YORK®

CodePak™

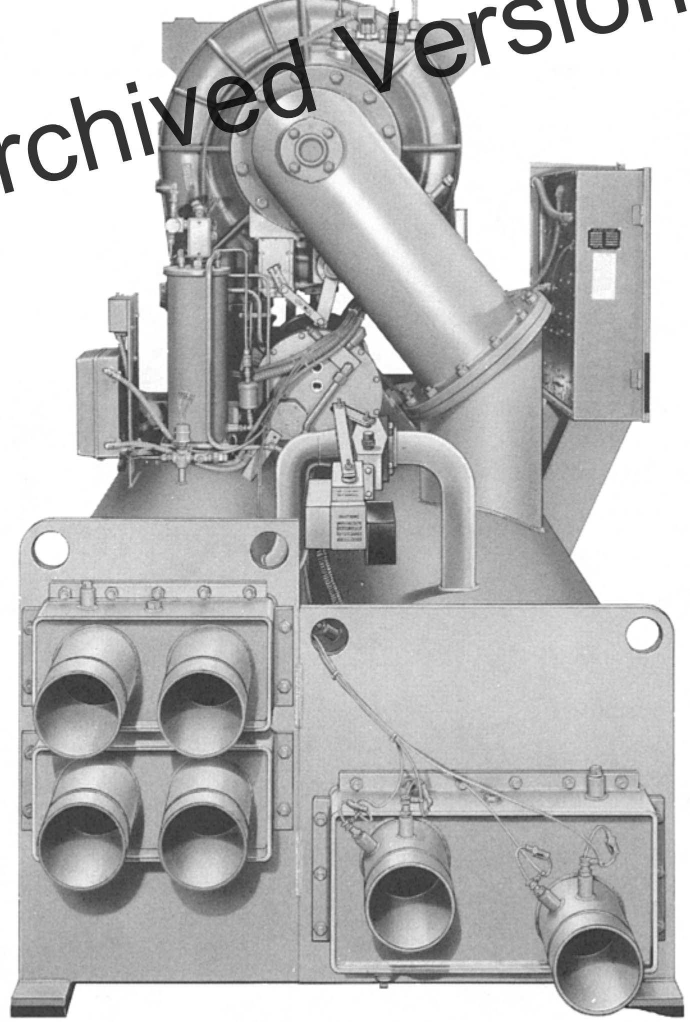
CENTRIFUGAL LIQUID CHILLERS

INSTALLATION & OPERATING

Supersedes: 160.46-NO2(988) | 591 | FORM 160.46-NO2

MODEL YT A1 M1 B1 THRU YT L6 X6 F2 (STYLE E & F) HEAT RECOVERY

150 THRU 1000 TONS



REFERENCE LITERATURE

FORMS

160.46-N1 - Installation
160.46-O1 - Operating & Maintenance
160.46-PA1.2 - Dimensions & Physical Data
160.46-PA1.5 - Nozzle Arrangements
160.46-PA2.2 - Heat Recovery Wiring Diagram (Style E)
160.48-PA7 - Heat Recovery Wiring Diagram (Style F)

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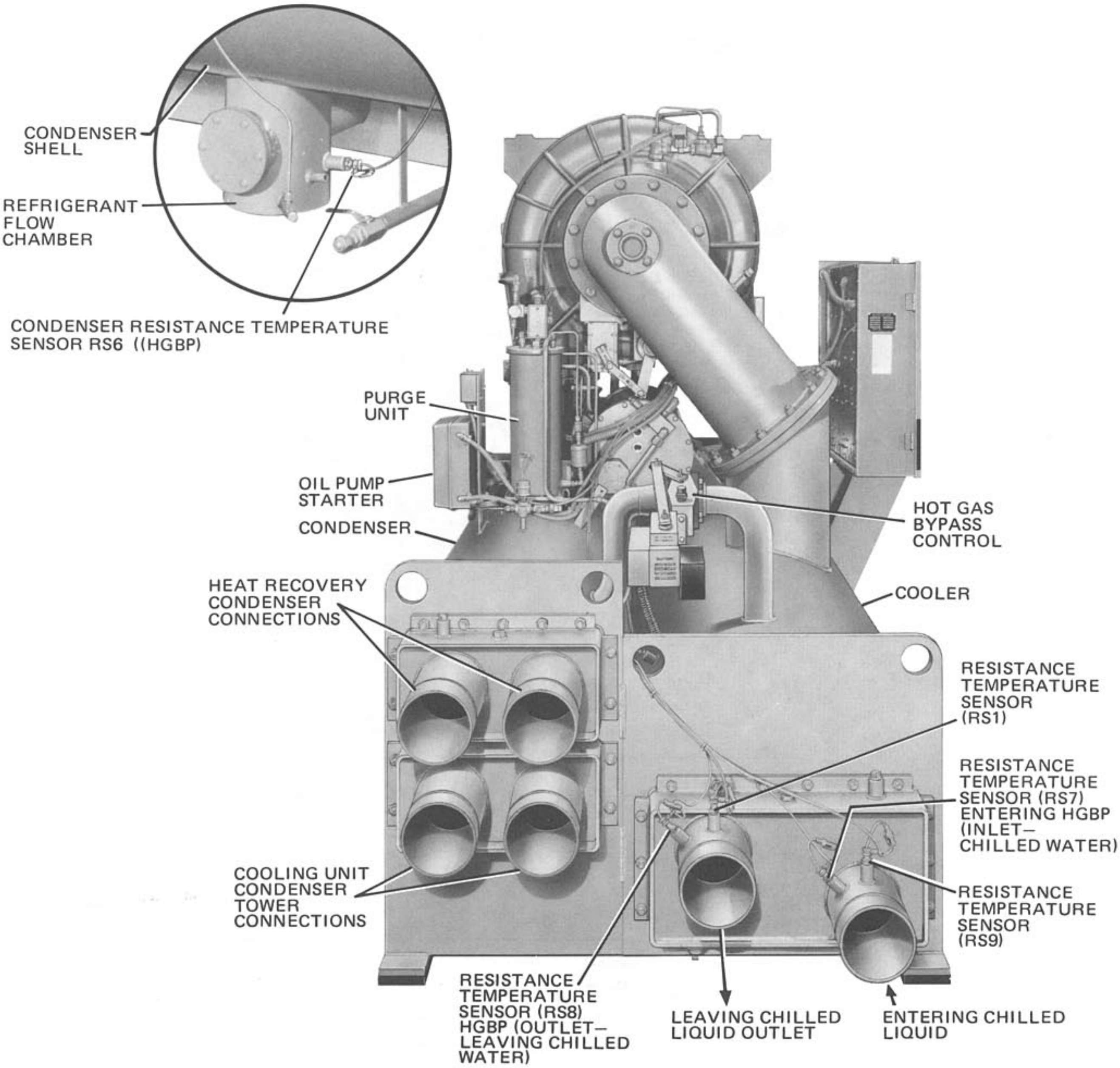

FIG. 1 — LOCATION OF RESISTANCE TEMPERATURE SENSORS

HEAT RECOVERY CODEPAK

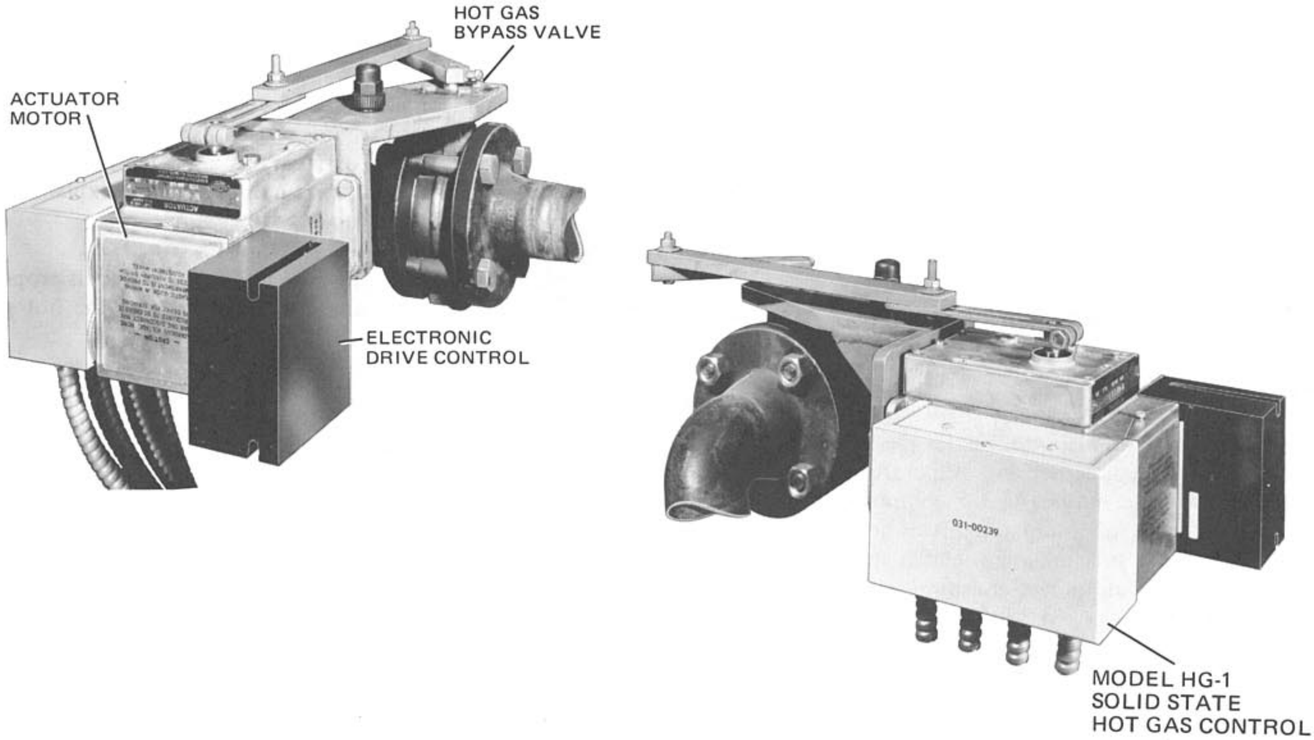

FIG. 2 – HOT GAS BYPASS VALVE AND CONTROLS

INTRODUCTION

The Heat Recovery type Codepak utilizes a double bundle condenser which contains two separate water circuits – one for the cooling tower circuit and one for a hot water circuit. The refrigerant circuit is common for both tube bundles.

The heat recovery Codepak includes a hot gas by-pass system completely factory assembled and wired consisting of a hot gas valve, external electric actuator motor and linkage, and a solid state sensing control. This control senses entering and leaving chilled water temperature to indicate load and also measures the condenser refrigerant temperature to indicate head. Both measurements are compared to an adjustable reference point to activate the hot gas valve. Hot gas is actuated when necessary and only in the amount required for stable and efficient chiller operation.

Heat Recovery Water Pump

A typical water piping is shown in the standard Installation Instructions (Fig. 7). Each application may require different approaches in accordance with the building or job design. The water pump should be wired to suit.

Hot Gas By-Pass Control System (Refer to Heat Recovery - Hot Gas By-Pass Wiring Diagram Form 160.46-PA2.3 - Style E 160.48-PA13 - Style F.)

COMPONENT DESCRIPTION

1. **Heat Recovery Hot Gas By-Pass (HGBP)** – The Hot Gas arrangement is used to prevent the compressor from surging at light loads and consists of the following devices mounted external to the control panel.

   (1) Resistance Temperature Control Sensor RS6 – This thermistor device, located in the condenser liquid, senses the condenser liquid temperature and provides a signal to hot gas control HG-1.

   (2) Resistance Temperature Control Sensor RS7 – This thermistor device senses the return chilled liquid temperature and provides a signal to the hot gas control HG-1.

   (3) Resistance Temperature Control Sensor RS8 – This thermistor device senses the leaving chilled liquid temperature and provides a signal to hot gas control HG-1.

(4) Hot Gas Control HG-1 – This solid state control requires Resistance Temperature Sensors RS6, RS7, and RS8 as inputs in determining the DC output voltage which is fed to an electronic drive control which in turn modulates a hot gas valve motor.

START-UP

To start and operate the Heat Recovery Codepak refer to the standard operating instruction, with one exception. The heat recovery water pump should be operating or turned on when hot water is required to suit the job application.

HOT GAS CONTROL SYSTEM

Operation

The hot gas control system regulates the flow of refrigerant gas between the condenser and evaporator during part load operation to avoid surging of the compressor. This system supplies only the minimum amount of hot gas necessary to prevent surging and maintain chiller operation at high efficiency (minimum power consumption). The basic components are a motorized hot gas bypass valve, an HG-1 electronic hot gas controller, an electronic actuator motor drive between the controller and the motor and three identical thermistor temperature sensing elements.

The temperature sensing elements are located in the return (entering) chilled liquid, the supply (leaving) chilled liquid and in the condensed refrigerant. The sensor resistance varies with the sensed temperatures as shown in Table 1.

TABLE 1 – TEMPERATURE SENSOR RESISTANCE

Sensor Temperature (°F)	Sensor Resistance* (Ohms)
120	1130
115	1260
110	1400
105	1560
100	1750
95	1960
90	2200
85	2480
80	2790
77	3000
75	3150
70	3560
65	4040
60	4590
55	5230
50	5970
45	6830
40	7830
38	8280
32	9800
30	10370

*Resistance values within ± 1%.

The sensor resistance signals are used as inputs to the HG-1 electronic hot gas bypass controller. The controller electronically computes the difference between the entering and leaving chilled liquid temperatures to provide a measure of the chiller cooling load (assuming constant chilled liquid flow). The condensing temperature signal is used to provide an electrical signal which is proportional to the compressor head. These signals are electronically compared to four control settings which are individually determined for each system during actual operation: "Ch. Liquid Temp. Range", "Condensing Temp.", "Ratio" and "Sensitivity". The function of each of these controls will be explained in detail in the System Calibration procedure.

The HG-1 produces a control signal output which is proportional to the required amount of opening of the hot gas valve.

The HG-1 output signal is used to control an electronic drive control. This device is used as an interface control between the hot gas controller and the actuator motor. As such, it receives the proportional signal and operates the actuator motor until it reaches the desired position. The hot gas bypass valve is connected to the actuator motor shaft by a linkage and opens and closes in response to the movement of the shaft. The electronic drive control also contains a DC voltage supply which is used to power the HG-1 circuitry. 115V supply voltage for the system is obtained from the control center.

System Calibration

Hot gas system calibration consists of operating the chiller at two different light surge conditions, making some temperature measurements and adjusting the HG-1 controls. By referring to Fig. 3 & 4, the adjustment procedure can be most easily visualized.

The calibration procedure is as follows:

1. Preset the HG-1 control adjustments:

   (a) Ch. Liquid Temp. Range: Fully counterclockwise.

   (b) Condensing Temp.: Fully clockwise.

   (c) Ratio: 3.

   (d) Sensitivity: Fully counterclockwise.

   Hot gas bypass valve should be closed at this time.

2. Run chiller at a load condition where unit just begins to surge using manual vane control. Accurately measure condensing temperature and entering and leaving chilled liquid temperatures.

3. Subtract the leaving chilled liquid temperature from the entering chilled liquid temperature. The difference (corresponding to ΔT_1 in Fig 4) should be used as the setting for the "Ch. Liquid Temp. Range" control.

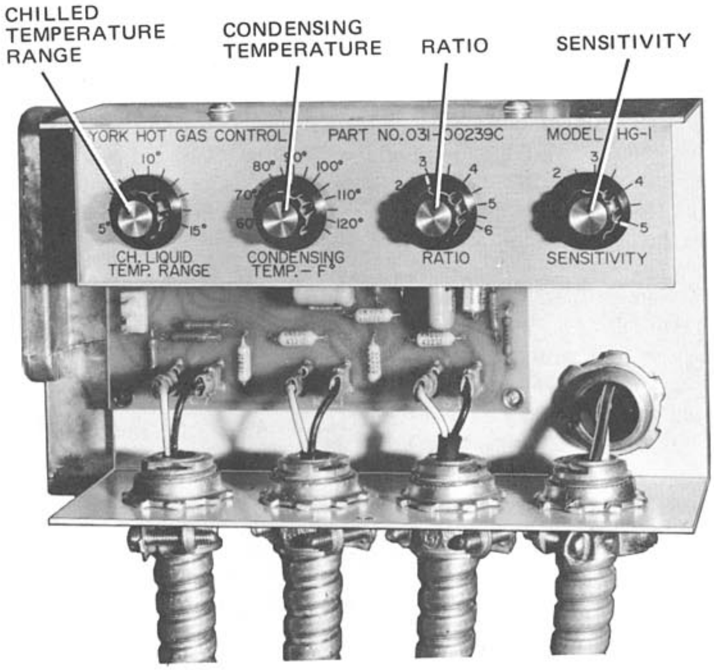

FIG. 3 — MODEL HG-1 WITH COVER REMOVED

4. Use the condensing temperature reading as the "Condensing Temp." setting on the HG-1 control. This corresponds to CT_1 in Fig. 4.

5. Run the chiller at a different load condition until the unit begins surging. Measure the temperatures as in Step 2.

6. Compute the difference between the measured entering and leaving chilled liquid temperatures. This corresponds to ΔT_2 in Fig. 4.

7. Find the difference between the condensing temperatures in both runs and divide it by the difference in the chilled liquid ranges, i.e., $(CT_1 - CT_2) \div (\Delta T_1 - \Delta T_2)$. The result is the "Ratio" setting on the HG-1 control, which corresponds to the slope of the system surge line.

8. With the HG-1 adjusted to the settings found in the previous sections, adjust the "Sensitivity" control slightly past the point where the hot gas valve is open sufficiently to eliminate surging. Adjust the "Sensitivity" control in small increments, allowing the valve actuator motor to run and stop between adjustments. Careful adjustment provides sufficient hot gas to eliminate surging without causing inefficient operation resulting from excessive hot gas injection.

NOTE: If system parameters are known, the "Ratio" setting can be calculated from the change in condensing temperature for each degree change in chilled liquid temperature range. Then it is only necessary to run the chiller at one setting to make all adjustments (Steps 1, 2, 3, 4 and 8).

To better understand the calibration and operation of the hot gas control system an example follows: The chiller is run until it just begins to surge. At this point, the following temperatures are measured: SLT = 45°F, RLT = 55°F and CT = 105°F. The HG-1 control settings are "Ch. Liquid Temp. Range" = 10°F (ΔT_1 = 55° – 45°) and "Condensing Temp." = 105°F (CT_1). These points correspond to Operating Point 1 in Fig. 1. The chiller is then run at a different load condition (Operating Point 2) until surging occurs and the following temperatures measured: SLT = 45°F, RLT = 50°F and CT = 90°F. From these readings the cooling range is computed as 5°F (ΔT_2). Thus, the "Ratio" setting will be "Ratio" = ([105–90] ÷ [10–5]) = 3. After these settings are made, the "Sensitivity" should be adjusted just enough to eliminate surging. The, with SLT = 45°F, and RLT = 50°F, whenever the condensing temperature exceeds 90°F, the hot gas valve will open. When the condensing temperature falls below 90°F, the hot gas valve will close.

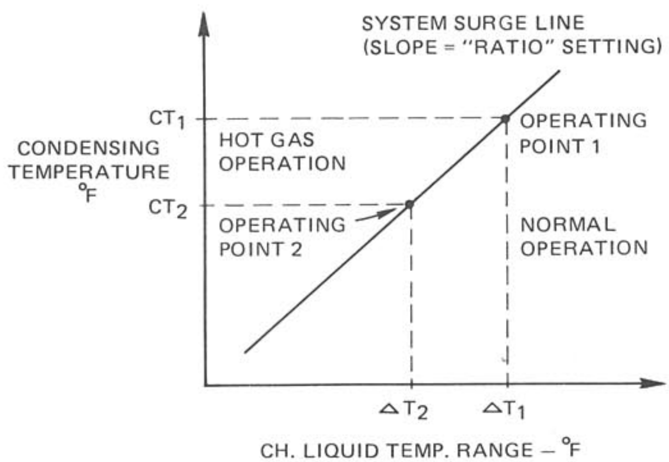

FIG. 4 — SYSTEM OPERATION

Troubleshooting the Hot Gas Bypass System

The entire hot gas bypass system is given complete operational tests at the factory. The only adjustments which need to be performed in the field are the system calibrations described in the previous section. Before replacing any components, make the operational checks described in the following sections to locate the defective component.

Check to see that all components are properly connected per the wiring diagram Form 160.45-PA2.8. With power applied to the main control center, the actuator motor should have 115 VAC between terminals L1 and L2. The voltage measured between the red (+) and blue (–) wires which are spliced in the motor terminal box should be 20 ± 1 VDC when measured with a sensitive voltmeter (Simpson Model 260 or equal). If this voltage is not correct disconnect the red, blue and yellow wire splices in the motor terminal box. Measure the voltage between the red and blue wires coming from the actuator motor drive control. If the voltage is correct, the HG-1 control is defective. If the voltage is not within the specified range the actuator motor drive is defective.

Check sensor wiring and location. Sensor RS6 should be connected to CT terminals (1, 2) on HG-1 and be installed in a well under the condenser. Sensor (RS7) should be connected to RLT terminals (3, 4) and installed in return (entering) chilled liquid line. Sensor RS8 should be connected to the SLT terminals (5, 6) and installed in the supply (leaving) chilled liquid line. The sensors utilize a thermistor temperature sensing element which resistance changes with variations in sensed temperature. The sensor body and tip must be coated with heat conduction compound to provide rapid, accurate response. To properly check resistance, disconnect the wires and remove the sensing unit from its well. Immerse the sensor bulb in a container of water, but do not wet the electrical connections.

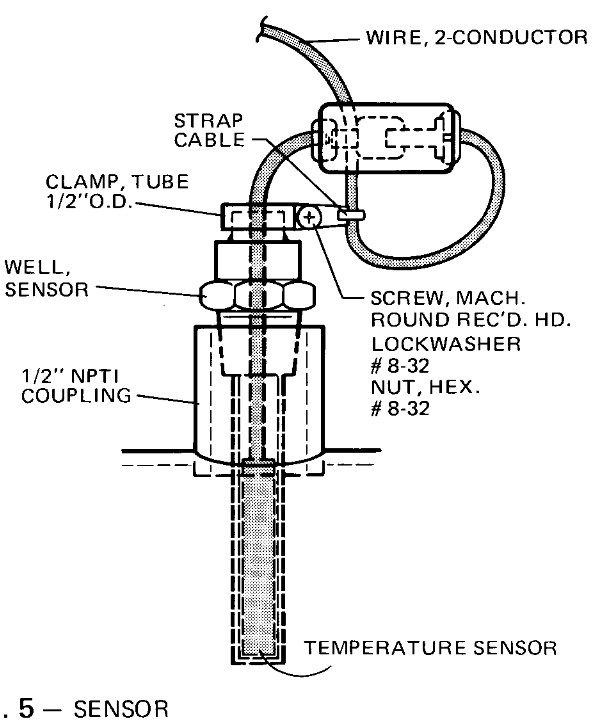

FIG. 5 – SENSOR

Using a precision thermometer, adjust the temperature of the water surrounding the sensor by adding water as necessary to bring the water temperature into the range shown in Table 1. The probe must be agitated in the water for a minimum of two minutes at a constant temperature to make an accurate measurement. If it is necessary to install a new temperature sensor, the sensor should be replaced in its well after applying a light coating of heat conduction compound (York Part No. 013-00898) to the side and bottom of the sensor. Electrical connections should be made to the terminal block in the well assembly. Make sure the sensor is fully inserted and touching the bottom of the well.

Operation of the actuator motor may be checked by disconnecting and insulating the wires connected to motor terminals 2 and 3. Connecting a jumper wire between terminals X and 2 should cause the motor shaft to rotate in the clockwise direction. Connecting a jumper wire between terminals X and 3 will cause the motor to rotate counterclockwise. If the motor is at either end of its travel, an internal limit switch is operated to disconnect the motor winding from the control terminal (2 or 3). Thus, it may be necessary to first operate the motor in the opposite direction to close the limit switch in order to check the operation of the other winding. With the motor in an intermediate position (not at either limit of its travel) the voltage between terminals X and 2 or X and 3 should be about 25 VAC. If this voltage is not correct, the motor is defective. Reconnect the wires to terminals 2 and 3 before proceeding with the trouble shooting procedure. If it is necessary to replace the actuator motor, the valve linkage should be installed with the motor in its fully clockwise position and the valve closed.

To check for proper operation of the actuator motor electronic drive control, it is necessary to disconnect the 115 VAC power to the unit. Disconnect the splices in the red, blue and yellow wires located in the motor terminal box. Connect a 1000 ohm, (1 watt or greater) potentiometer or rheostat (variable resistor) as shown in Fig. 7 Connect a sensitive DC voltmeter between the yellow (+) and blue (–) leads. With the variable resistor set such that the measured voltage is less than 4 VDC, the motor should move to its clockwise limit and stop. Moving the wiper such that the voltage is increased into the range of 5.5 to 6.5 VDC, the motor should begin to move in the counterclockwise direction. Changing the wiper position in small increments, such that the voltage increase is about 0.5 VDC, should cause the motor to rotate and stop in short intervals. By repeating this procedure, the motor should move through its entire counterclockwise rotation with about a 2 volt change in signal. By reversing this procedure and incrementally reducing the voltage signal, the motor should rotate fully clockwise and stop.

If the motor does not move in both directions as described above, either the electronic drive assembly is defective or the actuator motor feedback potentiometer is dirty. Before replacing the electronic drive assembly, remove the back cover from the actuator motor and clean the feedback resistance element and its wiper with TV tuner cleaner or relay contact cleaner. Repeat the test procedure; if the system functions properly, it should be assumed that a dirty feedback potentiometer was the cause of the problem.

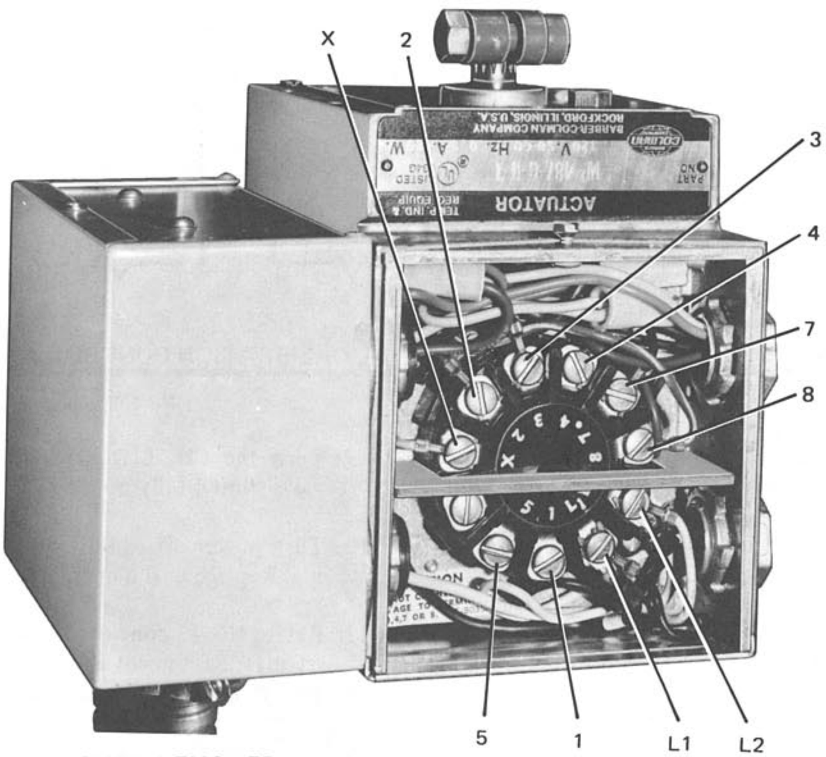

FIG. 6 – ACTUATOR WITH COVER REMOVED

If this has not corrected the problem, replace the electronic drive control and proceed to the following section for details on the adjustment of replacement electronic drive units.

If the previous testing has shown the sensors, actuator motor and electronic drive unit to be functional, the HG-1 control should be assumed defective and replaced. Before removing the HG-1 control, the four control settings should be noted so that it is not necessary to repeat the entire system calibration when the new control is installed. When replacing either the HG-1 control or the solid state actuator drive unit, it is necessary to adjust an internal calibration control in the drive unit to insure proper tracking of this control with the HG-1 output signal. To accomplish this, the use of a special test device (see Figure 8) or three precision resistance decade boxes is requied.

The following is the adjustment procedure to be followed after replacing defective solid state controls:

1. Connect marked leads from adjustment fixture to terminals CT, RLT, and SLT on HG-1 control (Part No. 031-000239).

2. Preset adjustments on HG-1 control as follows:

CH. LIQUID TEMP. RANGE	– 10°
CONDENSING TEMP.	– 90°
RATIO	– 3
SENSITIVITY	– 3

3. Remove oval nameplate from actuator motor control (Part No. 025-20799).

   NOTE: Nameplate is attached with self-adhesive backing and will be re-installed at completion of adjustment procedure.

4. Apply power to circuit (115 VAC to terminals L1 and L2). If actuator motor begins rotating allow it to stop before proceeding to the next paragraph.

5. Using a small screwdriver, slowly turn the adjustment screw on actuator motor counterclockwise until actuator motor begins to move. NOTE: Adjustment screw is located in hole exposed when nameplate is removed. Actuator motor shaft must move in counterclockwise direction.

6. Carefully turn the adjustment screw clockwise in small increments, allowing the actuator motor to run and stop between increments of adjustment. Continue to make these adjustments until the actuator motor stops at the limit of its clockwise rotation due to operation of its internal limit switch (listen for "click" when limit switch operates).

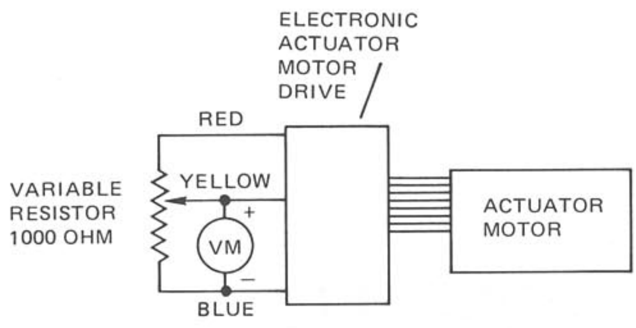

FIG. 7 – VARIABLE RESISTOR CHECK

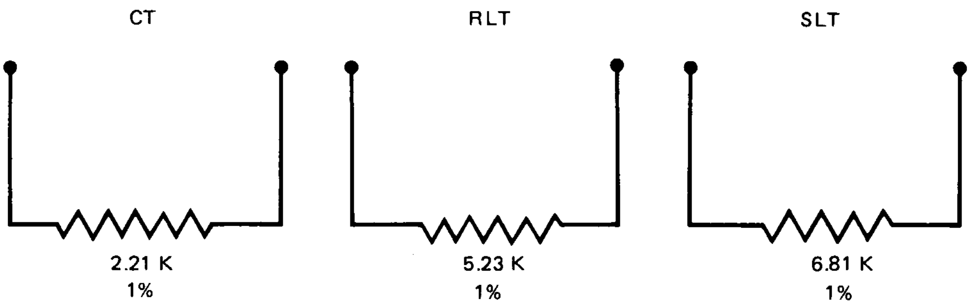

FIG. 8 – SPECIAL TEST DEVICE TO ADJUST AN INTERNAL CALIBRATION CONTROL – HG1

7. At this point, the hot gas control system is calibrated with actuator motor in its fully clockwise position (bypass valve closed).

8. Turn the CH. LIQUID TEMP. RANGE knob to 12°. The actuator motor should rotate counterclockwise and the valve should open partially.

9. Turn the CH. LIQUID TEMP. RANGE to 13°. The valve should fully open.

10. Turn power off and disconnect adjustment fixture wiring. Replace oval nameplate on actuator motor.

11. Reset HG-1 control to original system calibration settings. Reconnect RS6, RS7 and RS8 sensors. The hot gas bypass control system should now be operational.