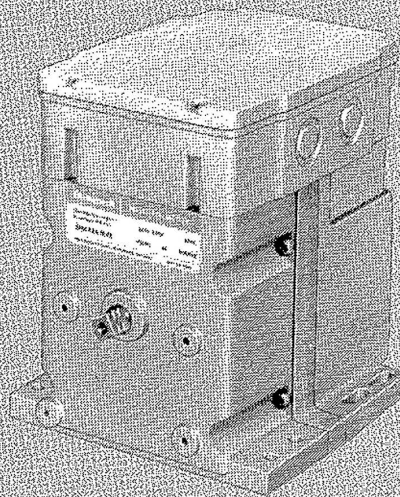


# Honeywell

M9184 AND M9194 MODUTROL MOTORS ARE REVERSING, PROPORTIONAL MOTORS USED TO OPERATE VALVES OR DAMPERS IN ELECTRIC (SERIES 90) MODULATING CIRCUITS.

- Replaces M944A,C,D; M954 motors.
- Oil immersed motor and gear train for reliable performance and long life.
- Wiring box provides NEMA 3 weather protection.
- Actuator motor and circuitry operate from 24 volts AC. Models available with factory installed transformer, or an internal transformer can be field added.
- Quick-connect terminals standard – screw terminal adapter available.
- Adapter bracket for matching shaft height of older motors is standard with replacement motors.
- Field adjustable stroke (90° to 160°) models available.
- Nominal timing of 30 seconds for 90° and 60 seconds for 160° stroke is standard. Other timings are available.
- Die-cast magnesium housing.
- Available accessories include valve and damper linkages, explosion proof housing, and auxiliary switches.
- Integral auxiliary switches are available factory mounted, or can be field added to TRADELINE models.
- Field addable interface modules can be mounted in wiring box to upgrade actuator to Series 70 (electronic) control.
- Models available with tapped output shaft.
- M9181, M9184 rated for 150 lb.-in. torque with standard timing.
- M9191, M9194 rated for 300 lb.-in. torque with 2 or 4 minute timing for 160° stroke.

## MODUTROL IV MOTORS



**M9184, M9181**  
**M9194, M9191**

# SPECIFICATIONS

## TRADELINE MODELS

TRADELINE MODELS are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. TRADELINE model specifications are the same as those of standard models unless specified otherwise. M9184D1013, M9184D1021 and M9194D1003 are TRADELINE models.

## STANDARD MODELS

	M9184A,B,C,D,F M9194D,E	
<b>Control Type</b>		<b>Suffix Letter</b>
91 is Series 90		<b>A:</b> Fixed stroke (90° or 160°) No auxiliary switches
<b>Power Rating</b>		<b>B:</b> Fixed stroke (90° or 160°) 1 auxiliary switch
8 is high power - 75 lb.-in. at 30 sec. for 160° 150 lb.-in. at standard timing (60 sec. for 160°)		<b>C:</b> Fixed stroke (90° or 160°) 2 auxiliary switches
9 is extra high power - 300 lb.-in. at 2 or 4 minute timing for 160°		<b>D:</b> Adjustable stroke (90° to 160°) No auxiliary switches
<b>Output Drive</b>		<b>E:</b> Adjustable stroke (90° to 160°) 1 auxiliary switch
4 is dual-ended shaft, non-spring return		<b>F:</b> Adjustable stroke (90° to 160°) 2 auxiliary switches
1 is single-ended shaft, non-spring return		

### ELECTRICAL RATINGS:

	VOLTAGE (V @ 50/ 60 Hz)	CURRENT DRAW (A)	POWER CONSUMPTION (W)
(Without Transformer)	24	0.80	18
With Internal Transformer	120	0.24	23
	208	0.14	23
	240	0.12	23

**NOTE:** Some motors furnished to HVAC equipment manufacturers have no adapter bracket, a single-ended shaft and/or no wiring box.

### CONTROLLER TYPE:

Series 90 Control Circuit—135 ohm series 90 proportioning controller. Series 90 high or low limit controller with manual minimum position potentiometer (with a combined total resistance of up to 500 ohms) may also be used in the control circuit.

**MOTOR ROTATION:** Normally closed. The closed position is the limit of counterclockwise rotation as viewed from the power end of the motor. See Fig. 2. Motor opens clockwise (as viewed from the power end). Motors are shipped in the closed position.

**STROKE:** Fixed stroke models available with 90° or 160° stroke. Other models available with field adjustable stroke from 90° to 160°. Start position of shaft changes with adjustment of stroke. (Midpoint of stroke remains fixed as stroke is adjusted, as shown in Fig. 2.) Stroke is adjusted by means of cams located in wiring compartment. (See Stroke Setting Procedure.)

**TIMING:** Standard timing is 30 seconds for 90° stroke, 1 minute for 160° stroke. Other timing are available.

### DEAD WEIGHT LOAD ON SHAFT:

Power or Auxiliary End—200 lb. [90.8 kg] maximum.  
Maximum Combined Load—300 lb. [136.2 kg]

### AMBIENT TEMPERATURE RATINGS:

Maximum—150° F [66° C] @ 25% duty cycle.  
Minimum—minus 40° F [-40° C].

**CRANKSHAFT:** 3/8 inch [9.5 mm] square.

M9184, M9194 have double-ended shaft.  
M9181, M9191 have single-ended shaft.

# ORDERING INFORMATION

WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR AUTHORIZED DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER.

IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:

1. YOUR LOCAL HONEYWELL RESIDENTIAL AND BUILDING CONTROLS SALES OFFICE (CHECK WHITE PAGES OF YOUR PHONE DIRECTORY).
2. RESIDENTIAL AND BUILDING CONTROLS CUSTOMER SERVICE  
HONEYWELL INC., 1885 DOUGLAS DRIVE NORTH  
MINNEAPOLIS, MINNESOTA 55422-4386 (612)542-7500

(IN CANADA—HONEYWELL LIMITED/HONEYWELL LIMITEE, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO M1P 2V9) INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.

AUXILIARY SWITCH RATINGS (amperes):

ONE CONTACT RATING <sup>a</sup> AMPS	120 V	240 V
Full Load	7.2	3.6
Locked Rotor	43.2	21.6

<sup>a</sup> 40 VA pilot duty, 120/240 Vac on opposite contact.

DIMENSIONS: See Fig. 1.

UNDERWRITERS LABORATORIES INC. LISTED:

File No. E4436; Guide No. XAPX.

CANADIAN STANDARDS ASSOCIATION CERTIFIED:

General listing File No. LR1620, Guide 400-E.

	TIMING		TORQUE in lb.-in. [N·M]	
	90° STROKE MOTORS	160° STROKE MOTORS	NORMAL RUNNING	BREAKAWAY <sup>a</sup>
M9184	15 sec	30 sec	75 [8.5]	150 [17.0]
	30 sec	1 min	150 [17.0]	300 [34.0]
M9194	1,2 min	2,4 min <sup>b</sup>	300 [34.0]	600 [68.0]

<sup>a</sup> Breakaway torque is the maximum torque available to overcome occasional large loads such as a seized damper or valve. MOTOR MUST NOT BE USED CONTINUOUSLY AT THIS RATING.

<sup>b</sup> Stalling of 2,4 min motor will damage motor.

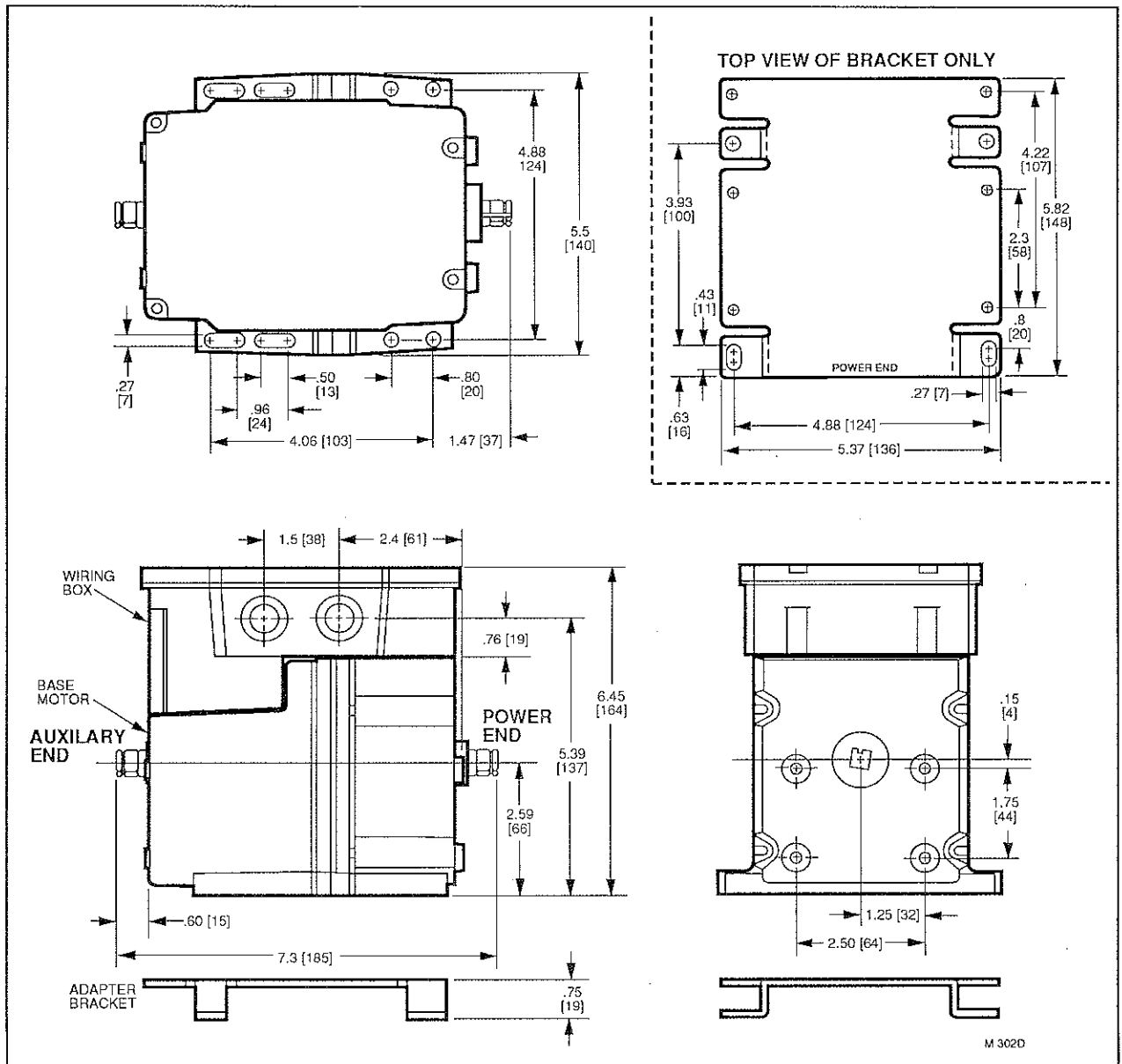


FIG. 1—M9184, M9194 MOUNTING DIMENSIONS IN in. [mm IN BRACKETS].  
NOTE: M9181, M9191 do not have auxiliary shaft. All other dimensions are the same.

## ACCESSORIES:

- ES650117 Explosion-proof Housing—encloses motor for use in explosive atmospheres. Not for use with Q601, Q618, and Q455 Linkages. Order separately from Nelson Electric Co. Requires Honeywell 7617DM Coupling.
- Q607 External Auxiliary Switch—controls auxiliary equipment as a function of motor position.
- Internal Auxiliary Switch Kits—can be field-installed on TRADELINE Models.
  - 220736A—One-switch kit.
  - 220736B—Two-switch kit.
- Q605 Damper Linkage—connects motor to damper. **INCLUDES MOTOR CRANK ARM.**
- Q618 Linkage—connects Modutrol motor to water or steam valve.
- Q601 Bracket and Linkage Assembly—connects Modutrol motor to water or steam valve.
- Q100A,B Linkage—connects Modutrol motor to butterfly valve. Requires adapter bracket included with replacement motors.
- Q209E,F Potentiometer—limits minimum position of motor.
- Q68 Dual Control Potentiometer—controls 1 through 9 additional motors.
- Q181 Auxiliary Potentiometer—controls 1 or 2 additional motors.
- 221455A Motor Crank Arm—Infinitely adjustable crank arm. Approximately 0.75 inches shorter than the 7616BR and 4074ELY crank arms, can rotate through downward position and clear base of motor without requiring use of adapter bracket.
- 220741A Screw Terminal Adapter—converts the standard quick-connect terminals to screw terminals.

- Transformers—mounted internally, provide 24 Vac power to motor
  - 198162JA—24 Vac; 50/60 Hz (for electrical isolation).
  - 198162EA—120 Vac; 50/60 Hz.
  - 198162GA—220 Vac; 50/60 Hz.
  - 198162AA—120/208/240 Vac; 50/60 Hz.
- Q7130A—Interface Module with selectable voltage ranges (4-7 Vdc, 6-9 Vdc, and 10.5-13.5 Vdc). Adapts motor to M71XX function.
- Q7230A—Interface Module, selectable voltage or current control, with adjustable null and span. Adapts motor to M72XX function; 4-20 mA, 2-10 Vdc.
- Q7330A—Interface Module, for W936 economizer applications. Adapts motor to M73XX function.
- Q7630A—Interface Module, 3-wire 14-17 Vdc control with minimum position capability. Adapts motor to M76XX function.
- 7617ADW Crank Arm—0.75 inches shorter than 7616BR crank arm, to allow full rotation without 220738A adapter bracket.
- 4074BYK—Control up to 6 M91XX motors in unison from one Series 90 controller.
- 4074EAU—Drive 2 or 3 M91XX motors from a W973 Single-zone Logic Panel and W7100 Discharge Air Controller.
- 4074EDC—Drive one M91XX motor from a 4-20 mA Controller.
- 4074EED—Drive up to 4 M91XX motors from a 4-20 mA Controller.
- 221508A Resistor Board —plugs onto quick-connects in wiring box of M91XX motor. Can be used in place of 4074BYK, EAU, EDC, or EED resistor kits (functions described above).

# INSTALLATION

## WHEN INSTALLING THIS PRODUCT...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained service technician.
4. After installation is complete, check out product operation as provided in these instructions.

## CAUTION

1. Disconnect power supply before beginning installation to prevent electrical shock and equipment damage.
2. Never turn the motor shaft by hand or with a wrench—this will damage the motor.
3. Always conduct a thorough checkout when installation is complete.

## LOCATION

Install the Modutrol motor in any location except where acid fumes or other deteriorating vapors might attack the metal parts, or in atmospheres of escaping gas or explosive vapors. In excessive salt environments, mounting base and screws should be zinc or cadmium plated, not stainless steel or brass: Use the 220738A adapter bracket for mounting on these surfaces. Motors are rated for am-

peratures between -40° F and 150° F [-40° C and 66° C].

Allow enough clearance for installing accessories and servicing the motor when selecting a location. See Fig. 1. If located outdoors, mount upright and use liquid-tight conduit connectors with wiring box, to provide NEMA 3 weather protection.

## MOUNTING

Always install motors with the crankshaft horizontal. Mounting flanges extending from the bottom of the

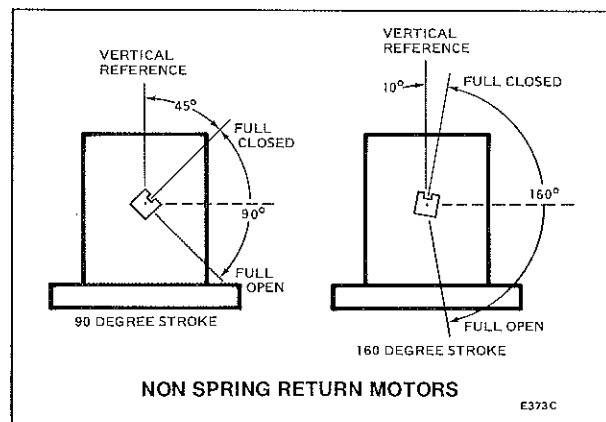


FIG. 2—MOTOR SHAFT POSITIONS AT LIMITS OF STROKE - VIEWED FROM POWER END.

motor housing are drilled for 1/4 inch [6.4 mm] zinc plated machine screws or bolts.

All M9184 motors are shipped from the factory in the closed position (at the limit of counterclockwise rotation as viewed from the power end of the motor, as shown in Fig. 2).

### ADAPTER BRACKET

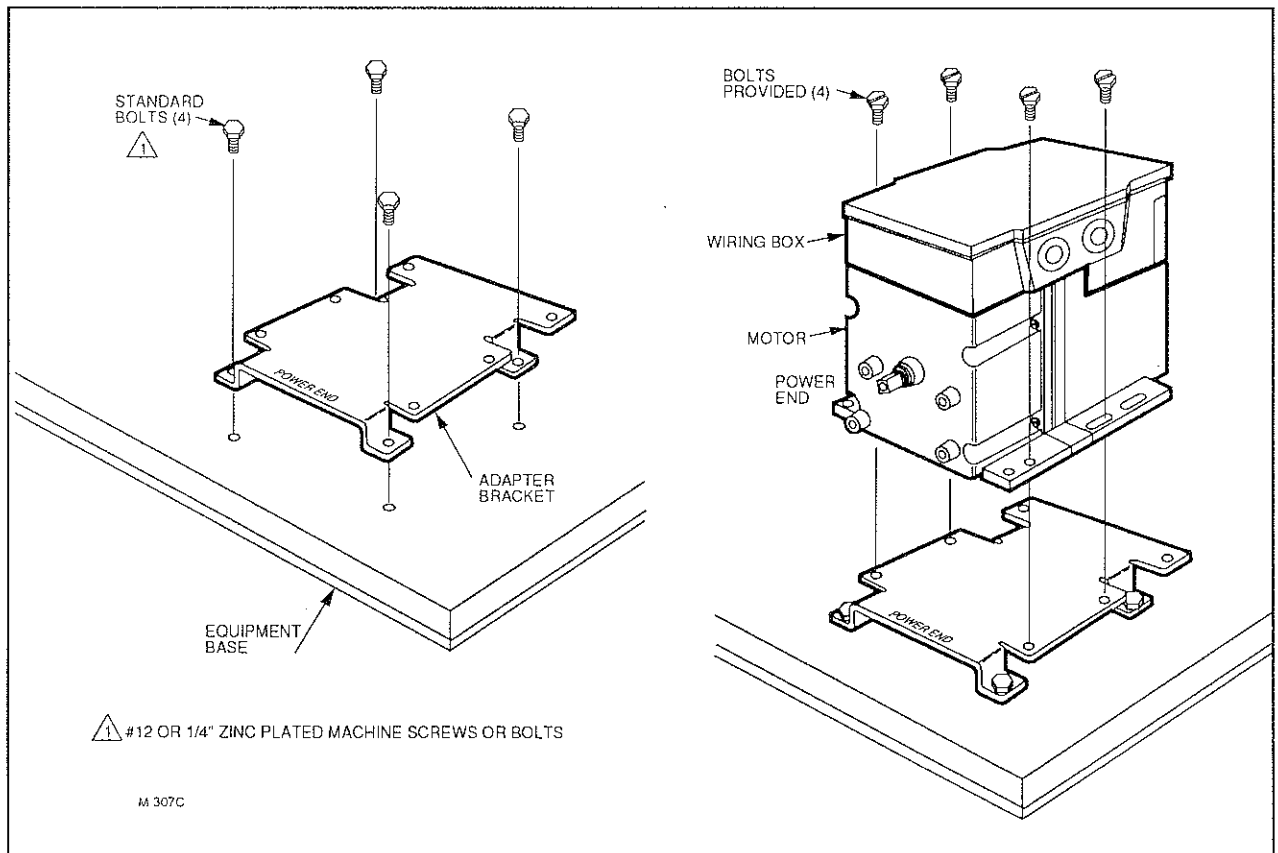
The 220738A Adapter Bracket, positioned between the motor and the equipment, raises the shaft height of the M9184, M9194 motor by 0.75 inch to match that of the M944 and M954 motor. This is required on all valve linkage applications, Q607 External Auxiliary Switch applications, and on some damper linkage applications (either to provide clearance for the crank arm to rotate through the

downward position, or to allow the damper linkage to reach the shaft).

To mount the motor with the bracket:

1. Mount the bracket to the equipment with existing or standard bolts.
2. Mount the motor to the bracket using the bolts provided to the threaded holes in the bracket. See Fig. 3.

For valve linkage applications, the bracket should first be mounted to the linkage. The bracket then provides a convenient base on which the motor can be positioned. After the motor shaft is aligned to the linkage, it can then be attached to the bracket with the 4 bolts provided with the bracket. These bolts go through the inner set of holes of the motor flange and into the threaded holes of the bracket.



**FIG. 3—MOUNTING THE MOTOR WITH A BRACKET.** (With this option, the bracket is first mounted to the equipment with standard bolts. The motor is then mounted to the bracket using the bolts provided with the bracket, which thread into the threaded bracket holes.)

### DAMPER LINKAGES

A 220738A Adapter Bracket is packed with replacement motors. Use of this bracket is optional for many damper applications. The bracket is needed in damper applications requiring the crank arm to rotate through the bottom plane of the actuator. If the bracket is not used in a replacement application, the damper linkage will have to be adjusted to the new shaft location.

The motor comes without a crank arm. The crank arm is included in the Q605 linkage or may be ordered separately (see Accessories).

For detailed instructions on the assembly of specific linkages, refer to the instruction sheet packed with each linkage. In general, however, check the following points of operation when installing a motor and linkage.

1. Linkages for valves and louver type dampers should be adjusted so that the damper or valve moves through

only the maximum required distance when the motor moves through its full stroke.

2. With modulating control, maximum damper opening should be no more than 60°. Little additional airflow is provided beyond this point.

3. The motor must be stopped at the end of its stroke by the limit switch and must not be stalled by the damper or valve. The motor will be damaged if it is not permitted to complete its full stroke.

4. Do not exceed the motor ratings in any installation.
5. Do not turn motor shaft manually or with a wrench—this will damage the motor.

### VALVE LINKAGES (See Fig. 4)

The 220738A Adapter Bracket must be used with the Q100, Q601 and Q618 linkages in all valve applications.

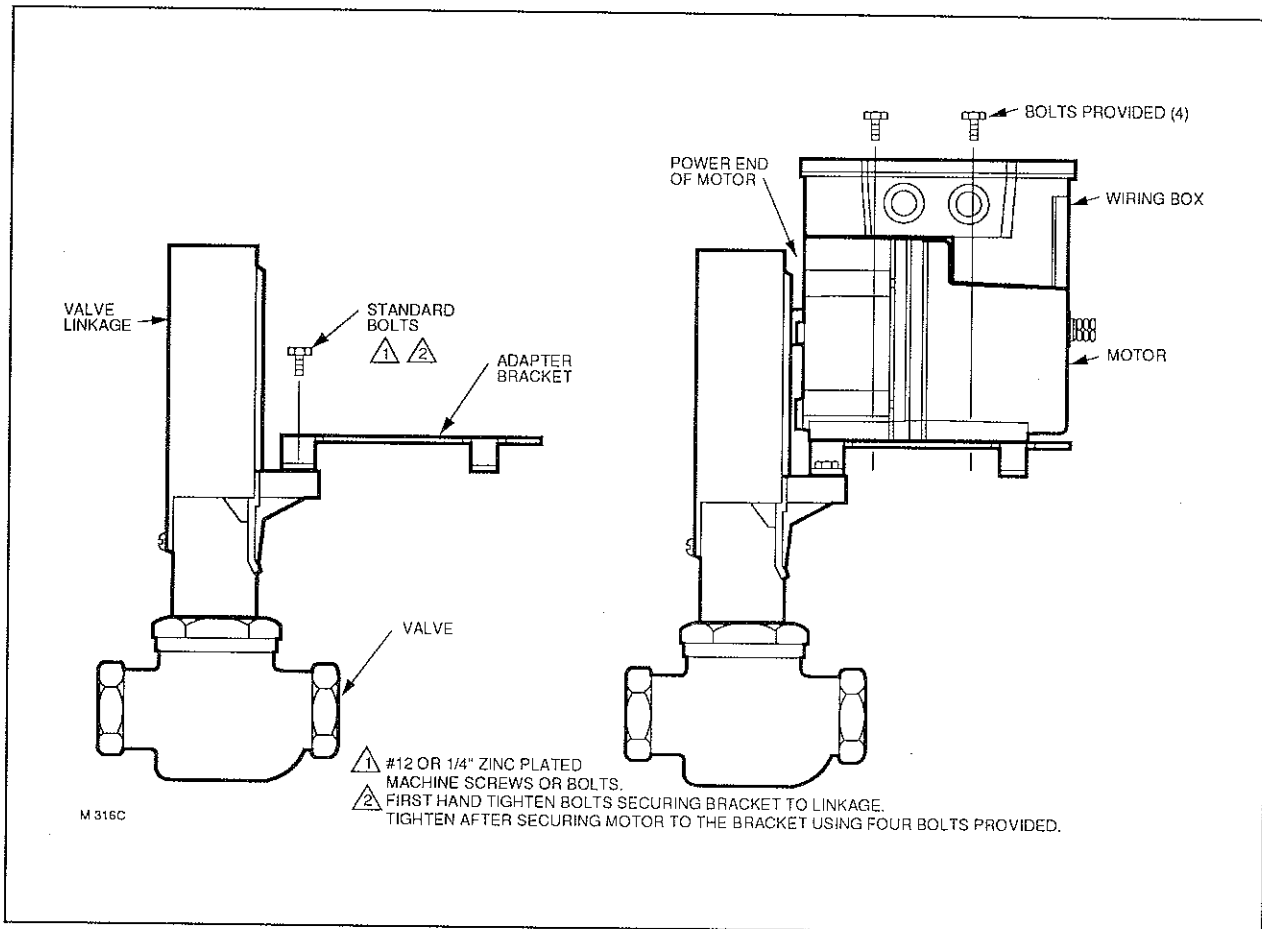


FIG. 4—MOUNTING ON VALVE LINKAGE WITH ADAPTER BRACKET.

**WIRING**

Disconnect power supply before wiring to prevent electrical shock or equipment damage. All wiring must agree with applicable codes, ordinances, and regulations.

A transformer is required to supply 24 Vac power to the motor. Make sure that the power requirements stamped on the motor correspond to the characteristics of the power supply.

Figs. 6-8 show internal schematics. Figs. 9-14 show connections for various system applications. Figs. 15-19 show connections for unison control, and Fig. 20 shows connection for operation from a 4-20 mA controller.

The motor terminals are quick-connects located on top of the printed circuit board shown in Fig. 5. A screw terminal adaptor is available. Access to the wiring compartment is gained by removing the 4 screws in the top of the wiring box and lifting off the cover.

**WIRING BOX**

When used with liquid-tight conduit connectors, the wiring box provides NEMA 3 weather protection for the motor. The box also provides knock-outs for wiring conduits, and encloses terminals. The wiring box, standard with replacement motors, is required for housing an internal transformer, internal auxiliary switches, or interface modules.

When the motor includes auxiliary switches or an integral transformer, either field or factory installed, all wiring must be NEC Class 1 or CEC Class 1.

**CONNECTION DIAGRAMS**

These motors are designed for use in series 90

proportioning control circuits employing a 135 ohm series 90 controller. Series 90 high or low limit controls or manual minimum position potentiometers may also be used in the control circuit.

The standard series 90 controller has R, W, and B terminals. As the controller reduces R to W resistance, the motor will drive closed (CCW as viewed from the power end).

The M9184/M9194 Modutrol motors can also be used with the W973 Singlezone Logic Panel and W7100 Discharge Air Controller in heating, cooling, and economizer applications. Fig. 14 illustrates the connections required when the W973 logic panel is employed.

**CAUTION**

M9184/M9194 Modutrol Motors with the electronic balancing relay are designed to ignore the presence of electrical pickup (unwanted input signals) and will work with standard wiring used with other nonsolid state Modutrol motors. However, there may be rare cases in which very large pickup is present, such that motor performance becomes erratic. This may happen when the series 90 controller wires are run near wires carrying large electrical currents (large electric motors). Reroute series 90 controller wires away from these conductors, or use twisted cable (Belden type 8443-3 wire, or equivalent) to ensure proper control. If shielded cable is used, the shield must not be grounded.



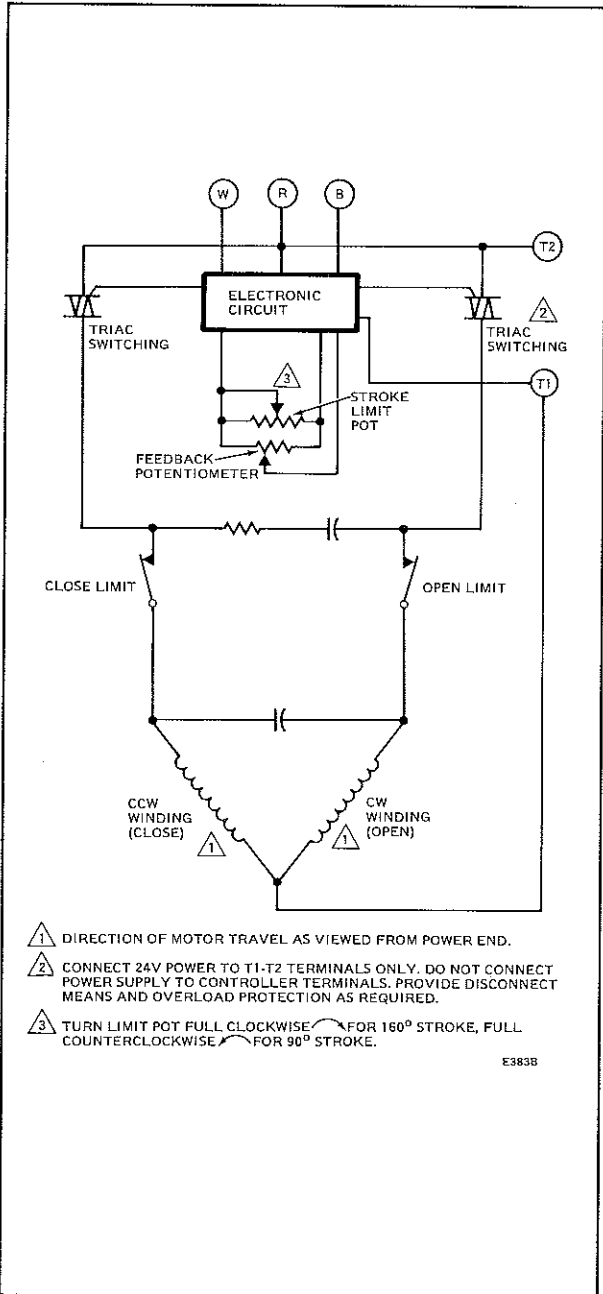


FIG. 8—INTERNAL SCHEMATIC FOR M91XXD,E,F ADJUSTABLE STROKE MOTORS.

NOTE: In most applications, a single 135 ohm potentiometer in the limit controller provides only 50% operation of a valve or damper. For those applications where the limit controller must be able to operate the valve or damper to 100% of its capacity, it must have either one 270 ohm potentiometer or 2-series-connected potentiometers with combined total resistance up to 280 ohms. If a 2-potentiometer limit controller is used, it should be wired into the circuit as shown in Figs. 10 and 12. In general, a 2-position controller, or a controller with a narrow throttling range, should not be used as a high or low limit in a series 90 circuit as this will usually cause rapid cycling (hunting) of the motor.

**IMPORTANT**

1. Unison control of multiple Modutrol motors is for Series 90 motors with solid state balance relays only.
2. Use the same stroke on all motors connected in parallel.
3. When individual motor transformers are used, they must have the same characteristics and they must all be powered by a single branch circuit.
4. All motors must be in phase when using common transformer supply. Connect same transformer lead to T1 on each motor; connect the other transformer lead to T2 on each motor.
5. M9184 motors cannot be wired in parallel with electromechanical balance relay Modutrol motors.
6. Do not disconnect any paralleled motor, or remaining motors will not operate properly.

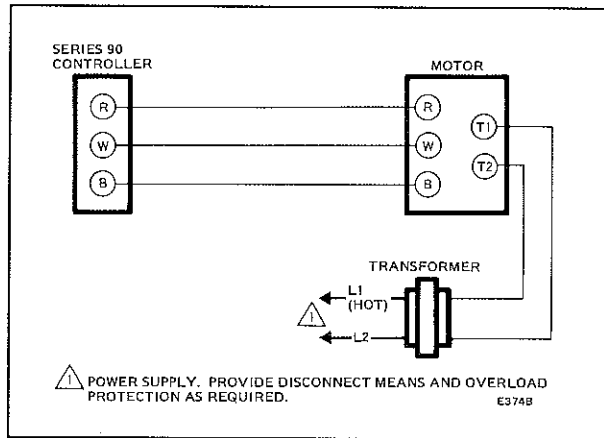


FIG. 9—M9184/M9194 USED WITH A SERIES 90 CONTROLLER.

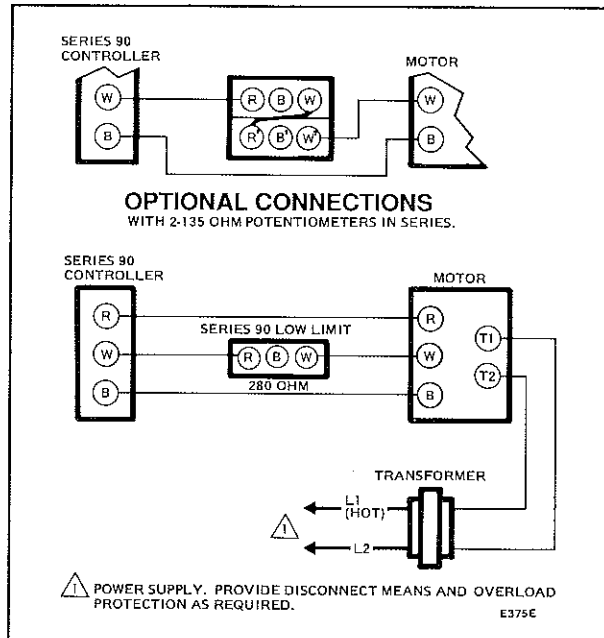


FIG. 10—M9184/M9194 USED WITH MODULATING LOW LIMIT.

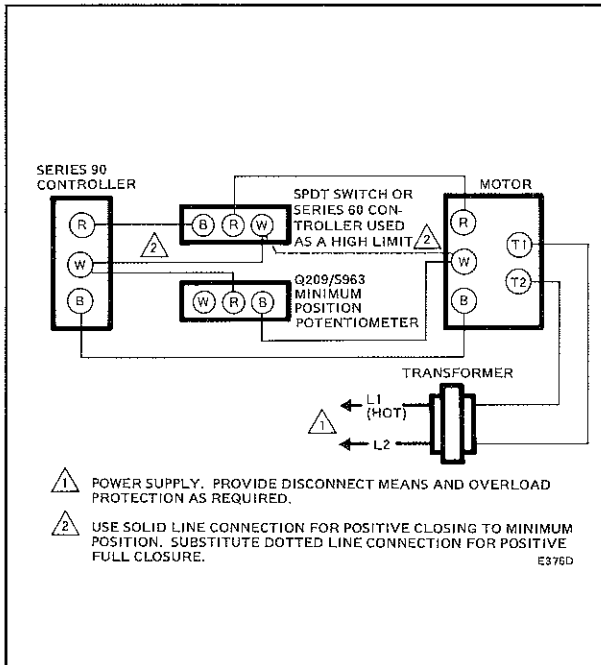


FIG. 11—M9184/M9194 USED WITH A SERIES 90 CONTROLLER, A MANUAL MINIMUM POSITION POTENTIOMETER, AND A SPDT SWITCH FOR 2-POSITION HIGH LIMIT CONTROL.

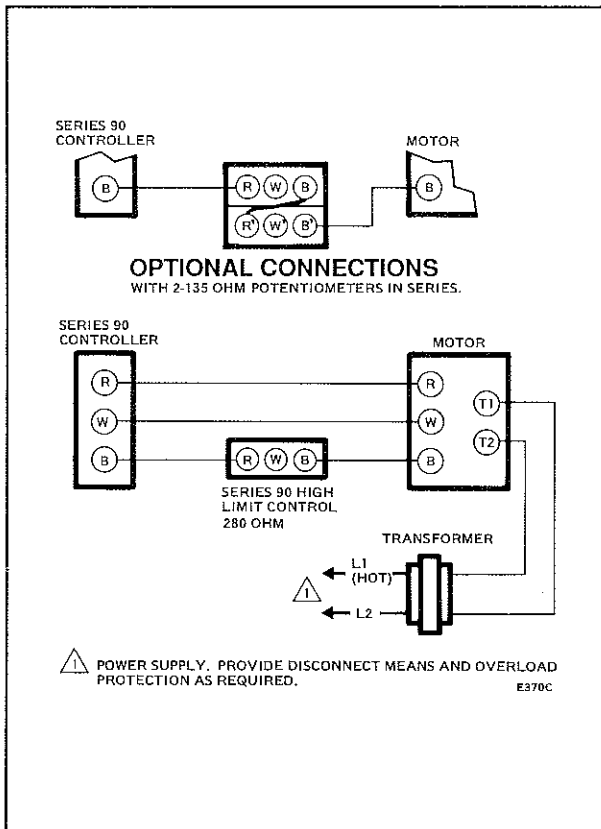


FIG. 12—M9184/M9194 USED WITH A SERIES 90 CONTROLLER AND A SERIES 90 HIGH LIMIT.

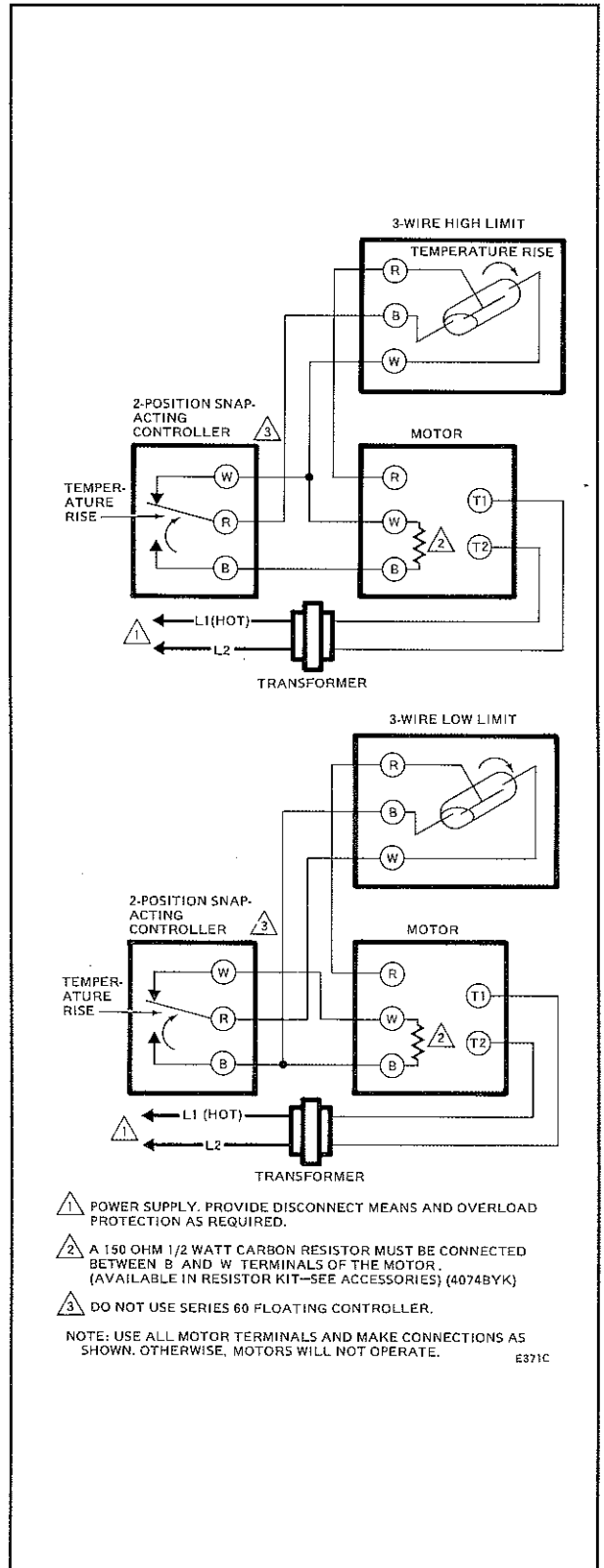


FIG. 13—M9184/M9194 MOTOR USED WITH A 2-POSITION CONTROLLER AND HIGH OR LOW LIMIT CONTROLLER IN LOW VOLTAGE SERIES 60 CIRCUIT (heating application).

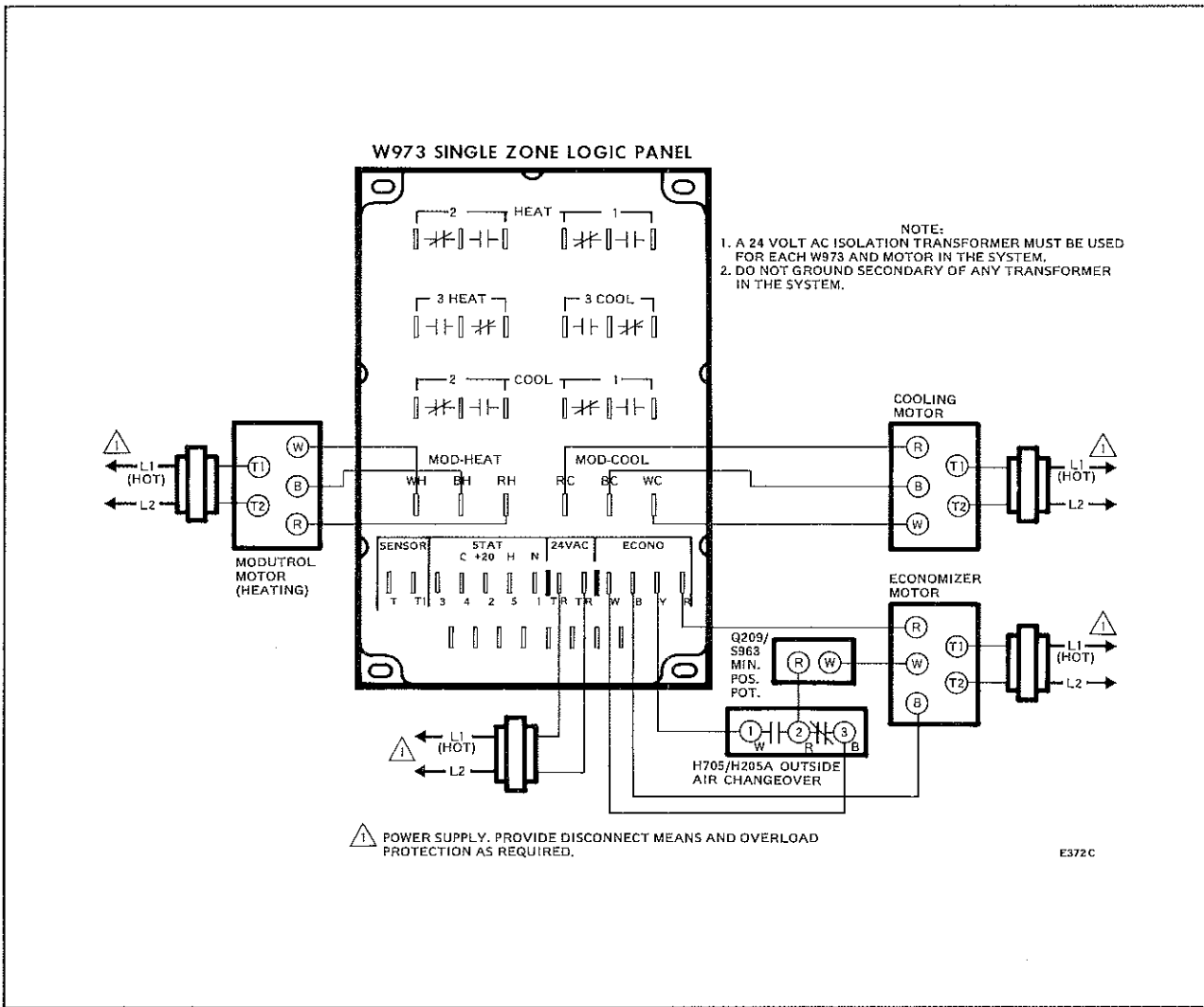


FIG. 14—M9184/M9194 MOTORS USED WITH A W973 SINGLEZONE LOGIC PANEL.

Up to 6 motors may be operated from one series 90 controller by placing the proper value resistor across the W-B terminals of the controller. 4074BYK Resistor Kit contains 5 specially labeled resistors for this purpose. See Table 1.

1. Select the proper resistor for the number of motors used.
2. Install 220741A Screw Terminal Adapter if it is not already present.
3. Connect selected resistor across W and B terminals as in Fig. 15.

The 221508A Resistor Board can be used in place of the resistor kit and screw terminal adapter.

Table 1—4074BYK RESISTORS.  
(1% METAL FILM, 1/8 WATT)

NO. MOTORS	RESISTOR NO.	RESISTANCE (ohms)
2	802139 BEAA	140.0
3	802139 HBFH	71.5
4	802139 EHFH	47.5
5	802139 DFHH	35.7
6	802139 CJAH	28.0
Two-position <sup>a</sup>	100100BFB	150.0

<sup>a</sup>5% Composition, 1/2 Watt.

Up to 4 M9184 motors may be operated in unison from both the W973 Singlezone Logic Panel and W7100 Discharge Air Controller when the proper value resistor is placed across the R and B terminals. The 4074EAU Resistor Kit (order separately) contains 2 resistors for this purpose. Use the 1300 ohm resistor when 2 motors are paralleled and the 910 ohm resistor when 3 motors are paralleled. If 4 motors are to be connected in parallel, use a 768 ohm, 1/4 watt, 5% carbon resistor (not included in the resistor kit). Fig. 19 illustrates the connections required for unison operation of 3 motors from the W973 logic panel.

The M9184/M9194 can be used with some Honeywell Industrial Control Products such as the Dialatrol/Dialapak, which has a 4-20 mA control output. It is necessary to use a resistor kit (4074EDC for controlling 1 motor or 4074EED for controlling up to 4 motors from one controller) or Q7230 Interface Module or 221508A Resistor Board to interface to the 4-20 mA signal source (Fig. 20).

**IMPORTANT**

After the valve or damper linkage is connected to the motor, it may be necessary to interchange the blue and yellow connections at the motor terminals to obtain the proper action of the valve or damper on a temperature increase or decrease at the controller.

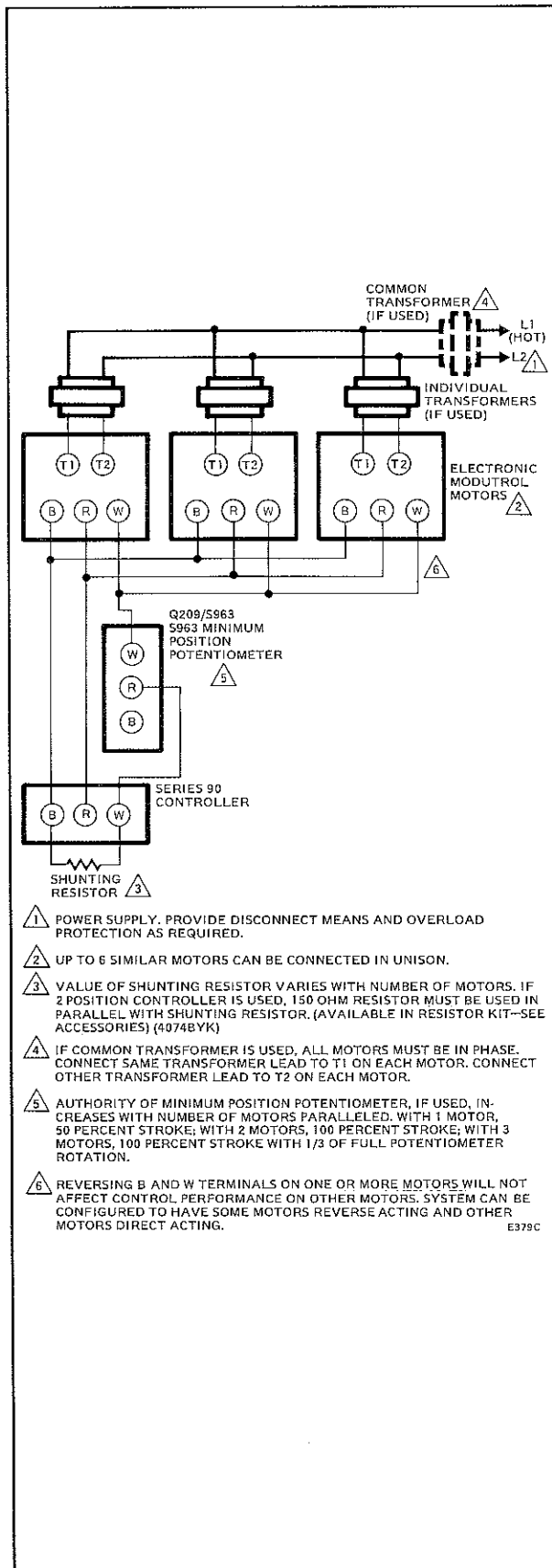


FIG. 15—UNISON CONTROL OF M9184/M9194 MOTORS IN A HEATING APPLICATION. ONE MINIMUM POSITION POTENTIOMETER IS USED FOR ALL MOTORS.

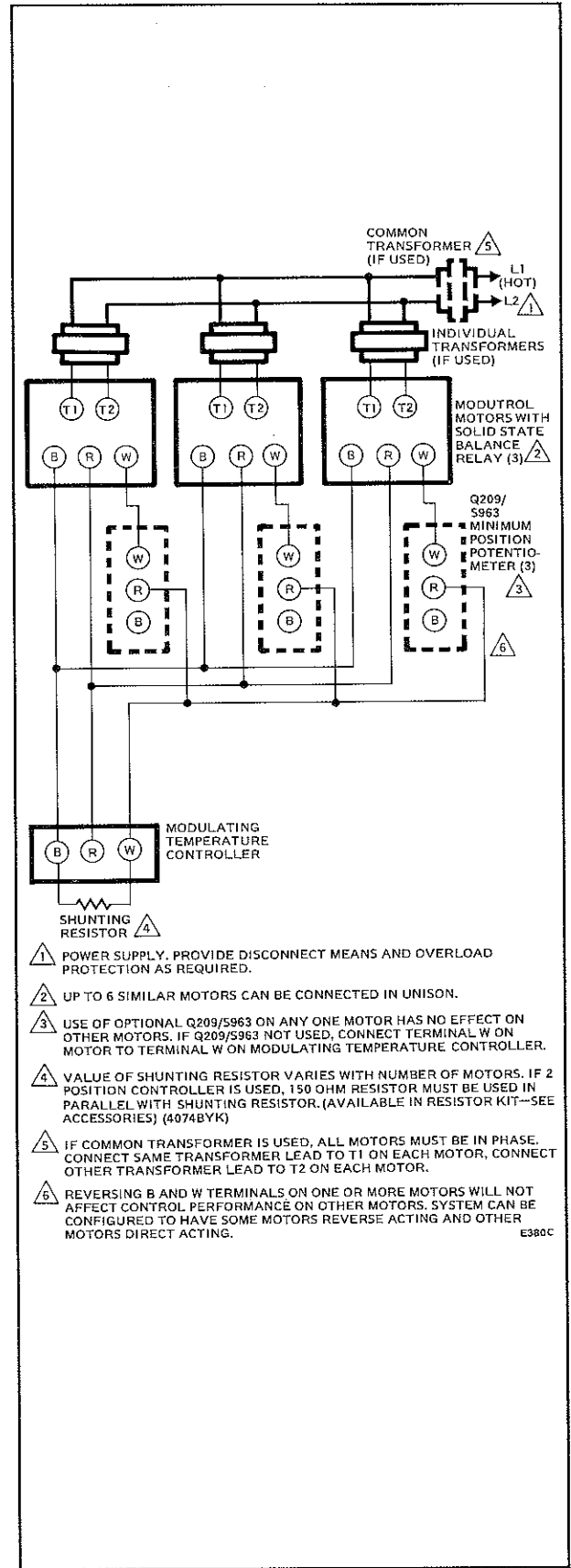


FIG. 16—UNISON CONTROL OF M9184/M9194 MOTORS IN A HEATING APPLICATION. SEPARATE MINIMUM POSITION POTENTIOMETER IS USED FOR EACH MOTOR.

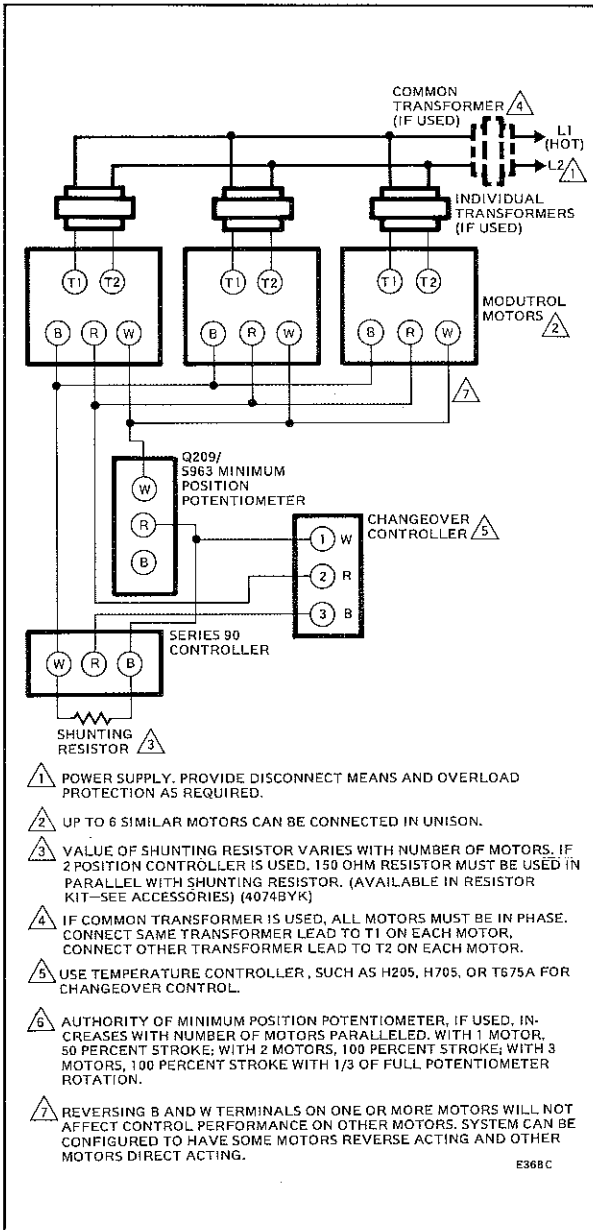


FIG. 17—UNISON CONTROL OF M9184/M9194 MOTORS IN A COOLING APPLICATION USING MINIMUM POSITION POTENTIOMETER FOR ALL MOTORS.

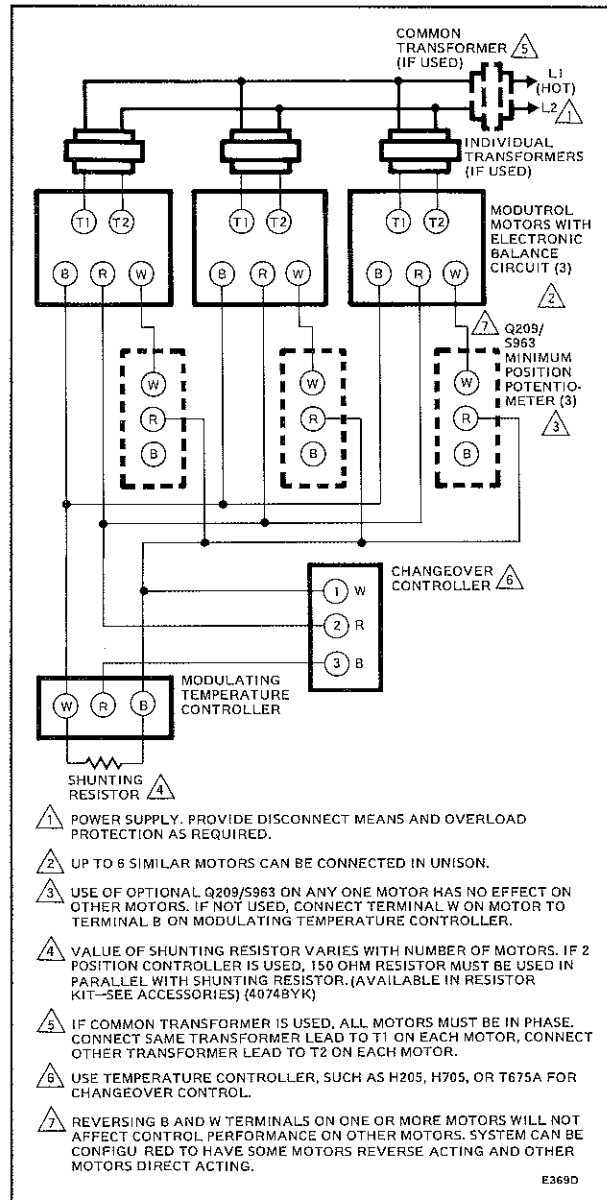


FIG. 18—UNISON CONTROL OF M9184/M9194 MOTOR USING SEPARATE MINIMUM POSITION POTENTIOMETERS. SYSTEM SHOWN IS AN ECONOMIZER APPLICATION.

## SETTINGS AND ADJUSTMENTS

### STROKE SETTING

On M9184D,F and M9194D,E motors, stroke is field adjustable and can be set between 90° and 160°. TRADELINE motors are factory set for 160°. In order to change stroke, both mechanical and electrical adjustments are required. The mechanical adjustments (cams) establish the full open (clockwise, as viewed from the power end) and full closed (counterclockwise) positions of the motor shaft. The electrical adjustment (trim pot) provides sufficient resistance change to ensure that cams will actuate both limit switches.

### CAUTION

Detach linkage from motor before adjusting stroke.

### BEFORE SETTING STROKE:

1. Remove top cover from motor.
2. Disconnect controller from motor.
3. Connect R,B,W terminals on 135 ohm potentiometer (Q209 or S963) to matching terminals on motor.

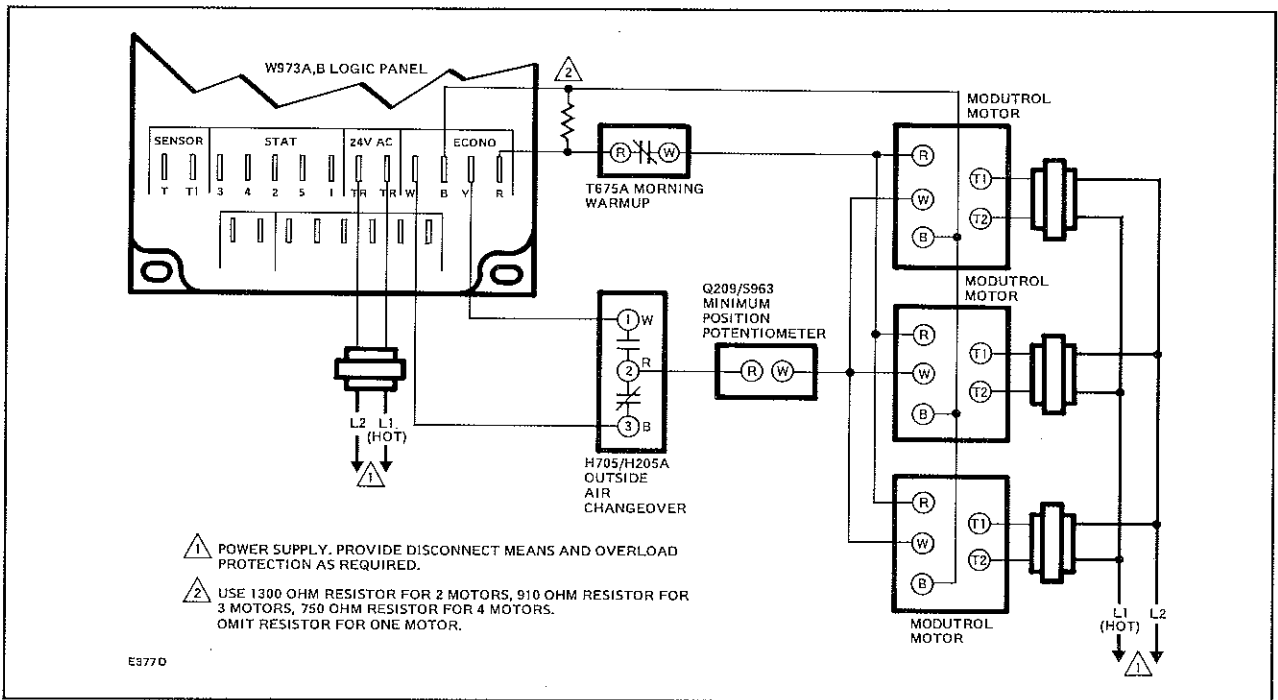


FIG. 19—UNISON CONTROL OF 3 MOTORS USING ONE MINIMUM POSITION POTENTIOMETER AND A W973 SINGLEZONE LOGIC PANEL SYSTEM SHOWN IN AN ECONOMIZER APPLICATION. FOR HEATING OR COOLING, USE THE MOD-HEAT OR MOD-COOL W973 TERMINALS.

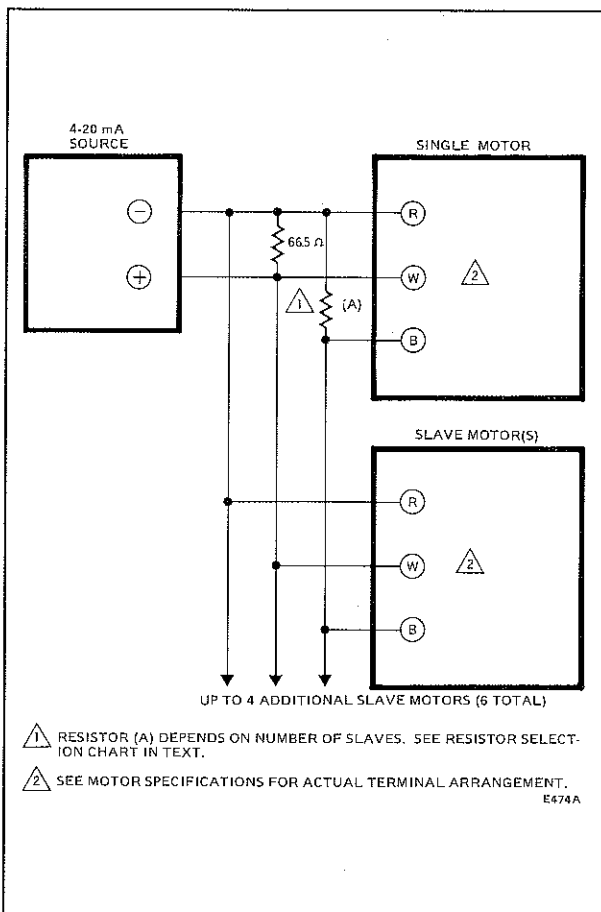


FIG. 20—RESISTOR CONNECTIONS FOR SINGLE OR UNISON CONTROL OF M9184/M9194 MOTOR OPERATION FROM 4-20 mA SINGLE SOURCE.

#### 4074EED RESISTOR SELECTION CHART

TOTAL NUMBER OF MOTORS	MINIMUM OUTPUT VOLTAGE REQUIRED (Vdc) <sup>a</sup>	RESISTOR (A)	
		(Ohms)	Part No.
1	1.7	237	802139CDHA
2	2.0	150	802139BFAA
3	2.3	124	802139BCEA
4	2.7	113	802139BBDA
5	3.0	105	Not part of this kit, obtain separately.
6	3.3	97.6	Not part of this kit, obtain separately.

<sup>a</sup>Controller open circuit output voltage required to drive motor.

#### SETTING 160° STROKE (Fig. 21)

1. Turn trim pot fully clockwise ↻.
2. Drive motor to mid-position, using 135 ohm pot or by jumping B-R-W.
3. Insert 1/8 in. screwdriver blade into slot on inner yellow cam and MOVE TOP OF SCREWDRIVER as far as possible counterclockwise ↻ (viewed from power end). Repeat in successive cam slots until inner cam is against counterclockwise stop. Each click is approximately 2 degrees of rotation.

#### IMPORTANT

Set cams by moving top of screwdriver only. Pressing screwdriver against sides of cam slots or use of excessive force could cause damage.

4. Insert 1/8 in. screwdriver blade into slot on outer yellow cam and MOVE TOP OF SCREWDRIVER as far as possible clockwise ↻. Repeat in successive cam slots until outer cam is against clockwise stop.
5. Check motor stroke before connecting linkage.
6. Disconnect 135 ohm pot, reconnect controller, replace top cover on motor.
7. Attach linkage to motor.

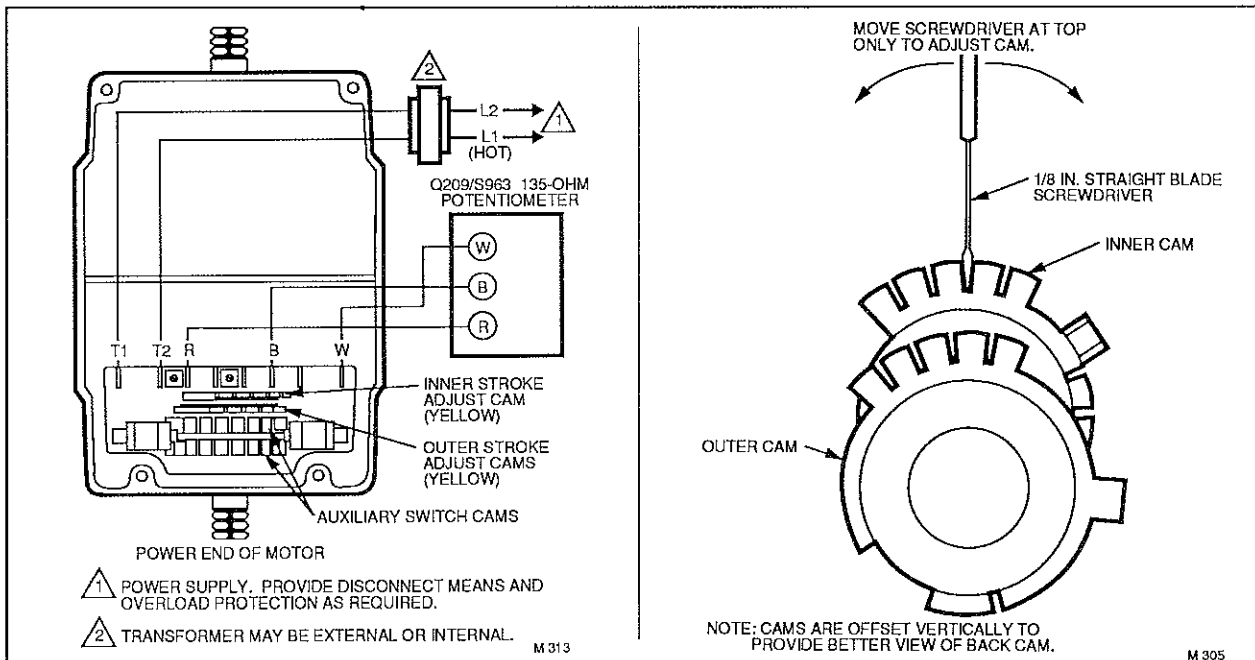


FIG. 21—STROKE ADJUSTMENT SETUP.

#### SETTING 90° STROKE (Fig. 21)

1. Turn trim pot fully counterclockwise.
2. Drive motor to mid-position, using 135 ohm pot or by jumping B-R-W.
3. Insert 1/8 in. screwdriver blade into slot on inner yellow cam and MOVE TOP OF SCREWDRIVER as far as possible clockwise (viewed from power end). Repeat in successive cam slots until inner cam is against clockwise stop.
4. Insert 1/8 in. screwdriver blade into slot on outer yellow cam and MOVE TOP OF SCREWDRIVER as far as possible counterclockwise. Repeat in successive cam slots until outer cam is against clockwise stop.
5. Check motor stroke before connecting linkage.
6. Disconnect 135 ohm pot, reconnect controller, replace top cover on motor.
7. Attach linkage to motor.

#### AUXILIARY SWITCHES

The auxiliary switches are spdt switches that are actuated by adjustable cams. The cams are mounted on the motor shaft at the power end of the motor. The settings of the cams determine the point in motor shaft rotation at which the the auxiliary equipment will be switched on or off. These cams can be set to actuate the switches at any angle within the stroke of the motor. Also, switch differential of 1° or 10° may be selected. TRADELINE motors are shipped with auxiliary switch cams which permit acceptance of Internal Switch Kits (220736A,B). Refer to installation sheet of 220736A,B to install kit.

Switching action and color coding are shown in Fig. 6.

Motors with factory added auxiliary switches are shipped in the closed position (counterclockwise, as viewed from power end) with auxiliary cams set to actuate switches 30° from the open position, and to provide 1° differential. With motor in the closed (full counterclockwise) position, auxiliary switch breaks R-B (Fig. 6). If differential

is changed to 10°, switch action is reversed; thus in the closed (ccw) position, R-B makes.

#### IMPORTANT

Do not turn motor shaft by hand or with a wrench as damage to the gear train and circuit board stroke limit contacts will result.

#### AUXILIARY SWITCH SETTING PROCEDURE (Fig. 22)

#### CAUTION

Disconnect ALL power supplies to de-energize the auxiliary switches before servicing.

1. Remove top cover from motor to gain access to motor terminals and cam adjustments.
2. Disconnect controller from motor and connect 135 ohm manual potentiometer with R,W,B terminals on pot connected to corresponding terminals on motor (Fig. 22).
3. Adjust 135 ohm pot so that motor shaft turns to position where auxiliary equipment is to be switched.
4. Insert a 1/8 in., straight-blade screwdriver into slot on cam associated with selected auxiliary switch. The inner (blue) cam actuates the inner (right) switch, the outer (red) cam actuates the outer (left) switch. MOVE TOP OF SCREWDRIVER to set cams. Each click is approximately 2 degrees of rotation.
5. For switch differential of 1°, check continuity of auxiliary switch R-B contact and rotate cam as follows:
  - a. If contacts are open, rotate cam clockwise until R-B contacts close.
  - b. If contacts are closed, rotate cam counterclockwise until R-B contacts open.
6. For switch differential of 10°, check continuity of auxiliary switch R-B contacts and rotate cam as follows:

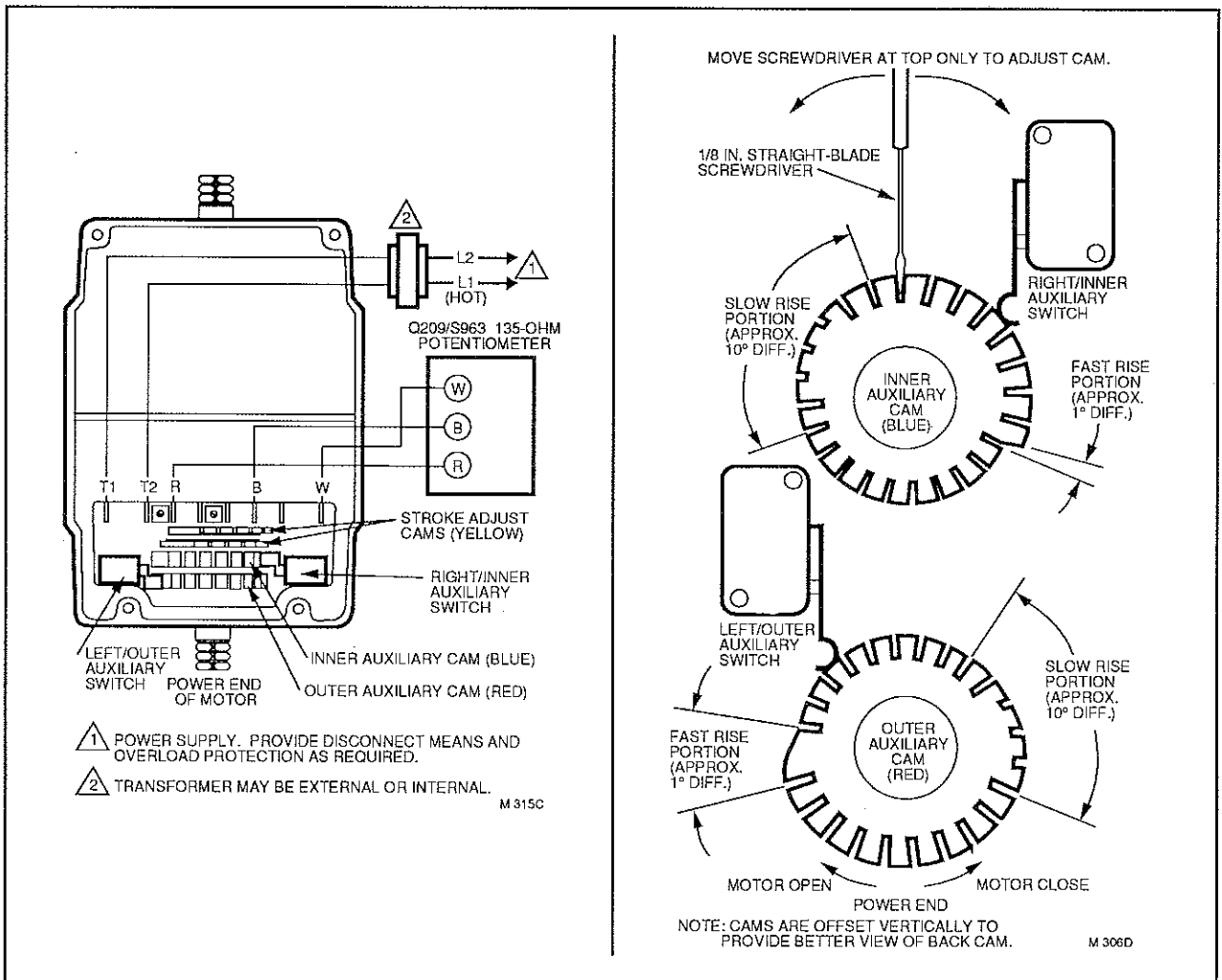


FIG. 22—AUXILIARY SWITCH ADJUSTMENT.

- a. If contacts are open, rotate cam counterclockwise until R-B contacts close.
- b. If contacts are closed, rotate cam clockwise until R-B contacts open.
- c. Final adjustment in the proper direction should be made to obtain contact make or break at the desired position.

7. Check for proper differential and switching of auxiliary equipment by running motor through full stroke (in both directions), using 135 ohm pot. Repeat adjustment if necessary.

8. Disconnect 135 ohm pot, reconnect controller, replace top cover on motor.

## OPERATION AND CHECKOUT

### MODULATING SERIES 90 CIRCUIT

The potentiometers, one in the controller and one in the motor, along with resistor network, form a bridge circuit. As long as the value of the controlled medium remains at the controller set point, the circuit is balanced, and the motor does not run.

When the value of the controlled medium changes, the potentiometer wiper in the controller is moved, which unbalances the bridge circuit. This unbalance is amplified, and energizes Triac switching to run the motor in the direction necessary to correct the change in temperature or pressure. The motor turns the feedback potentiometer to rebalance the circuit and stop the motor.

### CHECKOUT

After installation and linkage adjustment, check the

entire motor and control hookup to ensure that—

- the motor operates the damper or valve properly.
- the motor responds properly to the controller.

Inspect the motor, linkage, and valve or damper to see that all mechanical connections are correct and secure. In damper installations, the pushrod should not extend more than a few inches past the ball joints. Check to see that there is adequate clearance for the linkage to move through its stroke without binding or striking other objects.

Check to see that cams operate the auxiliary switches, if used, at the desired point of motor rotation.

NOTE: M9184/M9194 motors are shipped in the fully closed position (the limit of counterclockwise rotation as viewed from the power end of the motor).

SERIES 90 MOTORS OPERATION CHECK WITH MODUTROL MOTOR DISCONNECTED FROM CONTROLLER.

STEP	ACTION	RESPONSE	IF NO OR LIMITED RESPONSE
1.	Apply 24 Vac <sup>a</sup> .	None	—
2.	Open terminal B and short R to W.	Motor drives closed.	Proceed to Step 6.
3.	Open terminal W and short B to R.	Motor drives open.	Proceed to Step 6.
4.	Connect terminals R to B to W.	Motor must drive to mid-position.	Proceed to Step 6.
5.	Remove jumper wires. Check voltage between R to B <sup>b</sup> , and between R to W <sup>b</sup> . (Controller must be disconnected.)	17 to 20 volts.	No voltage or out of range. Proceed to Step 7.
6.	Motor does not drive.	Motor is defective.	Replace motor.
7.	Voltage out of range.	Motor printed wiring board defective.	Replace motor.
8.	Disconnect 24 Vac.	Spring return motors return to their normal mechanical position.	Spring mechanism defective —replace motor.

<sup>a</sup> Ensure motor transformer is sized properly. If a common transformer is used to power multiple motors, ensure power input is in phase with all motors.

<sup>b</sup> Motors may operate in Series 90 or two-position control applications. However, checking voltage between terminals R to B and R to W is necessary to confirm proper operation in electronic (W973, 4 to 20 mA etc.) applications.

## CHANGE-OUT

### IMPORTANT

- a. M9184/M9194 motors cannot replace slave motors in mechanical balancing relay master-slave motor systems (systems in which one master motor drives the other motors with Q68 Auxiliary Potentiometer). M9184/M9194 motors can replace the master motor.
- b. M9184/M9194 motors cannot be used with series 60 floating controllers.

In replacement applications, install and wire M9184/M9194 Mod Motors to operate the same as motor being replaced. If the M9184/M9194 replaces the master motor in a mechanical balancing relay master-slave motor system, attach the Q68 to the M9184/M9194.

### DAMPER APPLICATION

1. Turn off power to and remove wiring from the old actuator.
2. Remove crank arm from shaft of old actuator and remove the old actuator.
3. Check to see whether or not the adapter bracket is needed. If the linkage can reach the lower shaft position of the new actuator and the crank arm has clearance for the needed rotation, then the bracket is not needed. Use the

220738A Adapter Bracket or 221455A crank arm if the crank arm must rotate through the bottom plane of the motor (for damper applications).

4a. If the bracket is not needed, mount the new actuator directly to the equipment and refer to the INSTALLATION, SETTINGS & ADJUSTMENTS, and CHECKOUT sections of these instructions as needed.

4b. If the bracket is needed, refer to the Adapter Bracket sections and see Figs. 3 and 4 as well as the INSTALLATION, SETTINGS & ADJUSTMENTS, and CHECKOUT sections of these instructions.

5. Use old mounting bolts to mount the new actuator.

6. Mount the crank arm and linkage to the shaft of the new actuator.

7. Use the CHECKOUT procedures to test the proper adjustment of the crank arm and linkage.

### VALVE APPLICATION

When installing a M9184, M9194 motor in a valve application which has a Q100, Q455, Q601 or Q618 it will be necessary to use the Adapter Bracket (Part No. 220738A) to raise the motor shaft to the same height as that of the old motor.

Ensure that the motor stroke is 160° to control Honeywell V5011 two-way or V5013 three-way valves.