CP 3100

Warning

Forward this manual to the person responsible for Installation, Operation and Maintenance of the product described herein. Without access to this information, faulty Installation, Operation or Maintenance may result in personal injury or equipment damage.

Installation, Operation and Maintenance of the Airflex® Grinding Mill Slip Detection Control

Note: This manual is to be used for controls that use PLC model TSX-37. For controls that use PLC model TSX-17, use manual CP 3100, rev. January, 1993.

Caution:

Use Only Genuine Airflex® Replacement Parts

The Airflex Division of Eaton Corporation recommends the use of genuine Airflex replacement parts. The use of non-genuine Airflex replacement parts could result in substandard product performance, and may void your Eaton warranty. For optimum performance, contact Airflex:

In the U.S.A. and Canada: **(800) 233-5890**
Outside the U.S.A. and Canada: **(216) 281-2211**
Internet: **www.airflex.com**

January, 2007

204062

1.0 INTRODUCTION

Throughout this manual there are a number of HAZARD WARNINGS that must be read and adhered to in order to prevent possible personal injury and/or damage to the equipment. Three signal words "**DANGER**", "**WARNING**", and "**CAUTION**" are used to indicate the severity of the hazard, and are preceded by the safety alert symbol ⚠.

⚠ DANGER

Denotes the most serious injury hazard, and is used when serious injury or death WILL result from misuse or failure to follow specific instructions.

⚠ WARNING

Used when serious injury or death MAY result from misuse or failure to follow specific instructions.

⚠ CAUTION

Used when injury or product/equipment damage may result from misuse or failure to follow specific instructions.

It is the responsibility and the duty of all personnel involved in the installation, operation and maintenance of the equipment on which this device is used to fully understand the ⚠DANGER, ⚠WARNING, and ⚠CAUTION procedures by which hazards are to be avoided.

1.1 Description

Eaton's clutch slip detection control provides protection for grinding mill drive systems and has been developed to prevent costly damage to the motor, clutch, or other grinding mill drivetrain components. This system continuously monitors clutch performance during start-up and running operations.

This control will detect excessively fast starts, long starts, and clutch slippage during operation.

1.2 Application

Eaton's clutch slip detection control has been specifically designed to be used with Airflex VC grinding mill clutches. However, this control can be effectively applied to other clutch applications. Contact your Eaton sales representative for further information.

2.0 GENERAL OPERATION

2.1 Start Up Monitoring

2.1.1 During a mill start, the control monitors the time required to engage the clutch and bring the mill to full RPM (clutch lock-up). If the clutch locks up too quickly, a white warning light on the control enclosure will illuminate alerting the operator that an air flow adjustment is required to achieve optimum acceleration time. This condition, if not corrected, can eventually lead to drive train component damage.

2.1.2 If the clutch does not lock-up (full mill RPM not achieved) within a predetermined time frame, the control will abort the start (disengage the clutch). A red warning light will also illuminate to indicate the clutch was automatically disengaged because of excessive slippage.

2.1.3 Another start cannot be attempted until the control is physically reset at the mill. This prevents successive start attempts from a remote control room.

2.2 Monitors During Running Operation

2.2.1 While running, the RPM of the input and output shaft are continually compared. If for some reason the clutch begins to slip, the control will sense the difference in RPM and disengage the clutch, again illuminating a warning light and requiring the control to be physically reset.

2.2.2 An optional JOG and BYPASS feature is available with this control. In the JOG mode, the control protects the clutch as in the RUN mode, while the BYPASS feature does not protect the clutch.

2.3 System Description and Theory of Operation

2.3.1 Slip is detected by the use of two proximity sensors. These sensors generate pulses as targets pass them. Typically there is one target on the drive side (spider), and one on the driven side (drum hub). Applications operating at 400 RPM or greater require four targets on both the drive and driven side. By counting pulses within a predetermined time frame, the

control decides when an abnormal condition is occurring. A long start condition is detected if the output shaft pulse count does not match the input shaft pulse count within the required time. A short start condition is detected if the output shaft pulse count matches the input shaft pulse count before the short start time period has elapsed. During normal running operations, the two pulse outputs should match in total count within a preset count differential. If a condition occurs where this count differential is exceeded (slip condition), the control will deenergize the solenoid valve, thereby disengaging the clutch.

2.3.2 The number of starts is also monitored by the control. To prevent excessive heat generation and damage to the clutch, the control will allow a maximum of three starts within a ten minute period. Attempting more than three starts within this window will force the control into a cool-down mode, preventing further start attempts until the 30 minute cool-down period has expired.

2.3.3 Warning lights alert the operator to any of the fault conditions and are explained in detail in Section 5.0 - FAULT DESCRIPTION AND RESET PROCEDURES.

3.0 INSTALLATION

3.1 Factory Setup

3.1.1 The following specifications are factory set and cannot be modified by the customer. Any modification must be accomplished by an authorized Eaton representative.

1) Optional control requirements - **JOG** and BYPASS feature.

2) The delay time that will occur between the pressing of the start and/or jog buttons and the actual clutch engagement.

   Note: The jog delay time and the run delay time do not have to be the same.

3) The short start time.

4) The long start time.

5) The amount of slip that is allowable before the clutch will disengage.

6) The cool down time.

7) Restart delay time after the output side has stopped.

The above information will be preprogrammed in the PLC at Eaton Airflex before shipment.

Warning:

When servicing the equipment operated by this control, the service disconnect must always be locked out and tagged out per OSHA requirements (29 CFR Part 1910). Always use a lock on the service disconnect for this control as well as the motor controller.

3.2 Control Panel

3.2.1 The control should be installed by a qualified electrician and wired in compliance with the National Electrical Code.

3.2.2 Ensure the cabinet is properly grounded.

3.2.3 Proper wiring techniques are essential to assure the inherent safety features of the Airflex control system. Use only accepted methods of installing conduit and 14 gauge stranded machine tool wire (U.L. Listed, 105°C temperature rating, oil resistant) for wiring components to the control panel.

3.2.4 Wire in accordance with the control schematic found in the control enclosure.

3.3 Sensor Target Installation

3.3.1 Accurate and reliable operation of the Slip Detection feature of the control is dependent upon installation and proper set-up of the proximity sensor targets. Targets and fasteners are included as a part of the control package.

Warning:

The use of items other than factory supplied targets as sensor targets may result in faulty operation of the control.

3.3.2 For applications under 400 RPM, one target is required on the both the input and output shafts. Applications operating at speeds greater than 400 RPM require four targets be mounted on both the input and output shafts.

Note: Some synchronous motor applications may use only one proximity sensor (on the output shaft only) in which case the target should be mounted to the output hub only. Refer to the clutch application drawing for proper target location and quantity. Contact your local Airflex Representative for copies of appropriate drawings.

3.3.3 Targets should be mounted at a diameter equal to or less than that of the clutch spider or drum hub area. When multiple targets are required, they should be installed equally spaced (i.e. with four targets, they should be located at 90 degree intervals, +/- one degree). Clutch applications purchased as a package with the control will be pre-drilled to accept the target fasteners.

3.3.4 Orientation of the target is dependent upon ease of drilling and tapping of the hubs to accept the fasteners. Recommended position is similar to that shown in Figure 1, to allow for ease of clutch maintenance without disturbing the position of the proximity sensors. Target orientation shown in Figure 2 allows for radial fastener installation in the event that axial clearance is limited. Ensure that the target location will not interfere with guarding or adjoining bearing housings., etc. that may damage the target during operation.

3.4 Sensors

See Figure 3 for System Diagram

3.4.1 To ensure that the sensors deliver a pulse to the control of sufficient magnitude, the sensor cable lengths should not exceed 33 feet. For longer distances, consult the factory.

3.4.2 It is required that the sensor wires be run inside a dedicated conduit to prevent any EMI or RFI noise interference. Install conduit as close to the sensor as possible with a minimal amount of exposed cable.

3.4.3 To eliminate exposed cable completely, use a box to house the sensor and a piece of liquid tight flexible metal conduit for the last few feet of cable.

3.4.4 Proximity sensors should be mounted to a rigid bracket or fixture to restrict movement during operation.

3.4.5 Sensors must be located with a maximum gap of 5/16 of an inch (0.312") from the sensor targets. See Figures 1 and 2.

3.4.6 Multiple target applications (for speeds greater than 400 RPM) require that all targets be located within the same plane or bolt circle to

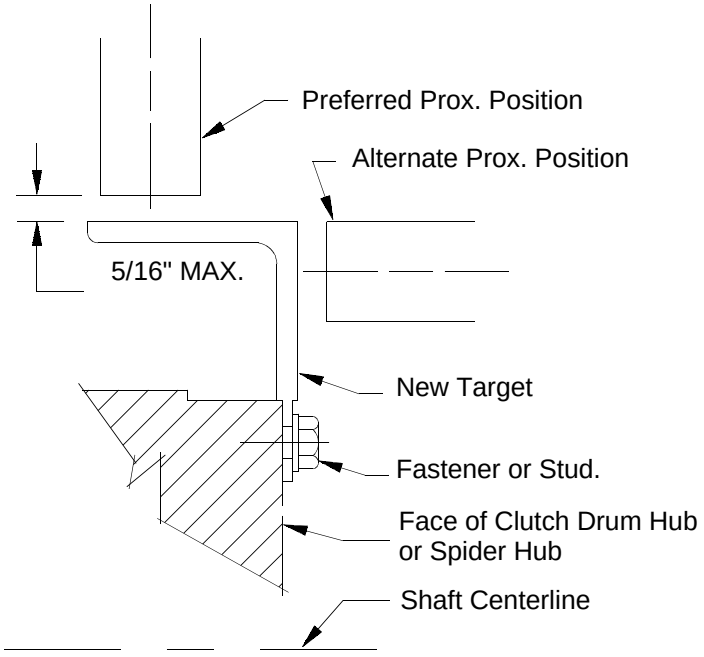

Figure 1

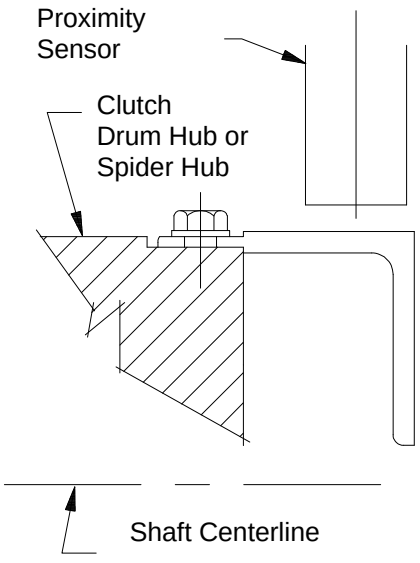

Figure 2

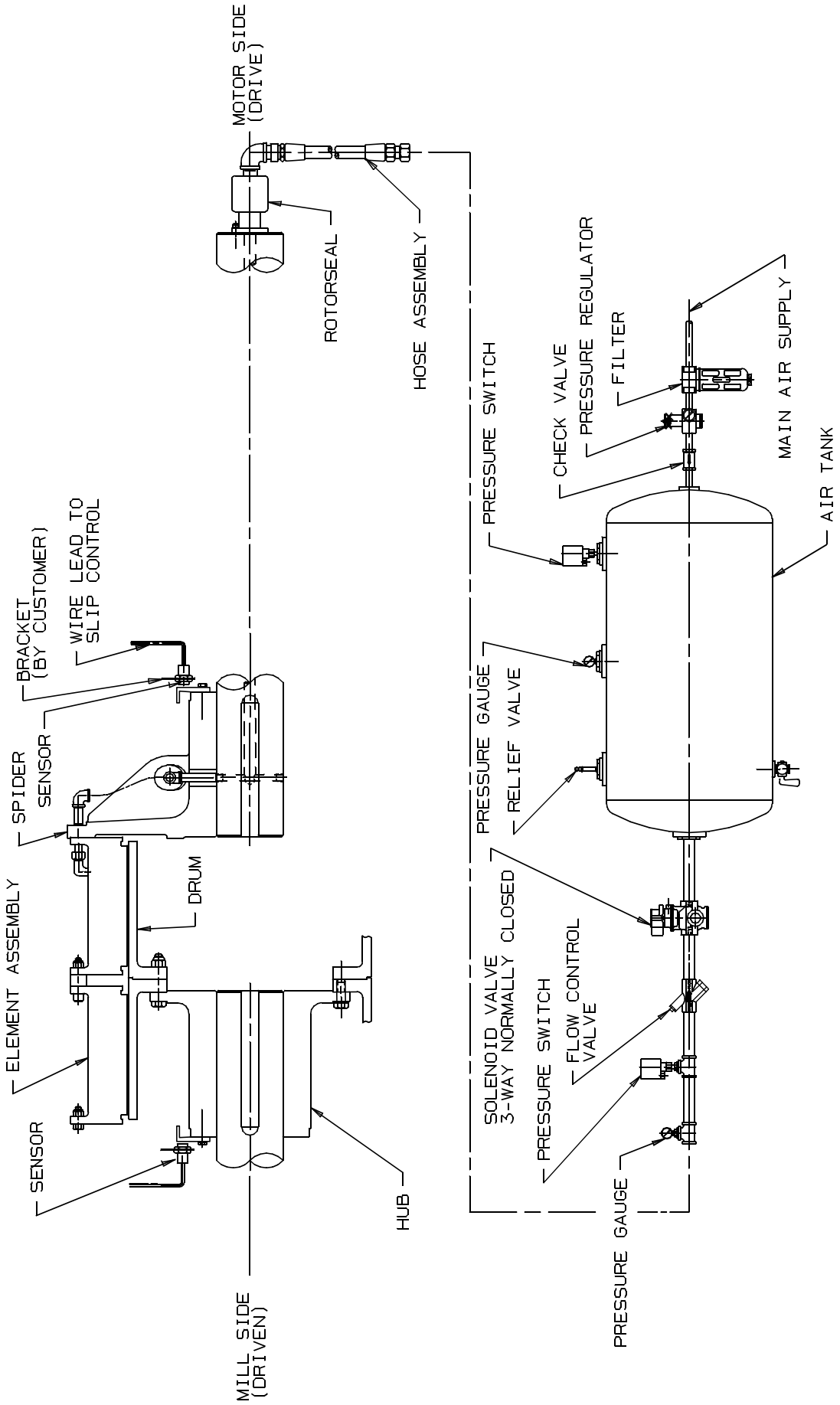

Figure 3

ensure that the gap range between the sensor and target is maintained. Adjust the position of the target if necessary.

Note: Avoid locating the the sensor too close to the target to eliminate any possibility of the target striking and damaging the sensor.

3.4.7 After installation of the targets and sensors, check the operation of the sensors by slowly rotating the motor shaft and driven shaft. With power restored to the control panel, verify that the LED's on the proximity sensors illuminate as each target passes the sensor.

4.0 SPECIFIC OPERATION

This section is intended to provide the operator with the necessary information to operate the mill and recognize any fault conditions. Section 5.0 - FAULT DESCRIPTION AND RESET PROCEDURES will give a detailed explanation of faults and the required steps to reset them.

Refer to Figure 4 for pilot light and pushbutton locations.

Note: Locations of pushbuttons may vary, depending on the features ordered. Refer to the drawing located inside the panel for specific informaton. Contact an Airflex representative if addtional copies of the drawing are required.

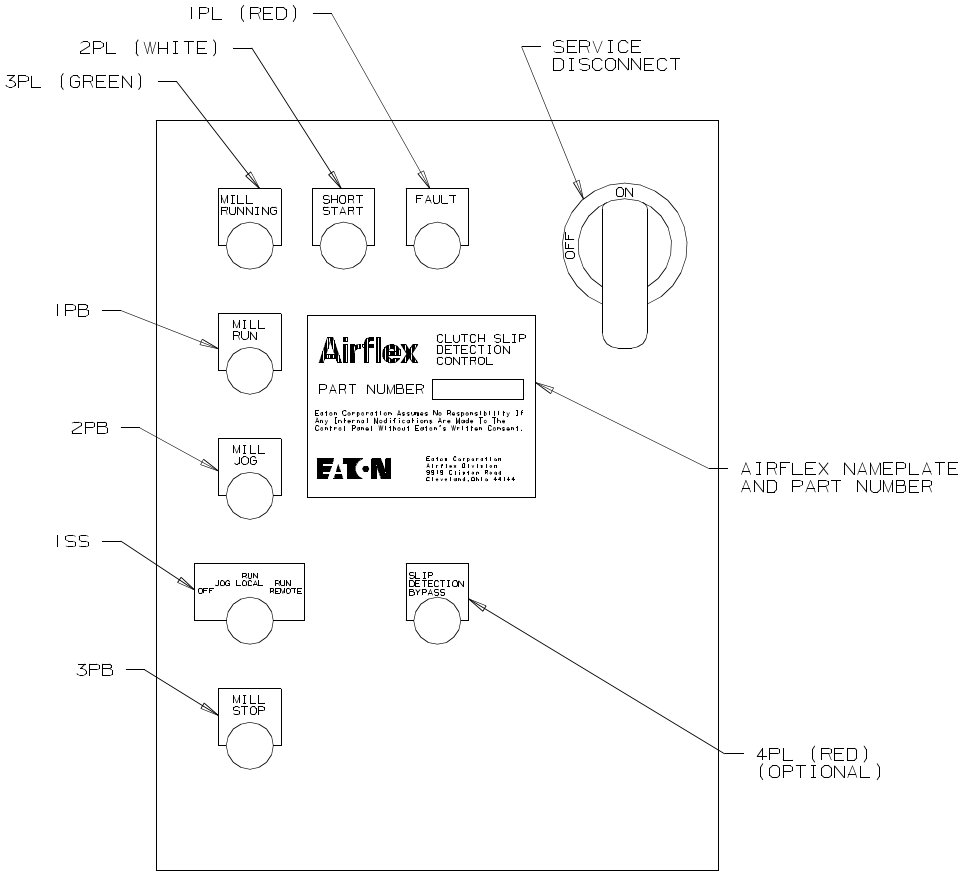

Figure 4

4.1 Selector Switches

4.1.1 **OFF**

When the selector switch is in the OFF position, the mill control panel is off, and any action made on the control panel will not engage the clutch.

Warning:

Do not rely on this switch for shut down while servicing. Always use the service disconnect switch when working on equipment.

4.1.2 **JOG**

When the selector switch is in the JOG position, the MILL JOG pushbutton will engage the clutch when the prestart jog delay period is over. The MILL JOG pushbutton must be held in until the jogging operation is over. The green run light will flash until the prestart jog delay period is over. After the delay period, the clutch will engage and the green run light will go solid. Releasing the JOG button will disengage the clutch and the green run light will go out.

4.1.3 **RUN LOCAL**

When the selector switch is in the RUN LOCAL position, the MILL RUN pushbutton on the control panel will activate the clutch after the start delay period.

4.1.3.1 The mill run circuit has a holding circuit, so the MILL RUN pushbutton does not have to be held in during the start delay period. The green run light will flash until the start delay period is over. The clutch will then engage and the light will go solid. The clutch will continue to run until the MILL STOP pushbutton is depressed or a fault condition occurs.

4.1.4 **RUN REMOTE**

When the selector switch is in the RUN REMOTE position, the MILL RUN pushbutton on the remote panel will activate the clutch after the start delay period. The MILL RUN pushbutton on the control panel will not start the clutch. The mill run circuit has a holding circuit, so the MILL RUN pushbutton does not have to be held in during the start delay period. The green run light will flash until the start delay period is over. The clutch will then engage and the light will go solid. The clutch will continue to run until the MILL STOP pushbutton is depressed or a fault condition occurs.

4.1.5 **MILL RUN**

The MILL RUN pushbutton will activate the holding circuit then engage the clutch after the start delay.

4.1.6 **MILL STOP**

The MILL STOP pushbutton will disengage the clutch and its holding circuit.

4.1.7 **Slip Detection BYPASS / NORMAL**

A keyed selector switch on the face of the control panel provides the means to bypass the slip monitoring function of the control under special circumstances.

4.1.7.1 When the switch is in the bypass position, the control will disregard any slippage or fault condition.

Warning:

Operation of the contol in bypass mode prevents slip detection and other system monitoring during start-up and operation of the clutch.

4.2 General Operation

4.2.1 The green RUN/STOP LED on the face of the PLC must be on solid for the mill to run. If the green LED is not on or it is blinking, consult Section 6.0 - TROUBLESHOOTING for details.

4.2.2 To engage the clutch:

1) Place the OFF-JOG-RUN LOCAL-RUN REMOTE selector switch in the desired operating mode.

2) If jog operation is desired, place the selector switch in JOG, and depress and hold the MILL JOG pushbutton. To release the clutch, release the MILL JOG pushbutton.

3) If starting the mill from the local panel is desired, place the selector switch in the RUN LOCAL position and depress the MILL RUN pushbutton on the control panel.

4) If starting the mill from a remote operating station, place the selector switch in the RUN REMOTE position and depress the MILL RUN pushbutton on the remote station.

5) To stop the mill, depress the MILL STOP pushbutton from either remote or local control panels.

4.2.3 When the MILL RUN or MILL JOG pushbutton is pressed, the mill run indicating light will flash until the prestart delay is over. When the prestart delay is over, the clutch will start to engage and the indicating light will stay on solid.

5.0 FAULT DESCRIPTION AND RESET PROCEDURES

5.1 Indicating Lights

5.1.1 All indicating lights are of the "Press to Test" type. Pressing any one will yield an on state unless there is no main power or the lamp is burned out.

5.2 MILL RUNNING Light (Green)

5.2.1 If the MILL RUNNING light is:

OUT - Either the lamp has failed or the clutch is not engaged.

FLASHING - The clutch is about to engage in either the jog, local run, or remote run modes.

ON - The clutch is engaged and operating normally.

5.3 SHORT START Light (White)

5.3.1 If the SHORT START light is:

OUT - Either the lamp has failed or no short starts has occurred.

FLASHING - The clutch has engaged too quickly. The light will time out after 3 minutes.

5.4 FAULT Light (Red)

5.4.1 If the FAULT light is:

OUT - Either the lamp has failed or no fault has occurred.

FLASHING - The PLC battery is low or dead. Replace the battery as soon as possible.

ON - A fault condition has occurred. One of the following conditions is present:

1) If the fault light has come on right after the start delay time was over, then three starts were attempted within a ten minute time period. This fault cannot be cleared until a ten minute cool down period has elapsed. After ten minutes have elapsed, use the normal fault reset procedure. (See Section 5.5 - Resetting a Fault)

2) A long start has occurred. This will occur within ten seconds after the clutch starts to engage. The clutch output side shaft did not come up to speed in a preset time period.

3) A slip condition has occurred on the mill. This can occur any time after the clutch has engaged. The clutch was disengaged from the input shaft due to too much slippage.

5.5 Resetting a Fault

5.5.1 To reset a fault, the following procedure should be used at the local panel:

1) Turn the OFF-JOG-RUN LOCAL-RUN REMOTE selector switch to the OFF position.

2) Depress and hold the red local MILL STOP pushbutton.

3) Depress and hold the black local MILL START pushbutton. At this time the red fault light will go out.

4) Release both pushbuttons.

5.5.1.1 If the light stays out, the fault is cleared and the mill is ready to restart as long as the reason is known. If the light stays on, then the fault was due to attemptiong to enage the clutch more than three times within a ten minute period and you must wait for the cool-down period to expire. After that time, use the fault reset procedure again.

5.6 Display Window

5.6.1 An information display is located on the front of the panel to provide various operating and historical information.

5.6.2 Upon power-up, the display defaults to the clutch output RPM (typically the pinion speed). Additional information that can be viewed is listed on Table 1.

5.6.3 To scroll through the pages of the display, the scroll-up or scroll-down *arrows* must be flashing in the appropriate direction. To scroll to the next page, press either the *SCROLL-UP* or *SCROLL-DN* key to set the arrow in the display to the flashing mode. Once the arrow is in the flashing mode, press the scroll next or scroll previous key to step though the 'pages'. See Figure 5.

TABLE 1	
Digital Display Readouts	
Page 1	Clutch Engaged RPM
Page 2	Start Time (Time to full engagement of last start)
Page 3	Number of Starts
Page 4	Number of Short Starts
Page 5	Number of Long Starts
Page 6	Number of Jog Starts
Page 7	Number of starts within 10 minute time frame

5.7 Resetting the Information in the PLC

5.7.1 The following procedure will reset the information stored in the PLC to zero values.

1**)** The mill should be stopped and at rest prior to resetting the PLC.

2**)** Scroll the display unit to 'page 5', using the procedures in section 5.6.3.

3**)** Press the SCROLL-DN key on the information display. This will cause the scroll-dn arrow on the display to begin to flash.

4**)** Press and hold the MILL STOP pushbutton on the face of the panel while simultaneously pressing the SCROLL NEXT key on the display.

5) Release all keys or pushbuttons. All information shown in the display - as listed in Table 1 - is now reset to zero.

6.0 TROUBLESHOOTING

6.1 Clutch

6.1.1 The clutch will not engage at all.

a) The motor is not running.

b) There is no power to the PLC.

c) The PLC is not running.

d) There is a fault.

e) The DC power supply has failed.

f) The selector switch is in the off position.

g) The valve has failed.

h) There is no air pressure.

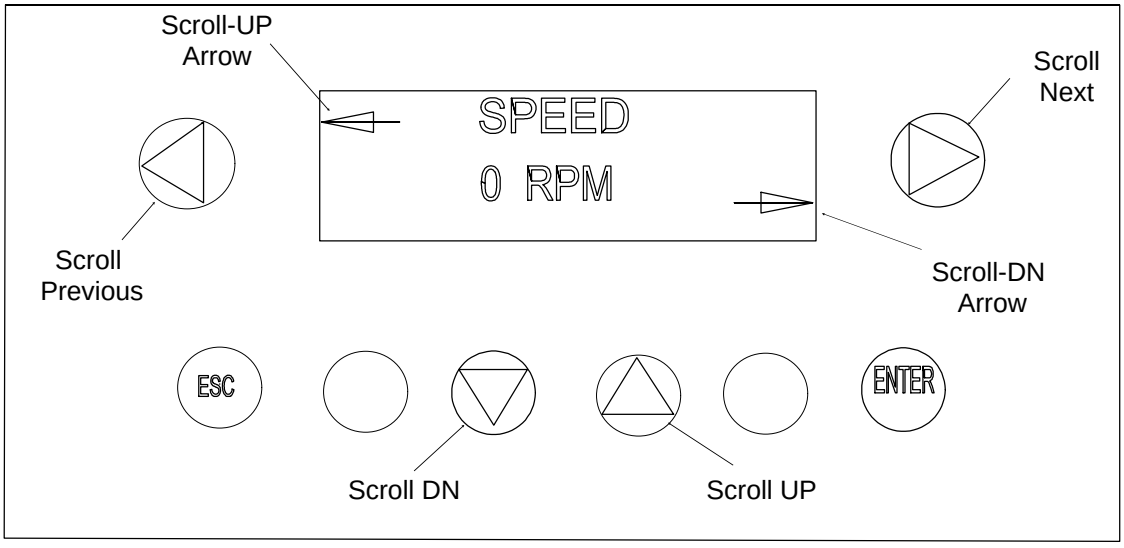

Figure 5

6.1.2 The clutch will engage for a short time but then aborts with a fault light.

a) There are no inputs from the sensors.

b) There is no DC power from the supply.

c) There was a long start situation.

d) There was no signal from the output sensor.

6.1.3 The clutch will engage for some time, then drops out with no fault light.

a The stop button was depressed.

6.1.4 The clutch will engage for some time, then drops out with a fault light

a) There was a long start.

b) There was a slipping condition on the clutch.

6.1.5 The clutch will engage for an extended period of time, then drops out with a fault light.

a) There was a slipping condition on the clutch.

6.2 Control Panel

6.2.1 The indicating lights do not function at all.

a) The PLC is not running.

b) There is no main power.

c) The bulbs have failed.

6.2.2 The indicating lights are on

a) Check Section 4.0 - SPECIFIC OPERATION and Section 5.0 - FAULT DESCRIPTION AND RESET PROCEDURES to see what the current situation is.

6.2.3 The OFF-JOG-RUN LOCAL-RUN REMOTE selector switch is not functioning.

a) The selector switch has failed.

b) No DC power feeding switch.

c) DC power supply has failed.

d) Observe PLC input light status while turning selector switch through all positions.

6.2.4 The display on the front of the panel does not come on.

a) The communication cable is disconnected or needs to be replaced.

6.2.5 The pushbuttons are not functioning.

a) DC power supply has failed.

b) Pushbutton contact block is faulty.

c) With selector switch in OFF position, depress pushbuttons and observe PLC input light status.

6.3 PLC

6.3.1 The RUN/STOP light is off.

a) There is no AC power to the PLC.

6.3.2 The RUN/STOP light is flashing.

a) The CPU has been put in the stop mode due to a very high or a very low incoming voltage condition.

b) The unit was shipped from the factory in the stop mode. The PLC must be restarted with a hand held programmer. Contact an Eaton Airflex representative.

6.3.3 The RUN/STOP light is on.

a) The PLC is running in a normal condition.

6.3.4 The TER light is flashing.

a) The CPU and program are running normally.

6.3.5 The I/O light is on.

a) The I/O module does not have 24VDC or needs to be replaced.

6.3.6 The ERR light is on.

a) The CPU has failed due to PLC hardware failure. Turn the main power off then back on. Check light status again. If light reappears, then the PLC is probably faulty and needs to be replaced. Contact an Eaton Airflex Representative.

6.3.7 The I/O MEM light off.

a) The I/O and the memory are O.K.

6.3.8 The BATTery light is off.

a) The battery is O.K.

6.3.9 The battery light is on.

a) The battery is failing or is not installed. Replace the battery as soon as possible.

6.3.10 The PLC display is not on at all.

a) The DC power supply on the PLC has failed or the wires have come loose. Check for DC voltage at the 0V and +24V terminals on the PLC. If there is no power, replace the PLC.

6.4 I/O

6.4.1 To check all the inputs (pushbuttons and hardware) to make sure the PLC is receiving the signal, refer to Table 2 to assist in locating the specific PLC LED's.

6.4.2 To check all the outputs to make sure the PLC is sending the proper signals, refer to Table 3 to assist in locating the specific PLC LED's.

Caution:

Test the MILL RUN and MILL JOG pushbuttons with the selector switch in the OFF position. Failure to do so may cause the mill to start.

7.0 ORDERING INFORMATION / TECHNICAL ASSISTANCE

In any correspondence regarding Airflex Equipment, refer to the information on the product nameplate and call or write:

Eaton Corporation
Airflex Division
9919 Clinton Road
Cleveland, Ohio 44144
Tel.: (216) 281-2211
Fax: (216)281-3890
Internet: **www.airflex.com**

TABLE 2
Input Devices

Input Device Activated	I/O LED	Condition
Proximity Switch #1	Input LED # 0	On
Proximity Switch #2	Input LED # 1	On
OFF-JOG-RUN LOCAL-RUN REMOTE Selector Switch		
OFF	Input LED # 2, 3 & 7	Off
JOG	Input LED # 2	On
RUN LOCAL	Input LED # 3	On
RUN REMOTE	Input LED # 7	On
Pushbuttons		
MILL RUN (Local)	Input LED # 5	On
MILL RUN (Remote)	Input LED # 9	On
MILL JOG	Input LED # 4	On
MILL STOP	Input LED # 12	Off

TABLE 3
Output Devices

Output Device Activated	Output LED #	Condition
Clutch Solenoid Valve	Output LED # 0	On
Red Fault Light	Output LED # 1	On
White Short Start Light	Output LED # 2	On
Green Mill Running Light	Output LED # 3	On
Optional Horn	Output LED # 4	On

Airflex®

Form ML-318
Revised September 3, 1997

EATON PRODUCT WARRANTY

Subject to the conditions stated herein, Eaton Corporation warrants to the Purchaser that each new Airflex Product manufactured by Eaton will be free from failures caused by defects in material and workmanship, and will deliver its rated capacity, for a period of twelve (12) months from the date of shipment to Purchaser, provided such Product is properly installed, properly maintained, operated under normal conditions and with competent supervision. Warranty claims shall be made in writing and the part or parts shall, if requested by Airflex Division, be returned prepaid to the Airflex Division for inspection. Upon a determination that a defect exists, Eaton shall thereupon correct any defect, at its option either by repairing any defective part or parts or by making available at Eaton's plant a repaired or replacement part. This warranty does not extend to normal wear parts or components of the Product, such as friction material and friction surfaces.

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