploded View

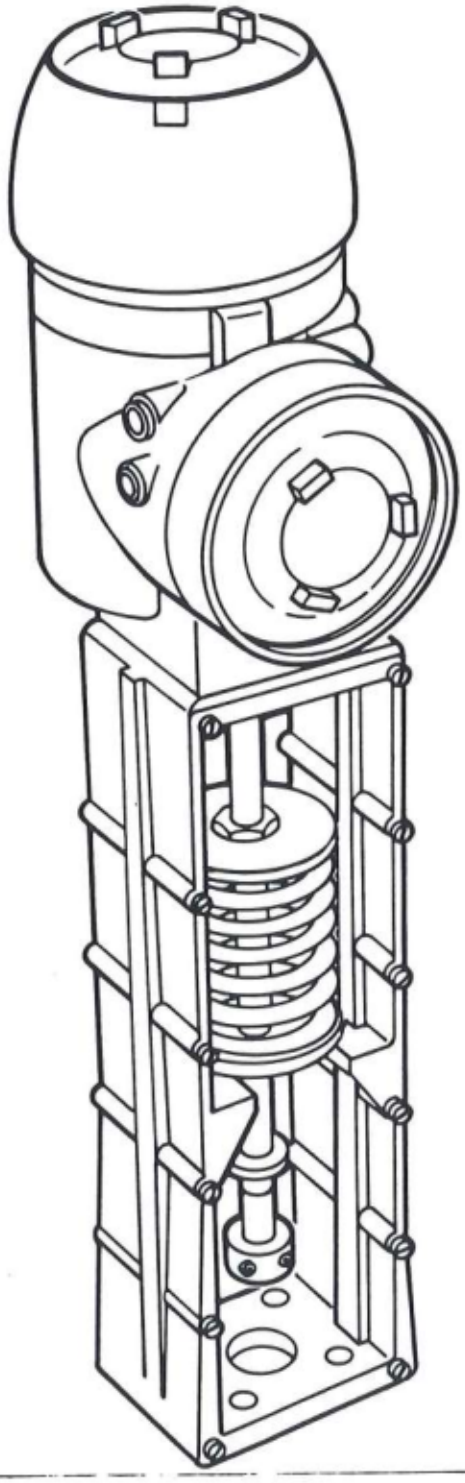
Legend for Figure 4-14
Exploded View

Item No.	Description	No. Required
1	O-ring, Control Cover	1
2	O-ring, Control Plate and Electrical Cover	2
3	O-ring, Control Plate Mounting Bolts	4
4	O- ring, Drain and Fill Plugs	2
5	O-ring, Pump Spring	1
6	O-ring, Pump	1
7	O-ring, Pump Nipple	2
8	Wiper ring	1
9	O-ring, Bushing	4
10	Seal, Hydraulic	1
11	Seal, Hydraulic	1
12	O-ring, Upper Shaft	1
14	O-ring	
15	Polymyte Piston Ring	1
16	O-ring, Seal Retainer, Terminal Blocks	4
17	O-ring, Seal Retainer	1
101	Bushing	1
102	Cylinder Cap	1
201	Pump	1
202	Nipple	1
203	Plug	1
204	Spring	1
205	Connector	5
301	Capacitor Plate	1
302	Capacitor Strap	1
402	Limit Switch	
501	Cylinder	1
502	Split Retaining Ring	2
503	Piston	1
504	Spacer (1,500 lb. (680 kg.) Hydra. only)	1
505	Retainer	1
506	Set Screw	3
507	Shaft	1
601	Control Cover	1
602	Wiring Diagram	1
603	Electrical Cover	1
604	Wiring Diagram	1
605	Hex Head Cap Screw	4
606	Control Plate	1
607	Hex Nut	3
608	Lock washer	3
609	Staff Extension	3
610	Seal Retainer	1

Legend for Figure 4-15
Exploded View (Continued)

Item No.	Description	No. Required
611	Flat washer	2
612	Slot Head Screw	2
613	Shaft Extension	1
614	Hex Head Bolt	2
615	Lock washer	2
616	Flat washer	2
618	Coil Wire Sleeve	1
619	Oil Fill Plug and Oil Drain Plug	2
620	Plate, Caution	1
621	Nameplate	1
622	Screws, Nameplate	4
623	Plug	1
624	Bushing, Lock Screw	1
625	Housing	1
626	Washer	1
627	Screw	1
628	Spacers, Terminal Blocks	2
630	Terminal Block No. 1	1
634	Terminal Block No. 2 (blank)	1
635	Screws	6
640	Screws, Capacitor Clamp	2
641	Capacitor (Single Phase Only)	1
642	Terminal Block	1

AH96 HYDRAMOTORS
MODELS B AND B-1



5. AH96 (PUSH-TYPE) HYDRAMOTORS

5.1 PRINCIPLE OF OPERATION

The AH96 Hydramotor is an electrohydraulic push-type linear actuator used for two position applications. Upon power interruption, the shaft is retracted to its de-energized position by a yoke mounted fail-safe return spring.

5.1.1 Model B

When the Hydramotor's power terminals are energized, the motor drives the pump to apply hydraulic fluid pressure to the piston while a normally open low pressure dump valve closes. The hydraulic fluid pressure to the piston extends the shaft and compresses the return spring (Figure 5-1A).

Force is limited by a pressure limiting hydraulic flow control valve. When the piston reaches the Hydramotor bushing at the end of its stroke, or the travel is limited by an external mechanical stop, the hydraulic fluid pressure will build until it reaches the pre-set maximum, at which point the flow control valve will open to relieve excess pressure on the piston and maintain position.

If, for any reason, the flow control valve fails to open when hydraulic fluid pressure exceeds the level required for normal Hydramotor operation, a redundant mechanical high pressure safety valve will open to relieve that pressure.

NOTE

When the shaft is held in the energized position, the pump motor runs continuously to maintain a constant shaft force.

When the Hydramotor terminals are de-energized, or upon power interruption, the dump valve opens to relieve hydraulic pressure. The energy stored in the return spring retracts the shaft.

5.1.2 Model B-1

When the Hydramotor's power terminals are energized, a normally open high pressure dump valve closes. The motor drives the pump to apply hydraulic fluid pressure to the piston, extending the shaft and compressing the return spring (Figure 5-1 B).

When the shaft reaches a preset travel limit, the limit switch will open the pump motor circuit. The dump valve remains closed, holding the shaft in its fully extended (energized) position until the circuit is broken.

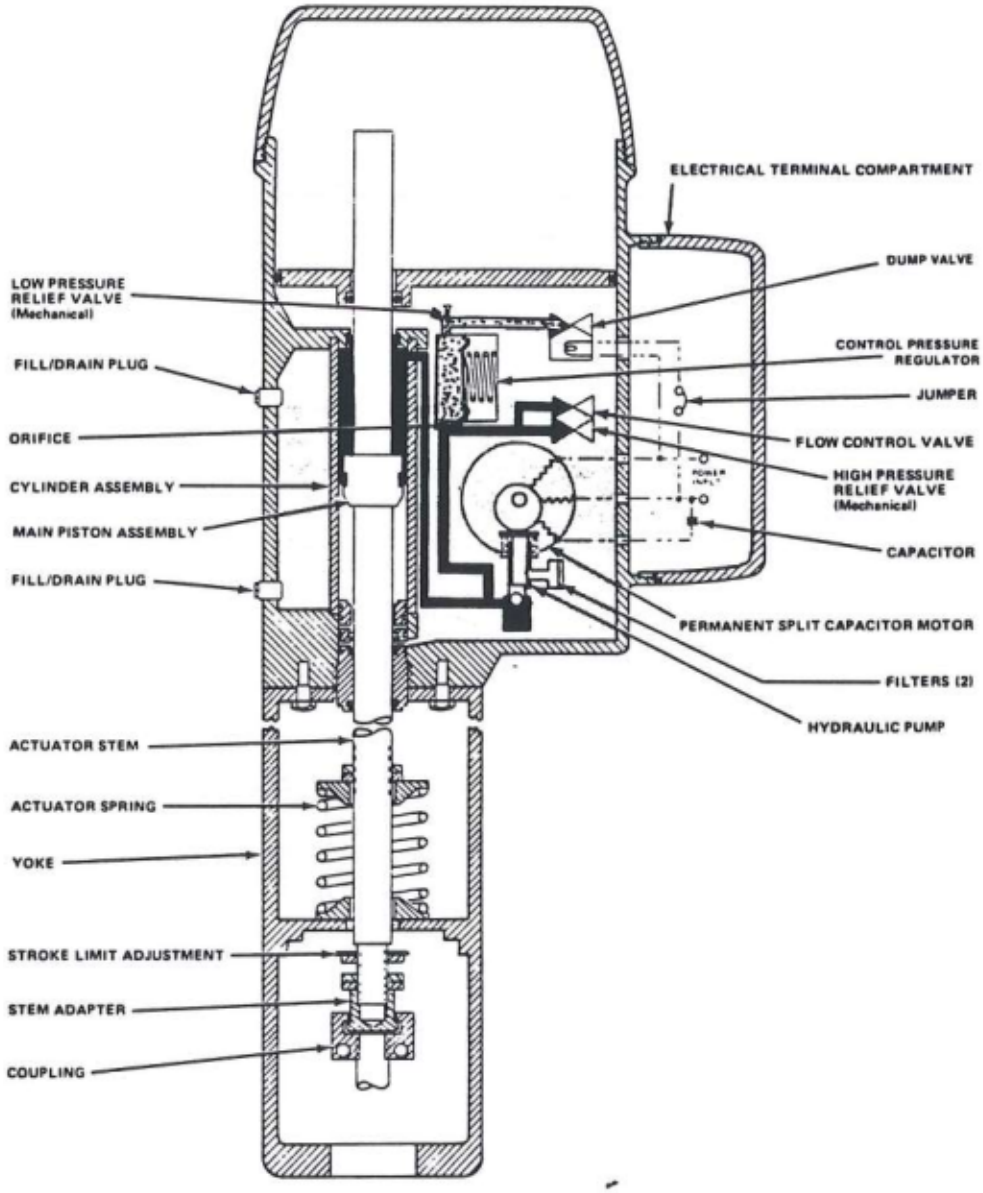


Figure 5-1 A. Hydramotor Assembly Model B

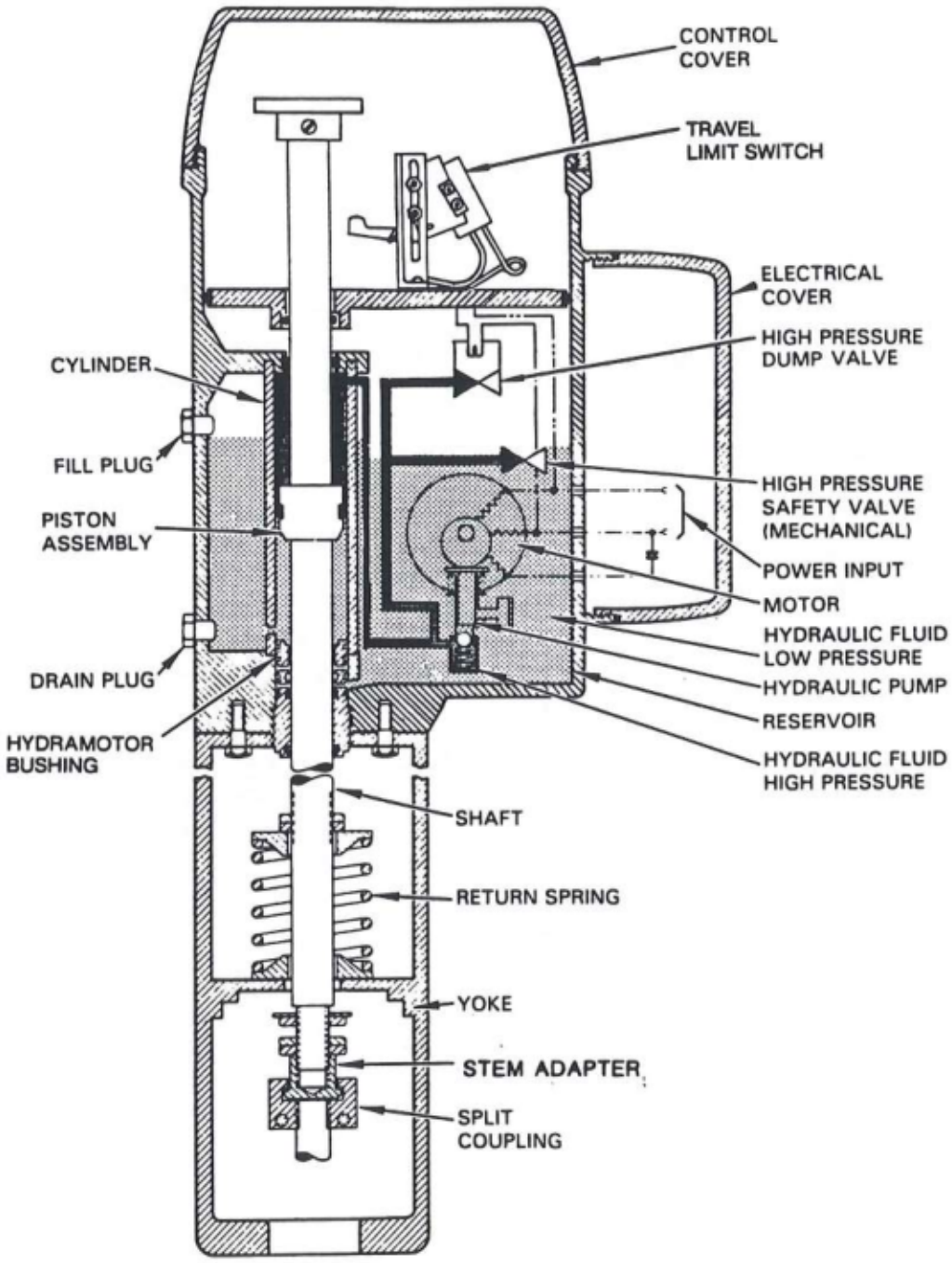


Figure 5-1 B. Hydramotor Assembly Model B-1

When the Hydramotor terminals are de-energized, or upon power interruption, the dump valve opens to relieve hydraulic pressure. The energy stored in the return spring retracts the shaft.

5.1.3 Recycling (Model B-1 only)

Recycle is a characteristic of two-position push-type Hydramotors, whereby the pump will restart intermittently for a very brief period of time (less than 0.5 seconds) in order to maintain the shaft in its energized position.

Recycle will occur when sufficient hydraulic fluid is internally bypassed in the Hydramotor for the shaft to move 0.10 inch off the fully stroked position. At that point, the motor will restart to drive the shaft back to the full stroke position. Because the motor is energized for such a short duration, no measurable heat is added to the fluid. (Regardless of the rate of recycle, the service life of the Hydramotor will not be reduced).

New Hydramotors leaving the ASCO General Controls factory are allowed a maximum recycle rate of three times every five minutes, but the normal rate is considerably less. When Hydramotors are installed in the field, recycle rates may increase. For example, if its oil temperature increases to +170°F (+77°C), a Hydramotor that recycles once in five minutes at +70°F (+21°C) may recycle every 30 seconds, yet return to recycling once in five minutes when the temperature returns to +70°F (+21°C).

The following is a "rule of thumb" to consider when determining the Hydramotor's condition. At temperatures below +104°F (+40°C), if the Hydramotor recycles less frequently than every 45 seconds, it is considered acceptable. If it recycles every thirty seconds or less it must be refurbished. Hydramotors recycling in the 30-45 second range should be judged on an individual basis.

5.2 WIRING DIAGRAMS

Refer to Figures 5-2 through 5-7 for External and Internal Wiring Diagrams , Single Phase and Three Phase.

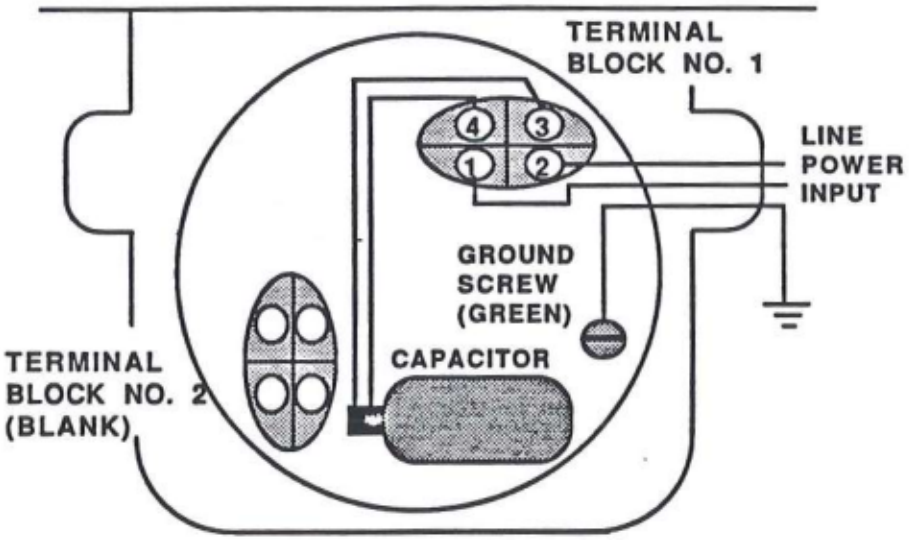


Figure 5-2. Wiring Diagram (External, Single Phase)

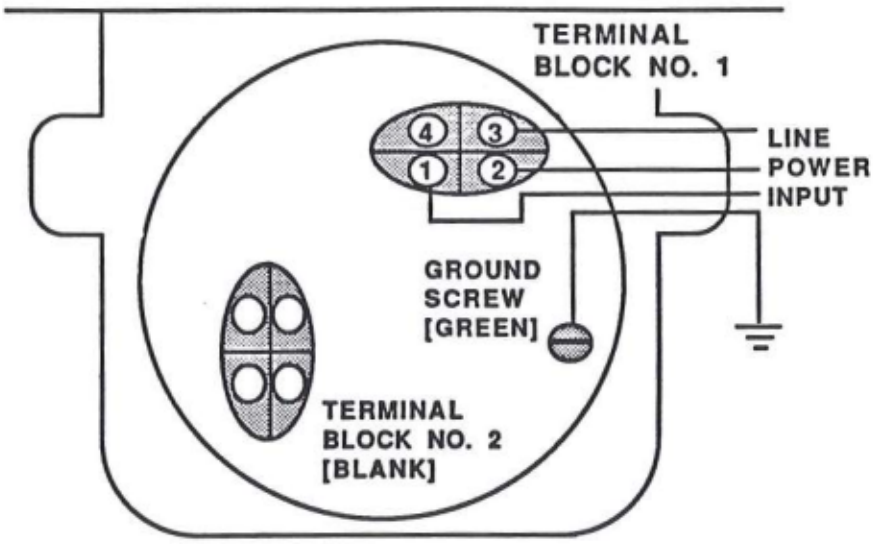


Figure 5-3 Wiring Diagram (External, Three Phase)

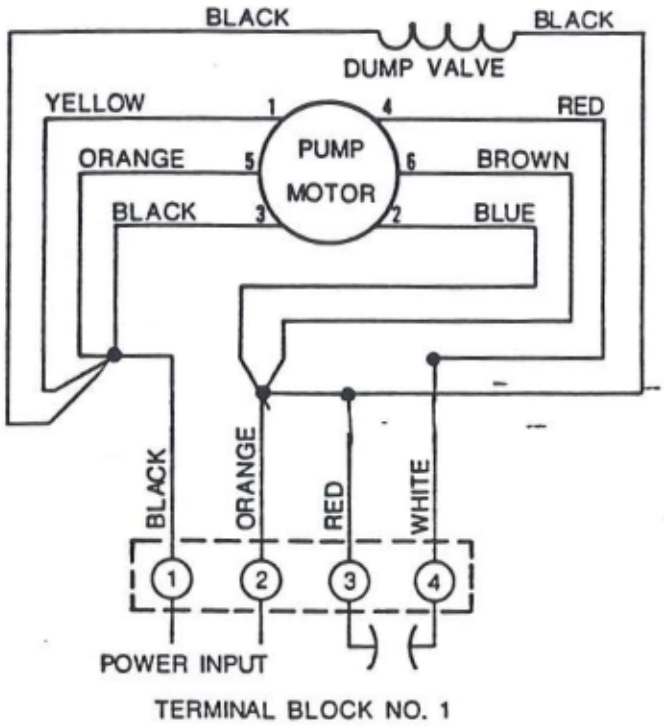


Figure 5-4A. Wiring Diagram (Internal, Single Phase) Model B
120/60 Hz, 110V/50Hz

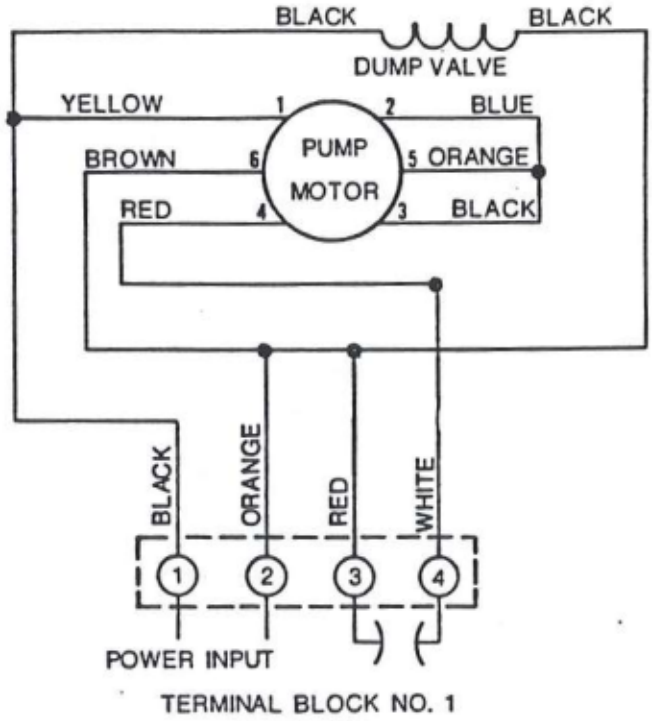


Figure 5-4B. Wiring Diagram (Internal, Single Phase) Model B
220V/50Hz, 240V/50Hz, 240V/60Hz
Note: Travel Limit Switch omitted on Model B

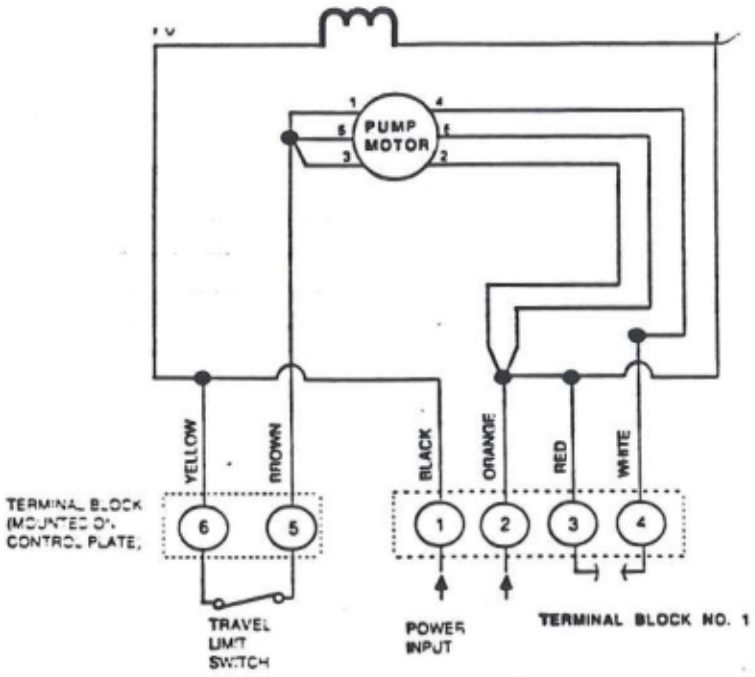


Figure 5-5A. Wiring Diagram (Internal, Single Phase) Model B-1
120/60 Hz, 110V/50Hz

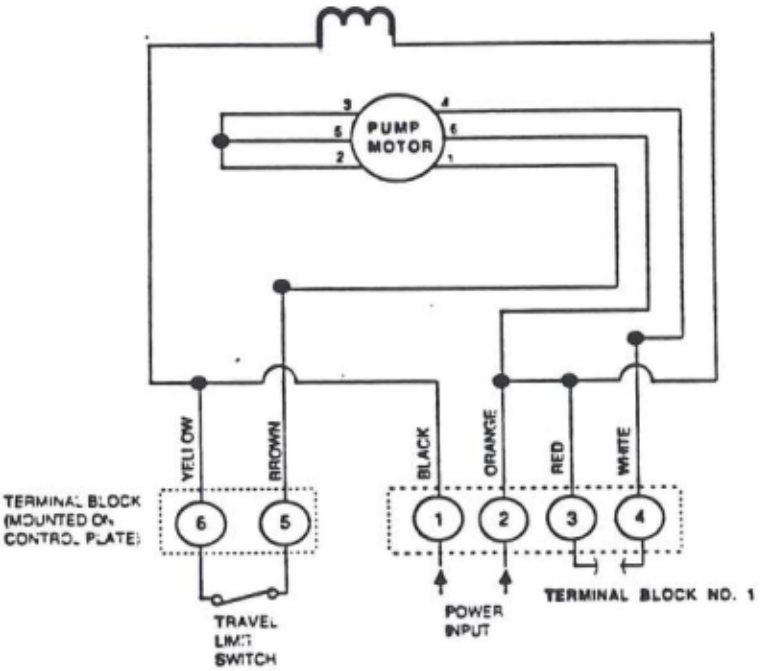


Figure 5-5B. Wiring Diagram (Internal, Single Phase) Model B-1
220V/50Hz, 240V/50Hz, 240V/60Hz
Note: Travel Limit Switch omitted on Model B

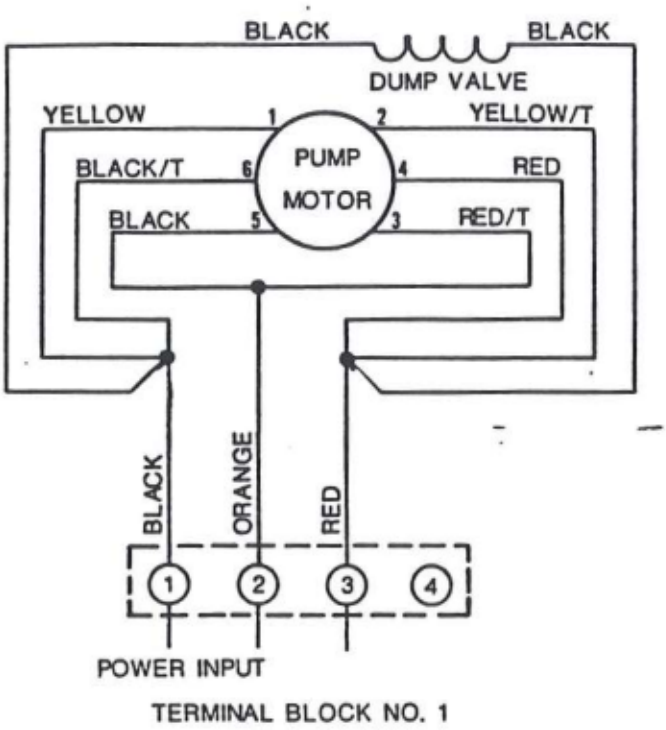


Figure 5-6A. Wiring Diagram (Internal, Three Phase) Model B
220V/50Hz, 230V/50Hz, 240V/60Hz

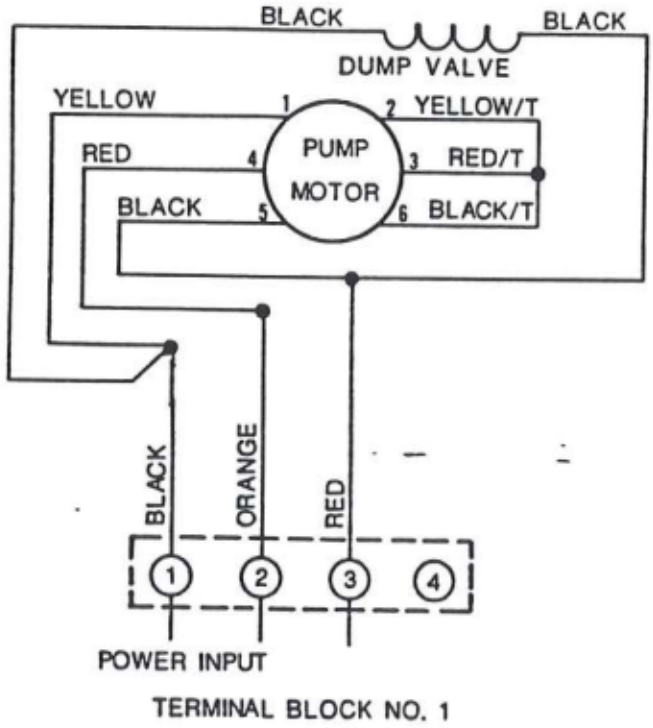


Figure 5-6B. Wiring Diagram (Internal, Three Phase) Model B
380V/50Hz, 440V/50Hz, 460V/60Hz, 480V/60Hz
Note: Travel Limit Switch omitted on Model B

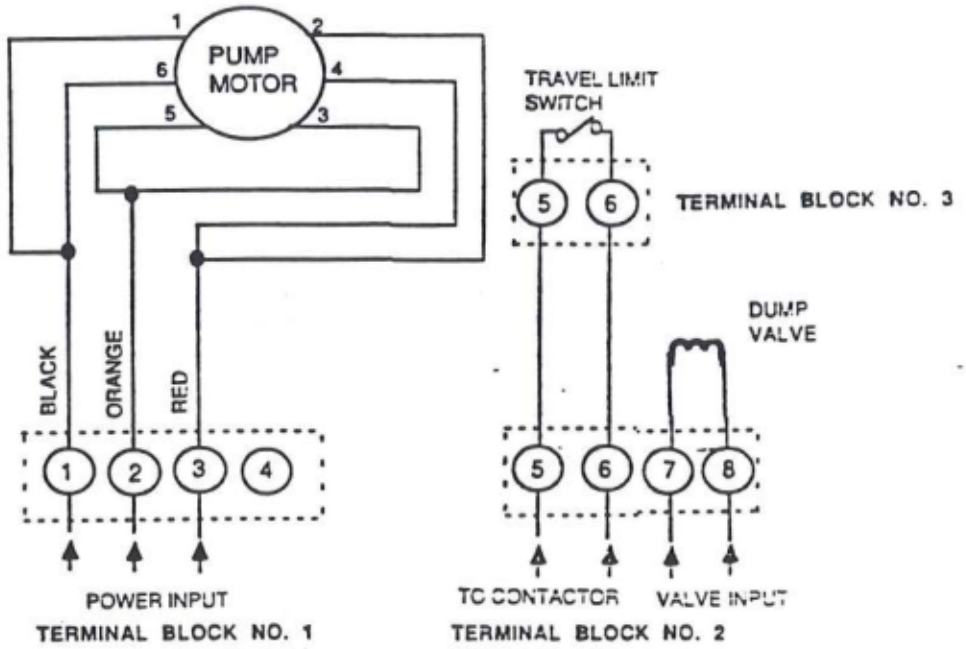


Figure 5-7A. Wiring Diagram (Internal, Three Phase) Model B-1
220V/50Hz, 230V/50Hz, 240V/60Hz

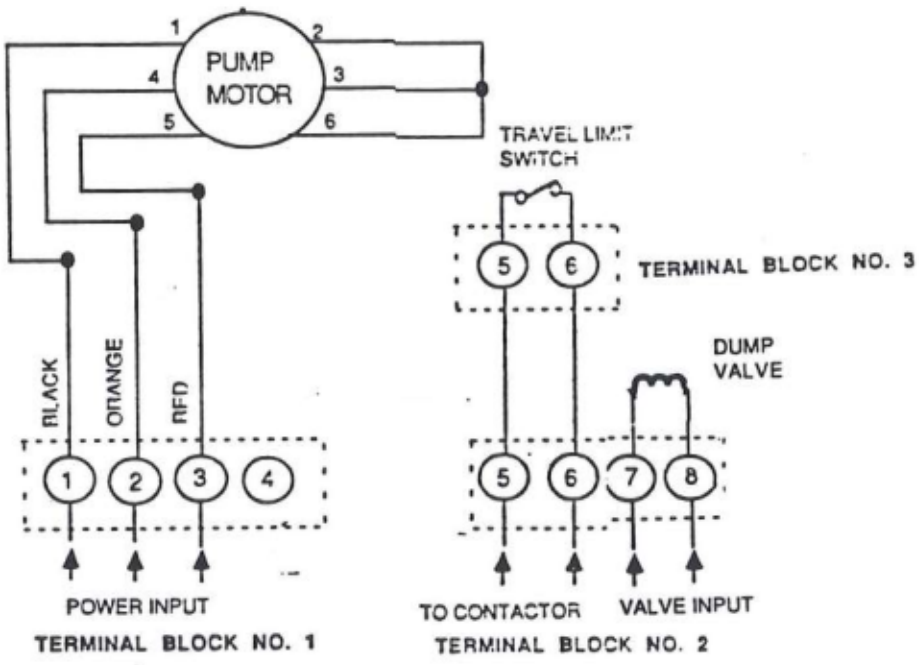


Figure 5-7B. Wiring Diagram (Internal, Three Phase) Model B-1
380V/50Hz, 440V/50Hz, 460V/60Hz, 480V/60Hz
Note: Travel Limit Switch omitted on Model B

5.3 STROKE ADJUSTMENT (Models B and B-1)

The mechanical travel limit stop nut prevents the application of excess force on the spring return stroke.

Both 1,500 lb. and 3,000 lb. (1,360 kg.) Hydramotors will provide a stroke length of 3 1/2 inches (89mm). The 4,000 lb. Hydramotors stroke to 4 inches (102mm).

5.3.1 Mechanical Travel Limit (see Figure 5-8).

1). Mount and wire the Hydramotor.
2). Energize the Hydramotor to extend the shaft. Check its travel to insure that the Hydramotor operates to the desired PCD stroke.

NOTE

The clearance between the stop nut and the bottom of the yoke web should be at least 1/16 inch.

3). Loosen the jam nut . The spring return stroke may be adjusted by threading the stop nut toward the Hydramotor to shorten the stroke or toward the PCD to lengthen it.
4). Hold the stop nut and tighten the jam nut against the stop nut .
5). Operate the Hydramotor through its full stroke a number of times to check operation. If proper stroking is not maintained, readjust the Hydramotor by repeating Steps 3 and 4 above.

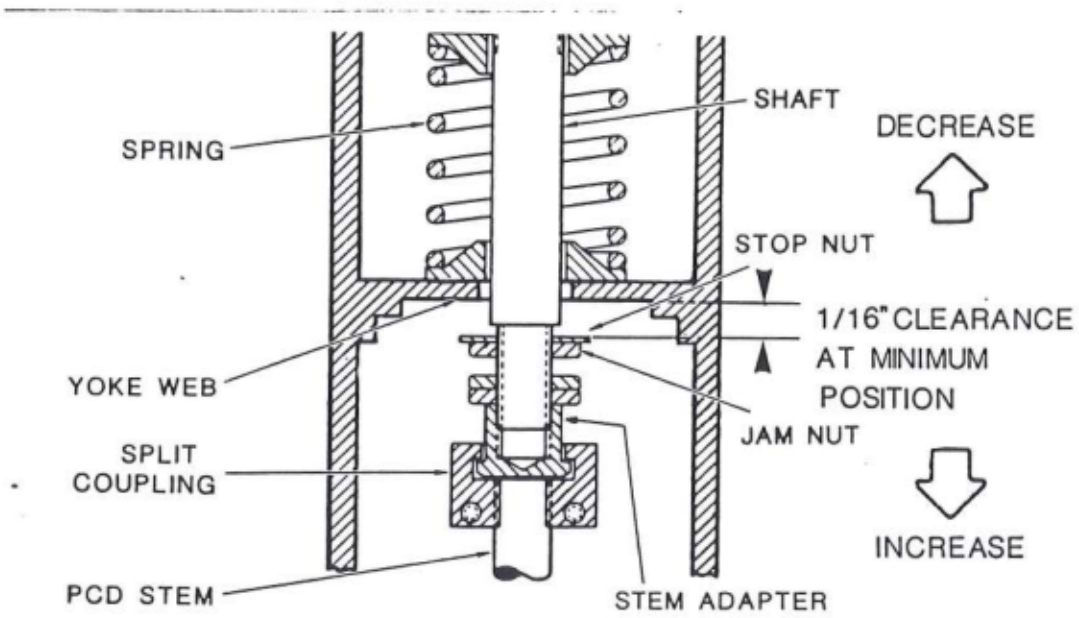


Figure 5-8. Mechanical Travel Limit

5.3.2 Limit Switch Adjustment (Model B-1 only)

Refer to Figures 5-9 and 5-10 for reference to the Limit Switch Adjustment and Control Plate Assembly viewing.

1). With the Hydramotor shaft connected to the PCD and de-energized (fully retracted), depress the switch arm until the switch just clicks, and measure the distance between the top of the switch arm and the underside of the switch collar (dimension X, Figure 5-9). This distance should be the stroke required for the PCD.

2). If the measured stroke (travel) distance is incorrect, loosen the two adjustment screws Lower the limit switch to increase the stroke or raise the limit switch to decrease the stroke. After the correct stroke is achieved, tighten both adjustment screws securely.

3). Operate the Hydramotor through several cycles and readjust the stroke as necessary.

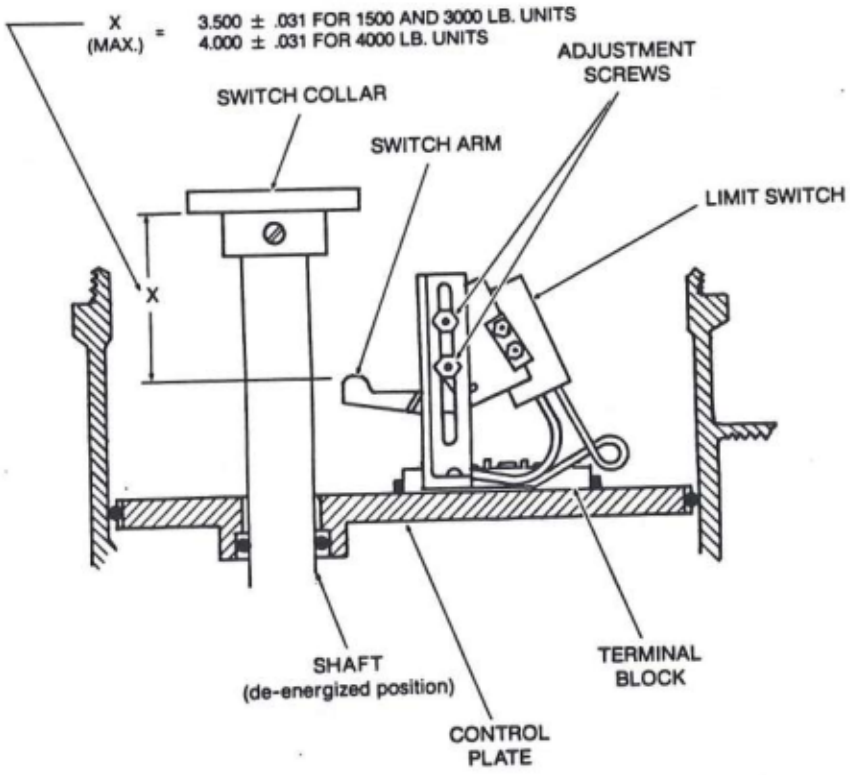


Figure 5-9. Limit Switch Adjustment

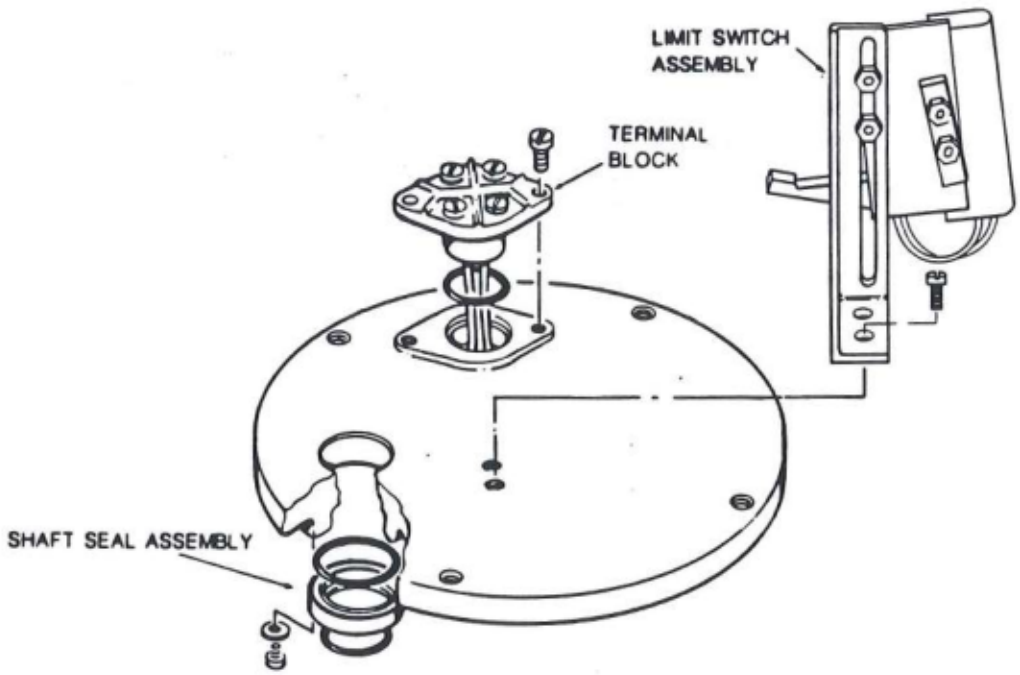


Figure 5-10. Control Plate Assembly

5.4 TROUBLESHOOTING

These charts are intended to assist in isolating and correcting operating problems. Follow the arrows perform each block-solution in sequence, and check the operation of the Hydramotor after each corrective stage.

5.4.1 Figures 5-12A, B and C are flowchart troubleshooting guide examples for **Model B**.as follows:

A. The Hydramotor will not stroke when the motor runs.

B. The motor does not run.

5.4.2 Figures 5-12A, B and C are flowchart troubleshooting guide examples for **Model B-1** as follows:

A. The Hydramotor will not stroke when the motor runs.

B. The motor does not run.

C. Hydramotor recycles more than once per 45 seconds.

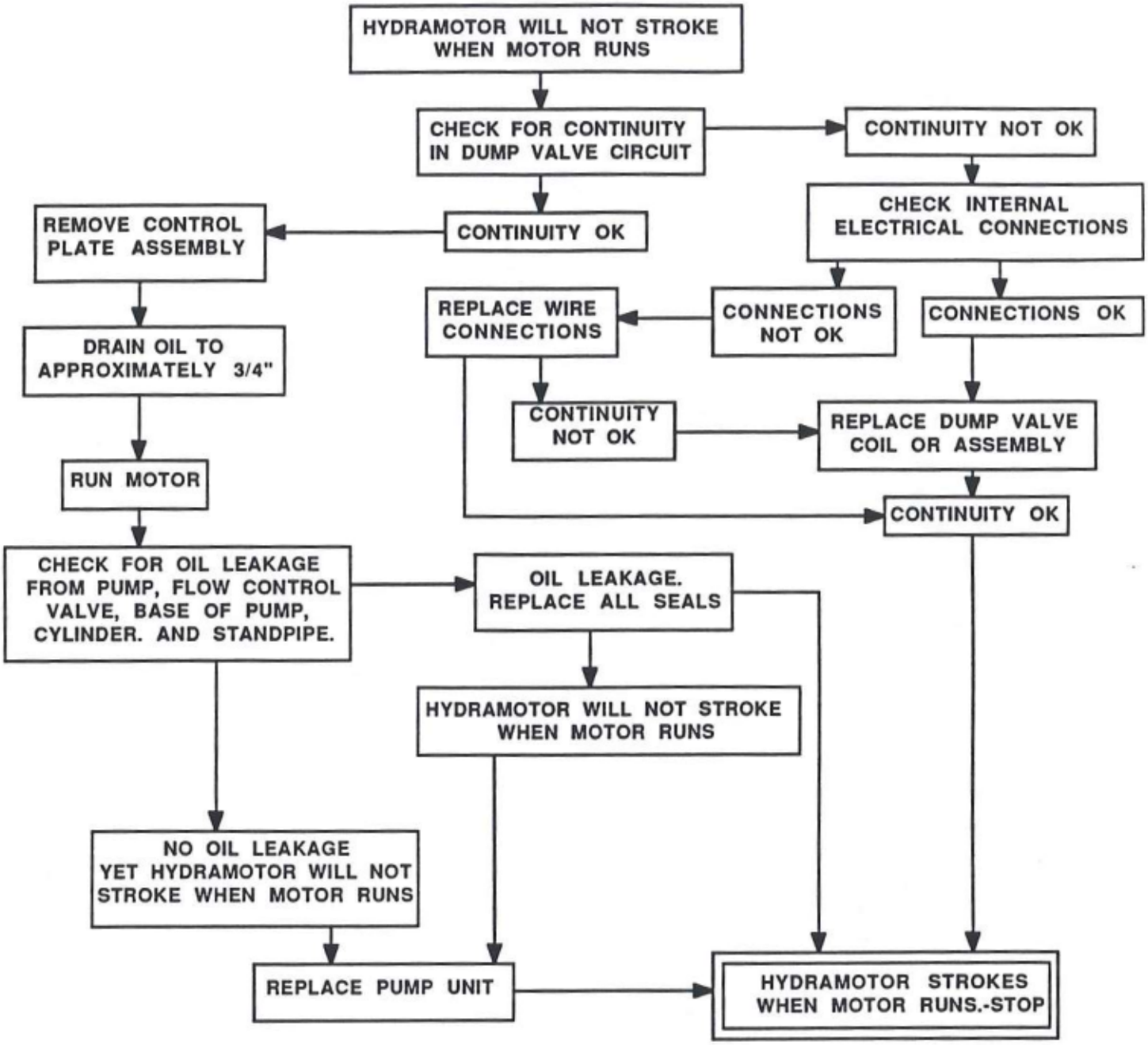


Figure 5-11A. Troubleshooting Guide. Motor Runs Properly
Model B

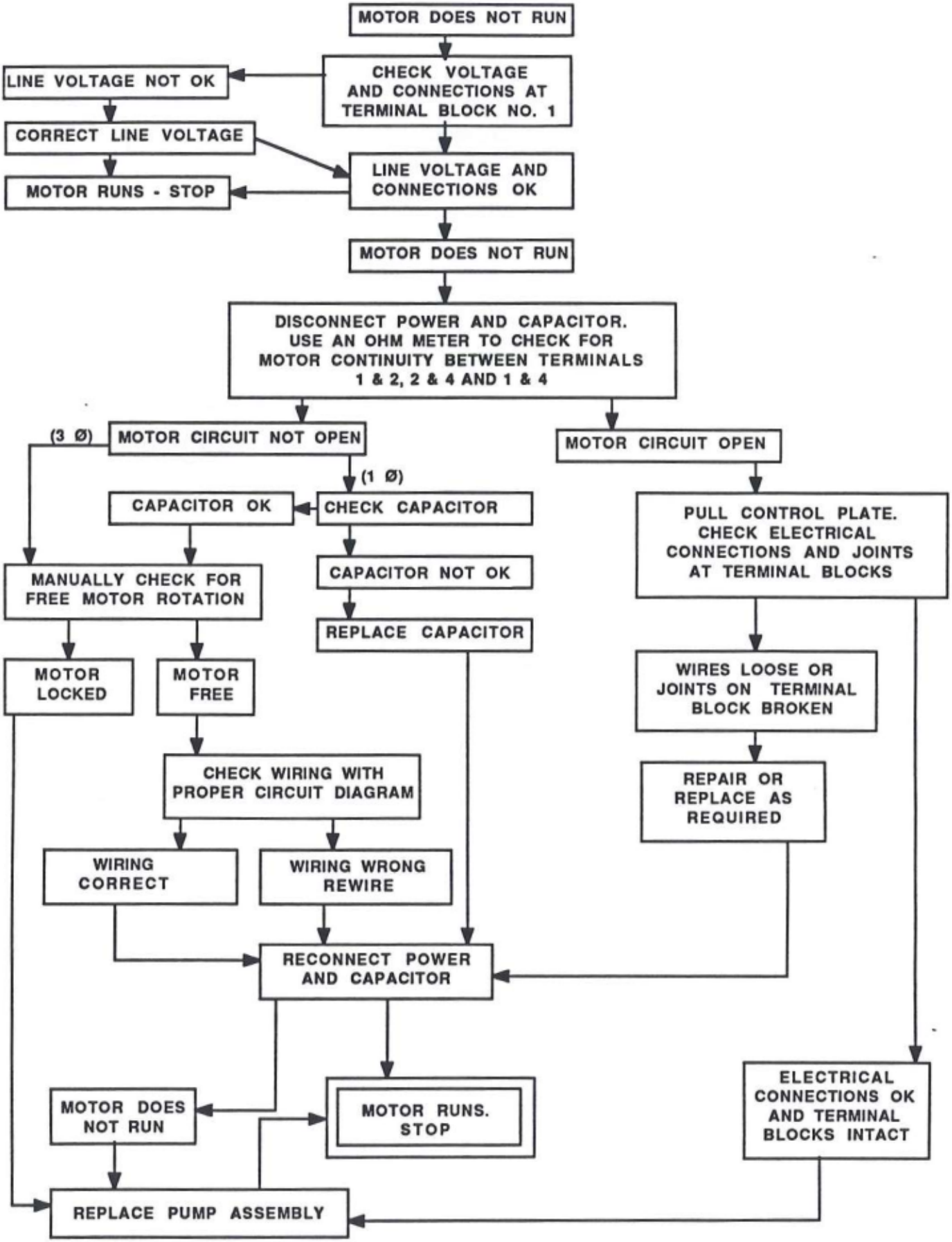


Figure 5-11B. Troubleshooting Guide. Motor Does Not Run Properly
Model B

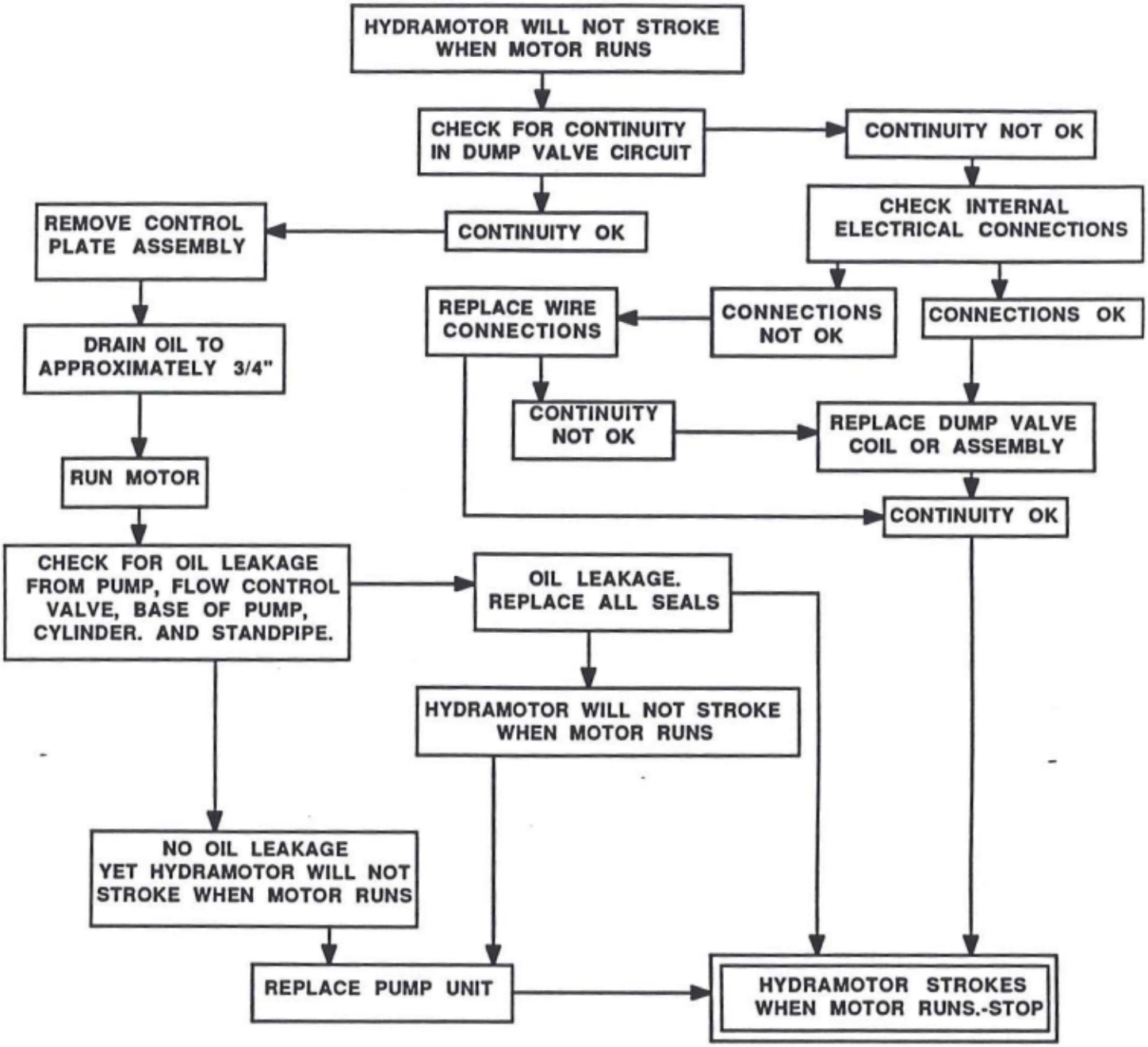


Figure 5-12A. Troubleshooting Guide. Motor Runs Properly.
Model B-1

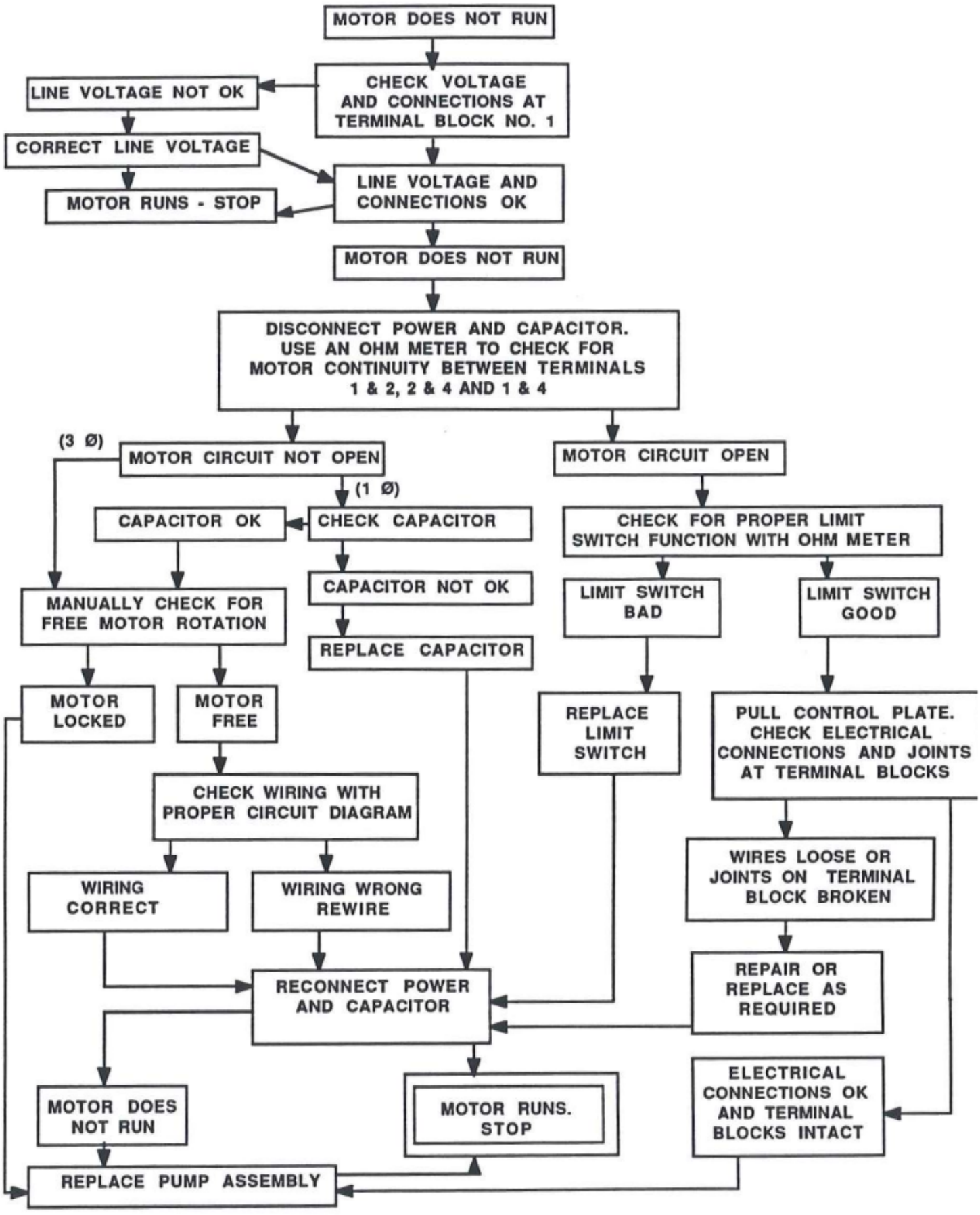
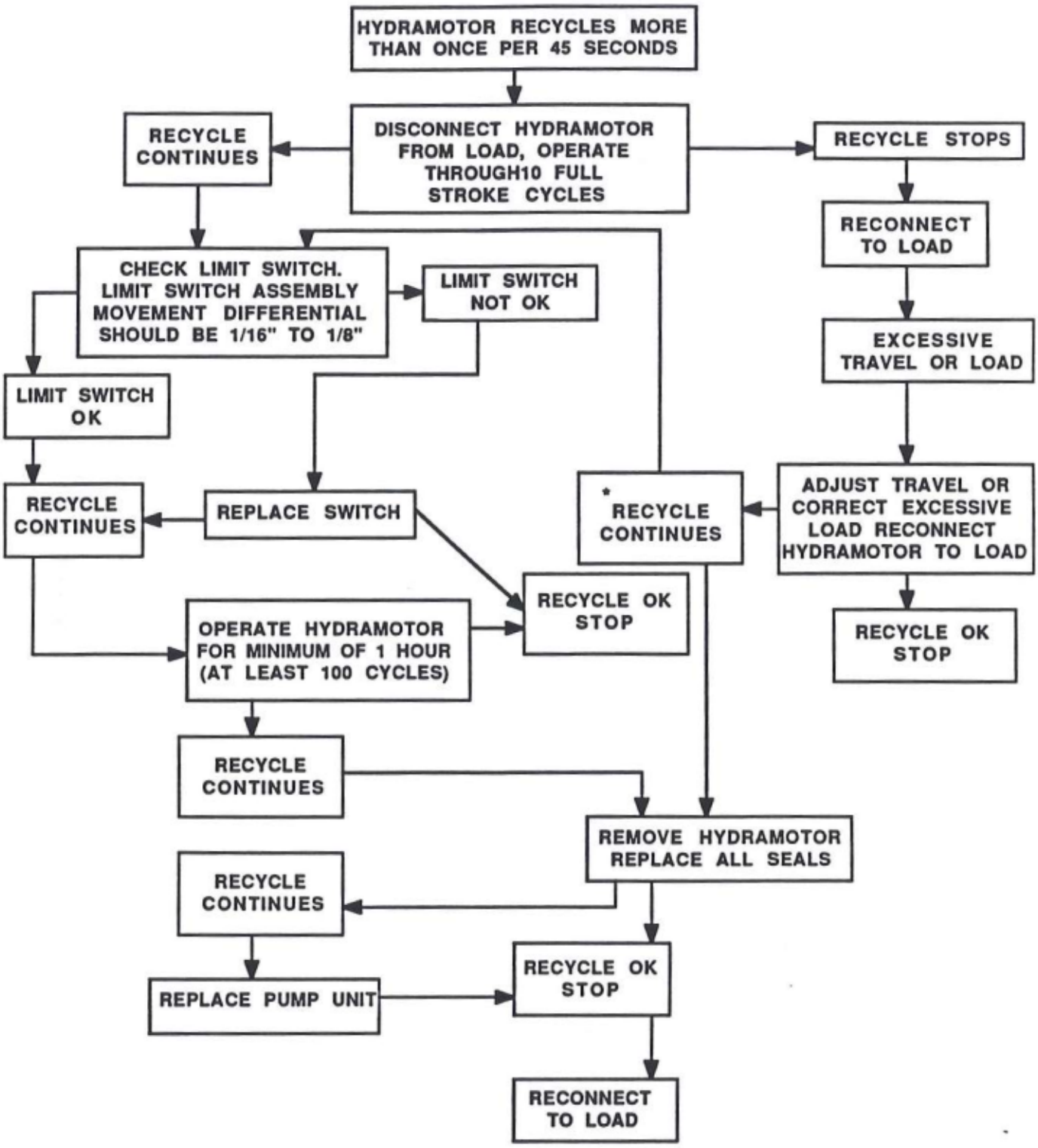


Figure 5-12B. Troubleshooting Guide. Motor Does Not Run Properly. **Model B-1**



*If the load travel or force has exceed the hydramotor rating for a significant period of time, the safety relief valve may have beendamaged.

Figure 5-12C Troubleshooting Guide. Recycle
Model B-1

5.5 OVERHAUL

5.5.1 Disassembly of the Hydramotor requires the following steps (see Figure 5-16 A and B at the end of this section for an exploded view):

A. Preparing the Hydramotor for Disassembly:

1). **Turn off the electrical power supply to the Hydramotor.**
2). Drain off the capacitor charge on single phase Hydramotors.
3). Return the shaft to its de-energized position. Disengage the manual override, if so equipped.

WARNING

THE ABOVE THREE STEPS MUST BE PERFORMED TO AVOID ELECTRICAL SHOCK/HYDRAULIC PRESSURE HAZARD.

4). Remove all slotted head screws from both sides of the yoke.
5). Remove the plastic dust covers (and metal stiffener plate if applicable) from the yoke.
6). Remove the Hydramotor from the PCD (per 1.6.1).
7). Move the Hydramotor to a clean work place for disassembly.
8). Assure availability of the proper tools per 1.7.2 and subsection 6.5 (SPECIAL TOOLS), expendable items (see Table 1-2), and appropriate kits per subsection 7.4 (STANDARD SERVICE KITS).
9). Remove the electrical and control covers, and remove and discard both O-rings.

B. Removing the Control Plate Assembly. **For Model B Hydramotors proceed to step 5;** otherwise, continue with step 1 for Model B-1 Hydramotors.

1). Remove the two slotted head screws securing the limit switch wires 5 and 6, Terminal Block No. 2, mounted on the control plate.
2). Remove the two limit switch wires and replace the screws in the Terminal Block.
3). Loosen the two set screws (653) and remove the switch collar (652).
4). Remove the two slotted head screws that secure the limit switch (402) to the control plate. Remove the post and limit switch together (see Figure 5-11A and B).
5). Install the Control Plate Removal Clamp (P/N S109795F) with the same screws removed from the limit switch post (see Figure 5-10).
6). Remove the four 1/4" hex head screws (605) that hold the control plate (606) to the housing (625).
7). Place the table top over the housing (part of the Power Module

Work Stand P/N S109795A).

8). Clamp a pair of locking pliers onto the Control Plate Removal Clamp at a slight angle approximately 30° (see Figure 5-14).

9). Place protective padding (a rag or towelling) between the locking pliers and the top of the housing.

10). Strike (with the palm of your hand) the end of the locking pliers in a downward manner. This action will lift the control plate off of the large O-ring seal in the housing. Then slide the control plate up and off the shaft.

NOTE

The control plate cannot be allowed to hang on its wiring outside the housing, rather use the table top.

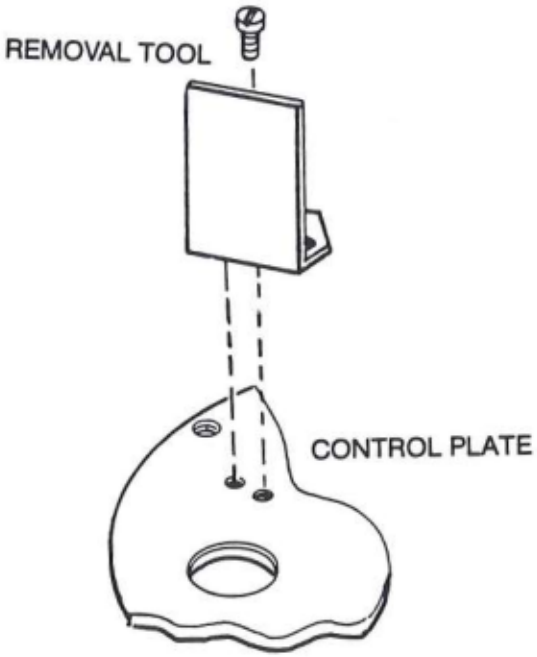


Figure 5-13 Control Plate Removal Tool

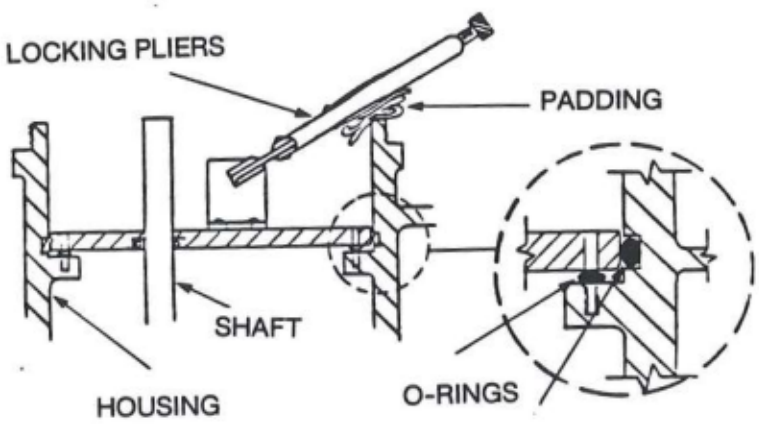


Figure 5-14. Removing the Control Plate

C. Removing the Pump

1). Remove the oil drain plug (619) on the rear of the housing (625) and drain the hydraulic oil into a one gallon container
2). After the oil has drained out, replace the oil drain plug (619) and secure it finger tight. There will be oil remaining in the cylinder (501) and pump (201).
3). Remove the three hex nuts (607) and the three lock washers (608) that hold the pump (201) in place.
4). Place a blunt tool, such as a large screwdriver, between the cylinder cap (102) and the pump (201) . Carefully pry them apart to allow the pump wires to be pulled up above the pump. This will not require very much leverage. The wires will come up one at a time.
5). Wipe the oil off of the nylon connectors (205). These connectors must be removed before the pump can be lifted out of the housing. **Do not cut the wires.**
Locking pliers may be used to reverse the crip by rotating the connectors 90° from their oroginal crimped position. Once the connector is removed, separate the wires.
6). Loosen the two slotted head screws on the top of the pump (201) and install the Pump Removal Tool (P/N S109795O).
7). Lift the pump (201) straight up tilt it to drain out excess oil, and lift it out of the housing (625)
8). The small nipple (202) that connects the pump to the housing may come out with the pump or stay in the housing. In either case, the nipple must be removed and its O-rings (7) replaced.
9). Place a drain pan under the Work Table (P/N S109795B). Turn the Hydramotor upside down and set it on the WorkTable The remaining oil will drain out.

D. Removing the Yoke and Spring Assembly

Refer to 6.4.1.

E. Removing the Shaft Assembly and Bushing

1). Remove the housing from the Work Table and secure in the Power Module Work Stand (P/N S109795A).
2). Remove the bushing lock screw (624) if so equipped (no screw is used on 4,000 lb. (1,800 kg.) Hydramotors).
3). Remove the two 15/16" hex bolts (614), two lock washers (615), and two washers (616).
4). Rotate the work stand 90° and tap the threaded end of the shaft (507) with a rubber mallet to remove the shaft, piston assembly, cylinder with cap, and stand pipe (617) per 6.2.1.
5). Install the Bushing Socket Tool (P/N S109795D for 1,500 Hydramotors, or P/N S109795L for 3,000 lb. (1,360 kg.) or 4,000 lb. (1,800 kg.) Hydramotors) and unscrew the bushing

(101) from the bottom of the housing (625).

F. Removing Electrical Components

1). Single Phase Hydramotors only: Remove screws 3 and 4 from Terminal Block No. 1 (see Figure 5-14). Replace the capacitor (641) if bad. Replace the screws in the Terminal Block (630).
2). Remove the screws (635) that secure Terminal Block No. 1 (630) to the housing. Remove Terminal Block No. 1, complete with its O-ring 16 and spacer (628).
3). Remove two screws that secure blank Terminal Block No. 2 (634) to the housing. Remove this blank Terminal Block complete with its O-ring (16) and spacer (628).
4). Remove the housing from the Power Module Work Stand and remove the two oil drain plugs (619) from the rear of the housing.
5). Separtate the cylinder (501) from the cap (02), remove the shaft (507) with piston assembly from the cylinder and remove the stand pipe (617).
6). The housing, yoke, springs, cylinder, stand pipe,and cylinder cap are ready for cleaning and inspection.
7). Refer to section 6 (OVERHAUL OF COMMON COMPONENTS) for instructions on disassembly of the piston and removal of the seal from the bushing.

G. Removing Seals from the Control Plate

1). Invert the control plate (606).
2). Remove the two slotted head screws and two brass washers that hold the shaft seal bushing to the control plate (see Figure 5-13).
3). Remove the seal bushing and discard its two O-rings.
4). Thoroughly clean the control plate by solvent de-greasing or similar method.

5.5.2 Assembly of Hydramotors

This procedure is to be followed after all Hydramotor components have been cleaned and inspected. All parts must be free from dirt impurities, and excessive wear (replace parts as necessary).

NOTE

The principle cause of hydraulic fluid bypass problems is improper sealing due to O-ring and seal damage in reassembly. Inspect and install O-rings and seals carefully, ensuring that they are not cut, rolled, abraded, or dislodged during assembly procedures. Prior to reassembly, lubricate the O-rings thoroughly with petroleum jelly.

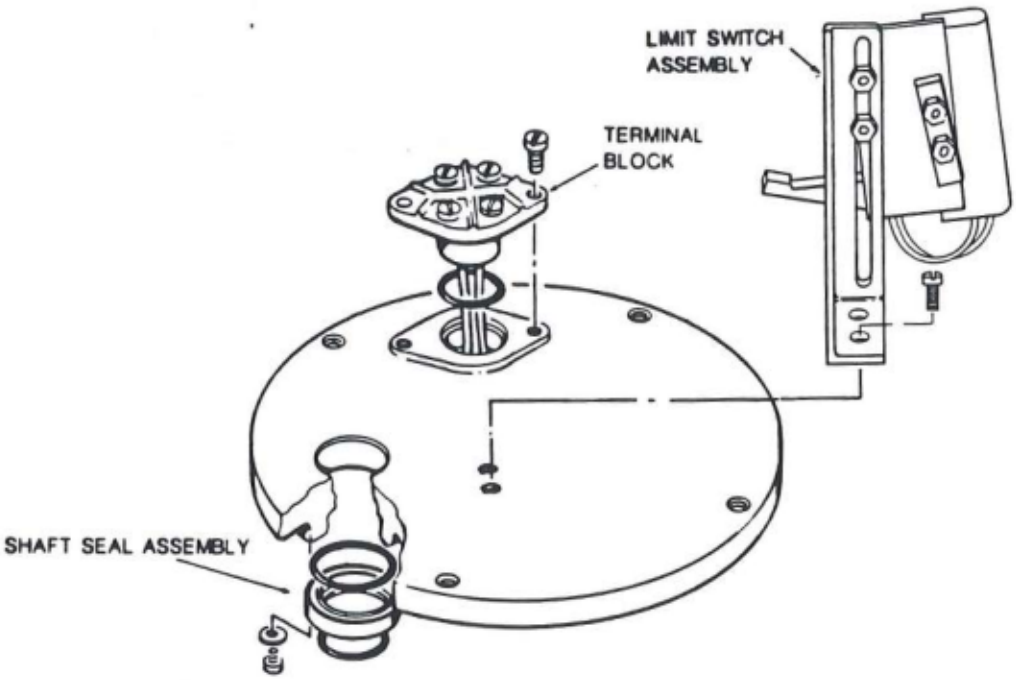


Figure 5-15. Upper Shaft Seals

A. Preparing the Housing for Assembly

1). Replace the O-rings (4) on the oil fill plug and oil drain plug (619) and assemble in the rear of the housing (625).
2). Place the housing (625) in the Power Module Work Stand (P/N S109795A) and secure.
3). Assemble the bushing per subsection 6.1 (BUSHING AND CYLINDER CAP).
4). Lubricate the O-ring (9) with white petroleum jelly and install the bushing (101) into the bottom of the housing (625) with the Bushing Socket Tool (P/N 109795D for 1,500 lb. (680 kg.) Hydramotors and P/N S109795L for 3,000 lb. (1,360 kg.) and 4,000 lb. (1,800 kg.) Hydramotors). Once the Bushing Socket Tool touches the housing, the bushing is tight. Turn the Bushing Socket Tool 1/4 turn ccw.

5). Install the bushing lock screw (624) if required. (No screw is required on 4,000 lb. (1,800 kg.) Hydramotors).
6). Lubricate the two Terminal Block O-rings (16) with petroleum jelly and install on Terminal Blocks No. 1 (630) and No. 2 (634). Fit spacers (628) onto the Terminal Blocks and secure them in the housing (625).
7). Reconnect the capacitor to terminals 3 and 4 on Terminal Block No. 1.

B. Shaft Assembly

1). Rotate the housing to the upright position.
2). Lubricate and assemble a new O-ring (14) on the shaft.
3). Perform the assembly procedures described in subsection 6.2 (SHAFT AND PISTON ASSEMBLY).
4). Lubricate the polymyte piston seal (15) and insert the shaft and piston assembly into the cylinder (501).
5). Lubricate both the seal (12) , the O-ring (13) and the cylinder cap (102), then install the assembly into the cylinder (501).
6). Replace two O-rings (7) on the stand pipe (617) and insert it into the cylinder cap (102). **(The machined end of the stand pipe fits into the cylinder cap.)**
7). Lubricate the tapered end of the shaft (507) with white petroleum jelly and insert it into the bushing (101) from above.
8). Carefully line up the stand pipe with the hole in the bottom of the housing as the cylinder slips over the bushing.
9). Install two 15/16" hex bolts (614) with their flat washers (616) and lock washers (615), finger tight.
10). Tighten the two hex bolts (614) to hold the cap securely in the housing (625).

C. Yoke and Spring Assembly

Refer to 6.4.3.

D. Pump

1). Install new O-rings (7) on the small nipple (202), lubricate with white petroleum jelly and install the nipple assembly into the bottom of the housing. Use care not to bind or cut the O-Rings.
2). Attach the Pump Removal Tool (P/N S109795O) to the pump (201). Carefully set the pump into the housing. Do not rest the pump on the nipple in the bottom of the housing. Place a small screwdriver in one of the rear stud holes to prevent the pump from seating fully, and to allow room for inserting the wiring assembly.
3). Refer to subsection 5.2 (WIRING DIAGRAMS) for the appropriate wiring combinations.

4). Place clean padding (rag or towelling) over the pump to prevent any loose wire strands from entering the top of the pump.
5). Connect the wiring by twisting the wire strands together. Use "duck bill" (flat nose) pliars to smooth out the wire twist. Insert into the connector (205). Crimp with a crimping tool such as Hollingsworth H-18.
6). After wiring is complete, carefully tuck all wiring down between the cylinder (501) and pump housing (201). Remove the protective padding.
7). Remove the screwdriver and gently lower the pump (201) onto the nipple (202). Do not drop or force the pump down on the nipple. The pump will settle down on the nipple with very little force.
8). Remove the Pump Removal Tool and tighten the two screws onthe pump.
9). Install three lock wshers (608) and nuts (607) onto the pump studs (609). **Torque these nuts to approximately 24 in.-lb. (±0%-10%).**
10). Carefully fill the housing to the level of the fill port with oil (approximately 3 1/2 quarts). Do not allow the oil to enter the large O-ring groove or the four 1/4" threaded holes used to hold down the control plate (giving the appearance of a leak). As the pump takes in oil, the proper oil level will be maintained.

E). Control Plate and Final Assembly

1). Insert a new O-ring (16) and seal (17) in the shaft seal retainer (610) and replace it into the bottom of the control plate (606).
2) Place four small O-rings (3) over the 1/4" bolt holes in the housing.
3). Lubricate and carefully install the large O-ring (2) in the groove at the top of the housing. **Do not get oil on this large O-ring or the four small O-rings (giving the appearance of a leak).**
4). Install the controller assembly (606). Snug down the four 1/4" hex bolts (605).
5) For Model B-1, install the Limit Switch Assembly with Limit Switch (402) before continuing; **otherwise, proceed to step 7 for Model B.**
6). Connect the wires to Terminal Blocks 4 and 5 on the Control Plate Terminal Block (642).
7). Replace the plastic dust covers and metal stiffener plate (if applicable) onto the yoke with mounting screws.
8). Apply power and test for correct operation.
9). Replace the control cover O-ring (1) on the top of the housing, apply anti-seizing lubricant to the threads, and screw on the control cover (601).
10). Replace the O-ring (2) on the electrical cover (603), apply anti-seizing lubricant to the threads, and screw in the cover (603).

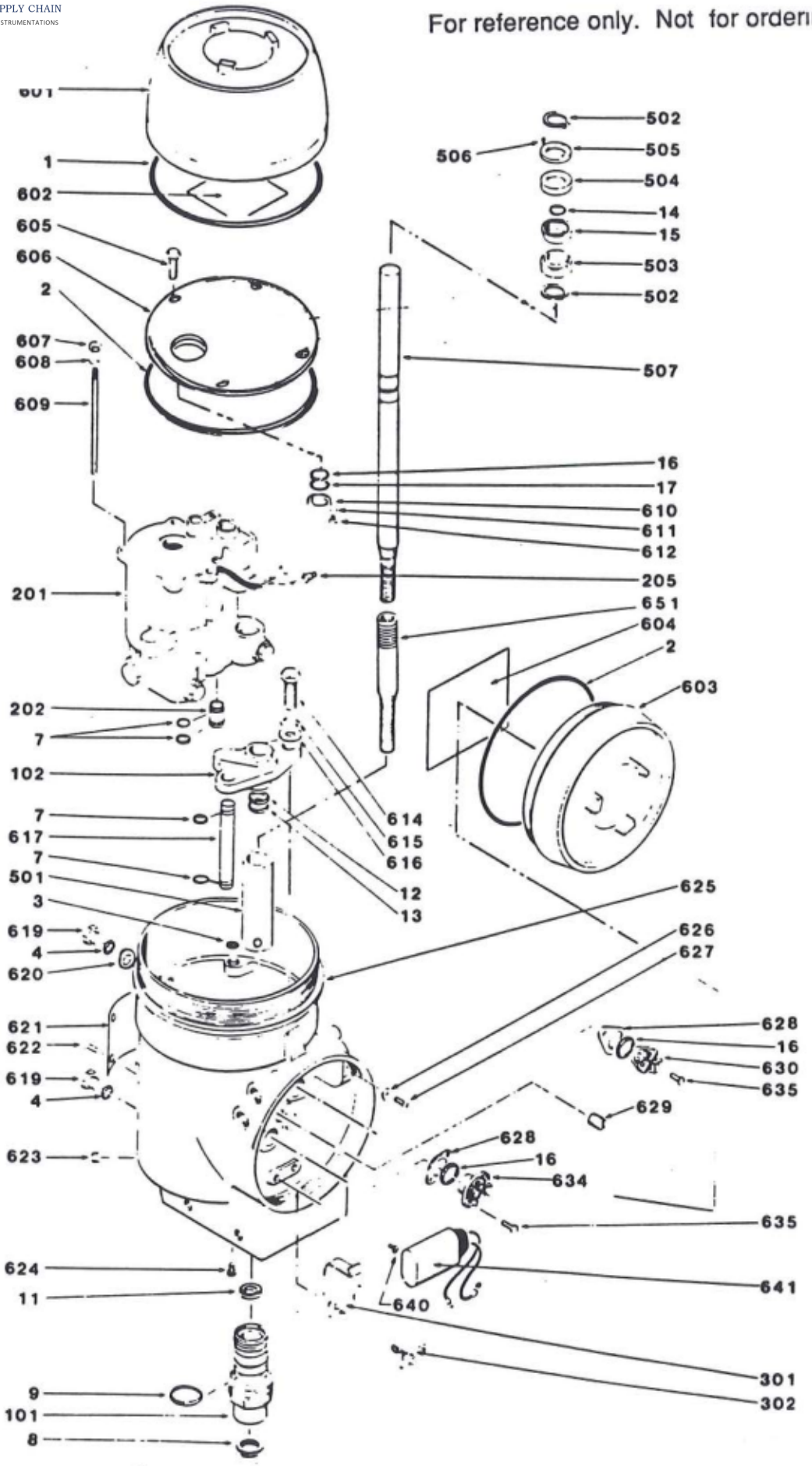


Figure 5-16A. Exploded View for **Model B**

Legend for Figure 5-16A
Exploded View for **Model B**

Item No.	Description	No. Required
1	O-ring, Control Cover	1
2	O-ring, Control Plate and Electrical Cover	2
3	O-ring, Control Plate Mounting Bolts	4
4	O- ring, Drain and Fill Plugs	2
5	O-ring, Pump Spring	1
6	O-ring, Pump	1
7	O-ring, Pump Nipple	4
8	Wiper ring	1
9	O-ring, Bushing	4
11	Seal	1
12	Seal	1
13	O-ring	1
14	O-ring	1
15	Polymyte Piston Ring	1
17	O-ring. Seal Retainer	1
101	Bushing	1
102	Cylinder Cap	1
201	Pump	1
202	Nipple	1
205	Connector	5
301	Capacitor Plate	1
302	Capacitor Strap	1
501	Cylinder	1
502	Split Retaining Ring	2
503	Piston	1
504	Spacer (1,500 lb. (680 kg.) Hydra. only)	1
505	Retainer	1
506	Set Screw	3
507	Shaft	1
601	Control Cover	1
602	Wiring Diagram	1
603	Electrical Cover	1
604	Wiring Diagram	1
605	Hex Head Cap Screw	4
606	Control Plate	1
607	Hex Nut	3
608	Lock washer	3
609	Double Ended Stud	3
610	Seal Retainer	1
611	Flat washer	2
612	Slot Head Screw	2
614	Hex bolt	2

Legend for Figure 5-16A.
Exploded View for **Model B** (Continued)

Item No.	Description	No. Required
615	Lock washer	2
616	Flat washer	2
617	Stand Pipe	1
619	Oil Fill Plug and Oil Drain Plug	2
620	Plate, Caution	1
621	Nameplate	1
622	Screws, Nameplate	4
623	Plug	1
624	Buching, Lock Screw	1
625	Housing	1
626	Washer	1
627	Screw	1
628	Spacers, Terminal Blocks	2
630	Terminal Block No. 1	1
634	Terminal Block No. 2	1
635	Screws	4
640	Screws, Capacitor Clamp	2
641	Capacitor (Single Phase Only)	1
651	Shaft Extension	1

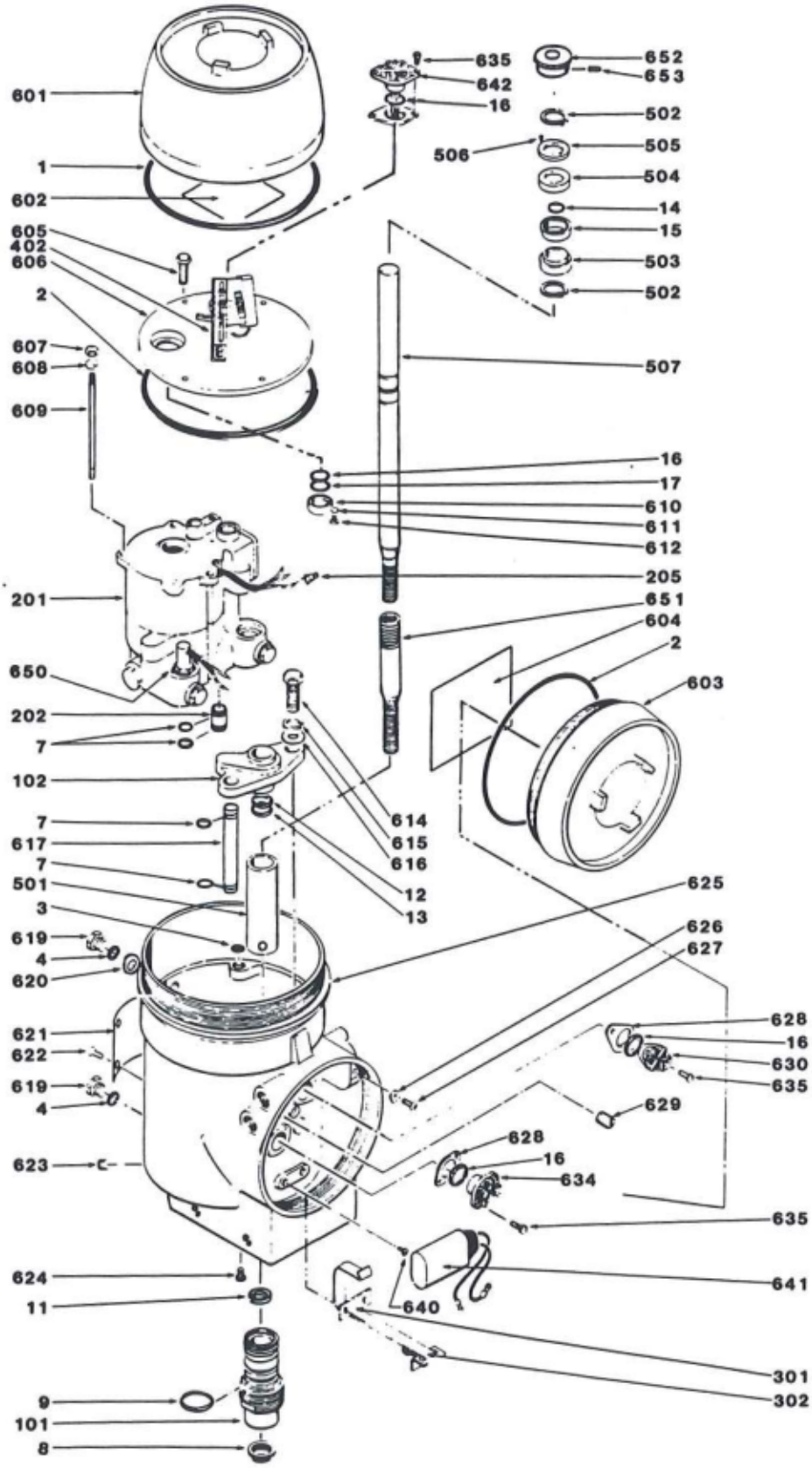


Figure 5-16B. Exploded View for **Model B-1**

Legend for Figure 5-16B
Exploded View for **Model B-1**

Item No.	Description	No. Required
1	O-ring, Control Cover	1
2	O-ring, Control Plate and Electrical Cover	2
3	O-ring, Control Plate Mounting Bolts	4
4	O- ring, Drain and Fill Plugs	2
5	O-ring, Pump Spring	1
6	O-ring, Pump	1
7	O-ring, Pump Nipple	4
8	Wiper ring	1
9	O-ring, Bushing	4
11	Seal	1
12	Seal	1
13	O-ring	1
14	O-ring	1
15	Polymyte Piston Ring	1
16	O-ring, Seal Retainer, Terminal Blocks	4
17	O-ring. Seal Retainer	1
101	Bushing	1
102	Cylinder Cap	1
201	Pump	1
202	Nipple	1
205	Connector	5
301	Capacitor Plate	1
302	Capacitor Strap	1
501	Cylinder	1
502	Split Retaining Ring	2
503	Piston	1
504	Spacer (1,500 lb. (680 kg.) Hydra. only)	1
505	Retainer	1
506	Set Screw	3
507	Shaft	1
601	Control Cover	1
602	Wiring Diagram	1
603	Electrical Cover	1
604	Wiring Diagram	1
605	Hex Head Cap Screw	4
606	Control Plate	1
607	Hex Nut	3
608	Lock washer	3
609	Double Ended Stud	3
610	Seal Retainer	1
611	Flat washer	2
612	Slot Head Screw	2

Legend for Figure 5-16B
Exploded View for **Model B-1**(Continued)

Item No.	Description	No. Required
614	Hex bolt	2
615	Lock washer	2
616	Flat washer	2
617	Stand Pipe	1
619	Oil Fill Plug and Oil Drain Plug	2
620	Plate, Caution	1
621	Nameplate	1
622	Screws, Nameplate	4
623	Plug	1
624	Buching, Lock Screw	1
625	Housing	1
626	Washer	1
627	Screw	1
628	Spacers, Terminal Blocks	2
630	Terminal Block No. 1	1
634	Terminal Block No. 2	1
635	Screws	6
640	Screws, Capacitor Clamp	2
641	Capacitor (Single Phase Only)	1
642	Terminal Block, Control Plate	1
650	Dump Valve	1
651	Shaft Extension	1
652	Switch Collar	1
653	Set Screw	2

OVERHAUL OF COMMON COMPONENTS

6. OVERHAUL OF COMMON COMPONENTS

This section explains the methods used to remove, disassemble, replace (as necessary) and reassemble components common to all Hydramotors. All procedures must be followed carefully to insure trouble-free operation of repaired Hydramotors.

The principle cause of Hydraulic fluid bypass problems is improper sealing due to O-ring and seal damage in reassembly. Inspect and install O-rings and seals carefully, insuring that they are not cut, abraded,or dislodged during assembly procedures. Prior to reassembly, lubricate thoroughly with white petroleum jelly.

6.1. BUSHING AND CYLINDER CAP

A common (101) bushing (see section's exploded view), is used for both pull and push type Hydramotors. Disassembly and assembly are the same for all Hydramotors. All bushings require one wiper ring. The push and pull type Hydramotors require different seal configurations as follows:

1). Pull type: require two seals on the inside and four O-rings on the outside diameter. The cylinder cap requires no seal or O-ring.
2). Push type: require one seal on the inside and one O-ring on the outside diameter. The cylinder cap requires a seal and O-ring.

All Model B-1 Hydramotors are equipped with improved Viton seals. Different bushings are required.

Bushings are made of brass and should be handled with care. Small nicks or scratches should be polished or removed with crocus cloth. Inspect the bushing for wear; the inside diameter must not be out of round.

If the bushing shows signs of wear, scoring, side-loading,or other damage, it should be replaced along with the shaft and yoke bushing. When reinstalling the Hydramotor, check alignment and linkage carefully to minimize side loading.

6.1.1 Removal of Seals (Refer to Figure 6-1 and 6-2)

Once the cylinder cap and bushing assemblies have been removed from the Hydramotor housing, proceed as follows:

1). To remove the bushing wiper ring, pierce it with a sharp awl or similar tool. Carefully pry the wiper ring out of the bushing.

2). Carefully remove the seals on the inside of the bushing and cylinder cap (push type Hydramotors only) and pry then out. Extreme care should be used to avoid scratching or marking the inside diameter of the bushing and cylinder cap.

3). Thoroughly clean and inspect the bushing and cylinder cap for wear, cracks, and for damaged threads or grooves; if damaged, replace. (Small nicks in the bushing threads as a result of the lock screw do not necessitate bushing replacement).

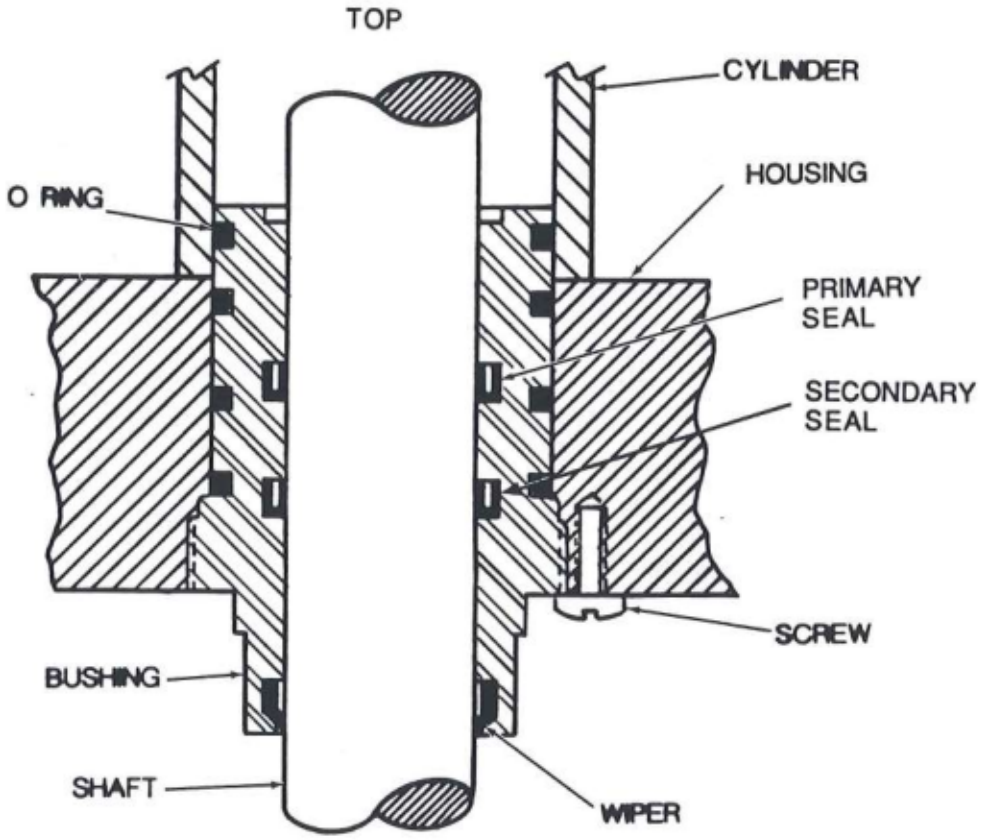


Figure 6-1 A. Assembled Seal, O-Ring, Wiper , and Bushing Pull Type

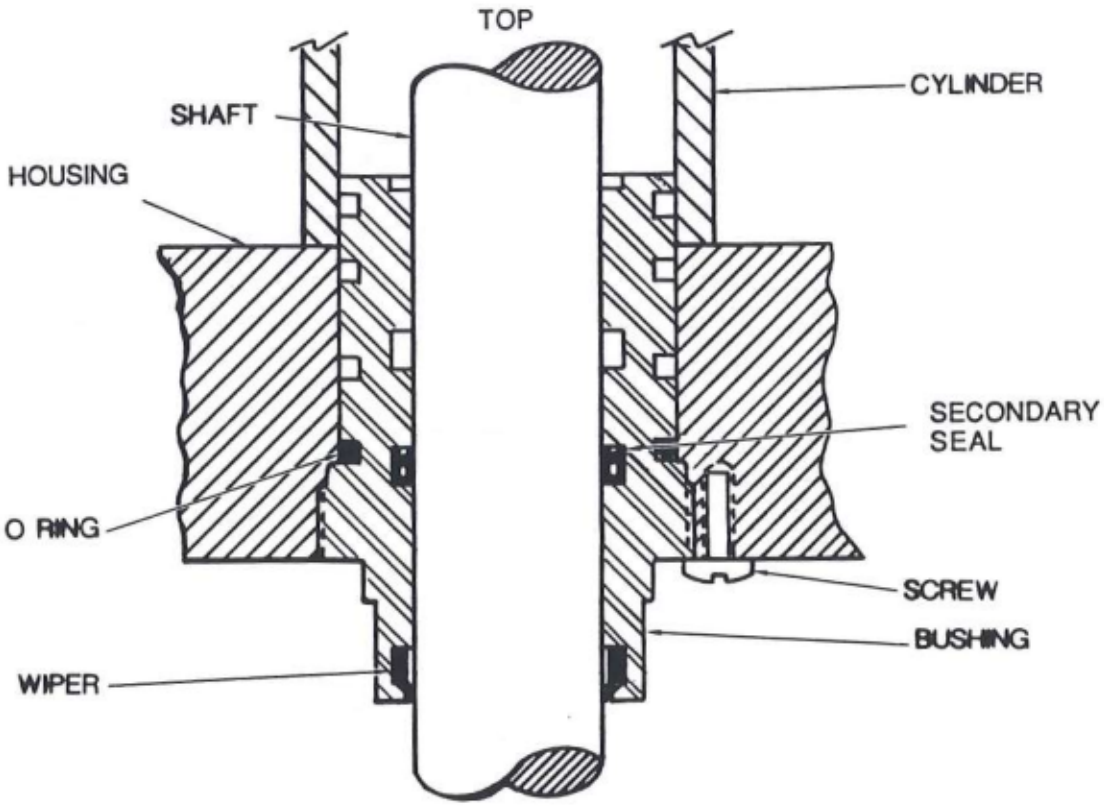


Figure 6-1 B Assembled Seal, O-Ring, Wiper (common to all), and Bushing Push Type

6.1.2 Bushing Reassembly

The following procedures require use of the Seal Installation Tool (P/N S108726A). Lubricate all seals and O-rings with white petroleum jelly before installation.

A. Bushing Seals

Push type Hydramotors contain one secondary seal in the bushing (the primary pressure seal is located in the cylinder cap). Pull type Hydramotors are equipped with two seals in the bushing, primary and secondary.

1). The secondary seal is installed first at the bottom end of the bushing (see Figure 6-2). Place the plug into the bushing from the top end. Hold the plug firmly and push it into the bushing until the end of the plug meets the seal groove.

2). Squeeze the seal together with its U-cup (groove) facing the top end (hydraulic pressure). Feed the seal into the bushing bore until its lower end is engaged in the seal groove. Insert the push rod and depress the seal down until it snaps into the groove.

3). **Pull type only**:
a. Remove the plug from the top end and insert it into the

bushing from the bottom end. The plug will be flush with the bottom end of the top groove.

b. The top seal U-cup must face upward, toward the pressure (see Figure 6-3). Place the seal into the bushing bore until its lower end starts into the groove.

c. Place the sleeve over the seal and place the push rod into the sleeve. Depress the push rod until the seal snaps into its groove.

4). Slide the wiper ring into the wiper cavity at the bottom end of the bushing.

B. O-Rings

Pull type Hydramotors require four O-rings. The three lower O-rings are installed on the bushing before the bushing is installed in the housing. The fourth O-ring is assembled on the bushing from the inside of the housing.

1). Replace the O-rings from the top end of the bushing and roll each down the bushing into the appropriate groove.

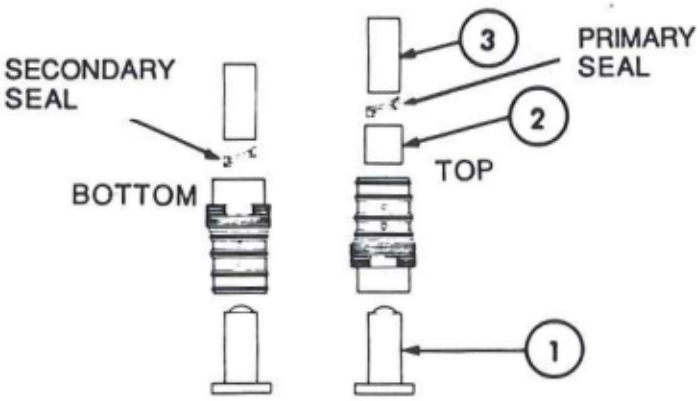


Figure 6-2. Installing Seals in Bushing

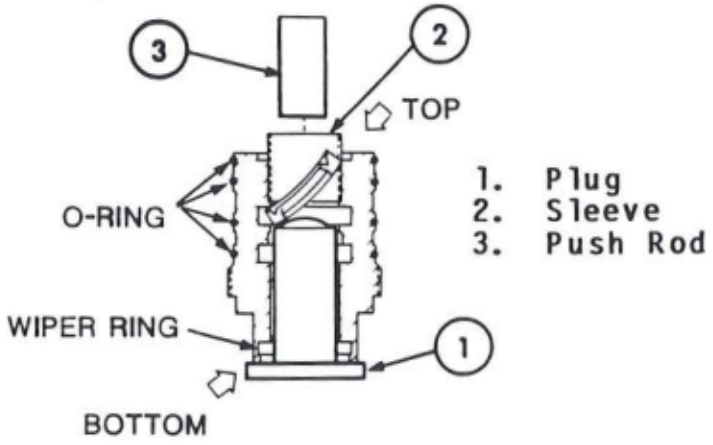


Figure 6-3. Using the Seal Installation Tools

6.1.3 Cylinder Cap Reassembly (Push Type Only)

Cylinder caps on push type Hydramotors contain one shaft seal and one O-ring (see Figures 6-4 A and B). To remove this seal and O-ring, refer to 6.1.1. **Avoid scratching the interior diameter of the cap.** The seal installation tool (P/N A108726A) can be used to replace the seal in the cap.

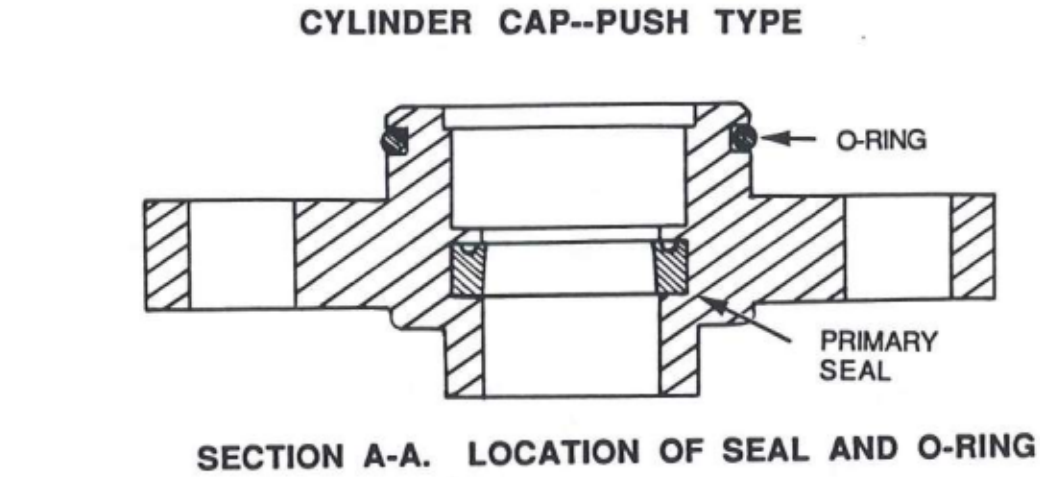


Figure 6-4A Installing the Seal and O-ring in Cylinder Cap
Section View: Location of seal and O-Ring

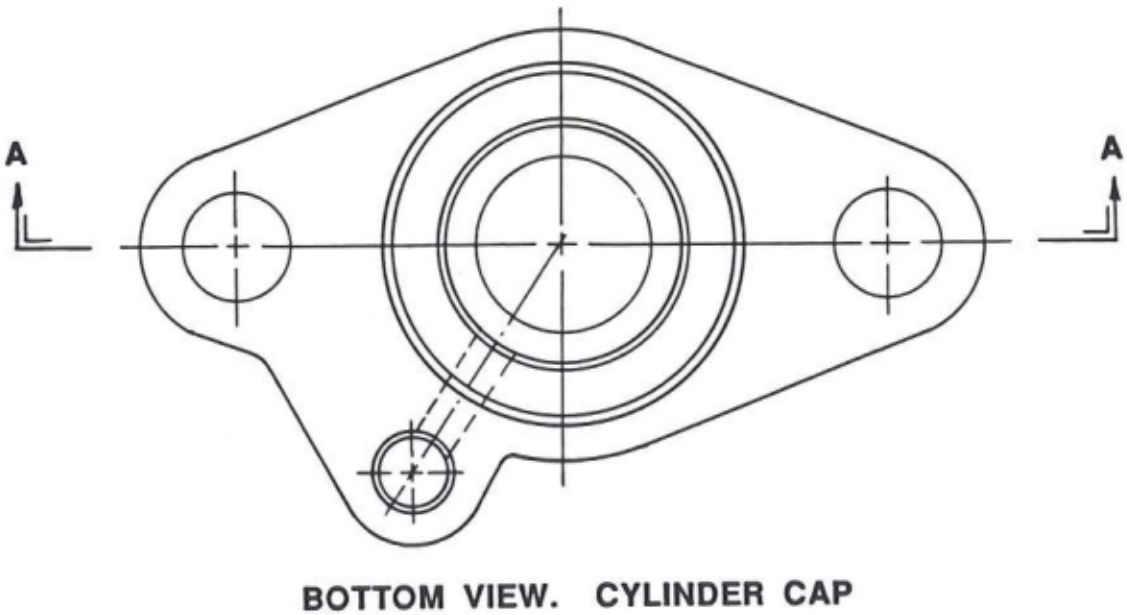


Figure 6-4B Location of the Seal and O-rings in Cylinder Cap
Bottom View: Cylinder Cap

6.2 SHAFT AND PISTON ASSEMBLY

There are three basic piston assemblies used in the Hydramotors. The only piston that requires a spacer on top of the seal is that used on the 1,500 pound Hydramotors. The 3,000 and 4,000 pound Hydramotors use only two hard parts in the piston assembly. Piston assembly components are the same for pull and push type Hydramotors.

6.2.1 Disassembly (see Figures 6-5 through 6-7)

When disassembling the piston from the shaft, both split retaining rings must be removed and replaced in the following manner:

1). Loosen the three Allen head set screws from the retaining cap (see Figure 6-5).
2). Remove the pressure-side split retaining ring (see Figure 6-6 or 6-7) 90° offset split ring pliers (external) are recommended.
3). Slide the piston off the shaft. Remove the polymyte seal.
4). Remove the second split ring.
5). Remove and discard the O-ring from the shaft.
6). Clean and inspect the shaft and piston parts. Replace any worn or damaged components. Inspect the surface of the shaft for wear (its surface should have a finish of 16 RMS). The piston components must be free of abraisions, cracks and nicks.

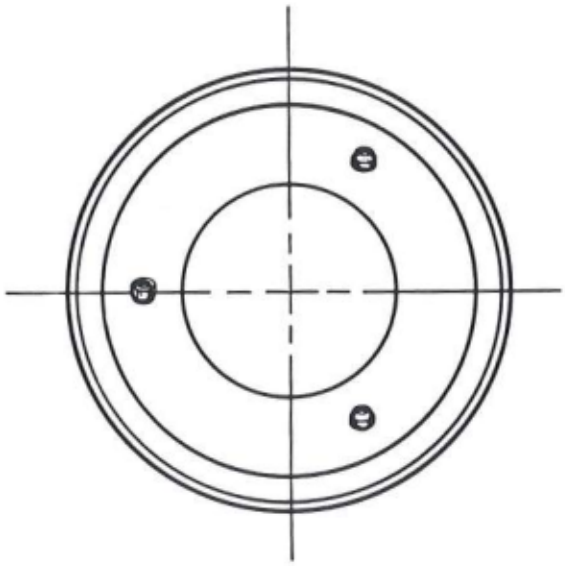


Figure 6-5. Location of Set Screws, Retainer Cap

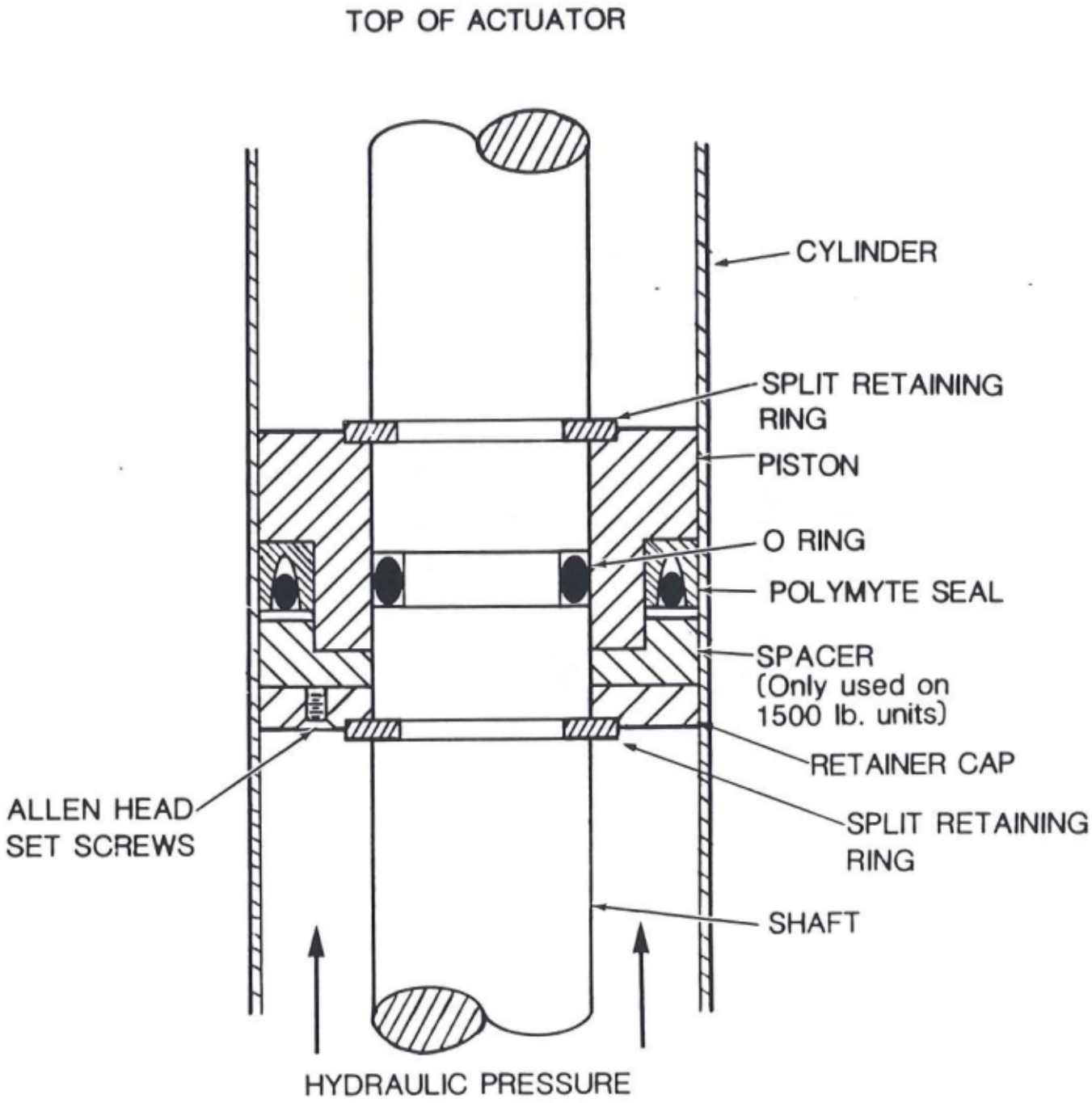


Figure 6-6. Shaft and Piston Assembly, Pull Type

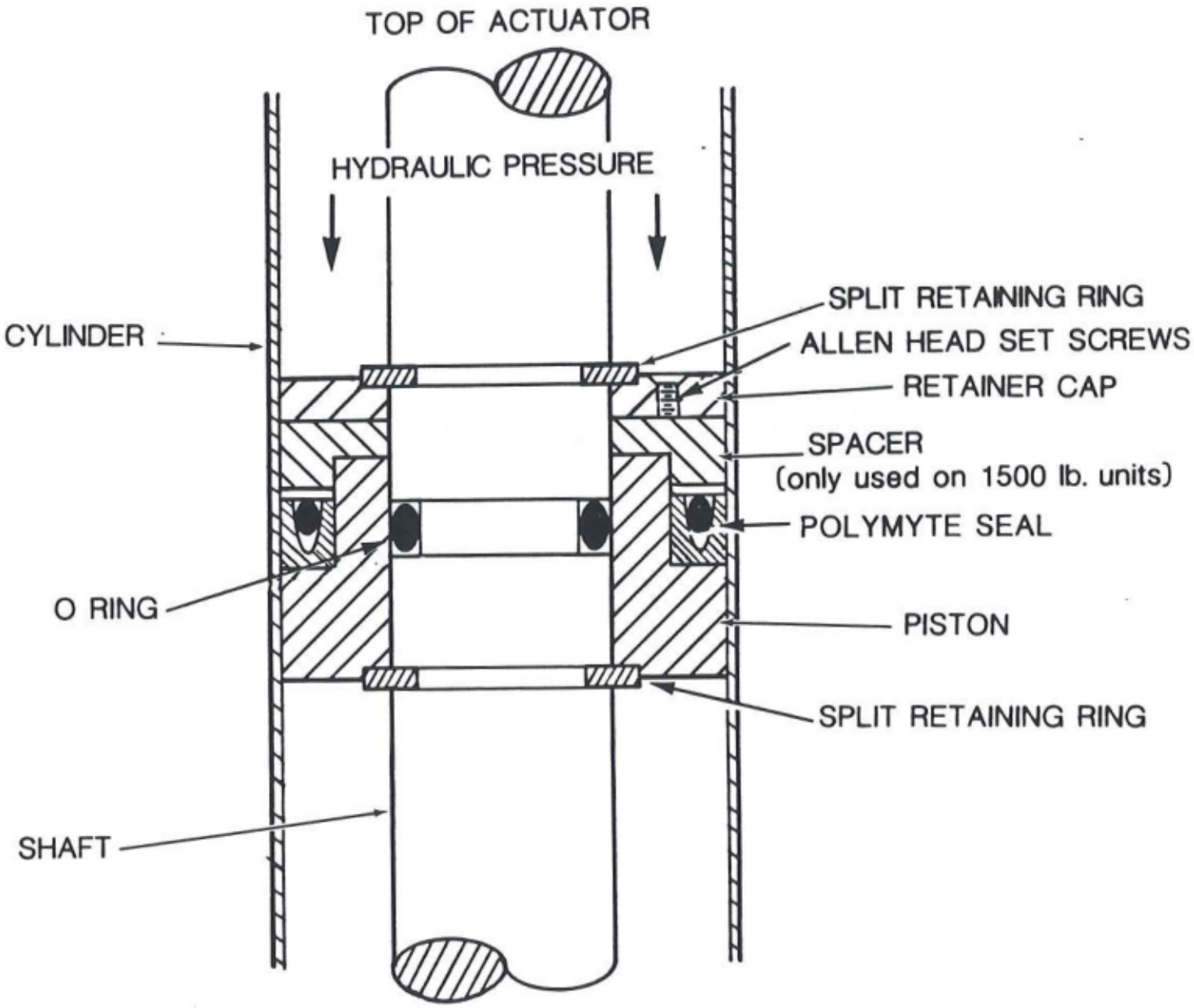


Figure 6-7. Shaft and Piston Assembly, Push Type

6.2.2 Assembly

To reassemble the piston on the shaft, perform the following steps:

1). Thoroughly lubricate a new O-ring with petroleum jelly and slip it over the threaded end of the shaft until it sets in its groove.

2). Thoroughly lubricate the polymyte seal with petroleum jelly and slide it onto the piston. The U-cup of the seal must face the pressure inlet (see Figure 6-8). **Proper seal orientation is critical.**

3). A. The top inside diameter of the piston has a beveled edge (Figure 6-9). Carefully slide the piston, **beveled edge first**, onto the shaft from the low pressure side. Installing the unbeveled edge first will result in damage to the shaft O-ring.

B. Slide the piston over the O-ring just far enough to expose the retaining ring groove behind the piston. If the piston slips past the O-ring, continue pushing the piston off of the shaft and start again. Do not try to push the piston back over the O-ring with the sharp edge of the piston.

4). Install the split retaining ring into the groove below the piston, with its rounded side facing towards the piston.

5). Seat the piston down on the split ring.

6). 1,500 pound Hydramotors only, install the spacer.

7). Install the retainer cap over the shaft.

8). Install the second split ring into its groove, with its round side towards the piston.

9). Tighten the three Allen head set screws in the retainer cap, thereby forcing the cap against the split ring.

10). The shaft and piston assembly are now ready to be assembled in the cylinder.

11). Be sure the U-cup of the polymyte seal faces away from the cylinder when installing the shaft. Lubricate the polymyte piston seal, cover the ends of the shaft, and insert the piston assembly into the cylinder.

12). Hold the cylinder and strike a sharp blow on a wooden block or other similar surface to install the piston assembly in the cylinder.

CAUTION

ON PUSH-TYPE HYDRAMOTORS THE SMALL HOLE DRILLED IN THE CYLINDER MUST BE TOWARD THE BOTTOM OF THE HOUSING. PULL-TYPE HYDRAMOTORS HAVE NO HOLE IN THE CYLINDER.

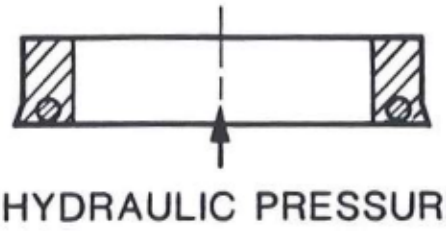


Figure 6-8. Orientation of Polymyte Seal (Pull Type Shown)

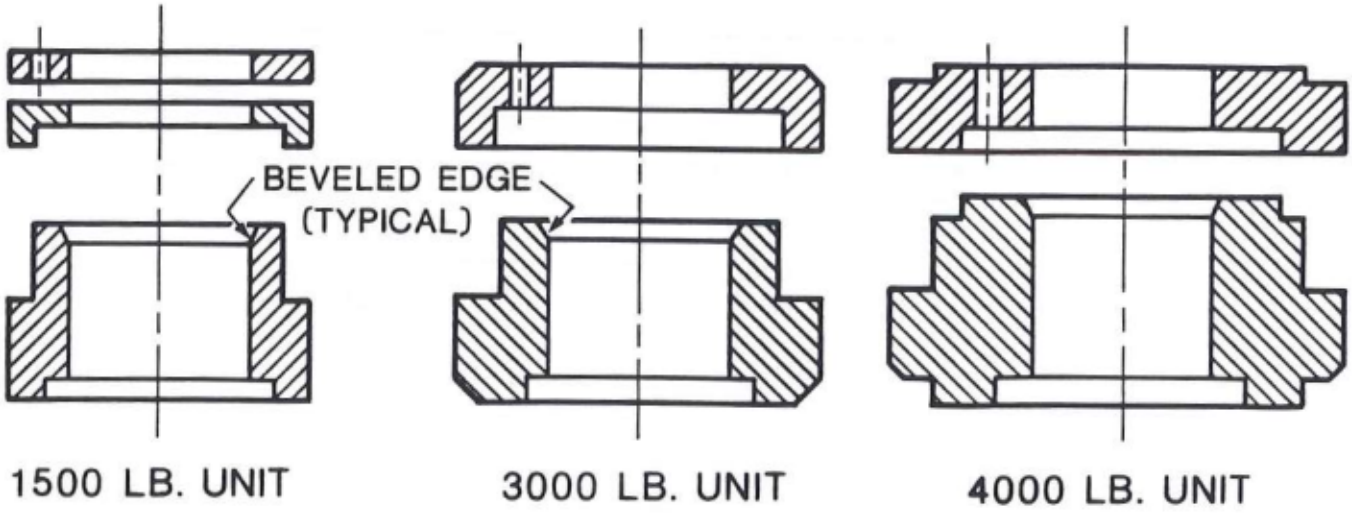


Figure 6-9. Piston Assemblies

6.3 YOKE AND RETURN SPRING ASSEMBLY - PULL TYPE

WARNING

PRELOADED SPRING HAZARD. RETURN SPRINGS ARE UNDER COMPRESSION. INCORRECT OR SUDDEN RELEASE OF SPRING FORCE COULD CAUSE SERIOUS PERSONAL INJURY OR PROPERTY DAMAGE. USE EXTREME CARE DURING REMOVAL. REMOVE ONLY AS INSTRUCTED HEREIN, FOLLOW ALL PROCEDURES CAREFULLY AND IN SEQUENCE, AND USE ONLY THE PROPER SPRING COMPRESSION TOOL.

6.3.1 Return Spring Removal - Pull-Type Hydramotors

1). Place an oil pan under the Work Table (P/N S109795B).
2). Set the Hydramotor on the Work Table with the yoke facing up.
3). Remove the stem adapter (727) and its jam nut (711), if so equipped.
4). Remove the spring retainer jam nuts (2) (711).

NOTE

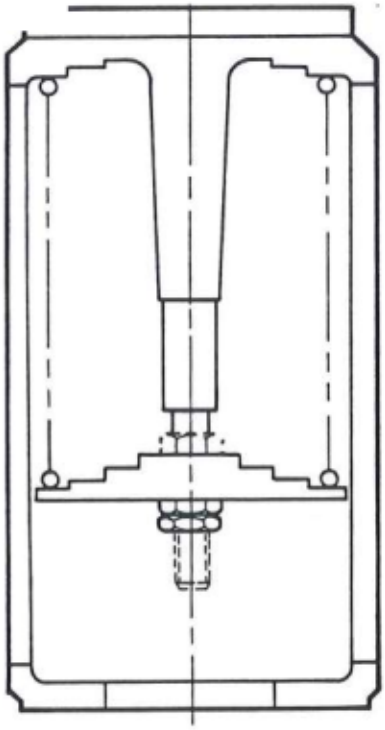
There are several spring arrangements used (see Figure 6-10). The procedure for disassembly is the same for all spring arrangements.

5). Install the Spring Compression Tool (P/N S108511A) on the yoke (see Figure 6-11).
6). Place the centering plate and clamp nut in the counterbore (bonnet mount opening) at the bottom of the yoke.
7). Insert the spring compression crank through the bore of the yoke.
8). Secure the centering plate and crank to the yoke with the clamp nut.

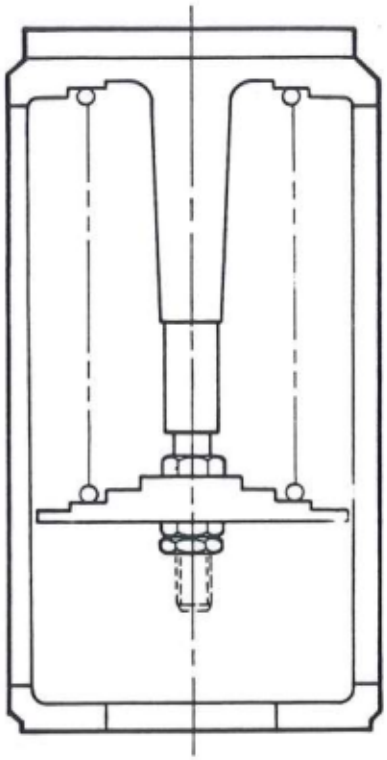
NOTE

The centering plate is machined with three rim diameters to match any size bonnet opening in the yoke.

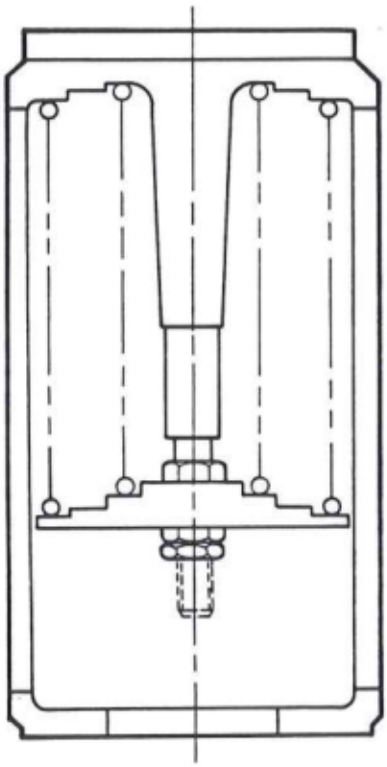
9). Turn the compression tool crank handle clockwise to position its cup against the spring retainer (708). Continue to turn the handle clockwise and compress the spring (707) sufficiently to loosen and remove the hex nut (711).
10). Slowly turn the crank handle counterclockwise until all compression is removed from the spring.
11). Unscrew the clamp nut. Remove the spring compression crank, clamp nut and centering plate from the yoke.
12). Remove the spring retainer (708) from the spring (707).
13). Lift or push to one side the spring(s) to expose the four 3/4" hex bolts (715) that secure the yoke to the housing. Remove the bolts (715) and lock washers (714).
14). Remove the yoke and spring(s) up and off the shaft assembly.
15). Remove the spring from the yoke and measure its length. The approximate free length of all springs is 12 3/4"



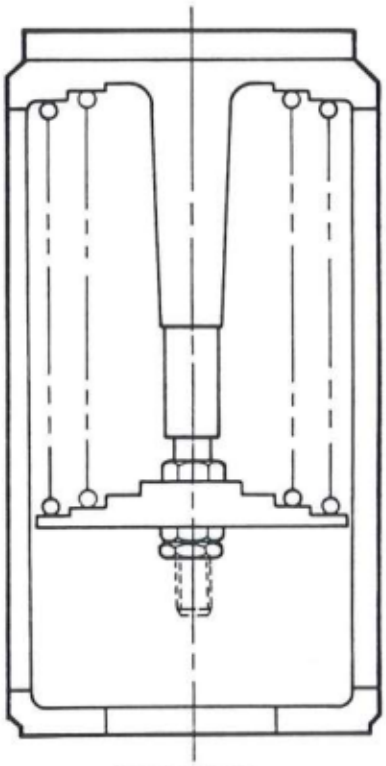
NUMBER 01
SPRING P/N 17443B
(YELLOW)



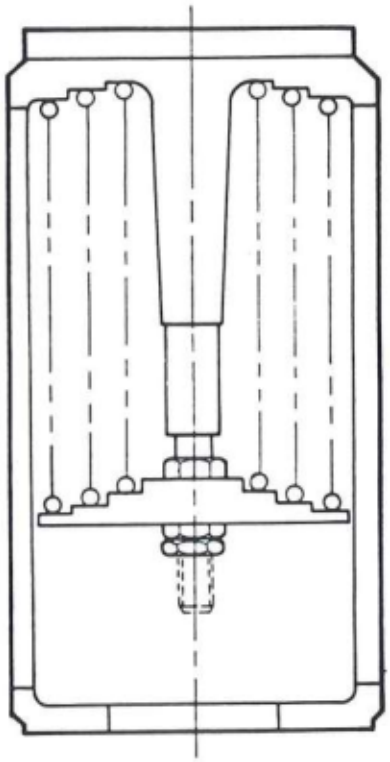
NUMBER 02
SPRING P/N 17444A
(RED)



NUMBER 04
SPRING P/Ns 17443B
(YELLOW)
AND 17445A (BLUE)



NUMBER 05
SPRING P/Ns 17443B
(YELLOW)
AND 17444A (RED)



NUMBER 06
SPRING P/Ns 17443B
(YELLOW),
17444A (RED)
AND 17445A (BLUE)

Figure 6-10. Spring Options, Pull Type

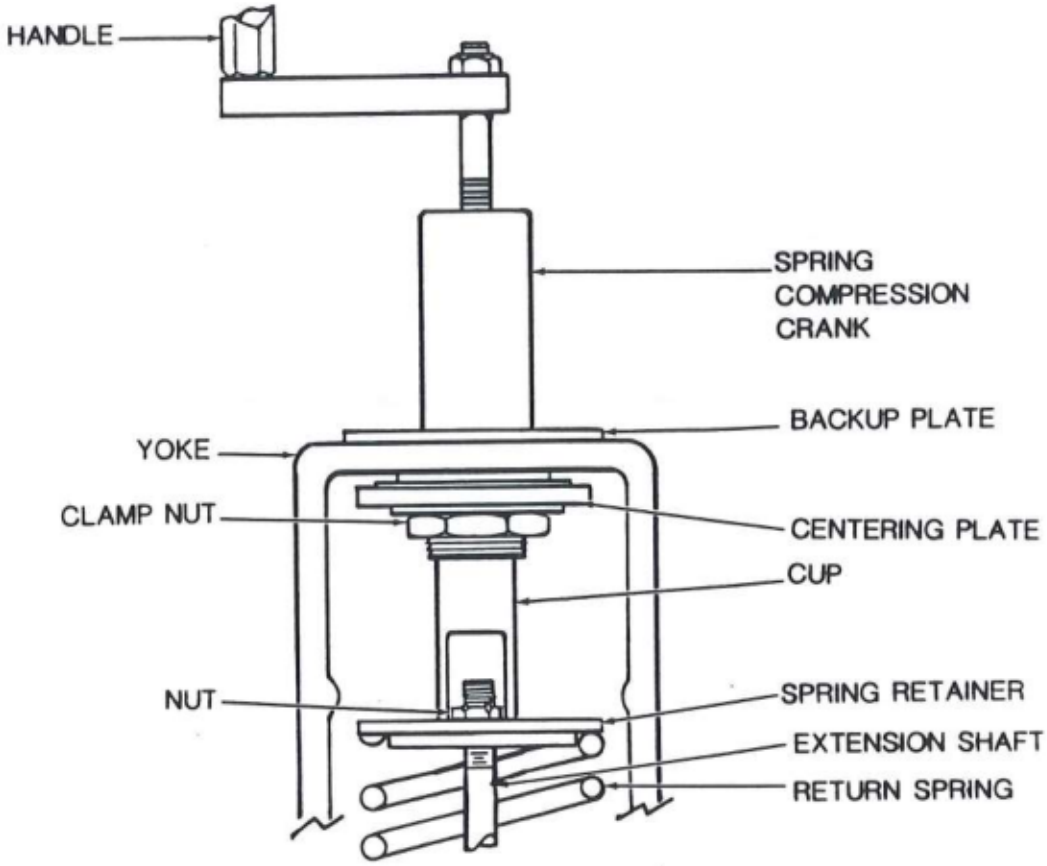


Figure 6-11 Using the Spring Compression Tool, Pull Type

6.3.2 Return Spring Assembly, Pull Type (see Figures 6-10 and 6-12)

1). With the housing upside down on the work table or on the floor, install the yoke (701), with spring(s) assembled, onto the shaft assembly.
2). Install four 3/4" hex bolts (715) and lock washers (714) to secure the yoke to the housing. Torque bolts to 30 lb-ft. (+0%-10%).
3). Install the spring retainer (708) on top of the spring(s).
4). Install the Spring Compression Tool (P/N S108511A, see Figure 6-11): Place the centering plate and clamp nut in position in the counterbore (bonnet mount opening) of the yoke. Insert the Spring Compression Tool through the bore of the yoke. Secure the centering plate to the yoke with the clamp nut.
5). Turn the crank handle clockwise to position the cup against the spring retainer. Continue to turn the crank handle clockwise, compressing the spring and spring retainer until the shaft assembly extends through the spring retainer (708). Screw the jam nut (711) onto the end of the shaft.
6). Install the Spring Height Gauge (P/N S109795J) on the yoke.
7). Compress the spring(s) and adjust the jam nut (711) to position of spring retainer to dimension A (see Table 6-1 or Table 6-2 (for pull type Hydramotors equipped with a manual override) and Figure 6-13)
8). Back off the Spring Compression Tool and recheck the spring height with the Spring Height Gauge (P/N S109795J). If necessary, compress the spring again, adjust the nut, and recheck. Remove the Spring Height Gauge.
9). Turn the crank handle counterclockwise until all spring compression is removed from the Spring Compression Tool. Unscrew the clamp nut from the Spring Compression Tool and remove its clamp nut, and centering plate from the yoke.
10). Thread the jam nut onto the shaft .
11). Thread the stem adapter jam nut (711) and stem adapter (727) onto the shaft assembly.

For reference only. Not for ordering purposes.

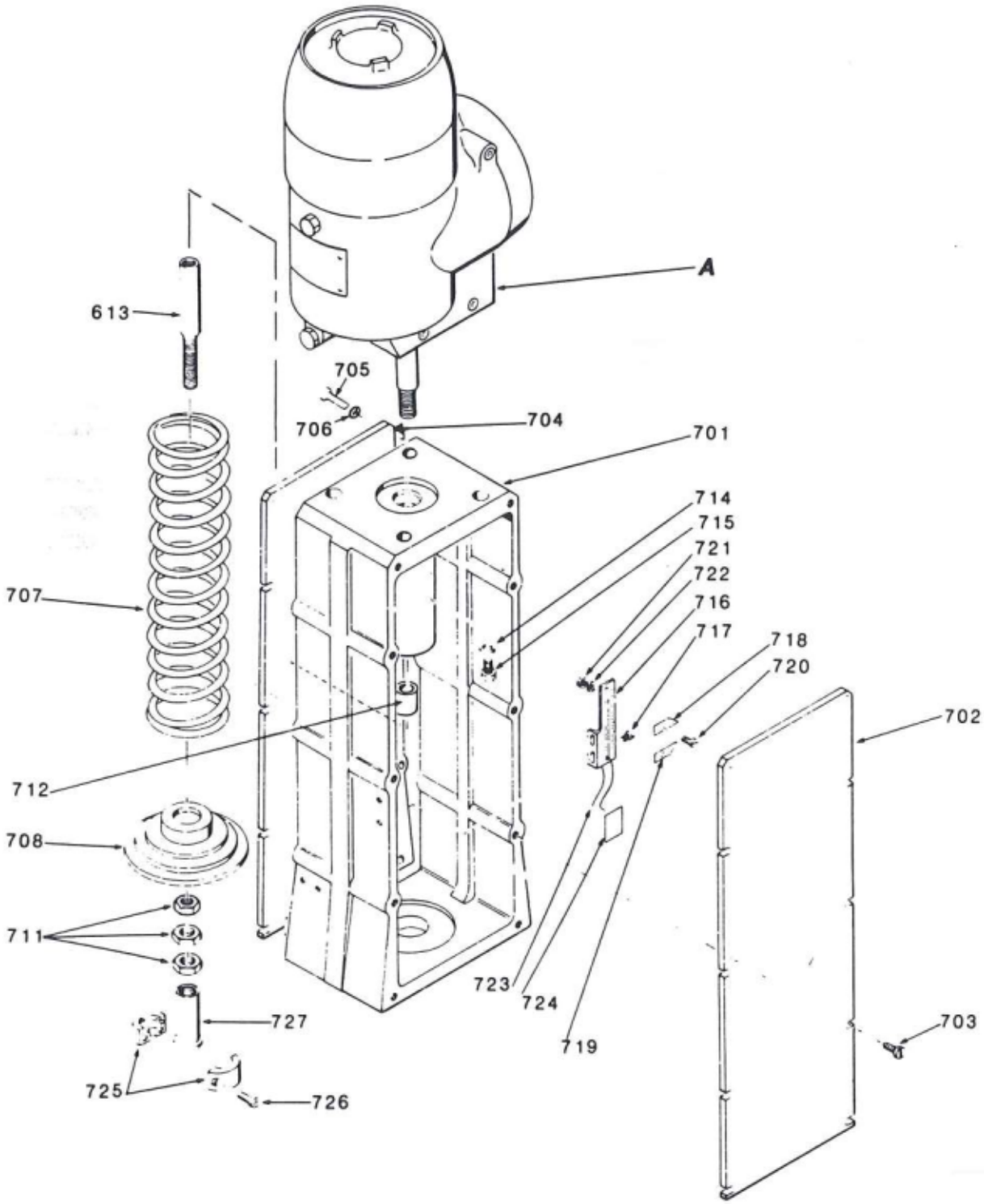


Figure 6-12. Exploded View for Spring and Yoke, Pull-Type

For reference only. Not for ordering purposes.

Legend for Figure 6-12.
Exploded View for Spring and Yoke, Pull Type

Item	Description	No. Required
A (Ref.)	Actuator Assembly	1
613	Shaft Extension	1
701	Yoke	1
702	Yoke Dust Cover, Plastic*	1
703	Screw, Dust Cover	10 or 12
704	Yoke Dust Cover, Plastic*	1
705	Screw, Stiffener	10 or 12
706	Lock washer	10 or 12
707	Return Spring	1, 2 or 3
708	Spring Retainer	2
711	Jam Nut	3
712	Bushing	1
714	Lock washer	4
715	Bolt ,Yoke Mounting	4
716	Indicator Plate	1
717	Screw, Indicator Plate	2
718	Position Indicator (Open)	1
719	Position Indicator (Shut)	1
720	Screw, Position Indicator	2
721	Nut	2
722	Washer	2
723	Wire	1
724	Tag	1
725	Split Coupling Assembly	1
726	Socket Head Cap Screw	2
727	Stem Adapter	1

* Also available for Hydramotors equipped with Auxiliary Switch Options (not shown).

Table 6-1. Spring Setting for Pull Type Hydramotors

(Refer to Dimension A Figure 6-13*, and Spring Options, Figure 6-10)

POWER UNIT CATALOG NUMBER	GROSS SHAFT FORCE Lbs. (kg)	STROKE Inches (mm)	SPRING ARRANGEMENT Nos. 01, 02, 05 Inches (mm)	SPRING ARRANGEMENT Nos. 04, 06 Inches (mm)
40, 41, & 46	1,500 (680)	3.50 (89)	9.30 (236)	9.55 (243)
60, 61, & 66	3,000 (1,360)	3.50 (89)	9.30 (236)	9.55 (243)
80, 81, & 86	4,000 (1,814)	4.00 (102)	9.55 (243)	9.80 (249)

* Units equipped with manual override -- refer to Table 6-2.

Table 6-2. Spring Setting for Pull Type Hydramotors With Manual Override

(Refer to Dimension A Figure 6-13*, and Spring Options, Figure 6-10)

POWER UNIT CATALOG NUMBER	GROSS SHAFT FORCE Lbs. (kg)	STROKE Inches (mm)	SPRING ARRANGEMENT Nos. 01, 02, 05 Inches (mm)	SPRING ARRANGEMENT Nos. 04, 06 Inches (mm)
40, 41, & 46	1,500 (680)	3.50 (89)	9.675 (246)	9.925 (252)
60, 61, & 66	3,000 (1,360)	3.50 (89)	9.675 (246)	9.925 (252)
80, 81, & 86	4,000 (1,814)	4.00 (102)	9.925 (252)	10.175 (258)

* Spring arrangement Dimension A does not appear on height gauge when used on units with manual override.

NOTE

When installing the spring height gauge to the yoke, the gauging surface must be aligned with the spring retainer. For multiple spring arrangements (numbers 4, 5, and 6), measure the outermost spring.

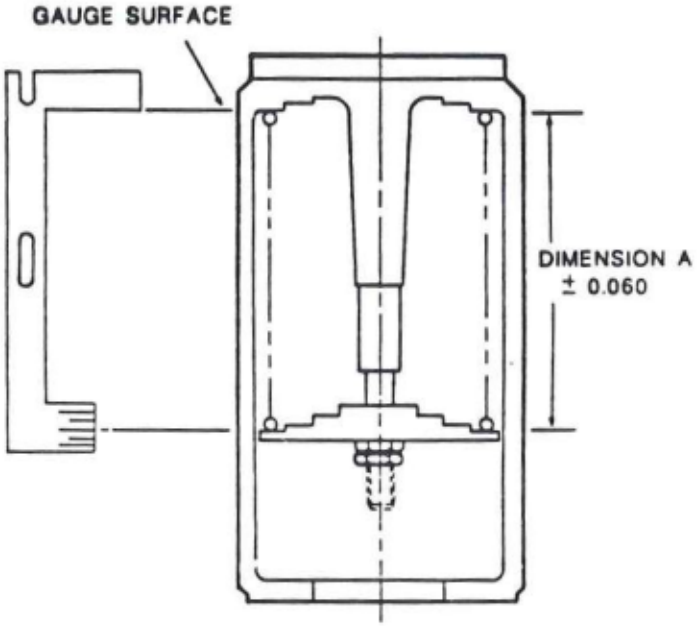


Figure 6-13. Location of Spring Height Gage for Pull Type Hydramotors With or Without Manual Override

6.4 YOKE AND RETURN SPRING ASSEMBLY, PUSH-TYPE

6.4.1 Spring Removal (see Figure 6-18 at the end of this section for exploded view). There are two methods of spring removal from push-type Hydramotors. Method 1 (step A) quickly separates the actuator from the yoke/spring assembly. Since the yoke is not dismantled, the spring setting is unaffected. Method 2 (step B) provides a total dismantle. Method 2 is required for checking the length of return springs or adjusting their loading.

NOTE

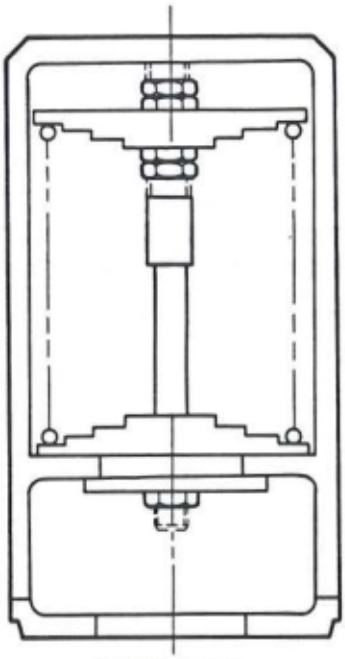
There are several spring arrangements used (see Figure 6-14). The procedure for disassembly is the same for all arrangements

WARNING

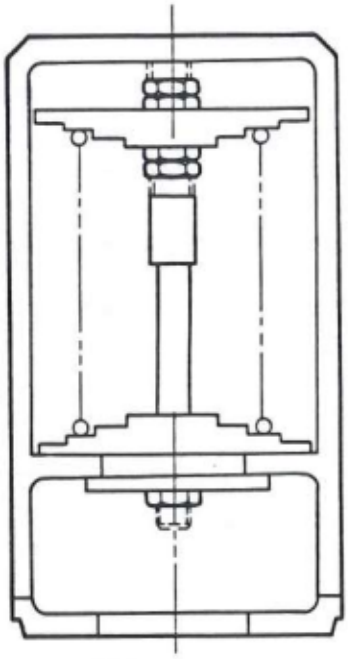
PRE-LOADED SPRING HAZARD. RETURN SPRINGS ARE UNDER COMPRESSION. INCORRECT OR SUDDEN RELEASE OF SPRING FORCE COULD CAUSE SERIOUS PERSONAL INJURY AND/OR PROPERTY DAMAGE. REMOVE ONLY AS INSTRUCTED HEREIN, FOLLOW THIS PROCEDURE CAREFULLY AND SEQUENTIALLY, AND USE ONLY THE RECOMMENDED SPRING COMPRESSION TOOL .

A. Method 1:
   1). Compress the spring by pulling the shaft with the Spring Compression Tool (P/N S108512A) (refer to Figure 6-15). The four 3/4" hex bolts (715) that secure the yoke to the power module will be exposed. Remove these bolts with their lock washers (714).
   2). Carefully release the compression on the spring and remove the Spring Compression Tool. Remove the yoke and spring as an assembly by unscrewing both off of the shaft.

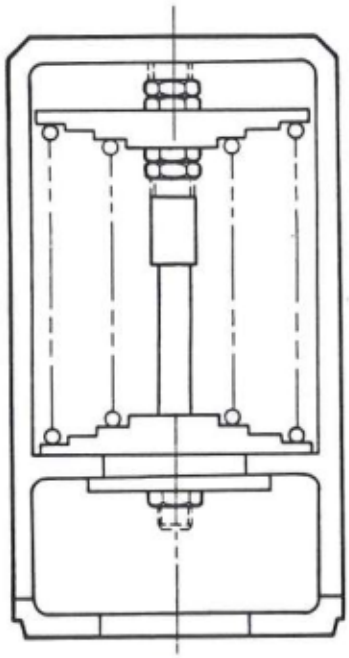
B. Method 2
   1). Set the Hydramotor on the Work Table (P/N S109795B) or on the floor with the yoke facing up. Remove the stem adapter (727) if so equipped.
   2). Prior to disassembly, measurements should be taken of the compressed spring length, and the location of the large stop nut (710). This will assure that during reassembly, the spring and nut may be returned to their original positions in the yoke.
   3). Hold the stop nut (710) and remove the jam nut (711) from the extension shaft (613).



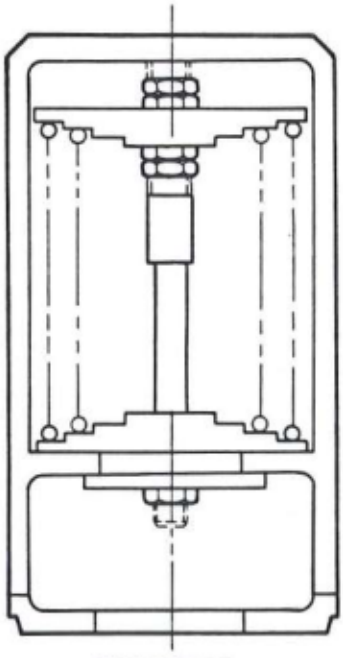
NUMBER 01
SPRING P/N 17443B
(YELLOW)



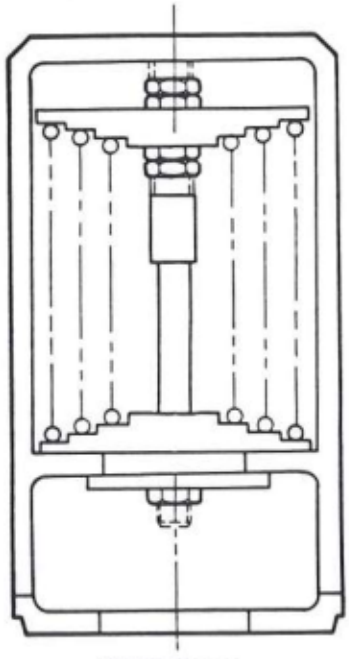
NUMBER 02
SPRING P/N 17444A
(RED)



NUMBER 04
SPRING P/Ns 17443B
(YELLOW)
AND 17445A (BLUE)



NUMBER 05
SPRING P/Ns 17443B
(YELLOW)
AND 17444A (RED)



NUMBER 06
SPRING P/Ns 17443B
(YELLOW),
17444A (RED)
AND 17445A (BLUE)

Figure 6-14. Spring Options , Push Type

4). Insert the Spring Compression Tool (P/N S108512A) through the bonnet mount hole at the base of the yoke. Screw the end of the tool onto the shaft (refer to Figure 6-15).

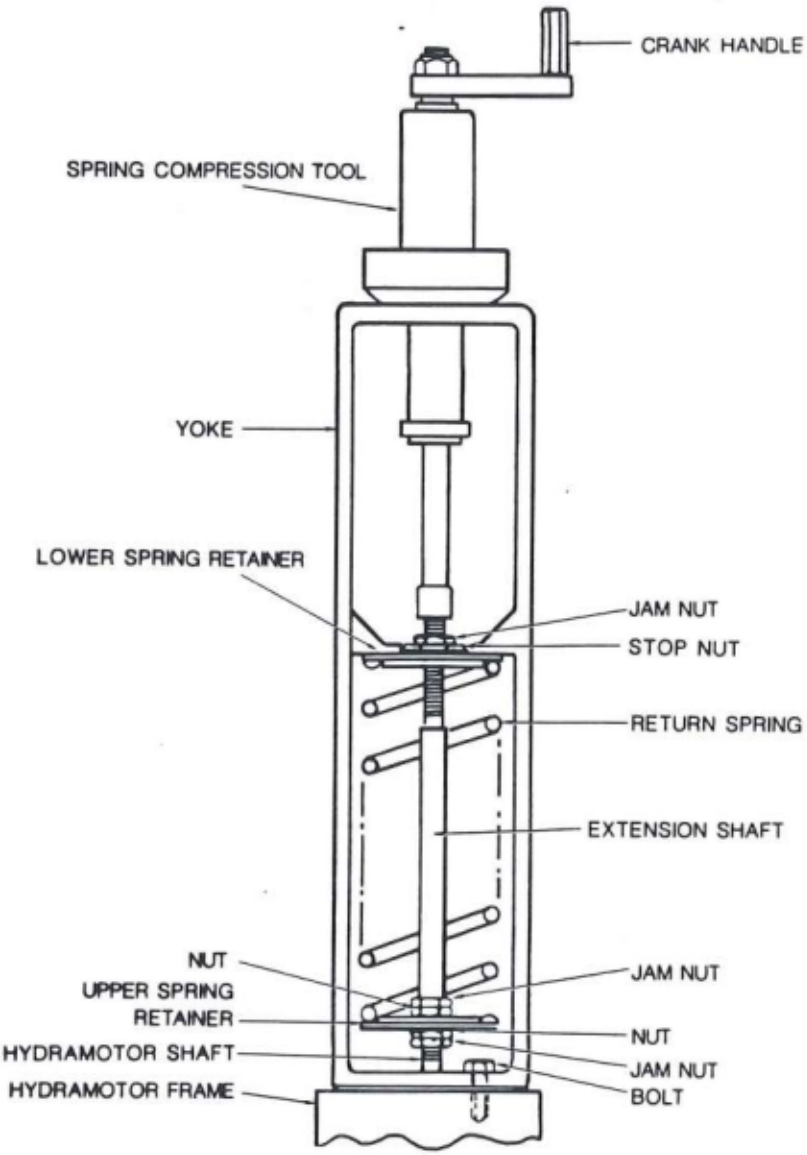


Figure 6-15. Using the Spring Compression Tool, Push Type

5). Turn the crank handle clockwise and compress the spring to relieve pressure on the stop nut (710).
6). Unscrew the stop nut as far as possible.
7). Turn the crank handle counterclockwise and release all pressure from the extension shaft (613). Remove the tool and stop nut.
8) Screw the jam nut 7 (711) onto the extension shaft (613). Replace the Spring Compression Tool.
9). Turn the crank handle clockwise and compress the spring until the threaded end of the shaft extension comes through the lower spring retainer (708).
10). Screw the jam nut (711) onto the extension shaft (by hand) to the end of the extension shaft threads.
11). Remove the four 3/4" hex bolts and lock washers securing the Hydarmotor to the yoke.
12). Lift or tilt the yoke back away from the housing.
13). Unscrew the spring and extension shaft assembly from the Hydramotor shaft as a unit.
14). Remove the extension shaft/spring assembly from yoke.

6.4.2 Checking Spring Free Length

1). Employ Method 2 (Step B) to remove the extension shaft/spring assembly from its yoke.
2). Place this spring assembly into a "dummy" yoke (P/N S109795U) so that the jam nut and shaft extend through the top of the yoke (see Figure 6-16).
3). Install the pull type Spring Compression Tool (P/N S108511A) into the bottom of the dummy yoke.
4). Turn the crank handle clockwise to compress the spring. The jam nut and shaft will extend through the opening at the top of the yoke.
5). Remove the jam nut. Turn the crank handle counter-clockwise to release spring pressure, then remove the spring compression tool.
6). Measure the spring(s)' length. Approximate free length of all springs is 12 3/4". If the measured free length of the No. 1 spring is less than 12 3/4", replace the spring.

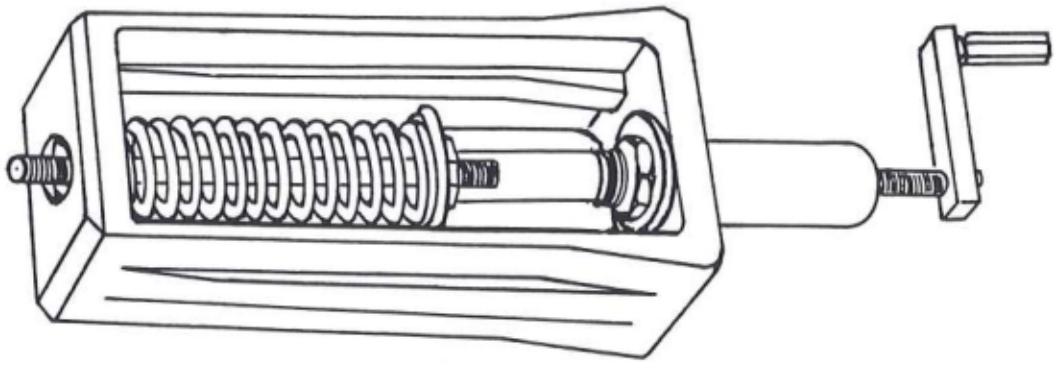


Figure 6-16. "Dummy" Yoke and Spring Assembly

6.4.3 Yoke and Spring Assembly

1). Install the yoke and spring(s) in reverse order of disassembly (Method 1 or Method 2).
2). Install four 3/4" hex bolts (715) with lock washers (714) to secure the yoke to the power module housing. Torque these bolts to 30 ft.-lb. (+0%-10%).
3). If the spring(s) were removed by Method 2, continue with steps a through k; otherwise, proceed to step 4.
   a). Check Table 6-3 to determine to what length the springs should be compressed. Stand the yoke on a table or floor.
   b). Remove the housing and yoke assembly from the Work Table.
   c). Install the Spring Height Gauge (P/N S109795J) on the yoke (see Figure 6-17).
   d). With the Hydramotor in its retracted condition, determine how much the spring height must be adjusted either up or down to achieve the proper dimension as required in Table 6-3.
   e). Using the Spring Compression Tool, compress the spring(s) far enough to insert two 2 1/2 " high pieces of metal or wood (see Figure 6-17).
   f). Turn the Spring Compression Tool ccw to block the shaft mounted spring retainer apart from the yoke.
   g). Loosen the upper and lower jam nuts (709) and move the upper jam nut closest to the spring retainer up or down by the amount of adjustment required as determined in step d.
   h). Recompress the spring(s) and remove the two blocks. Back off the Spring Compression Tool and recheck the spring height with the Spring Height Gauge.
   i). If necessary, repeat steps d through g to obtain a proper adjustment. Remove the Spring Height Gauge and the Spring Compression Tool.
   j). Tighten the top jam nut against the upper jam nut, being careful not to change the adjustment.
   k). Run the lower jam nuts up against the underside of the spring retainer and tighten them with a thin wrench or by using a punch and hammer.
4). Thread the jam nut (711) onto the extension shaft (613).

Table 6-3. Spring Setting for Push Type Hydramotors With or Without Manual Override

[Refer to Dimension A, Figure 6-17, and Spring Options, Figure 6-14]

POWER UNIT CATALOG NUMBER	GROSS SHAFT FORCE Lbs. (kg)	STROKE Inches (mm)	SPRING ARRANGEMENT Nos. 01, 02, 05 Inches (mm)	SPRING ARRANGEMENT Nos. 04, 06 Inches (mm)
(20,21,&26)* 40, 41, & 46	1,500 (680)	3.50 (89)	9.55 (243)	10.05 (255)
60, 61, & 66	3,000 (1,360)	3.50 (89)	9.55 (243)	10.05 (255)
80, 81, & 86	4,000 (1,814)	4.00 (102)	9.80 (249)	10.30 (262)

* For Reference Only.

NOTE

When installing the spring height gauge to the yoke, the gauging surface must be located at the top of the spring. For multiple spring arrangements (numbers 4, 5, and 6) measure the outermost spring.

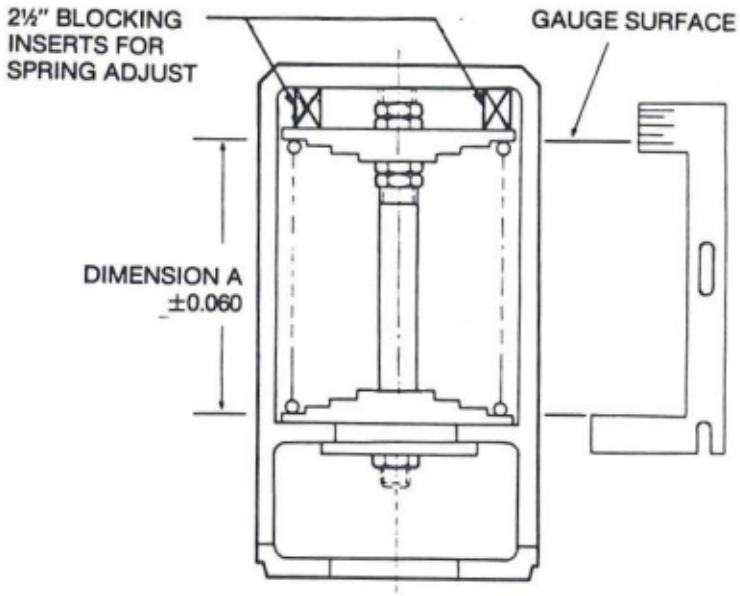


Figure 6-17 Spring Setting Measurement , Push Type

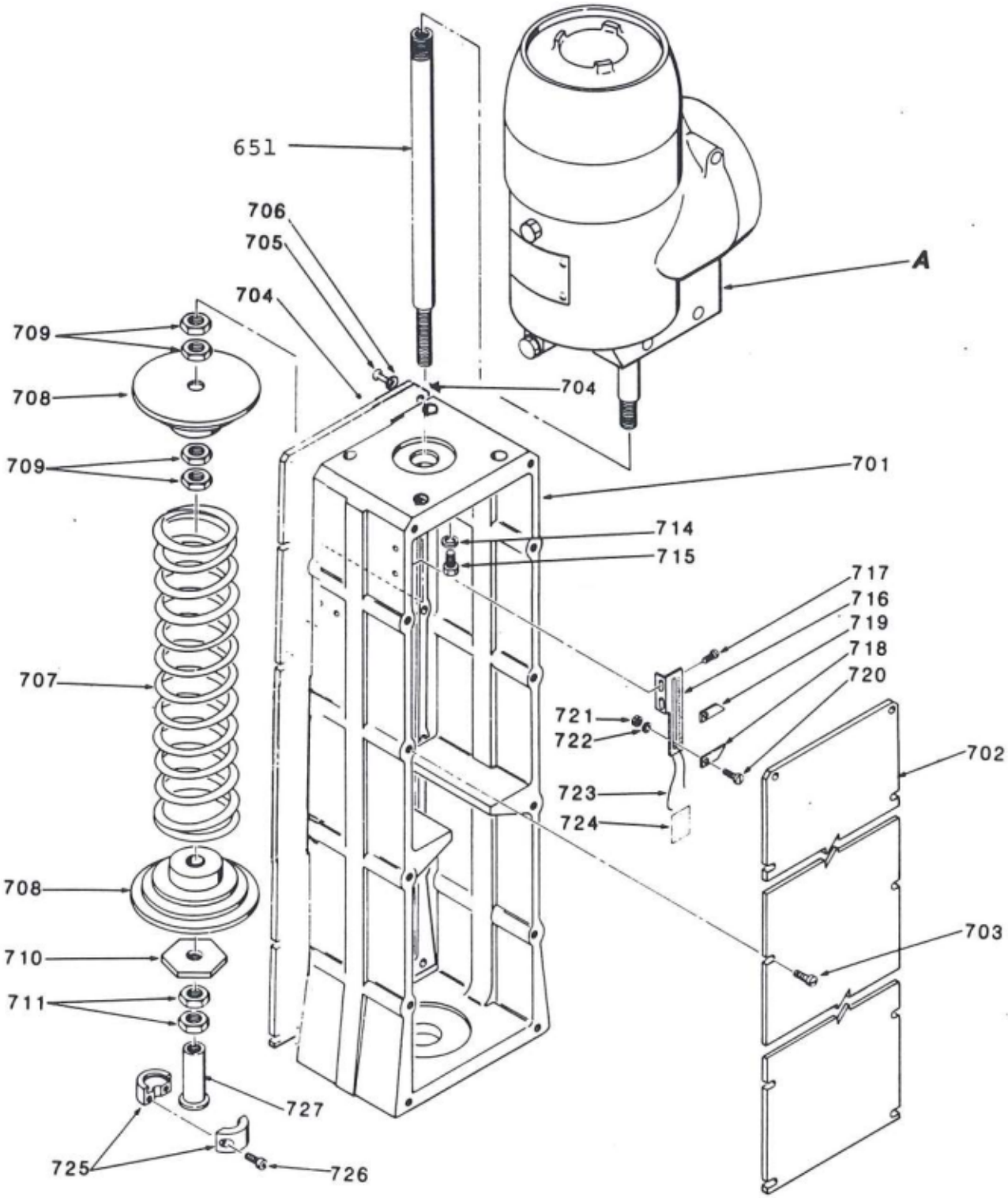


Figure 6-18. Exploded View for Spring and Yoke, Push Type

Legend for Figure 6-18.
Exploded View for Spring and Yoke, Push Type Models

Item	Description	No. Required
A (Ref.)	Actuator Assembly	1
651	Shaft Extension	1
701	Yoke	1
702	Yoke Dust Cover, Plastic*	1
703	Screw, Dust Cover	10 or 12
704	Yoke Dust Cover, Plastic*	1
705	Screw, Stiffener	10 or 12
706	Lock washer	10 or 12
707	Return Spring	1, 2 or 3
708	Spring Retainer	2
709	Nuts	2
710	Stop Nut	1
711	Jam Nut	2
714	Lock washer	4
715	Hex Bolt	4
716	Indicator Plate	1
717	Screw, Indicator Plate	2
718	Position Indicator Plate	1
719	Position Indicator (Shut)	1
720	Screw, Position Indicator	2
721	Nut	2
722	Washer	2
723	Wire	1
724	Tag	1
725	Split Coupling Assembly	1
726	Socket Head Cap Screw	2
727	Stem Adapter	1

* Dust covers for Hydramotors equipped with Auxiliary Switch Options are also available (not shown).

STANDARD OPTIONS

7. STANDARD OPTIONS

The following major option items can be factory assembled or retrofitted onto the Hydramotor. The catalog numbering system will reflect these options on the nameplate.

- Manual Override
- Auxiliary Switch Box
- Feedback Potentiometer

7.1 MANUAL OVERRIDE

The factory-installed optional manual override (M.O.) is an independent crank-driven mechanism mounted between the Hydramotor housing and yoke. This device enables manual extension or retraction of the shaft, sufficient to override the return spring force,in the event of a power failure or automatic shutdown. **The M.O. cannot overcome the hydraulic force of the Hydramotor.**

7.1.1 Setting the Position Indicator

1). **Pull-Type** Hydramotors: Set the M.O. position indicator to 1/8" above the OPEN position indicator (see Figure 7-1).

2). **Push-Type** Hydramotors: Set the M.O. position indicator to 1/8" below the OPEN position indicator (see Figure 7-2).

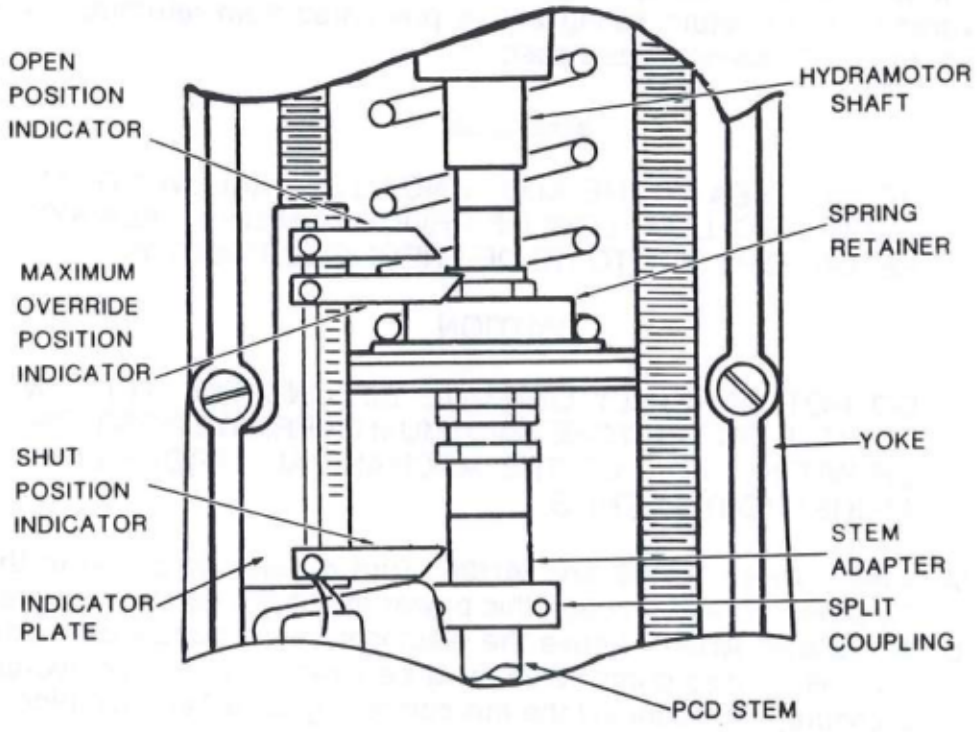


Figure 7-1. Position Indicators, Pull-Type

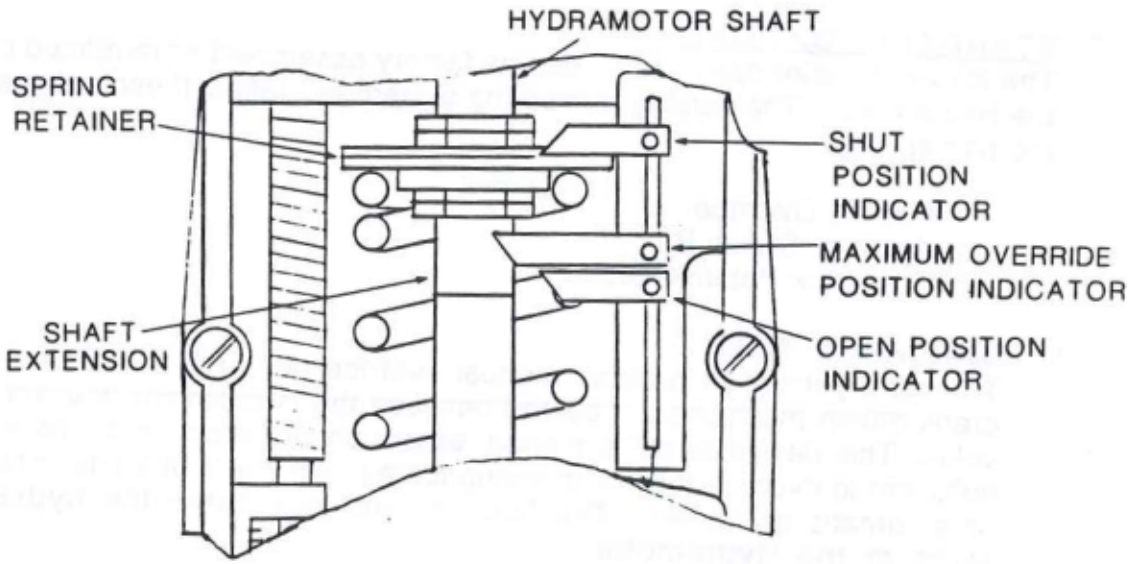


Figure 7-2. Position Indicators, Push-Type.

7.1.2 Operation of M.O. (see Figures 7-3 and 7-4).
If the M.O is left in its operative position when power is restored to the Hydramotor, the return spring will be prevented from returning the PCD stem to its fully de-energized position

.

WARNING

DO NOT LEAVE THE M.O. ENGAGED, ALLOWING AN UNCONTROLLED FLOW OF PROCESS MEDIA. ALWAYS RETURN THE M.O. TO ITS DE-ENERGIZED POSITION.

CAUTION

DO NOT MANUALLY OPERATE BEYOND THE YELLOW POINTER ON THE YOKE (MAXIMUM OVERRIDE POSITION) OR WITHIN 1/32" OF THE MECHANICAL STROKE LIMIT ADJUSTMENT SETTING.

1)A. **AH91, AH92, AH95 and AH96**: Turn off electric power to the Hydramotor (even though this power may have been interrupted).
B. **AH93 and AH94**: Leave the electrical power supply connected (the normally closed dump valve must be powered to relieve hydraulic pressure). Disconnect the mA control signal at Terminal Block No. 3 (the shaft will move to its de-energized position).

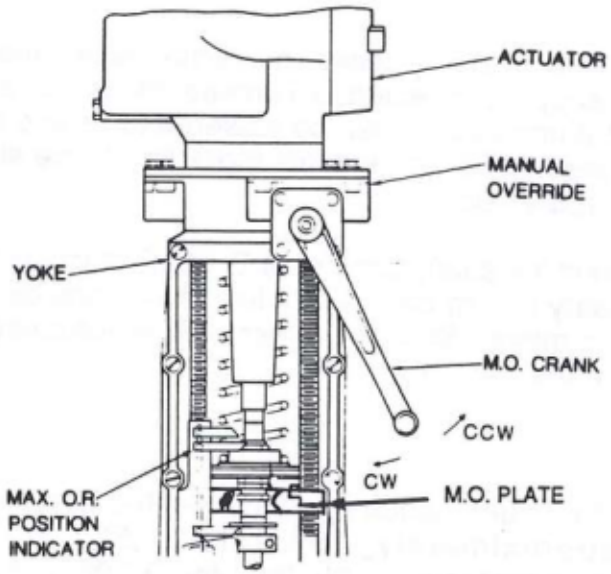


Figure 7-3. Manual Override, Pull Type

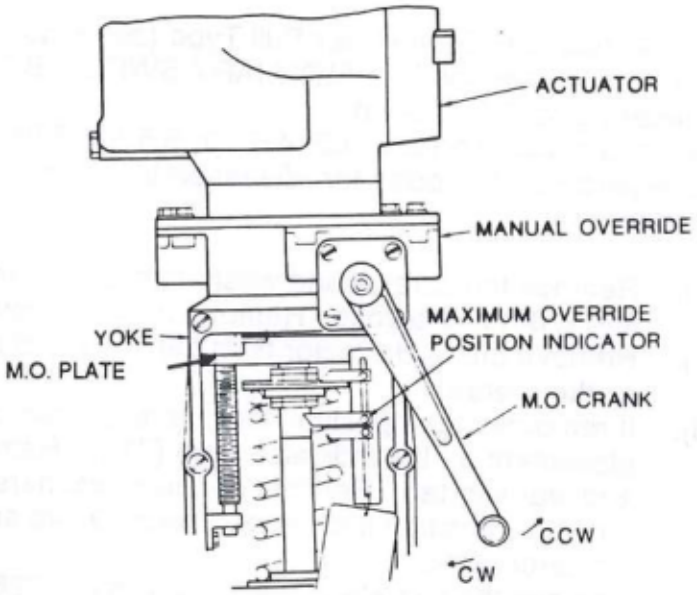


Figure 7-4. Manual Override, Push Type

C. **AH97 and AH98** : Leave the dump valve's independent electrical power supply connected to Terminal Block No. 2 (the normally closed dump valve must be powered to relieve hydraulic pressure). Disengage power to Terminal Block No. 1 (the shaft will move to its de-energized position).

2). To retract the shaft, turn the M.O. crank clockwise. It will be necessary to turn the crank a few revolutions before the shaft starts to move. Shaft movement will be indicated by an increase in load on the handle.

NOTE

Maximum required force on the crank handle is approximately_ 10 lbs. for 1,500 lb. (680 kg.) Hydramotors, 20 lbs. for 3,000 lb.(1,360 kg.) Hydramotors and 30 lbs. for 4,000 lb. (1,800 kg.) Hydramotors.

3). To extend the shaft, turn the crank counterclockwise until the plate just touches the stop. Check shaft travel position and/or position indicator.

4). **Before restoring electrical power for normal operation, return the M.O. to its disengaged position.**

7.1.3 Spring/Yoke/Manual Override for Pull Type (see Figure 7-5 and Figure 7-7 (following subsection 7.2 (AUXILIARY SWITCH BOX UNIT)).

A. Preparing for Disassembly
Refer to subsection 2.5, 3.5, 4.6, or 5.5 (OVERHAUL) as applicable to Hydramotor model for disassembly and reassembly of the Hydramotor.

1). Remove the screws and washers securing the dust covers (702) and (704) to the yoke. Remove the dust covers

2). Remove the Hydramotor from the PCD and bring it to a clean working area.

3). If removal of the position indicators is desired, mark their placement on the indicator plate (716). Remove the wire, tag, and warning tag. Remove the nuts, washers, and screws, then the three position indicators. Remove two screws and the indicator plate.

4). Remove the two Allen head cap screws (726, 1/4" - 20) and the split coupling assembly (725).

5). Loosen the lock nut (711) and unscrew the stem adapter (727) and nut from the extension shaft.

6). Turn the Hydramotor upside down and set it in the Work Table (P/N S109795B).

WARNING

RETURN SPRINGS ARE UNDER COMPRESSION. INCORRECT OR SUDDEN RELEASE OF SPRING FORCE COULD CAUSE SERIOUS PERSONAL INJURY OR PROPERTY DAMAGE. USE EXTREME CARE DURING REMOVAL, SERVICE ONLY AS INSTRUCTED HEREIN, FOLLOW ALL PROCEDURES CAREFULLY, AND USE ONLY THE RECOMMENDED SPRING COMPRESSION TOOLS.

NOTE

Several spring arrangements are available (see Figure 6-10). The procedure for disassembly is the same for all Hydramotors.

B. Disassembly for Pull-Type Hydramotors

1). Remove the bolts (818) and lock washers (819) that hold the two M.O. brackets (816) to the sides of the yoke. Remove the brackets and metal shims (817) if so equipped.
2). Turn the M.O. crank (802) counterclockwise until the M.O. drive plate (813) with two special brass nuts (814) comes off the threaded rods of the M.O.
3). Remove the nut and jam nut (711) from the end of the shaft extension (613).
4). Install the Spring Compression Tool (P/N S108511A) on the yoke per subsection 6.3 (YOKE AND RETURN SPRING ASSEMBLY-PULL TYPE).
5). Compress the return spring (707) just enough to back off the hex nut (711) from the shaft extension (613).
6). Carefully release all tension on the compressed spring and remove the hex nut.
7). Remove the Spring Compression Tool, then remove the spring retainer (708).
8). Depending on the spring combination, lift or push to one side the spring(s) to expose the four hex nuts (715) that secure the yoke and M.O. assembly to the M.O. adapter plate. Remove the nuts and lock washers (714).
9). Lift the yoke, complete with spring(s), up and off the shaft and M.O. assembly.
10). Lift the M.O. assembly (801) up and off the four studs (810). Remove the O-ring (807).
11). Remove the four 3/4" hex bolts (809) and lock washers (808) that secure the adapter plate (806) o the housing. Remove the adapter plate.
12). Use the Shaft Extension Tools (P/N S109795H) to loosen and remove the extension shaft (613).

C. Spring/Yoke/Manual Override Assembly for Pull Type Hydramotors

NOTE

Several spring arrangements are available (see Figure 6-12). The procedure for disassembly is the same for all Hydramotors.

1). Screw the four studs (810) into the adapter plate (806), and torque to approximately 30 ft.-lb.
2). Attach the adapter plate (806) to the assembly with four lock washers (808) and bolts (809), and torque to approximately 30 ft.-lb.
3). Thread the M.O. shaft extension (820) to the shaft.
4). Lubricate the adapter plate O-ring (807) with white petroleum jelly and place it onto the M.O. shaft extension (820).
5). Place the Hydramotor upside down in the Work Table (P/N S109795B).
6). Screw the short extension shaft (613) onto the M.O. extension shaft (820).
7.). Set the M.O. assembly (801) onto the studs (810)..
8). Set the yoke with spring(s) on the studs (810) and secure with four 3/4" hex nuts (715) and lock washers (714). Torque t o approximately 30 lb.-ft.
9). Place the spring retainer (708) onto the shaft and install the Spring Compression Tool (P/N S108511A) in the yoke according to the instructions in subsection 6.3 (YOKE AND RETURN SPRING ASSEMBLY-PULL TYPE). Compress the spring(s) and start the nut (711) onto the shaft.
10). Compress the spring(s) to the proper spring length and spin the nut (711) down on the spring retainer (708) to secure.
11). Remove the Spring Compression Tool and install the jam nut (711).
12). Install the M.O. drive plate (813) on the threaded rods with the smooth side towards the spring retainer (see Figure 7-5). It is important that both drive nuts (814) engage simultaneously, and the M.O. drive plate (813) must be parallel to the bottom of the yoke.
13). Turn the M.O. crank clockwise to expose the shaft ends.
14). Bolt the two brackets (816) to the yoke, and align with shims (817) as required.
15). Thread the stem adapter jam nut (711) and stem adapter (727) onto the shaft extension.
16). Install the split coupling halves (725) over the stem adapter (727) and secure with two socket head cap screws (726), finger tight.
17). Attach the position indicator plate (716) to the yoke with two screws (717).

18). Attach the three position indicators, OPEN, MAX. OVERRIDE, AND SHUT, in their original positions with three screws, washers, and nuts.
19). Thread the wire through the indicator plate, and attach the tag and warning tag.
20). Test and adjust the Hydramotor, referring to the appropriate sections of the manual.
21). Attach the stiffener (704) and dust cover (702) to the yoke with mounting screws.

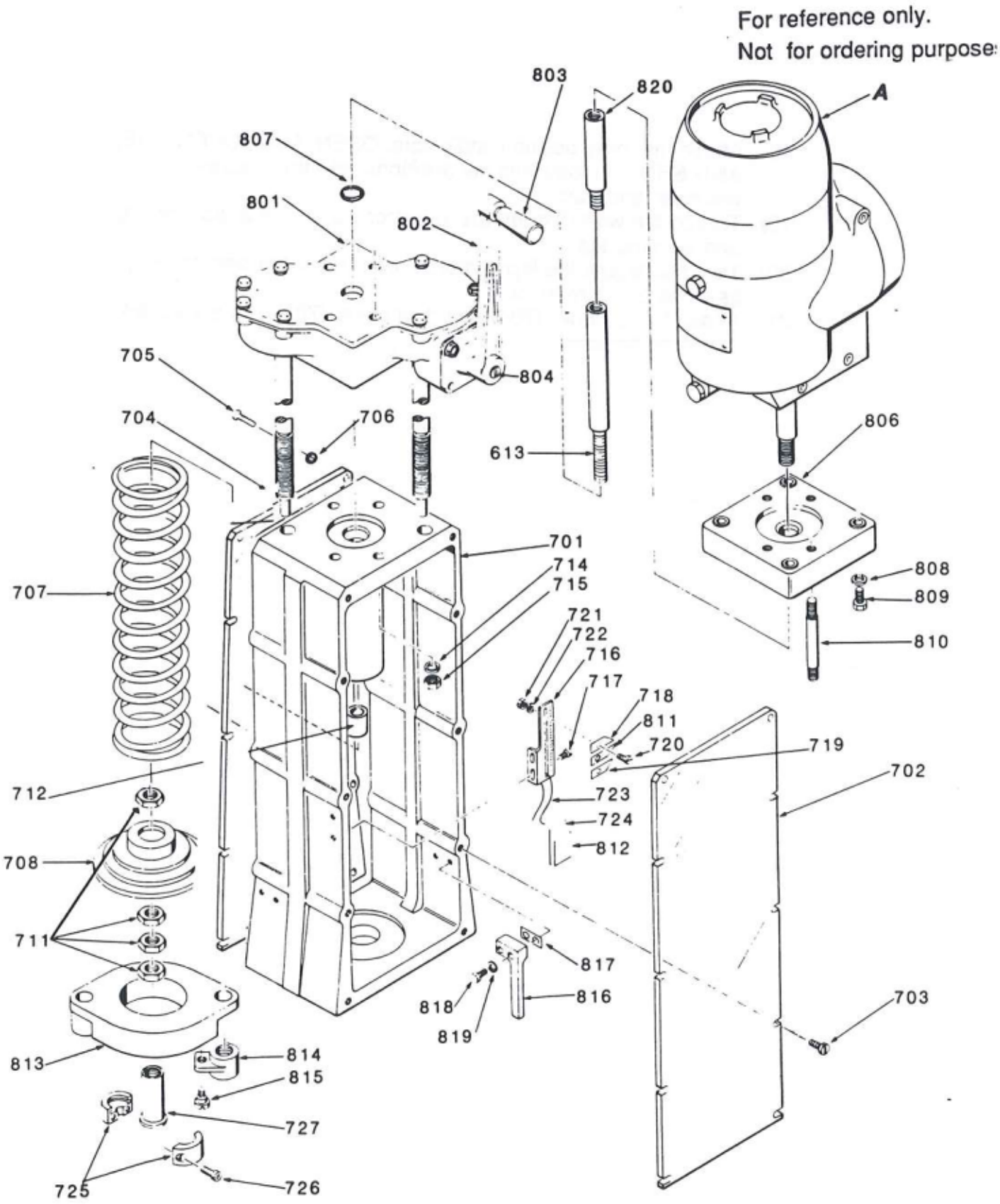


Figure 7-5. Exploded View for Yoke Assembly With Manual Override, Pull Type

Legend for Figure 7-5. Exploded View of Yoke Assembly With Manual Override, Pull Type

Item	Description	No. Required
A (Ref.)	Hydramotor Assembly	1
613	Shaft Extension	1
701	Yoke (17 1/2" or 20" length)	1
702	Yoke Dust Cover, Plastic*	1
703	Screw, Dust Cover	10
704	Yoke Dust Cover, Plastic*	1
705	Screw, Stiffener	10
706	Lock washer, Stiffener	10
707	Return Spring(s)	1, 2 or 3
708	Spring Retainer	1
711	Hex Nut	4
712	Bushing	1
714	Lock washer	4
715	Bolt, Yoke Mounting	4
716	Indicator Plate	1
717	Screw, Indicator Plate	2
718	Position Indicator (Open)	1
719	Position Indicator (Shut)	1
720	Screw, Position Indicator	2
721	Nut	2
722	Washer	2
723	Wire	1
724	Tag	1
725	Split Coupling Assembly	1
726	Socket Head Cap Screw/	2
727	Stem Adapter	1
801	Manual Override	1
802	M.O. Crank	1
803	1 M.O. Handle	1
804	Bolt, M.O. Crank	1
806	M.O. Adapter Plate	1
807	O-Ring	1
808	Lock washer	4
809	Bolt	4
810	Stud	4
811	Position Indicator (Max. M.O.)	1
812	Tag	1
813	M.O. Drive Plate	1
814	Special Nut	2
815	Retaining Screw	2
816	Bracket	2

Legend (Continued) for Figure 7-5. Exploded View of Yoke Assembly With Manual Override, Pull Type

Item	Description	No. Required
817	Shim(s)	-
818	Screw, Bracket	4
819	Lock washer, Bracket	4
820	M.O. Extension Shaft	1

**A special dust cover is available for Hydramotors with auxiliary switch options.*

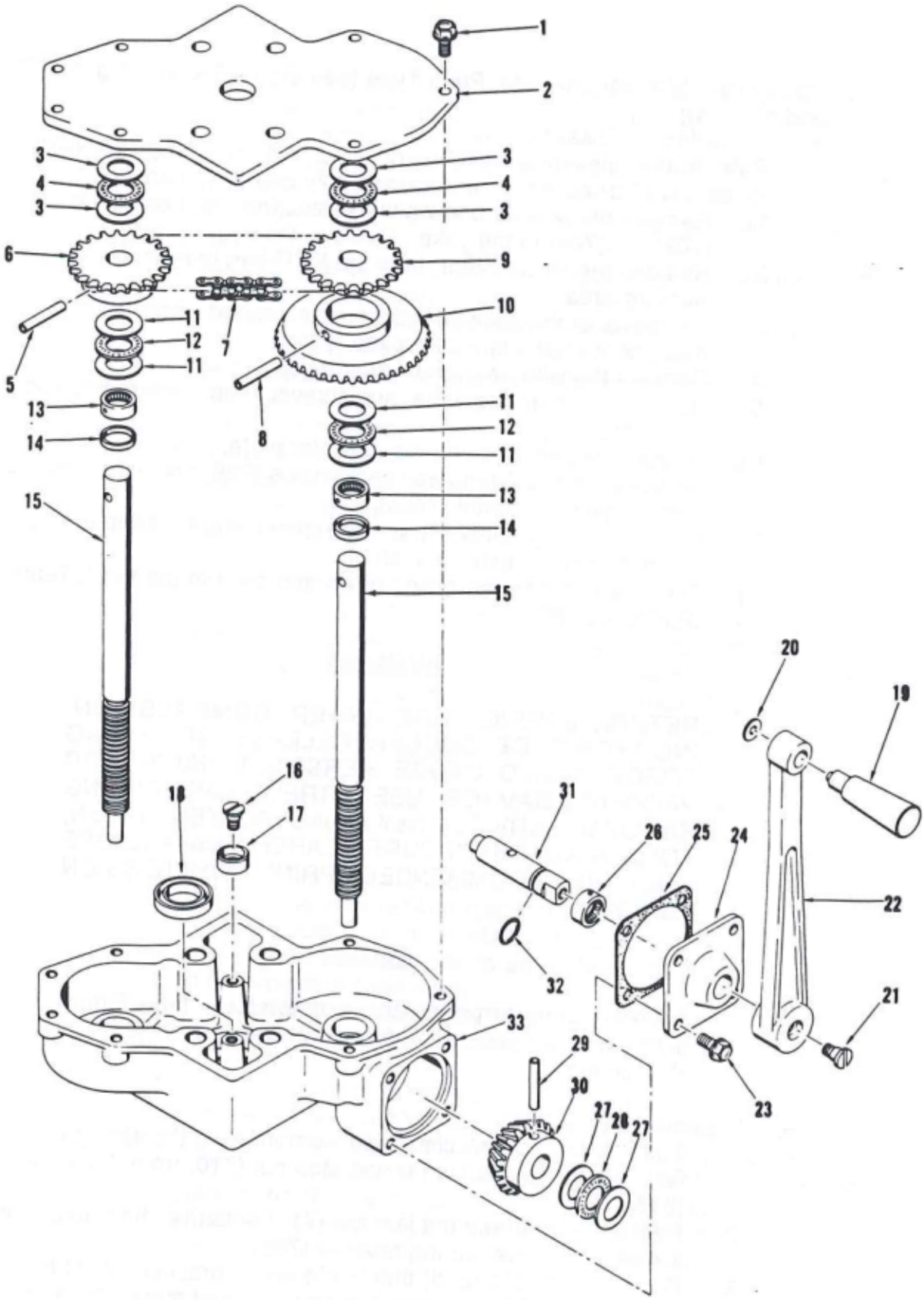


Figure 7-6. Exploded View for Manual Override

and lock washers (819), aligning with shims (822) as required.

12). Thread the stem adapter jam nut (711) and stem adapter (727) onto the shaft extension.

13). Install the split coupling halves (725) over the stem adapter (727) and secure with two socket head cap screws (726), finger tight.

14). Attach the position indicator plate (716) to the yoke with two screws (717).

15). Attach the three position indicators - OPEN, MAX. OVERRIDE, and SHUT, in their original positions with three screws, washers, and nuts.

16). Thread the wire through the indicator plate, and attach tag and warning tag.

17). Test and adjust the Hydramotor, referring to appropriate sections of the manual.

18). Attach the dust covers (702) and (704) to the yoke with mounting screws.

7.2. AUXILIARY SWITCH BOX UNIT

7.2.1 The optional, factory-installed auxiliary switch box assembly is a side-mounted device equipped with up to six switches, double pole, double throw (DPDT). The switches are for automatic remote control operations, and are actuated by the position of the shaft. Each switch can be independently set to open or close at any point along the shaft travel.

The auxiliary switches are cam operated to open or close control circuits.The cams revolve on a drum connected by a linkage assembly to the shaft. By positioning the cams on the drum, each switch can be made to actuate at any chosen point of Hydramotor shaft travel. Refer to Figure 7-8 for Auxiliary Switch Box Assembly Wiring.

WARNING

HAZARDOUS VOLTAGE. TOUCHING WIRES OR ELECTRICAL COMPONENTS, OR IMPROPER WIRING INSTALLATION, MAY CAUSE SERIOUS PERSONAL INJURY, DEATH, AND/OR PROPERTY DAMAGE. DISCONNECT ALL POWER SUPPLIES TO THE HYDRAMTOR AND SWITCH BOX BEFORE SERVICING. THIS EQUIPMENT MAY BE CONNECTED TO MORE THAN ONE POWER SOURCE.

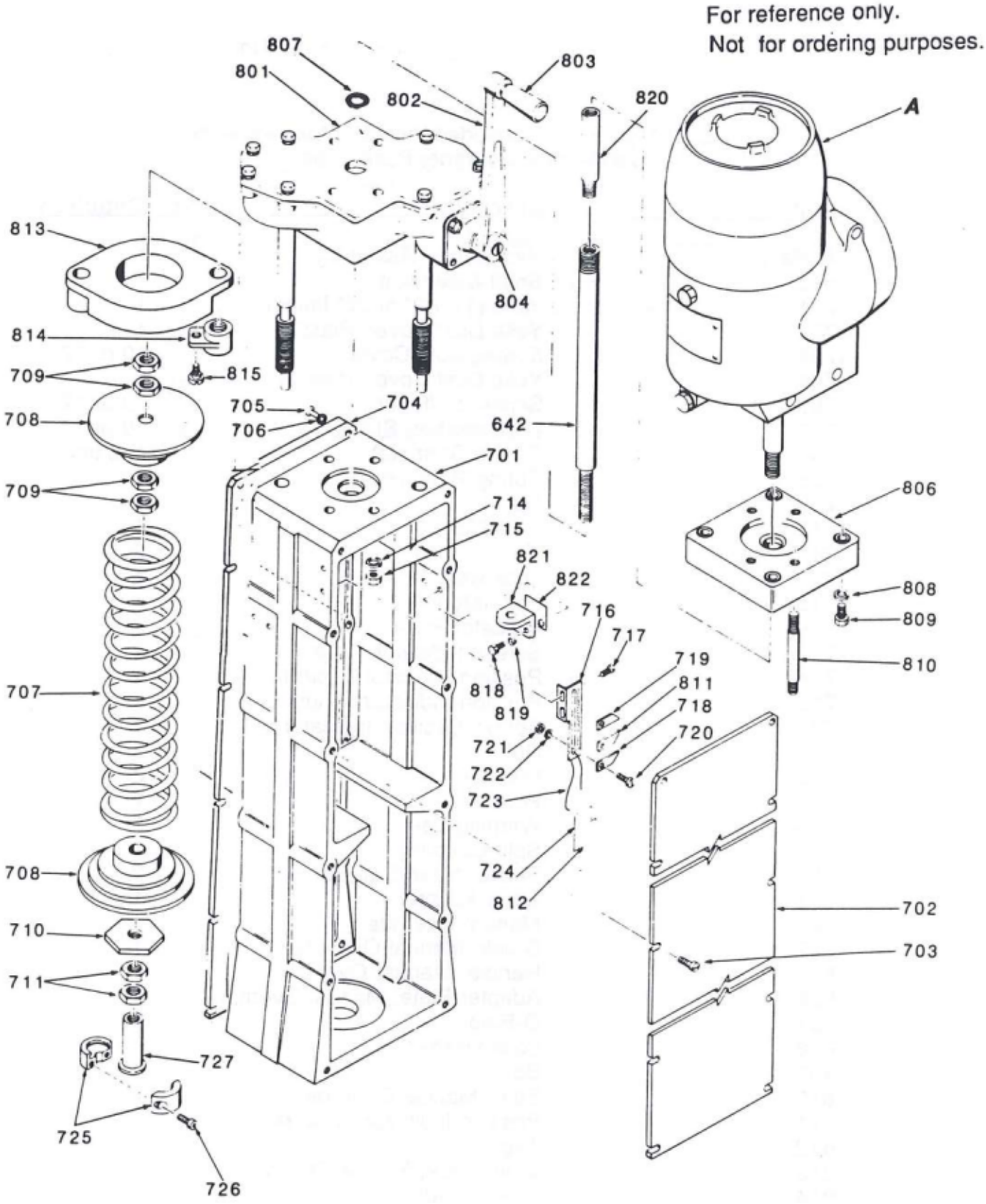


Figure 7-7. Exploded View for Yoke Assembly With Manual Override, Push-Type

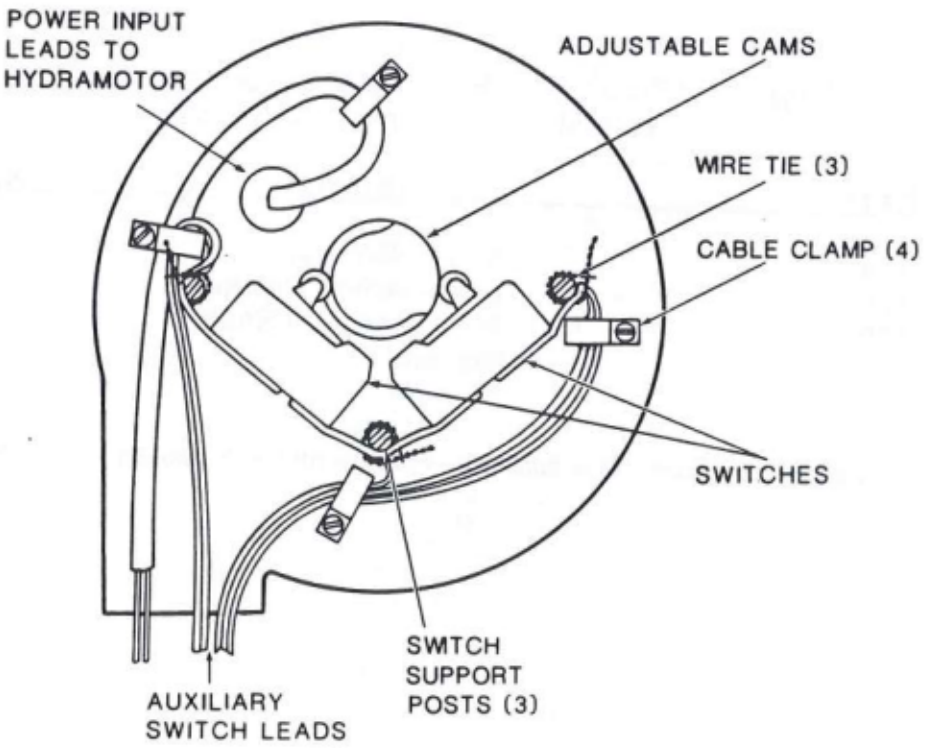


Figure 7-8. Auxiliary Switch Box Assembly Wiring

7.2.2 Extra Precautions:

a). Pass all leads to auxiliary switches through cable clamps, and attach them to switch support posts with insulating wire ties. Keep all wiring clear of the CAM area.

b). DPDT switches are rated for 10 amperes maximum current.

c). The total connected load of all auxiliary switches must not exceed 2,000 V.A. Use supply wiring suitable for +75° C (+192°F).

d). Power leads to the Hydramotor pass through the auxiliary switch box on Hydramotors so equipped.

7.2.3 Adjustment:
Each auxiliary switch is clearly numbered in Figure 7-9 to facilitate identification of its respective circuit. By altering the position of cams on the drum, each switch can be made to actuate at any chosen point of the Hydramotor shaft travel. Before adjusting cams, make sure the desired switch will be affected.

1). Remove the screw-in switch housing cover. The cams are positioned directly above the auxiliary switches.
2). To adjust the cams of any switches on the right side, grasp the cam directly above the proper switch and pull outward to slide the cam off its drive gear serrations on the drum.
3). To adjust the cams covering the switches on the left side, grasp the cam and push it forward off its serrations.
4). Rotate the cam after it is off its drive gear serrations, and adjust the cam so that it will activate the switch at the desired point of Hydramotor shaft travel.
5). Slide the cam)back onto its serrations. Care should be taken to insure that cams are properly seated.
6). Power the Hydramotor to check the switch adjustment. Repeat the above steps until the desired timing is obtained.

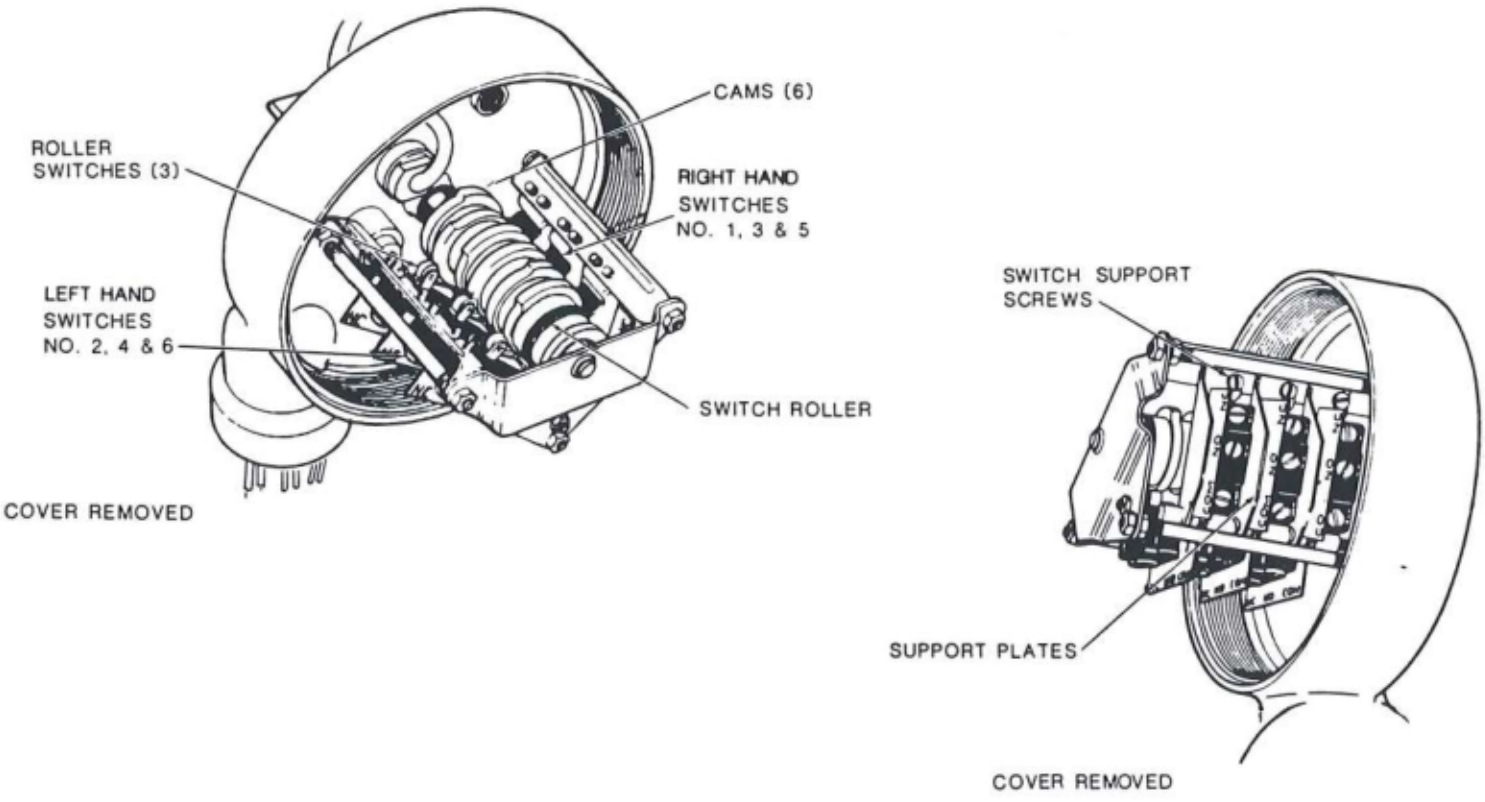


Figure 7-9. Auxiliary Switch Locations

7.2.4 Removal and Replacement of Auxiliary Switch Box (refer to Figure 7-10).

1). **Turn off power to the Hydramotor and to all switches.** Remove the auxiliary switch box cover and its O-ring. Note the inside of the wiring diagram .
2). Disconnect the Hydramotor power input leads (see Figure 7-8).
3). Remove the hex plugs underneath the cover and unscrew the two mounting screws from inside of the auxiliary switch housing.
4). Remove the conduit tube assembly and the auxiliary switch housing from the Hyramotor.
5). Remove the spacer. **Do not disassemble the linkage assembly unless parts are damaged. Maintain the exact assembly length.**
6). Remove the nut and lock washer securing the linkage assembly to the guide arm.
7). Remove the linkage assembly as a unit.
8). Replace in reverse order of disassembly.

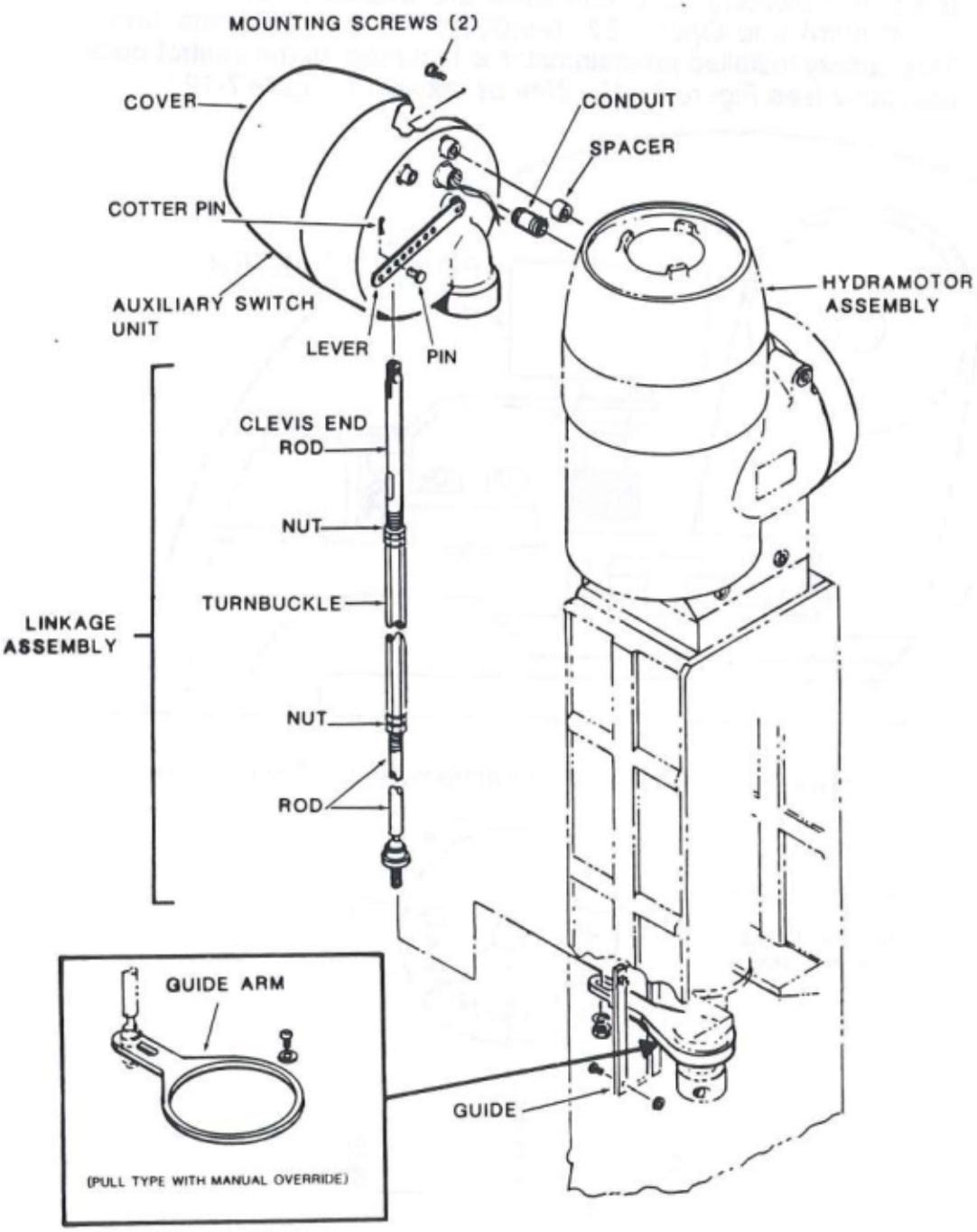


Figure 7-10. Auxiliary Switch Box and Linkage to Hydramotor Shaft

7.3 FEEDBACK POTENTIOMETER

AH91, AH92, AH93, and AH94 Models only: Two versions of position indicating potentiometers are available: Option E1 (0-1,000 ohm) and Option E2 (0-5,000 ohm) (for reference only). This factory installed potentiometer is mounted on the control plate assembly (see Figure 7-11). Wire as shown in Figure 7-12 :

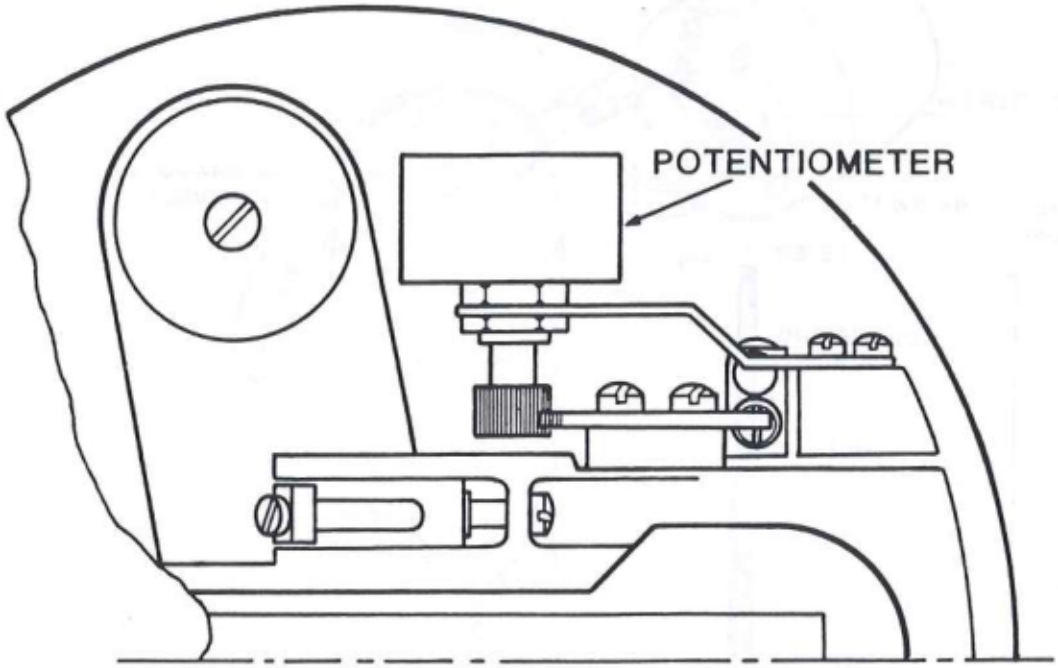


Figure 7-11. Location of Potentiometer on Control Plate

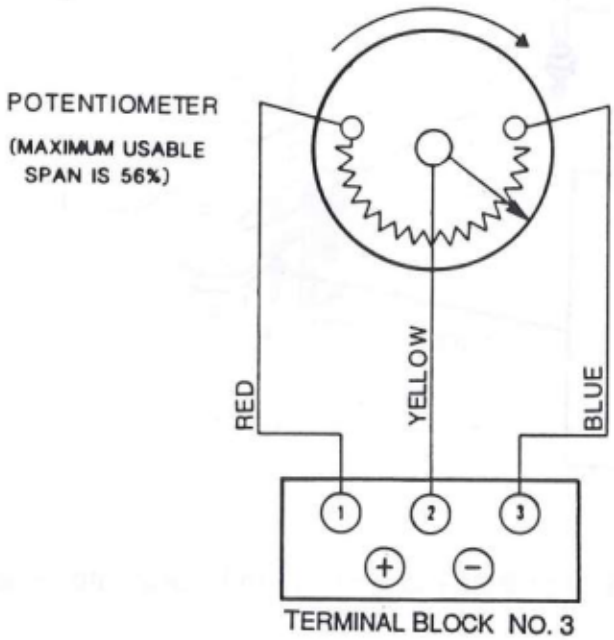


Figure 7-12. Typical Potentiometer Wiring Diagram