JOHNSON
PNEUMATIC CONTROL

OPERATORS MANUAL

JOHNSON SERVICE COMPANY
MAIN OFFICE AND FACTORY, MILWAUKEE 1, WISCONSIN
DIRECT BRANCHES IN PRINCIPAL CITIES

FOREWORD

Your Johnson automatic control system is the result of three quarters of a century of progress and development by the pioneer in the automatic control industry. Every effort has been made to develop control equipment which will meet all of the exacting needs of the modern heating, ventilating and air conditioning plant. Yet your system is custom-made for your job. From the large variety of control equipment which the Johnson Service Company manufactures, units have been selected which will best meet your requirements and produce the results desired.

Your system has been installed, put in operation and adjusted by trained mechanics in the direct employ of the Johnson Service Company, and under the supervision of expert control engineers. From start to finish it has been the responsibility of one organization devoted to nothing else. It is a system in which you can take pride, and which will give many years of excellent service.

While it has been the objective of the Johnson Service Company to produce a control system which will require little attention, a reasonable amount of routine maintenance will reward the owner by assuring continuous high performance, and will help to avoid later and more extensive attention. The purpose of this manual is to provide the owner with general instructions for maintenance of his control system. It is recommended that someone be made responsible for this activity, and that the maintenance instructions be followed carefully.

The Johnson Service Company maintains a service organization throughout the principal cities of the United States and Canada, which is available by calling your nearest Johnson branch office. You are invited to make use of this service facility whenever it is required. Similar service is available through Johnson sales agencies in many foreign countries.

I
PNEUMATIC CONTROL SYSTEMS

A. COMPONENTS OF A PNEUMATIC CONTROL SYSTEM (See Fig. 1)

1. Controllers (thermostats, humidostats, pressure regulators, etc.)
2. Controlled devices (valves, damper operators, etc.)
3. Air piping and distribution system.
4. Air compressor, filter and reducing station.

B. HOW A TYPICAL PNEUMATIC CONTROLLER WORKS

Air from the compressor is supplied to each controller at a constant pressure, usually 15 psi, and the controller in turn is connected to the valve or damper operator it actuates. The function of the controller is to apply a variable pressure to the controlled device in accordance with variations in the condition being controlled. The controller, in a sense, is an automatically adjusted pressure reducing valve.

A pneumatic relay is the part of a controller which actually regulates the control air pressure. To understand its operation, refer to Fig. 2 which shows a typical pressure reducing valve. Turning the adjusting screw to compress the adjusting spring causes the main valve to open, allowing the output pressure to increase. The output pressure, in turn, acts on the diaphragm to oppose the spring, and when the output pressure has increased sufficiently to balance the spring, the main valve again closes. Turning the adjusting screw to reduce the spring force allows the output pressure, acting on the diaphragm, to open the exhaust valve and vent the output pressure to atmosphere. When the output pressure has been reduced sufficiently, the adjusting spring closes the exhaust valve. For every value of spring force there is therefore a corresponding value of output pressure.

Fig. 3 shows how this reducing valve principle is applied to a thermostat. The lower diaphragm is the same as the diaphragm of Fig. 2. The spring and adjusting screw have been replaced by the upper diaphragm. Supply air pressure which is connected to the pin valve, passes through the chamber to the upper diaphragm and to atmosphere through the control port.

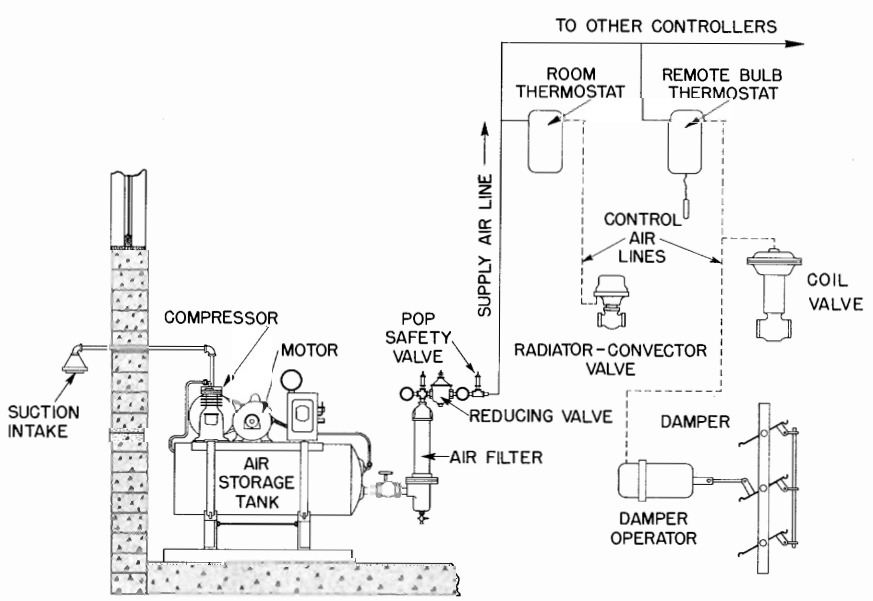


FIG. 1: TYPICAL PNEUMATIC CONTROL SYSTEM SHOWING THE VARIOUS COMPONENTS

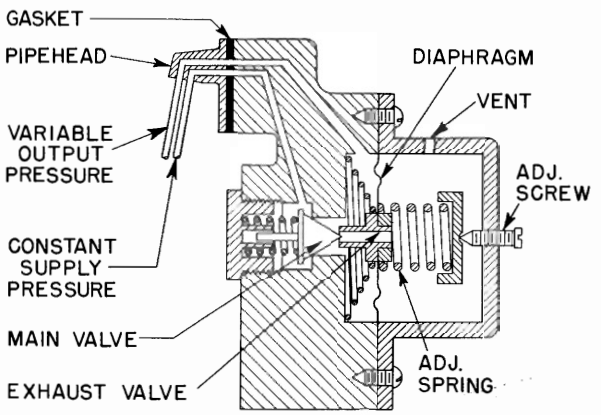


FIG. 2: TYPICAL PRESSURE REDUCING VALVE

The pin valve is adjusted so that when the control port is wide open, only a slight pressure exists in the upper diaphragm chamber. When the control port is closed, full supply pressure exists in this chamber. Any intermediate opening of the control port results in a proportionate pressure between minimum and maximum. Thus the variable pressure in the upper diaphragm chamber replaces the spring and adjusting screw of Fig. 2.

The control port in the room thermostat is opened and closed by the action of the bimetal element, which bends as the temperature changes.

C. SOME COMMON JOHNSON CONTROLLERS

Most Johnson controllers are comprised of a relay as described above, and a suitable sensing element of some sort arranged to operate the control port. Figs. 4 to 11 show typical Johnson controllers and explain their operation.

Sensitivity: Sensitivity is defined as the psi change in control pressure per degree change in temperature, percent change in relative humidity, etc. In most Johnson controllers the sensitivity is adjustable.

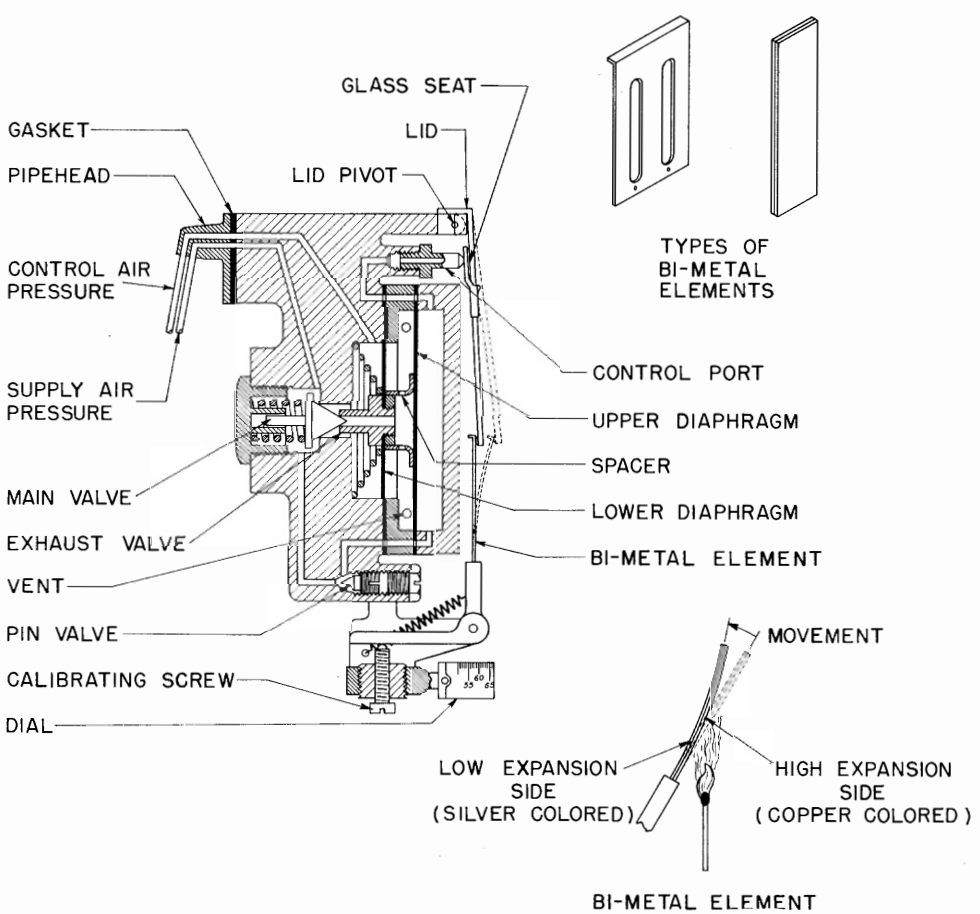


FIG. 3: TYPICAL ROOM THERMOSTAT AND BI-METAL ELEMENTS

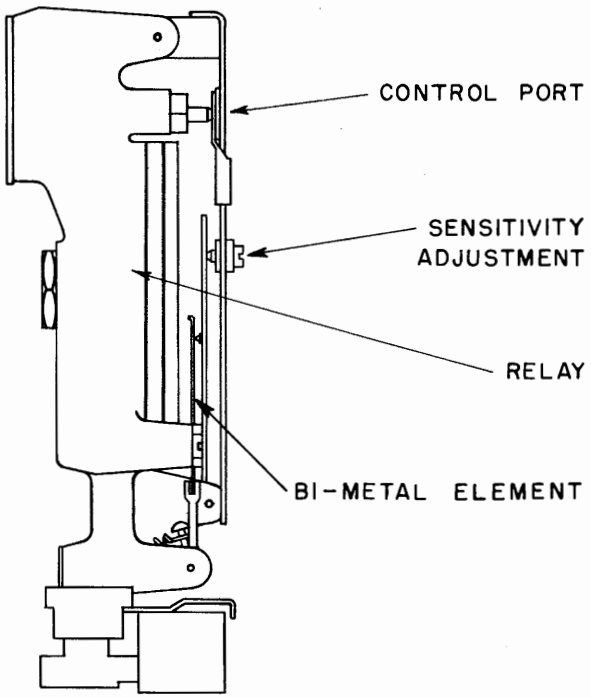


FIG. 4: BI-METAL THERMOSTAT WITH SENSITIVITY ADJUSTMENT

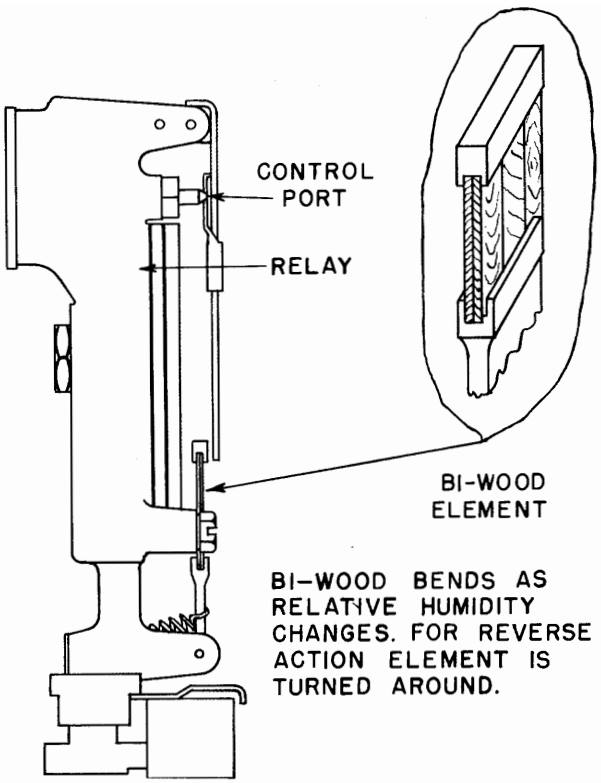


FIG. 5: BI-WOOD HUMIDOSTAT

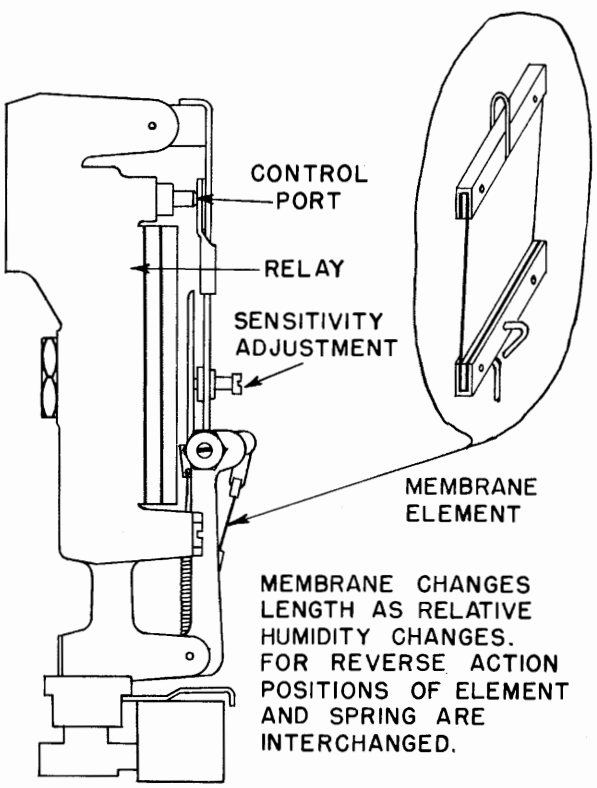
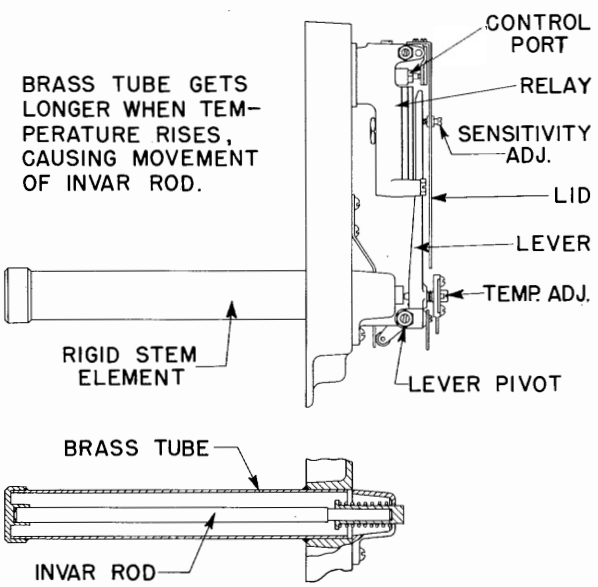


FIG. 6: MEMBRANE TYPE HUMIDOSTAT



CROSS SECTION OF RIGID STEM ELEMENT

FOR CONTROLLING DUCT TEMPERATURES FOR CONTROLLING LIQUID, ELEMENT IS PROVIDED WITH PIPE THREADS.

FIG. 7: RIGID STEM INSERTION THERMOSTAT.

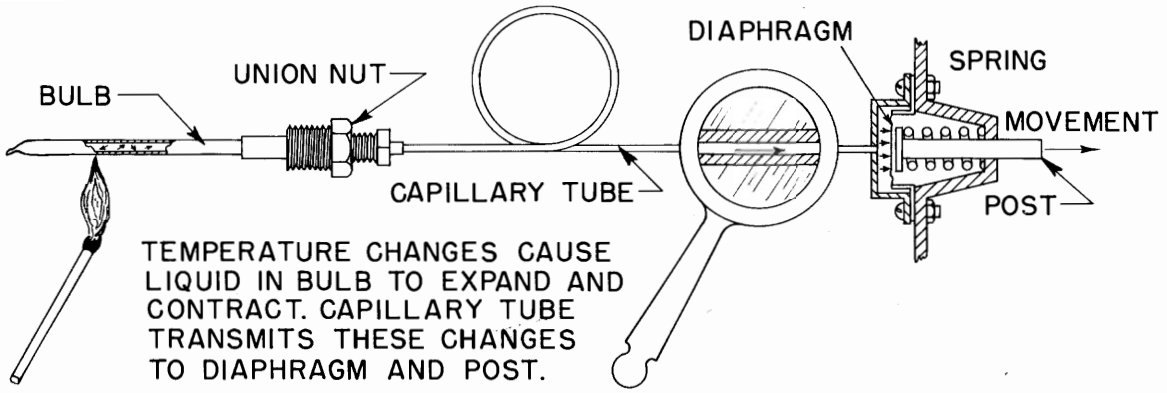


FIG. 8: LIQUID FILLED REMOTE BULB ELEMENT

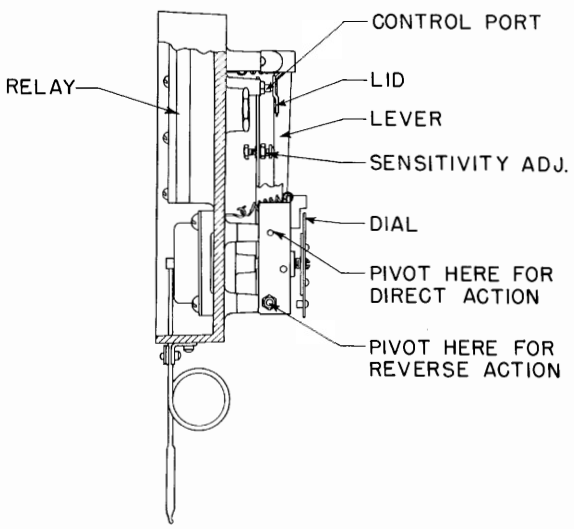


FIG. 9: THERMOSTAT WITH REMOTE BULB ELEMENT

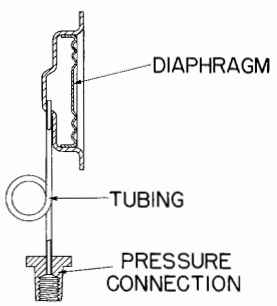


FIG. 10: PRESSURE ELEMENT

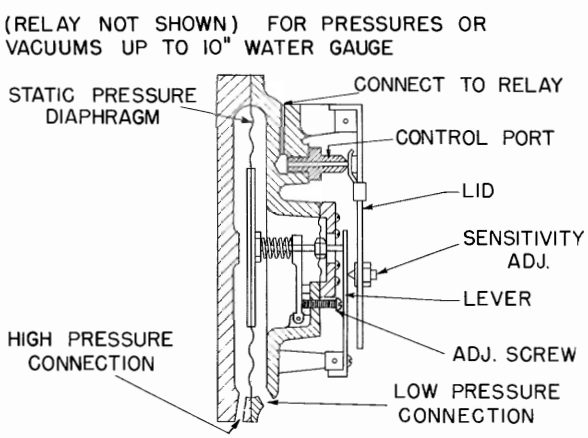


FIG. 11: STATIC PRESSURE REGULATOR

Non-Relay Thermostats

Non-relay thermostats use the control port pressure directly as the control pressure. They are limited in air capacity and are used only in certain applications.

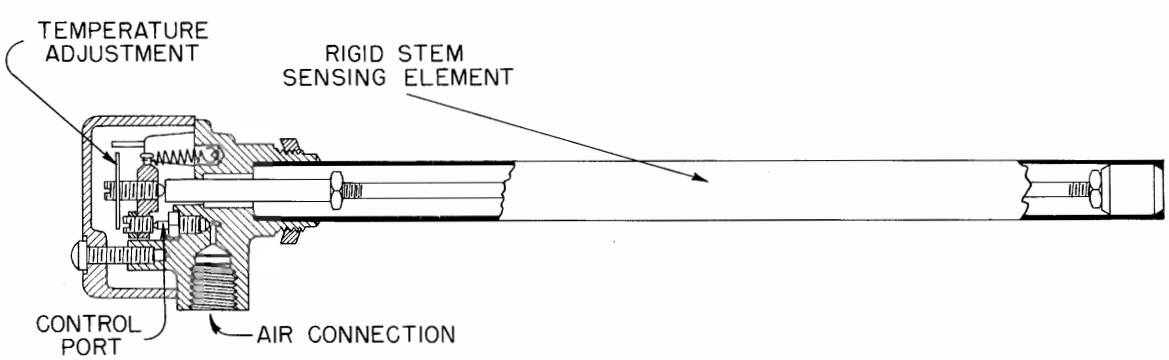


FIG. 12: NON-RELAY THERMOSTAT

D. CONTROLLED DEVICES

1. Dampers

Dampers are used for control purposes in a number of ways, some of which are illustrated in Figs. 13 to 16. Blades may have parallel operation, Fig. 16, or opposed operation, Figs. 13 and 14.

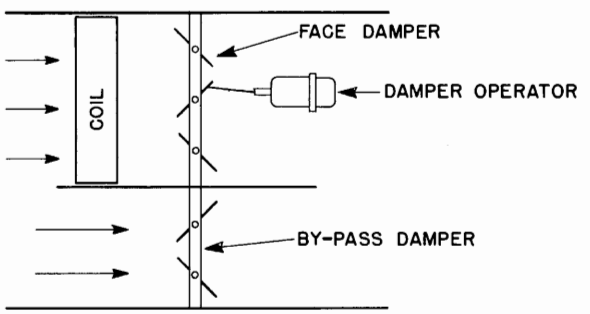


FIG. 13: FACE AND BY-PASS DAMPER PROPORTIONING TYPE

2. Piston Operators

Most Johnson damper operators are piston type, Fig. 17, which have a long stroke and require no amplifying levers. A special molded diaphragm provides a positive seal.

The piston is attached to the operator stem, and as air pressure is applied to the diaphragm, the piston and stem move outward against the force of the spring. The air pressure from the controller varies over the full range, usually 0 to 15 psi. However, the springs in the operator are so designed that full movement is obtained using only a portion of this range. 5 to 10 psi springs are the most common, and with such a spring the operator is in its normal position when the control pressure is between 0 and 5 psi (top view) and in its opposite-to-normal position when the control pressure is above 10 psi (bottom view). Between 5 and 10 psi the operator assumes a mid-position which is proportional to the air pressure. Other standard spring ranges are 3 to 8, 8 to 13, and 3 to 13 psi. Operators are mounted on the damper frame and connected directly to a louver, or are mounted externally on the duct and operate through a crank arm on a shaft extension.

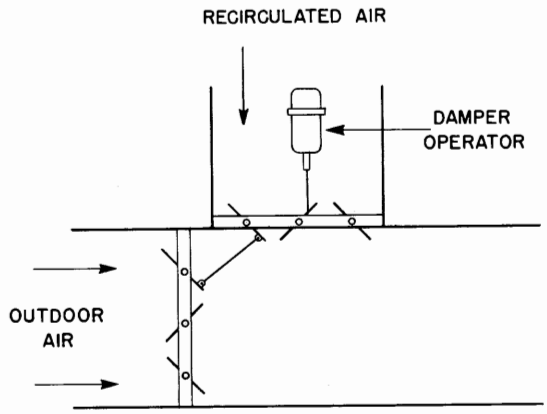


FIG. 14: OUTDOOR AND RECIRCULATED AIR MIXING DAMPER PROPORTIONING TYPE

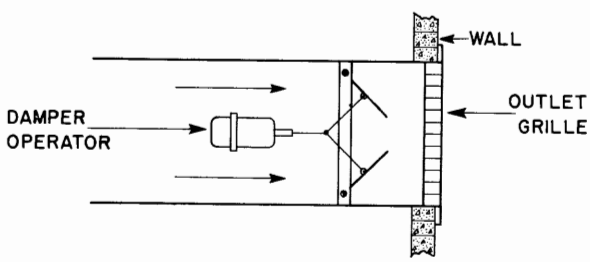


FIG. 15: VOLUME DAMPER

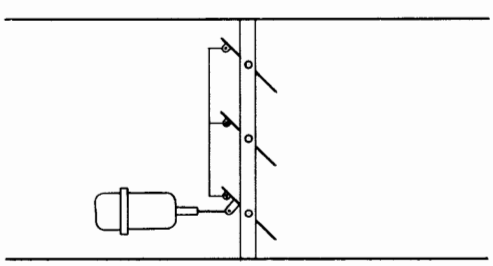


FIG. 16: DAMPER WITH PARALLEL OPERATING LOUVERS

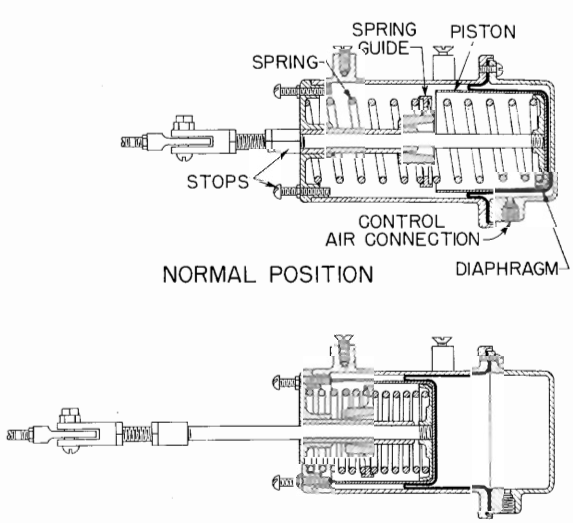


FIG. 17: PISTON DAMPER OPERATOR

3. Valves

Valve operators consist of a diaphragm or bellows, and a spring, Figs. 18 and 19. Their operation is similar to that described for damper operators, and standard spring ranges are 2 to 4, 3 to 6, 4 to 8, 7 to 11, and 9 to 13 psi. Bellows type valves are used mostly for radiators, convectors, and unit ventilators, where space is more restricted. Diaphragm valves are used on larger heating and cooling coils of central systems.

Several body patterns are available to meet various piping requirements, and a number of different types of inner valves are furnished, each having its own performance characteristics.

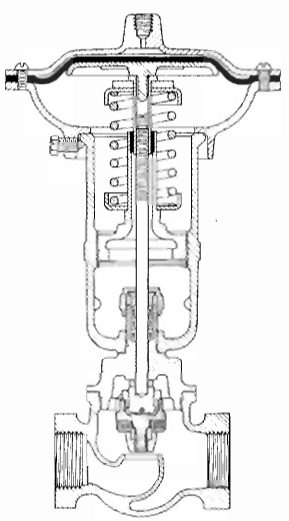


FIG. 18: TYPICAL DIAPHRAGM VALVE

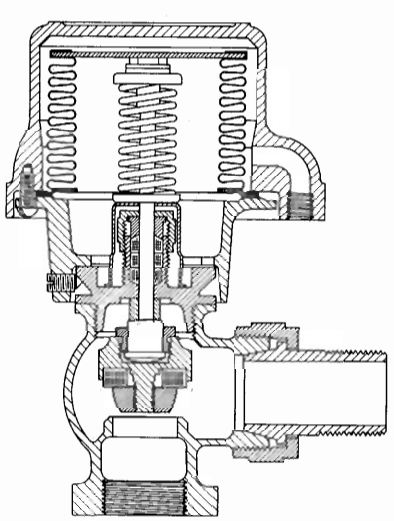


FIG. 19: TYPICAL SYLPHON VALVE

4. Miscellaneous Control Equipment

A *pilot positioner* may be applied to a valve, Fig. 20, or damper operator, Fig. 21, to provide more repositioning power or greater accuracy of positioning. It has a supply air connection, and supply and exhaust valves like a pneumatic relay. These valves are jointly operated by the pressure from the controller, and by the pilot spring attached to the operator stem. A small change in

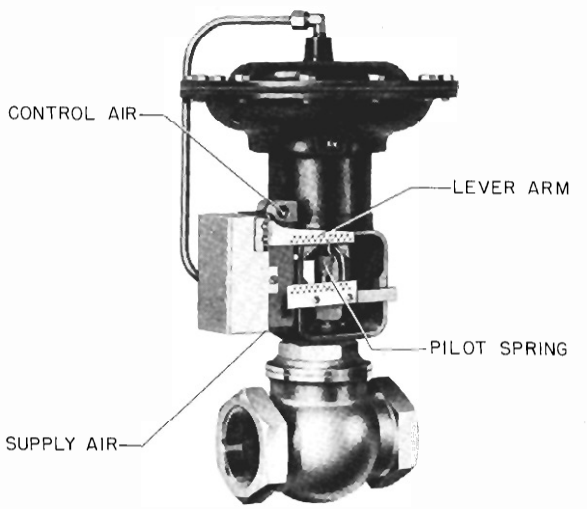


FIG. 20: TYPICAL VALVE WITH PILOT POSITIONER

control pressure can produce a large change in pressure on the operator until the stem moves sufficiently to cause the pilot spring to stop the operation.

When pilot positioners are used, the pilot spring determines the operating range of the valve or damper operator. This range is adjustable over wide limits.

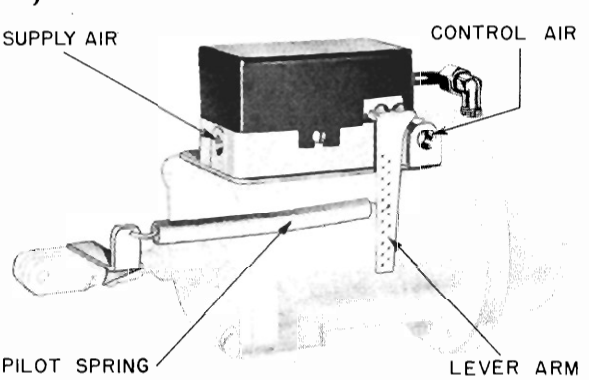


FIG. 21: PISTON DAMPER OPERATOR WITH PILOT POSITIONER

Cumulators, Fig. 22, are similar to relays except that they have no restrictor or control port and receive their variable pilot pressure from another controller. They are useful for reversing the action of a controller, converting from proportional to 2-position action, and for many special purposes.

3-Way Air Valves, Fig. 23, are used for switching purposes. They may be actuated by a manual pneumatic switch, or a 2-position controller, and are useful for automatic switching or switching from a remote point.

Solenoid Air Valves, Fig. 24, are similar to 3-way air valves except that they are operated electrically. A typical application is to close an outdoor air damper whenever the fan stops. There are many other uses for supplying or exhausting air when an electrical circuit is energized or de-energized.

FIG. 22: TYPICAL SINGLE POINT CUMULATOR

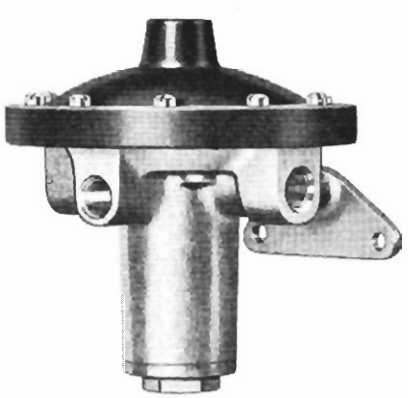


FIG. 23: 3-WAY AIR VALVE

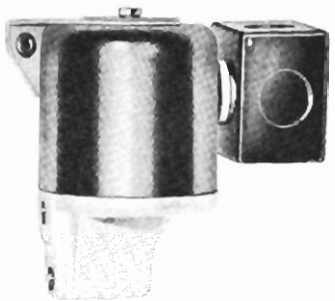


FIG. 24: THREE-WAY SOLENOID AIR VALVE

Pressure-Electric Switches, Fig. 25, are actuated by air pressure and open or close an electric circuit. Starting or stopping a refrigeration compressor, pump, fan, etc., are typical applications.

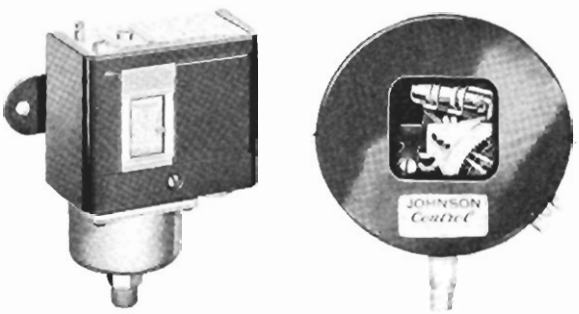


FIG. 25 PRESSURE ELECTRIC SWITCHES

Pneumatic switches are used for manually positioning various devices from a remote point. A gradual switch, Fig. 26, permits any position between open and closed. A selector switch, Fig. 27, has two or more connections and can position a device either

FIG. 26: GRADUAL SWITCH

FIG. 27 SELECTOR SWITCH

open or closed, or in some cases has a third position permitting automatic control. Various types of selector switches are available for a wide variety of switching functions.

5. Air Piping and Distribution System

The supply pressure for most single temperature controllers is 15 psi. Fig. 28 shows a typical air filter and reducing valve station for single pressure systems. In cases where two-temperature thermostats are used a dual supply pressure system is incorporated. The normal dual supply pressures used today are 15 psi and 19 psi. Older systems used 13 psi and 17 psi. The lower supply pressure is normally used for "day" control on dual thermostats and "heating" control for heating-cooling thermostats. The higher supply pressure then is used for "night" control on dual thermostats and "cooling" control on heating-cooling thermostats. Fig. 29 illustrates a typical filter and reducing valve station for dual pressure

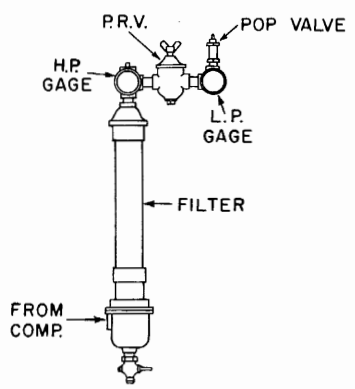


FIG. 28: SINGLE PRESSURE SYSTEM

systems and shows a 3-way air valve and switch for selecting either of the two pressures. Where it is not desired to switch all rooms to night control at the same time, the system may be divided into two or more circuits by installing additional switches and 3-way air valves.

Most air piping for the control system is concealed within the building structure, and except for possible damage due to building

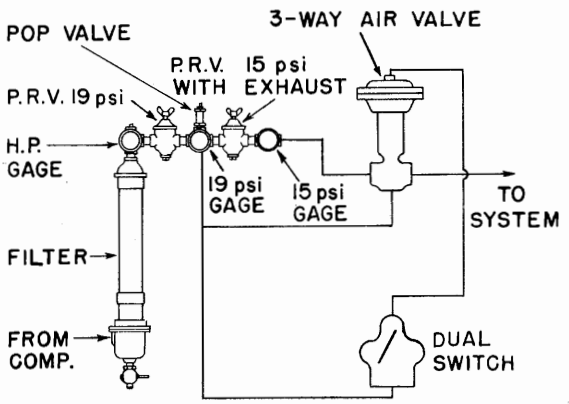


FIG. 29: DUAL OR TWO PRESSURE SYSTEMS

alterations, requires no servicing. Piping in fan and equipment rooms, boiler rooms and pipe shafts is often run exposed. These exposed lines are usually run in out-of-the-way places, with properly arranged supports and hangers. Care should be exercised that these lines do not become damaged.

II.
ADJUSTING TYPICAL CONTROLLERS

The control system is installed and adjusted by trained mechanics of the Johnson Service Company. Further minor adjustments of the control point may be necessary to meet the desires of occupants, and this is accomplished by turning the dial to the desired setting.

Due to unauthorized tampering, servicing, or various other reasons, further adjustments may occasionally be necessary.

A. RELAY PIN VALVE ADJUSTMENT

Pin valves are factory set and normally require no further adjustment.

To check:

1. Open control port. Relay should completely exhaust the control line.
2. Close control port. Control pressure should build up to full pressure.

If either (1) or (2) show incorrect functioning, see below.

Pin Valve Test Gauge

This gauge is equipped with a screw driver adapter to permit adjusting the pin valve on most instruments without removing gauge from the pin valve opening. See Fig. 30.

METHOD:

1. Remove pin valve cap screw.
2. Lift control port lid from control port of instrument.
3. Insert screw driver attachment into pin valve opening so that the bit engages the slot in the pin valve screw, with the rubber washer seated as in Fig. 30.
4. Turn the complete assembly (gauge and adapter), applying a steady pressure toward the pin valve to assure seating at the rubber gasket, until the gauge reads the desired value of pin valve pressure. For most instruments the correct pin valve pressure is 5 inches w. g.

   If a pin valve test gauge is not available, adjust pin valve with a screw driver and recheck relay operation as described above.
5. Replace pin valve cap screw.

On instruments such as the T-900 series the screw driver will not reach the pin valve so it is necessary to use a regular pin valve screw driver. The gauge is used as an indicator only.

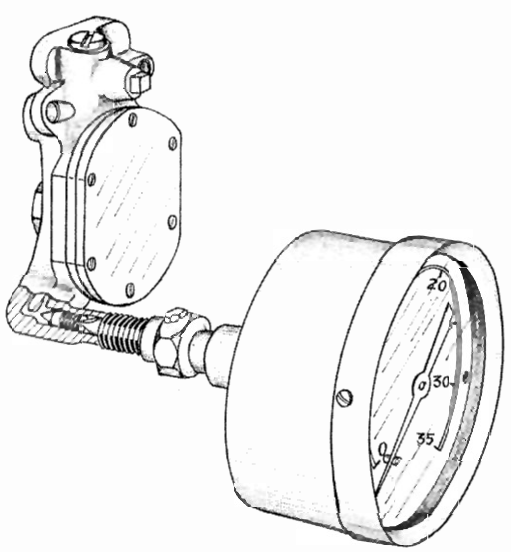


FIG. 30: PIN VALVE TEST GAUGE

B. SENSITIVITY ADJUSTMENT

The sensitivity adjustment always should be as high as possible without producing excessive hunting or cycling. To change the sensitivity adjustment, see Fig. 31.

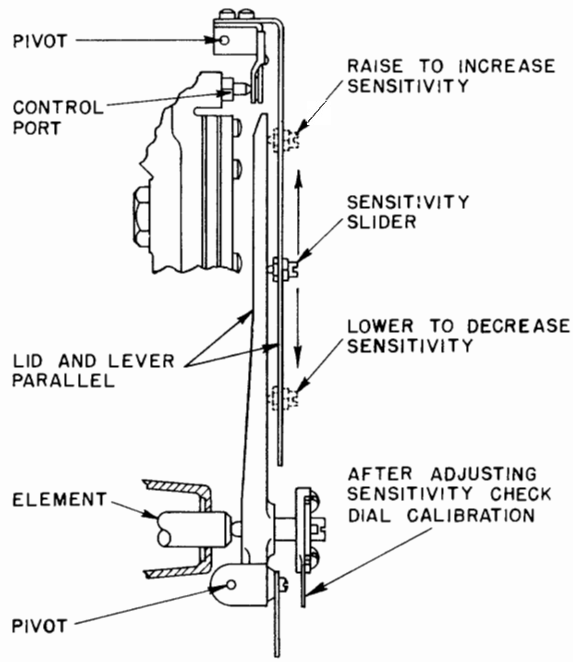


FIG. 31: SENSITIVITY ADJUSTMENT

Note: Changing the sensitivity adjustment sometimes changes the control point. See below.

C. DIAL ADJUSTMENT

This adjustment produces agreement between the Controller dial indication and the actual value of temperature, pressure or relative humidity being controlled, as read on a thermometer, pressure gauge or relative humidity indicator. All controllers are equipped with an adjustment in the dial assembly for this purpose. The principle of obtaining this agreement is the same for all controllers and involves the following steps:

1. Read the actual value of the medium being controlled.
2. Set the dial of the controller to agree with this value.
3. Without moving the dial, turn the adjusting screw until a gauge in the control line indicates approximately 7 psi.
4. Turn the dial to the desired control value.

Because of minor mechanical differences between various types of Johnson Controllers,

slight variations in the above procedure are necessary. Figures 32 to 37 illustrate proper adjusting procedures for several common types of thermostats. The same procedures would be followed for similar types of humidostats or pressure controllers.

Routine Servicing of Controllers

Controllers should be checked occasionally to see that they are actually controlling at the desired value. A simple observation of the temperature, relative humidity, pressure, etc. being maintained by the controller is sufficient.

Humidostats require more frequent checking than other controllers. Relative humidity is measured by taking wet and dry bulb temperature readings, and referring to wet and dry bulb temperature table. Use a good sling or motor driven psychrometer for taking wet and dry bulb temperatures. Be sure the wick is clean and the correct procedure is followed.

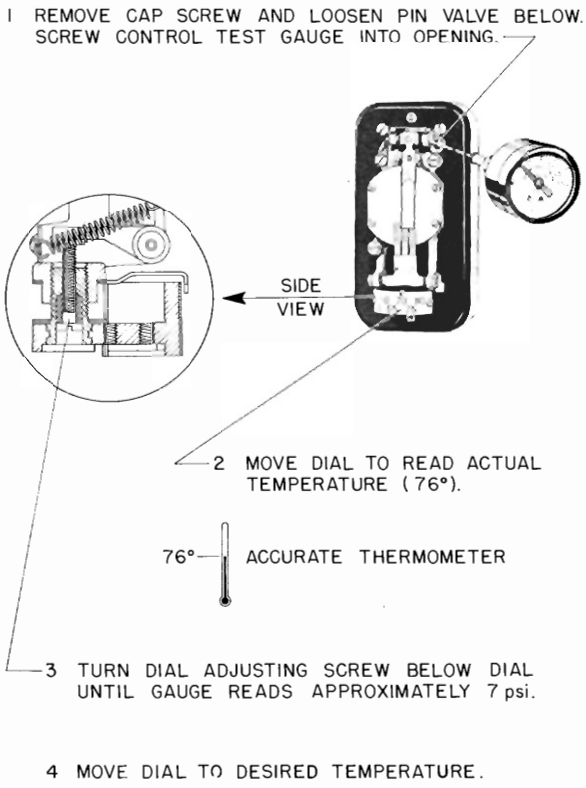


FIG. 32: ADJUSTING SINGLE TEMPERATURE ROOM THERMOSTAT

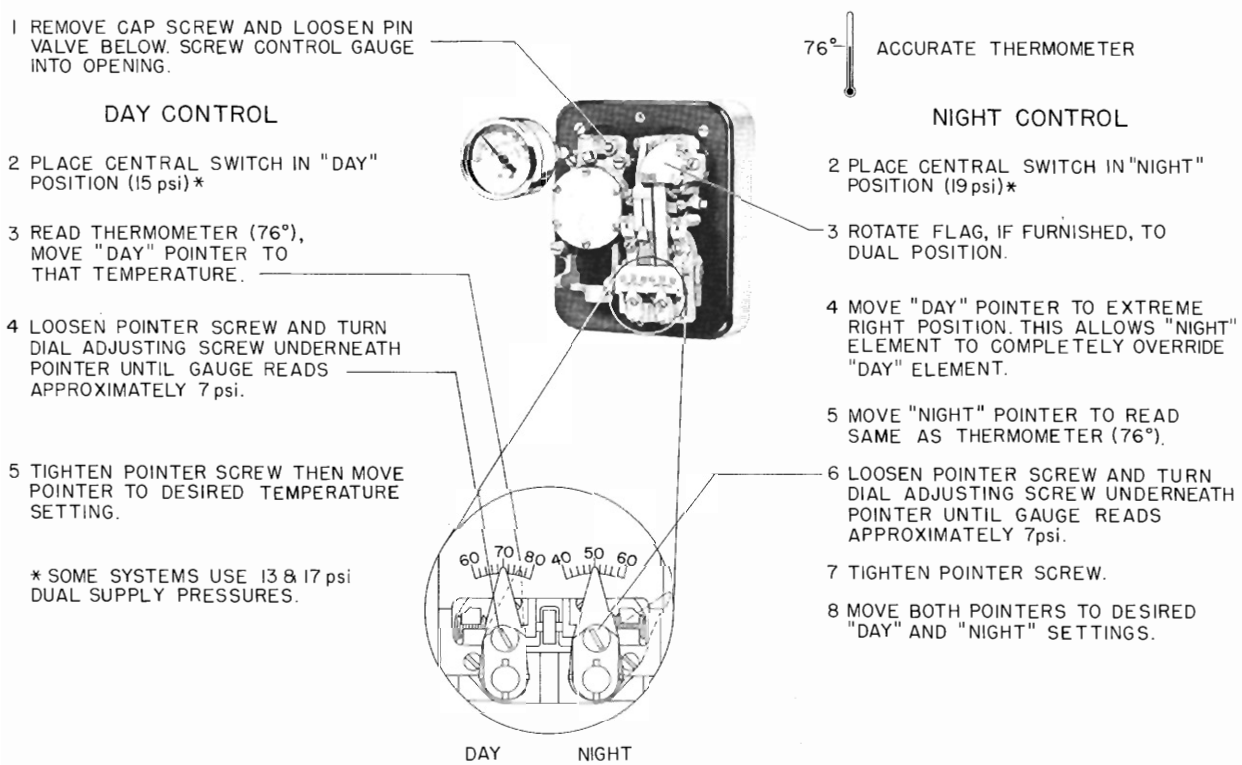


FIG. 33: ADJUSTING DUAL ROOM THERMOSTAT

1 NOTE: SINCE THERE ARE NO NUMERALS ON THE DIALS IT IS ASSUMED THAT THE DESIRED NOMINAL POINTER SETTINGS ARE IN THE CENTER. (EACH GRADUATION IS 2° F.)
SAMPLE DESIRED CONDITIONS — COOLING TEMPERATURE 78°
HEATING TEMPERATURE 73°

2 REMOVE CAP SCREW AND LOOSEN PIN VALVE BELOW. SCREW TEST GAUGE INTO OPENING.

HEATING CONTROL

3 PLACE CONTROL SWITCH IN "HEATING" POSITION (15 psi)*

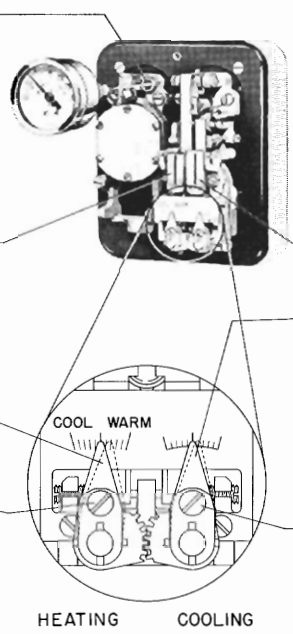
HEATING ELEMENT

4 READ THE THERMOMETER (76°), MOVE "HEATING" POINTER TO THAT TEMPERATURE (76° IS 3° WARMER THAN THE DESIRED 73° WHICH IS REPRESENTED BY THE CENTER OF THE DIAL).

5 LOOSEN POINTER SCREW AND TURN DIAL ADJUSTING SCREW UNDERNEATH POINTER UNTIL GAUGE READS APPROXIMATELY 7 psi.

6 TIGHTEN POINTER SCREW, THEN MOVE "HEATING" POINTER TO DESIRED TEMPERATURE (CENTER OF DIAL).

* SOME SYSTEMS USE 13 & 17 psi DUAL SUPPLY PRESSURES.



NOTE: FOR THE RIGHT HAND POINTER "COOL" IS TO THE RIGHT.

76° ACCURATE THERMOMETER

COOLING CONTROL

3 PLACE CONTROL SWITCH IN "COOLING" POSITION (19 psi)*

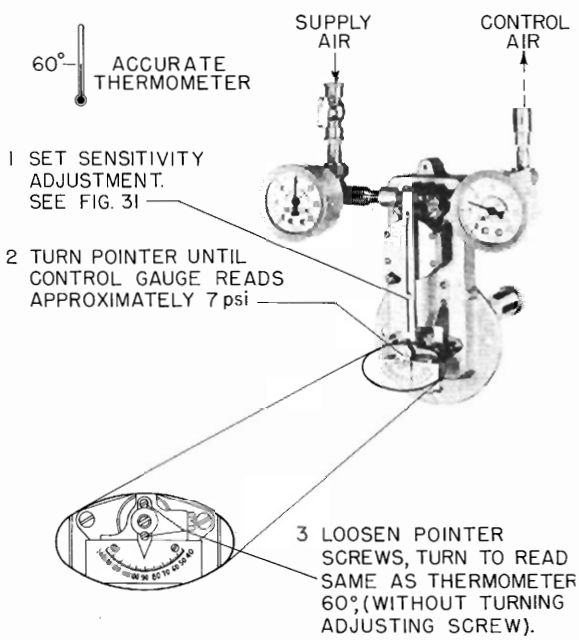
COOLING ELEMENT

4 READ THE THERMOMETER (76°), MOVE "COOLING" POINTER TO THAT TEMPERATURE (76° IS 2° COOLER THAN THE DESIRED 78° WHICH IS REPRESENTED BY THE CENTER OF THE DIAL). THE "HEATING" POINTER WILL ALSO MOVE BUT THIS WILL NOT AFFECT PREVIOUS ADJUSTMENTS.

5 LOOSEN POINTER SCREW AND TURN DIAL ADJUSTING SCREW UNDERNEATH POINTER UNTIL GAUGE READS APPROXIMATELY 7 psi.

6 TIGHTEN POINTER SCREW, THEN MOVE "COOLING" POINTER TO DESIRED TEMPERATURE (CENTER OF DIAL).

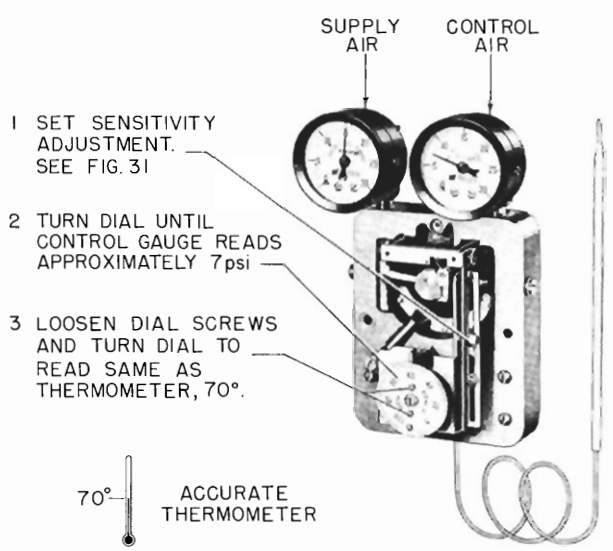
FIG. 34: ADJUSTING HEATING-COOLING THERMOSTAT



4 TIGHTEN POINTER SCREWS AND TURN POINTER TO DESIRED TEMPERATURE.

5 IF SENSITIVITY MUST BE CHANGED, REPEAT STEPS 2,3 & 4.

FIG. 35: ADJUSTING RIGID STEM THERMOSTAT



4 TIGHTEN DIAL SCREWS AND TURN DIAL TO DESIRED TEMPERATURE.

5 IF SENSITIVITY MUST BE CHANGED, REPEAT STEPS 2,3 & 4.

FIG. 36: ADJUSTING REMOTE BULB THERMOSTAT

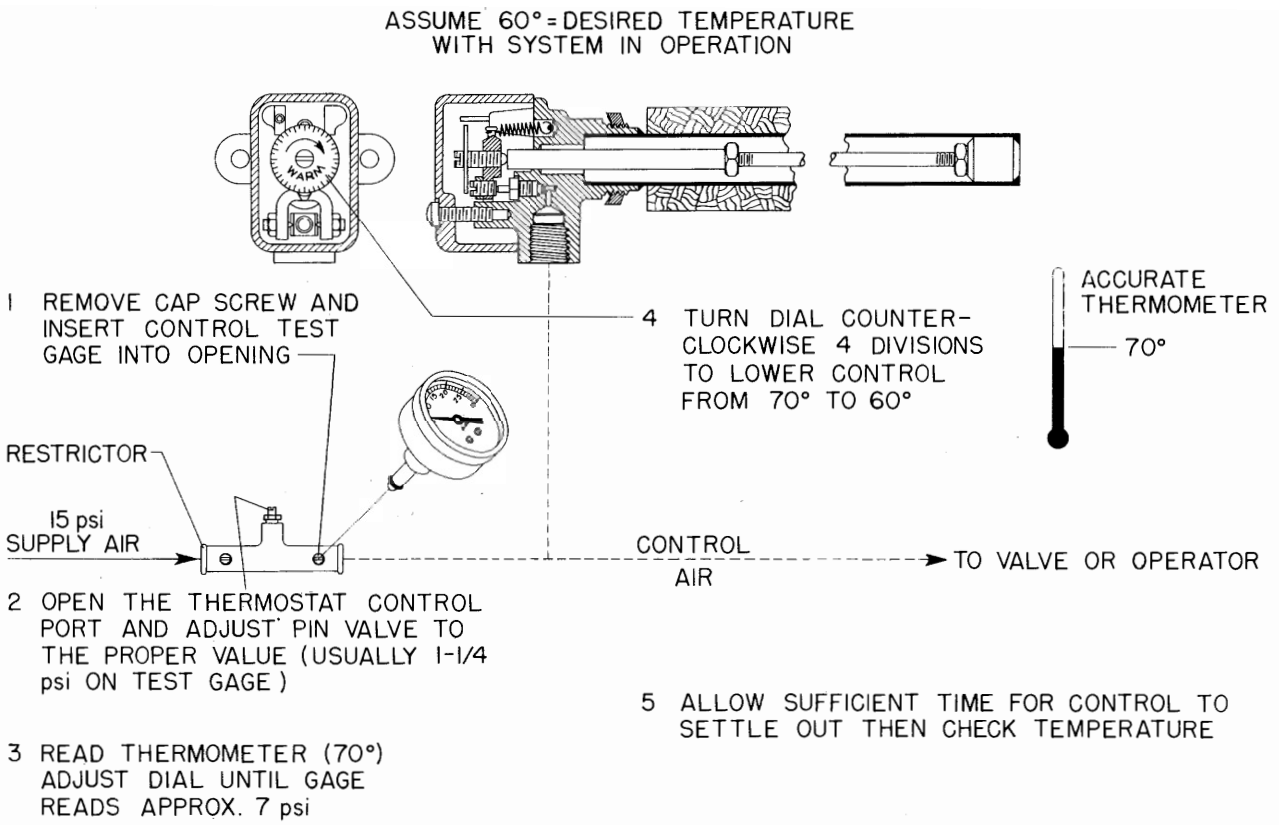


FIG. 37: ADJUSTING NON-RELAY THERMOSTAT

III.
MAINTENANCE OF CONTROLLED DEVICES

1. Piston Operators

See that piston operator stems are kept clean. Do not lubricate the stem. If diaphragm requires replacement, proceed as follows:

1. Remove cylinder head and discard old diaphragm.
2. Turn new diaphragm inside out, so that company name and part number are on inside.
3. Roll back flange and insert piston in diaphragm. An exploded view of the piston operator is shown in Fig. 38.
4. Place the assembly on the upper end of the cylinder, with the loop of the diaphragm between the piston and the cylinder wall, being sure the diaphragm does not wrinkle.
5. Put the cylinder head in place, with the air connection in the desired position, and tighten the screws uniformly.

2. Dampers

Dampers should be checked about once a year (or oftener in localities where the air is especially dirty or contaminated). Clean pivots of dirt or other foreign matter and see that they operate freely. Clean any rust or corrosion from the damper blades and repaint. See that linkage operates freely.

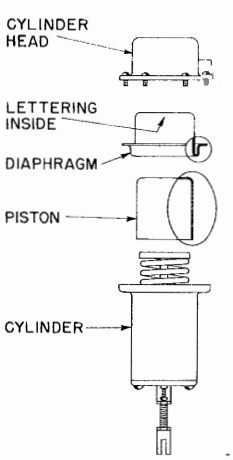


FIG. 38: EXPLODED VIEW OF PISTON OPERATOR

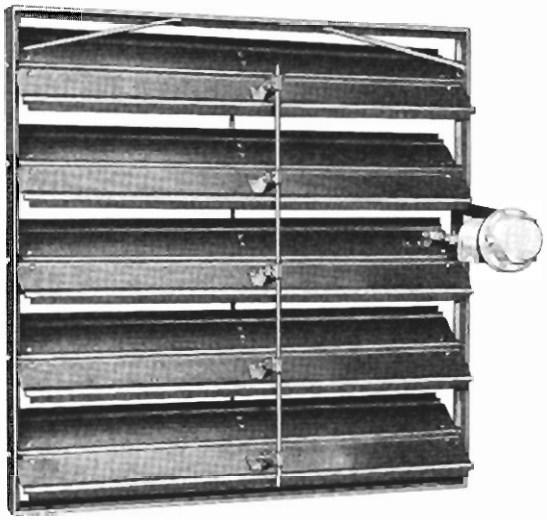


FIG. 39: TYPICAL LOUVER DAMPER

B. VALVE SERVICING AND MAINTENANCE

1. Replacing Bellows or Diaphragms

Figs. 40 and 41 show partially exploded views of typical valves for reference in removing and replacing bellows and diaphragms, and for gaining access to the packing nut.

Replace any leaking bellows or diaphragms whenever necessary. Tighten screws uniformly.

2. Adjusting Packing

Check packing adjustment once a year, or oftener if necessary. Tighten packing only enough to prevent leaks. Hand tight is sufficient on most low pressure jobs. Where tighter adjustment is necessary, turn nut with wrench enough to stop leak, then back off $\frac{1}{8}$ turn.

On sylphon valves tighten packing nut by turning spring support.

3. Replacing Valve Discs

If valve does not close tightly replace the valve disc.

On normally open valves, remove the top assembly by unscrewing the centerpiece.

On normally closed valves, remove the stem and disc assembly through the bottom of the valve by removing the bottom cap and unscrewing the stem extension.

Remove the valve disc by unscrewing the nut or plug on the disc holder. (See Page 16 Fig. 42) Replace with proper type of new disc, being sure that all foreign matter and particles of old disc are removed from holder so that new disc seats square.

Valve seats will seldom need refacing, but if they do, consult your nearest Johnson branch office.

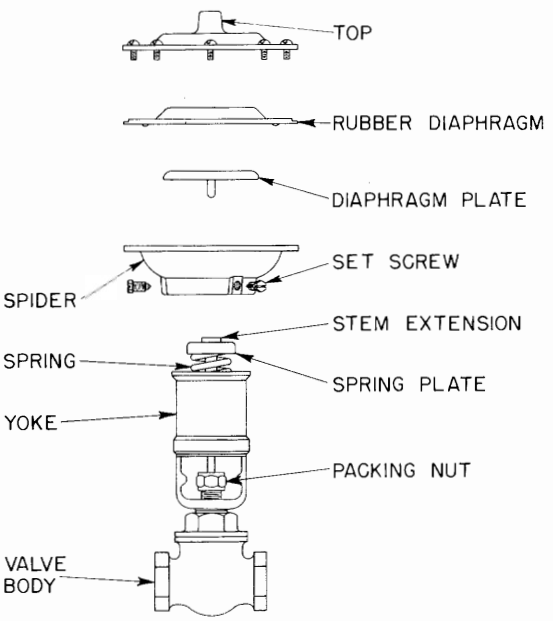


FIG. 40: EXPLODED VIEW OF RUBBER DIAPHRAGM VALVE

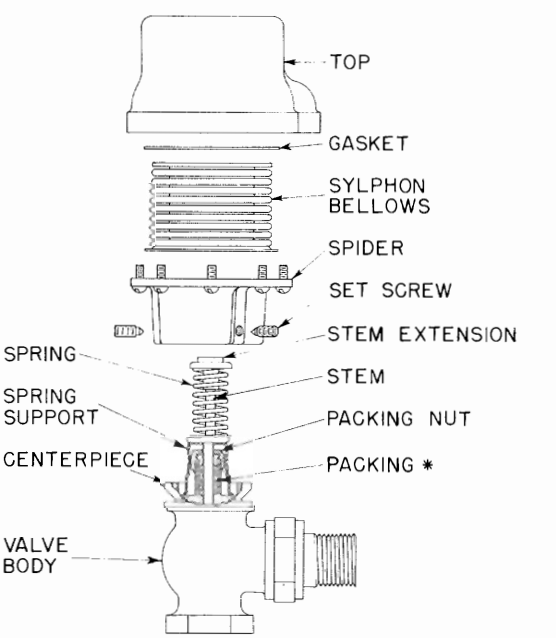


FIG. 41: EXPLODED VIEW OF SYLPHON VALVE

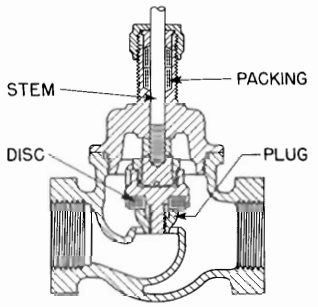


FIG. 42: CROSS SECTION THRU VALVE

C. SERVICING AIR COMPRESSORS

1. LUBRICATION. Keep oil at proper level. Use SAE-10 cylinder oil. Drain and refill crankcase after first two weeks of operation, and thereafter every 2 or 3 months.
2. STORAGE TANK. Accumulated dirt, oil and water must be eliminated periodically. Blow off tank through pet cock or drain plug at bottom at least once a week, or oftener in moist climates.
3. AIR FILTER. If equipped with pet cock at bottom, drain when draining tank. Inspect excelsior packing after 2 years of service and every year thereafter. Replace when it shows signs of becoming saturated with oil. Clean or renew felt pads when dirty.
4. SUCTION FILTER. Clean suction filter every 6 months, or oftener when atmosphere is especially dirty.
5. MOTOR. Oil every 3 months or as recommended on motor name plate, if motor does not have permanently lubricated bearings.
6. V-BELT. Adjust tension after first month of operation. Check every 6 months thereafter. Avoid excessive belt tightness, which overloads bearings. Correctly adjusted belt permits an inch or so of flexing between pulleys.

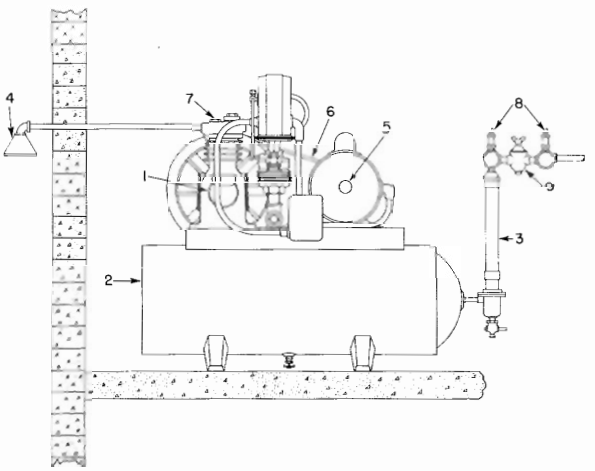


FIG. 43: COMPRESSOR SERVICING POINTS

7. VALVES. Remove and clean intake and exhaust valves once each year. If leakage exists after cleaning, causing inefficient compressor operation, replace with new valves.
8. POP SAFETY VALVES. Blow off pop valves every six months to insure against sticking.
9. REDUCING VALVES. Check adjustment periodically. They should be set to maintain the correct system pressure at all times.

IV
HELPFUL HINTS IN OPERATING HEATING, VENTILATING, AIR CONDITIONING AND INDUSTRIAL PROCESS SYSTEMS

1. Steam pressures and vacuums should be maintained at the correct value, and with as little variations as possible, to secure accurate control results.
2. Steam Systems should be kept clean and free of dirt and other foreign substances that interfere with proper operation of control valves and traps.
3. All steam traps should be checked frequently and kept in proper working condition. A faulty trap not only can be wasteful, but it will prevent the control valve from properly performing its function.
4. Pressures in hot water and chilled water heating and cooling systems should be maintained at the correct value, and with as little variation as possible to allow control valves to function properly.

5. Water systems should be kept free of dirt, and should not have present injurious agents that will attack parts of the control valves or other parts of the system. A check of the water conditions by water treatment specialists is recommended, and proper treatment should be applied where its need is indicated.
6. Check and clean all strainers in steam and water systems frequently.
7. In fan systems, maintain velocities and static pressures constant and at the correct value to allow dampers to operate properly and produce accurate volume and temperature results.
8. Air filters in fan systems should be replaced or cleaned frequently to maintain sufficient volume of air and eliminate faulty results due to reduction of the capacity of the system.

V
EXCHANGE POLICY:

As an aid in maintaining Johnson control systems in top operating condition, the Johnson Service Company has inaugurated an exchange policy on controllers. Whenever a controller requires more than the routine adjustments and servicing outlined in this manual, it may be exchanged, at a nominal price, for a similar controller that has been completely overhauled and adjusted by factory trained control experts. In order to take full advantage of this exchange policy, and at the same time insure uninterrupted performance of the control system, spares of the more commonly used items should be on hand. Control systems vary widely in the number and variety of controllers used, and it therefore is impossible to set down a general recommendation regarding the quantity and type of spares that should be purchased. Your Johnson representative will be glad to make such a recommendation for your particular control system and requirements.

The following pages show the various controllers on which an exchange is available. Inquire at your nearest branch office for price and details.

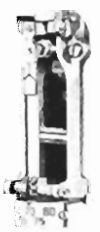
T-400

T-401

T-402

T-403

T-425



T-441

SINGLE TEMPERATURE

T-460

T-461

Dual

T-432
Heating-Cooling

T-315
Sub-master

T-435
Htg.-Cooling Sub-master

MOVEMENTS ONLY

Proportional

2-Position

For T-460, T-461, T-432 T-315, T-435 and H-101

RELAYS

ROOM THERMOSTATS

Direct Acting

Reverse Acting

For T-316, T-317, H-152, H-153 & H-159

Direct Acting

Reverse Acting

For T-318, T-319 & H-156

Direct Acting

Reverse Acting

Proportional

Direct Acting

Reverse Acting

2-Position

For T-350, T-350, R-302 & H-351

RELAYS FOR INSTRUMENTS OTHER THAN ROOM THERMOSTATS

H-102
Type BW

H-105
Type BW

H-103
Type G

H-107
Type HT

H-101
Type BW
Submaster

ROOM HUMIDOSTATS

Direct Acting

Reverse Acting

Proportional
1:1 Ratio C-108
2:1 Ratio C-102

Direct Acting

Reverse Acting

2-Position
C-101

STANDARD CUMULATORS

Direct Acting

Reverse Acting

C-2

Differential
C-109

S-222
GRADUAL SWITCH

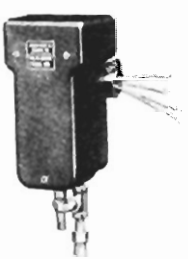
V-20 Three-Way

C-120
Duplex Pressure Selector

C-104
Averaging
2, 3 or 4 Points

SPECIAL CUMULATORS

V-15



V-14

Type A & B

SOLENOID AIR VALVES

Type 1A

Type 2A
R-125

Type 4A

16-184

PRESSURE REDUCING VALVES

V-128
Rubber Diaphragm

V-129

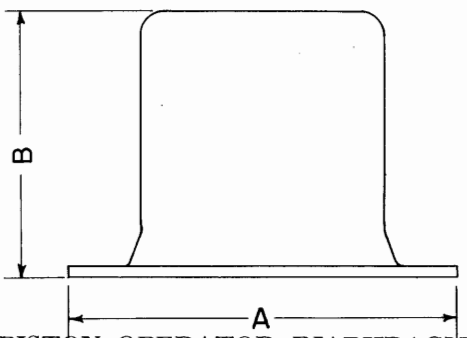
V-127
Sylphon

3-WAY AIR VALVES

VI
REPAIR PARTS POLICY

Controlled devices such as valves and damper operators can best be repaired and serviced on the job. While complete spare piston damper operators may be desirable in many cases to insure uninterrupted service while repairs are being made, it usually is not practical to remove and replace valves.

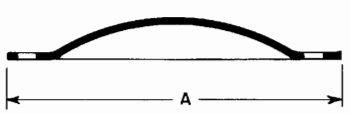
Below are listed the spare parts which should be kept available. Quantities should be gauged by the number of controlled devices of each type in the system.



PISTON OPERATOR DIAPHRAGMS

Operator Size	Dimensions	
	A	B
2S	3-1/4″	2″
2	3-1/4″	3″
3	4-5/16″	3″
4	5-3/8″	3″
6	7-5/8″	5-3/8″

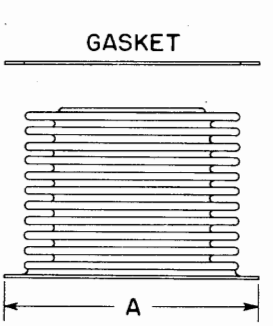
In ordering specify operator size.
For installation see Fig. 38.



DIAPHRAGMS FOR VALVES WITH DIE-CAST & OLD STYLE OPERATORS

Diaphragm Size	Dimension "A"
1	4-5/16″
2	5″
3	5-7/8″
4	7-1/2″

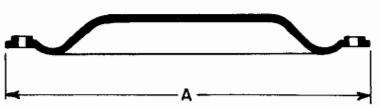
In ordering specify diaphragm size.



Bellows Size	Dim. "A"
1	3″
1-1/2	3-7/16″
2	4-1/8″
3	5-3/16″
4	6-7/16″
5	9-9/16″

SYLPHON BELLOWS FOR VALVES

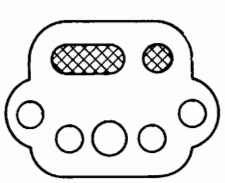
In ordering specify bellows size and order one gasket for each bellows.
For installation see Fig. 41.



RUBBER DIAPHRAGMS FOR SUPERSENSITIVE VALVES

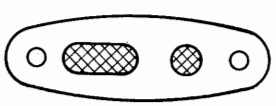
Diaphragm Size	Dimension "A"	No. of Holes
3-R	6″	10
4-R	8-1/8″	12
5-R	11-7/8″	14
8-R	16-1/2″	18

In ordering specify diaphragm size.
For installation see Fig. 40.



Part No. 26-46

For all "Model" Thermostats, Humidostats, Relays & Cumulators which are mounted on a pipehead or metal base.



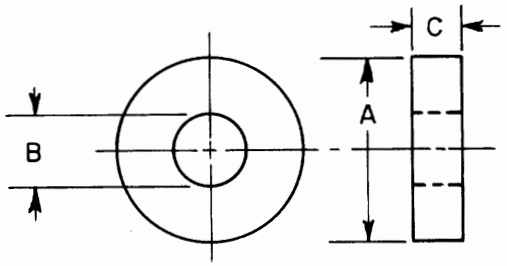
Part No. 26-35

For all old Style Regular Thermostats

Place on pipehead so that long hole (supply air) is on the left.

THERMOSTAT GASKETS

COMPOSITION DISCS



In ordering specify the following:

1. **Bulletin number of valve if possible.**
2. **Pipe size of valve.**
   (In lieu of 1 and 2 measure old disc and specify dimensions A, B & C).
3. **Service (Steam, water, brine, etc.)**
4. **If steam, give maximum pressure.**
5. **If water, give maximum temperature.**

For installation see Fig. 42.

N.O. VALVES FULL SIZE SEAT					N.O. VALVES SIZE SMALLER SEAT			
VALVE SIZE (IN.)	DIMENSION (IN.)			DISC PART NUMBER	DIMENSION (IN.)			DISC PART NUMBER
	A	B	C		A	B	C	
1/2	3/4	5/16	15/64	10-4713	5/8	17/64	15/64	10-4712
3/4	1	7/16	15/64	10-4714	3/4	5/16	15/64	10-4713
1	1-1/4	17/32	1/4	10-4715	1	7/16	15/64	10-4714
1-1/4	1-1/2	19/32	11/32	10-4716	1-1/4	17/32	1/4	10-4715
1-1/2	1-3/4	11/16	11/32	10-4717	1-1/2	19/32	11/32	10-4716
2	2-3/16	11/16	11/32	10-4718	1-3/4	11/16	11/32	10-4717
2-1/2	2-7/8	1-3/4	15/32	10-4719	2-39/64	1-1/2	3/8	10-13537
3	3-3/8	2-1/16	15/32	10-4720	2-7/8	1-3/4	15/32	10-4719
3-1/2	4	2-1/2	1/2	10-4721	3-3/8	2-1/16	15/32	10-4720
4	4-3/8	2-13/16	1/2	10-4722	3-3/8	2-1/16	15/32	10-4720
5	5-7/16	4-1/16	1/2	10-4724	4-3/8	2-13/16	1/2	10-4722
6	6-3/4	5-1/4	1/2	10-4725	5-7/16	4-1/16	1/2	10-4723
8	9-23/64	7-1/16	19/32	10-4727	6-3/4	5-1/4	1/2	10-4725
10	11-13/64	9-1/16	5/8	10-4729	9-23/64	7-1/16	19/32	10-4727

V-50 VALVE N.O. V-PORT					V-50 VALVE N.C. V-PORT			
VALVE SIZE (IN.)	DIMENSION (IN.)			DISC PART NUMBERS	DIMENSION (IN.)			DISC PART NUMBERS
	A	B	C		A	B	C	
1/2	13/16	1/4	15/64	10-24493-68734	1-3/32	17/32	1/4	10-24499-68734
3/4	1-3/32	3/8	1/4	10-24492-68734	1-3/32	17/32	1/4	10-24499-68734
1	1-13/32	37/64	9/32	10-24491-68734	1-13/32	21/32	9/32	10-24498-68734
1-1/4	1-41/64	25/32	11/32	10-24490-68734	1-41/64	25/32	11/32	10-24490-68734
1-1/2	2-1/64	1-1/16	11/32	10-24489-68734	2-1/64	1-1/16	11/32	10-24489-68734
2	2-39/64	1-1/2	3/8	10-13537-68734	2-39/64	1-1/2	3/8	10-13537-68734

V-50 VALVE N.O. MODULATING PLUG					V-50 VALVE N.C. MODULATING PLUG			
VALVE SIZE (IN.)	DIMENSION (IN.)			DISC PART NUMBERS	DIMENSION (IN.)			DISC PART NUMBERS
	A	B	C		A	B	C	
1/2	13/16	1/4	15/64	10-24493-68734	1-3/32	17/32	1/4	10-24499-68734
3/4	13/16	1/4	15/64	10-24493-68734	1-3/32	17/32	1/4	10-24499-68734
1	1-3/32	3/8	1/4	10-24492-68734	1-3/32	17/32	1/4	10-24499-68734
1-1/4	1-13/32	37/64	9/32	10-24491-68734	1-13/32	37/64	9/32	10-24491-68734
1-1/2	1-41/64	25/32	11/32	10-24490-68734	1-41/64	25/32	11/32	10-24490-68734
2	2-1/64	1-1/16	11/32	10-24489-68734	2-1/64	1-1/16	11/32	10-24489-68734

Continued on next page

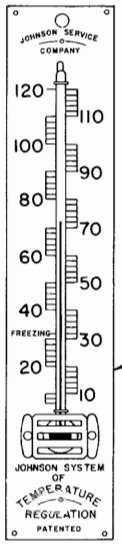
V-186 VALVE N.O. MODULATING PLUG					V-186 VALVE N.C. MODULATING PLUG			
VALVE SIZE (IN.)	DIMENSION (IN.)			DISC PART NUMBERS	DIMENSION (IN.)			DISC PART NUMBERS
	A	B	C		A	B	C	
1/2	13/16	1/4	15/64	10-24493	1-3/32	17/32	1/4	10-24499
3/4	13/16	1/4	15/64	10-24493	1-3/32	17/32	1/4	10-24499
1	1-3/32	3/8	1/4	10-24492	1-3/32	17/32	1/4	10-24499
1-1/4	1-13/32	37/64	9/32	10-24491	1-13/32	37/64	9/32	10-24491
1-1/2	1-41/64	25/32	11/32	10-24490	1-41/64	25/32	11/32	10-24490
2	2-1/64	1-1/16	11/32	10-24489	2-1/64	1-1/16	11/32	10-24489

N. C. VALVES: SIZE SEAT					N. C. VALVES: SIZE SMALLER SEAT			
VALVE SIZE (IN.)	DIMENSION (IN.)			DISC PART NUMBERS	DIMENSION (IN.)			DISC PART NUMBERS
	A	B	C		A	B	C	
1/2	1	17/32	15/64	10-15784	1	17/32	15/64	10-15784
3/4	1	17/32	15/64	10-15784	1	17/32	15/64	10-15784
1	1-1/4	19/32	1/4	10-15785	1	17/32	15/64	10-15784
1-1/4	1-1/2	23/32	11/32	11-16362	1-1/4	19/32	1/4	10-15785
1-1/2	1-3/4	11/16	11/32	10-4717	1-1/2	23/32	11/32	11-16362
2	2-3/16	11/16	11/32	10-4718	1-3/4	11/16	11/32	10-4717
2-1/2	2-7/8	1-3/4	15/32	10-4719	2-39/64	1-1/2	3/8	10-13537
3	3-3/8	2-1/16	15/32	10-4720	2-7/8	1-3/4	15/32	10-4719
3-1/2	4	2-1/2	1/2	10-4721	3-3/8	2-1/16	15/32	10-4720
4	4-3/8	2-13/16	1/2	10-4722	3-3/8	2-1/16	15/32	10-4720
5	5-7/16	4-1/16	1/2	10-4724	4-3/8	2-13/16	1/2	10-4722
6	6-3/4	5-1/4	1/2	10-4725	5-7/16	4-1/16	1/2	10-4723
8	9-23/64	7-1/16	19/32	10-4727	6-3/4	5-1/4	1/2	10-4725
10	11-13/64	9-1/16	5/8	10-4729	9-23/64	7-1/16	19/32	10-4729

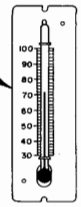
THREE-WAY MIXING VALVE FOR AIR, UPPER SEAT V-127 V-129					THREE-WAY MIXING VALVE FOR AIR, LOWER SEAT V-127 V-129			
VALVE SIZE (IN.)	DIMENSION (IN.)			DISC PART NUMBERS	DIMENSION (IN.)			DISC PART NUMBERS
	A	B	C		A	B	C	
1/8	5/8	17/64	15/64	10-4712-18	5/8	17/64	15/64	10-4712-18
1/4	5/8	17/64	15/64	10-4712-18	5/8	17/64	15/64	10-4712-18
3/8	5/8	17/64	15/64	10-4712-18	5/8	17/64	15/64	10-4712-18
1/2	1	17/32	15/64	10-15784-3	3/4	5/16	15/64	10-4713-3
3/4	1	17/32	15/64	10-15784-3	3/4	5/16	15/64	10-4713-3
1	1-1/4	19/32	1/4	10-15785-3	1	7/16	15/64	10-4714-3

On valves used for hot and/or cold water, brine, air, gas and low pressure steam under 50 pounds pressure, add the suffix "3" after the part number shown.

On valves over 50 pounds steam pressure use part numbers as shown above.

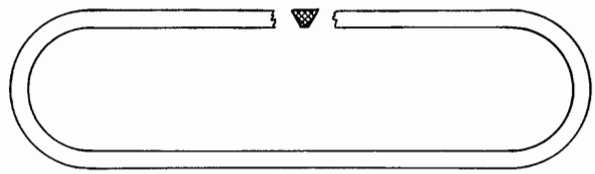


PART NO. 26-85
FOR ALL "MODEL"
THERMOSTAT COVERS

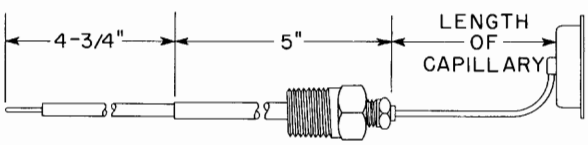


PART NO. 26-116
FOR ALL REGULAR
THERMOSTAT COVERS

THERMOMETERS FOR THERMOSTAT COVERS



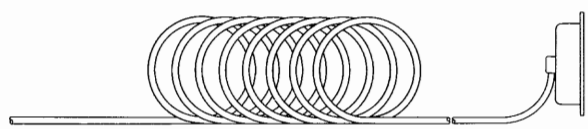
COMPRESSOR V-BELTS
In ordering specify compressor Bulletin number or length of V-belt required.



NON-COMPENSATED CAPILLARY 49-12191
AVAILABLE 6' LENGTH ONLY

COMPENSATED CAPILLARY 49-9237
AVAILABLE IN FOLLOWING LENGTHS: 8', 15', 25', 35', 50', 65', 75' & 85'.

STYLE "B" ELEMENT

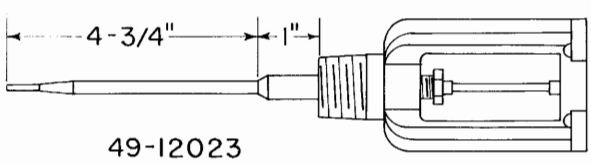


NO CAPILLARY 49-11992
AVAILABLE 8' LENGTH ONLY

NON-COMPENSATED CAPILLARY 49-12848
AVAILABLE 6' LENGTH ONLY

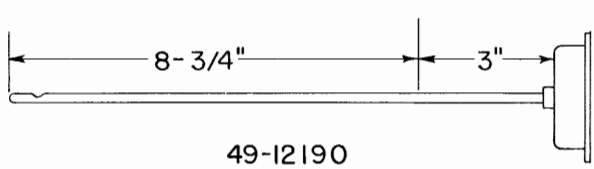
COMPENSATED CAPILLARY 49-12037
AVAILABLE IN FOLLOWING LENGTHS: 8', 15', 25' & 35'.

AVERAGING ELEMENT



49-12023

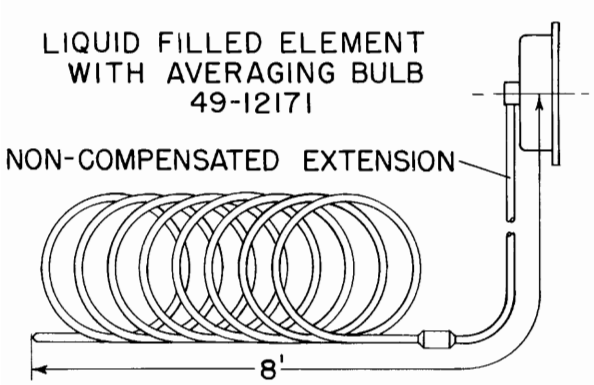
IMMERSION ELEMENT



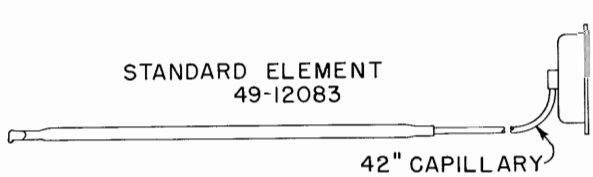
49-12190

INSERTION ELEMENT

FOR T-800 & T-900 THERMOSTATS



FOR T-333 & T-335 THERMOSTATS



FOR T-271 & T-281 THERMOSTATS

LIQUID FILLED ELEMENTS

VII
MODERNIZATION OF OLD SYSTEMS

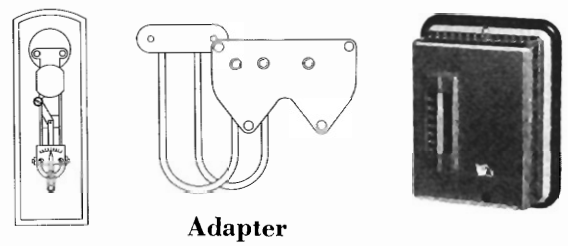
Pneumatic control systems have been in use for many years, and in a large number of the older buildings these systems are out of date. Whether or not such a system is still in operation, a modernization program to bring it up to date and where necessary to put it back in operation will reward the owner with all of the advantages of a modern control system, and will enable him to obtain continued returns on the original investment.

In most cases the original air piping will be intact. Modernization will consist chiefly of removing the old thermostats and replacing them with modern instruments, and in modernizing or replacing the valves and other controlled equipment. Included in any modernization program is a thorough check of the existing air piping system, with repairs and extensions when necessary, and repair or replacement of the existing air compressor.

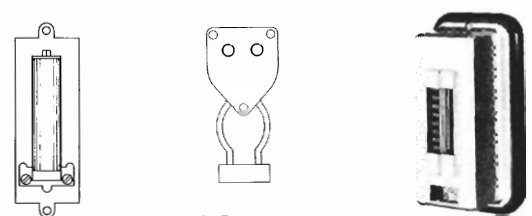
In some cases existing old systems are of a make that is now obsolete and no longer manufactured. Such systems include Bishop-Babcock, Swan, National, American, Standard, etc. The Johnson Service Company has available adapters for converting any type of thermostat installation, whether it is an old Johnson system, or any other make, to new and modern Johnson instruments. These adapters make conversion simple and convenient, and eliminate the need for cutting and patching of plaster, or otherwise defacing walls. Conversion to any of the modern Johnson thermostats is provided, thus adding the comfort, convenience and economy of dual, heating-cooling or submaster thermostats when these features are desired. For additional information on modernizing any obsolete system, consult your nearest Johnson Branch Office.

Conversion from Old to New Thermostats

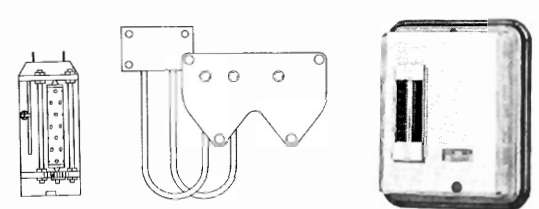
Typical Examples



Old Style Regular Johnson Thermostat — **Adapter** — **to** — **Modern Johnson Dual Thermostat**



National Thermostat — **Adapter** — **to** — **Modern Johnson Single-Temp. Thermostat**



Bishop Babcock Thermostat — **Adapter** — **to** — **Modern Johnson Heating-Cooling Thermostat**

JOHNSON CONTROL EQUIPMENT FOR ALL TYPES OF AUTOMATIC TEMPERATURE AND HUMIDITY CONTROL

PIONEER SPECIALISTS in the field of automatic temperature control, Johnson Service Company has manufactured, planned and installed complete control systems for three quarters of a century. These systems have established an enviable record of comfort, economy and convenience unmatched in the industry.

The products shown below are manufactured by Johnson for Johnson Controlled systems.

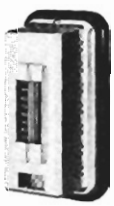
THERMOSTATS

Johnson thermostats are available in a wide variety of styles for every temperature control installation.

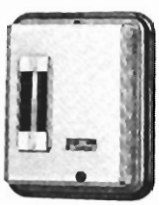
Room thermostats, single or two-temperature, are equipped with highly sensitive, bi-metal temperature sensing elements. Two-temperature thermostats have two separate bi-metal sensing elements, allowing two completely independent settings instead of a fixed temperature difference between the two operating temperatures, as provided in most thermostats. The changeover from one temperature to the other, is accomplished by changing the supply pressure.

Remote bulb capillary thermostats are recommended for installations where severe vibration exists at the point of measurement, where it would be inconvenient to make adjustments at the point of measurement or where it is desirable to have all instruments at a central location. The expansion of the liquid-filled element is linear resulting in uniform dial graduations. Available either direct or reverse acting and with two-position or proportional action. All models equipped with sensitivity adjustment. Immersion and insertion thermostats are provided for the control of temperatures in ducts, tanks and enclosed chambers.

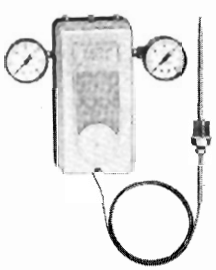
The Submaster Thermostats are adaptable to a wide range of control problems. The control point of these instruments is varied by changing the air pressure from the master thermostat or is adjustable manually by means of an adjusting dial. These thermostats employ the use of liquid-filled elements.



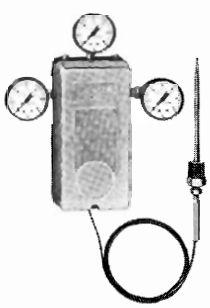
T-400 Room Thermostat



T-460 Day-Night Room Thermostat



T-900 Liquid Filled Capillary Thermostat Style "B" Bulb



T-901 Liquid Filled Capillary Thermostat Style "B" Bulb

T-904 Liquid Filled Immersion Thermostat

T-800 Liquid Filled Capillary Thermostat Style "B" Bulb

T-802 Liquid Filled Insertion Thermostat

VALVES

Johnson valves are simple and rugged in design, meeting every heating and air conditioning requirement. There are no complicated moving parts.

"Sylphon" metal bellows operate radiator and convector valves on installations where space is limited. Valves are also operated by molded rubber diaphragms which are enclosed in strong metal tops, forming a single unit. Made of specially molded rubber, resistant to age and oxidation. These tops operate valve stems against the pressure of dependable springs.

Valve bodies are available in standard sizes and styles to fit all requirements. Furnished with modulating plug or flat disc inner valve, normally open or normally closed, for the control of steam, hot or cold water, brine and other liquids and gases. Three-way mixing and by-pass valves are also available.

Where maximum power or greater accuracy of positioning is required, Johnson valves with rubber diaphragm operators are fitted with pilot positioners.

Other valves in line include solenoid and reversing valves for air and electric motor operated valves.

V-103
Normally Open
Globe Valve

V-103
Globe Valve
with V-510
Pilot
Positioner

V-149
Water Valve
"Sylphon" Operator

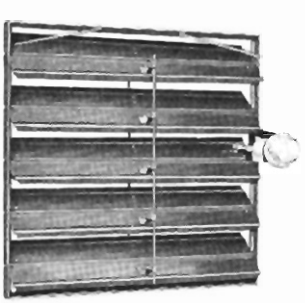
V-152
Angle Valve
for Water

V-153
Convector Valve
Enclosed "Sylphon"
Operator

V-157
Convector Valve
Exposed "Sylphon"
Operator

DAMPERS

All Johnson dampers, for controlling the flow of air, are designed and built to meet the demands of all types of control systems. There are no standard sizes. Each damper is "made to measure" for each particular application. The maximum dimensions of any damper depend upon the characteristics of the system it is to serve. All dampers are built with solid stops on the fan side to prevent air leakage. Pin stops furnished on order. Blades are made of 16-gauge galvanized sheet steel, finished in black lacquer. Dampers made of monel metal, aluminum, copper and rust resisting alloys will be furnished on order.



D-203
Standard
Louver Damper

D-201
Double Mixing
Damper

Damper Operators are similar in principle to valves. Seamless metal bellows or specially molded rubber diaphragms operate dampers through suitable linkage. The long stroke Piston operators are designed to operate dampers directly from the piston rod without the use of levers. The piston operator is furnished with a pilot positioner where highly accurate positioning or maximum power is desired.

HUMIDOSTATS

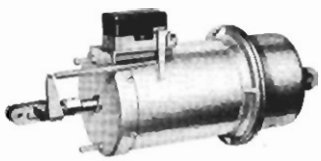
Humidostats are designed for the accurate control of the addition to, or removal of moisture from air in the system or space. Room humidostats are available with various elements with adjustable sensitivity. Insertion humidostats are designed for the accurate control of the relative amounts of moisture in heating, ventilating and air conditioning ducts. Room and insertion types available with bi-wood, horn or animal membrane elements. Under normal conditions the instrument will control within 1% relative humidity.

SWITCHES

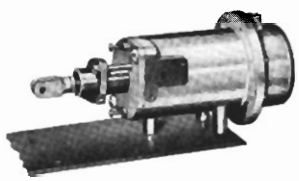
Pneumatic Switches are designed to permit the remote switching of control devices. Selector switches are used for placing remote devices in any one of either two or three positions or for transferring a common supply air line. Gradual switches are designed for installations where proportional action is desired for manually positioning remote regulators.

THERMOMETERS

Red-reading thermometers for air and liquids are easily fastened to a wall or ducts. Have either 6-inch or 9-inch scale. Dial thermometers, with liquid-filled elements, are available for applications where it is desired to locate the indicating head of the thermometer at a point remote from the place at which the temperature is to be measured. Provided with separable sockets or union connections at measuring bulb.



D-251 Piston Damper Operator with D-265 Pilot Positioner



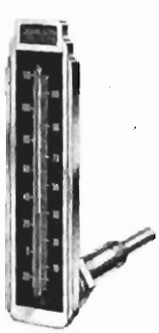
D-255 Two-Stage Piston Damper Operator

H-102 Room Humidostat

H-159 Insertion Humidostat

S-232 2-Position Selector Switch

S-224 Gradual Switch



T-28 Angle Shank Thermometer

T-33D Dial Thermometer Liquid Filled Element

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