

## INSTALLATION INSTRUCTIONS FOR SUNNEN MPS-585A HYDRAULIC PRESSURE TRANSDUCER

Install the Hydraulic Pressure Transducer in the hydraulic supply line to the spindle drive motor and connect cables as follows:

**WARNING:** TURN ELECTRICAL POWER OFF AT MAIN BUSS BOX OR MAIN POWER SOURCE WHEN PERFORMING ANY MAINTENANCE ON MACHINE ELECTRICAL SYSTEM.

**CAUTION:** Disconnect and reconnect wires one at a time. Unit will not function properly if wires are reversed.

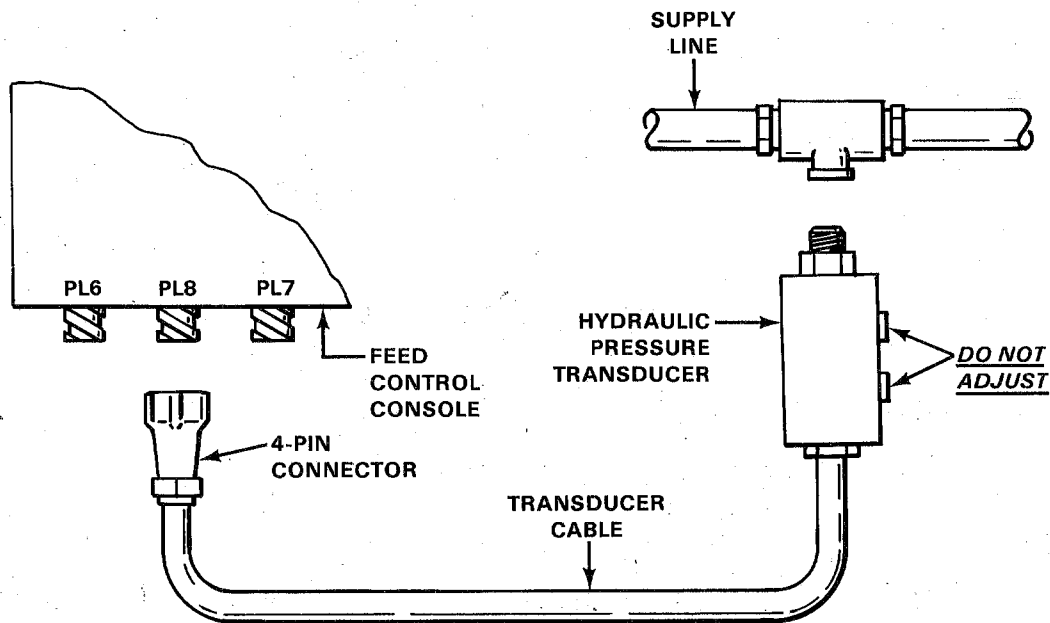


FIGURE 1, Hydraulic Pressure Transducer

### HYDRAULIC PRESSURE TRANSDUCER

1. **DISCONNECT** Electrical Power Cord from Control Console.
2. **IF INSTALLED:** Disconnect the old Transducer Cable from Feed Control Console and remove old Hydraulic Pressure Transducer from hydraulic supply line.
3. Install the new Hydraulic Pressure Transducer in the hydraulic supply line to the spindle motor (see Figure 1).
4. Connect the Transducer Cable to Feed Control Console.

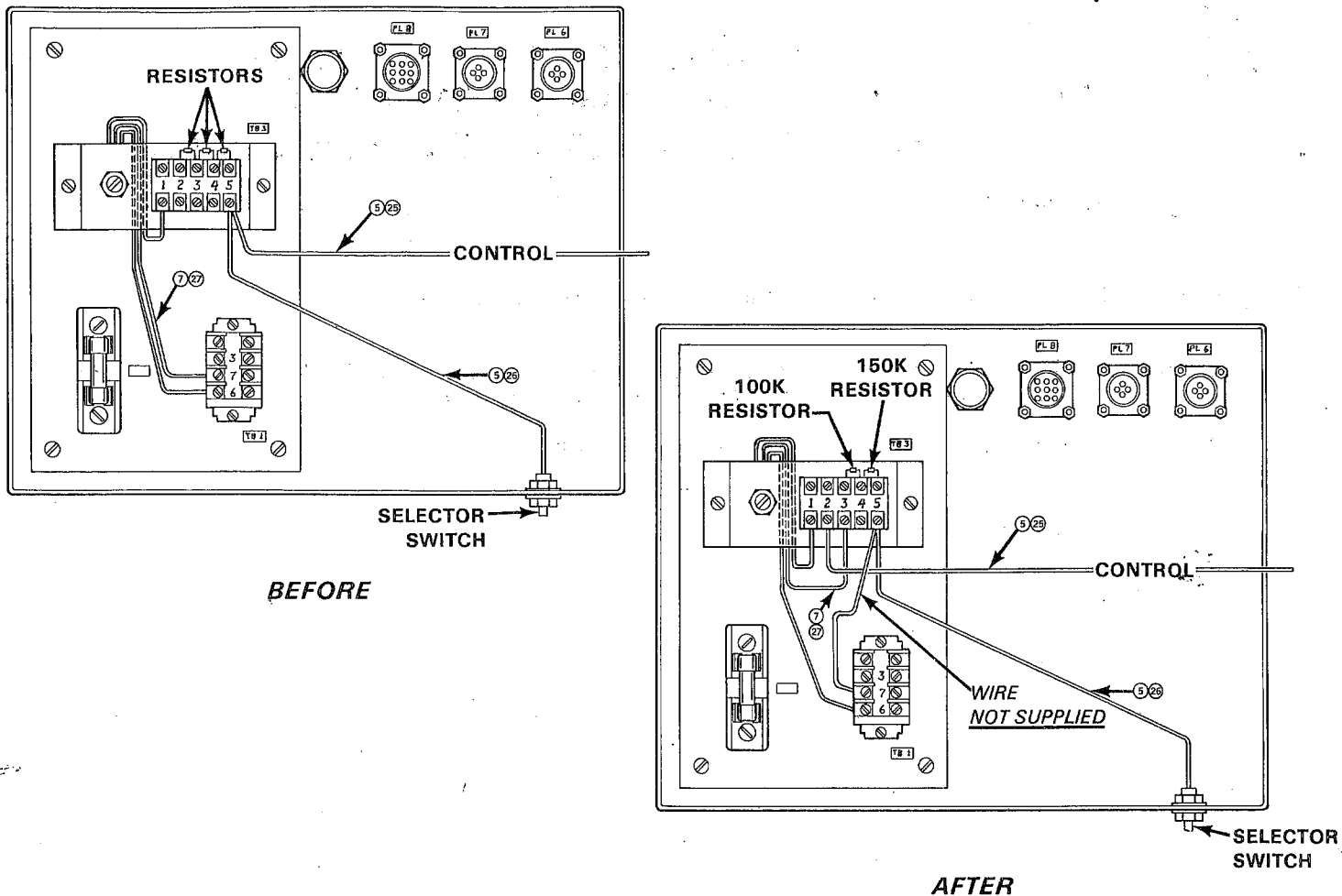


FIGURE 2, Feed Control Console

### FEED CONTROL CONSOLE

6. Open Door to Feed Control Console.
7. Remove three (3) Resistors (1k, 1k, 2.2k) from Terminal Block TB3 (see Figure 2).
8. Install 100k Resistor (Color Coded: brn/blk/yel) on Terminal Block TB3. Attach one lead to terminal #3 and the other to terminal #4.
9. Install 150k Resistor (Color Coded: brn/grn/yel) on Terminal Block TB3. Attach one lead to terminal #4 and the other to terminal #5.
10. Remove wire #7 (Lead 27 connected to potentiometer) from terminal #7 on Terminal Block TB1 and connect to terminal #3 on Terminal Block TB3.
11. Remove wire #5 (Lead 25 connected to Control, *NOT* wire #5 (Lead 26 connected to

Selector Switch), from terminal #5 on Terminal Block TB3 and connect to terminal #2 on Terminal Block TB3.

12. Connect a wire (*NOT SUPPLIED*) from terminal #5 on Terminal Block TB3 to terminal #7 on Terminal TB1.
13. To recalibrate "MPS" System, refer to Section II of "MPS" Installation & Operation Instructions.

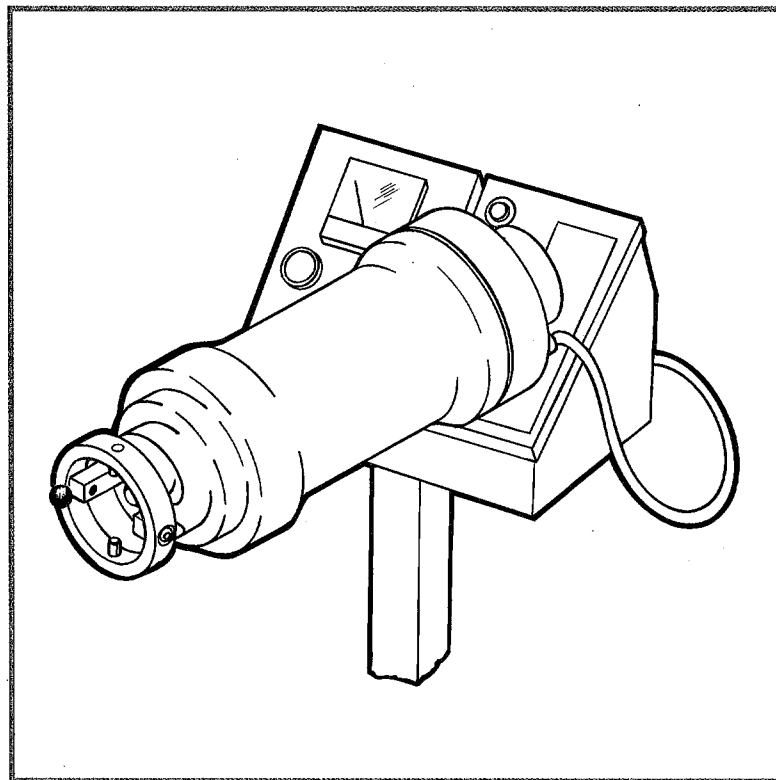
**NOTE: DO NOT ADJUST:** The "Zero" and "Span" adjustment settings on your new Hydraulic Pressure Transducer are preset at the factory.

14. Close Door on Feed Control Console.
15. **RECONNECT** Electrical Power Cord to Control Console.



# Installation, Setup and Operation

# INSTRUCTIONS



for



**SUNNEN® MODULAR POWER FEED SYSTEMS**

**Model: MPS-10 & MPS-11**

READ THE FOLLOWING INSTRUCTIONS THOROUGHLY AND CAREFULLY BEFORE UNPACKING,  
INSPECTING, OR INSTALLING THE SUNNEN® MODULAR POWER FEED SYSTEMS.

\*SUNNEN® AND THE SUNNEN LOGO ARE REGISTERED TRADEMARKS OF SUNNEN PRODUCTS COMPANY.\*

## GENERAL INFORMATION

The Sunnen® equipment has been designed and engineered for a wide variety of parts within the capacity and limitation of the equipment. With proper care and maintenance this equipment will give years of service.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY AND THOROUGHLY BEFORE UNPACKING, INSPECTING, OR INSTALLING THIS EQUIPMENT.

**IMPORTANT:** Read any supplemental instructions BEFORE installing this equipment. These supplemental instructions give you important information to assist you with the planning and installation of your Sunnen equipment.

Sunnen Technical Service Department is available to provide telephone assistance for installation, programming, & troubleshooting of your Sunnen equipment. All support is available during normal business hours, 8:00 AM to 4:30 PM Central Time.

Review all literature provided with your Sunnen equipment. This literature provides valuable information for proper installation, operation, and maintenance of your equipment. Troubleshooting information can also be found within the Instructions. If you cannot find what you need, call for technical support.

Where applicable, programming information for your Sunnen equipment is also included. Most answers can be found in the literature packaged with your equipment.

**Help us help you. When ordering parts, requesting information, or technical assistance about your equipment, please have the following information available:**

- Have ALL MANUALS on hand. The Customer Services Representative or Technician will refer to it.
- Have Model Number and Serial Number printed on your equipment Specification Nameplate.
- Where Applicable: Have Drive model and all nameplate data. Motor type, brand, and all nameplate data.

**For Troubleshooting, additional information may be required:**

- Power distribution information (type - delta, wye, power factor correction; other major switching devices used, voltage fluctuations)
- Installation Wiring (separation of power & control wire; wire type/class used, distance between drive and motor, grounding).
- Use of any optional devices/equipment between the Drive & motor (output chokes, etc.).

**For fast service on your orders call:**

Sunnen Automotive Customer Service toll free at: 1-800-772-2878

Sunnen Industrial Customer Service toll free at: 1-800-325-3670

Customers outside the USA, contact your local authorized Sunnen Distributor.

Additional information available at: <http://www.sunnen.com> or e-mail: [sunnen@sunnen.com](mailto:sunnen@sunnen.com)

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## ESD PREVENTION REVIEW

Let's review the basics of a sound static control system and its effective implementation. First, in the three step plan:

1. Always ground yourself when handling sensitive components or assemblies.
2. Always use a conductive or shielded container during storage or transportation. These materials create a Faraday cage which will isolate the contents from static charges.
3. Open ESD safe containers only at a static safe work station.

At the static safe work station, follow these procedures before beginning any work:

- A. Put on your wrist strap or foot grounding devices.
- B. Check all grounding cords to make sure they are properly connected to ground, ensuring the effective dissipation of static charges.
- C. Make sure that your work surface is clean and clear of unnecessary materials, particularly common plastics.
- D. Anti-static bubble wrap has been included for use at the machine when an ESD safe workstation is not available.

You are now properly grounded and ready to begin work. Following these few simple rules and using a little common sense will go a long way toward helping you and your company in the battle against the hazards of static electricity. When you are working with ESD sensitive devices, make sure you:

**GROUND**  
**ISOLATE**  
**NEUTRALIZE**

## SUNNEN® LIMITED PRODUCT WARRANTY

Sunnen® Products Company and its subsidiaries (SPC) warrant that all new SPC honing machines, gaging equipment, tooling, and related equipment will be free of defects in material and/or workmanship for a period of one year from the date of original shipment from SPC.

Upon prompt notification of a defect during the one-year period, SPC will repair, replace, or refund the purchase price, with respect to parts that prove to be defective (as defined above). Any equipment or tooling which is found to be defective from improper use will be returned at the customer's cost or repaired (if possible) at customer's request. Customer shall be charged current rates for all such repair.

Prior to returning any SPC product, an authorization (RMA#) and shipping instructions must be obtained from the Customer Service Department or items sent to SPC will be returned to the customer.

**Warranty Limitations and Exclusions** This Warranty does not apply to the following:

- Normal maintenance items subject to wear and tear: (belts, fuses, filters, etc).
- Damages resulting from but not limited to:
  - › Shipment to the customer (for items delivered to customer or customer's agent F.O.B., Shipping Point)
  - › Incorrect installation including improper lifting, dropping and/or placement
  - › Incorrect electric power (beyond +/- 10% of rated voltage) including intermittent or random voltage spikes or drops
  - › Incorrect air supply volume and/or pressure and/or contaminated air supply
  - › Electromagnetic or radio frequency interference from surrounding equipment (EMI, RFI)
  - › Storm, lightning, flood or fire damage
  - › Failure to perform regular maintenance as outlined in SPC manuals
  - › Improper machine setup or operation causing a crash to occur
  - › Misapplication of the equipment
  - › Use of non-SPC machines, tooling, abrasive, fixturing, coolant, repair parts, or filtration
  - › Incorrect software installation and/or misuse
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Except in the case of F.O.B., Buyer's destination shipments, SPC will not be liable for any settlement claims for obvious and/or concealed shipping damages. The customer bears the responsibility to unpack all shipments immediately and inspect for damage. When obvious and/or concealed damage is found, the customer must immediately notify the carrier's agent to make an inspection and file a claim. The customer should retain the shipping container and packing material.

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Any alteration or reverse engineering of the software is expressly forbidden and is in violation of this agreement.

SPC reserves the right to update the software covered by this agreement at any time without prior notice and any such updates are covered by this agreement.

# **SAFETY INSTRUCTIONS**

## **READ FIRST**

This machine, like any equipment, may be dangerous if used improperly. Please read all warnings and instructions before attempting to use this Unit.

Always disconnect power at main enclosure before servicing Unit.

Always wear eye protection when operating this Unit.

DO NOT attempt any repair or maintenance procedure beyond those described in this book. Contact your Sunnen® Field Service Engineer or Technical Services Representative for repairs not covered in these instructions.

DO NOT attempt to defeat any safety device on this machine or on any of the optional equipment.

Unit MUST be operated at least 18 in. (457 mm) above floor.

**WARNING:** Unit operates at EXTREMELY high temperatures.

 Indicates CE version ONLY.

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# GENERAL INFORMATION & SPECIFICATIONS

## Sunnen® Modular Power Feed System

<b>MODEL:</b>	<b>MPS-10</b>	<b>MPS-11</b>
<b>Electrical Requirements:</b>	115 V, 60 Hz, 1 Ph	115 V, 50/60 Hz, 1 Ph
<b>Color:</b>	Pearl Gray	Pearl Gray

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## INTRODUCTION

This Instruction Manual is provided to give the information required to install and operate the Sunnen® Modular Power Feed System.

Model MPS-10 is designed for power-stroked machines equipped with electric spindle drive motors. (Use Appendix A with the following instructions.)

Model MPS-11 is designed for power-stroked machines equipped with hydraulic spindle drive motors. (Use Appendix B with the following instructions.)

When ordering parts for, or requesting information about your Unit, include the model and serial numbers of your Machine.

**READ THE FOLLOWING INSTRUCTIONS THOROUGHLY AND CAREFULLY BEFORE UNPACKING, INSPECTING, OR INSTALLING SUNNEN® MODULAR POWER FEED SYSTEM.**



# SECTION 1 INSTALLATION

## GENERAL

This section is designed to aid the user in unpacking, inspecting, and installing of Sunnen® MPS Modular Power Feed Systems, Models MIPS-10 and MPS-11 (see Figure 1-1).

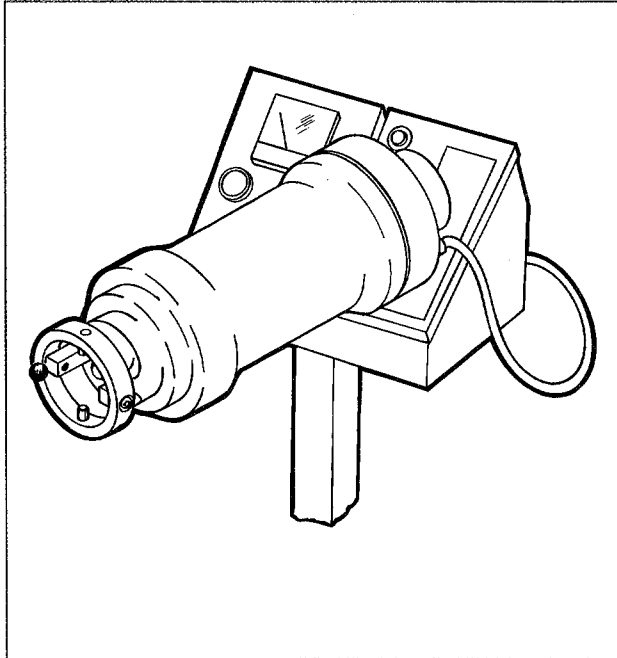


FIGURE 1-1, Modular Power Feed System

## SUGGESTED TOOLS & MATERIALS

The following tools and materials are suggested for installing the Sunnen Modular Power Feed System:

- Wire Cutters/Strippers
- Screw Driver (Std. & Jewelers)
- Hex Key (1/8" & 1/4")
- Slip-Joint Pliers (Small Nose)
- Open End Wrench (7/1)
- Electrical Tape

## UNPACKING & INSPECTING

Unpack Modular Power Feed System and inspect for signs of damage resulting from the improper handling by carrier. If damage is evident, immediately file a claim with the carrier.

## WARNING

Turn electrical power off at main buss box or main power source when performing any maintenance on machine's electrical system.

## INSTALLING SPINDLE NOSE ADAPTER

The following procedure is for installing Spindle Nose Adapters (see Figure 1-2) on machines equipped with 32mm or 40mm drive shafts (see step 1) or on machines equipped with #4 or #5 "Morse" Tapered Drive (see step 2). Consult your local Sunnen Field Engineer if your machine drive assembly differs from the following.

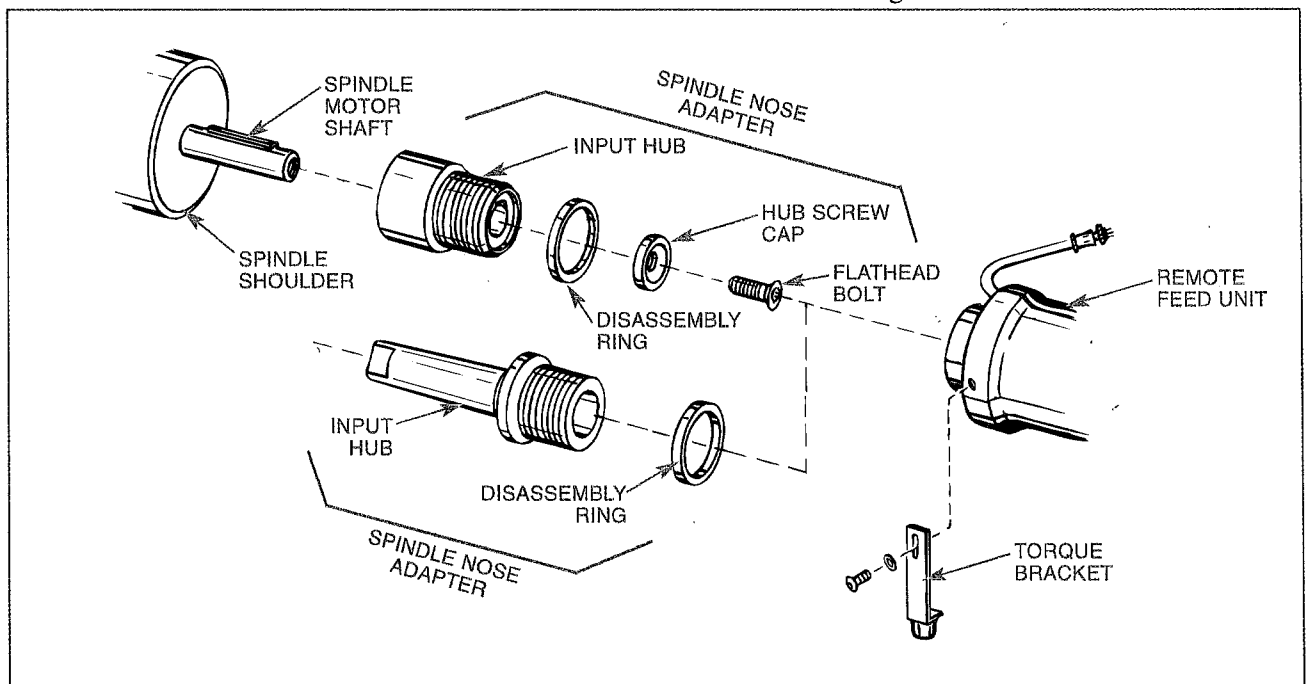
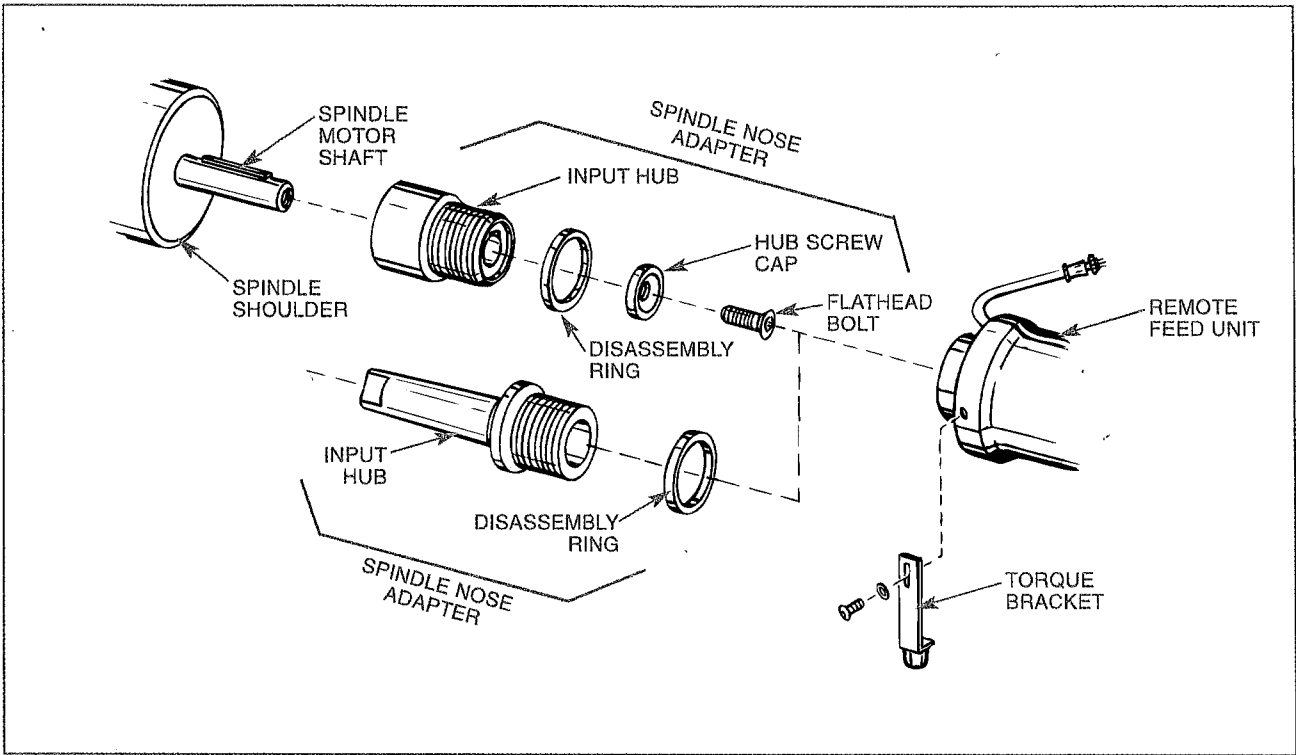


FIGURE 1-2, Remote Feed Unit



FIGURE\*1-3, Remote Feed Unit

**STEP 1- Spindle Nose Adapter (32/40mm):**

- Align Keyway in Input Hub with the key on the Spindle Motor Shaft and slide hub onto shaft.
- Place Hub Screw Cap (chamfer side out) on end of Input Hub and secure with Flathead Bolt to Spindle Motor Shaft. Tighten bolt (30 to 40 ft-lbs / 40-50 newton meters) until hub is firmly seated against Spindle Shoulder.

**STEP 2- Spindle Nose Adapter (#4/5 Morse Taper):**

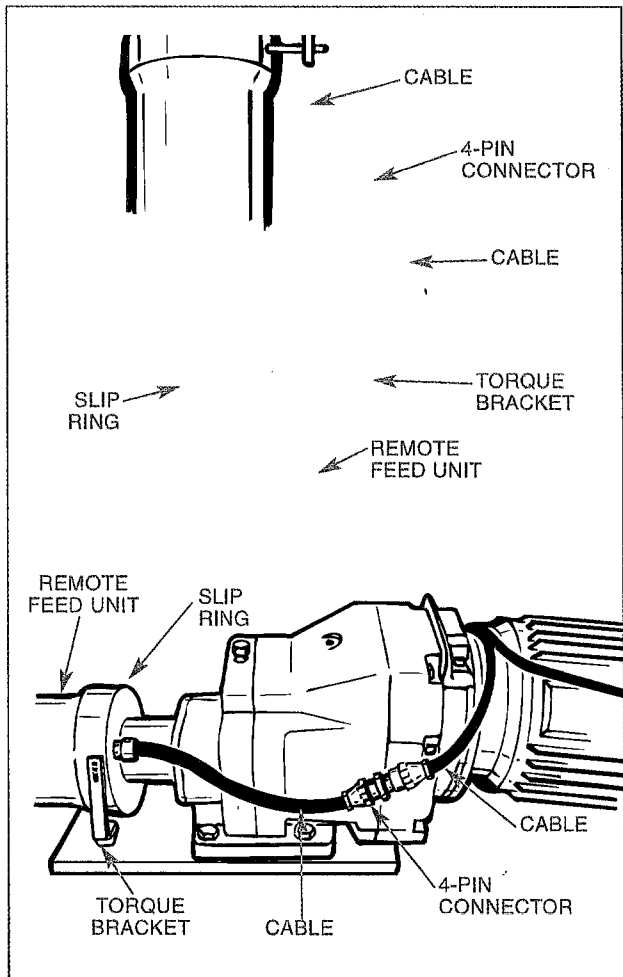
- Loosen Locking Nut on Drive Assembly.
- Slide "Morse" Tapered Drive out of the machine's spindle taper.
- Remove Locking Nut.
- Remove Key.
- Install Locking Nut on Input Hub.
- Align Slots in Locking Nut and Input Hub, and install Key.
- Install Input Hub in the machine's spindle taper.
- Tighten Locking Nut.

**INSTALLING REMOTE FEED UNIT**

**CAUTION**

DO NOT install Remote Feed Unit unless Disassembly Ring is in place on Input Hub.

1. Install Disassembly Ring on Input Hub (see Figure 1-3).
2. Install Remote Feed Unit by turning onto threaded Input Hub. Hand tighten.



FIGURE\*1-4, Torque Bracket

3. Install Torque Bracket on Remote Feed Unit (see Figure I-4).

**NOTE:** A Torque Bracket must be installed to prevent the Slip Ring on the Remote Feed Unit from turning while in operation. (If Torque Bracket supplied with the system does not work on your machine, you will need to make a bracket for your machine.)

## FEED CONTROL CONSOLE

1. Position the Feed Control Console in a convenient location.

2. Attach the Motor and Control Cables to bottom rear of the Feed Control Console (see Figure I-5).

- PL6 - Motor Cable (4.Pin Connector) is for the Remote Feed Unit.
- PL7 - Control Cable @Pin Connector) is for control signal output, Machine's Main Electrical Control Panel.
- PL8 - Used with MIPS-11 ONLY - Transducer Cable (4.Pin Connector) is for the Hydraulic Pressure Transducer.

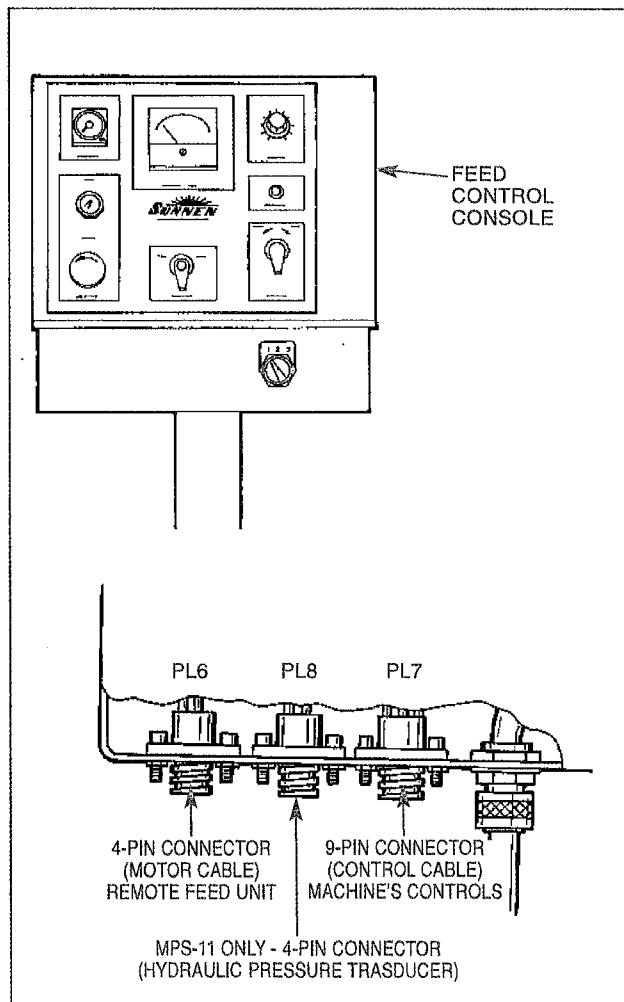


FIGURE-1-5, Feed Control Console

## REMOTE FEED UNIT CONNECTION

Route Motor Cable between Feed Control Console and Remote Feed Unit. Attach to 4-Pin Connector on Remote Feed Unit (refer to Figure I-4).

**NOTE:** Ensure cable is free to move with the stroking action of the machine.

## INSTALLING TRANSFORMER OR TRANSDUCER

1. Install Current Transformer (see Appendix A) on machines equipped with electric spindle drive motors or a Hydraulic Pressure Transducer (see Appendix B) on machines equipped with hydraulic spindle drive motors.

Appendix A - Current Transformer (Electric Spindle Drive Motor)

Appendix B - Hydraulic Pressure Transducer (Hydraulic Spindle Drive Motor)

2. Route the Control Cable to the Machine's Main Electrical Control Panel.

**NOTE:** Use Cord Connector where cable enters the panel to provide an oil tight connection.

## WIRING OPTIONS

When connecting cables to the Machine's Main Electrical Control Panel, refer to the Wiring Diagram included in this instruction package. The Feed Control Console can be wired for one of two modes of operation. In either mode, the STOP Button on the Feed Control Console is fully functional and will stop all machine and feed functions when depressed. The modes are as follows:

**MASTER CONTROL MODE** - Wiring Options 1A and 1B allow the Feed Control Console to control BOTH machine and feed functions. (Honing Cycle Start Button is used to start both machine and feed functions. Honing cycle stops when Honing Timer times out, when STOP Button is depressed, or when Machine's Stop Button is depressed.) See step 1, Wiring Option 1A (when control circuit exists on the machine) or step 2, Wiring Option 1B (when NO control circuit exists on the machine).

**SLAVE CONTROL MODE** - Wiring Option 2 (see step 3) allows the Machine's Controls to control BOTH machine and feed functions. (The feed cycle is started and stopped in conjunction with the machine's spindle, from an auxiliary contact signal from the machine. The Honing Cycle START Button and Honing Timer on the Feed Control Console are not functional in this mode.)

**NOTE:** The System requires 115V, 1-Ph input - Two optional Transformers are available from Sunnen:

PEM-516A (Domestic):	PEM-517A (Export):
208/230/460V Primary	220/380/440V Primary
115V Secondary	115V Secondary
250 Volt/Amps	250 Volt/Amps

1. WIRING OPTION 1A, (Master Control Mode) for machine on which a Control Circuit Exists (see Figure 1-6).

**WARNING**

These are general wiring instructions. Consult with your local sunnen field engineer, or sunnen products company, for specific instructions for wiring your machine. Improper wiring could result in personal injury or damage to the equipment.

A. Connect Yellow Wire (MPS Control Cable) and Violet Wire (MPS Control Cable) in series with Machine's Control Circuit Fuse (or Machine's EMERGENCY STOP Switch) as follows:

- Disconnect Wire from Machine's Control Circuit Fuse and connect to Violet Wire (MPS Control Cable). Connect Yellow Wire (MPS Control Cable) to Machine's Control Circuit Fuse.

B. Replace the Machine's Hold-In Contact with the MPS' Auxiliary Contact as follows:

- Disconnect Wire(s) from one Terminal of the Machine's Cycle Hold-In Contact and connect to Orange Wire (MPS Control Cable).
- Connect Black Wire (MPS Control Cable) to the open Terminal on the Machine's Cycle Hold-In Contact.
- Disconnect Wire(s) from second Terminal of the Machine's Cycle Hold-In Contact and connect to Green Wire (MPS Control Cable).
- Connect Brown Wire (MPS Control Cable) to the open Terminal on the Machine's Cycle Hold-In Contact.

C. Individually tape off ends of remaining wires.

**THEORY OF OPERATION**

When the MPS Honing Cycle START Button (1 PB) is depressed, the Honing Timer (TI) will be automatically set to the desired (preset) honing time. This will close Timer Contacts Z1 and Z2. Contact Z2 closes only momentarily while START Button (1 PB) is being depressed; Contact Z1 remains closed during the entire honing cycle. The closing of Contact Z2 energizes Relay 1 CR. Contact 1 CR1, which is wired in parallel with the Machine's START Switch, energizes Machine's Cycle Relay (CR). Machine's Contact CR1, which is wired in series with Timer Contact Z1, closes - providing a holding circuit for MPS Cycle Relay 1 CR; Machine's Contact CR2 also closes, energizing Machine's Contactor 1 M, which turns the spindle ON.

When Honing (TI) times out, or the MPS STOP Button or the Machine's STOP depressed, cycle will STOP.

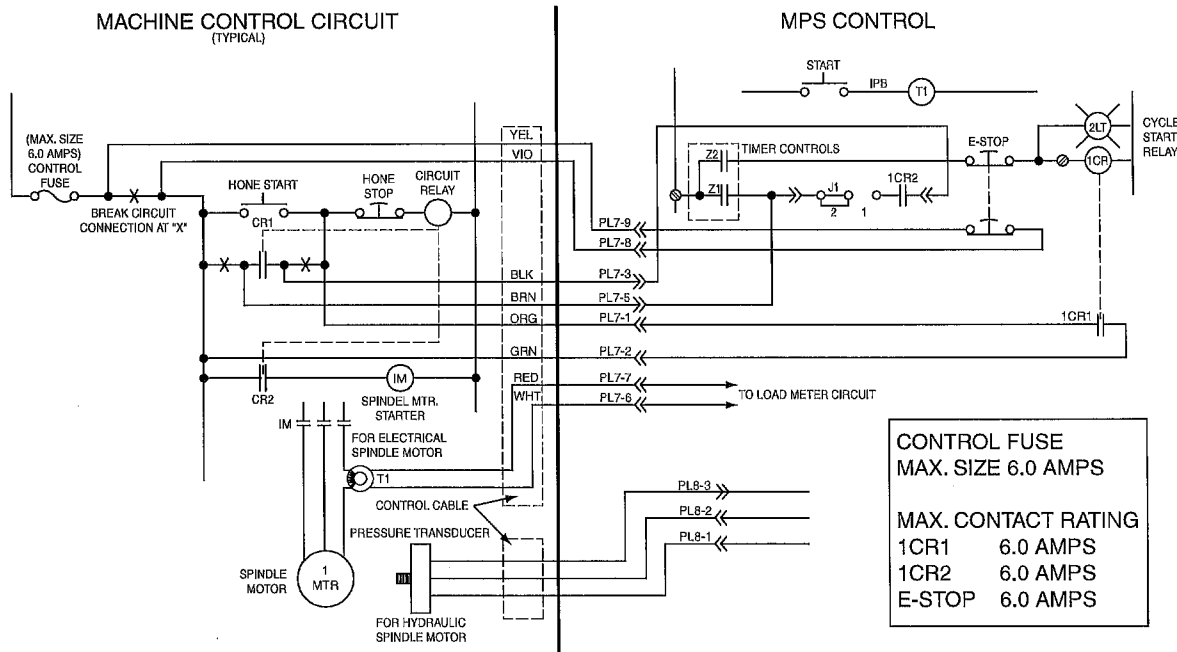


FIGURE 1-6, Wiring Option 1A

2. WIRING OPTION 1B, (Master Control Mode) for machine on which NO Control Circuit Exists (see Figure 1-7).

**WARNING**

These are general wiring instructions. Consult with your local sunnen field engineer, or sunnen products company, for specific instructions for wiring your machine. Improper wiring could result in personal injury or damage to the equipment.

A. Connect Yellow Wire (MPS Control Cable) and Violet Wire (MPS Control Cable) in series with Machine's Control Circuit Fuse (or Machine's EMERGENCY STOP Switch) as follows:

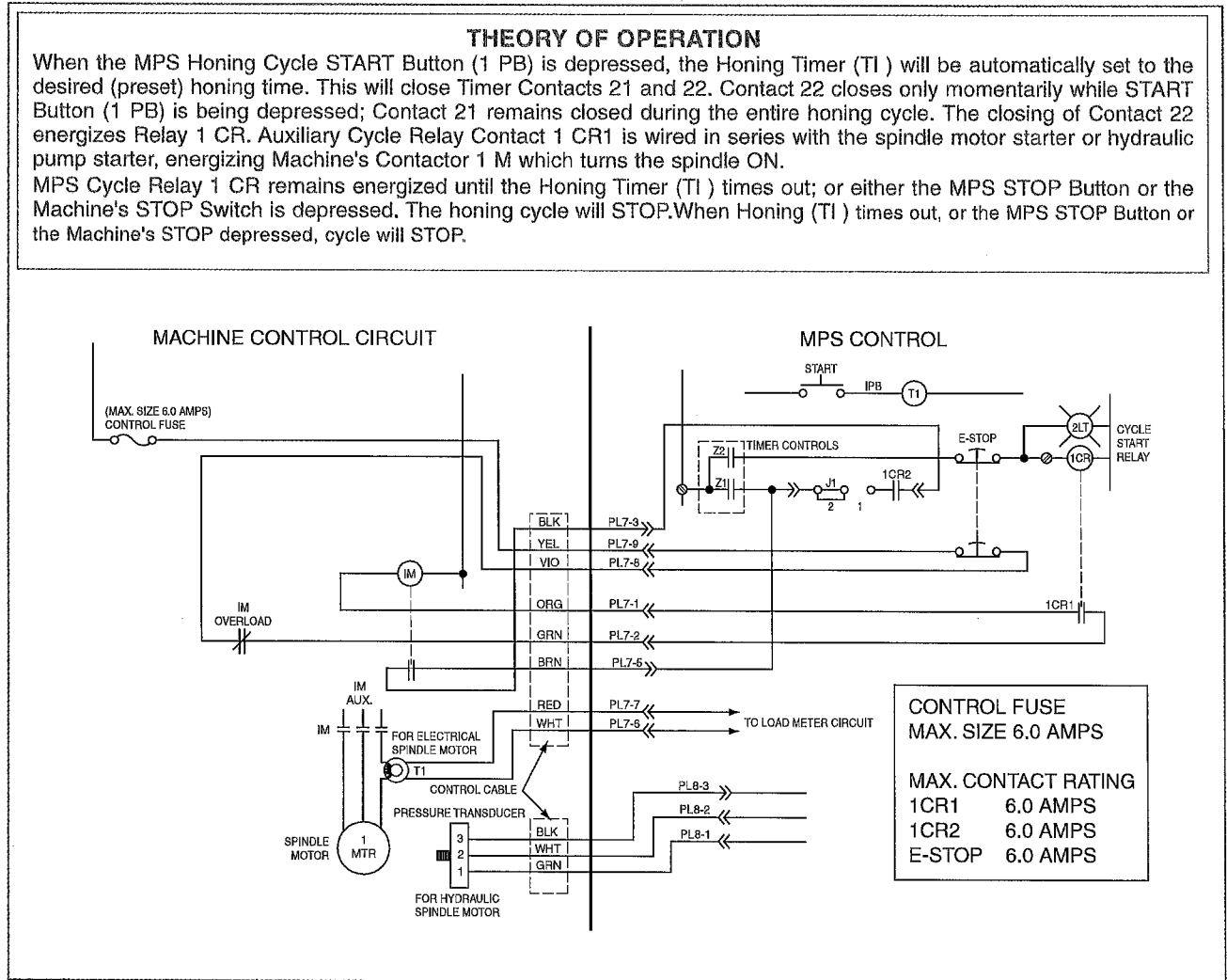
- Disconnect Wire from Machine's Control Circuit Fuse and connect to Violet Wire (MPS Control Cable).
- Connect Yellow Wire (MPS Control Cable) to Machine's Control Circuit Fuse.

B. The Honing Machine may be started and stopped directly through the normally open auxiliary contacts of the MPS's Cycle Relay by wiring as follows:

**NOTE:** Green and Orange Wires (MPS Control Cable) are connected between the Machine's STOP Switch and Motor Starter Coil. Black and Brown Wires (MPS Control Cable) are connected to an Auxiliary Contact to provide an external hold-in from the Machine.

- Connect Orange Wire (MPS Control Cable) to the Machine's Wire leading to the Motor Starter Coil.
- Connect Green Wire (MPS Control Cable) to the Machine's Wire leading to the STOP Switch.
- Connect Black Wire (MPS Control Cable) to a Terminal on the Auxiliary Contact in the Machine's Cycle Start Circuitry.
- Connect Brown Wire (MPS Control Cable) to second Terminal on the same Auxiliary Contact in the Machine's Cycle Start Circuitry.

C. Individually tape off ends of remaining wires.



**FIGURE 1-7, Wiring Option 1B**

3. WIRING OPTION 2, Slave Control Mode (see Figure 1-8).

**WARNING**

These are general wiring instructions. Consult with your local sunnen field engineer, or sunnen products company, for specific instructions for wiring your machine. Improper wiring could result in personal injury or damage to the equipment.

A. Connect Yellow Wire (MPS Control Cable) and Violet Wire (MPS Control Cable) in series with the Control Circuit Fuse (or in series with the Machine's STOP Switch) as follows:

- Disconnect Wire from Machine's Control Circuit Fuse and connect to Violet Wire (MPS Control Cable).
- Connect Yellow Wire (MPS Control Cable) to Machine's Control Circuit Fuse.

B. Connect Black Wire (MPS Control Cable) to a Terminal on the Normally Open Auxiliary Contact in the Machine's Cycle Start Circuitry (either the Cycle Start Relay or Spindle Contactor).

C. Connect Blue Wire (MPS Control Cable) to another Terminal on the same Normally Open Auxiliary Contact in the Machine's Cycle Start Circuitry.

D. Individually tape off ends of remaining wires.

**THEORY OF OPERATION**

When the Machine's Controls are used to control BOTH the machine and feed functions, MPS control is started and stopped through an Auxiliary Contact closure supplied by the Machine's Controls (Master Controls). The Auxiliary Contact can be either a normally open contact on the Cycle Relay or on the Spindle Motor Starter. When the Auxiliary Contact closes, it overrides the MPS Timer Contacts and energizes MPS relay 1 CR to place the MPS control in cycle. When the Machine cycle stops, the Auxiliary Contact opens and allows the 1 MPS control to drop out of cycle (honing cycle will stop). Depressing either the MPS STOP Button or the Machine's STOP Switch will stop all machine and feed functions.

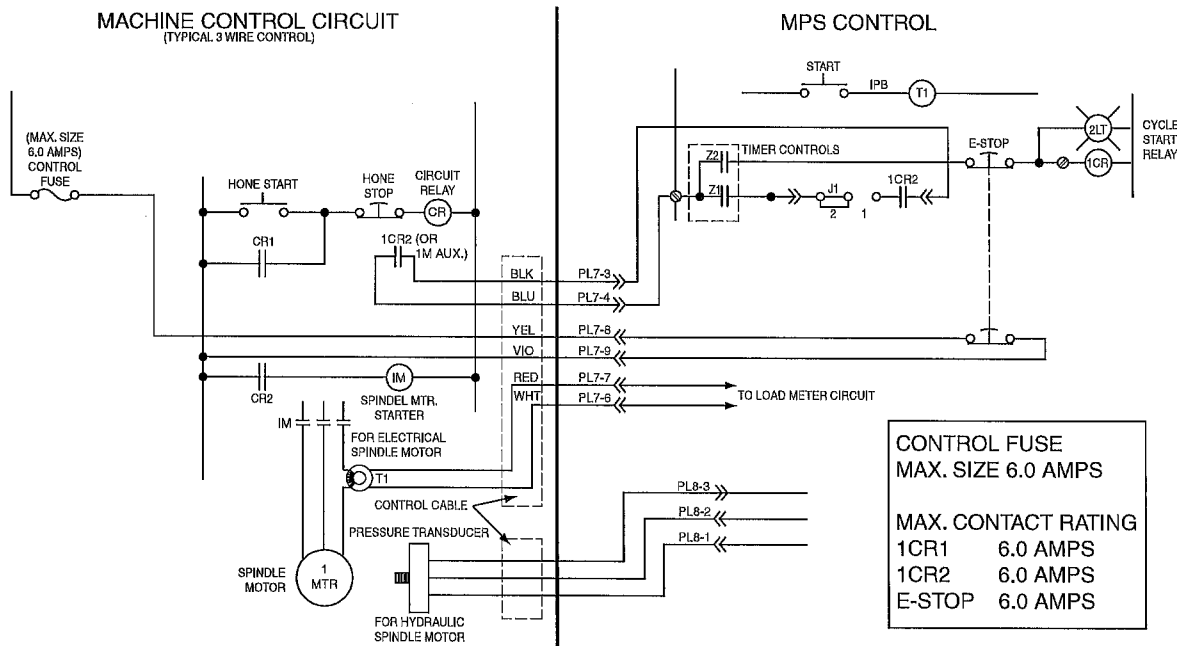


FIGURE 1-8, Wiring Option 2

# SECTION 2

## PREPARING FOR OPERATION

### GENERAL

This section is designed to aid the user in making adjustments to the Modular Power Feed System before the System and the Machine can be operated.

### MAJOR CONTROLS

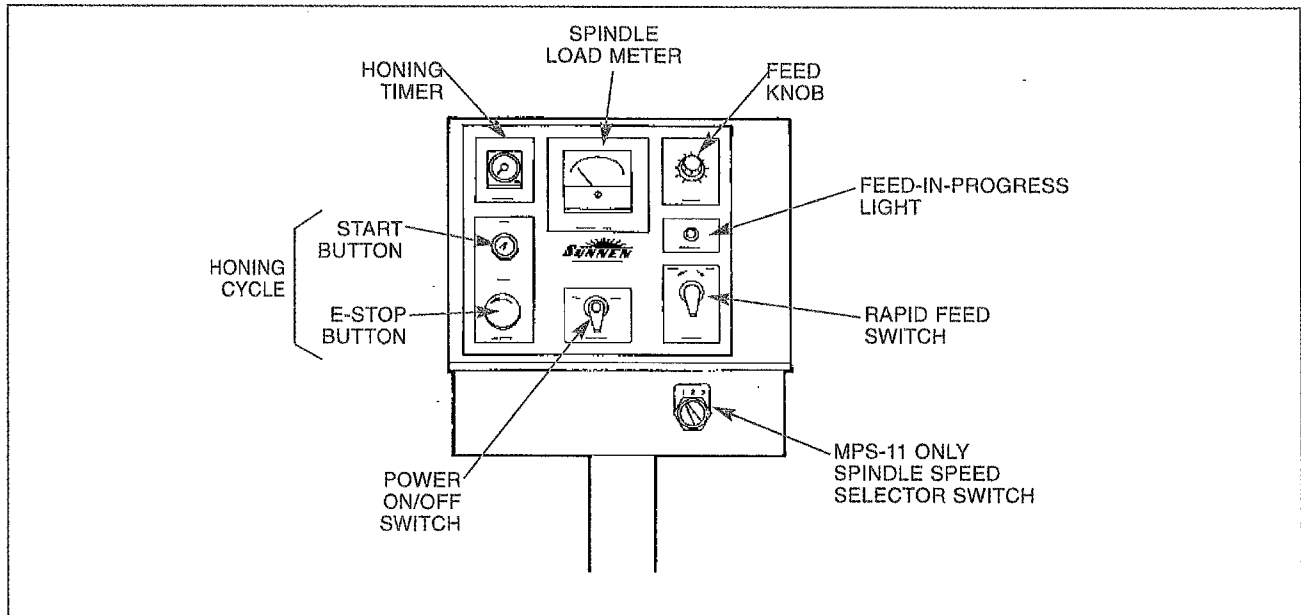
For location of controls, *see Figure 2-1*; for the function of the controls, *refer to Table 2-1*.

**TABLE 2-1, Control Functions**

NOMENCLATURE	DESCRIPTION	FUNCTION
<b>SPINDLE LOAD</b>	Meter	Indicates the percentage of spindle load produced
<b>HONING TIME</b>	Timer <sup>1</sup>	Sets the length of the honing cycle (Automatically stops all machine and feed functions at the end of a cycle)
<b>HONING CYCLE</b>		
START	Pushbutton Switch <sup>1</sup>	Starts all machine and feed functions
STOP	Pushbutton Switch (Locking)	Stops all machine and feed functions
<b>POWER</b>	White Lens Indicating Light	Indicates when power to Modular Power Feed System is ON
ON/OFF	Selector Switch	Controls power to Feed Control Console
<b>RAPID FEED</b>		
EXPAND/RETRACT	Jog Switch	Manually feeds stones in or out during setup.
<b>FEED IN PROGRESS</b>	Green Lens Indicating Light	Indicates when stones are being expanded during honing cycle
<b>FEED</b>	Selector Knob	Controls spindle load (Setting is based on bore diameter, condition of bore, material, and stones used)
<b>SPINDLE SPEED<sup>2</sup></b>	Selector Switch (Three Position)	Compensates for changes in hydraulic pressure at various spindle speeds to maintain a 3 H.P. load

NOTE<sup>1</sup>: Operative only when the MPS Feed Control Console is installed as Master Control to control BOTH feed and machine functions.

NOTE<sup>2</sup>: Installed on MPS-11 Units ONLY.



**FIGURE 2-1, Feed Control Console**

## ADJUSTMENTS

1. Turn ON Electrical Power at Main Buss Box or Main Power Source.
2. Remove any tooling from Remote Feed Unit.
3. Turn ON power to Modular Power Feed System and the Machine.
4. Set the Spindle Motor rpm at approximately mid-range, under a no-load condition.
5. Set Stroke Speed to slowest rate.
6. Set Machine's Stroke Stops to shortest distance.
7. Turn OFF oil supply to Oil Nozzle.
8. Rotate STOP Button to ensure it is not in the lock position. .
9. Depress START Button:
  - Master Control - Depress Start Button on Feed Control Console. Honing Timer must be set for unit to operate.
  - Slave Control - Depress Start Button on Machine's Controls.
10. Depress STOP Button on Feed Control Console; BOTH the Machine and the Modular Power Feed System should STOP operating.

11. Loosen two (2) Screws securing Feed Control Console Door.
12. Turn RAPID FEED Switch to EXPAND (see Figure 2-2). Shaft on Remote Feed Unit should rotate counterclockwise when looking into Remote Feed Unit. If rotation is incorrect, proceed as follows:
  - Open Door on Feed Control Console.
  - Reverse blue wires at terminals #8 and #5 on Terminal Block TB2 inside of the Feed Control Console.
  - Close Door and recheck rotation.
13. Move JUMPER to Position 1 (refer to Figure 2-2). Use Position 2 ONLY if latching contact is not used in Option 1B.

**NOTE:** Position 1 is for External-Hold, and Position 2 is for Self-Hold (refer to Figure 2-2).

### Zero L.E.D. Adjustment

Adjust Zero LED as follows (see Figure 2-3):

1. Remove any tooling from Remote Feed Unit.
2. Set the Spindle Motor rpm at approximately mid-range, under a no-load condition.
3. Set Stroke Speed to slowest rate.

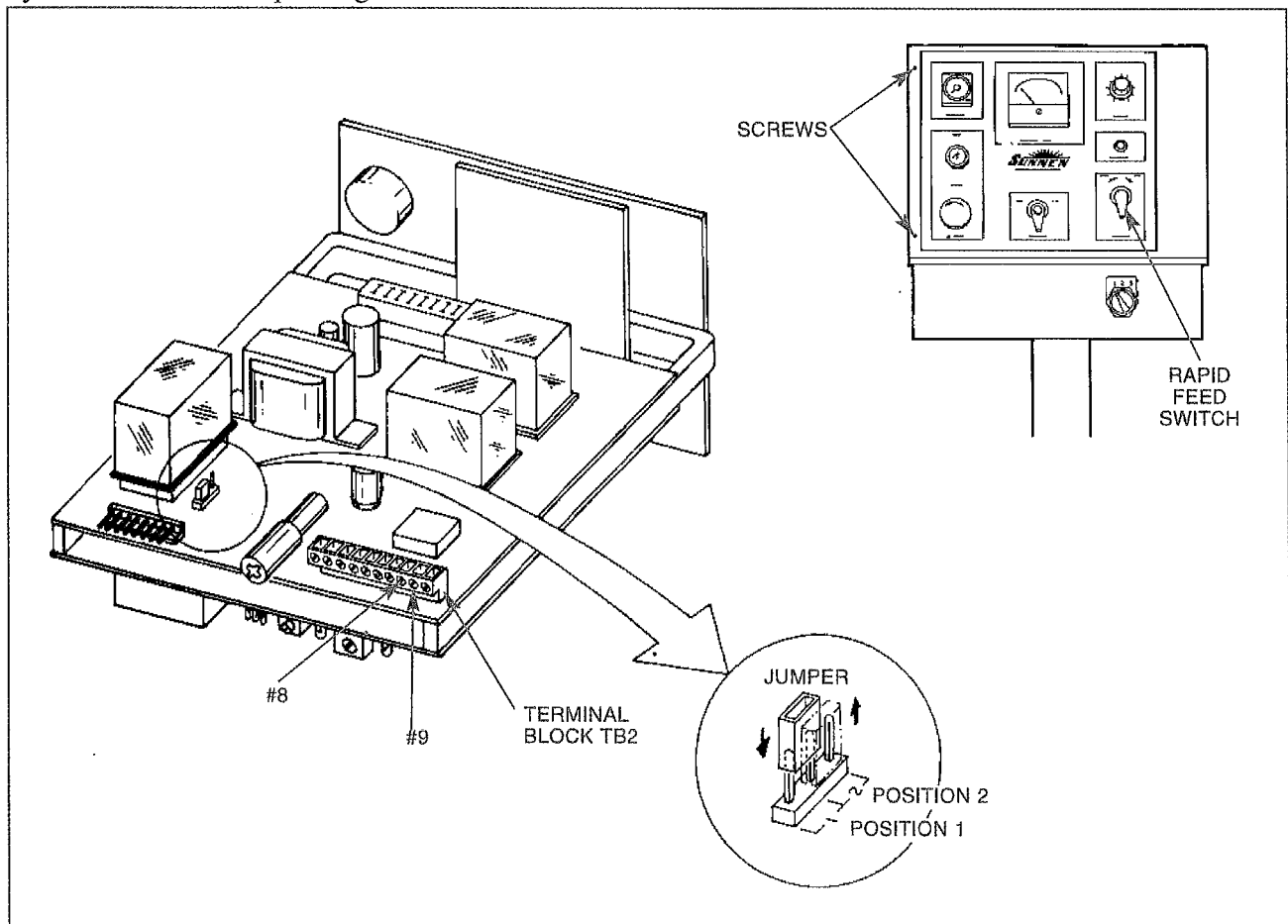


FIGURE 2-2, Feed Control Console (Internal View)



4. Set Machine's Stroke Stops to shortest distance.
5. Turn OFF oil supply to Oil Nozzle. t. Turn STOP Button to ensure it is not in the lock position.
6. Depress START Button:
  - Master Control - Depress Start Button on Feed
  - Control Console. Honing Timer must be set for unit to operate.
  - Slave Control - Depress Start Button on Machine's Controls.

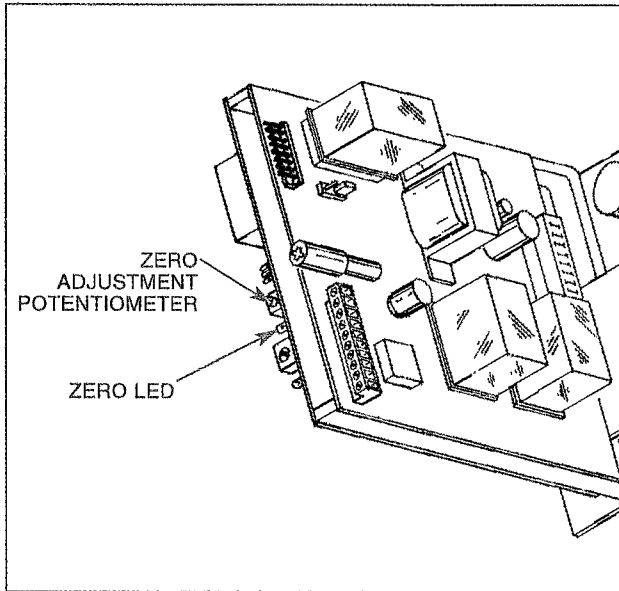


FIGURE 2-3, Zero LED Adjustment

**WARNING**

**TAKE NECESSARY PRECAUTIONS TO PREVENT ELECTRICAL SHOCK WHILE COMPLETING ZERO ADJUSTMENT. CONTROL IS WIRED AT 115 VOLTS.**

7. Open Door to Feed Control Console.
8. Turn Zero Adjustment Potentiometer until Zero L.E.D. begins to blink (flicker).
  - Adjust clockwise if Zero L.E.D. is not on.
  - Adjust counterclockwise if Zero L.E.D. is on continuously.

**NOTE:** When setting the Zero Adjustment, the Hydraulic Sensitivity Adjustment SHOULD be adjusted to approximately its mid-range setting (refer to step 8 and Figure 2-4).

9. Depress STOP Button on Feed Control Console.
10. SHUT OFF power to the Modular Power Feed System and the Machine.

**Calibration, MPS-11 Only**

Spindle Load Meter Calibration (for machines with hydraulic spindle drive motors):

1. Install a Hydraulic Pressure Gage in the Hydraulic Supply Line to the Spindle Motor.
2. Operate the machine under a no load condition with no tooling installed (refer to Section III, Setup and Operation).

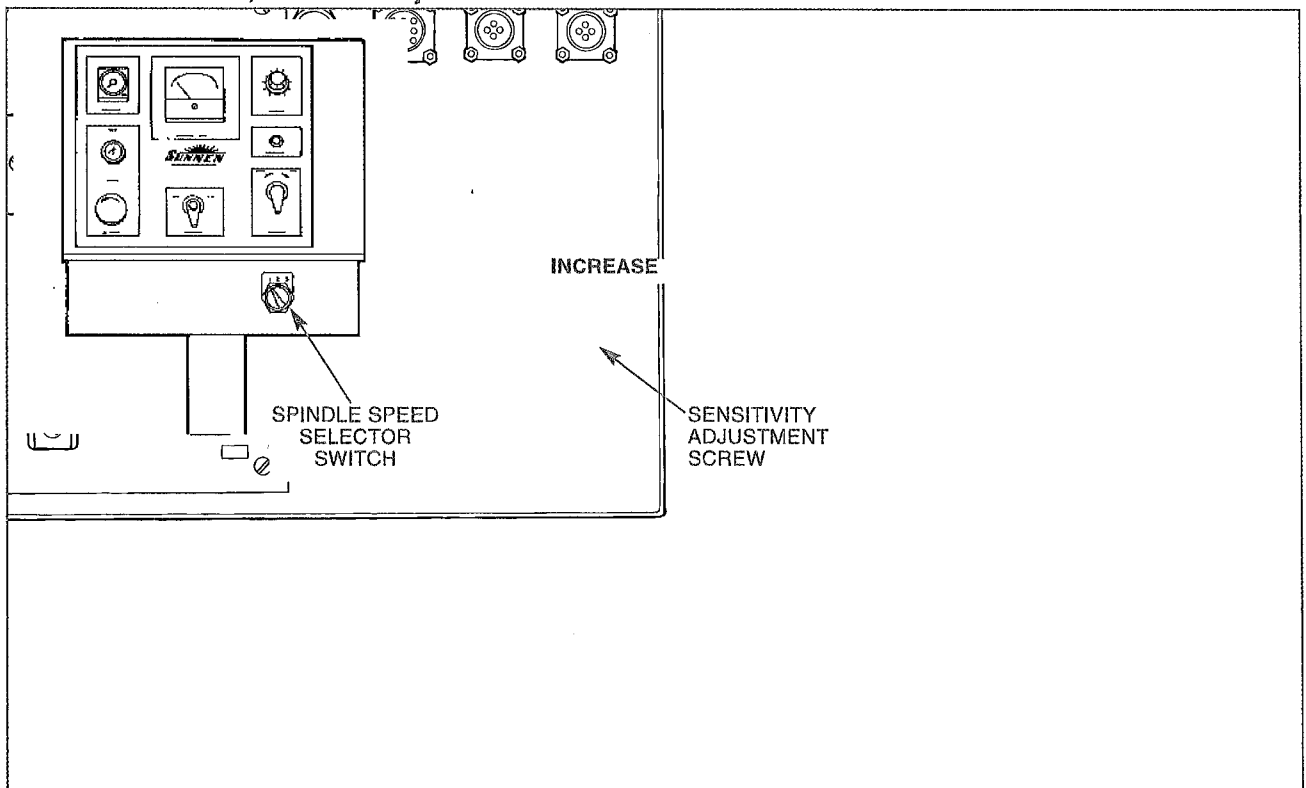


FIGURE 2-4, Feed Control Console (Internal View)

3. Adjust the spindle speed to approximately 150 rpm.
4. Measure the hydraulic pressure in the supply line to the Spindle Motor.
5. Calculate the OPERATING PRESSURE adjusted for 3 H.P. at 150 rpm using the following formula:

CID = motor Cubic Inch Displacement / revolution

$$\text{FLOW RATE (GPM)} = \frac{\text{CID} \times \text{RPM}}{231}$$

$$\text{PRESSURE (PSI)} = \frac{5152}{\text{GPM}}$$

OPERATING PRESSURE = Idle Speed Pressure + PSI

Sample Calculation:

SPINDLE SPEED (RPM) = 150

SPINDLE SPEED SELETOR SWITCH = 2-MED (see Table 2-2)

IDLE SPEED PRESSURE @ 150 RPM = 75  
(Reading of hydraulic pressure gage)

CID = 6.5IN<sup>3</sup>/REV (obtain from hydraulic motor specifications)

$$\text{GPM} = \frac{6.5 \times 150}{231} = 4.22$$

$$\text{PSI} = \frac{5152}{4.22} = 1218$$

OPERATING PRESSURE = 75 + 1218 = 1293

6. Operate the machine with tooling and a prehoned scrap workpiece installed (refer to Section III, Setup and Operation).
7. Increase machine load by increasing feed until hydraulic pressure equals the calculated OPERATING PRESSURE.
8. Adjust the Spindle Speed Selector Switch (see Figure 2-5 and Table 2-2).

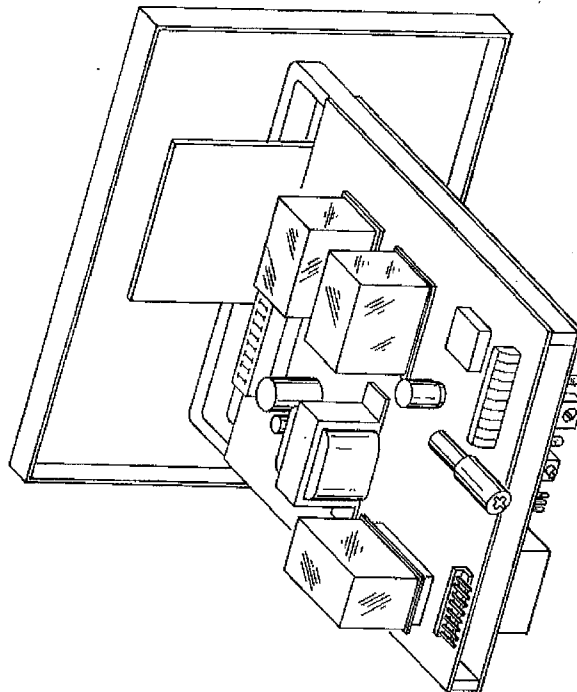
**TABLE 2-2, Spindle Speed Selector Switch**

TO COMPENSATE FOR PRESSURE CHANGES AT VARIOUS SPINDLE SPEEDS, A SPINDLE SPEED SELETOR SWITCH HAS BEEN INCORPORATED INTO THE MPS-11. POSITION SWITCH AS FOLLOWS:

SPINDLE SPEED	SWITCH POSITION
BELOW 150 RPM	1-LOW
150 TO 275 RPM	2-MED
ABOVE 275 RPM	3-HIGH

**NOTE:** The Hydraulic Sensitivity Adjustment SHOULD be adjusted to approximately its mid-range setting. It SHOULD NOT be in its fully counter-clockwise setting (refer to Figure 2-5).

9. Turn the Sensitivity Adjustment Screw inside the Feed Control Console until Spindle Load Meter reads 100% at the calculated OPERATING PRESSURE (refer to Figure 2-5).
  10. Check and readjust Zero L.E.D. Adjustment as necessary.
  11. SHUT OFF power to the Machine and the Modular Power Feed System.
  12. Set RED Cycle Switch on rear of Honing Timer to 50 Hz or 60 Hz as required.
- NOTE:** Switch is located on the lower right rear of Timer, below point where wires are connected.
13. Close Door to Feed Control Console and secure by tightening two (2) Screws.



**FIGURE 2-5, Feed Control Console (Internal View)**

# SECTION 3

## SETUP & OPERATION

### GENERAL

This section describes setup and operating procedures for the MPS-10 and MIPS-11. Prior to operating the Modular Power Feed System, the Operator should ensure that all adjustments described in Section II are complete.

### SAFETY PRECAUTIONS

The following precautions should be followed to ensure maximum safety of personnel while working on or around power-stroked honing machines.

- Ensure all guards are in place before operating.
- Keep machine clear of tools or other foreign objects.
- Wear proper safety items such as, safety glasses, gloves, non-slip safety shoes and other personal safety equipment as necessary or required.
- DO NOT wear loose clothing or jewelry while working on or around machine.
- Keep area around machine free of paper, oil, water and all other debris at all times.
- When lifting workpiece or tooling, use proper lifting procedure.

- Turn OFF electrical power at Electrical Control Enclosure Disconnect Switch when performing service not requiring power.
- Turn OFF electrical power at Main Power Source when performing maintenance on or cleaning of Electrical Control Enclosure.
- DO NOT adjust stroke length while honing.
- Stay clear of all moving parts.

### SETUP & OPERATION (TYPICAL)

1. Position workpiece so centerline of bore is in approximate alignment with center-line of spindle motor shaft (see Machine's Operating Instructions).
2. Assemble the Sunnen Wide Range Power Honing Tool according to Installation Instructions packaged with tool (see Figure 3-1).
3. Slide Input Yoke Adapter onto the Hex Shaft of the Remote Feed Unit. Turn Adapter to ensure it locks onto Pins in the Drive Ring (see Figure 3-2).
4. Slide Universal Cover over Input Yoke Adapter.
5. Adjust Stroke Stops (see Machine's Operating Instructions).

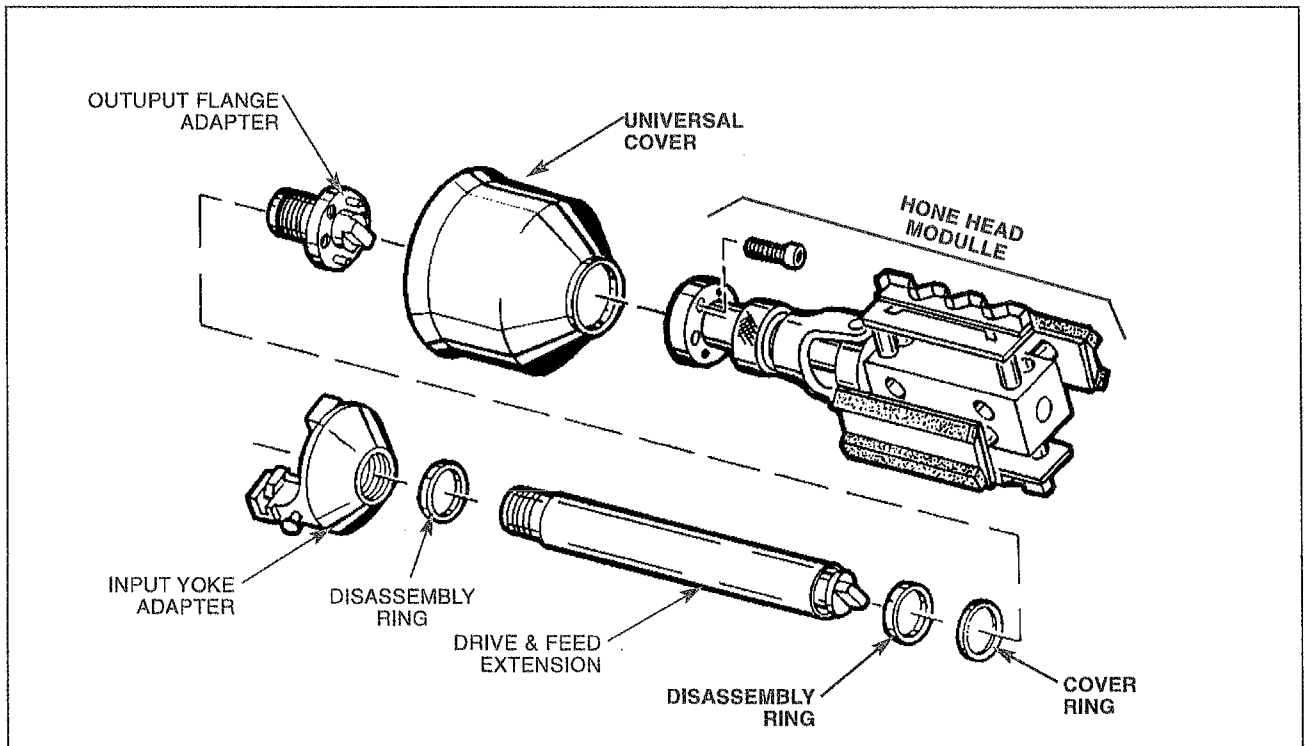


FIGURE 3-1, Honing Tool

6. Adjust the Spindle Speed (see Machine's Operating Instructions).

7. MPS-11 ONLY - For machines equipped with hydraulic spindle drive motors, adjust the Spindle Speed Selector Switch. This must be done to maintain a 3 H.P. load (see Table 3-1; refer to Section II.C.8.).

8. Adjust the Stroke Speed (see Machine's Operating Instructions).

9. Adjust the Oil Nozzle to ensure an ample amount of honing oil is supplied to the bore.

**CAUTION**

Use ONLY full strength Sunnen Industrial Honing Oil.

10. If Feed Control Console is wired to control BOTH machine and feed functions, set Honing Time for one honing cycle by rotating Bezel on the Honing Timer to the desired honing time (see Figure 3-3). Timer automatically resets each time Honing Cycle START Button is pushed, until you readjust the honing cycle time.

11. Adjust the Feed Knob to the lowest setting that gives good cutting action u&h respect to bore diameter, condition of the bore, mated, and stones wed (see Table 3-2).

**NOTE:** The Feed Settings shown in the table are offered as a suggested starting point. Experience with your particular machine and part will dictate the most eco-nomical feed setting for your shop.

12. Turn ON power to the Machine and the Modular Power Feed System. Power Light should now be lit on Feed Control Console.

13. Turn and hold the RAPID FEED Switch to EXPAND, until all the stones contact the bore wall. Shaking the honing tool shaft keeps the hone from binding in the bore while the stones are being fed out.

14. Retract the stones slightly by turning RAPID FEED Switch to RETRACT. (Starting the hone with the stones pressed tightly against the bore wall would produce unnecessary stone wear.)

**CAUTION**

The STOP Button on Feed Control Console STOPS BOTH machine and feed functions (refer to Figure 3-3). After STOP Button has been pressed, it must be rotated counterclockwise before the machine and feed functions can be restarted.

15. Press START Button.

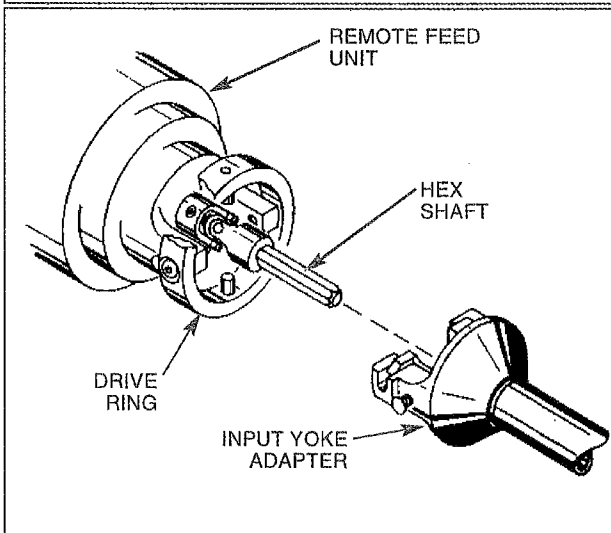
If wired as Master Control - Depress Start Button on Feed Control Console.

If wired as Slave Control - Depress Start Button on Machine's Controls.

**TABLE 2-2, Spindle Speed Selector Switch**

TO COMPENSATE FOR PRESSURE CHANGES AT VARIOUS SPINDLE SPEEDS, A SPINDLE SPEED SELECTOR SWITCH HAS BEEN INCORPORATED INTO THE MPS-11. POSITION SWITCH AS FOLLOWS:

SPINDLE SPEED	SWITCH POSITION
BELOW 150 RPM	1-LOW
150 TO 275 RPM	2-MED
ABOVE 275 RPM	3-HIGH



**FIGURE 3-2, Tool Installation**

**TABLE 2-2, Spindle Speed Selector Switch**

DIAMETER (inches)	SPINDLE (rpm)	ROUGH BORE	NORMAL BORE (Clean Up)
2	400	10	50
3	270	10	60
4	200	10	70
5	160	10	75
6	130	10	80
8	100	10	85
10	80	10	90

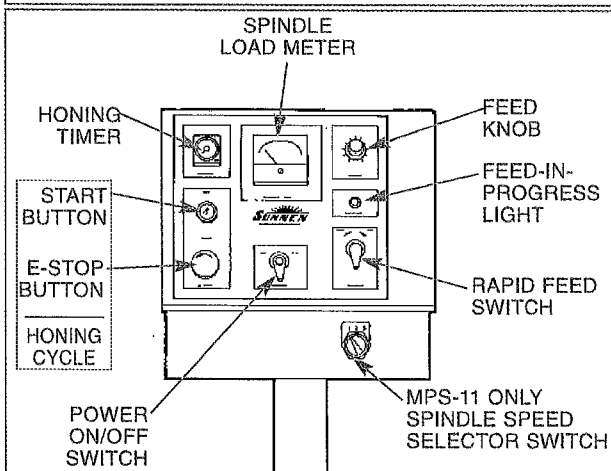
FOR FAST STOCK REMOVAL INCREASE SPEED

**IF STONES WEAAR RAPIDLY**

1. REDUCE FEED
2. USE HARDER STONES

**IF FEED-IN-PROGRESS LIGHT IS ON CONTINUALLY AND SPINDLE LOAD DECREASES**

1. INCREASE FEED
2. DRESS STONES
3. USE SOFTER STONES



**FIGURE 2-1, Feed Control Console**

# A - CURRENT TRANSFORMER INSTALLATION INSTRUCTIONS

FOR MACHINES EQUIPPED WITH  
ELECTRIC SPINDLE DRIVE MOTORS

Install Current Transformer in Machine's Main Electrical Control Panel as follows, using Ring Connectors (see Figure A-1):

## WARNING

Turn electrical power off at main buss box or main power source when performing any maintenance on machine electrical system.

1. Wrap Primary Winding on Current Transformer per Table A-1.

**NOTE:** The Zero Adjustment should be checked whenever there is a change in the number of turns on the Current Transformer.

2. Connect two (2) Black Wires of Primary Winding in series with one phase of the Electrical Supply Voltage to the Spindle Drive Motor.
3. Place Current Transformer in bottom of control panel.
4. Place Current Transducer in bottom of control panel.
5. Connect the White Wire (MPS Control Cable) to Terminal 1 on the Current Transducer.
6. Connect the Red Wire (MPS Control Cable) to Terminal 2 on the Current Transducer.
7. Connect the Black Wire on the Current Transformer to Terminal 3 on the Current Transducer.
8. Connect the White Wire on the Current Transformer to Terminal 4 on the Current Transducer.

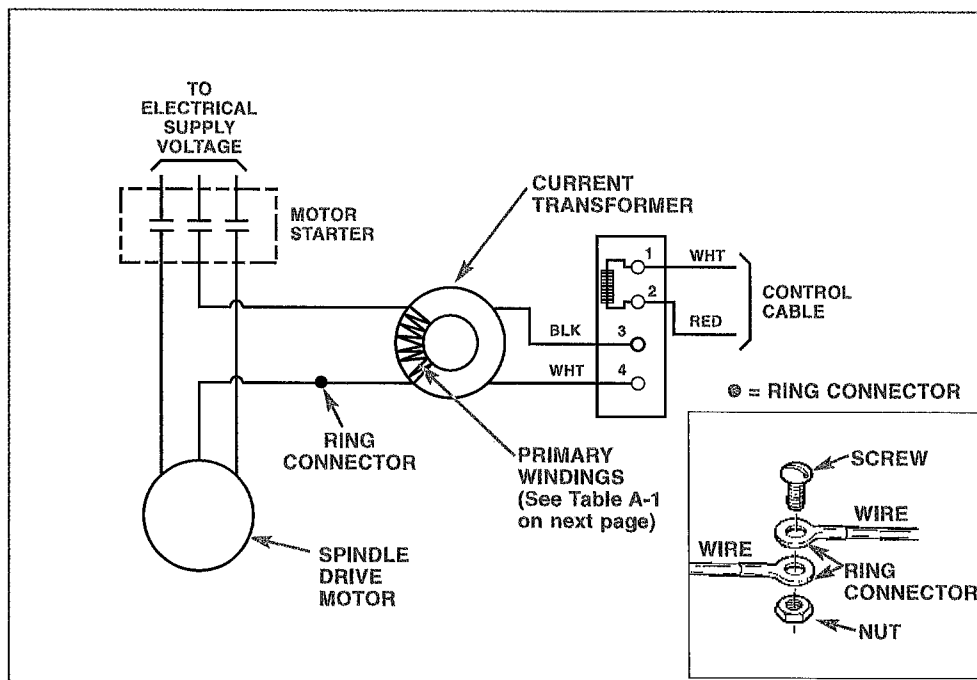


FIGURE A-1, Current Transformer

APPENDIX A

**TABLE A-1, Current Transformer**

THIS TABLE GIVES THE NUMBER OF REQUIRED TURNS OF WIRE THROUGH THE CENTER OF THE CURRENT TRANSFORMER FOR VARIOUS SPINDLE MOTORS (BY HORSEPOWER & LINE VOLTAGE). THE NUMBER OF TURNS HAVE BEEN CALCULATED TO GIVE THE EQUIVALENT OF 5.0 HORSEPOWER LOAD WHEN SPINDLE LOAD METER READS 100%.

SPINDLE HORSEPOWER	LINE VOLTAGE	NUMBER OF TURNS
2.0	230	5
2.0	380	6
2.0	460	6
3.0	230	8
3.0	380	9
3.0	460	11
5.0	230	6
5.0	380	8
5.0	460	8
7.5	230	8
7.5	380	9
7.5	460	11
10.0	230	8
10.0	380	9
10.0	460	11
15.0	230	11
15.0	380	12
15.0	460	14
20.0	230	9
20.0	380	12
20.0	460	14

\* Adding number of turns increase load meter sensitivity.  
 Reducing number of turns decreases load meter sensitivity.

NOTE: The zero adjustment should be checked whenever there is a change in the number of turns on the current transformer.

# B - HYDRAULIC PRESSURE TRANSDUCER INSTALLATION INSTRUCTIONS

FOR MACHINES EQUIPPED WITH  
HYDRAULIC SPINDLE DRIVE MOTORS

Install the Hydraulic Pressure Transducer in the hydraulic supply line to the spindle motor as follows (see Figure B-1):

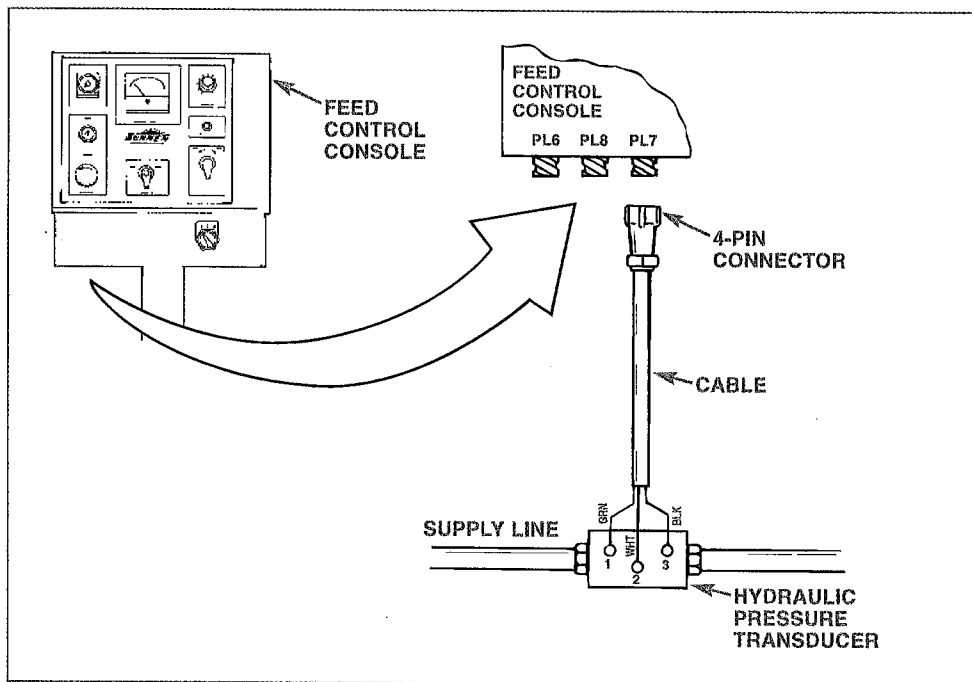
## WARNING

Turn electrical power off at main buss box or main power source when performing any maintenance on machine electrical system.

1. Connect the Transducer Cable to the Transducer as labeled.

NOTE: The motor must discharge into the Hydraulic Reservoir; a meter-out circuit is not acceptable.

2. Route and connect the Transducer Cable to the bottom rear of the Feed







Like any machinery, this equipment may be dangerous if used improperly. Be sure to read and follow instructions for operation of equipment.

## FRACTION / DECIMAL / MILLIMETER EQUIVALENTS CHART

INCH			INCH			INCH		
FRACTION	DECIMAL	MILLIMETER	FRACTION	DECIMAL	MILLIMETER	FRACTION	DECIMAL	MILLIMETER
....	.003937	0,1000	9/32	.281250	7,1438	21/32	.656250	16,6688
....	.007874	0,2000	19/64	.296875	7,5406	....	.669291	17,0000
....	.011811	0,3000	5/16	.312500	7,9375	43/64	.671875	17,0656
1/64	.015625	0,3969	....	.314961	8,0000	11/16	.687500	17,4625
....	.015748	0,4000	21/64	.328125	8,3344	45/64	.703125	17,8594
....	.019685	0,5000	11/32	.343750	8,7313	....	.708661	18,0000
....	.023622	0,6000	....	.354331	9,0000	23/32	.718750	18,2563
....	.027559	0,7000	23/64	.359375	9,1281	47/64	.734375	18,6531
1/32	.031250	0,7938	3/8	.375000	9,5250	....	.748031	19,0000
....	.031496	0,8000	25/64	.390625	9,9219	3/4	.750000	19,0500
....	.035433	0,9000	....	.393701	10,0000	49/64	.765625	19,4469
....	.039370	1,0000	13/32	.406250	10,3188	25/32	.781250	19,8438
3/64	.046875	1,1906	27/64	.421875	10,7156	....	.787402	20,0000
1/16	.062500	1,5875	....	.433071	11,0000	51/64	.796875	20,2406
5/64	.078125	1,9844	7/16	.437500	11,1125	13/16	.812500	20,6375
....	.078740	2,0000	29/64	.453125	11,5094	....	.826772	21,0000
3/32	.093750	2,3813	15/32	.468750	11,9063	53/64	.828125	21,0344
7/64	.109375	2,7781	....	.472441	12,0000	27/32	.843750	21,4313
....	.118110	3,0000	31/64	.484375	12,3031	55/64	.859375	21,8281
1/8	.125000	3,1750	1/2	.500000	12,7000	....	.866142	22,0000
9/64	.140625	3,5719	....	.511811	13,0000	7/8	.875000	22,2250
5/32	.156250	3,9688	33/64	.515625	13,0969	57/64	.890625	22,6219
....	.157480	4,0000	17/32	.531250	13,4938	....	.905512	23,0000
11/64	.171875	4,3656	35/64	.546875	13,8906	29/32	.906250	23,0188
3/16	.187500	4,7625	....	.551181	14,0000	59/64	.921875	23,4156
....	.196850	5,0000	9/16	.562500	14,2875	15/16	.937500	23,8125
13/64	.203125	5,1594	37/64	.578125	14,6844	....	.944882	24,0000
7/32	.218750	5,5563	....	.590551	15,0000	61/64	.953125	24,2094
15/64	.234375	5,9531	19/32	.593750	15,0813	31/32	.968750	24,6063
....	.236220	6,0000	39/64	.609375	15,4781	....	.984252	25,0000
1/4	.250000	6,3500	5/8	.625000	15,8750	63/64	.984375	25,0031
17/64	.265625	6,7469	....	.629921	16,0000	1	1.000000	25,4000
....	.275591	7,0000	41/64	.640625	16,2719	1-1/16	1.062500	26,9880

**FORMULAS:**

MULTIPLY	BY	=	TO GET
INCHES (in)	x 25.4	=	MILLIMETERS (mm)
FEET (ft)	x 0.3048	=	METERS (m)

MULTIPLY	BY	=	TO GET
MILLIMETERS (mm)	x 0.03937	=	INCHES (in)
METERS (m)	x 3.281	=	FEET (ft)

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SPECIAL MACHINE TOOLS  
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## CENTURY HORIZONTAL HONING MACHINE

### MACHINE SPECIFICATIONS

MODEL  
NUMBER

SERIAL  
NUMBER

VOLTAGE

PHASE

CYCLE

## APPLICATION OF THIS MANUAL

IN AN INSTRUCTION MANUAL DESIGNED TO COVER MORE THAN ONE MODEL MACHINE, CERTAIN DIFFICULTIES ARE ENCOUNTERED BECAUSE OF THE DETAIL DIFFERENCES IN EACH MACHINE.

IT IS THE PURPOSE OF THIS MANUAL TO ILLUSTRATE AND DESCRIBE THE ARRANGEMENT AND OPERATION OF THE CENTURY HONING MACHINE UNDER ALL CONDITIONS AND SPECIFICATIONS. THEREFORE, THE SPECIFIC MACHINE THAT YOU HAVE IN OPERATION MAY OR MAY NOT HAVE ALL OF THE ARRANGEMENTS OR ATTACHMENTS. YOUR ALLOWANCE FOR THESE DIFFERENCES WILL BE NECESSARY FOR THE APPLICATION OF THIS MANUAL.

IN ADDITION TO THE ABOVE, ENGINEERING CHANGES HAVE BEEN MADE AND WILL CONTINUE TO BE MADE IN A CONSTANT ENDEAVOR TO IMPROVE CENTURY EQUIPMENT. THEREFORE, YOU MAY FIND THAT YOUR MACHINE MAY VARY SOMEWHAT FROM THE DETAILS IN THIS MANUAL. HOWEVER, THE PRINCIPLES OF OPERATION REMAIN THE SAME AND WITH THIS UNDERSTANDING WE KNOW THAT YOU WILL FIND THIS MANUAL EXTREMELY HELPFUL IN MAINTAINING YOUR MACHINE IN THE BEST OPERATING CONDITION.

## FORWARD

YOUR CENTURY HONING MACHINE IS THE PRODUCT OF MANY YEARS OF EXPERIENCE AND SKILL IN THE MANUFACTURE OF HONING PROCESS EQUIPMENT. SINCE THE BEGINNING OF HONING AS A COMMERCIAL PROCESS THE SCOPE HAS BROADENED FROM THE FINISHING OF AUTOMOTIVE CYLINDERS TO PRACTICALLY EVERY FIELD OF MANUFACTURE WHERE A CYLINDRICAL SURFACE OF ACCURACY AND QUALITY OF SURFACE IS REQUIRED IRRESPECTIVE OF SIZE FROM FRACTIONS OF AN INCH TO MORE THAN 90 FEET IN LENGTH. THE STOCK REMOVAL RANGES FROM LESS THAN ONE THOUSANDTH OF AN INCH TO MORE THAN  $\frac{1}{2}$  AN INCH.

IT IS TO OUR VITAL INTEREST AND YOURS THAT THE MACHINE BE MAINTAINED IN A HIGHLY PRODUCTIVE CONDITION. FOR THAT PURPOSE THIS MANUAL HAS BEEN PREPARED WITH TREATMENT OF THE MORE IMPORTANT DETAILS OF OPERATION AND MAINTENANCE.

## THE HONING PROCESS

THE HONING PROCESS IS THE OPERATION OF FINAL SIZING AND CREATING THE DESIRED FINISH PATTERN ON THE INTERIORS OF CYLINDER BORES USING EXPANDING HONES PROVIDED WITH ABRASIVE STONES OF SUITABLE GRIT AND GRADE. HONING IS ACCOMPLISHED BY SIMULTANEOUS ROTATIONS AND RECIPROCATIONS OF THE HONE WITHIN THE BORE WITH THE HONE ABRASIVES UNDER PRELOADED PRESSURE.

HONING PERFORMS A THREEFOLD OPERATION. FIRST, IT IS A STOCK REMOVAL PROCESS. SECOND, AND AT THE SAME TIME, A FINISH PATTERN IS GENERATED TO PROVIDE THE BEST POSSIBLE SURFACE TO PROMOTE THE MOST DESIRABLE LUBRICATION CONDITION. THIRD, THE CYLINDRICAL SURFACE GENERATED IS EXTREMELY ACCURATE IN RELATION TO STRAIGHTNESS, ROUNDNESS, AND SIZE. THE GRIT AND GRADE OF THE STONE IS DETERMINED BY THE CHARACTERISTICS OF THE WORK PIECE, THE STOCK REMOVAL, AND THE RESULTANT SURFACE FINISH REQUIRED. WHERE HIGH STOCK REMOVAL IS REQUIRED, A COARSE STONE MAY BE USED FOR FASTER ACTION AND A SECOND OPERATION WITH A FINER STONE TO OBTAIN THE DESIRED FINISH.

THE HONING TOOL OR HONE IS BASICALLY A MECHANISM TO CARRY MULTIPLE ABRASIVE STONES UNDER PRELOADED PRESSURE. THE HONE HAS A BODY WHICH CARRIES SEVERAL RELATIVELY LONG AND NARROW STONES OF ARTIFICIAL ABRASIVE MATERIAL MOUNTED IN METAL HOLDERS CARRIED IN SHOES WHICH HAVE FREE AXIAL MOVEMENT WITHIN ESTABLISHED LIMITS. THE TYPE OF TOOL AND THE METHOD OF EXPANDING IT DEPENDS ON OPERATION AND PRODUCTION REQUIREMENTS.

CENTURY MACHINE, INC.  
1ST STREET WEST.  
P.O. BOX 30  
COULTER, IOWA 50431

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**SPINDLE DRIVE:** Rotation of the spindle is accomplished by hydraulic power supplied by a variable volume pump. The speed of rotation is adjustable by pressure compensated flow control valve located at the front of the machine. Counter clockwise on the rotary dial is stop and clockwise increasingly higher RPM.

**RECIPROICATION:** Reciprocation of the headstock is accomplished by hydraulic power supplied by a variable volume pump. The speed of reciprocation is adjustable by a pressure compensated flow control valve located at the front of the machine. Counter clockwise on the rotary dial is stop and clockwise is increasingly faster. The length of reciprocation stroke is controlled by the adjustable limit switch dogs located on the side rail of the machine.

**CONTROL STATION:** Each machine is arranged so that it can be operated by one operator. The operator has at his finger tips the electrical push button controls. Each machine has all or part of the following push buttons doing the jobs indicated:

- (1) Reverse  
Causes head to traverse out of the tube when short stroking.
- (2) Forward  
Causes head to traverse into the tube when short stroking.
- (3) Inch forward/reverse  
Causes head to go in the direction indicated at slow (40 FPM) rate for setup.
- (4) Dwell  
Causes head to hesitate at bottom of tube from 0 to 15 seconds.
- (5) Coolant on/off  
turns coolant on or off for honing of tube.
- (6) Spindle Jog  
Causes spindle to rotate only while being depressed.
- (7) Hydraulic start  
Starts hydraulic pump for reciprocation & spindle rotation.
- (8) Hydraulic stop  
Stops hydraulic pump.

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**PERIODIC INSPECTION:** To keep machine in perfect operating condition, it is necessary to check certain points of the machine periodically. This will bring to attention of those concerned, the fact that certain parts are wearing or need adjusting. Also, in the case of proper lubrication, it may prevent undue wear on the machine. Most important checking points are:

POINT	FREQUENCY
Hydraulic Cylinders	Monthly
Oil Level Hyd. Tank	Daily
Coolant Level	Weekly
Hydraulic Filter	Yearly (change)
Driveshaft Support Bushing	Weekly

#### LUBRICATION

**LUBRICATION:** Of utmost importance is the proper lubrication of the machine. Following are the proper lubrication of the machine. Following are points needing lubrication, showing type of lubrication to be used and frequency of lubrication change.

POINT	TYPE	FREQUENCY
Spindle Bearing	High Quality Multi- Purpose Bearing Grease	2 to 6 Months
Hydraulic Tank	Light Hyd. Oil	Add As Needed



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OPERATION SET UP

- (1) Load part on fixture and clamp in position with bore on centerline of machine.
- (2) Press hydraulic start.
- (3) Install head and drive shaft into bore.
- (4) Using inching, move spindle drive forward and connect driveshaft to spindle.
- (5) Expand head until close to bore size.
- (6) Using inching move into the bore stopping 1.5 inches from bottom of bore, set reversal trip.
- (7) Using inching move out of bore until flush set forward trip.
- (8) Set estimated time on timer dial.
- (9) Turn coolant on and adjust flow.
- (10) Set feed to approximately 50 %.
- (11) Press start button and adjust stroke and spindle speeds.
- (12) Readjust feed, forward/reverse, spindle and stroking speeds to desired rates.

SURFACE FEET PER MINUTE

BORE DIA.	HARDENED STEEL							MILD STEEL							CAST IRON				
	30	40	50	60	70	80	90	100	110	120	130	140	150	180	200				
	<u>R.P.M. FOR HONING</u>																		
1	115	153	191	229	267	306	344	382	420	458	497	535	573	688	764				
1-1/4	91.8	123	153	183	214	245	274	306	337	367	398	428	459	551	612				
1-1/2	76.3	102	127	153	178	204	230	254	279	305	330	356	381	457	508				
1-3/4	65.5	87.3	109	131	153	175	196	218	240	262	283	305	327	392	436				
2	57.3	76.4	95.5	115	134	153	172	191	210	229	248	267	287	344	382				
2-1/8	54.0	72.0	90.0	108	126	144	162	180	198	216	234	252	270	324	360				
2-1/4	51.0	68.0	85.5	102	119	136	153	170	187	204	221	238	255	306	340				
2-3/8	48.3	64.4	80.5	96.6	113	129	145	161	177	193	209	225	242	290	322				
2-1/2	45.8	61.2	76.3	91.7	107	122	138	153	168	184	199	213	230	275	306				
2-5/8	43.5	58.0	72.5	87.0	102	116	131	145	160	174	189	203	218	261	290				
2-3/4	41.7	55.6	69.5	83.4	97.2	111	125	139	153	167	181	195	209	250	278				
2-7/8	39.6	52.8	66.0	79.2	92.4	106	119	132	145	158	172	185	198	238	264				
3	38.2	51.0	63.7	76.4	89.1	102	114	127	140	152	165	178	191	228	254				
3-1/8	36.6	48.8	61.0	73.2	85.4	97.6	110	122	134	146	159	171	183	219	244				
3-1/4	35.1	46.8	58.5	70.2	81.9	93.6	105	117	129	140	152	164	176	211	234				
3-3/8	33.9	45.2	56.5	67.8	79.1	90.4	102	113	124	136	147	158	170	203	226				
3-1/2	32.7	43.6	54.5	65.5	76.4	87.4	98.1	109	120	131	142	153	164	196	218				
3-5/8	31.5	42.0	52.5	63.0	73.5	84.0	94.5	105	116	126	137	147	158	189	210				
3-3/4	30.6	40.8	51.0	61.2	71.4	81.6	91.8	102	112	122	133	143	153	184	205				
3-7/8	29.6	39.4	49.3	59.1	69.0	78.8	88.6	98.5	108	118	128	138	148	177	197				
4	28.7	38.2	47.8	57.3	66.9	76.4	86.0	95.6	105	115	124	134	143	172	191				
4-1/4	26.9	35.9	44.9	53.9	62.9	71.8	80.8	89.8	98.8	108	117	126	135	162	180				
4-1/2	25.4	34.0	42.4	51.0	59.4	67.9	76.3	84.4	93.3	102	110	119	127	153	170				
4-3/4	24.1	32.2	40.2	48.2	56.3	64.3	72.4	80.4	88.4	96.9	105	113	121	145	161				
5	22.9	30.6	38.2	45.9	53.5	61.1	68.8	76.4	84.0	91.7	99.3	107	115	138	153				
5-1/4	21.8	29.1	36.4	43.6	50.9	58.2	65.4	72.7	80.0	87.2	94.5	102	109	131	145				
5-1/2	20.8	27.8	34.7	41.7	48.6	55.6	62.4	69.4	76.3	83.3	90.2	97.2	104	125	139				
5-3/4	19.9	26.6	33.2	39.8	46.5	53.1	59.8	66.4	73.0	80.0	86.3	93.0	99.6	120	133				

SURFACE FEET PER MINUTE (CONT.)

BORE DIA.	HARDENED STEEL										MILD STEEL					CAST IRON						
	30	40	50	60	70	80	90	100	110	120	120	130	140	150	180	200	120	130	140	150	180	200
	R.P.M. FOR HONING																					
6	19.1	25.5	31.8	38.2	44.6	51.0	57.2	63.6	70.0	76.3	82.7	89.0	95.4	114	127	70.0	76.3	82.7	89.0	95.4	114	127
6-1/4	18.3	24.4	30.6	36.7	42.8	48.9	55.0	61.1	67.2	73.3	79.4	85.5	91.7	110	122	67.2	73.3	79.4	85.5	91.7	110	122
6-1/2	17.6	23.5	29.4	35.2	41.1	47.0	52.8	58.7	64.6	70.4	76.3	82.2	88.1	106	117	64.6	70.4	76.3	82.2	88.1	106	117
6-3/4	17.0	22.6	28.3	34.0	39.6	45.3	50.9	56.6	62.3	67.9	73.6	79.2	84.8	102	113	62.3	67.9	73.6	79.2	84.8	102	113
7	16.4	21.8	27.3	32.7	38.2	43.7	49.1	54.6	60.1	65.5	71.0	76.4	81.9	98.3	109	60.1	65.5	71.0	76.4	81.9	98.3	109
7-1/4	15.8	21.1	26.4	31.6	36.9	42.2	47.4	52.7	58.0	63.2	68.5	73.8	79.1	94.9	105	58.0	63.2	68.5	73.8	79.1	94.9	105
7-1/2	15.3	20.4	25.4	30.5	35.6	40.7	45.8	50.9	56.0	61.1	66.2	71.0	76.4	91.6	98.4	56.0	61.1	66.2	71.0	76.4	91.6	98.4
7-3/4	14.8	19.7	24.6	29.5	34.4	39.4	44.3	49.2	54.1	59.0	64.0	68.9	73.8	88.6	98.4	54.1	59.0	64.0	68.9	73.8	88.6	98.4
8	14.3	19.1	23.9	28.7	33.4	38.2	43.0	47.8	52.6	57.4	62.1	66.9	71.7	86.0	95.6	52.6	57.4	62.1	66.9	71.7	86.0	95.6
8-1/2	13.5	18.0	22.5	27.0	31.5	36.0	40.4	44.9	49.4	53.9	58.4	62.9	67.4	80.9	89.9	49.4	53.9	58.4	62.9	67.4	80.9	89.9
9	12.7	17.0	21.2	25.5	29.7	33.9	38.2	42.4	46.7	50.9	55.2	59.4	63.7	76.4	84.9	46.7	50.9	55.2	59.4	63.7	76.4	84.9
9-1/2	12.1	16.1	20.1	24.1	28.1	32.2	36.2	40.2	44.2	48.3	52.3	56.3	60.3	72.4	80.4	44.2	48.3	52.3	56.3	60.3	72.4	80.4
10	11.5	15.3	19.1	22.9	26.7	30.6	34.4	38.2	42.0	45.8	49.7	53.5	57.3	68.8	76.4	42.0	45.8	49.7	53.5	57.3	68.8	76.4
10-1/2	10.9	14.6	18.2	21.8	25.5	29.1	32.7	36.4	40.0	43.7	47.3	50.9	54.6	65.5	72.8	40.0	43.7	47.3	50.9	54.6	65.5	72.8
11	10.4	13.9	17.4	20.8	24.3	27.8	31.3	34.7	38.2	41.7	45.1	48.6	52.1	62.5	69.5	38.2	41.7	45.1	48.6	52.1	62.5	69.5
11-1/2	10.0	13.3	16.6	19.9	23.3	26.6	29.9	33.2	36.5	39.9	43.2	46.5	49.8	59.8	66.4	36.5	39.9	43.2	46.5	49.8	59.8	66.4
12	9.5	12.7	15.9	19.1	22.3	25.5	28.6	31.8	35.0	38.2	41.4	44.6	47.7	57.3	63.7	35.0	38.2	41.4	44.6	47.7	57.3	63.7
12-1/2	9.2	12.2	15.3	18.3	21.4	24.4	27.5	30.6	33.6	36.7	39.7	42.8	45.3	55.0	61.1	33.6	36.7	39.7	42.8	45.3	55.0	61.1

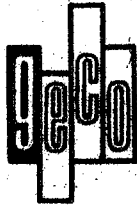
**REPLACEMENT PARTS AND  
ASSEMBLY DRAWINGS**

**ALL PARTS ARE STAMPED WITH  
IDENTIFYING PART NUMBERS**

**WHEN ORDERING PARTS;  
SPECIFY MODEL NUMBER  
AND SERIAL NUMBER OF MACHINE**

**MODEL AND SERIAL NUMBER  
LOCATED ON NAME TAG**

**PARTS MAY VARY ON INDIVIDUAL MACHINES;  
HOWEVER THIS LIST WILL HELP TO MAKE  
IDENTIFICATION OF PARTS EASIER.**



# spherette



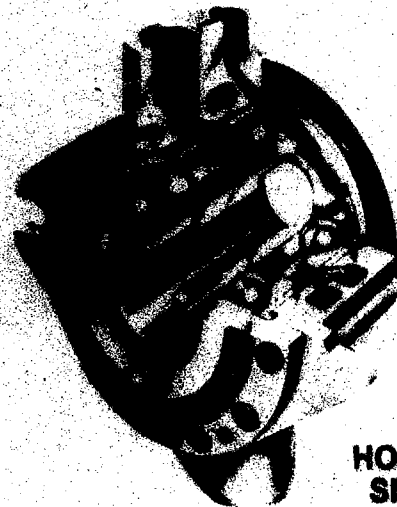
## Low Speed High Torque Hydraulic Motors

### Operating Principles:

The GECO Spherette (S Series) LBHT hydraulic motor is extremely simple, consisting of very few moving parts. It is of the axial piston design consisting of two opposed ball piston assemblies and multilobe cam.

The torque is created by applying pressure between the pistons which forces the hydraulically balanced balls to traverse down the inclined tracks of the multilobe cam. This action provides 26 power strokes per revolution which results in a relatively constant torque and smooth rotation.

Torque is proportional to pressure and speed is proportional to oil flow. The motor can be reversed instantaneously by interchanging the pressure and return ports.



**HOLLOW  
SHAFT**

### **OUTSTANDING FEATURES**

- Hollow Shaft Design
- Compact
- Free Wheeling
- Low Torque Ripple
- Low Noise (Under 80dba)
- High Power to Weight Ratio
- Low Cost



**NORTH AMERICAN HYDRAULICS, INC.**

P. O. BOX 15431 • BATON ROUGE, LA 70805 • PHONE (504) 927-8004 • TELEX NO. 586 384 NAHI RTR

# INSTALLATION INFORMATION

## Mounting

The motor can be mounted in any plane, however, the system must insure that the motor's case be filled with oil at all times. The case drain line must be open to tank and unrestricted.

## Control

The motors are reversible and when used in conjunction with a variable delivery pump, stepless speed control can be obtained.

## Boost/Back Pressure

A back pressure must be maintained at all times (Refer to Boost Pressure Curve). This also applies for closed loop/regenerative applications. A boost flow of 1.5 GPM per motor is required at minimum prime mover speed.

## Fluids

Any good quality mineral based hydraulic oil may be used provided a minimum viscosity of 35 Cts. is obtained at the maximum operating temperature.

## Filtration

Filtration of 10 micron should be maintained in closed loop systems. In an open loop system minimum filtration levels of 35 micron is recommended.

## Case Pressure

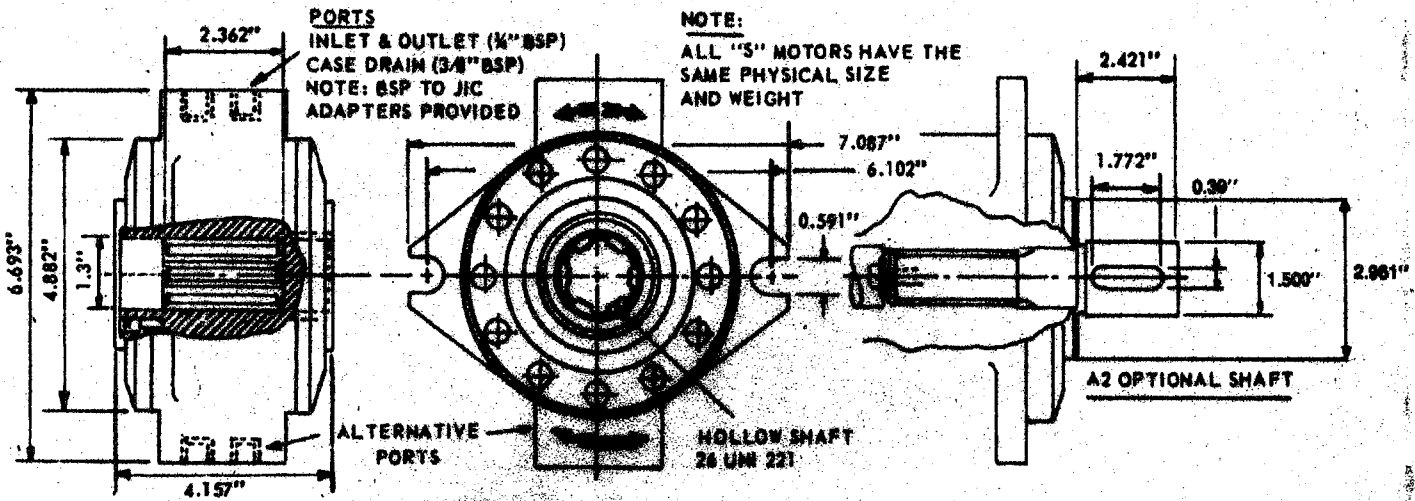
The motor case pressure should not be allowed to exceed 20 p.s.i.

## Typical Applications

- \* Machine Tools
- \* Conveyors
- \* Plastic Injection
- \* Hoist
- \* Mixers
- \* Auger

## Options

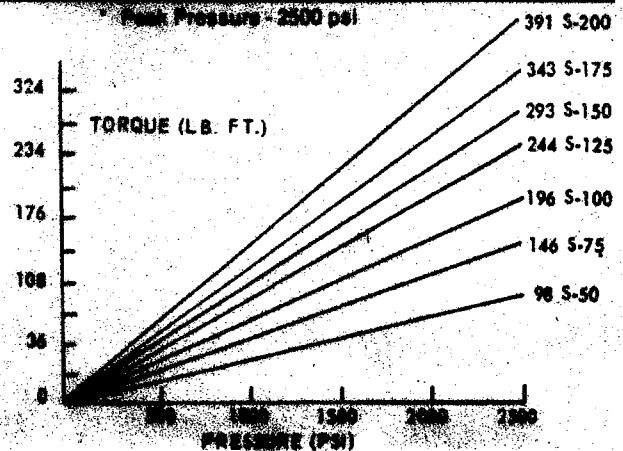
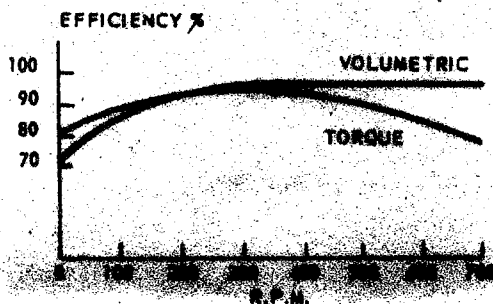
- \* Shaft Drive
- \* Double end shaft (for disc type brakes)



## PERFORMANCE DATA

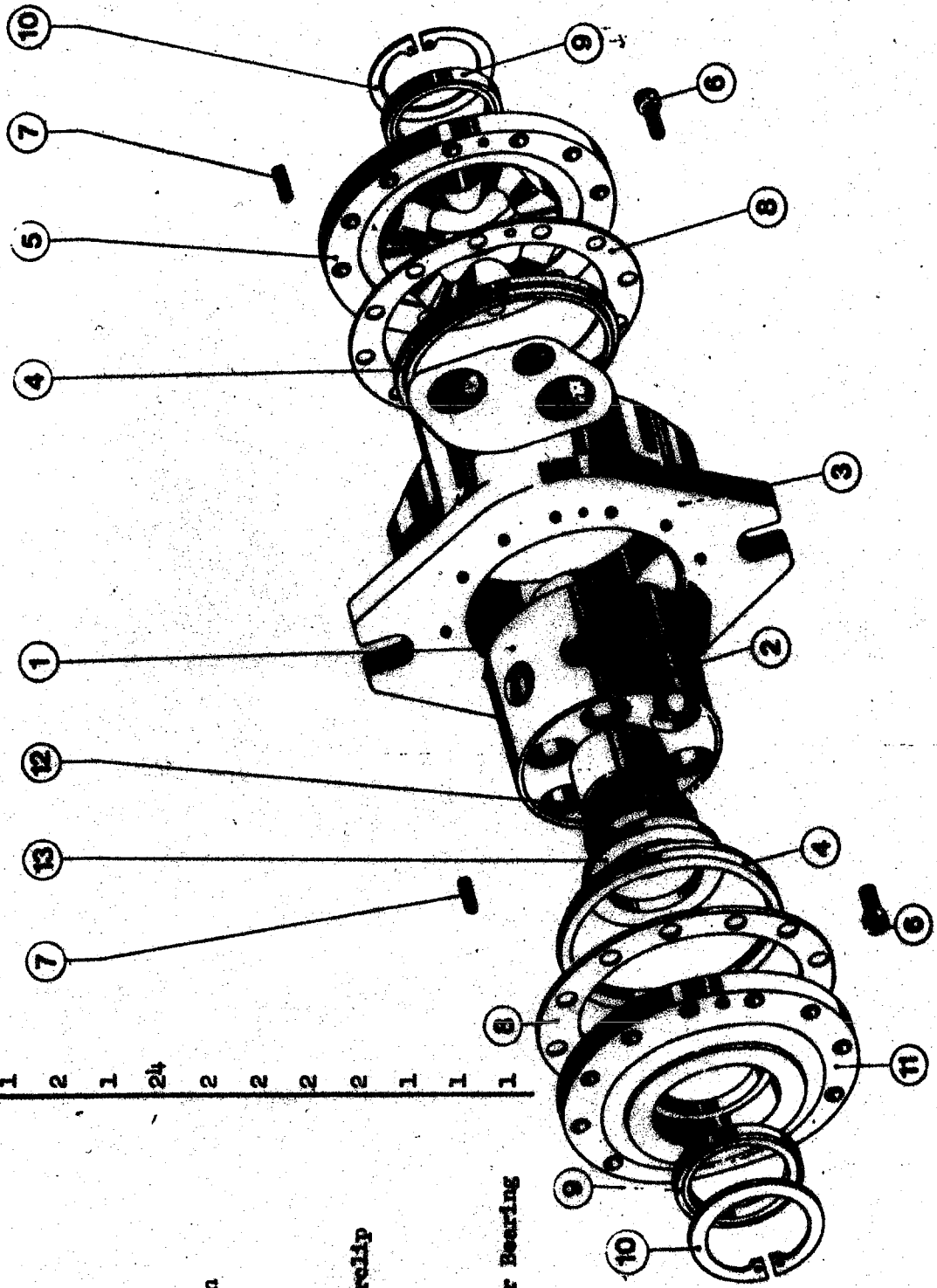
MODEL	Theo. Displacement cu. in./rev.	Theo. Torque (Lb./Ft. Per 100 psi)	Rated Pressure psi	Speed RPM	Weight Lbs.
S-50	2.86	3.93	1700	700	17.6
S-75	4.42	5.87	1700	700	17.6
S-100	5.92	7.88	2000	700	17.6
S-125	7.38	9.79	2000	700	17.6
S-150	8.84	11.73	2000	700	17.6
S-175	10.34	13.72	2000	700	17.6
S-200	11.80	15.68	2000	700	17.6

## TYPICAL PERFORMANCE CHARACTERISTICS



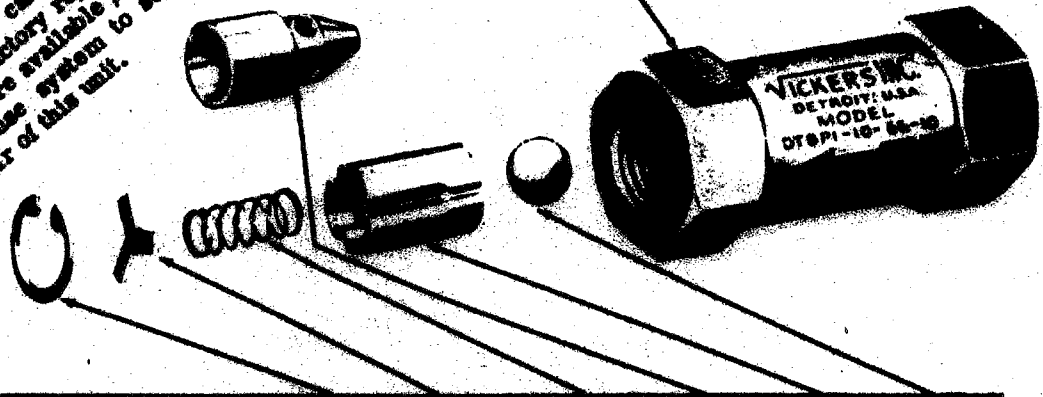
**PARTS LIST SPHERETTE - S50 - S75**

ITEM	DESCRIPTION	QTY
1	Rotor	1
2	Piston	14
3	Housing	1
4	Spacer	2
5	Complete	1
6	Cap Screw	24
7	Locating Pin	2
8	Gasket	2
9	Shaft Seal	2
10	Internal Clevislip	2
11	Complete	1
12	Bushing	1
13	Axial Roller Bearing	1



**NOTICE**  
 As this complete unit can be replaced  
 at a nominal cost, factory repair is not  
 practical. Parts are available from our  
 Branch Warehouse system to support  
 customer repair of this unit.

**BODY - SOLD AS AN ASSEMBLY ONLY.  
 ORDER BY MODEL NUMBER.**



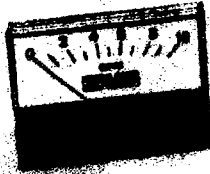
MODEL NUMBER	PIPE SIZE	CRACKING PRESSURE P.S.I.	SNAP RING	WASHER	SPRING	POPPET	SLEEVE	BALL
DT8P1-02-5-10	1/4	5	92733	113714	113859	—	113715	1651
DT8P1-02-30-10		30			216999			
DT8P1-02-65-10		65			114994			
DT8P1-03-5-10	3/8	5	106642	123740	123761	123737	—	—
DT8P1-03-30-10		30			217000			
DT8P1-03-65-10		65			123760			
DT8P1-06-5-11	3/4	5	98702	125673	125779	125674	—	—
DT8P1-06-15-11		15			222541			
DT8P1-06-30-11		30			216998			
DT8P1-06-65-11		65			125780			
DT8P1-10-5-11	1-1/4	5	113752	125635	125631	125634	—	—
DT8P1-10-30-11		30			216548			
DT8P1-10-50-11		50			257354			
DT8P1-10-65-11		65			125632			



# HEDLAND

## 1/2" SERIES REMOTE READOUT FLOW METERS ENGINEERING SPECIFICATIONS

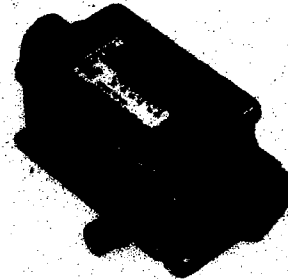
(Spec. sheet only. For flow ranges and ordering, see sales literature)



(RECEIVING UNIT)



(EXTENSION CABLE)



(SENDING UNIT  
FLOW METER)

66-00-00 1/2" SERIES REMOTE READOUT

### OPERATING SPECIFICATIONS: FLUIDS

**OPERATING TEMPERATURE:** The maximum operating temperature is 240° F.

**PRESSURE RANGE:** The maximum operating pressure is 3000 PSI with a 3:1 factor of safety.

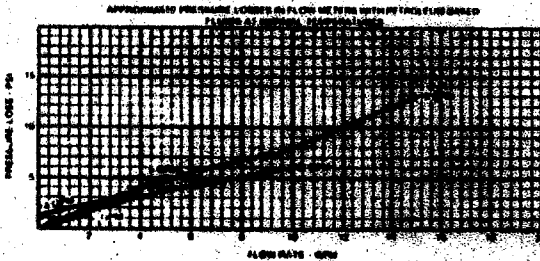
**EFFECT OF DENSITY:** The meter is affected by fluid density. Most petroleum based fluids have a specific gravity very close to the .84 used in calibration. For heavier fluids, the indicated flow reads high and correspondingly lighter fluids cause the readings to be low. For these cases a properly calibrated scale can be used or a correction factor applied to the standard scales. A correction chart is available for fluids from 1.25 to .65 specific gravity. The correction factor is:

$$\text{OIL SCALE} - \sqrt{.84/\text{specific gravity}}$$

$$\text{WATER SCALE} - \sqrt{1.0/\text{specific gravity}}$$

For petroleum based hydraulic fluids, this correction factor is small enough to be ignored.

#### PRESSURE DROP (LOSS) OIL



**ACCURACY:** within ±5% full scale

**REPEATABILITY:** within ±1%

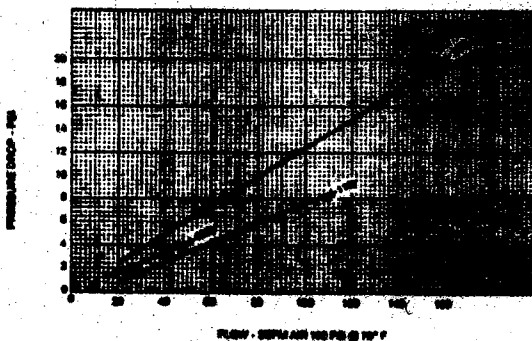
**STANDARD & SPECIAL FLUIDS:** Standard meters are calibrated for oil at 110° F ± 5° F. Special meters can be calibrated for other specific gravities upon request at a slight additional cost (or a conversion factor for other specific gravities can be supplied free of cost). Consult factory. Typical fluids converted include alcohol, glycerine, HWBF, phosphate esters, waterglycol, water, etc.

### OPERATING SPECIFICATIONS: PNEUMATIC & GASES

**PRESSURE RANGE:** The maximum continuous operating pressure is 500 PSI with a 10:1 factor of safety. Meters are calibrated for air at 100 PSI. For other pressures refer to conversion factor chart.

**EFFECT OF DENSITY:** Meters are calibrated for air with a specific gravity of 1.0. For gasses heavier or lighter than air refer to conversion factor chart or consult factory.

#### PRESSURE DROP (LOSS) AIR



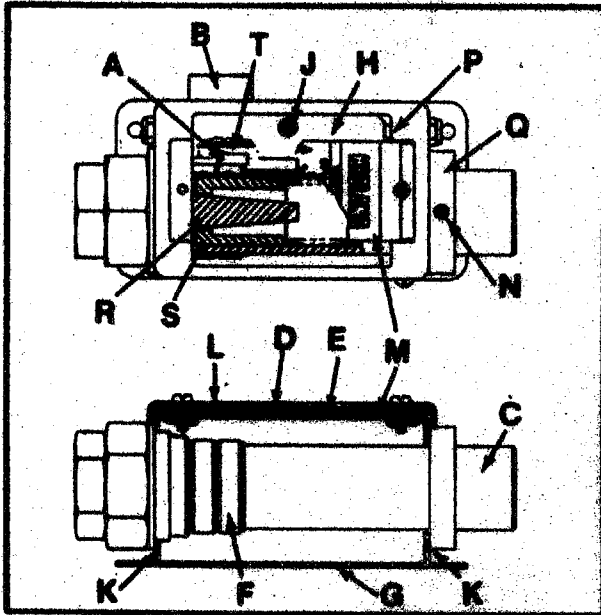
DETERMINE FLOW RATES USING DIFFERENT PRESSURES & TEMPERATURES										
$\text{SCFM (actual)} = \frac{\text{SCFM (indicated)}}{k_1 k_2 k_3}$					Where: $k_1$ = Conversion factor for inlet pressure. $k_2$ = Conversion factor for temperature. $k_3$ = Conversion factor for specific gravity					
TABLE 1: PRESSURE CORRECTION FACTOR ( $k_1$ )										
OPERATING PRESSURE, psig										
psig	25	50	75	100	125	150	175	200	225	250
$k_1$	1.200	1.331	1.151	1.00	.862	.735	.775	.731	.692	.658
$k_1 = \sqrt{\frac{114.7}{14.7 \times \text{psig}}}$										
TABLE 2: TEMPERATURE CORRECTION FACTOR ( $k_2$ )										
OPERATING TEMPERATURE, °F										
°F	10	32	50	75	80	110	125	150	175	190
$k_2$	.940	.928	.921	1.00	1.016	1.027	1.035	1.072	1.090	1.107
$k_2 = \sqrt{\frac{460 + °F}{520}}$										
TABLE 3: SPECIFIC GRAVITY CORRECTION FACTOR ( $k_3$ )										
$k_3 = \sqrt{\text{Sp. Gr.}}$										

**OTHER GASES:** Pneumatic Flow Meters are calibrated for air at 100 PSI and 70° F. For other gases a conversion factor

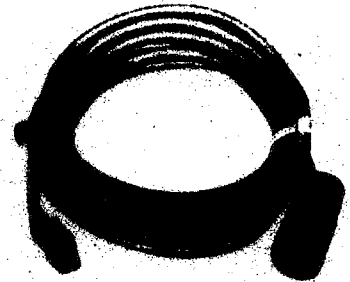
# PRINCIPLE OF OPERATION:

An orifice piston containing a magnetic ring is located inside of the Flow Meter body, and is part of the sliding piston assembly. A spring returns the piston and magnet to the "no flow" position. There is a flow orifice in the center of the piston which is blocked in the "no flow" position by the stationary metering cone. The piston movement presents a gradually increasing flow area. Incoming flow will build up pressure to push the piston to a position on the cone where the pressure drop across the increased area and the spring force are in balance. The variable area feature produces uniform scale increments throughout the adjustment range. An indicator following the magnets position slides on the outside of the Flow Meter body. The wiper assembly attached to this indicator varies the voltage proportionately to the flow rate of the meter sending signal to remote receiver by way of cable.

## SENDING UNIT - FLOW METER



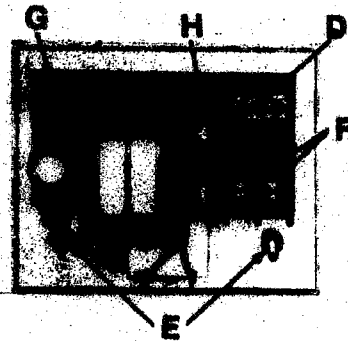
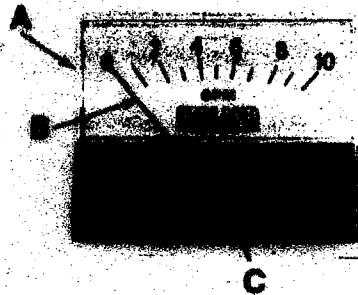
- A - Wiper Assembly
- B - Cable Connector
- C - Flow Meter Asm.
- D - Meter Window
- E - Cover Gasket
- F - Indicator (follower)
- G - Housing
- H - Potentiometer Housing
- J - Factory Calibration Screw
- K - Seals (Buna-N)
- L - Cover Asm. w/Screw Retainers
- M - Scale
- N - Holding Screw
- P - Slide Rod
- Q - Retainer Ring
- R - Tapered Metering Cone
- S - Orifice Piston Asm. (Magnetized)
- T - Potentiometer



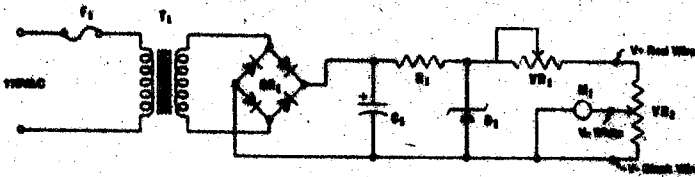
(FIG. B)  
CONNECTING CABLE

## RECEIVING UNIT

- A - Receiver Body
- B - Pointer
- C - Zero-Adjust
- D - Extension Cable Socket
- E - Panel Mounting Screws
- F - AC Connection
- G - Line Loss Adjustment
- H - Fuse - .25 Amp



## HEDLAND FLOW METER W/REMOTE READOUT ELECTRIC SCHEMATIC



### PARTS LISTING

- T. 110:28V Signal Transformer
- BR. Full Wave Bridge Rectifier
- C. 470mf 35V Capacitor
- R. 1k Ω 1/2 Watt Resistor
- D. 24V Zener Diode
- VR, 2.5k Ω Linear Variable Resistor
- VR, Mystr 3.0k Linear Resistor
- F. 0.25 AMP Fuse
- M. 200 Ω / Volt Panel Meter

## STANDARD FEATURES:

- 1 - Strong, completely sealed steel formed body, water and oil resistant.
- 2 - Formed double sealed steel cover (with lip).
- 3 - Unbreakable Lexan window (full cover).
- 4 - Oversize neoprene cover gasket matches with double ribbed lip of body. Other seals - Buna-N.
- 5 - Chrome plated pan head cover screws with screw

- 6 - Wire guard.
- 7 - Prewired potentiometer (see electrical information for specifications).
- 8 - 15 ft. remote cord w/prewired connectors
- 9 - Zero adjustment on receiver
- 10 - Line loss adjustment on receiver (field calibration).

## ELECTRICAL - STANDARD

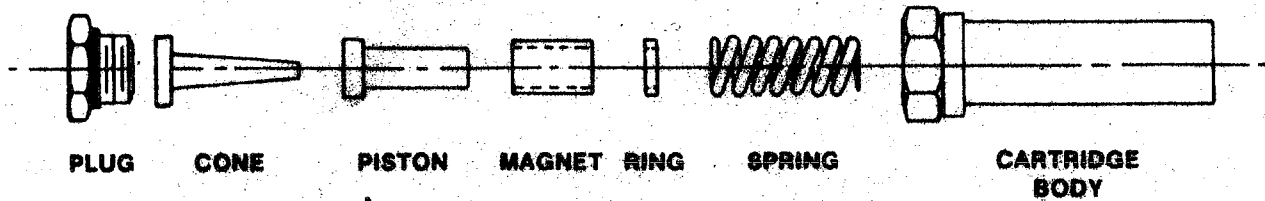


# FILTRATION

The Hedland Flow Meters will allow the flow of particles, which would normally jam most valves or flow controls. Normal system filtrations should be sufficient. Systems which do not have any filtration should be equipped with at least a 200 mesh sieve or 74 micron filter. Most hydraulic systems would already have a much finer filtration.

Within the body of the sending unit, dirt or sealing agents, such as teflon tape, may lodge within and cause malfunction. If a malfunction does occur and you are using proper filtration, we would recommend disassembly and cleaning. This can be done as follows:

On a clean bench, remove smaller hex from larger and all internal parts should slide out when tilted (see picture). Plugged sending unit can be returned to the factory for cleaning at a minimal cost.



## WARRANTY

All Hedland products are covered by a full 1 year limited warranty.

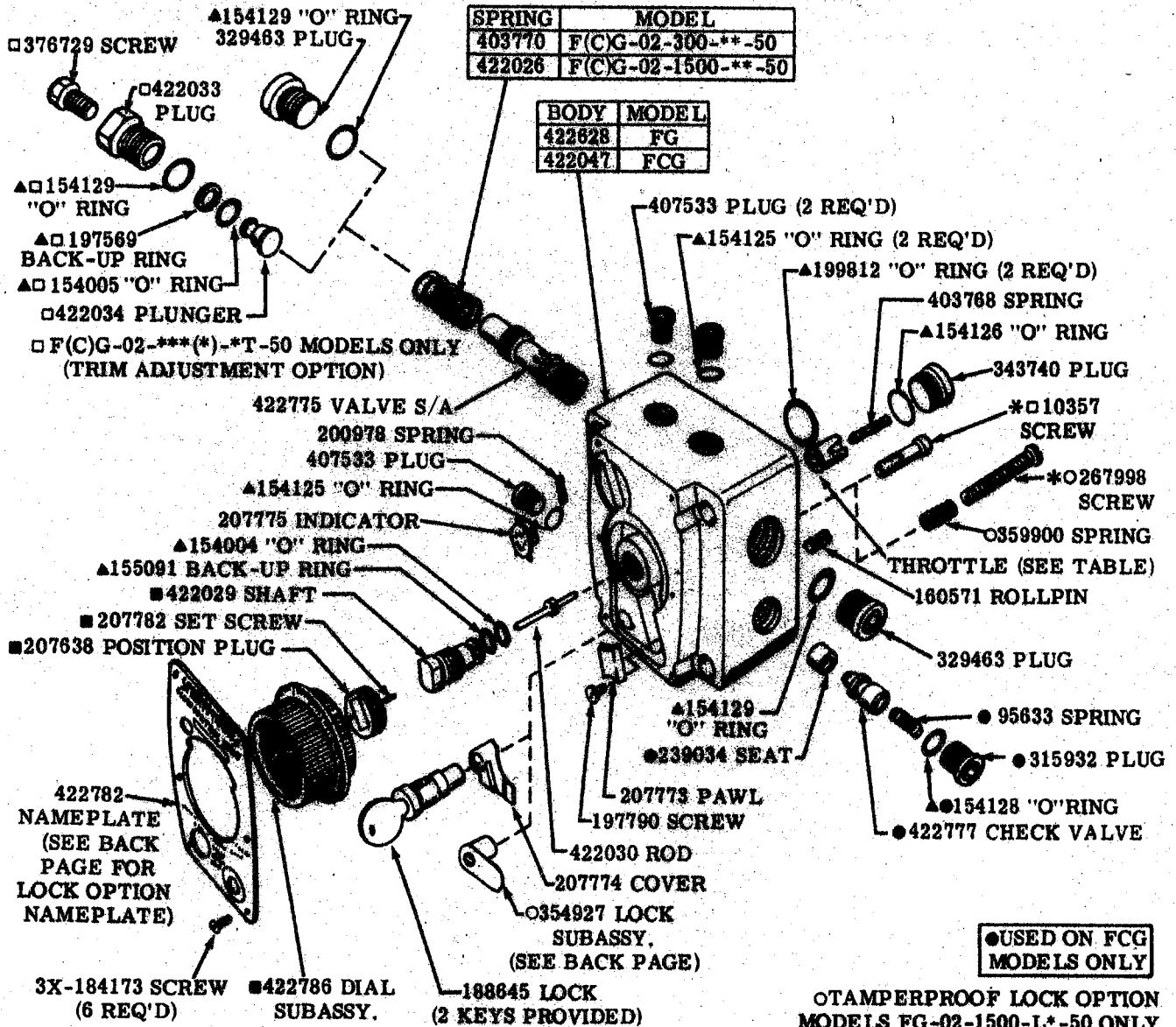
## SPECIAL APPLICATIONS AND INSTALLATIONS

Call Hedland Applications Department at (414) 639-6770 or your local Hedland distributor.

# HEDLAND

DIV. OF RACINE FEDERATED, INC.  
2200 SOUTH STREET - RACINE, WI 53404  
TEL. (414) 639-6770 TELEX 254 271

F(C)G-02-300-\*\*-50  
 F(C)G-02-1500-\*\*-50



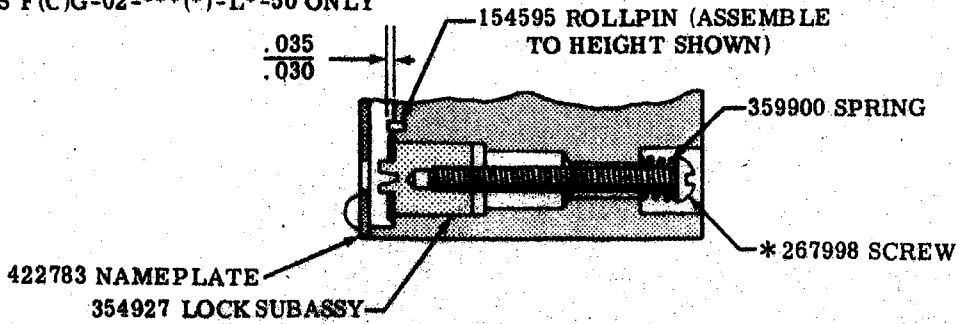
WITH 422029 CONTROL SHAFT SCREWED FULLY IN, ADJUST 207638 POSITIONING PLUG IN 422786 DIAL SO THAT "O" ON DIAL LINES UP WITH POINTER ON NAMEPLATE WHEN DIAL IS ASSEMBLED ON SHAFT. LOCK SECURELY WITH 207782 SET SCREW.

INCLUDED IN 920037 GASKET KIT

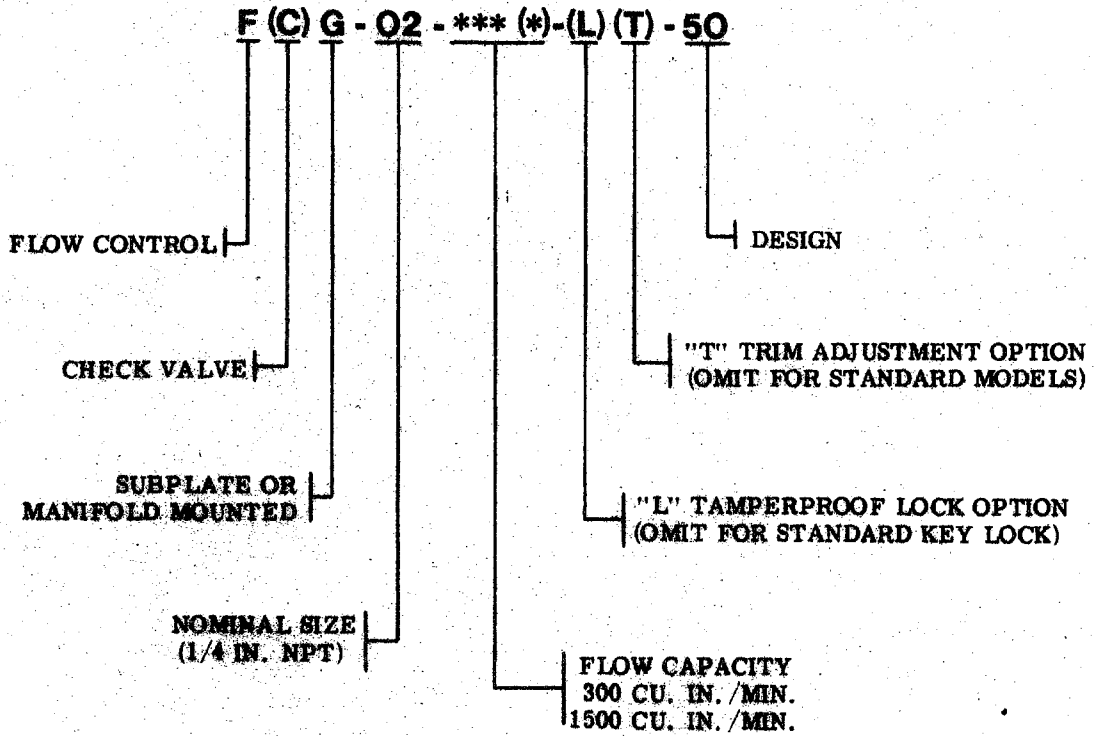
THROTTLE	MODEL
422027	F(C)G-02-300-**-50
422028	F(C)G-02-1500-**-50

\* COAT THREADS WITH LOCTITE SEALANT. TIGHTEN TO LOCKING POSITION THEN BACK OFF 1/4 TURN.

**TAMPERPROOF LOCK OPTION  
MODELS F(C)G-02-\*\*\*(\*)-L\*-50 ONLY**

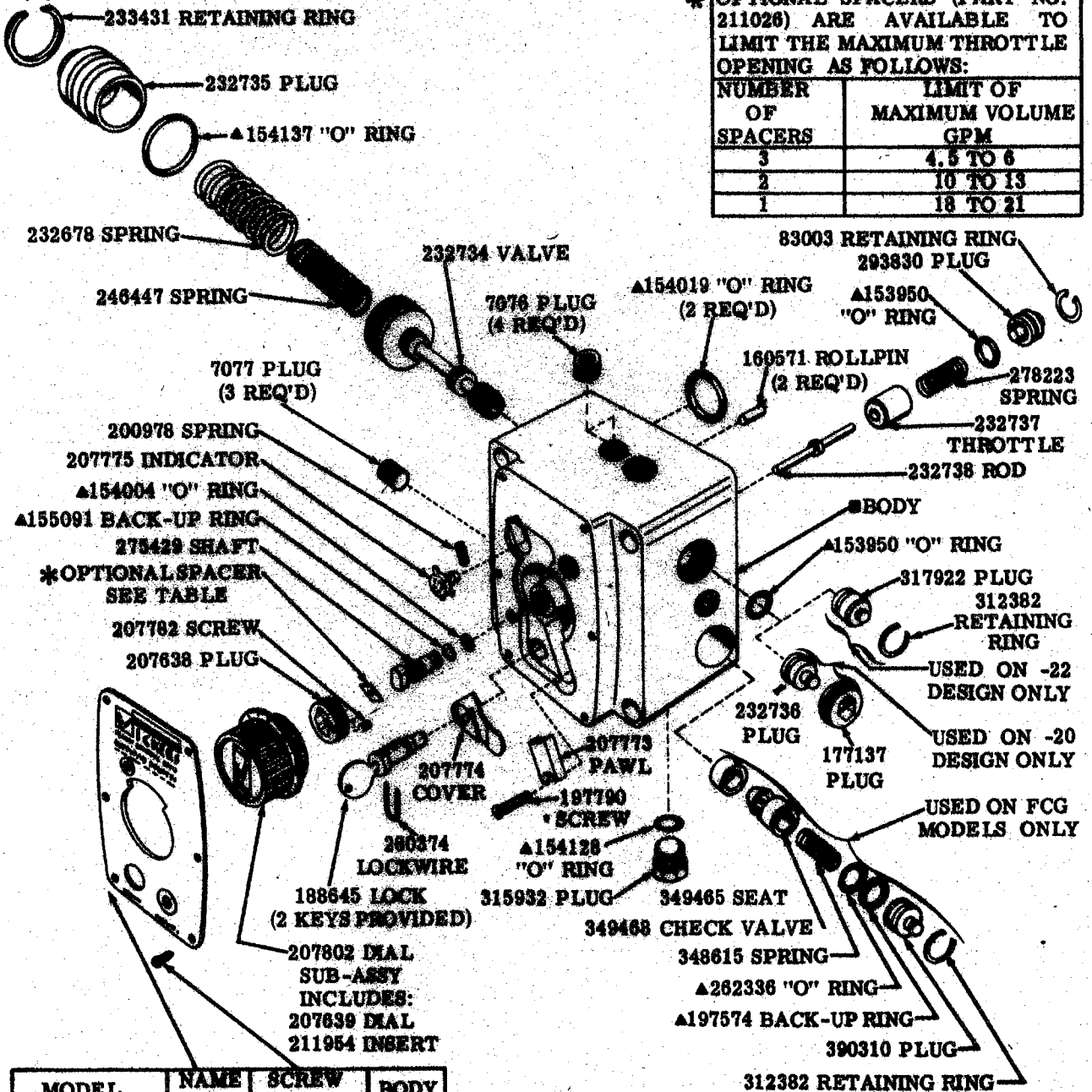


**MODEL CODE BREAKDOWN**



To insure sustained efficiency and maximum trouble-free life of this precision equipment, initial and continuous filtration of the fluid medium to 25 microns absolute or less is essential. (For information pertaining to Sperry Vickers economical 3 or 10 micron filters, see installation drawing 522140.)

F(C)G-03-28-20/22



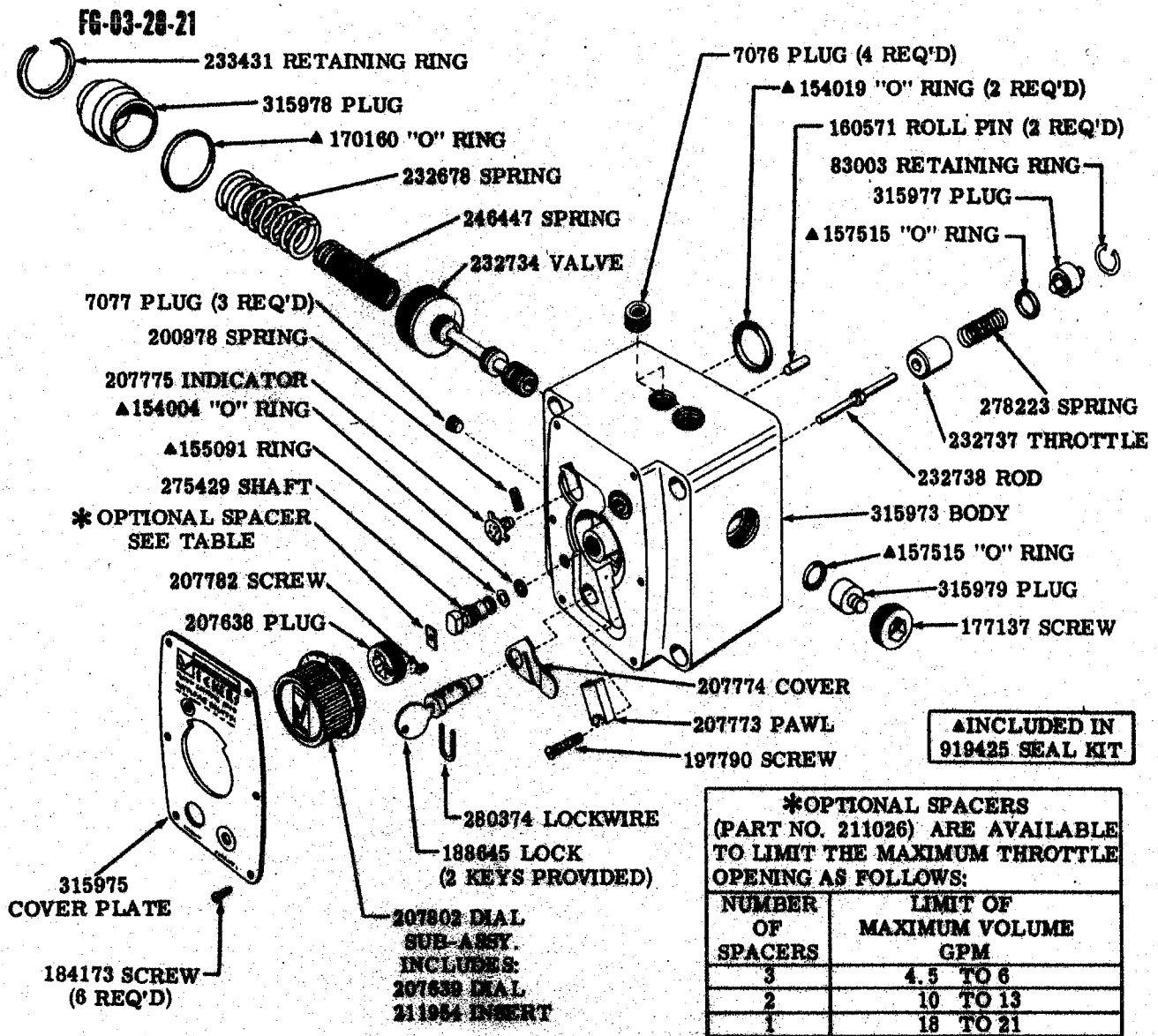
\* OPTIONAL SPACERS (PART NO. 211026) ARE AVAILABLE TO LIMIT THE MAXIMUM THROTTLE OPENING AS FOLLOWS:

NUMBER OF SPACERS	LIMIT OF MAXIMUM VOLUME GPM
3	4.5 TO 6
2	10 TO 13
1	18 TO 21

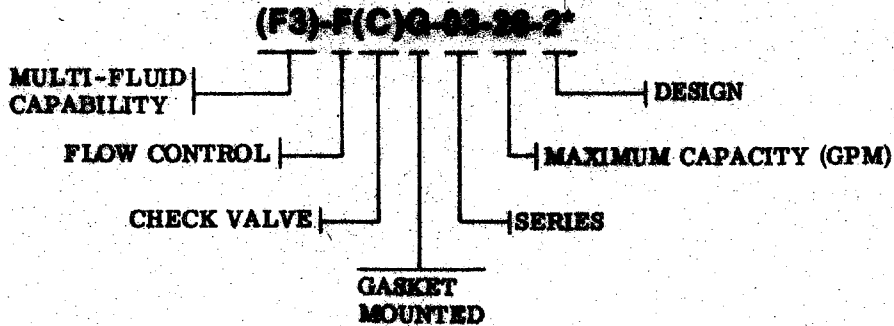
MODEL	NAME PLATE	SCREW (6 REQ'D)	BODY
FG-03-28-20	232740	184173	232732
FG-03-28-22	315975	3X-117855	350937
FCG-03-28-22			390309

F3 EQUIVALENT  
919398 SEAL KIT

▲INCLUDED IN  
819213 SEAL KIT



## MODEL CODE BREAKDOWN



To insure sustained efficiency and maximum trouble-free life of this precision equipment, initial and continuous filtration of the fluid medium to 25 microns absolute or less is essential. (For information pertaining to Sperry Vickers economical 3 or 10 micron filters, see installation drawing 522140.)

Litho in U. S. A.



**SPERRY VICKERS**



**SERVICE  
PARTS  
INFORMATION**

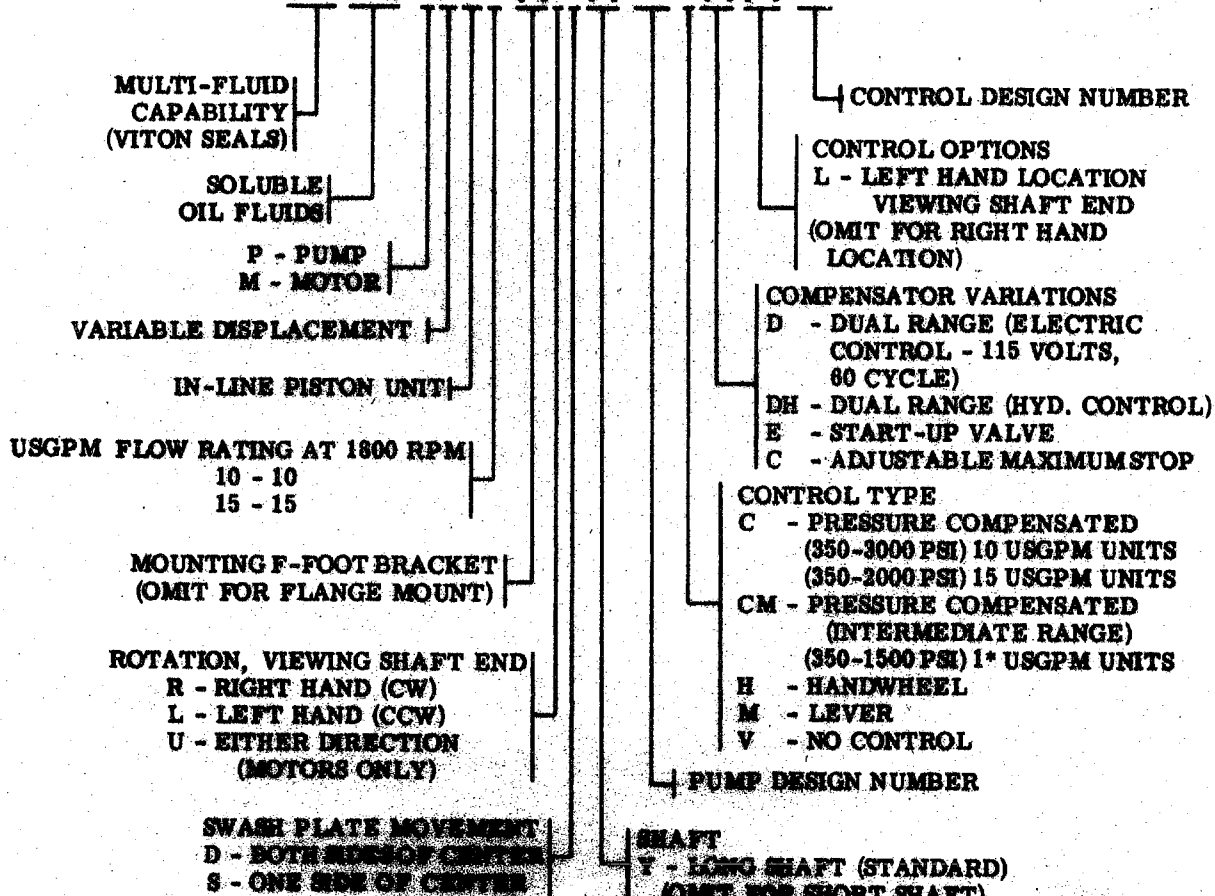
**PVB10-(F)\*\*(Y)-30-\*(\*) (L)-1\***  
**PVB15-(F)\*\*(Y)-30-\*(\*) (L)-1\***  
**MVB10-(F)UD(Y)-30-\* -10**

**SPERRY VICKERS  
TROY, MI. 48064**



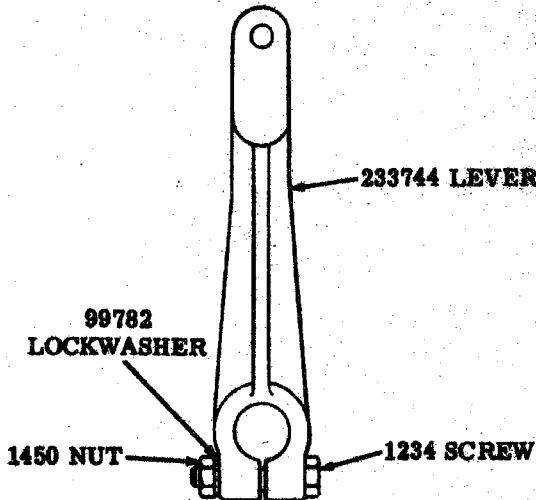
# MODEL CODE BREAKDOWN

(F3/F6)-\*VB\*-(\*)\*\*(\*)-30-\*(\*)-(L)-1\*



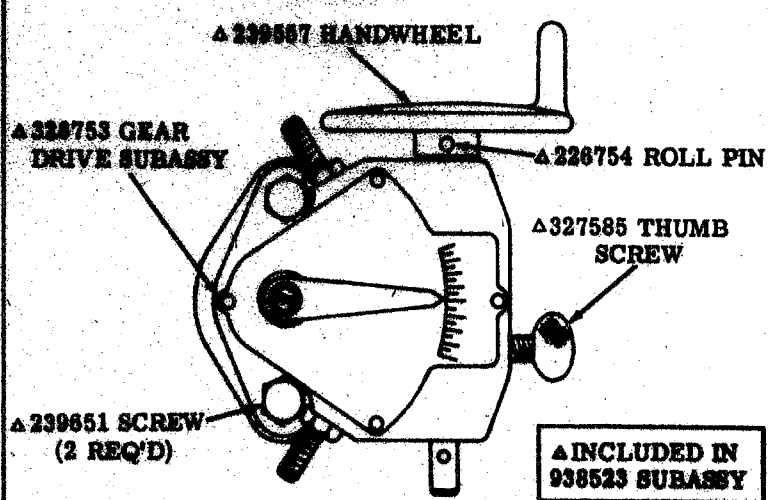
## MANUAL LEVER CONTROL MODEL

\*VB\*-(\*)\*\*(\*)-30-\*(\*)-(L)-1\*



## HANDWHEEL CONTROL MODEL

\*VB\*-(\*)\*\*(\*)-30-\*(\*)-(L)-1\*



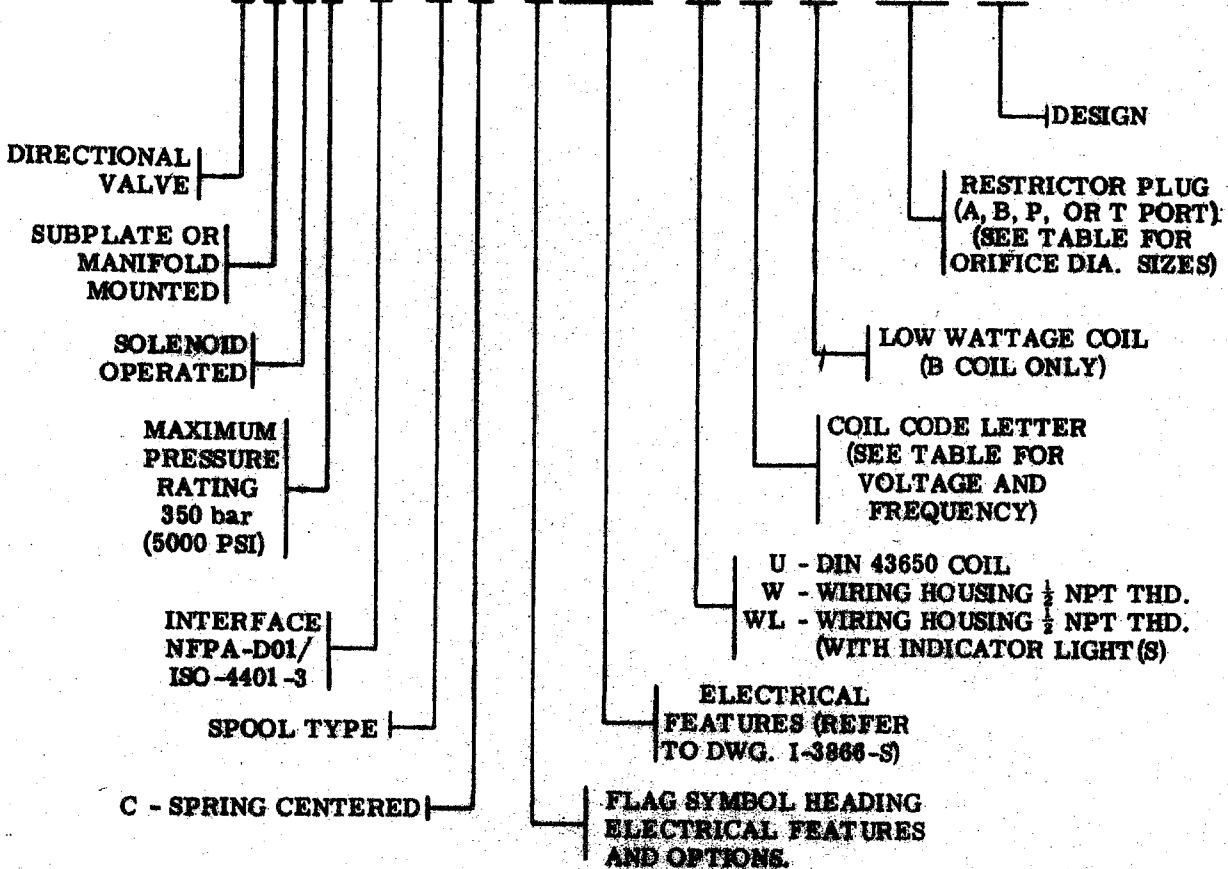
Δ INCLUDED IN 938523 SUBASSY

To insure sustained efficiency and maximum trouble-free life of this precision equipment, initial and continuous filtration of the fluid medium to 25 microns absolute or less is essential. (For information pertaining to Sperry Vickers economical 3 or 10 micron filters, see installation drawing 522140.)



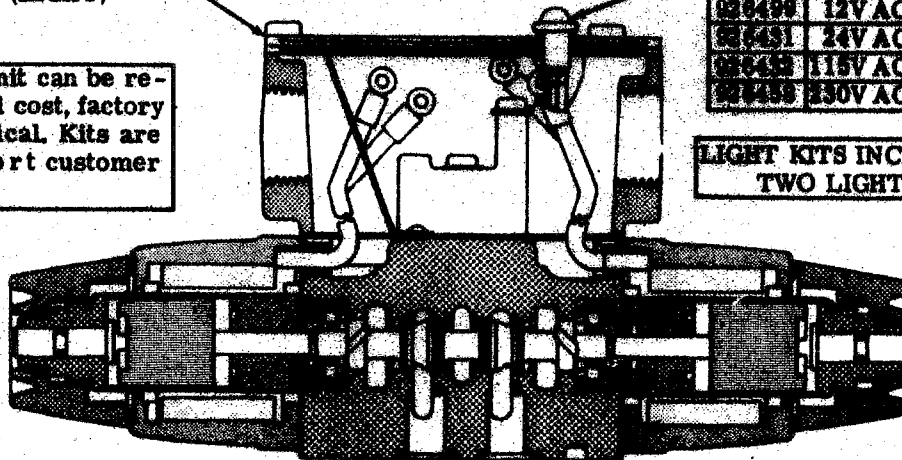
# MODEL CODE BREAKDOWN

**DG4V-3- \* C -M(P\*\*)-\*\*\*- \* -(9)- (\*\*\*)-40**



635065 CARRIER (LIGHT)

As this complete unit can be replaced at a nominal cost, factory repair is not practical. Kits are available to support customer repair.



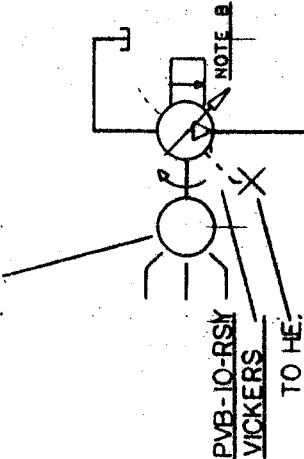
LIGHT KIT	VOLTAGE RANGE
63450	12V AC/DC
63451	24V AC/DC
63452	115V AC/DC
63453	230V AC/DC

LIGHT KITS INCLUDE TWO LIGHTS

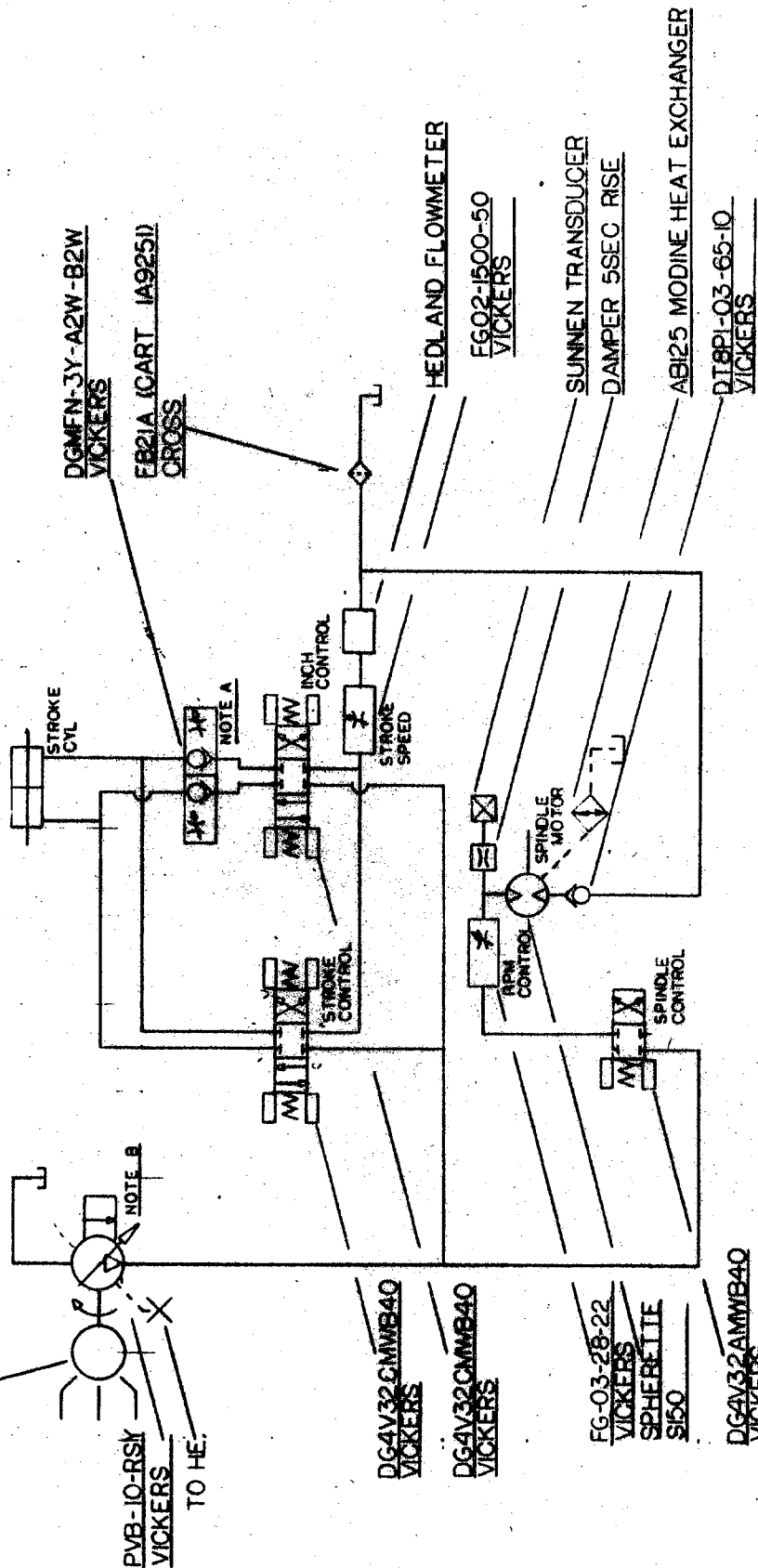
For satisfactory service life of these components in industrial applications, use full flow filtration to provide fluid which meets ISO cleanliness code 18/15 or cleaner. Selections from Vickers OFF, OFR, and OFRS series are recommended.

ALL DG4V3 VALVES MOUNTED ON DAMAN  
 PART # ADO1P042P12-IPD0103041F-ITD01030411  
 NOTE A SET INCH STROKE SPEED AT 40 FPM  
 NOTE B SET PUMP PRESSURE 1450 PSI. AT  
 PORT GA ON MANIFOLD

10HP 230/460 VAC  
 3PH 60HZ  
 LINCOLN



10317 - 1.5 BORE  
 CENTURY



DGMFN-3Y-A2W-B2W  
 VICKERS

EB21A (CART 1A9251)  
 CROSS

HEDLAND FLOWMETER

FG02-1500-50  
 VICKERS

SUNNEN TRANSDUCER  
 DAMPER 5SEC RISE

AB125 MODINE HEAT EXCHANGER

DT8PI-03-65-10  
 VICKERS

PVB-10-RS1  
 VICKERS

TO HE:

DG4V32CMMB40  
 VICKERS

DG4V32CMMB40  
 VICKERS

FG-03-2B-22  
 VICKERS

SPHERETTE  
 S150

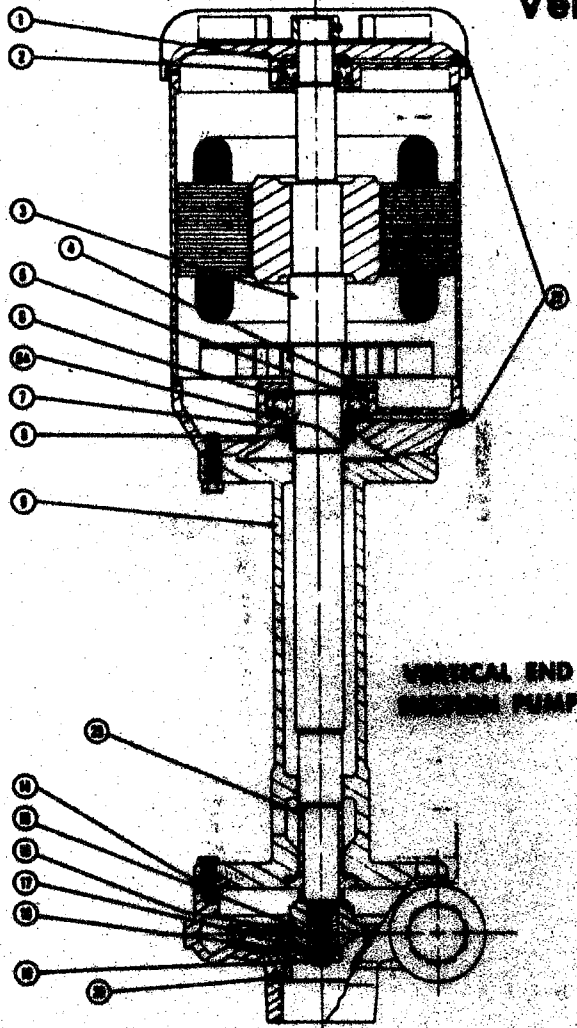
DG4V32AMMB40  
 VICKERS

CENTURY MACHINE INC	
86H HYDRAULIC DIA	
	10317



# Vertical End Suction Pumps

## INTEGRAL SHAFT



Part No.	Description
1	Lead Spring
2	Ball Bearing
3	Shaft
4	Ball Bearing Retainer
5	Smoothing
6	Ball Bearing
6A	Press Collar
7	Grease Seal
8	Rubber Slinger
9	Stem
14	Impeller Housing
15	Impeller
16	Square Key or Woodruff Key
17	Impeller Retaining Washer
18	Lock Washer
19	Impeller Retaining Screw
20	Wear Ring
22	Grease Fitting
23	Throttle Sleeve
24	Adapter
25	Locknut & Washer
26	Ball Bearing Housing
27	Motor End Bracket ('CM' Models)
28	Ball Bearing Retainer ('CM' Models)
30	Discharge Flange

### General Repair:

**DISASSEMBLY** ... Shut off main power switch and disconnect the motor wiring. Close the inlet and outlet valves, disconnect the piping at the outlet and remove from service. Remove the screws securing the impeller housing (14) to the stem (9), remove the impeller housing. Take off the retaining cover (17) and slide the impeller (15) and throttle sleeve (23) off the shaft (3). Take off the stem (9) by removing four screws securing it to motor end bell and slide it off the shaft. Check for wear, replace worn parts where necessary and reassemble by reversing the procedure.

**BALL BEARING REPLACEMENT** ... Follow the above steps to stem removal. Remove screws in fan cover & remove cover, loosen set screw in fan and remove fan, remove four screws securing upper end bell to stator and remove end bell, remove screws in bearing retainer (4), lay a block of wood or some other soft material on the floor and tap the shaft (3) and ball bearing (6) out of the stator and lower end bell using the weight of the stator as you drop the shaft on the

block of wood lightly. (Fig. 1) Tap the old bearings off the shaft and install new ones by following the instructions on page 10. To reassemble, reverse procedure.

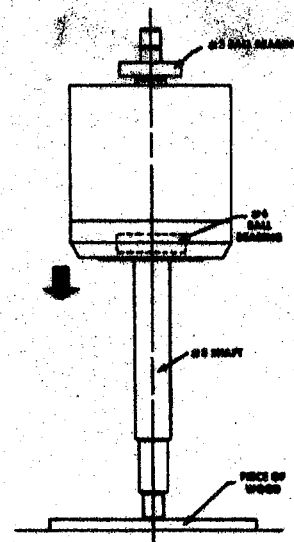
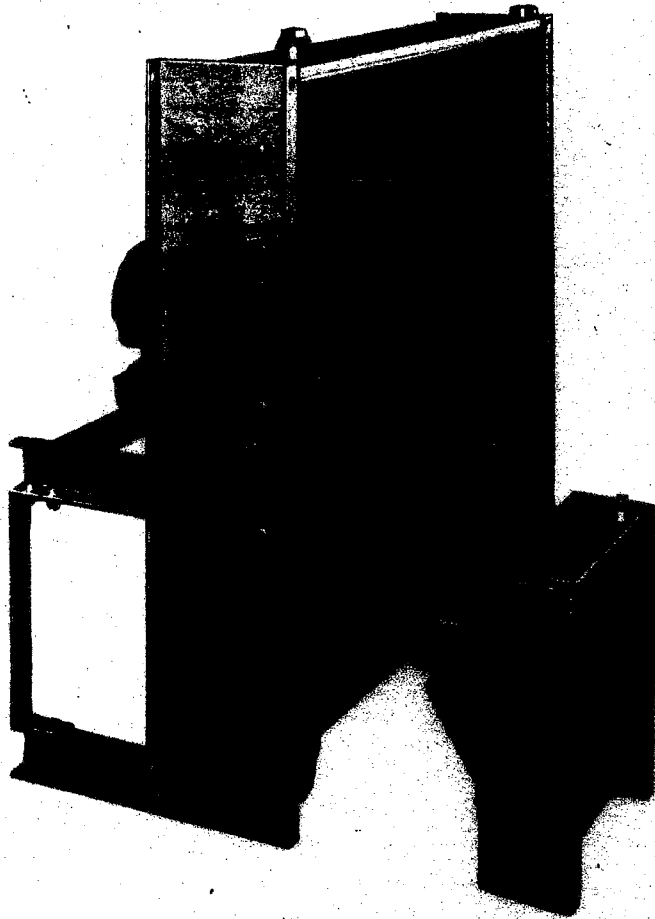


FIG. 1





# INSTALLATION AND SERVICE Industrial oil coolers



## INSTALLATION

- 1) Set unit level on a firm solid foundation. The larger oil cooler models have lifting holes to facilitate unit hoisting. Refer to dimensional drawing on back page for placement of anchor bolts. Use 1/2-inch diameter anchor bolts for models through AB-131 and 5/8-inch for larger models.
- 2) Add vibration isolators (by others). For non-standard units with belt-driven fans, specify vibration isolators that will provide rubber-in-shear as well as rubber-in-compression absorption. Avoid contact of oil or grease at vibration isolators.
- 3) Tighten anchor bolt fasteners firmly to foundation.

## PIPING

To avoid possible non-warranted damage to the oil cooler assembly, use the following piping precautions.

- 1) Use same size piping for supply and return connections at the oil cooler.
- 2) Allow for linear expansion and contraction of piping in the direction away from the oil cooler. Use flexible connectors or suitable expansion joints on all oil cooler inlet/outlet piping. See typical schematics below.
- 3) Select properly tensioned and aligned piping support clamps or hangers and position them to relieve any piping stress at the oil cooler inlet/outlets ports. Do not support from flexible connectors.
- 4) Provide piping disconnect on each inlet/outlet line with unions or flanges as close as feasible to oil cooler inlets/outlets for future oil cooler service.

## ELECTRICAL CONNECTION

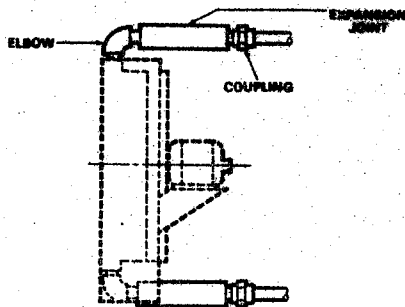
Follow wiring diagram furnished with fan motor. If fan rotation is in the wrong direction, (blow-through cooling is standard) interchange motor leads as recommended by motor manufacturer.

## SERVICE

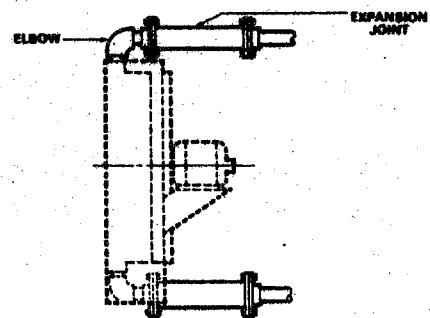
For continuous efficiency oil cooler cores must be periodically cleaned with either vacuum or compressed air. If wet cleaning is required, shield motor and spray on a mild soap solution and flush with clear water. **CAUTION:** Do not use any cleaning solution that is not compatible with aluminum.

## INSPECTION ON ARRIVAL

1. Inspect unit upon arrival. In case of damage, report immediately to transportation company.
2. Check rating plate on motor to verify that power input and motor specification requirements match available electric power at point of installation.
3. Inspect unit received for conformance with description of product ordered (including specifications where applicable).



PIPING SCHEMATIC OF COOLER



PIPING SCHEMATIC OF COOLER

# 41-505.1 INSTALLATION AND SERVICE

## dimensions for model AB-125

### sound emission data

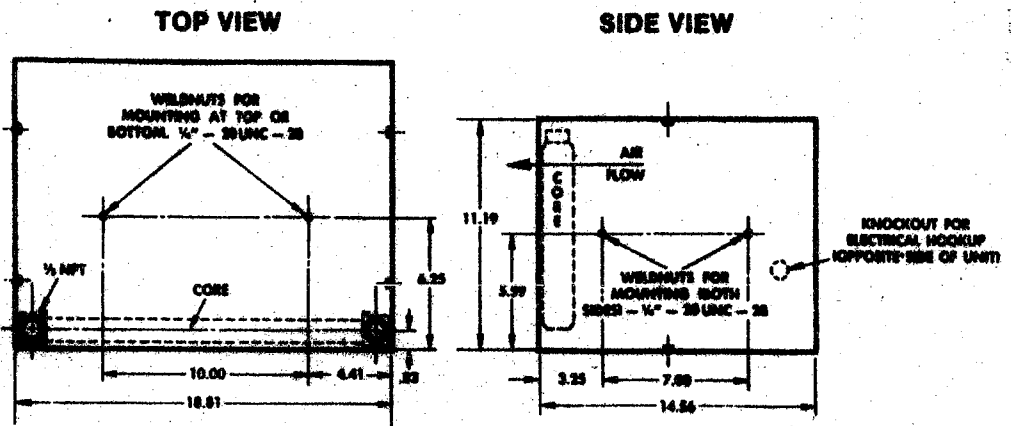
This oil cooler has been tested for sound emission in Modine's reverberant sound testing chamber. Sound levels of the unit at 5' are 71.6 dB (A) and 65.4 dB (A) at 10'.

### motor data

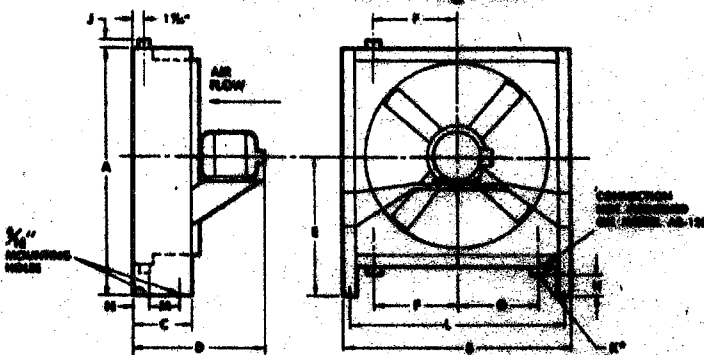
1/12 HP, 1550 rpm, single-phase, 115 volts, 60 Hertz. The motor is the totally enclosed type.

### oil capacity

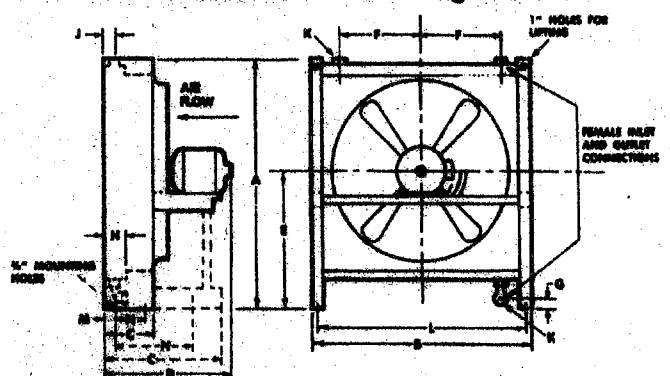
Static oil capacity of Model AB-125 core is 0.17 gal.



## dimensions for models AB-128 through AB-131



## dimensions for models AB-132 through AB-176



### DIMENSIONS (INCHES)

MODEL NO.	AB-128	AB-129	AB-130	AB-131
PART NO.	1A-9354	1A-9355	1A-9356	1A-9357
A	17-1/4	22-3/4	27-7/8	31-1/2
B	13-3/4	19	22-1/4	26-1/2
C	7	7	10	10
D (Approx)	16-1/4	16-1/4	20	20-1/4
E	10-3/4	13-1/4	17-3/16	19
F	3-1/2	5-13/16	7-7/16	9-9/16
G	—	3-3/16	4-9/16	6-7/16
H	3-1/4	3-1/4	5-9/16	5-1/2
J	3/8	3/8	3/8	1
K*	1	1	1	1-1/4
L	11-3/4	17	20-1/4	24-1/2
M	4-3/4	4-3/4	7-1/2	7-1/2
N	1-1/4	1-1/4	1-1/4	1-1/4
Fan Dia.	10	14	18	18
Mtr. HP	1/3 **	1/3	3/4	1
Oil Cap. gal.	0.31	0.57	0.75	1.01
Approx. Wt.	75	100	150	225

### DIMENSIONS (INCHES)

MODEL NO.	AB-132	AB-162	AB-164	AB-166†	AB-170†	AB-174†	AB-176†
PART NO.	1A-9216	1A-9217	1A-9218	1A-9219	1A-9220	1A-9221	1A-9222
A	40-11/16	45-1/2	48-3/4	53-1/4	60-1/4	70-11/16	78-3/4
B	34-1/4	40-1/2	44-3/4	47-3/4	58-3/8	68-3/8	74-11/16
C	12	12	12	24-3/4	24-3/4	29-1/4	31-3/4
D (Approx)	25-3/4	28	28	32-3/4	33	38	39-3/16
E	23-1/2	25-3/4	27-11/16	28-11/16	33-3/8	36-7/16	42-3/4
F	—*	18-3/16	18-3/16	18-3/8	24-3/4	26-1/2	30-13/16
G	5-3/8	4-3/8	4-3/8	4	4	4	4
H	3-7/16	3-3/8	3-3/8	4-3/16	4-3/16	4-3/16	4-3/16
J	1-13/16	1-13/16	1-13/16	1-13/16	1-13/16	1-13/16	1-13/16
K	1	1-1/2	1-1/2	2	2	2	2
L	32-3/4	39	43-1/4	45-7/32	56-9/16	64-1/8	72-11/16
M	2	2	2	2	2	2	2
N	6	8	8	21-1/2	21-1/2	26-1/4	28-3/4
Fan Dia.	24	30	30	36	42	48	60
Mtr. HP	2	3	3	5	5	7-1/2	7-1/2
Oil Cap. gal.	1.53	1.96	2.41	2.71	3.79	5.02	6.35
Approx. Wt.	300	375	450	600	750	1000	1500

\* NPT (Internal Thread)

\*\* Model AB-128 has 1/3 HP, single-phase, 60 Hertz, 115 volt, totally enclosed motor. All other models have three-phase, 60 Hertz 230/460 volt, totally enclosed motors.

\* Model AB-132 has single connections at centers of top and bottom tanks.

† Dimensions for this model indicated on drawing in broken line.

NOTE: All motors are three-phase, 60-Hertz, 230/460 volt totally enclosed.

# LINCOLN

## RECEIVING

Uncrate the motor and check for any damage. Turn the shaft by hand to be certain that it rotates freely. Claims for any damage done in shipment must be made by the purchaser against the transportation company.

## SAFETY DEPENDS ON YOU

Lincoln motors are designed and built with safety in mind. However, your overall safety can be increased by proper installation . . . and thoughtful operation on your part. Read and observe all instructions and specific safety precautions included in this manual and, most importantly, think before you act and be careful.

## SAFETY PRECAUTIONS

**WARNING:** The high voltage and rotating parts associated with motor applications can cause serious injury. It is important to observe and follow safety precautions to protect personnel from such injury. Personnel should be instructed to:

1. Have all installation, maintenance and repair work performed only by qualified people.
2. Disconnect and lock out all power sources before doing any work on the equipment.
3. Follow the procedures outlined under "Caution When Lifting Motors" whenever the equipment is lifted.
4. Make the electrical installation in accordance with the National Electrical Code and local codes.
5. Properly ground the equipment in accordance with the National Electrical Code.
6. Be sure shaft key is fully captive before unit is energized.
7. Keep hands, hair, clothing and tools away from all moving parts when operating or repairing equipment.
8. Carefully consider the application and provide proper safeguards for personnel to prevent contact with moving or live parts.
9. If the motor is repaired be sure all Lincoln Electric nameplates and decals remain clear and legible.

It is strongly recommended that all concerned personnel be familiar with and adhere to the contents of NEMA MG2, "Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators."

## CAUTION When Lifting Motors & Machinery

Do not use the lift ring on the motor to lift the motor along with additional equipment, such as pumps, compressors or other driven machinery. In the case of assemblies on a common base, do not lift with the motor lift ring, but rather use a sling around the base or the lifting means provided on the base. In all cases, take care to assure lifting only in the direction intended in the design of the lifting means. Also, be careful to avoid hazardous overloads due to deceleration, acceleration or shock forces.

Mount the motor to a firm foundation being sure that the motor rests evenly on all feet. Shimms may be required when precise alignment is required.

Use a properly designed and installed coupling system between the motor shaft and load (see "Maintenance" on page 2).

## 143T thru 284T Frame Sizes

Lincoln motors may be mounted in any position. The motors have drain holes suitable for standard horizontal and vertical mountings.

Other mounting positions may require either rotation of the end brackets or drilling additional holes to attain proper drainage.

Before drilling additional holes in the motor enclosure, remove the end brackets to prevent blindly drilling into the winding or other functional parts of the motor. Make sure the inside of the motor is cleared of drill chips and any other foreign matter before reassembling the motor.

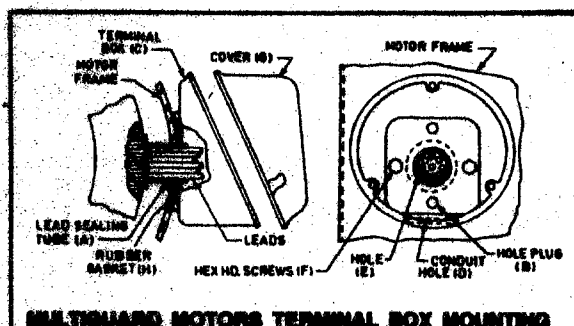
To mount the terminal box, place the inner gasket and the box in place on the motor with the conduit knock-out in the desired location. Install and tighten the two mounting studs.

Install the input power conduit. After connecting and insulating the leads (see "Electrical Connections") place the outer gasket and cover on the terminal box and tighten the acorn nuts.

## 284T thru 445T Frame Sizes

Ball bearing motors of this type may be mounted in any position. To maintain the best protection, on open motors, the end brackets can be rotated to any of four positions 90° apart. When vertical or ceiling mounted, a drain hole in the lowest part of the frame is desirable. The TEPC steel frame motors have drain holes in each end bracket which may require rotation for ceiling or wall mounting positions.

## TERMINAL BOX MOUNTING INSTRUCTIONS



## MULTIQUARD MOTORS TERMINAL BOX MOUNTING

1. Make sure lead sealing tube (A) is over leads and up against coil nose, and that rubber gasket (H) is over the lead sealing tube, as shown.
2. Rotate the terminal box (C) so hole (D) is in the best position for installation of the conduit.
3. Install the hole plugs (B) in the two holes not used for mounting the terminal box. Install hole plugs from the back side of the terminal box.
4. Slip the motor leads, and the lead sealing tube (A) through the terminal box hole (E), and mount terminal box to frame using two hex head screws (F).
5. Make motor electrical connections per the motor nameplate and "Electrical Connections" page 2.
6. Assemble cover (G) to the terminal box (C) using the slot-head screws provided. When the cover is properly installed, the mating fit of the box and cover rim provide a leak-proof seal.

## TERMINAL BOX MOUNTING CONTINUED

**LINCOLN MOTORS TERMINAL BOX MOUNTING**

1. Place the rubber gasket (H) over the motor leads and up against the motor frame.
2. Rotate the terminal box (C) so hole (D) is in the best position for installation of the conduit.
3. Install the hole plugs (B) in the two holes not used for mounting the terminal box. Install hole plugs from the back side of the terminal box.
4. Slip the motor leads through terminal box hole (E), and mount terminal box to frame using two hex head screws (F).
5. Make motor electrical connections per the motor nameplate and "Electrical Connections" on this page.
6. Assemble cover (G) to the terminal box (C) using the slotted head screws provided. When the cover is properly installed, the mating fit of the box and cover rim provides a leak-proof seal.

**TEFC STEEL FRAME MOTORS TERMINAL BOX MOUNTING**

1. Place the rubber gasket (H) over the lead sealing tube and up against the motor frame.
2. Rotate the terminal box (C) so hole (E) is in the best position for installation of the conduit.
3. Install the hole plugs (B) in the two holes not used for mounting the terminal box. Install hole plugs from the back side of the terminal box.
4. Slip the motor leads through terminal box hole (E), and the box over the sealing tube (A), and mount terminal box to frame using two hex head screws (F).
5. Make motor electrical connections per the motor nameplate and "Electrical Connections" on this page.
6. Assemble cover (G) to the terminal box (C) using the slotted head screws provided. When the cover is properly installed, the mating fit of the box and cover rim provides a leak-proof seal.

## BEARING SYSTEM LUBRICATION

Your motor is equipped with double-shielded ball bearings\* having sufficient grease to last indefinitely under normal service. When the motor is used constantly in dirty, wet or corrosive atmospheres, it is advisable to add one quarter ounce of grease per bearing every three months. Use a good quality rust inhibited polyurea based grease, such as Chevron SRI.

\* The bearings opposite the shaft extension and on the 143T, 145T and 284T thru 445T frame TEFC motors are double sealed. These maintenance-free bearings have no regreasing provision and require no additional lubrication throughout the life of the motor.

When greasing the bearings, keep all dirt out of the area. Wipe the fittings completely clean and use clean equipment. More bearing failures are caused by dirt introduced during greasing than from insufficient grease.

Original Lincoln quality is maintained by replacement per Lincoln parts list P-80-A, P-89-A and P-150-A. This table is provided as information only.

## BEARING TABLE

Frame	Shaft Extension End			Opposite Shaft Extension End		
	Size*	ODP	TEFC	Size*	ODP	TEFC
140T	205			203	—	ZZ
180T	207			205	—	FF
210T	208			206	FF	FF
280T	300		FF	208	FF	FF
280T	310		on All Enclosures	209	FF	ZZ
380T	311			300	FF	ZZ
380T	313			311	FF	ZZ
440T	315			313	FF	ZZ
440T	318			315	FF	ZZ

FF — Double shielded

ZZ — Double sealed

\* All bearings except the 318 are single-row radial deep-groove ball bearings. The 318 size is a single-row maximum capacity type ball bearing.

ODP frames 280T thru 440T double shaft extension motors have both bearings as listed under "Shaft Extension End."

## Motor Voltage vs. Power System Voltage

Motor should be applied to voltage systems per the following:

NEMA Motor Nameplate Voltage	Nominal System Voltage
200	208
230	240
480	480
575	600

## TRI-VOLTAGE (208-230/480) MOTORS

Lincoln motors ½ HP through 3 HP, nameplated 208-230/480 volts are suitable for operation on either 208 volts or 230 volts at the low voltage connection. See page 3 for the connection diagram.

## DUAL VOLTAGE (300/480 or 230/480) MOTORS

Some Lincoln motors are wired for operation on either of two input voltages. Proper connection of the motor leads for either voltage is shown on the motor nameplate. For example, "LOW VOLTAGE" on the nameplate shows the wiring for the lower of the two possible input voltages. Each motor lead is tagged with the lead number corresponding to the connection diagram.

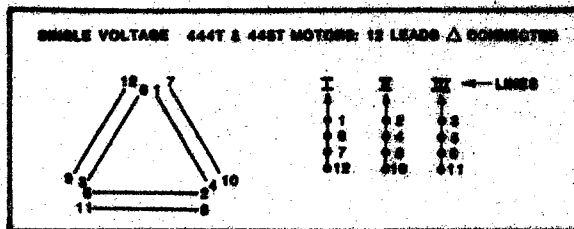
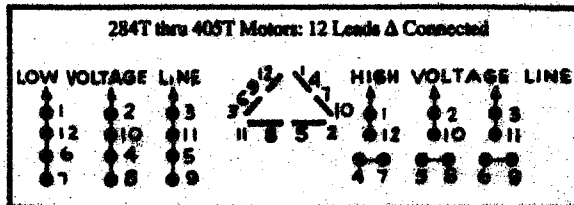
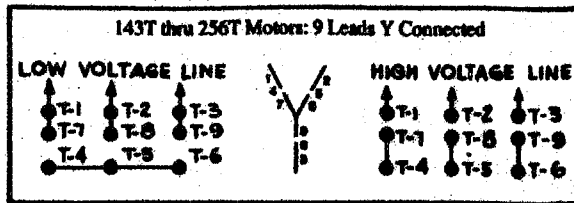
Dual voltage Lincoln motors nameplated 230/480 volts are suitable for 208 volt operation on the low voltage connection up to the maximum amps at 208 volts as listed on the nameplate. Such a motor (230 motor on 208 system) may not meet all NEMA performance limits. DO NOT apply 200 volt motors on 230 volt systems.

Connection diagrams for standard dual voltage motors are reproduced below. See this page and the next for Part Winding Start and Star-Delta Start connection diagrams.

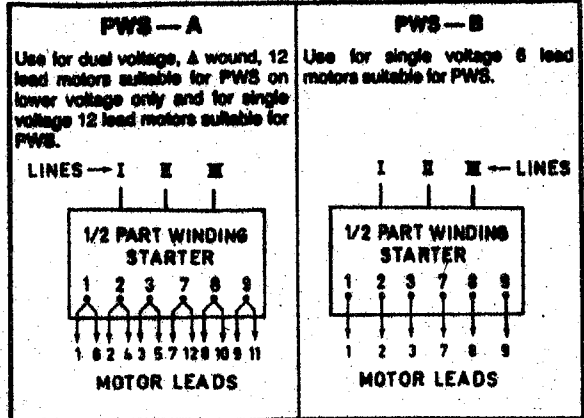
## SINGLE VOLTAGE (444T and 445T) MOTORS

These larger motors are specifically wound for operation on 400 or 460 or 575 volts. See below for the connection diagram.

**CONNECTION DIAGRAMS FOR  
LINCOLN ELECTRIC MOTORS**



**PART WINDING START CONNECTIONS**



1M — Closed at start and for run. 2M — Run only contactor.  
NOTE: These diagrams apply to current Lincoln motors. For earlier motors contact the factory giving specific Lincoln code numbers from the nameplate.  
Overload relay protection is required by the National Electrical Code. Consult the starter manufacturer for sizing.

**STARTING OPTIONS FOR STANDARD 60 HERTZ MOTORS**

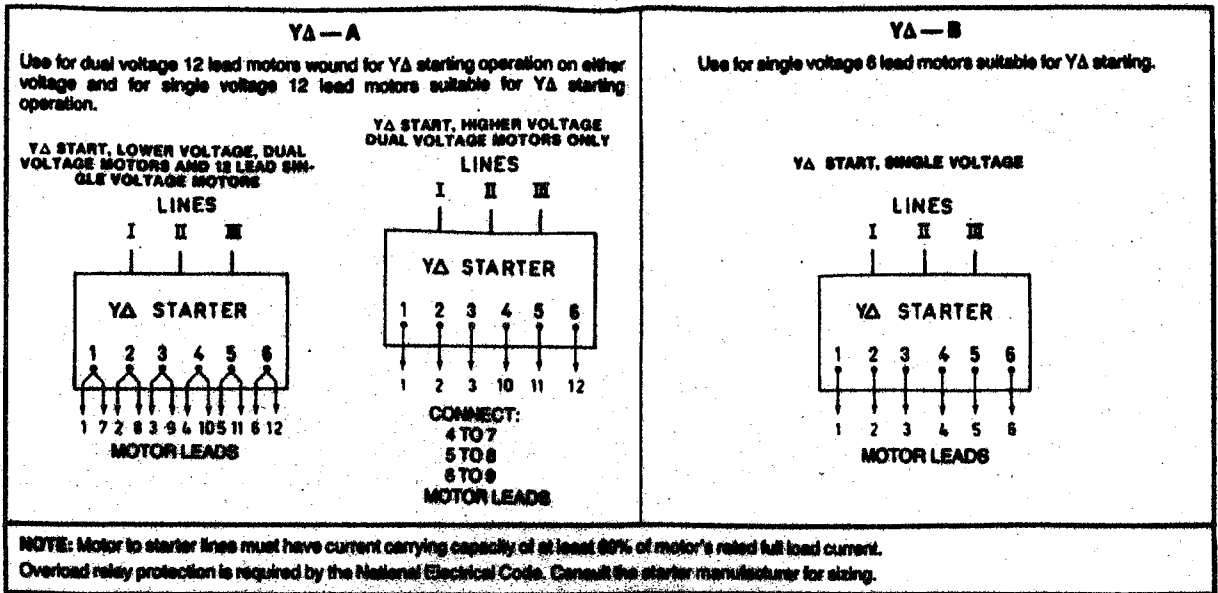
TYPE	HP	SPEED	FRAME	60 Hz (4) STATOR VOLTAGE	PHASE	NO. LINES	STARTABILITY PER VARIOUS MEANS OF STARTING			
							APPLICABLE TO THIS LINE	PWS	YES PER DIAGRAM YA-Pg. 4	PRIMARY RESISTANCE OR AUTOTRANSFORMER
Aluminum Frame	1/2 — 3	All	143T — 256T	208/416	Y	3	Yes	No	No	Yes
	5 — 25	All	184T — 384T	208/416 230/460	Y	3	Yes	No	No (5)	Yes
Steel Frame	1/2 — 30	1200	284T — 384T	230/460 208/416	Δ	12	Yes	No (2)	Yes	Yes
	2 1/2 — 30	1800	384T — 405T	230/460 208/416	Δ	12	Yes	No (2)	Yes	Yes
	2 1/2 — 50	1800	384T — 405T	230/460 208/416	Δ	12	Yes	Yes (1) Low Voltage Only per Diagram PWS-A Above	Yes	Yes
	90 — 75	1200	404T — 405T	230/460 208/416	Δ	12	Yes	No (1)	Yes	Yes
	40 — 125	1800	384T — 405T	230/460 208/416	Δ	12	Yes	No (1)	Yes	Yes
	25 — 100	3600	384T — 405T	230/460 208/416	Δ	12	Yes	No (3)	Yes	Yes
	100 — 125	1800	444T — 445T	480 or 475	Δ	12	Yes	Yes per Diagram PWS-A Above	Yes	Yes
125 — 250	1800	444T — 445T	480 or 575	Δ	12	Yes	Yes per Diagram PWS-A Above	Yes	Yes	

- These motors can be ordered per price page 7125 for single voltage PWS. Specify per the following: Voltage/phase/Hertz-PWS. They will have six leads out and are connected per diagram PWS-B Above. They can also be connected for across the line (XL) the autotransformer starting on this same single voltage by joining leads 1 & 7, 2 & 8, and 3 & 9.
- These motors are not available as standard per price book for PWS. They can be requested as a special quote. All other instructions and connections under (1) above would apply.
- 3600 RPM motors are not satisfactory nor available for PWS, as standard or special.
- Motors wound for other voltage combinations such as 208/416, 230/460 and single voltage PWS or YDS. All of the same basic information applies. See appropriate price page for availability.
- 12 lead dual voltage, suitable for YDS on other voltage may be requested as a single quote. YA-A diagram on page 4 would apply.

Lincoln motor bulletin D5T provides complete information about the various starting means applicable to Lincoln motors in current production.

**NOTE:**  
PWS is the lowest cost and most popular system of Reduced Voltage Starting on 60 Hertz power systems. Automatic autotransformer is expensive, but offers the best selection of different motor torques to start loads with different torque requirements — particularly hard to start loads. Autotransformer starters can be applied to any motor.

## STAR-DELTA ( $\Delta$ ) CONNECTIONS



The above diagrams apply to current model Lincoln motors. For other models contact the factory giving specific Lincoln code numbers from the nameplate.

### Connection to Power Supply

Proper branch circuit supply to a motor should include a disconnect switch, short circuit current fuse or breaker protection, motor starter (controller) and overload relay protection.

Short circuit current fuses or breakers are for the protection of the branch circuit. Starter or controller overload relays are for the protection of the motor.

Each of these should be properly sized and installed per the National Electrical Code and local codes.

Unless specifically exempted by the National Electrical Code or local codes ground the motor as specified in the codes. On 143T thru 234T Frames, a grounding screw and lug are provided for this purpose. A tapped hole for this screw identified by ground symbol  $\oplus$ , is located in the frame and is accessible inside the mounted terminal box. On 284T thru 445T Frames one of the terminal box mounting screws which is accessible inside the mounted terminal box, is used for grounding purposes. It is identified by ground symbol  $\oplus$ .

### Overload Relays and Trip Time

The National Electrical Code specifies an overload relay in each phase of the three phase power supply to protect the motor against excessive input current caused by the following:

**Overloading** — Overloading a motor causes excessive input current which increases motor temperature, shortens stator life and can cause an overload burnout.

**Voltage Variation (From Nameplate)** — Excessively high voltage increases life current by 25 to 50%. Excessively low voltage increases load current by 10% or more.

**Voltage Unbalance (Between Phases)** — A voltage unbalance of 3.5% can result in a current unbalance and temperature increase of 25%.

**Single Phasing** — When starting, single phased motors develop no torque and draw high current. Single phasing under load approximately doubles the load current.

Overload relays should be sized per the instructions of the starter manufacturer. In general, sizing of overload relays is based on a percent of motor nameplate full load current depending on the type of starter.

Under normal conditions, overload relays provide protection between 110 and 120% of their current rating. No extra allowance for service factor is necessary.

On across the line starting, the trip time for properly sized overload relays should be approximately 15 seconds under locked rotor current conditions of 600% full load current. If the starting time goes beyond

15 seconds, the overload relay should disconnect the motor from the line to prevent motor stator overload burnout.

Oversizing the overload relay is NOT the way to eliminate excessive tripping. Eliminating excessive voltage drop, reducing starting time and properly sizing the motor are correct answers.

For complete details on starting limits relating to time, frequency, high inertia loads, or for across the line and reduced voltage starting methods, consult Lincoln motor bulletin D6T.

For specially enclosed air over (TRAO) motors, the air velocity over the motor from the driven fan must be at least that shown on the motor nameplate. Higher loads than shown on the nameplate are possible at higher air velocities. See Lincoln application bulletin D4T for complete details.

### OPERATION

After checking that the shaft key is secure, operate the motor free of load and check the direction of rotation. If the motor rotates in the wrong direction, interchange any two line leads. Couple the motor to its load and operate for a minimum of one hour. During this period, check for any unusual noise or thermal conditions. Check the actual operating current to be sure that the nameplate current times service factor is not exceeded for steady continuous loads. See "Maintenance" below for possible causes of unusual noise or heat.

### MAINTENANCE

Periodically inspect your motor for excessive dirt, friction or vibration. Dust may be blown from inaccessible locations using compressed air. Keep the ventilation openings clear to allow free passage of air. Be sure the drain holes in the motors are kept open and the shaft slinger is positioned against the end bracket.

Grease or oil can be wiped by using a petroleum solvent.

Overheating of the bearing caused by excessive friction is usually caused by one of the following factors:

1. Bent shaft.
2. Excessive belt tension.
3. Excessive end or side thrust from the gearing, flexible coupling, etc.
4. Poor alignment.

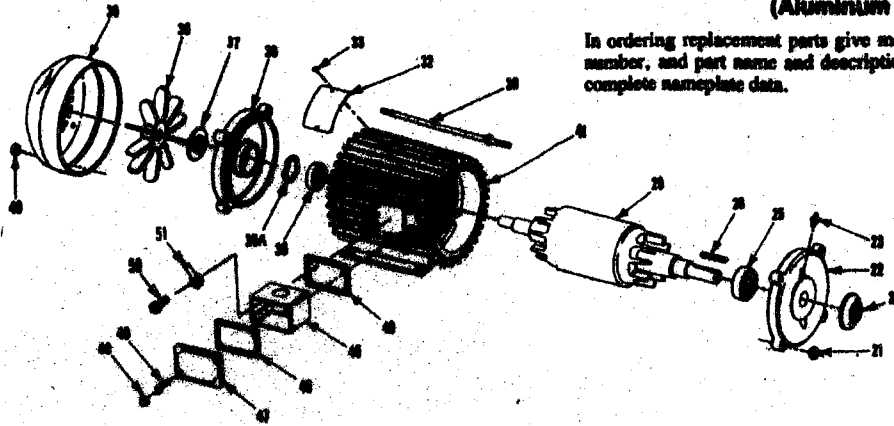
Damaging vibrations can be caused by loose motor mounting, by misalignment resulting from the settling or distortion of the foundation, or it may be transmitted from the driven machine. Vibration may also be caused by excessive belt or chain tension.

## HOW TO ORDER REPLACEMENT PARTS

All parts should be ordered from Authorized Motor Warranty Shops or branch offices. A "Service Directory" listing all Authorized Motor Warranty Shops geographically is available upon request. These shops stock GENUINE replacement parts and have factory trained personnel to service your motor.

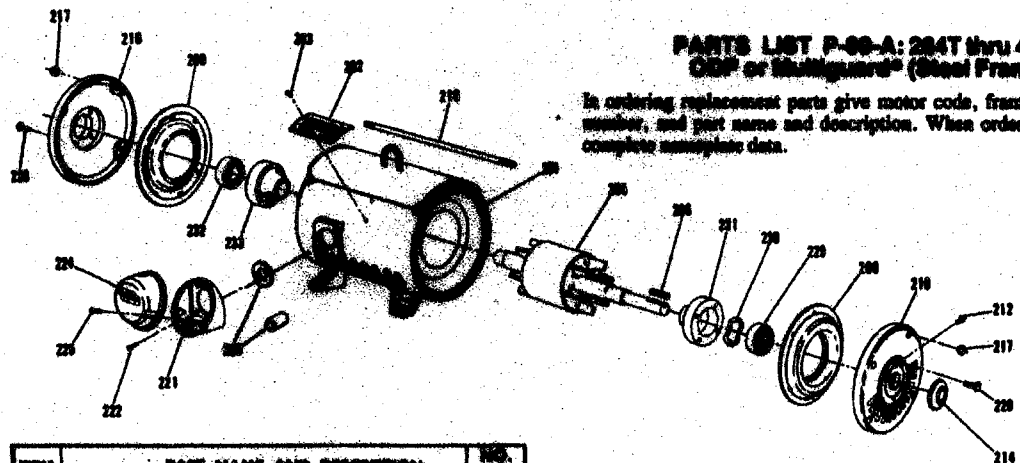
### PARTS LIST P-90-A: 143T thru 256T (Aluminum Frame)

In ordering replacement parts give motor code, frame size, part item number, and part name and description. When ordering a stator give complete nameplate data.



ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
21	Hex Nut	4
22	End Bracket (Shaft End)	1
23	Grease Fitting	2*
25	Bearing (Shaft End)	1
26	Rubber Slinger	1
28	Key	1
29	Rotor & Shaft Assembly	1
30	Through Bolt	4
32	Nameplate	1
33	Drive Screw, Nameplate Mounting	1
35	Bearing (Blower End)	1
35A	Spring Washer (Blower End)	2
* One grease fitting only for shaft end of 143T and 145T motors.		

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
34	End Bracket (Blind End)	1
37	Rubber Slinger - except 143T & 145T	1
38	Fan	1
39	Fan Shroud	1
40	Hex Nut	4
41	Stator (Windings & Motor Shell)	1
45	Conduit Box Kit, includes items 45-51	1
46	Conduit Box Basket	2
47	Conduit Box Cover	1
48	Stud, Conduit Box Mounting	2
49	Lock Nut	2
50	Grounding Screw	1
51	Grounding Lug	1



### PARTS LIST P-90-A: 284T thru 445T OD® or Multiguard® (Steel Frame)

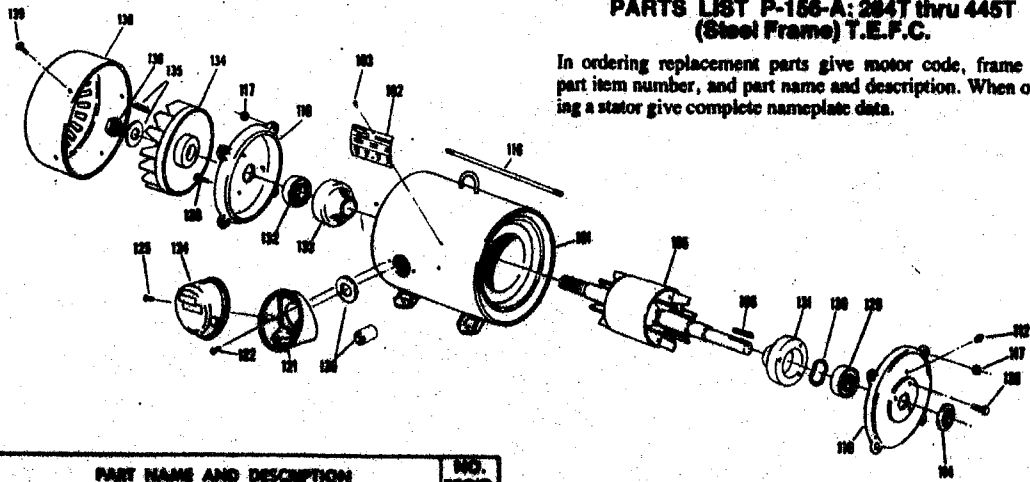
In ordering replacement parts give motor code, frame size, part item number, and part name and description. When ordering a stator give complete nameplate data.

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
201	Stator (Windings & Motor Shell)	1
202	Nameplate	1
203	Drive Screw, Nameplate mounting	2
204	Rotor & Shaft Assembly	1
205	Key	1
209	Air Baffle	2
210	End Bracket (Shaft End)	1
212	Grease Fitting	2
214	Slinger	1
216	Through Bolts	4
217	Hex Nuts	8
218	End Bracket (Opposite End) Conduit Box Kit, includes: Items 220-225	1

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
220	Washer (Conduit Box to Frame, Lincguard)	1
220	Sleeve (Conduit Box to Stator, Multiguard)	1
221	Conduit Box Body	1
222	Self Tapping Screw, Conduit Box to Frame	2
224	Conduit Box Cover	1
225	Self Tapping Screw, Cover Mounting	1
228	Hex Head Screw	6
229	Bearing, Shaft End	1
230	Thrust Washer	1
231	Cast Iron Cartridge, Shaft End	1
232	Bearing, Opposite End	1
233	Cast Iron Cartridge, Opposite End	1

**PARTS LIST P-156-A: 294T thru 445T  
(Steel Frame) T.E.F.C.**

In ordering replacement parts give motor code, frame size, part item number, and part name and description. When ordering a stator give complete nameplate data.



ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
101	Stator (Windings & Motor Shell)	1
102	Nameplate	1
103	Drive Screw, Nameplate Mounting	2
105	Motor & Shaft Assembly	1
106	Key	1
110	End Bracket (Shaft End)	1
112	Grease Fitting	1
114	Blower	1
116	Thru Bolts	4
117	Hex Nuts	8
118	End Bracket (Opposite End)	1
	Conduit Box Kit, includes: Items 120-125	1
120	Washer	1
120	Sleeve	1
121	Conduit Box Body	1
122	Self Tapping Screw, Conduit Box to Frame	2

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
124	Conduit Box Cover	1
125	Self Tapping Screw, Cover Mounting	4
128	Hex Head Screw	6
129	Bearing, Shaft End	1
130	Thrust Washer	1
131	Bearing Cartridge, Shaft End	1
132	Bearing, Blind End	1
133	Bearing Cartridge, Blind End	1
134	Blower	1
135	Washer	1
	Key	1
136	Hex Nut	1
138	Blower Shroud	1
139	Hex Head Screw	4

**WARRANTY**

The Lincoln Electric Company, the Seller, warrants all new motors and accessories thereof against defects in workmanship and material, provided the equipment has been properly stored, installed and operated under normal conditions. All installed motors and accessories listed in the Standard Price Book are warranted for five years from date of shipment.

If the Buyer gives the Seller written notice of any defects in equipment within any period of warranty and the Seller's inspection confirms the existence of such defects, then the Seller shall correct the defect or defects at its option, either by repair or replacement F.O.B. its own factory or other place as designated by the Seller. The remedy provided Buyer herein for breach of Seller's warranty shall be exclusive.

No expense, liability or responsibility will be assumed by the Seller for repairs made outside of the Seller's factory without written authority from the Seller.

The Seller shall not be liable for any consequential damages in case of any failure to meet the conditions of any warranty. The liability of the Seller arising out of the supplying of said equipment or its use by the Buyer, whether on warranties or otherwise, shall not in any case exceed the cost of correcting defects in the equipment in accordance with the above guarantee. Upon the expiration of any period of warranty, all such liability shall terminate.

The foregoing guarantees and remedies are exclusive and except as above set forth there are no guarantees or warranties with respect to accessories or equipment, either expressed or arising by operation of law or trade usage or otherwise implied, including with limitation the warranty of merchantability, all such warranties being waived by the Buyer.

**World Headquarters Telephone**  
**(216) 481-8100**  
**Cleveland, Ohio**



**THE LINCOLN ELECTRIC COMPANY**

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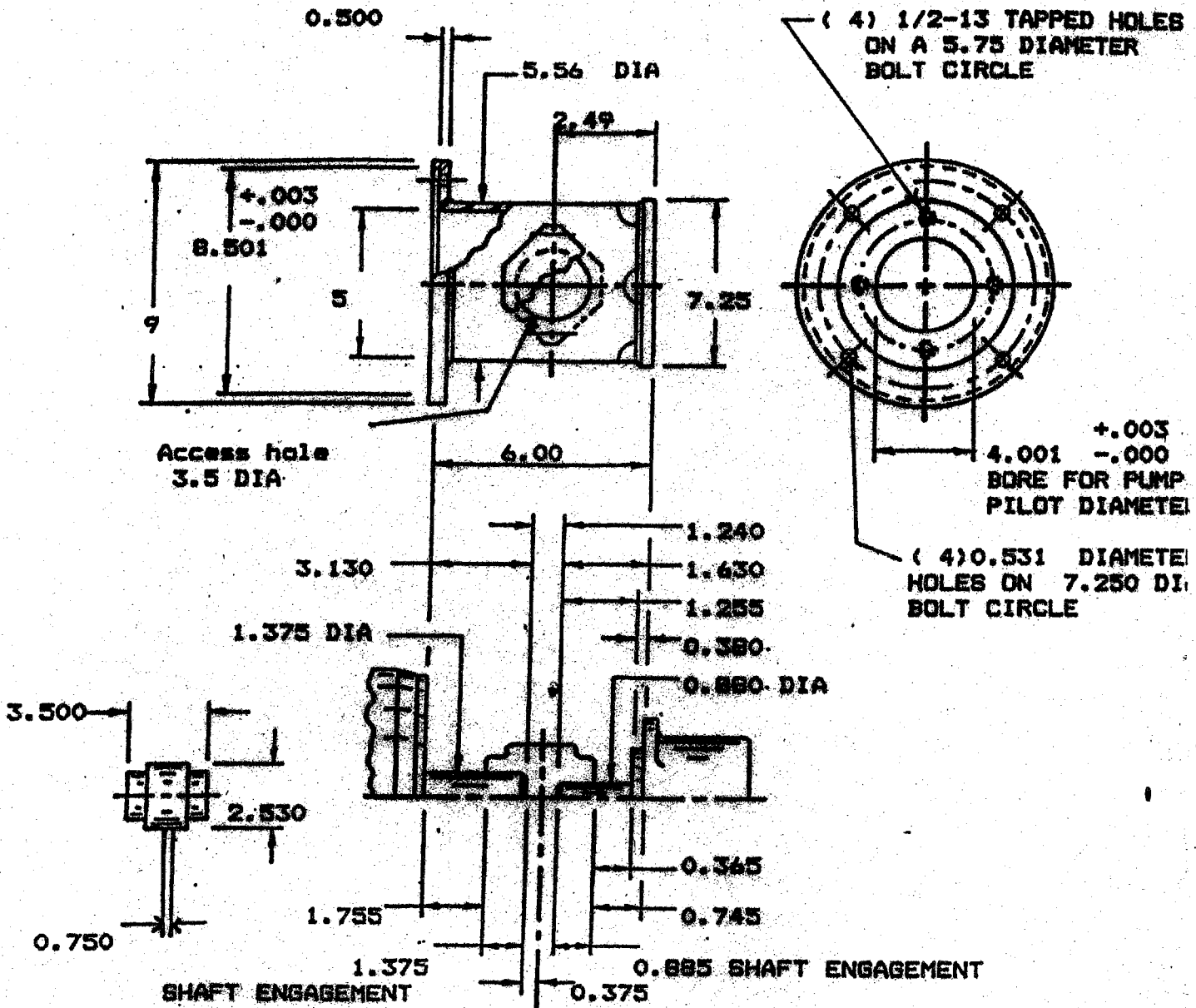
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# PUMP / MOTOR ADAPTORS



ADAPTOR: Model No. 1202-320-X-6  
Part No.

MOTOR: Frame Size 213TC/215TC

PUMP: Make CROSS  
Model SERIES 50 SHFT C  
Mounting SAE B , 2

COUPLING Make LOVEJOY , L-100

CUSTOMER: Name CENTURY MACHINE  
Address COULTER IA  
P.O. No. 10669  
QTY. (2) TWO

CERTIFIED BY: R.H. Bull

APPROVED BY: \_\_\_\_\_

By RHB

Date 7-21-86

SHIPPING SCHEDULE: 9-30-87  
BSF Order No 10669

# Instructions For Type PB1 And PB2 Pushbutton Devices

I.L. 17153

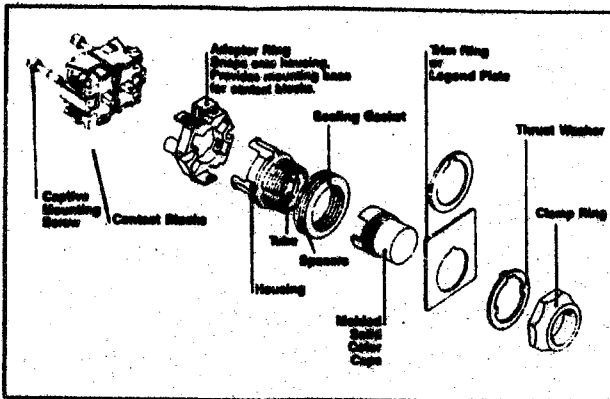


Fig. 1 Pushbuttons

## PUSHBUTTON

### CAP INSTALLATION

The positioning of the operator's tube is important to proper cap insertion on a pushbutton or mushroom pushbutton operator. Fig. 1A shows the proper tube location needed for the insertion of the pushbutton cap.

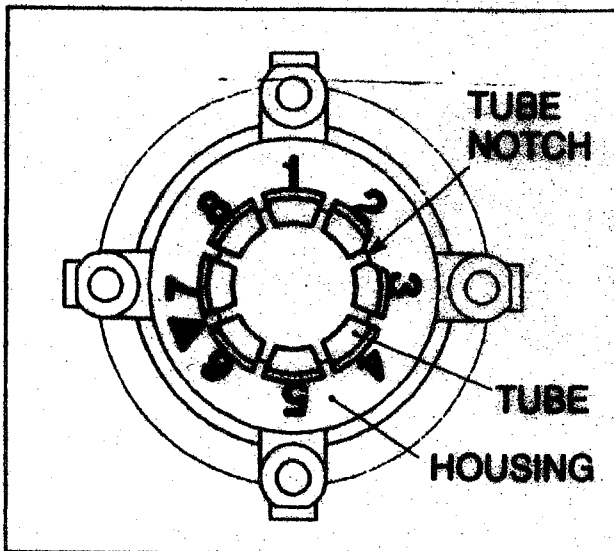


Fig. 1A Tube Position for Cap Insertion for Pushbuttons

### MOUNTING

To install PB1 and PB2 devices:

1. Remove clamp ring, thrust washer, and trim washer. (See Fig. 1)
2. Remove spacers to the number required as shown in Table 1. (Required number based on panel thickness)
3. Insert the operator into the panel mounting hole (Mtg. Matrix Fig. 2)
4. Add either legend plate or trim ring, line up the anti-turn keyways, and insert the thrust washer so that the "tang projection" of the thrust washer engages the legend plate and the panel mounting hole keyway.

5. Secure the unit with the clamp ring. (Max. Torque: PB1—15 lb.-ft. or PB2—1 lb.-ft.)

Panel thickness	Spacers	Gaskets
1/16	4	1
1/8	3	1
3/16	2	1
1/4	1	1
9/32	0	1

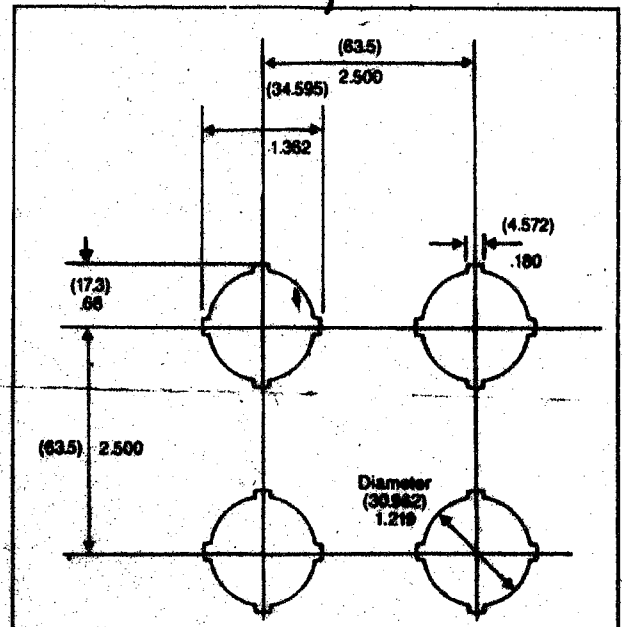


Fig. 2 Mounting Matrix in Inches (mm)

This industrial type control is designed to be installed, operated, and maintained by adequately trained workmen. These instructions do not cover all details, variations, or combinations of the equipment; its storage, delivery, installation, check out, safe operation, or maintenance. Care must be exercised to comply with local, state, and national regulations, as well as safety practices, for this class of equipment.

### INDICATING LIGHT

Type PB1 and PB2 indicating lights come in either transformer or full voltage varieties. As shown in Fig. 3, indicating lights are mounted in the same manner as other PB1 and PB2 devices. The (color) lens of the indicating light is removable from the panel front by merely unscrewing it from the clamp ring. This feature facilitates the changing of bulbs without removing the light from the panel. The PBIXA lamp installer is available to facilitate lamp replacement.

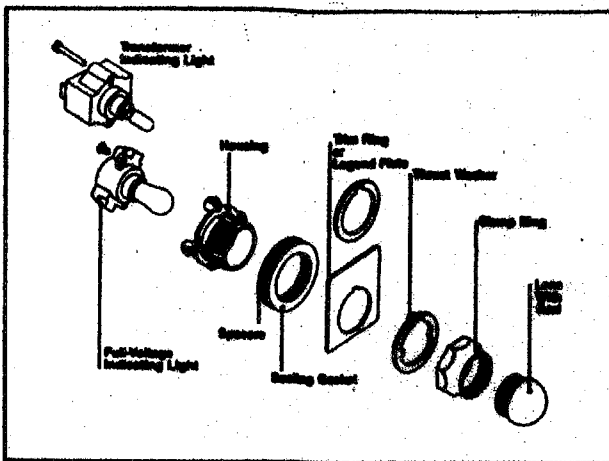


Fig. 3 Indicating Light

**SELECTOR SWITCH**

Selector Switch operators are available in both PB1 and PB2 lines. They come in 2, 3, & 4 Positions maintained, key operated, spring return, and select-o-push types. Various colors, handle shapes, and sizes are available and can be converted during installation. Contact switching sequences are also field convertible by means of a unique cam and operator design.

These instructions do not attempt to show all the available features of the PB1/PB2 Selector Switch. If the desired contact switching sequence cannot be found from the information printed in our catalog, please contact a factory representative.

The contact switching sequence of PB1 and PB2 Selector Switches can be modified by adding Normally Open (NO) and Normally Closed (NC) contact blocks. The operating cam may be moved and/or changed to effect the manner in which these NO and NC contacts change state.

Once the proper cam, position, and contact blocks are identified based on the desired switching sequence, any selector switch may be modified by following these instructions:

1. Using a screwdriver, pry off the black plastic adaptor from a PB1 operator housing and remove the operating cam as shown in Fig. 4 & 5. (Note - PB2 devices do not have this adaptor because the cam is a snap fit and can be pryed off directly.)
2. Rotate the operator's handle counterclockwise until the "arrow indicator," between 6 and 7, on the bottom of the operator housing lines up with the notch in the tube. See Fig. 5.
3. The cam position can now be set by placing the cam onto the operator so that the appropriate position number is visible in the "window" provided in the cam.
4. The operator is completed by placing the adaptor back onto the operator housing and snapping it

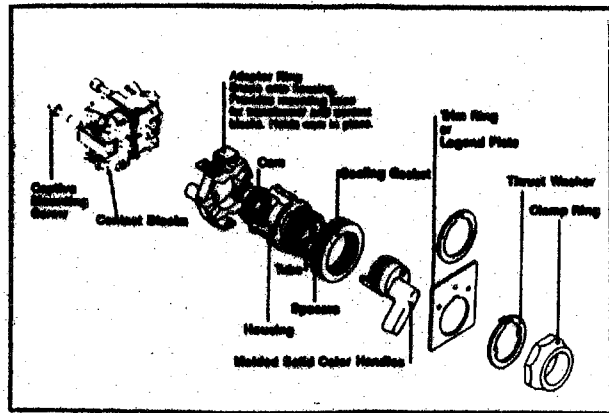


Fig. 4 Maintained Selector Switch

into place. The cylindrical posts on the adaptor are used in locating the contact blocks, and should be positioned on the left and right side of the operator housing as shown in Fig. 5. (Note - PB2 devices do not have an adaptor, the cam is a snap fit onto the bottom of the operator housing.)

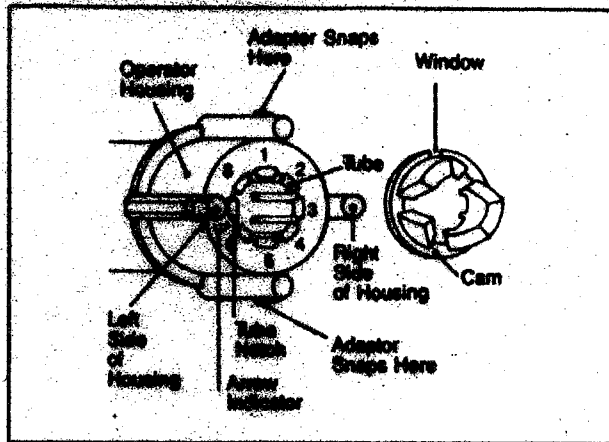


Fig. 5 Cam Installation  
(As viewed from the rear of the panel)

5. Contact blocks may now be installed to obtain the final desired switch sequence. **ALL PB1 AND PB2 CONTACT BLOCK INSTALLATION INSTRUCTIONS AND CHARTS DESCRIBE THE "LEFT" AND "RIGHT" SIDES OF THE DEVICE AS VIEWED FROM THE REAR OF THE OPERATOR.** (i.e. - As viewed by the Electrician from behind the panel.)
6. The contact blocks are made of transparent plastic so that the switching sequence may be confirmed after assembly.

**CAUTION**

The tube position described for selector switch cam insertion is different than that needed for proper assembly of pushbutton operators. Special care should be taken to make sure that these instructions are followed in detail.

**control**

**INSTRUCTIONS**

**CAUTION:** Before installing in a nuclear application, determine that the product is intended for such use.

**CR9440K1J1, K1K1, K1L1, and K1M1 SERIES A small snap-action oil-tight limit switches**

**GENERAL INFORMATION**

These switches are intended primarily to operate a magnetic switch or contactor in a control system when the mechanism being governed has reached a pre-determined setting. They can be used to produce a final stop or a slowdown by interrupting the coil circuit of the proper magnetic device. They are also used to indicate to an operator, through the use of an indicating light or other electrical signal, the progress of the controlled operation.

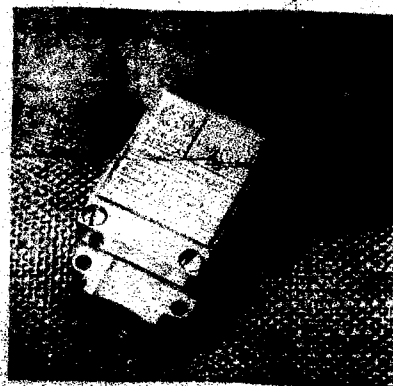
Fundamentally, the four switches are identical, the only difference being that of the operating head and its linkage which operates the contact unit. This design feature makes possible an adequate stock with a minimum of pieces. It should be noted that the roller lever on the operating head of the CR9440-K1J1 Series A, is adjustable through 360°, and that all of the operating heads may be indexed, relative to the switch body, to any of the four 90° positions. The life of the contact unit is, of course, dependent upon the load imposed and the severity of the service cycle. For best service the switch should not be operated faster than 100 times a minute and the speed of the tripping member should not exceed 100 feet a minute. The small size of these devices makes them widely applicable where space is at a premium.

**DESCRIPTION**

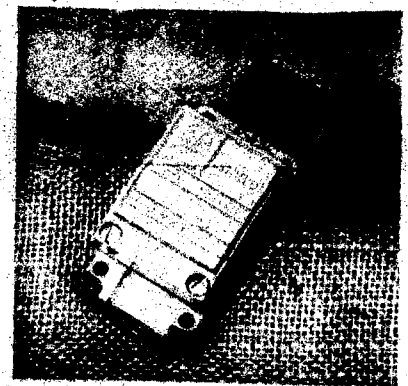
The electrical symbol for this oil-tight limit switch is:



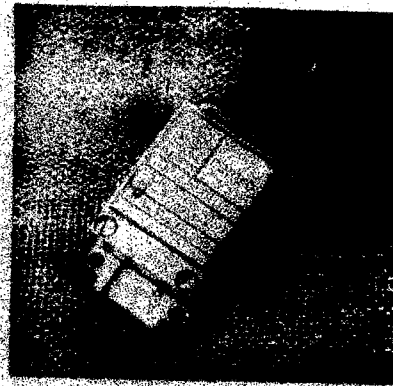
This symbol is cast on the underside of the limit switch cover. The four circles represent stationary contacts and the bar, across the lower two circles, the movable, bridging contact. The circuit including the lower circles is termed "normally closed", while that involving the upper circles is the "normally open" circuit. The switch is so constructed that the movable contact travels from one set of stationary contacts to the other with a vigorous snap-action, regardless of the speed at which the tripping member of the purchaser's machine displaces the operating lever or plunger furnished with the head of the limit switch. Also incorporated in the switch mechanism is a spring-return feature so that the normally closed contact is open only while operating pressure is maintained on the roller lever, push-rod, or plunger. When this pressure is released, the operating lever or plunger, as the case may be, also returns to its normal position, ready for the next operation.



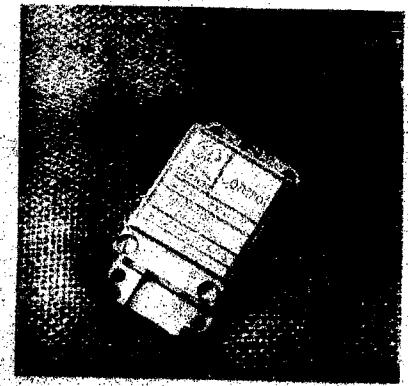
CR9440K1J1 SERIES A



CR9440K1K1 SERIES A



CR9440K1L1 SERIES A



CR9440K1M1 SERIES A

FIGURE 1

The following table lists the rating of these switches. Loads in excess of these values will dis-proportionately reduce the life of the contact unit.

**CONTACT RATINGS**

VOLTS	MAXIMUM AMPERE RATING			
	CONTINUOUS CARRY	MAKE	AC BREAK	DC BREAK
110-120	10	40	6.0	0.25
220-240	10	30	3.0	0.10
460-480	10	15	1.5	....
550-600	10	12	1.2	....

These switches have a continuous capacity of 10 amperes. Into the operating head and mechanism of each of these switches is incorporated provision for over-travel—that is, travel beyond that point at which the contacts are operated. In the case of the CR9440K1J1 Series A roller-lever-operated form, contact operation is obtained whether the lever is moved clockwise or counter-clockwise.

**INSTALLATION**

It will be noted from the photos in Figure 1, that four holes are provided for mounting screws. These switches should be mounted securely, using four No. 6 screws and lock washers. The surface on which the switch is to be mounted should be flat so that no distortional stresses will be set up in the switch frame, and the location of the switch must be such that proper operation will result when the moving element trips the switch. Note that travel in excess of that shown on the outline diagrams will result in damage or jamming of the devices.

A 1/2 inch pipe tap is provided for conduit connection. Unless a good connection is made at this point, the benefit of the airtight enclosure will be lost.

To adjust the roller-lever of the CR9440K1J1 Series A switch, the socket-head clamp screw (A—Figure 2), should first be loosened. The operating lever can then be moved to the desired angle and the clamping screw tightened to between 5 and 6 lbs. in torque. Exceeding this torque only closes the gap in the clamp and prevents re-adjustment. The shaft (B—Figure 2) is slotted so that when desired, it can be moved relative to the loosened operating lever, and the tripping point set at a given angle.

**WIRING**

In making electrical connections to the contact unit note that the two binding screws (1 and 2—Figure 2) nearest the conduit pipe tap, provide connection for the normally closed circuit, while the other two binding screws (3 and 4—Figure 2) are for the normally open set of contacts. The terminal numbers are molded on the switch units. Because of the small gap and fast travel of the contacts, opposite polarities should not be connected to this switch.

As a check to avoid such a condition, it should be possible to place a test jumper from any terminal to any other terminal without causing a short circuit.

After the electrical connections are made, it is advisable to test the equipment, with power applied, by operating the switch manually to be certain that it functions as intended. This operation, of course, consists of operating the switch by hand in a manner simulating that in which the moving element of the machine will operate the device.

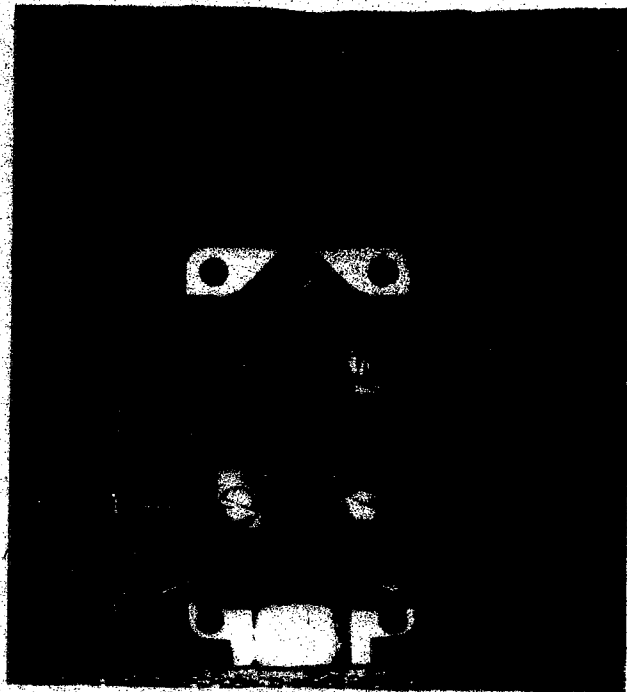


FIGURE 2

**MAINTENANCE**

The switch operating heads are lubricated at the factory and need no further attention. The switch unit (C—Figure 2) should not be lubricated under any conditions. The roller on the lever of the CR9440K1J1 Series A switch is molded of a graphitic phenolic compound and requires no lubrication. If necessary, a switch unit should be replaced as a unit by removing the screw (D—Figure 2) which holds the unit to the enclosure.

**GENERAL PARTS**

When ordering parts, refer to the nearest General Electric Sales Office, giving the complete nameplate rating of the device, and a full description of the part desired.

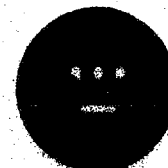
GENERAL ELECTRIC COMPANY  
 GENERAL PURPOSE CONTROL DEPARTMENT  
 BLOOMINGTON, ILLINOIS 61701

10/78

**GENERAL ELECTRIC**

Printed in U.S.A.

# Instructions for Solid State, Time Delay Interlocks for Type A/200 Starters and Contactors; On-Delay Cat. TF-56



L.L. 15139  
File 8200

## OPERATION

The Westinghouse TF time delay interlocks are designed to be mounted on, and used in conjunction with, Type A/200 starters and contactors as shown in Fig. 1.

A bracket for panel mounting is available.

Available catalog numbers and styles:

Timer Cat. No.	Seconds Relay	Style Number
TF-56L	0.3	1279C91G01
TF-56AL	0.5	1279C91G02
TF-56BL	1	1279C91G03
TF-56CL	1.5	1279C91G04
TF-56DL	2	1279C91G05
TF-56EL	3	1279C91G06
TF-56FL	5	1279C91G07
TF-56GL	10	1279C91G08
TF-56HL	15	1279C91G09
TF-56JL	20	1279C91G10

Mounting Bracket: Style No. 177C943H16

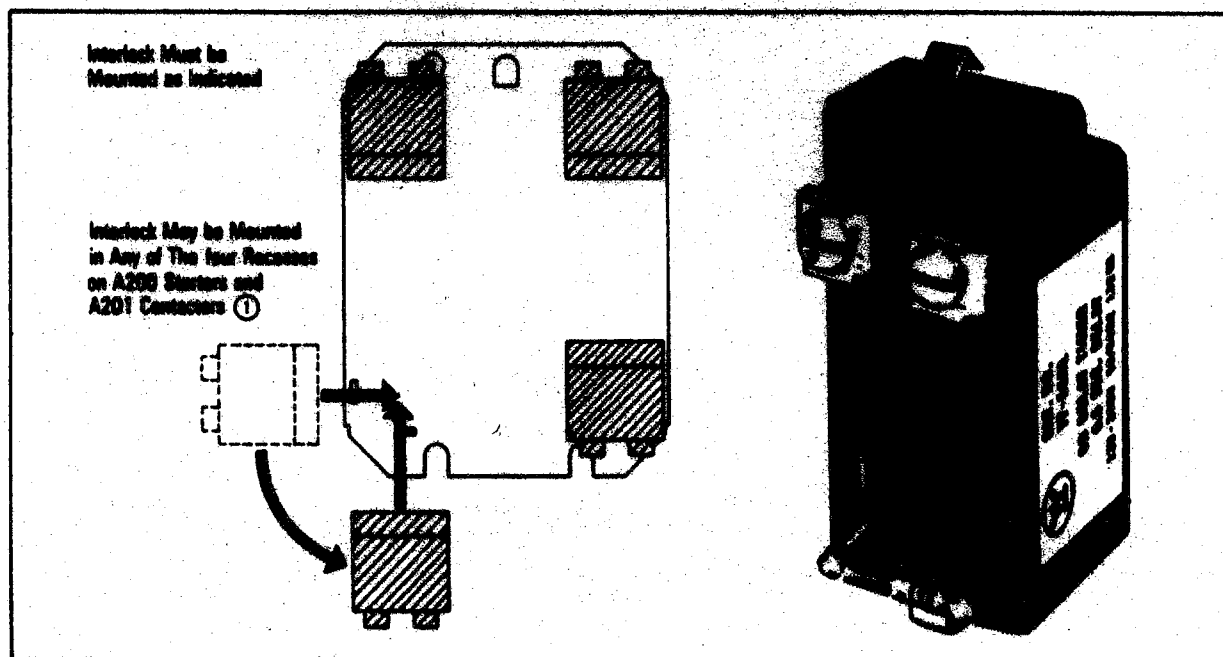


Fig. 1 Interlock Mounting Positions and Interlock

## INSTALLATION

1. Select the position desired for mounting the interlock. See Fig. 2.
2. With the spring clips of the interlock aligned with the clip slots, slide the interlock into the recess so that both spring clips lock into their slots. The rear of the interlock will then be flush against the rear of the recess.
3. Wire the interlock in accordance with Fig. 3.

## REMOVAL

The interlock may be removed from the contactor by depressing the forward spring clip (1) and pulling the interlock from the contactor recess. See Fig. 1.

## TIME RANGE

Desired delay time may be selected but is fixed by value of external resistor.

## FUSING

If fusing is desired, we suggest using a fuse with an  $I^2T$  rating equal to or less than 0.5 amp<sup>2</sup>sec.

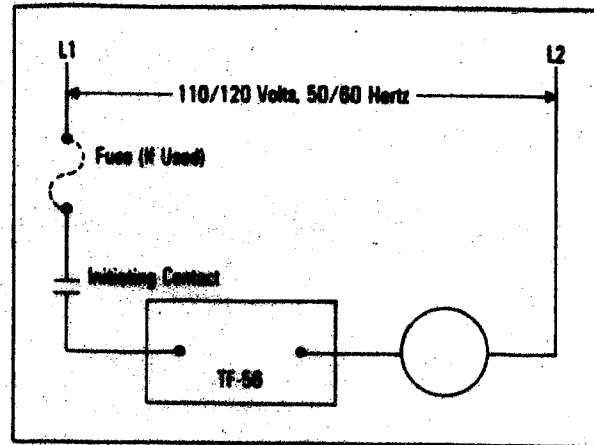


Fig. 2 Connection Diagram

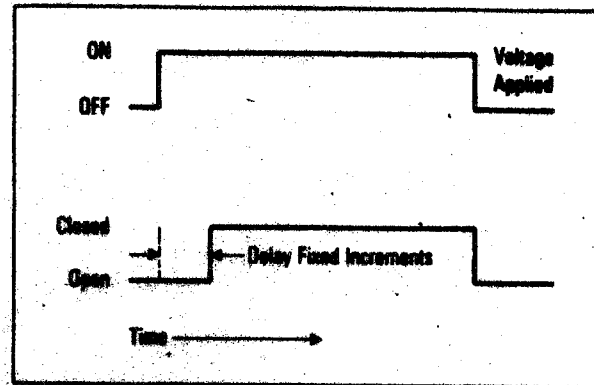


Fig. 3 ON Delay Timing Sequence (TF-56)

# Instructions for A200, Size 00, 0, or 1 3 Pole Motor Controller

I.L. 16958A  
Model J

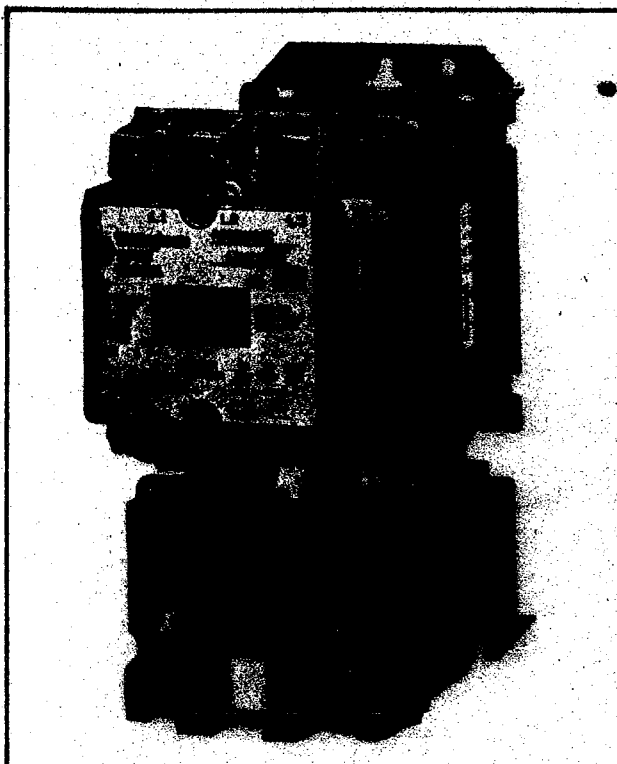


Fig. 1 Size 1 A200 Motor Controller

## THE CONTROLLER

The A200 motor controller, when wired as shown in Figure 6 or 7, will operate as a full voltage starter and will give protection against overload, but not against short circuit currents, when wired and provided with overload relay (OLR) heaters as listed in heater selection tables or when used with any means of inherent protection activated by motor temperature.

The controller should be protected against short circuits by providing branch circuit protection not to exceed the maximum protective device ratings listed in Table II.

CONTROLLER RATINGS				
NEMA SIZE	3 PHASE HORSEPOWER AT			
	60 HERTZ 200 V	230 V	50 HERTZ 200 V	60 HERTZ 480/575 V
00	1½	1½	1½	2
0	3	3	5	5
1	7½	7½	10	10

This industrial type control is designed to be installed, operated, and maintained by adequately trained workmen. These instructions do not cover all details, variations, or combinations of the equipment, its storage, delivery, installation, check out, safe operation, or maintenance. Care must be exercised to comply with local, state, and national regulations, as well as safety practices, for this class of equipment.

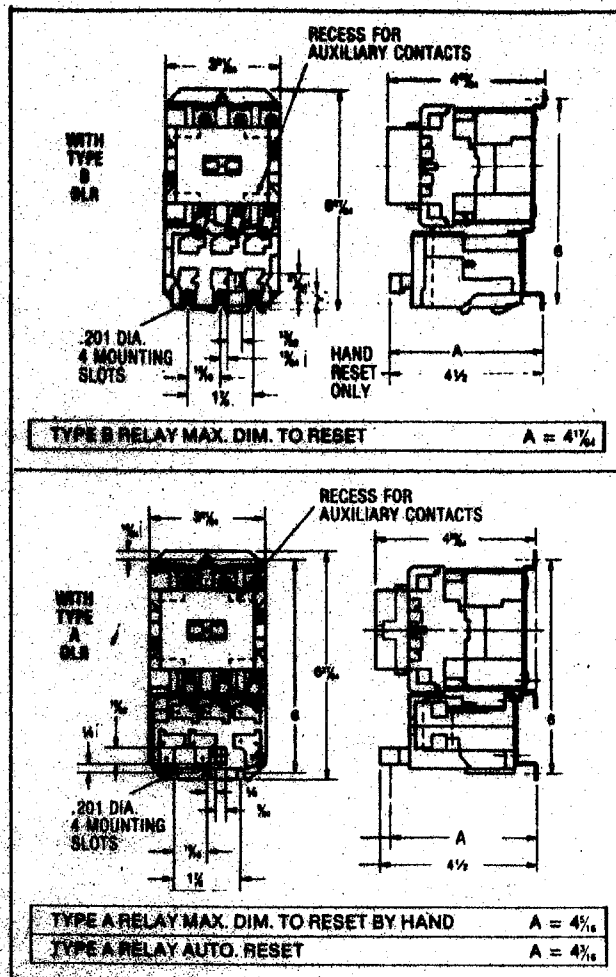


Fig. 2 Dimension Drawings (Dim. in inches)

## AUXILIARY CONTACTS — L56 (RATED B600)

One normally open pole adjacent to the power poles is supplied as the holding circuit auxiliary. A maximum of four additional L56 auxiliary units can be installed in the recesses of each contactor. These may be mounted with the terminals in line with the power poles or may be mounted with the terminals in a right angle relationship to the power poles. They mount by means of a spring clip which snaps into locations provided in the motor controller unit. To remove the L56 disengage the top spring clip, by pressing on the extended tab, and withdraw the unit.

L56 AUXILIARY CONTACTS	
Contact Type	Catalog No.
1 Normally Closed	L56E
1 Normally Open	L56D
2 Normally Closed	L56C
2 Normally Open	L56B
1 Normally Open and 1 Normally Closed	L56

L56 CONTACT RATINGS (B600)		
AC Volts	Make	Break
24-120	30A	3A
120-600	3600VA	360VA



**TYPE B OVERLOAD RELAY (See Figure 3)**

This A200 motor controller is usually equipped with a Type B block type ambient compensated overload relay (with gray reset rod). The controller can also be supplied with a non-ambient compensated overload relay (with red reset rod). The relay is of the bimetal actuated type equipped with a normally closed control contact. An optional isolated normally open control circuit is available for field mounting. When the overload relay trips, a yellow dot will appear flush with the molded surface below the reset rod. Resetting the relay returns this indicator to its normal concealed position.

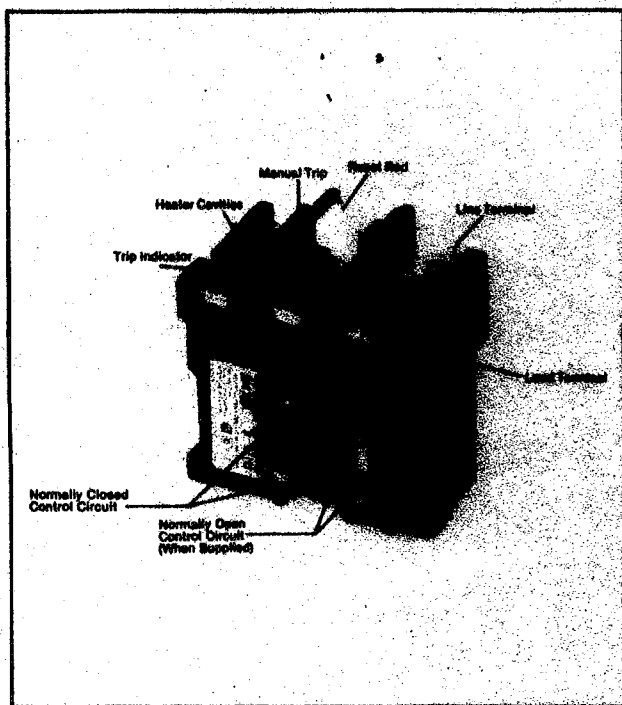


Fig. 3 Type B Overload Relay

**TYPE A OVERLOAD RELAY (See Figure 4)**

The A200 motor controller can be equipped with a Type A block type non-ambient compensated overload relay (unmarked and with red reset rod) or with a block type temperature compensated overload relay (marked "ambient compensated" and with gray reset rod). The relay is of the bimetal actuated type equipped with trip indicator, trip adjustment covering  $\pm 15\%$  of rating and a normally closed control contact. It may be operated with either hand or automatic reset.

Reset operation is determined by the position of the plate on the load side of the overload base. Position the reset plate away from the panel to set the "hand" position. Loosen the locking screw, move the reset plate toward the panel, and retighten the screw to set the "auto" position.

Automatic reset should not be used with 2-wire control circuits where automatic starting of the motor may be hazardous.

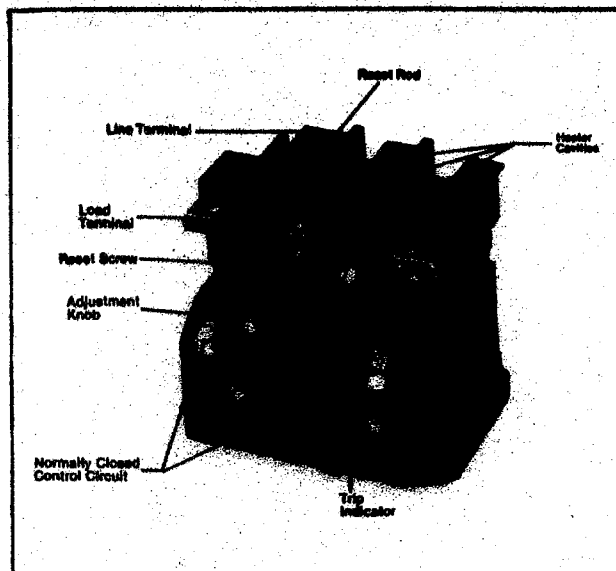


Fig. 4 Type A Block Overload Relay

OVERLOAD RELAY CONTROL CONTACT RATINGS				
AC Volts	Normally Closed		Normally Open	
	Make	Break	Make	Break
<b>Type A</b>				
24-120	20A	2A	5A	.5A
120-600	2400VA	240VA	600VA	60VA
<b>Type B</b>				
24-120	30A	3A	30A	3A
120-600	3600VA	360VA	3600VA	360VA

**COIL**

The A200 motor controller is available with a single or dual voltage coil. When equipped with a single voltage coil, the contactor is wired as shown in Figures 6 and 7. A connection diagram for a dual voltage coil is shown in Figure 5. When supplied with a dual voltage coil, the motor controller is normally wired for the high voltage connection. The wiring may be changed to the low voltage connection by removing and reconnecting the jumpers as illustrated below.

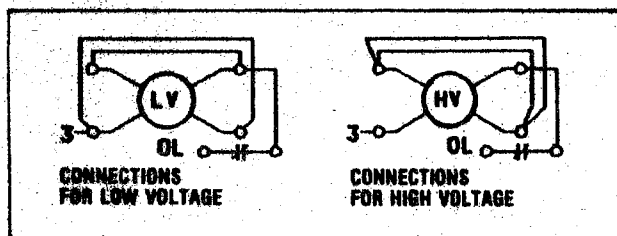


Fig. 5 Dual Voltage Coil Connections

**AC COIL DATA, SIZE 00, 0 AND 1 (TYPICAL VALUES)**

Inrush VA	Sealed VA	Sealed Watts	Pickup (Time in Milliseconds)	Dropout
160	25	7.8	16-24	12-16

# A200 SIZE 00, 0, OR 1, 3 POLE MOTOR CONTROLLER

I.L. 10056A

## REPLACEMENT COIL: ORDER BY PART NUMBER, VOLTAGE, AND FREQUENCY

SIZE 00, 0, 1 AC OPERATING COILS		
Voltage	Freq.	Part Number
24	60	505C00G16
120/110	60/50	505C00G01
208	60	505C00G02
240	60	505C00G12
277	60	505C00G18
380	50	505C00G07
480/440	60/50	505C00G13
600	60	505C00G05
120/240*	60/60	505C00G10
240/480*	60/60	505C00G03

\* Dual Voltage Coils. Use only on starters originally supplied with a dual voltage coil.

TABLE I -- REPLACEMENT OVERLOAD RELAY	
OVERLOAD RELAY	CATALOG NUMBER
Type B Non-ambient compensated	BN13A
Type B Ambient Compensated	BA13A
Type A Non-ambient compensated	AN13A
Type A Ambient Compensated	AA13A

This motor controller is suitable for use on a circuit capable of delivering not more than the current (line symmetrical amperes) shown below in circuits rated not more than the voltage shown below:

Short-Circuit Protective Device (SCPD)	Max. Rating SCPD	Circuit Breaker Interrupting Rating	Short-Circuit Rating		Typical Protective Device Cat. No.
			Current	Voltage	
Class H Fuse	80A	—	5,000A	600V	10001, 10002
Class J Fuse	80A	—	100,000A	600V	10001, 10002
Class R Fuse	80A	—	100,000A	600V	10001, 10002
Class T Fuse	80A	—	100,000A	600V	10001, 10002
Magnetic Only <sup>1</sup> Type CB <sup>2</sup>	30A	Marked MCP	5,000A 25,000A	600V 600V	MCP
Thermal/Mag. Type CB <sup>3</sup>	80A	14,000A	10,000A 25,000A	600V 600V	FS HFS
Mag. Only Type CB + CL <sup>4</sup>	30A	MCP + Current Limiter	100,000A	600V	MCP + CL
Thermal/Mag. Type CLB <sup>5</sup>	80A	100,000A	100,000A	600V	PCL

- <sup>1</sup> Instantaneous Adjustable Trip
- <sup>2</sup> Circuit Breaker
- <sup>3</sup> Inverse Time Circuit Breaker
- <sup>4</sup> Instantaneous Adjustable Trip with Current Limiting Attachment
- <sup>5</sup> Inverse Time Current Limiting Breaker.

### HEATERS

Heaters are not included with the motor controller and must be ordered separately per the heater selection table and the information listed below. When installing heaters be sure that connecting surfaces are clean and heaters are attached securely to the relay in the proper location with the screw provided. The trip rating of a heater in a 40°C Ambient is 125% of the minimum full load current shown in Table II. When tested at 600 percent of its trip rating, the relay will trip in 20 seconds or less.

Heaters should be selected on the basis of the actual full load current and service factor as shown on the motor nameplate or in the manufacturer's published literature. When the service factor of the motor is 1.15 to 1.25, select heaters from the heater application table. If the service factor of the motor is 1.0, or there is no service factor shown, or a maximum of 115% protection is

desired, select one size smaller heater than indicated. When motor and overload relay are in different ambients and when using non-compensated overload relays, select heaters from the table using adjusted motor currents as follows: decrease rated motor current 1% for each °C motor ambient exceeds controller ambient. Increase rated motor current 1% for each °C controller ambient exceeds motor ambient.

TABLE II -- F SERIES HEATER SELECTION

For compensated OLR's in any size enclosure, and non-compensated OLR's in enclosures with volume not less than 4000 cu. in. Wire with 75°C wire

Code Marking	Full Load Current of Motor (Amperes) (40°C Ambient)	Max. Protect. Device Amp	Load Wire Size
FH03	.25 — .27	1*	#14
FH04	.26 — .31	1*	#14
FH05	.32 — .34	1*	#14
FH06	.35 — .38	1*	#14
FH07	.39 — .42	1*	#14
FH08	.43 — .46	2*	#14
FH09	.47 — .50	2*	#14
FH10	.51 — .55	2*	#14
FH11	.56 — .62	3*	#14
FH12	.63 — .68	3*	#14
FH13	.69 — .75	3*	#14
FH14	.76 — .83	3*	#14
FH15	.84 — .91	3*	#14
FH16	.92 — 1.00	3*	#14
FH17	1.01 — 1.11	3*	#14
FH18	1.12 — 1.22	3*	#14
FH19	1.23 — 1.34	5*	#14
FH20	1.35 — 1.47	6*	#14
FH21	1.48 — 1.62	6*	#14
FH22	1.63 — 1.78	6*	#14
FH23	1.79 — 1.95	6*	#14
FH24	1.96 — 2.15	6*	#14
FH25	2.16 — 2.35	10*	#14
FH26	2.36 — 2.58	10*	#14
FH27	2.59 — 2.83	10*	#14
FH28	2.84 — 3.11	15	#14
FH29	3.12 — 3.42	15	#14
FH30	3.43 — 3.73	15	#14
FH31	3.74 — 4.07	15	#14
FH32	4.08 — 4.39	15	#14
FH33	4.40 — 4.87	15	#14
FH34	4.88 — 5.3	20	#14
FH35	5.4 — 5.9	20	#14
FH36	6.0 — 6.4	20	#14
FH37	6.5 — 7.1	25	#14
FH38	7.2 — 7.8	25	#14
FH39	7.9 — 8.5	30	#14
Above Heaters for use on Size 00			
FH40	8.6 — 9.4	30	#14
FH41	9.5 — 10.3	35	#14
FH42	10.4 — 11.3	35	#14
FH43	11.4 — 12.4	40	#14
FH44	12.5 — 13.5	45	#14
FH45	13.6 — 14.9	45	#14
FH46	15.0 — 16.3	50	#12
FH47	16.4 — 18.0	60	#12
Above Heaters for use on Size 0			
FH48	18.1 — 19.8	60	#12
FH49	19.9 — 21.7	70	#10
FH50	21.8 — 23.9	80	#10
FH51	24.0 — 26.2	80	#10
Above Heaters for use on Size 1			

\*15 ampere protective device is permitted by NEC. Fuse size shown in table limits fault current.

# A200 SIZE 00, 0, OR 1, 3 POLE MOTOR CONTROLLER

I.L. 16958A

**WARNING:** To provide continued protection against fire and shock hazard, the complete overload relay must be replaced if burnout of a current element occurs. See Table I.

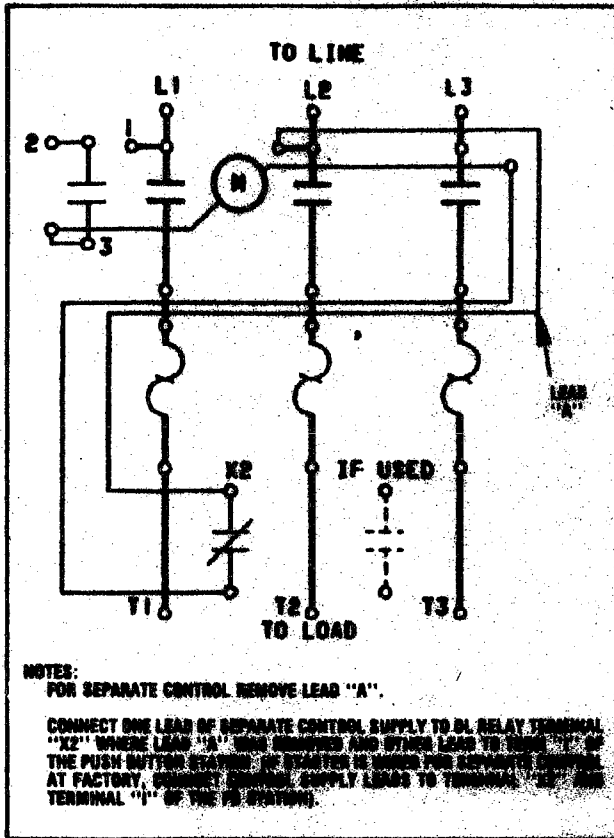


Fig. 6 Connection Diagram (Type B Overload)

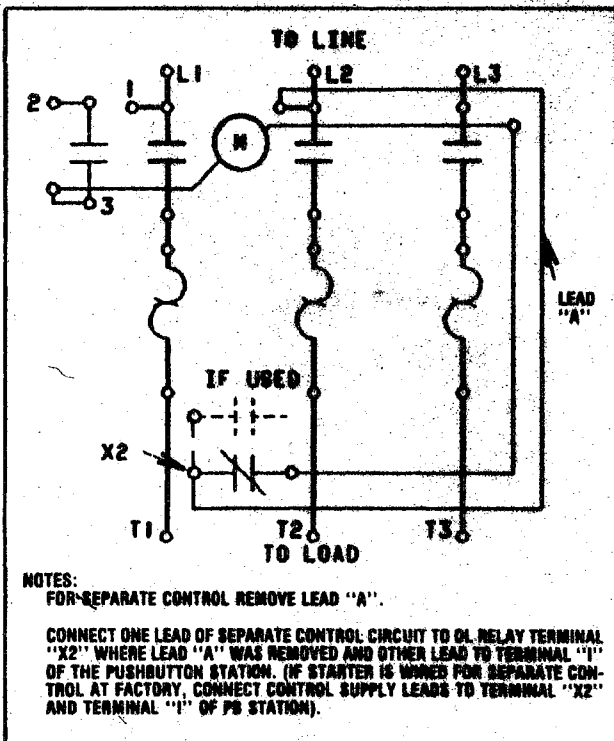


Fig. 7 Connection Diagram (Type A Overload)

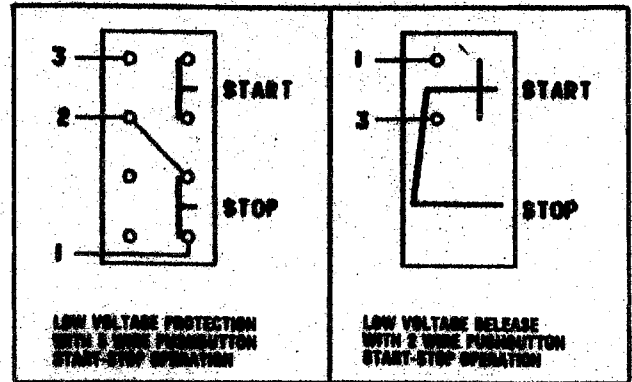


Fig. 8 Control Station Connection Diagram

POWER CIRCUIT TERMINALS	
NEEA Size 00-0-1	Wire Size #14 - 8 AWG
Wire with copper conductors only.	

TABLE III — ACCESSORIES		
Alarm Circuit Contact for Type B Overload Relay Rated B500 (1 normally open pole)		Cat. No. B3NO-2
Fuse Block Kits — Meet requirements of NEC concerning common control fusing.		
Cat. No.	Qty.	Description
F56	2	Contactor mounted Fuse Holder for 1 600 volt Bussman KTK Fuse
FKR	1	Panel mounted Fuse Holder for 2 Class GC (Bussman KTKR) Fuses*
*Use when available fault current exceeds 10,000 amperes		
Order Fuses Separately By Ampere Rating.		
Controller Size 00-0-1	Minimum Wire Size in Control Circuit #16 AWG	Suggested Fuse Size† 10 AMP
†When using a control transformer, select fuse size per the National Electrical Code.		

TABLE IV — RENEWAL PARTS	
Pole Combination and Size	Contact Kit Part Number
3 Pole Size 00	373B331G18
3 Pole Size 0	373B331G04
3 Pole Size 1	373B331G09

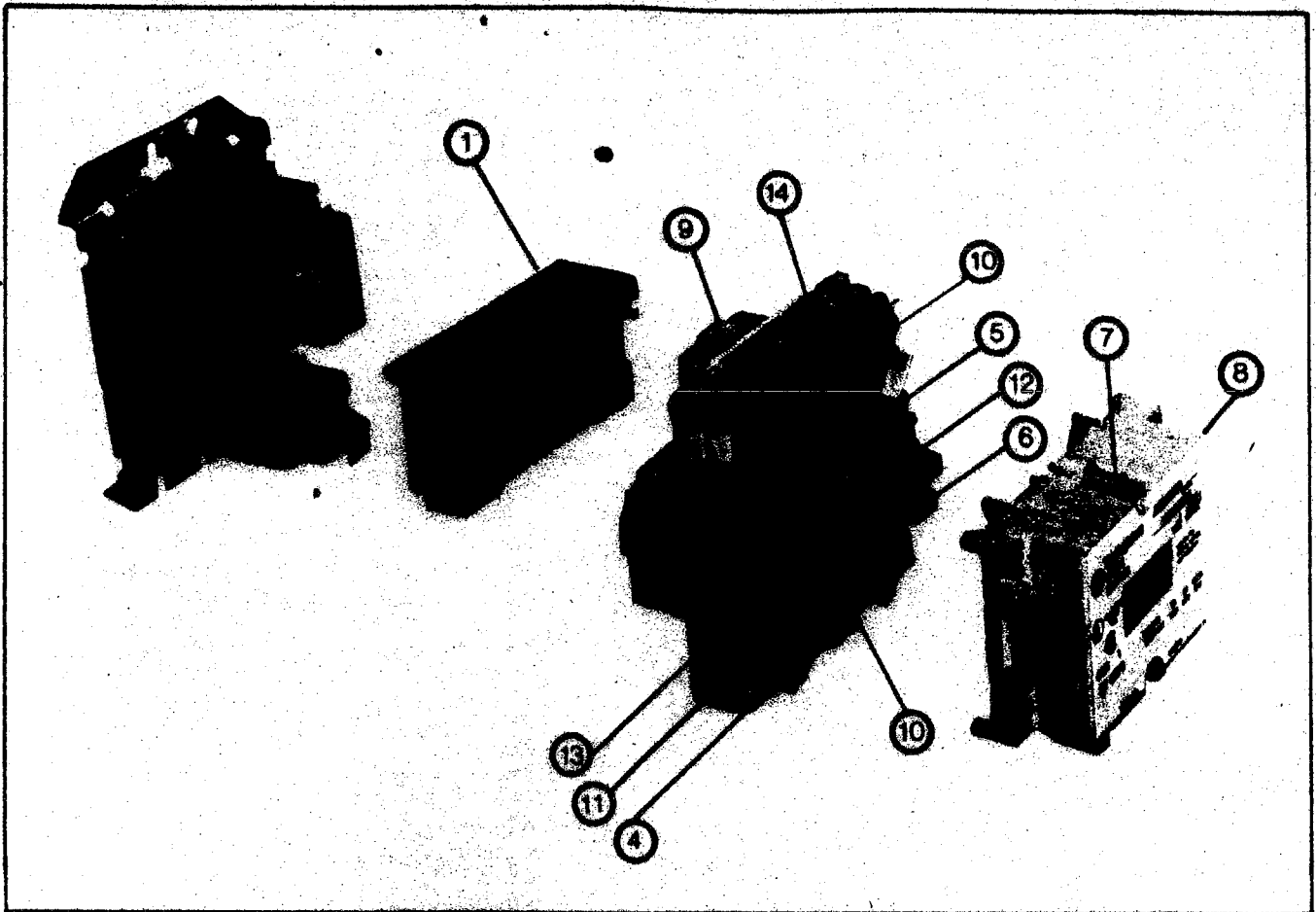


Fig. 9 Size 1 A200 Contactor (Exploded View)

**MAINTENANCE — First Turn Off Power**

**To Inspect Contacts**

Refer to Figure 9. Loosen the two arc box assembly screws (7) located immediately above and below the nameplate and remove the arc box (8). Contacts (5) are visible. Retighten the screws per Table V.

**To Replace Contacts**

After removing the arc box and with replacement contacts at hand, compress the overtravel spring (12) and remove the moving contact (5) from the crossbar (6). Disconnect any power cables. Remove the retaining screws (11) and lift out the stationary contact assembly (14).

To replace contacts, reverse the above procedure, making sure that stationary contacts are secure, (see Table V) moving contacts are free to move, overtravel springs are seated and the crossbar moves freely when the arc box is in position.

The silver cadmium oxide contact buttons need **NO** dressing or lubricant throughout their life. **Important** — Replace all contacts and springs as a group to avoid misalignment.

**To Replace The Coil**

Refer to Figure 9. Loosen the assembly screws (10) located to the immediate top and bottom of the arc box. Remove connector straps to the overload relay. Pull the loosened upper base structure (9) forward. Pull the coil (1) from the upper base structure and check the auxiliary contacts for secureness when repositioning the upper base. Tighten the assembly screws and the connector straps screws referring to Table V.

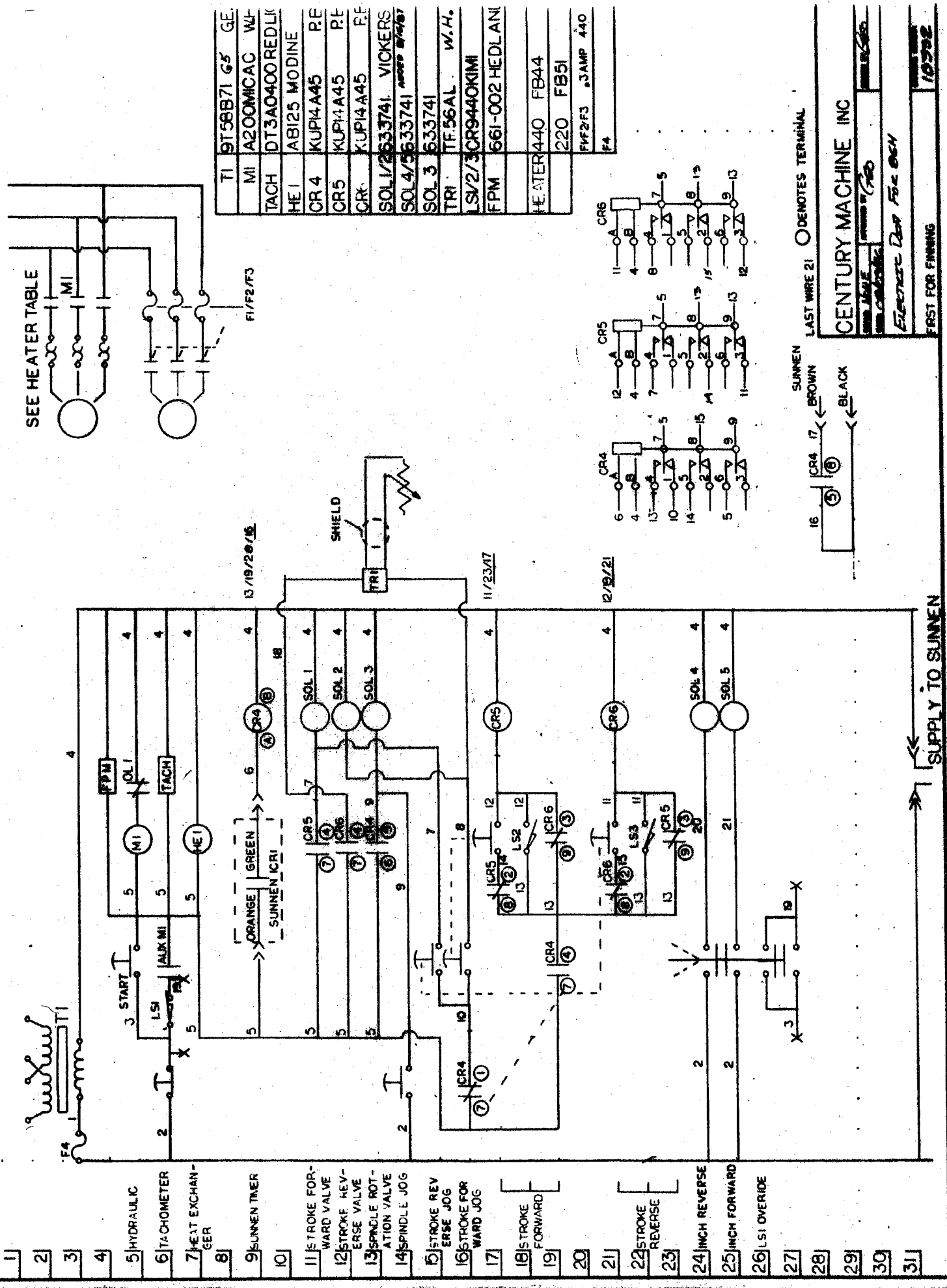
**Magnet — Armature Assembly**

Self alignment and permanent air gap features of the magnet armature make replacement unnecessary. Mating pole face surfaces should be kept clean.

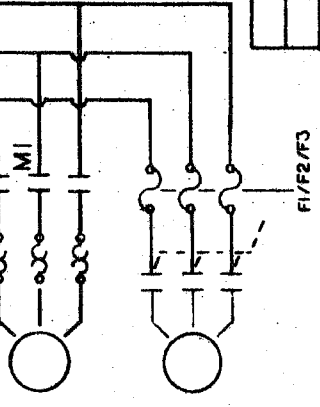
**Arc box must be in place when the contactor interrupts a circuit.**

**TABLE V — RECOMMENDED DRIVING TORQUE**

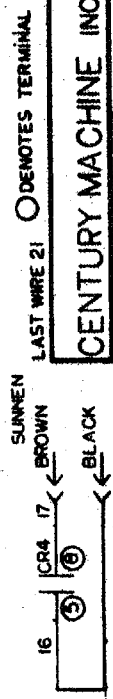
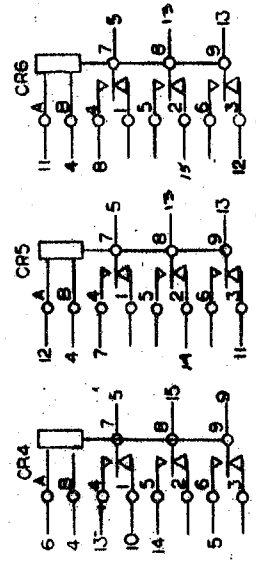
Location (Qty.)	Torque (lb.-in.)	Fig. 9 Item
Cover Screw (2)	7— 9	7
Coil Wire Connector (2)	7— 9	13
Stationary Contact Screw (6)	7— 9	11
Main Power Connector (6)	18—20	4
Overload Relay Connecting Screws (3)	16—18	—
Overload Heater Fastening Screws (6)	16—18	—



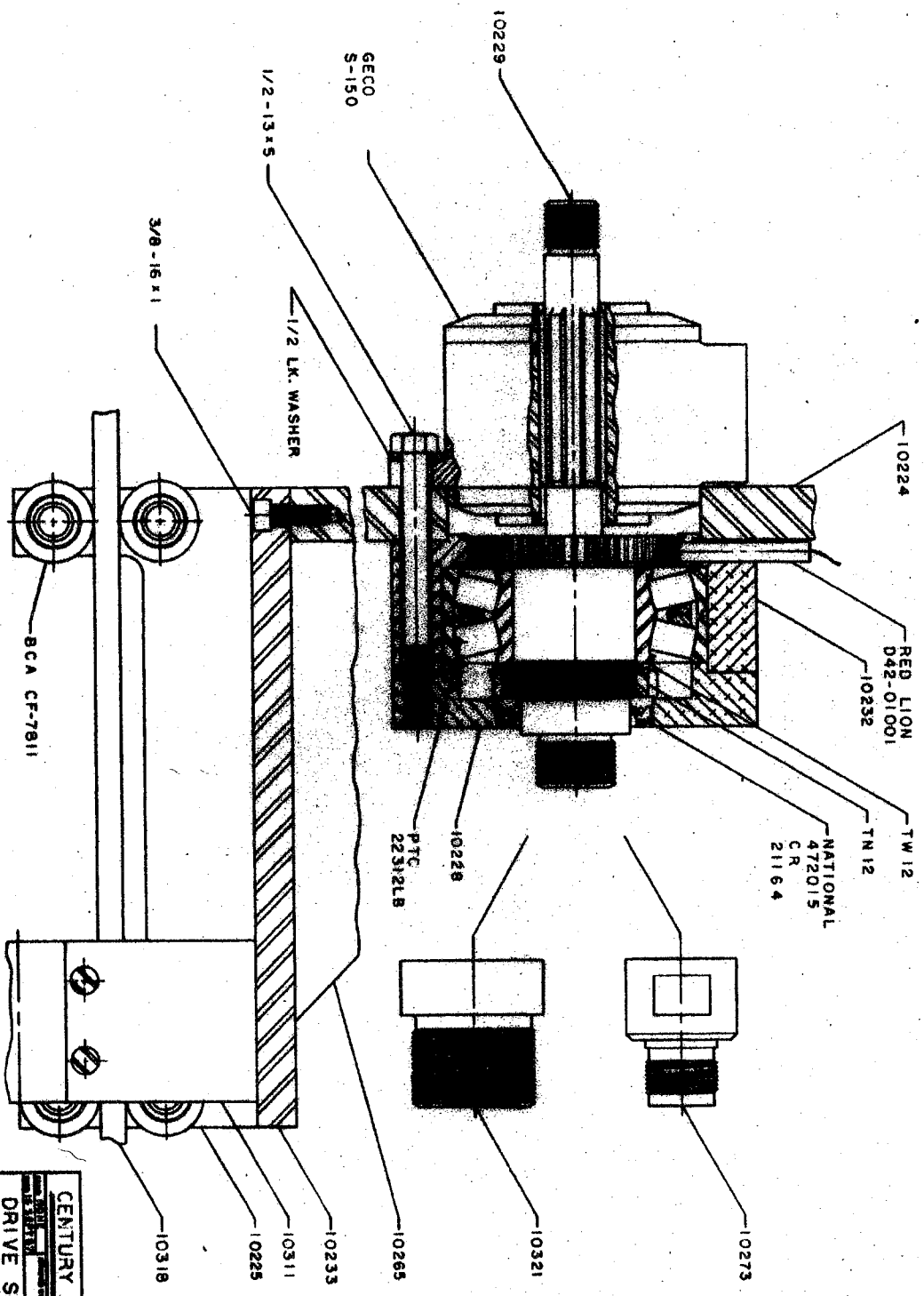
SEE HEATER TABLE



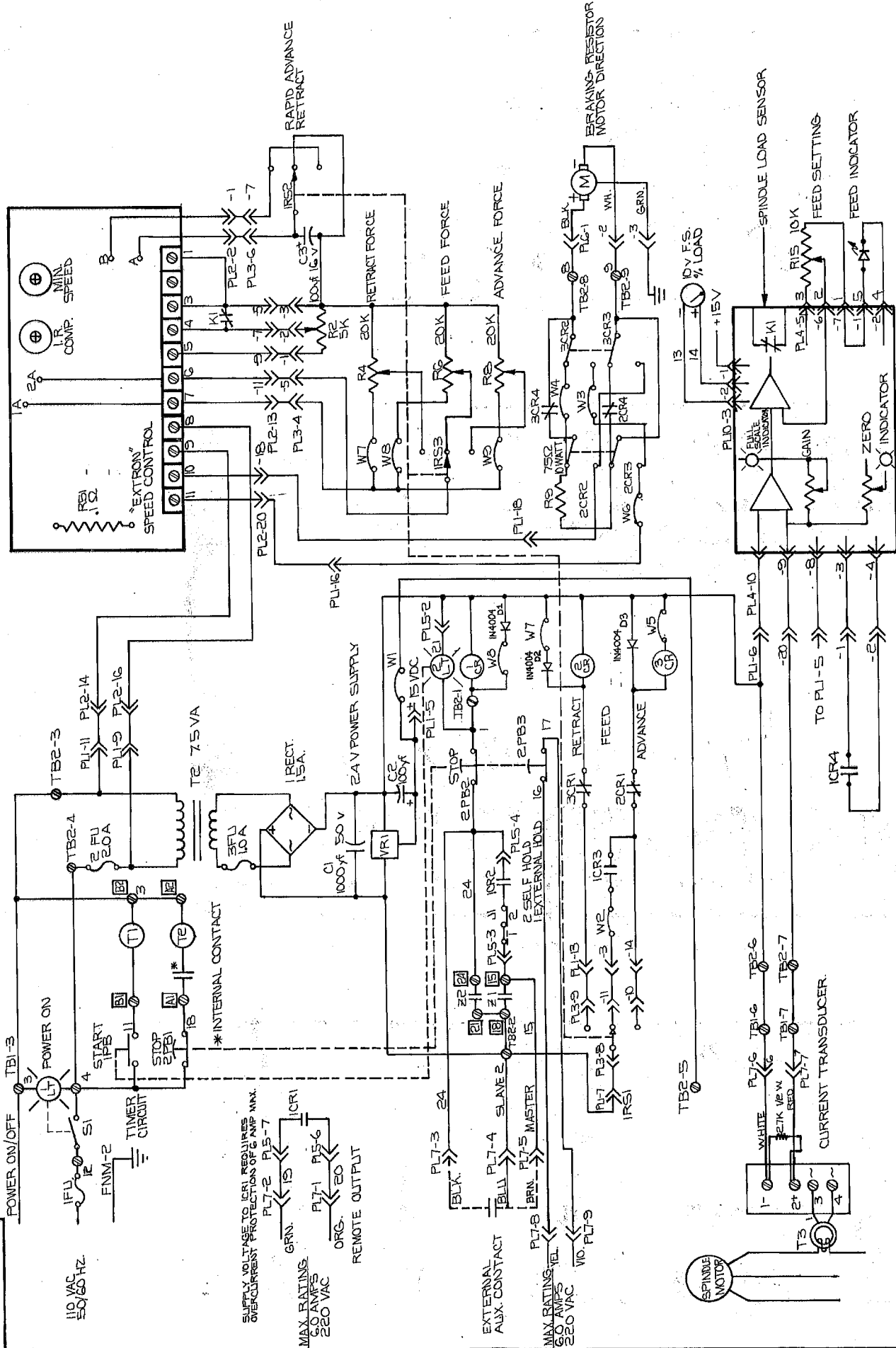
TI	9T58B71	GE.
MI	A200MICAC	WJ
TACH	DT3A0400	REDLIK
HE1	ABI25	MODINE
CR 4	KUPI4A45	RE
CR5	KUPI4A45	RE
CR6	KUPI4A45	RE
SOL1/2	633741	VICKERS
SOL4/5	633741	W.H.
SOL3	633741	
TRI	TF56AL	W.H.
LSV/2/3	CR9440KIMI	
FPM	661-002	HEDLANI
HEATER	440	FB44
	220	FB51
	FV2/F3	JAMP 440
	F4	



CENTURY MACHINE INC  
 ELECTRIC DEPT FOR EACH  
 FIRST FOR FINING  
 10292



CENTURY MACHINE INC.  
 DRIVE SPINDLE  
 MODEL 96H  
 10365



PART NAME		MPS10 CONTROL WIRING DIAGRAM	
SCALE	SCALE NONE		
DIMENSIONAL TOLERANCES	UNLESS OTHERWISE SPECIFIED		
DESIGNED BY	DATE	BY	DATE
DRAWN BY	DATE	REVISION	DATE
WFO. EPTL	15-19-68		
REVISION	DATE	BY	DATE
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