MANUAL

ELECTRIC FIRE PUMP CONTROLLER

METRON SERIES M430 and M435

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PART I: GENERAL DESCRIPTION

The basic function of the Fire Pump Controller is to start the pump motor to maintain the water system pressure. This may be accomplished by automatically starting the pump motor upon drop in pressure in the water main or from a number of other demand signals. They can be started by remote manual means, but cannot be stopped remotely. The controllers can be set to stop automatically or require manual stop after an automatic start.

PART II: FUNCTIONS

A. Automatic Starting From:

1. Drop in line pressure.
2. Deluge valve operation, Option D.
3. Loss of remote alarm power, Option P.

B. Alarm and Signals:

1. **Remote indication of pump operation**. One set of normally open (N.O.) and normally closed (N.C.) contacts located in the controller operate when pump is running.
2. **Loss of power to the controller**. One (1) Single Pole Double Throw (SPDT) contact located in the controller operates for loss of power, loss of one phase, or low voltage.
3. **Phase reversal of power to controller**. One (1) SPDT contact located in the controller operates for phase reversal of the power to the controller.
4. **Motor Current exceeds 125% of Normal**. One (1) SPDT contact located in the controller operates when the motor current exceeds 125% of normal.
5. **Power On pilot light on controller**. This light is on whenever both the isolation switch and circuit breaker of the controller are closed indicating that power is available and the controller is set for operation.
6. **Phase reversal pilot light**. This pilot light is on whenever there is a phase reversal of the power to the controller.
7. **Engine Lockout (Option E)**. When an engine drive system is used as a backup a normally open auxiliary contact on the motor contactor is provided to prevent the engine from starting if the electric motor is running.
8. **Electric Motor Lockout (Option M)**. The electric motor lockout is generally used in conjunction with engine lockout above. If the engine is running due to a power outage, or other reasons, the electric motor can be locked out until the engine is stopped.

C. Sequential Starting (Option S): This optional feature is provided for multiple fire pump installations. This provision times the start of the pump motors by a preset time interval so that all motors do not come on at once.

D. Principal Components of Controller:

1. Isolation Switch
2. Circuit Breaker
3. Overcurrent Monitor
4. Contactor
5. Pressure Switch

The incoming line is connected directly to the isolation switch. From there, the power is fed to the circuit breaker and then to the contactor. Both the isolation switch and circuit breaker are normally closed. The contactor is operated either manually or automatically to start the motor.

PART III: INSTALLATION

The Fire Pump Controller has been assembled and wired at the factory with the highest workmanship standards. All wiring and functions have been thoroughly tested to assure correct operation when properly installed. Before operating the controller, perform the Initial Installation Start-Up Procedure, Part IV.

The cubicle should be well grounded according to local standards. Make sure that all applicable external control wires are connected to appropriate terminals as shown in the External Hookup drawings. If the controller is supplied with Option "D" Deluge Valve Start, and it is not being used the terminals for this must be jumpered (see the External Hookup drawings). Failure to make the proper connections will cause the controller to malfunction. Connection from the contactor to the motor may be done after the test procedure is completed. The contact ratings of the remote alarm contacts of the controller are shown in the Schematic drawing.

After installation has been completed, perform the Initial Installation Start-Up Procedure, Part IV before operating the controller.

PART IV: INITIAL INSTALLATION START-UP PROCEDURE

A. **General:** All but the final test can be made with; the motor disconnected. This will eliminate the need for starting and stopping the motor several times during the test procedure. If the output connections from the contactors to the motor were made on initial installation, disconnect them for the first part of the Initial Installation Start-Up Procedure. Refer to External Hookup drawings for nomenclature of all controls. Refer to schematic for location of contacts for remote alarms.

The controls and their functions are as follows:

1. **Isolation Switch**: This switch is connected in the circuit between the line and the circuit breaker. Its function is to disconnect the main power to the controller.

2. **Circuit Breaker** :The circuit breaker is located between the motor contactor and isolation switch. Its function is to protect the line from damage due to a short in the load.

3. **Overcurrent Monitor**: The overcurrent monitor (1OCM) senses the motor current through a set of current transformers (CTs) in the controller. When the motor current exceeds 125% of normal a yellow LED illuminates on the monitor and a set of dry contacts change state. When the motor current exceeds 300% the monitor begins timing based on how much the current exceeds 300% of normal and a red LED begins flashing. The greater the current the shorter the time period such that at 600% of normal the monitor activates in approximately 14 seconds. When the monitor activates (at the end of timing), a set of normally open contacts close which energize the shunt trip in the circuit breaker causing it to trip. This method of motor overcurrent protection is mandated in NFPA 20 Chapter 7.

4. **Emergency Start Handle**: This control is used to start the fire pump in case of any malfunction within the control circuits.

5. **Start Button**: The pushbutton starts the pump motor by exciting the contactor coil so that it closes.

6. **Stop Button**: This pushbutton stops the pump motor by opening the contactor coil circuit, thereby disconnecting the current to the pump motor.

B. Series M430 Wye-Delta Open Transition:

1. Close isolation switch and measure voltage at output of isolation switch. Voltage should be the same as incoming line voltage.

2. Close circuit breaker and measure voltage at input of motor contactor. Voltage should be the same as in Step 1. The Power On pilot light on controller should be on. In addition, the red Phase Reversal pilot light should not be on. If it is, check that all three phases are present and of the correct voltage. If all power is correct, turn the controller isolation switch OFF, reverse any two of the three phase wires connected to terminals L1, L2, or L3, of the power monitor, then turn isolation switch and circuit breaker back ON. The Phase Reversal pilot light should not be on.

3. Push start button. Motor run contactor 1MC and motor shorting contactor 1MS should close. After a time delay, 2TR times out, motor shorting contactor 1MS drops out and contactor 2MC closes. Remote pump operating alarm should be energized.

4. Push stop button. Motor contactors should open.

5. Drop water pressure at water inlet to controller so the pressure switch will close. Contactors should operate in same sequence as described in Step #3. Allow water pressure to return to normal, using jockey pump. If controller is set for automatic stop, running period timer should be set for at least 10 minutes. Motor contactors should open after this time period. If controller is set for manual stop (as is standard for controllers when shipped from factory), push stop button.

6. Turn circuit breaker off.

7. Reconnect output from contactors to pump motor and repeat Steps #3 through #5. Check the motor for correct rotation. Pump motor should start and stop as controller functions are operated.

C. Series M435 Wye-Delta Closed Transition: The start-up procedure is the same for the Series M435 as in the Series M430. There is an additional contactor (3MC) and a set of transition resistors which provides power to the motor windings during transition from the wye connection to the delta connection. After the time delay 2TR times out contactor 3MC closes which connects the resistors to the motor windings. After contactor 3MC closes contactor 1MS opens which in turn allows contactor 2MC to close, thus connecting the motor windings in the delta configuration. The motor will now run at full speed and deliver rated horsepower to the load.

D. Sequential Starting (Option S): The sequential start timers provide a time delay between the pressure switch contacts closing and the motor contactor closing. Where sequential starting is used, set the sequential start timers for approximately ten (10) second intervals. Perform Initial Installation Start-Up procedure for appropriate controller and check for sequential timing on automatic starts. Sequential starting is bypassed by manual starting.

PART V: OPERATION OF CONTROLLER

After the installation and test procedure are completed, the controller is ready for normal operation.

A. Manual Controller: Isolation switch and circuit breaker should be closed. Controller is now ready for manual operation. The controller is started by pushing the start button. If for some reason the motor fails to start when the start button is pushed the emergency manual lever may be moved to the "On" position. This lever must be manually locked in the "On" position or it will return to "Off" when released. This lever is for emergency use only.

B. Automatic Controllers / (All Types): The isolation switch and circuit breaker should be closed. For a sequential start controller and sequential start, timing relay 3TR should be set for approximately ten (10) second intervals. Local requirements may dictate different time settings. For controllers set for automatic stop, set the running period timer for at least 10 minutes running time. To activate the automatic stop feature, the jumper on the Manual Stop Jumper Block must be removed.

C. **Emergency Manual Operation:** Emergency manual operation is provided in case of failure of control circuitry. This lever is manually moved to the "On" position and must be manually latched in the "ON" position or it will return to "Off" when released. The lever should be moved from the "Off" position to the "On" position in as quickly a motion as possible to prevent burning the contacts. The circuit breaker should be tripped to disconnect the circuit before releasing emergency lever. This lever is for emergency use only. A mechanical interlock switch is connected to the emergency lever to operate the contactor electrically when all circuitry is functioning properly. This is provided to prevent inadvertent slow closing of contactor and burning of contacts.

PART VI: SEQUENCE OF OPERATION

A. **Introduction:** The explanation of the sequence of operation will start with the assumption that the controller has been properly installed, all external connections have been made and the isolation switch and circuit breaker are closed. In other words, the controller is operational. The Power On pilot light should be on. All wiring on the primary side of the transformer 1CPT will be referred to as the primary circuit. All wiring on the secondary side of the transformer 1CPT will be referred to as the secondary circuit.

B. **Manual Operation:**

1. SERIES M430
   For manual operation there is a start pushbutton switch on the controller and field terminals for an optional remote start switch located elsewhere. These switches have normally open contacts which close to energize 1CR. 1CR locks in on its own N.O. contact and stays energized until the stop button is depressed. An additional N.O. contact of 1CR closes and energizes 2CR and 2TR. A contact of 2CR in the primary circuit then closes and energizes motor contactor 1MS through N.C. contacts of 3CR and 2MC (2MCA). When contactor 1MS closes, auxiliary contact 1MSA closes and energizes contactor 1MC, which locks in on its own N.O. auxiliary contact. The motor is thus connected in the wye configuration. After a time delay relay 2TR times out, N.O. contacts of 2TR close and energize relay 3CR. The N.C. contacts of 3CR in the primary circuit then open and de-energize contactor 1MS, which in turn allows contactor 2MC to close. The motor is then switched to the delta or run configuration.

   To stop the controller manually, the stop pushbutton switch is depressed. This breaks the circuit to the coil of 1CR. The N.O. contacts of 1CR open to de-energize 2CR. The N.O. contacts of 2CR in the primary circuit then open and de-energize contactors 1MC and 2MC which stop the motor.

2. SERIES M435
   Manual operation for the Series M435 controllers is essentially the same as for the M430 except that an additional contactor and a set of transition resistors are used to keep the motor energized during transition from wye to delta.

   After the time delay relay 2TR times out and the N.O. contacts of 3CR close and energize 3MC. A N.C. auxiliary contact of 3MC opens and de-energizes 1MS which allows 2MC to close. A N.C. auxiliary contact of 2MC opens and de-energizes 3MC which completes the transition to the delta or run condition. Contactor 3MC provides power to the motor windings through the transition resistors during the period of time between the opening of 1MS contactor and the closing of 2MC contactor to prevent the motor from being completely disconnected from the power source during the start sequence.

C. **Automatic Operation / (Pressure Switch):** On drop of water pressure the N.C. contact in the pressure switch closes energizing 2CR. 2CR locks in through the manual stop jumper or through N.C. contacts of 1TR. The N.O. contacts of 2CR in the primary circuit close and the sequence described previously in Manual Operation takes place.

In controllers with sequential starting, 3TR is energized by the pressure switch starting its timing cycle. After 3TR times out a N.O. contact closes and energizes 2CR.

On Controllers set for automatic stop, a running period timer is used to keep the motor running for a preset time period regardless of whether the contact of the pressure switch has opened. This is accomplished by keeping 2CR (or 3TR) locked in through the N.C. contacts of the timer 1TR until the timer times out and these contacts open. If the pressure switch contacts have not opened by the time 1TR times out, 2CR (or 3TR) will remain energized until the pressure switch resets and its contacts open.

On controllers set for manual stop only, a jumper is installed in parallel with the N.C. contacts of 1TR thus 2CR (or 3TR) is held in the energized state. The controller must be stopped with the manual stop pushbutton switch which breaks the circuit to 2CR (or 3TR). The N.O. 2CR contact in the primary circuit opens and stops the motor.

D. **Automatic Operation / (Deluge Valve - Option D):** The deluge valve switch is a N.C. switch. When it opens, 7CR is de-energized. The N.C. contacts of 7CR in the automatic circuit close and energize 2CR (or 3TR). The remaining sequence to start and stop the motor is the same as automatic operation with the pressure switch closing.

E. **Remote / Pump Running Signal:** One (1) N.O. and one (1) N.C. contact is available for remote indication that the pump is running.

F. **Remote / Loss of Power, Loss of Phase, Low Voltage:** One (1) SPDT contact is available for loss of line power, loss of phase, or low voltage.

G. **Remote / Phase Reversal:** One (1) SPDT contact is available for remote indication of phase reversal of the incoming power to the controller.

H. **Engine Lockout / (Option E):** A N.O. auxiliary contact ont he motor contactor is provided to prevent an engine type controller from starting if the electric motor is running. Circuitry for this is provided in engine controllers supplied with Option "E".

I. **Electric Motor Lockout / (Option M):** Terminals are available to connect to an external switch to lockout the electric motor. This may be necessary to prevent the motor from starting, when the engine is running or when low suction is used, etc. The external switch will close to energize 9CR. A N.C. contact of 9CR will break the circuit to 2CR (or 3TR) and stop the motor. With the Electric Motor Lockout feature energized it is still possible to start the motor manually.

J. **Power Failure Start / (Option P):** On loss of reliable source of 120V AC, relay 8CR will be de-energized. The N.C. contact of 8CR will close and start the electric motor in the same manner as for drop in water pressure described in Section C.

PART VII: NOMENCLATURE

1CR	Manual Start Relay
2CR	Control Relay
3CR	1MS Delay Relay
5CR	Transformer Secondary Power Available Relay (Option D, J, or P)
7CR	Deluge Start Relay (Option D)
8CR	Power failure Start Relay (Option P)
9CR	Motor Lockout Relay (Option M)
1TR	Run Period Timer
2TR	Transition Delay Timer
3TR	Sequential Start Timer (Option S)
1MC	Motor Run Contactor
2MC	Motor Run Contactor
3MC	Transition Contactor
1MS	Shorting Contactor
1MCA	1MC Auxiliary Contact
2MCA	2MC Auxiliary Contact
3MCA	3MC Auxiliary Contact
1MSA	1MS Auxiliary Contact
1CS	Stop Switch
2CS	Start Switch
1PL	Power ON Pilot Light
2PL	Phase Reversal Pilot Light
1IS	Isolation Switch
1CB	Circuit Breaker
1PS	Pressure Switch
1CPT	Control Power Transformer
1PM	Power Monitor
1PR	Phase Loss Relay
2PR	Phase Reversal Relay
1OCM	Overcurrent Monitor