

Pneumatic Relays and Switches

ENGINEERING DATA

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INTRODUCTION

GENERAL

This sheet provides the user with information about miniature relays and switches. Push-on barb connections are used for all connections. Main connections are for 1/4-in. (6-mm) O.D. tubing, except for the RP975 and the SP970, which use 5/32-in. (4-mm) O.D. tubing. All other connections are for 5/32-in. (4-mm) O.D. tubing.

AIR DATA

Table 1 provides air consumption and capacity information for the relays, switches, and restrictors described in this sheet.

Table 1. Air Data.

Device	Air Consumption in scfm (L/sec)	Air Capacity* in scfm (mL/sec)
RP418A-C Electric/Pneumatic Relays	0.0	0.42 (200)
RP470A Higher-of-Two-Pressures Relay	0.0	0.039 (18.3)
RP470B Lockout Relay	0.0	0.039 (18.3)
RP471A Snap-Acting Relay	0.002 (1.0)	0.039 (18.3)
RP670A, B Switching Relays	0.0	0.039 (18.3)
RP913A Load Analyzer	0.040 (18.9)	0.011 (5.2)
RP922A Pneumatic Potentiometer	0.007 (3.3) †	—
RP970A Capacity Relay	0.002 (1.0)	0.039 (18.3)
RP971A Ratio Relay	0.002 (1.0)	0.032 (15)
RP972A Reversing Relay	0.002 (1.0)	0.039 (18.3)
RP973A Averaging Relay	0.007 (3.33)	0.002 (1.0)
RP975A Hesitation Relay	0.022 (10.4)	0.002 (1.7)
SP470A, B Pneumatic Switches	0.0	0.177 (83.3)
SP970A-D Manual/Minimum Position Switches	0.022 (10.4)	0.002 (1.7) §
14002913-001 0.005-In. Restrictor	0.002 (1.0)	0.011 (5.2)
14002913-002 0.007-In. Restrictor	0.004 (1.7)	0.022 (10.4)
14003238-004 Biasing Repeater Relay	0.022 (10.4)	0.002 (1.7)
14003617-002 Minimum/Maximum Pneumatic Signal Limiter	0.022 (10.4)	0.002 (1.7) **

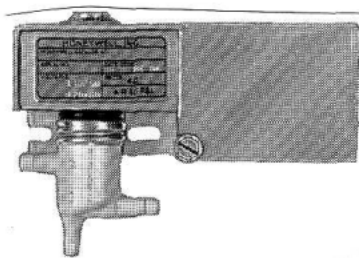
* Air capacities are for a 1 psi (7 kPa) drop (8 to 7 psi [55 to 48 kPa]).

† Adjustable air supply application.

§ SP970A and B only: above the knob setting, the device feeding the pilot determines the capacity.

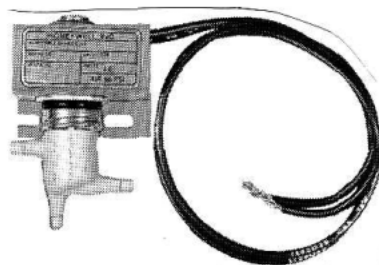
** For input signal high limit setting only.

RP418A-C ELECTRIC/PNEUMATIC RELAYS



R2624

RP418A



R2622

RP418B

GENERAL

The RP418A-C Electric/Pneumatic Relays are electrically operated pneumatic switches that open and close the air supply to pneumatic controls. The control input to an RP418 is an ON/OFF line voltage signal. An RP418 can function as a diverting relay, a selector relay, or a stop-and-bleed relay.

OPERATION

When the RP418 coil is deenergized, Ports 2 and 3 are connected and Port 1 is blocked (Fig. 1A). When the relay coil is energized, Ports 1 and 3 are connected and Port 2 is blocked (Fig. 1B).

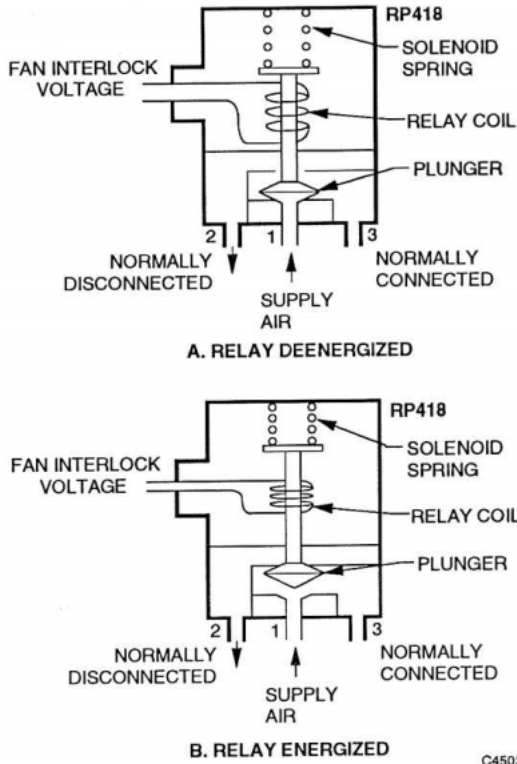


Fig. 1. RP418A-C Operation.

Figure 2 shows a typical application of an RP418. When the fan turns on, the coil energizes, passing supply air through Ports 1 and 3 to the damper actuator. When the fan turns off, supply Port 1 is blocked and Ports 2 and 3 are connected, bleeding the air from the damper actuator to the atmosphere.

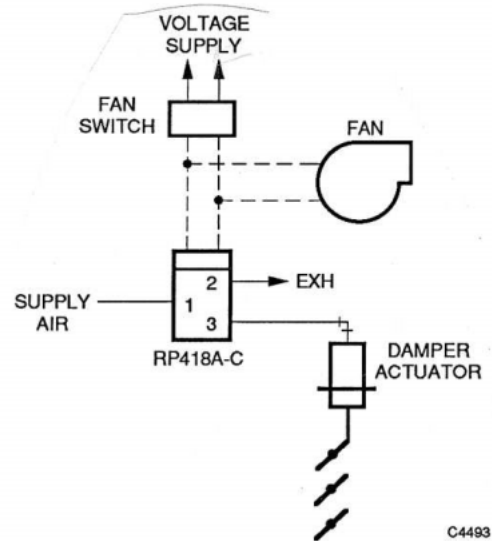


Fig. 2. RP418A-C Typical Application.

APPLICATION

An RP418 is used for interlock between an electrical and a pneumatic control system and can be used as a stop-and-bleed relay or as a diverting or selector relay. Depending upon the piping hookup, the RP418 functions as a three-way normally open or normally closed air valve or a three-way diverting control.

RP470A HIGHER-OF-TWO-PRESSURES RELAY



RP470A

GENERAL

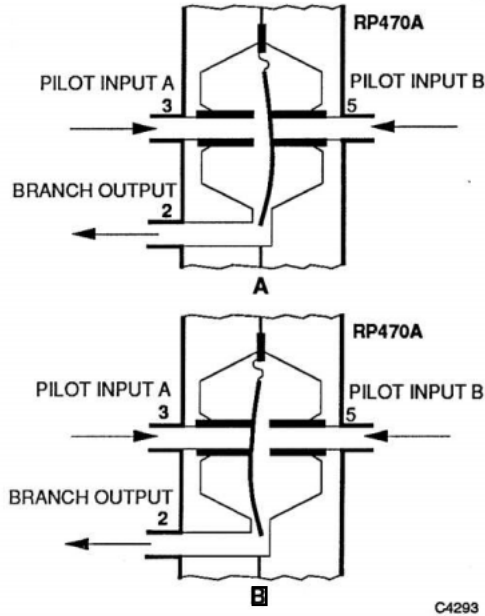
The RP470A Higher-of-Two-Pressures Relay is a three-port relay used to transmit the higher of two input signals from a thermostat to a valve or damper actuator. The RP470A selects the higher pressure with a sensitivity of 0.12 to 0.18 psi (0.9 to 1.2 kPa). Because of its high sensitivity, the RP470A can be used in sensor lines such as those from an LP914 or LP915 Temperature Sensor within an accuracy of 2 to 3 degrees F (1.1 to 1.7 degrees C).

NOTE: Do not use the RP470A on small-nozzle sensors such as the TP974. Greater errors will occur because of the air leakage involved during internal switching on the RP470A.

6

OPERATION

When the pressure at Port 3 is greater than the pressure at Port 5 (Fig. 3A), Port 3 supplies the output through Port 2 and the output at Port 2 equals the Port 3 pressure. When the pressure at Port 5 is greater than the pressure at Port 3 (Fig. 3B), Port 3 closes off and the output at Port 2 equals the Port 5 pressure.

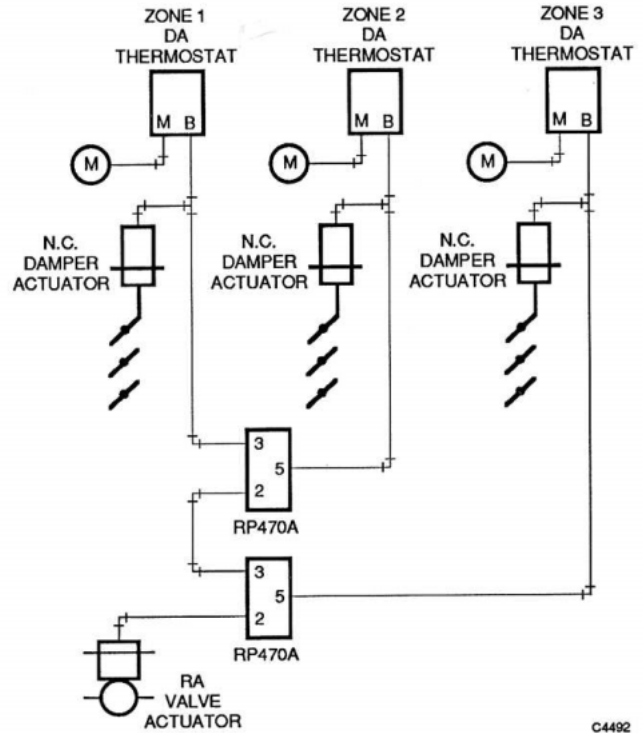


C4293

Fig. 3. RP470A Operation.

APPLICATION

Figure 4 shows a typical application using three zone thermostats and two RP470As for control. Each zone is controlled by a separate thermostat. The thermostat that calls for the most cooling (transmits the highest branchline pressure) controls the cooling valve through one or both of the RP470As.



C4492

Fig. 4. RP470A Typical Application.

RP470B LOCKOUT RELAY



R734

RP470B

GENERAL

The RP470B Lockout Relay is a three-port relay used to shut off one pressure signal when a second signal is higher. It can also be connected to function as a repeater for signal isolation or as a lower-of-two-pressures selector.

For easy identification, the RP470A body is all gray and the RP470B body is gray and black. Other differences are internal.

OPERATION

When the pressure at Port-2 is greater than the input pressure at Port 5 (Fig. 5A), Port 2 supplies the output

through Port 3. When the pressure at Port 5 is greater than the pressure at Port 2 (Fig. 5B), the diaphragm closes off the output (Port 3). This action prevents the Port 2 signal from passing through Port 3.

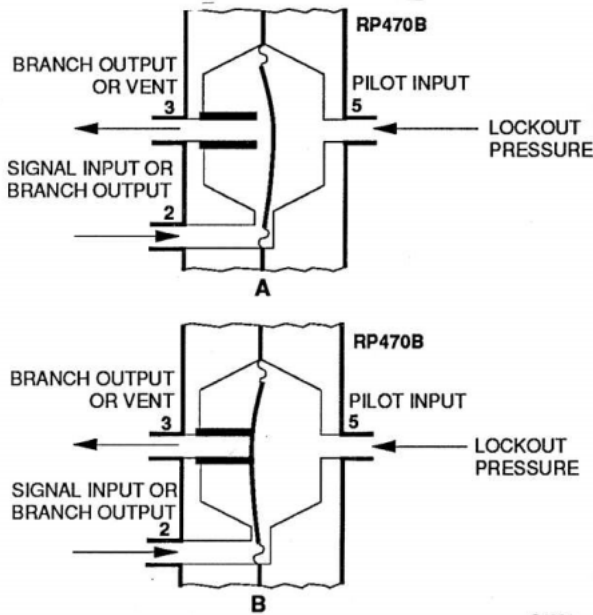


Fig. 5. RP470B Operation.

APPLICATION

Figure 6 shows a typical lockout application for the RP470B. When the outdoor air temperature is higher than the return air temperature, the mixed air controller becomes disabled.

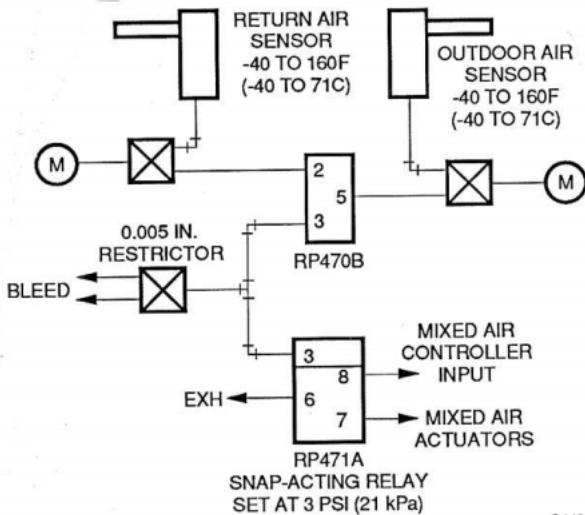


Fig. 6. RP470B Typical Lockout Application.

Figure 7 shows the RP470B piped as a repeater. This application provides circuit isolation by repeating the input pressure with a second air source. The signal at Port 5 blocks Port 3 until the signal at Port 2 builds up a matching pressure, thus maintaining Port 2 equal to Port 5. Port 3 acts as an exhaust port.

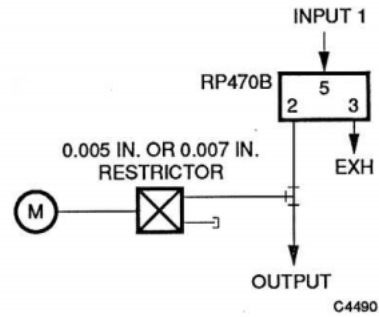


Fig. 7. RP470B Piped as a Repeater.

Figure 8 shows the RP470B in a lowest-of-several-pressures application. In this application, the RP470Bs act as repeaters, but repeat only the lowest input pressure. Note that all inputs are isolated and a restricted main is required.

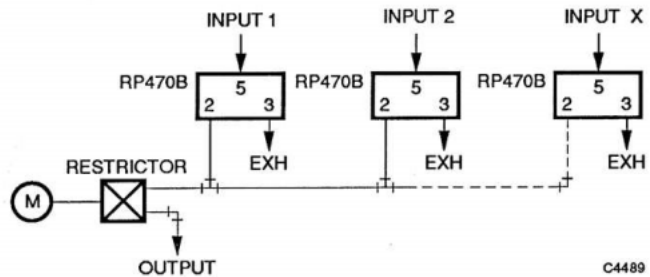


Fig. 8. RP470B Piped for Lowest-of-Several-Pressures Selection.

Figures 9 and 10 show special applications.

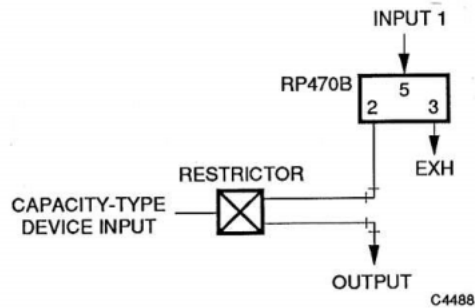


Fig. 9. RP470B Piped for Lower-of-Two-Pressures Selection with Capacity-Type Device Input.

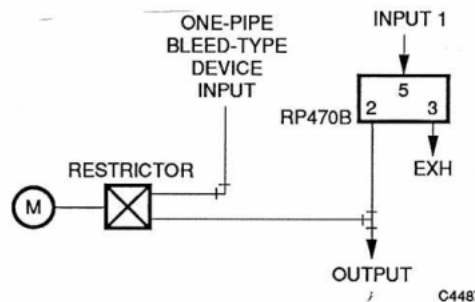
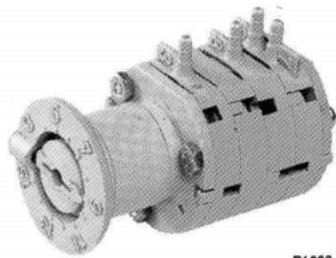


Fig. 10. RP470B Piped for Lower-of-Two-Pressures Selection with One-Pipe, Bleed-Type Device Input.

RP471A SNAP-ACTING RELAY



RP471A

R1633

GENERAL

The RP471A Snap-Acting Relay is a spdt, positive-acting pneumatic switch that provides positive switching action on modulating signal lines with an adjustable switching point. The switching differential is specified at 1.0 psi (7 kPa) but actually operates at 0.3 to 0.4 psi (2 to 3 kPa), nonadjustable.

The RP471A has a slight air bleed in its pilot chamber, approximately 0.002 scfm (1.0 ml/sec), which keeps the device from locking up when the pilot passage is blocked. This bleed is necessary for the operational design, because it prevents air from being trapped in the circuit. The switching pressure is manually adjustable for 3 to 15 psi (21 to 103 kPa) operation.

OPERATION

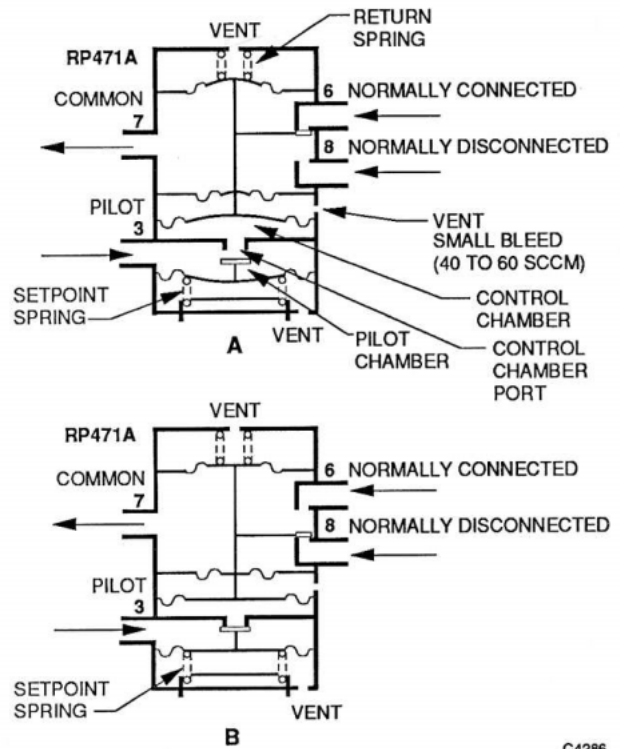
The return spring (Fig. 11A) has an equivalent pressure of less than 1 psi (7 kPa). The pilot pressure at Port 3 must equal or exceed the switching pressure developed by the setpoint spring. At that point, the control chamber port opens. Pilot pressure enters the control chamber and pushes up the control chamber diaphragm, opening Port 8 and closing Port 6. When the pilot pressure drops below setpoint, the setpoint spring relaxes and closes the control chamber port. Air trapped in the control chamber bleeds to the atmosphere.

When the control chamber pressure is less than the pressure of the return spring, Port 6 connects to Port 7 and Port 8 closes (Fig. 11B). Port 3 is the pilot port.

APPLICATION

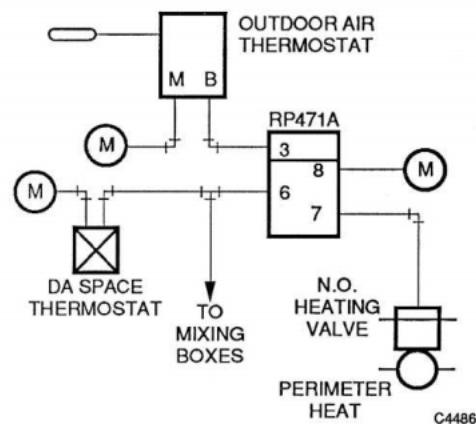
Figure 12 shows a typical RP471A application. When the outdoor air thermostat branchline pressure is higher than the RP471 setpoint, main air pressure is applied to the normally open valve, closing it. When the branchline pressure drops,

the valve actuator is placed under control of the space thermostat through Port 6. The setscrew located between the 3 and 15 psi markings is a stop for the adjustment. However, if it is necessary to lock the setting, the setscrew may be used by turning it to contact the adjustment.



C4286

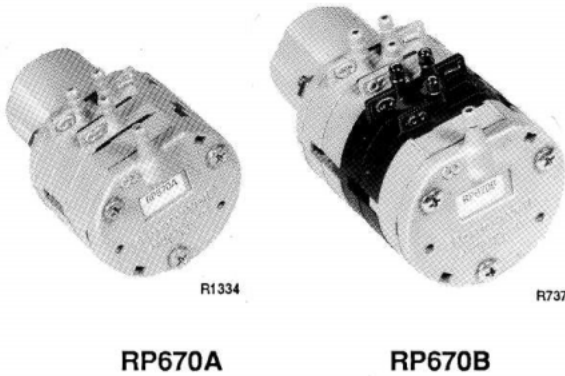
Fig. 11. RP471A Operation.



C4486

Fig. 12. RP471A Typical Application.

RP670A AND B SWITCHING RELAYS



GENERAL

The RP670A and B Switching Relays are two-position relays. The RP670A has spdt switching action and the RP670B has dpdt switching action. The RP670A is all gray. In the RP670B, one spdt switch is gray while the second spdt switch is black. The switch point is factory set and does not usually require adjustment. However, the switch point may be field readjusted 2 to 3 psi (14 to 21 kPa) by using the screwdriver slot in the top of the relay body.

The RP670 is available with switching ranges of 3 to 7 psi (20 to 50 kPa), 13 to 17 psi (90 to 120 kPa), 18 to 22 psi (124 to 152 kPa), and 20 to 25 psi (140 to 175 kPa).

Both models are used in pneumatic heating and cooling control systems where a valve or a damper actuator must be switched from one circuit to another. Switchover pilot pressure must be two position, not modulated, because during the 2 psi (14 kPa) span that switching occurs, all three ports of the switch (6, 7, and 8) are interconnected. If not considered, this situation can cause problems during a slow (modulating) switchover.

OPERATION

To prevent floating, a two-position signal to the pilot port (Fig. 13) is required. This signal must cover 4 to 6 psi (28 to 41 kPa), 14 to 16 psi (97 to 110 kPa), or 19 to 21 psi (131 to 145 kPa). When the pilot pressure exceeds the preset spring pressure, Port 8 opens and connects to Port 7 and Port 6 closes (Fig. 13A). When the pilot pressure is less than the preset spring pressure, Port 8 closes and Port 6 opens and connects to Port 7 (Fig. 13B).

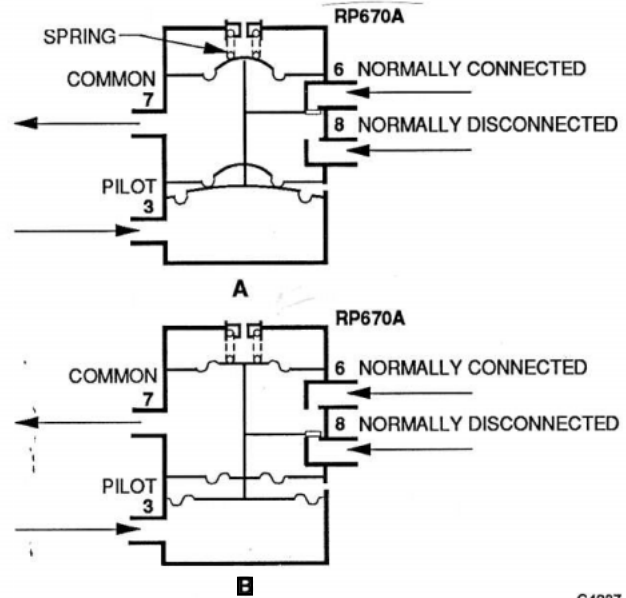


Fig. 13. RP670A Operation.

C4287

APPLICATION

Figure 14 shows a typical application for heating/cooling operation using an RP670A (spdt). During the cooling cycle, the pilot pressure (Port 3) is below the minimum switching pressure of the relay. Ports 6 and 7 are connected. Port 8 is blocked, removing the low-limit controller from the system.

During the heating cycle, the pilot pressure is above the preset switching pressure. Ports 7 and 8 are connected and the low limit controller resumes its override operation. Port 6 is blocked.

An RP670B (dpdt) can be piped in the same type of system as shown in Figure 14. It can also be piped to two systems which use the same pilot signal because Ports 6, 7, and 8 are duplicated in the black section of the relay.

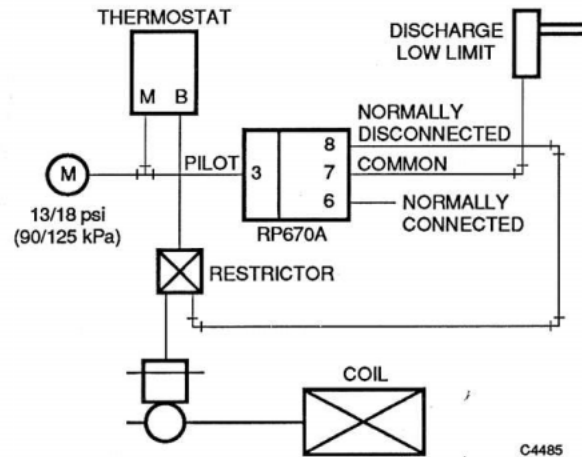
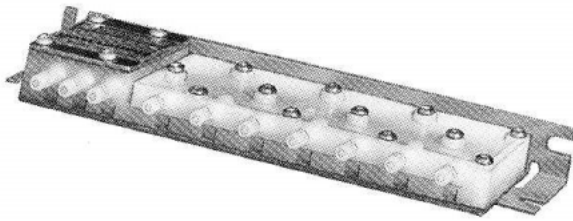


Fig. 14. RP670A Typical Application.

RP913A LOAD ANALYZER



RP913A

R3654

GENERAL

The RP913A Load Analyzer is a bleed type, diaphragm logic pressure selector used in pneumatic control applications. The RP913A selects the highest and/or lowest branch pressure input from up to seven inputs and passes the signal on to operate a final control element. The RP913A must be connected to devices that do not consume air because its output capacity is low.

OPERATION

The RP913A contains 14 small diaphragms and control nozzles (Fig. 15). The diaphragms are arranged in two rows of seven diaphragms. Each input pressure is connected to two diaphragms, one in each row.

The top row of diaphragms and control nozzles selects the highest pressure. The nozzles are connected in series and then vented. The diaphragm with the highest input pressure controls by exhausting just enough restricted main air to maintain a pressure balance between the upper and lower diaphragm chambers. All other nozzles are open because their input pressures are lower than the input pressure at the controlling diaphragm.

The bottom row of diaphragms and control nozzles selects the lowest pressure. Both the lower diaphragm chambers and the nozzles are connected in parallel and the nozzles are vented. The diaphragm with the lowest input pressure controls by exhausting just enough restricted main air to maintain a pressure balance between the upper and lower diaphragm chambers. All other nozzles are closed because their input pressures are higher than the input pressure at the controlling diaphragm.

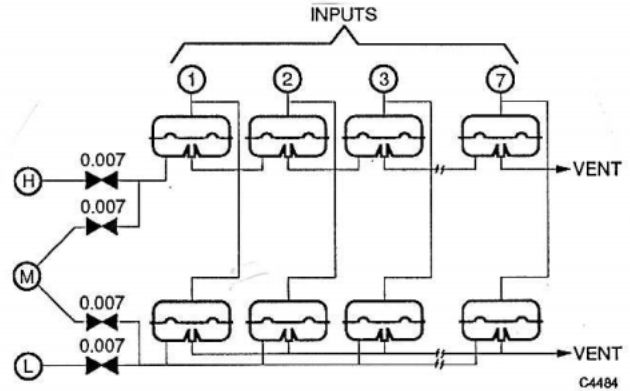


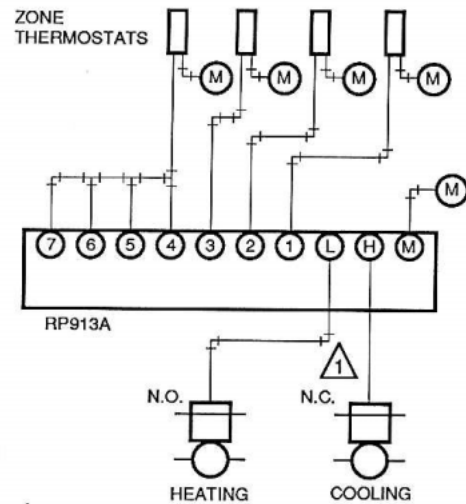
Fig. 15. RP913A Operation.

APPLICATION

Figure 16 shows a typical application in which the coldest zone (lowest pressure from a direct-acting thermostat) modulates a normally open heating valve and the warmest zone (highest pressure from a direct-acting thermostat) modulates a normally closed cooling valve.

NOTES:

1. If fewer than seven inputs are used, the unused input ports must be connected together for a lowest-pressure application (see Fig. 16). Otherwise, the RP913 will interpret the port left open as 0 psi and the lowest-pressure output will always be 0.
2. Unused ports do not have to be connected together for highest-pressure-only applications (L port plugged).



⚠ Plug Port H or L when not used

C4483

Fig. 16. RP913A Typical Application.

In applications that require more than seven inputs, two RP913As can be connected to provide 12 inputs (Fig. 17). Each additional RP913A provides five additional inputs. Main air must be connected to each RP913A.

For installations using two RP913As for 12 inputs, all seven inputs of the first RP913A are connected to any two ports of the second RP913A. The remaining five input ports on the second RP913A are then connected to additional inputs. The H or L output of the second RP913A is used for controlling small valve or damper actuators. An RP970A Capacity Relay should be used when the H or L output supplies large or multiple actuators, or devices that use air.

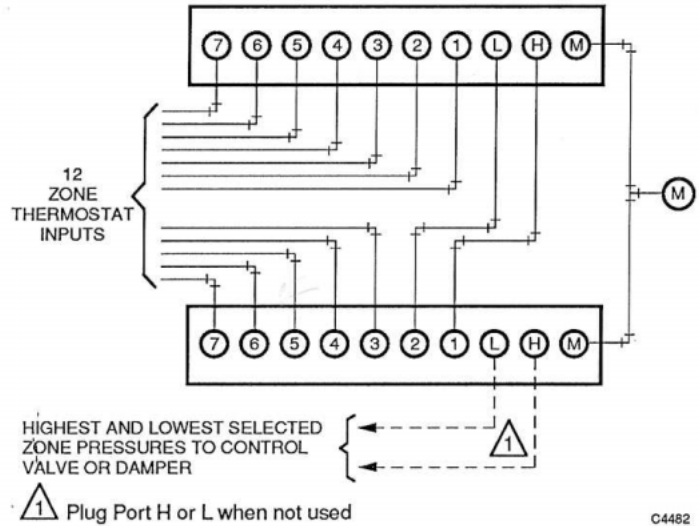
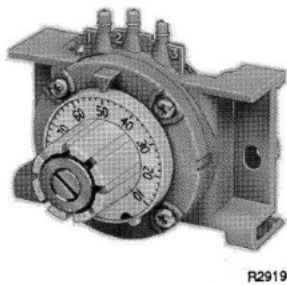


Fig. 17. Two RP913As Piped for Twelve Inputs.

RP922A PNEUMATIC POTENTIOMETER



RP922A

GENERAL

The RP922A Pneumatic Potentiometer is a three-port pneumatic potentiometer used in control systems to provide the following functions:

- Averaging two input pressures
- Summing two input pressures
- Acting as an adjustable flow restriction
- Acting as an adjustable pressure supply

OPERATION

The RP922A consists of a long, restricted air passage with air connections at each end and a mid air connection that is controlled at a pressure value based on the relative inputs at the two end connections (Fig. 18).

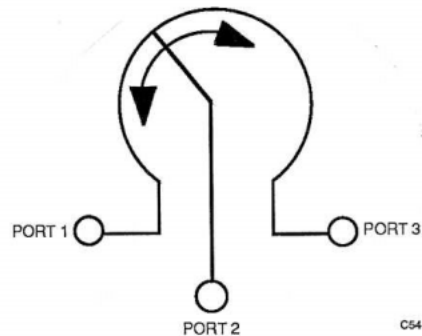


Fig. 18. RP922A Operation.

APPLICATION

1. Averaging-Ratio Relay, Summing Relay:
 - A typical application uses the RP922A to provide averaging-ratio pressure output (Fig. 19 and Table 2). Ports 1 and 3 connect to pressure signals and Port 2 connects to a controller input port. Port 2 is a functional output of Ports 1 and 3.
 - In another application, the RP922A sums the input velocity signals of two ducts with different areas to produce a total flow signal (Fig. 20).

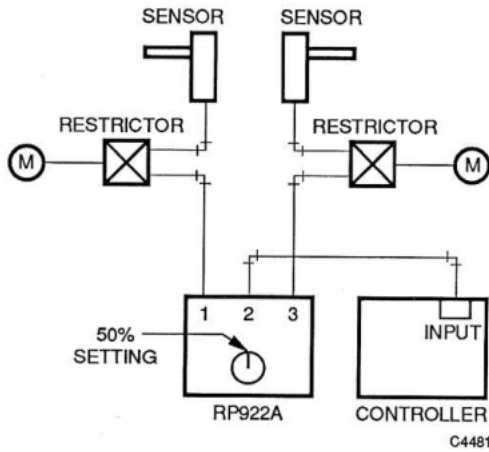


Fig. 19. RP922A Typical Averaging-Ratio Relay Application.

Table 2. Ratio Pressure at Port 2.

Ratio	Scale Setting	Output at P2*
9-1	10	$\frac{9(P1) + P3}{10}$
3-1	25	$\frac{3(P1) + P3}{4}$
2-1	33	$\frac{2(P1) + P3}{3}$
1-1	50 (Averaging)	$\frac{P1 + P3}{2}$
1-2	67	$\frac{P1 + 2(P3)}{3}$
1-3	75	$\frac{P1 + 3(P3)}{4}$
1-9	90	$\frac{P1 + 9(P3)}{10}$

* Idealized response. Actual response is higher than the calculated response by about 5 percent of the difference between P1 and P3.

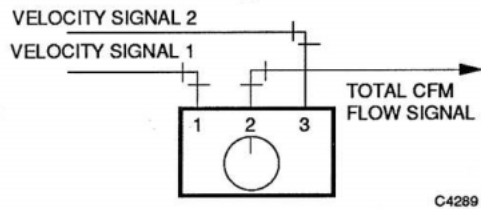


Fig. 20. RP922A Typical Summing Relay Application.

2. Adjustable Flow Restriction:

— In this application, the RP922A functions as an adjustable airflow restriction. A 30 percent scale setting is equivalent to a 0.007-inch restrictor; a 90 percent scale setting is equivalent to a 0.005-inch restrictor (Fig. 21).

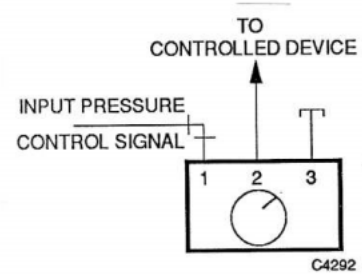


Fig. 21. RP922A Typical Adjustable Flow Restrictor Application.

3. Adjustable Pressure Supply:

- In the application shown in Figures 22 and 23, the RP922A provides an adjustable pressure from 10 to 90 percent of the pressure at Port 1.
- In the application shown in Figure 24 (see also Table 2), the RP922A widens the effective proportional band of a controller by reducing the sensor input pressure by a fixed ratio (e.g., a scale setting of 50 doubles the controller proportional band).

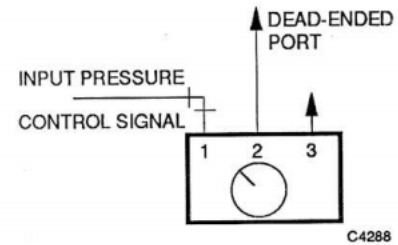


Fig. 22. RP922A Typical Adjustable Pressure Supply Application.

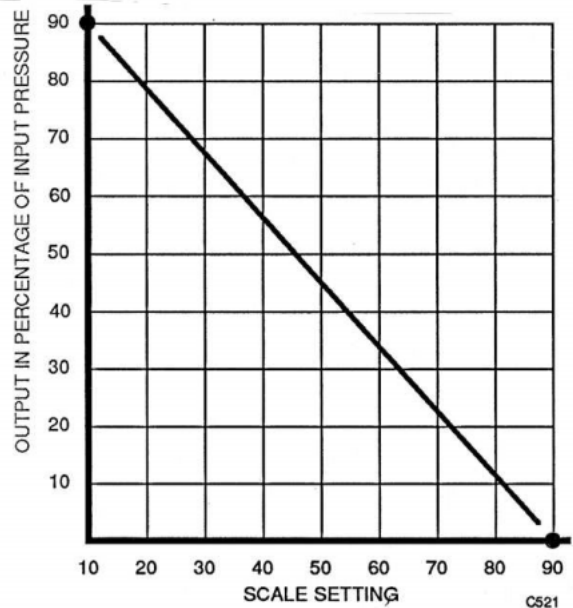


Fig. 23. RP922A Output Pressure According to Scale Settings.

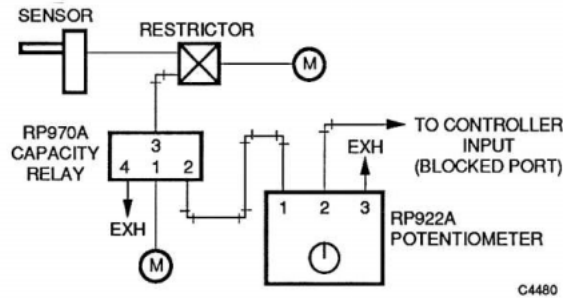
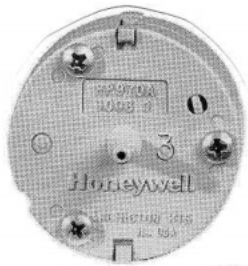


Fig. 24. RP922A Typical Adjustable Sensor Input Span Application.

RP970A CAPACITY RELAY



R745

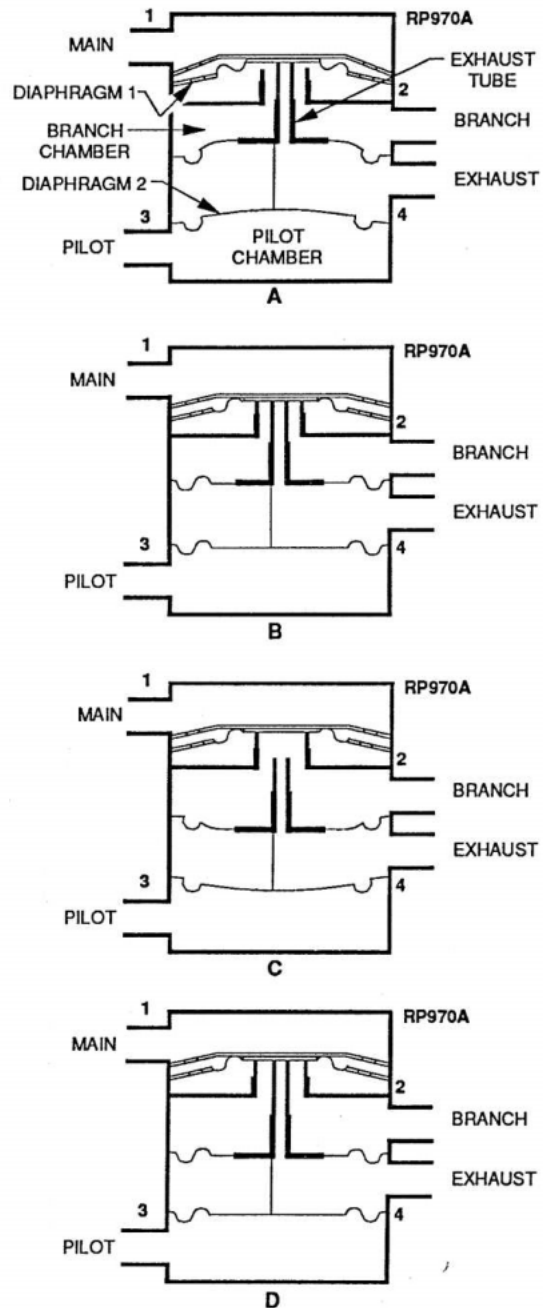
RP970A

GENERAL

The RP970A Capacity Relay is a direct-acting relay used to isolate an input, repeat a pressure, and increase the capacity of an input signal.

OPERATION

When the pilot pressure increases, the exhaust tube raises the diaphragm off the branch chamber port and main air flows into the branch line, pushing against Diaphragm 2 (Fig. 25A). This pressure forces the exhaust tube down and closes the branch chamber port. Branchline pressure now equals pilot pressure (Fig. 25B). As the pilot pressure drops, the branchline pressure against Diaphragm 2 forces the exhaust tube down, which opens the exhaust port (Fig. 25C). This function allows the branch air to bleed out through the exhaust Port 4. When the branchline pressure equals the pilot pressure, the exhaust tube rises and the exhaust chamber port closes (Fig. 25D).



C4295

Fig. 25. RP970A Operation.

APPLICATION

Figure 26 shows a typical application for the RP970A. The RP970A increases (and repeats) the output signal from the bleed-type duct thermostat, improving signal response over a long transmission line or to a high-capacity load (additional actuators).

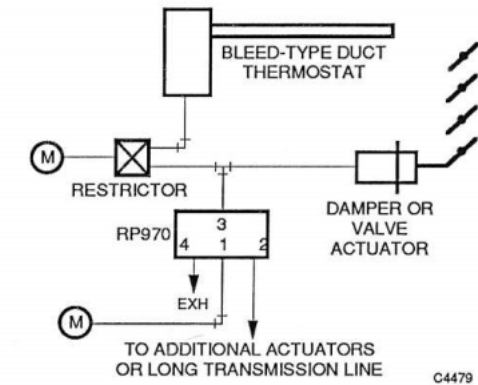
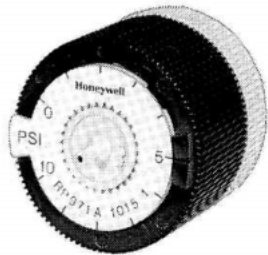


Fig. 26. RP970A Typical Application.

RP971A RATIO RELAY



RP971A

GENERAL

The RP971A Ratio Relay is a nonbleed pneumatic relay which produces a modulating pressure output in proportion to pilot input changes. The RP971A is used to control pneumatic valve or damper actuators in sequence from a single signal source. The RP971A comes in two models, one with a fixed pilot pressure span of 3 psi (21 kPa) and the other with a fixed pilot pressure span of 5 psi (34 kPa). The output of each is a 10 psi (69 kPa) change. This pilot pressure span is nonadjustable; however, the start point of the pilot pressure is adjustable from 0 to 10 psi (0 to 69 kPa). Rotating the start adjustment causes a detent click. Each click equals approximately 0.1 psi (0.7 kPa). Figure 27 shows schematic cutaway illustrations of a pneumatic ratio relay. Exhaust Port 4 is not used.

OPERATION

The effective area ratio between the pilot and the feedback diaphragms (Fig. 27) controls the ratio between the pilot and

branchline pressures. The 3 psi (21 kPa) model gives a 10 psi (69 kPa) variation in branchline pressure for a 3 psi (21 kPa) change in pilot pressure. The start adjustment sets the pilot pressure at which the branchline pressure begins to increase above 3 psi (21 kPa). For example, a 5 psi (34 kPa) setting outputs 3 psi (21 kPa) with a 5 psi (34 kPa) pilot signal.

Figure 27A shows the RP971A in a balanced condition. As the pilot pressure increases, the exhaust tube lifts Diaphragm 1, feeding main air into the branch chamber (Fig. 27B) through small holes in the diaphragm. This pressure pushes down on the feedback diaphragm and retracts the exhaust tube, which returns the relay to a balanced condition (Fig. 27C). When the pilot pressure drops, the exhaust tube retracts further and bleeds the branchline air into the atmosphere. See Figure 27D. When sufficient air has bled off, the relay returns to a balanced condition with a new and lower branchline pressure (Fig. 27E).

APPLICATION

Figure 28 shows a typical application for an RP971A. The three RP971As with 3 psi (21 kPa) spans are set for inputs of 3 to 6 psi (20 to 40 kPa), 6 to 9 psi (40 to 60 kPa), and 9 to 12 psi (60 to 80 kPa), respectively. The thermostat signal through the relays can then proportion, in sequence, three identical valves or actuators that all have 3 to 13 psi (21 to 90 kPa) springs.

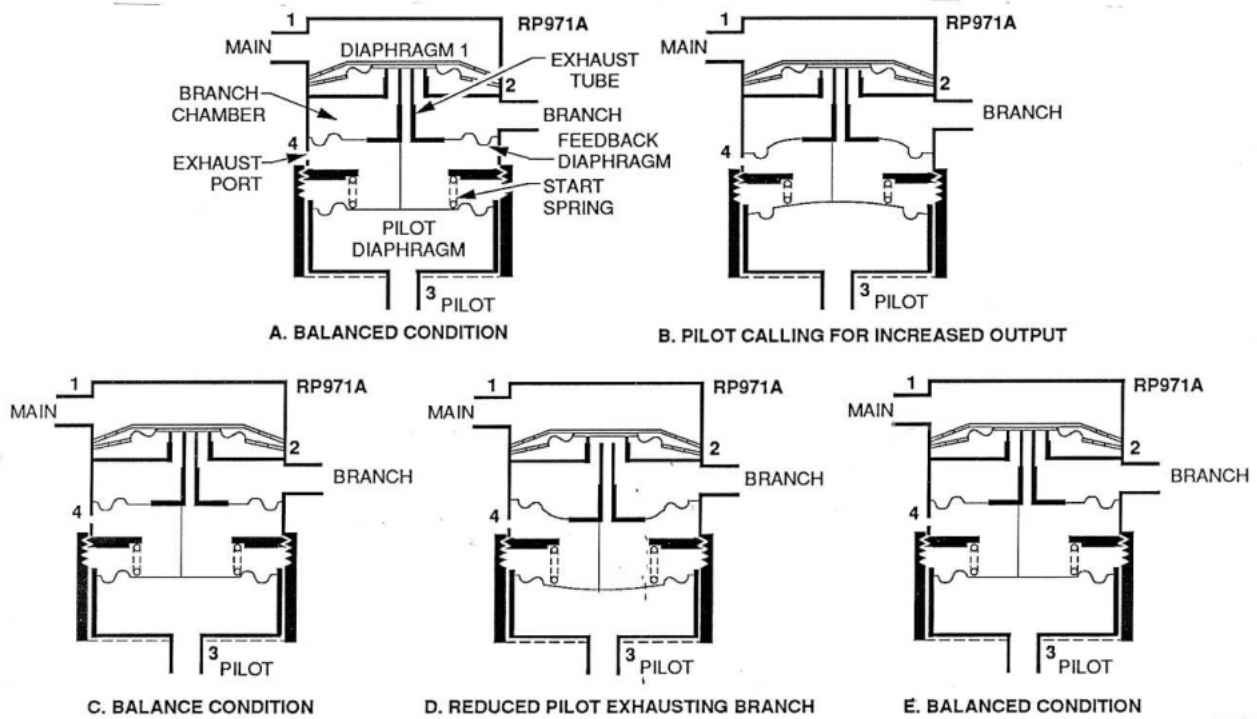


Fig. 27. RP971A Operation.

C4502

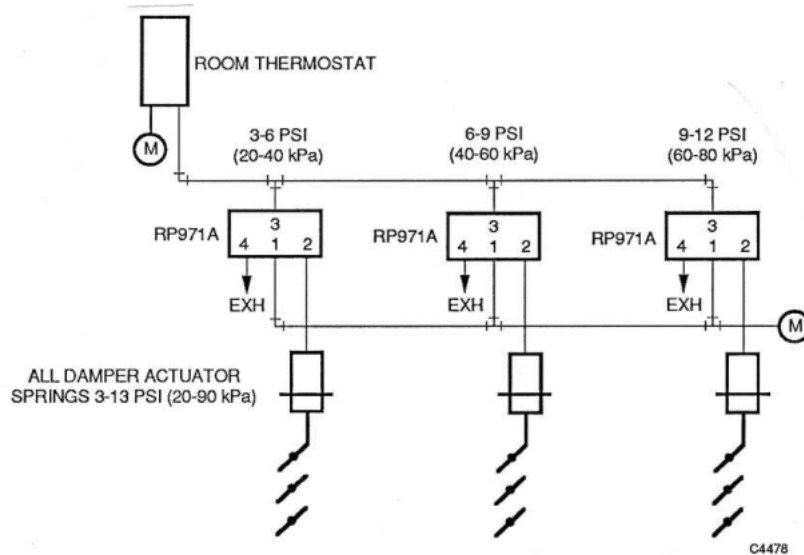
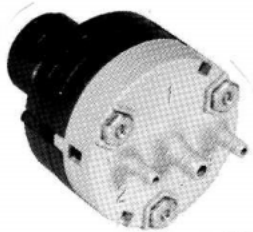


Fig. 28. RP971A Typical Application.

C4478

RP972A REVERSING RELAY

GENERAL



R751

RP972A

The RP972A Reversing Relay has three distinct, detented, field-adjustable reversing settings: 13 psi (90 kPa) minus pilot, 16 psi (110 kPa) minus pilot, and 18 psi (124 kPa) minus pilot. It comes factory set at 16 minus pilot to give an exact reversal for 3 to 13 psi (21 to 90 kPa) inputs. The 13 minus pilot setting gives a 0 psi (0 kPa) output on a 13 psi (90 kPa) main. The 18 minus pilot setting gives a 3 to 15 psi (21 to 103 kPa) exact reversal which is a commonly used range for international applications.

Internally, the RP972A is the same as the RP970A Capacity Relay with a biasing spring in the pilot chamber. Other characteristics are also similar to the RP970A. The small Allen hex screw in the middle of the setpoint plunger is for factory calibration. If required, however, the setpoint may be shifted ± 1 to 2 psi (± 7 to 14 kPa) with this screw.

OPERATION

The three bayonet lock positions for the RP972A are 13 psi (90 kPa), 16 psi (110 kPa), and 18 psi (124 kPa) (Fig. 29A). The output of the RP972A equals the lock position value, minus the pilot pressure. Of the three indicators on the front of the RP972A, only one will point to a letter designation.

The indicator is set on Position B for reversing 3 to 13 psi (21 to 90 kPa) signals. In the absence of a pilot pressure, the spring pushes the exhaust tube against the diaphragm and allows main air into the branch line (Fig. 29B). When the branchline pressure equals 16 psi (110 kPa), the pressure on the feedback diaphragm equals the adjustment spring pressure and the exhaust tube drops, closing off the feed to the branch chamber and Port 2. The relay is now in a balanced condition (Fig. 29C). Any air entering the pilot chamber compresses the spring, opening the exhaust chamber port and lowering the branchline pressure accordingly (Fig. 29D). As the pilot pressure decreases, the spring pushes the exhaust tube up allowing main air to enter the branch line and raise the branchline pressure. When the branchline pressure equals the spring pressure minus the pilot pressure, the exhaust tube is retracted and the relay is balanced with the new higher branchline pressure.

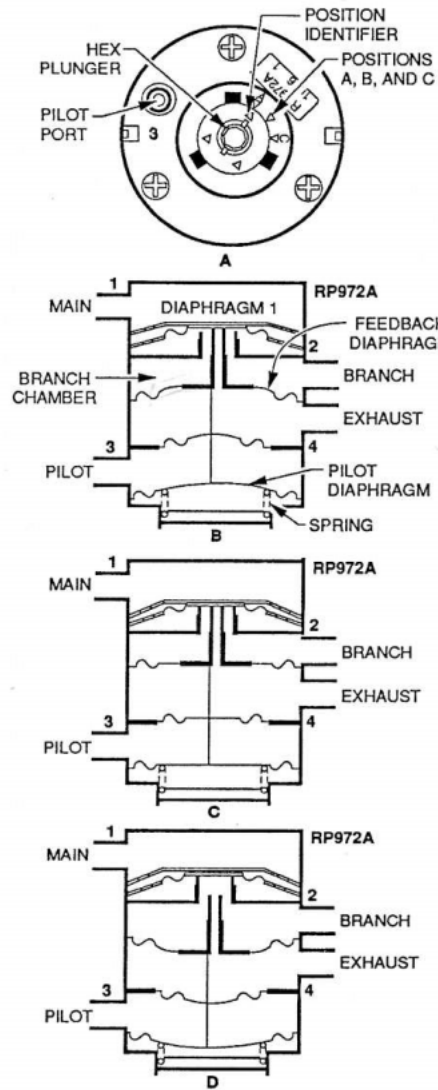


Fig. 29. RP972A Operation.

C4296

APPLICATION

Figure 30 shows a typical application for an RP972A. With a fall in temperature, branchline pressure for the direct-acting thermostat decreases. The RP972A branchline pressure increases, opening the normally closed steam valve.

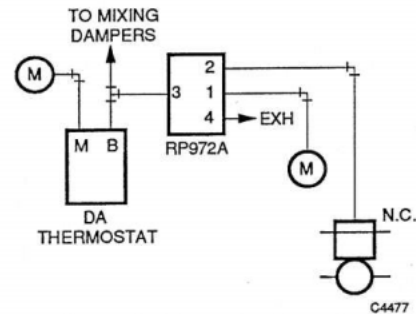
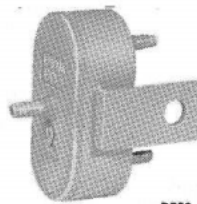


Fig. 30. RP972A Typical Application.

C4477

RP973A AVERAGING RELAY



R753

RP973A

GENERAL

The RP973A Averaging Relay is a direct-acting, three-port, pneumatic relay that averages two input pressures to supply a controller input or to operate a valve directly.

OPERATION

The RP973A consists of two 0.005-inch matched restrictors in a single housing (Fig. 31). The two signals to be averaged are each fed through a restrictor to a common chamber (Fig. 31A). This construction ensures that the pressure at the output can never be more than the average of the two input pressures, as often occurs in valve-unit type averaging relays. The higher pressure flows through the restrictor and out the other input.

The output pressure is the average of the two input pressures within ± 20 percent or ± 7 psi of the difference between the high and the low and always falls approximately half-way between the two input pressures. The closer the input pressures are in psi, the more accurate the RP973A becomes. For example, if the inputs are 3 and 13 psi (21 and 90 kPa), the output will be 8 ± 2 psi (55 ± 14 kPa) (Fig. 31B). If the inputs are closer, however, at 12 and 13 psi (83 and 90 kPa), the output is closer to the average, at 12.5 ± 0.7 psi (86 ± 5 kPa).

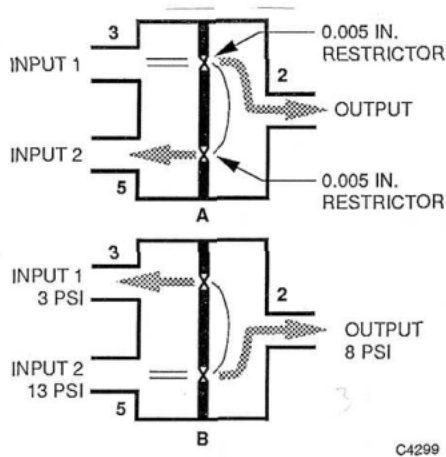


Fig. 31. RP973A Operation.

APPLICATION

The RP973A can be used to average two LP914 Temperature Sensor lines (Fig. 32). The output will be within ± 15 percent of the mathematical average of the input signals. The closer the signals, the more accurate the RP973A becomes.

Because input signal air flows from higher to lower, do not use this device on bleed-type thermostat lines other than the LP914 or LP915. If bleed-type devices (including another RP973A) are to be averaged, use an isolating (repeating) circuit (Fig. 33).

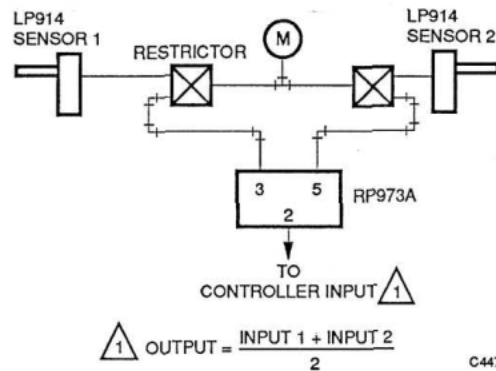


Fig. 32. RP973A Typical Averaging Circuit.

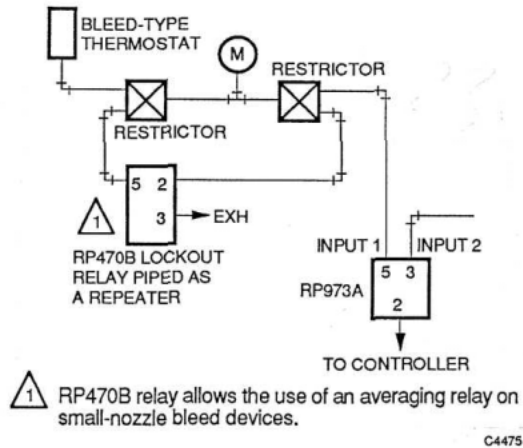
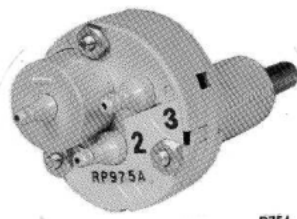


Fig. 33. RP973A in an Isolating Circuit.

RP975A HESITATION RELAY



RP975A

GENERAL

The RP975A Hesitation Relay can be combined with the MP909 actuator to eliminate the MP516 actuator in unit ventilator applications. It is also a bleed device similar to the SP970 Manual/Minimum Position Switch. Figure 34 shows RP975A output according to its knob settings. The RP975A scale plate is marked from 0 to 100 and the knob rotates 188 degrees, limited by breakaway stops, representing an output

pressure range of 7 to 12 psi (48 to 83 kPa). The relay goes to minimum whenever the pilot pressure is greater than 2.5 psi (17.2 kPa) and less than the minimum setting. If the stops are broken away, the knob rotation is 300 degrees, representing an output pressure range of 5 to 13 psi (34 to 90 kPa).

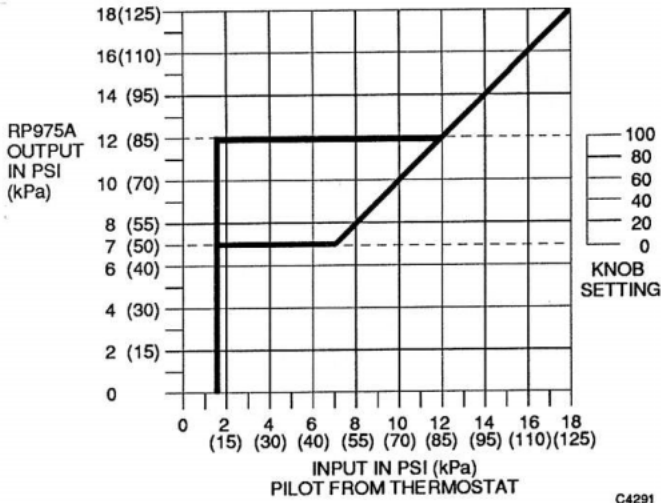


Fig. 34. RP975A Output Pressure According to Knob Setting.

OPERATION

The main air flows through a 0.007-inch restriction in Port 1 into the two branch chambers (Fig. 35A). When the pilot pressure force is less than the spring force, the air entering the lower branch chamber flows out of the exhaust port. When the pilot pressure exceeds approximately 1.5 psi (10 kPa), internal Port A between the lower branch chamber and the exhaust chamber closes and Port B in the pilot chamber opens at one end only (Fig. 35B). The branchline pressure then begins to increase up to the spring setting.

At the pressure dictated by the knob setting (7 to 12 psi [48 to 83 kPa]), the branchline pressure in the upper branch chamber overcomes the spring and opens Port C (Fig. 35C). Excess air from the branch line flows out the pilot port because the pilot pressure is less than the branchline pressure. (Note the similarity to the SP970A and B with exhaust air flowing out the pilot line. A restricted pilot line cannot be used.) If the pilot pressure increases above the knob setting, pilot air flows into the branch chamber until the branchline pressure equals the pilot line pressure. Then the excess bleed air again exhausts through the pilot (Fig. 35D).

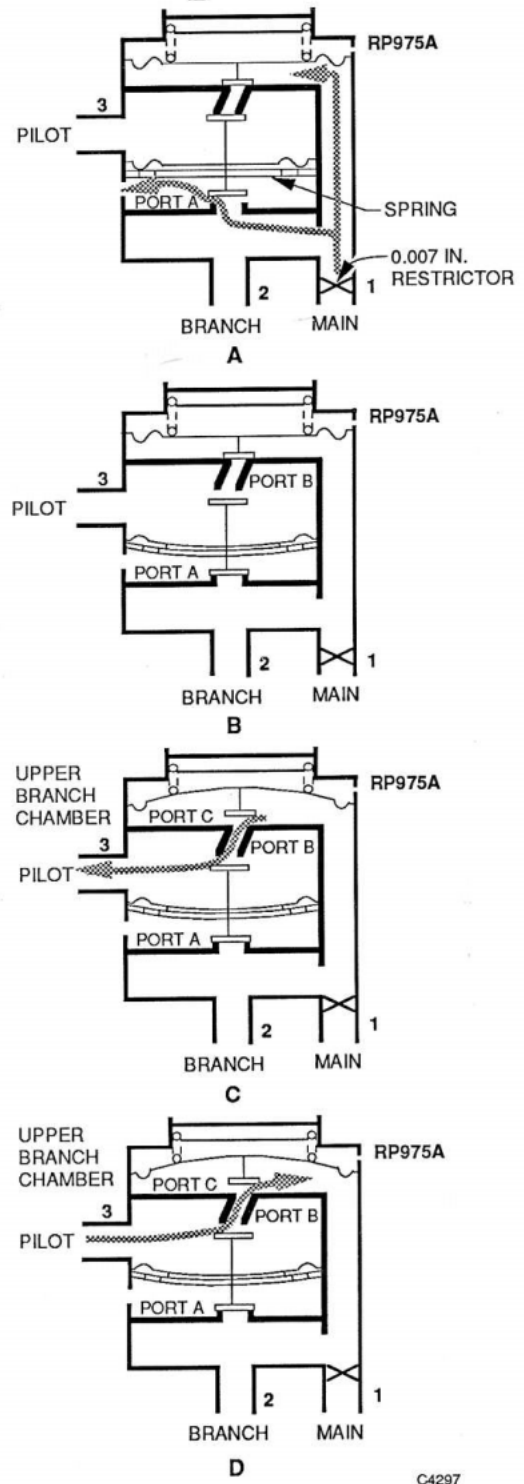


Fig. 35. RP975A Operation.

APPLICATION

Figure 36 shows a typical hookup for the RP975A and a pneumatic damper actuator. When the thermostat branchline pressure exceeds 1.5 psi (10 kPa), the damper actuator goes to a preset minimum position determined by

the knob setting. When the branchline pressure of the thermostat reaches the setting of the RP975A, the thermostat controls the damper actuator. When the thermostat branchline pressure drops below the RP975A setting, the damper actuator drops to the minimum position and stays there until the thermostat branchline pressure drops below 1.5 psi (10 kPa); then the output of the hesitation relay drops to zero.

To use the RP975A with a restricted pilot line, an RP470B Lockout Relay must be added (Fig. 37).

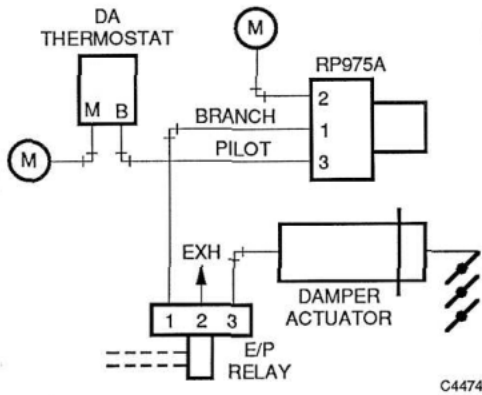


Fig. 36. RP975A Typical Application.

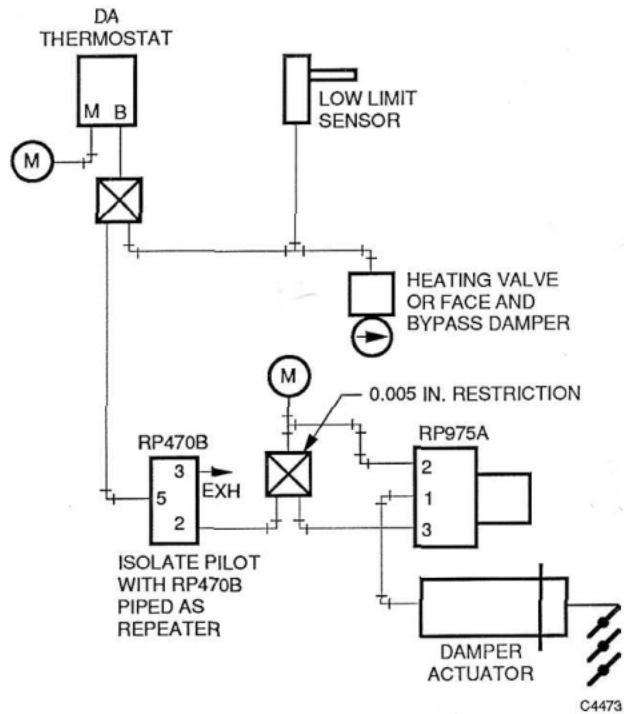
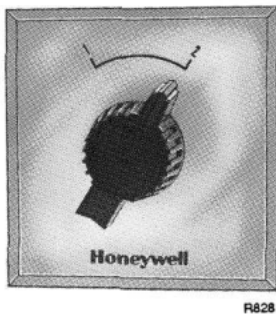


Fig. 37. RP975A in an Isolating Circuit.

SP470A AND B PNEUMATIC SWITCHES



SP470B

GENERAL

The SP470A and B Pneumatic Switches manually divert air between various system components such as valve and damper actuators and thermostats. The SP470A is the Switch only, and the SP470B is the Switch mounted in a panel. These switches are available in two- or three-position models and can be panel or in-line mounted. When the switch knob is rotated to the selected position, a detent click is noticeable and the switch ports align as shown in Figure 38. Figure 38A shows port alignment for two-position switching, and Figure 38B shows port alignment for three-position switching.

The SP470 fits in narrow, partition-type walls and is typically installed on a 4 x 4 x 1-1/2 in. (102 x 102 x 38 mm) standard electrical box.

OPERATION

The SP470 two-position switch (Fig. 38A) is for circuit interchange. Position one connects Ports 7-8 and Ports 6-9. Position two connects Ports 7-6 and Ports 8-9.

The SP470 three-position switch (Fig. 38B) is for sequential switching of one port (Port 7) to the other ports (Ports 6, 8, and 9). Position one connects Ports 7-9, position two connects Ports 7-8, and position three connects Ports 7-6. The unconnected ports are blocked to airflow.

NOTE: Both switching models bleed to the atmosphere when the switch is between positions. Thus these switches should not be left between positions.

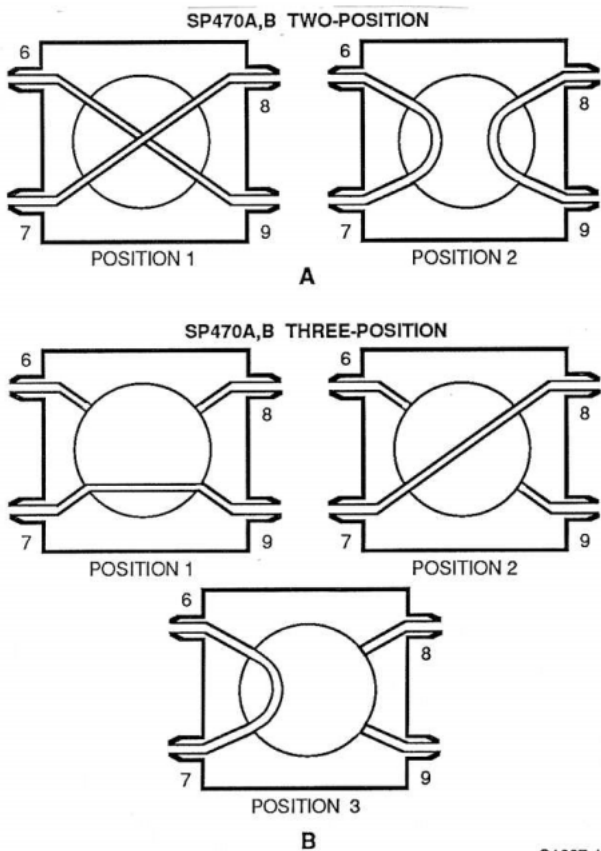
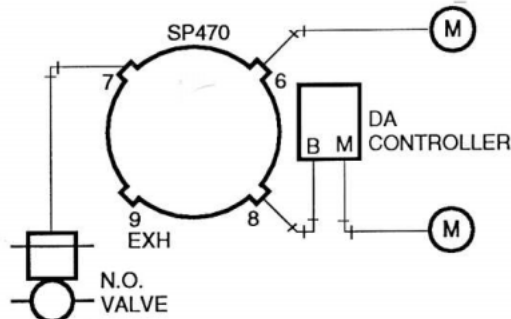


Fig. 38. SP470A, B Operation.

APPLICATION

Figure 39 shows a typical application for sequential switching. In Position 1, the actuator exhausts through Port 9 and the valve opens. In Position 2, the switch connects the actuator to the direct-acting controller and the valve is in the automatic mode. In Position 3, the switch connects the actuator to main air and the valve closes.

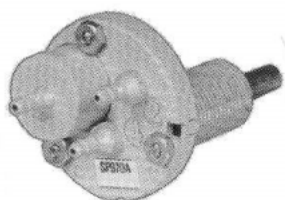


NOTES:

- Position 1, valve open: Ports 7 and 9 connected, Ports 6 and 8 blocked
- Position 2, valve auto: Ports 7 and 8 connected, Ports 6 and 9 blocked
- Position 3, valve closed: Ports 7 and 6 connected, Ports 8 and 9 blocked

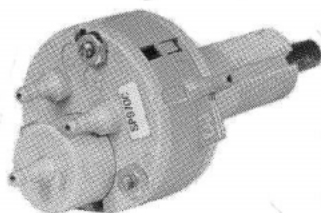
Fig. 39. SP470A, B Typical Three-Position Application.

SP970A-D MANUAL/MINIMUM POSITION SWITCHES



SP970A

R1325



SP970C

R833

GENERAL

The SP970A-D Manual/Minimum Position Switches are 0.007-inch bleed-type switches whose capacity is not directly affected. The 0.007-inch restriction in the SP970 supplies minimum-position air. The pilot feeds the branch. The capacity of the SP970, above minimum position, is a function of the capacity of the device feeding the pilot. Pressure builds to the minimum pressure slowly during start-up, but once there the pilot feeds and bleeds from that point.

NOTE: The device feeding the pilot must be able to exhaust the airflow from the 0.007-inch restricted main. A high-capacity device such as the RP920 Controller works well.

The SP970C must be used with a low-capacity, bleed-type device as an input because the SP970C has an isolated pilot. This makes the SP970C a true bleed-type device. The pilot of the SP970A or B may be used as the restricted main to any 0.007-inch bleed-type thermostat.

OPERATION

SP970A AND B THREE-PORT SWITCHES

The SP970A and B three-port switches are used to regulate the branchline pressure at a preset limit (Fig. 40A). Main air flows through the restriction in Port 1 into the branch chamber. In the manual positioning mode, when the Port 2 chamber output pressure rises above the knob setting, the exhaust nozzle opens and excess air is exhausted through Port 4, maintaining the desired pressure in the branch line (Fig. 40B).

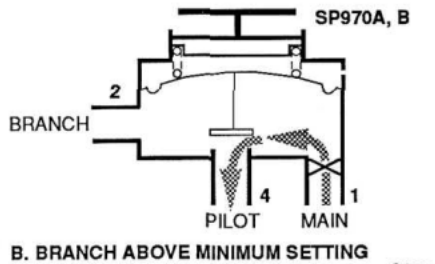
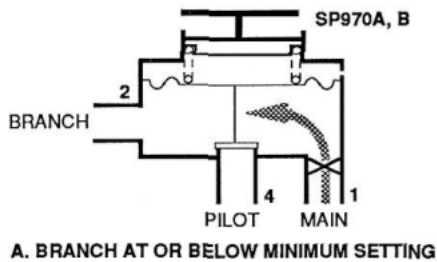
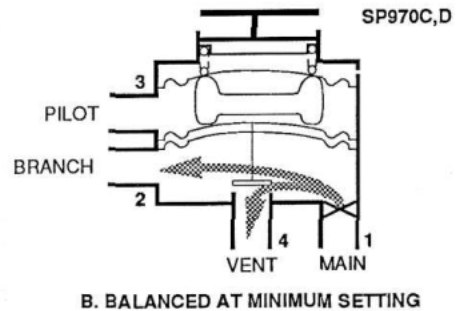
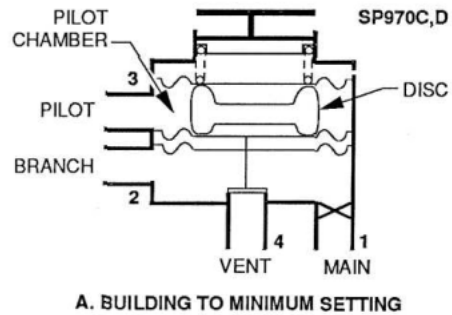


Fig. 40. SP970A and B Operation.



SP970C AND D FOUR-PORT SWITCHES

The SP970C and D four-port switches have two additional diaphragms that isolate the pilot chamber so it is dead-ended (Fig. 41A). The disc shown in Figure 41 is a free-floating coupling between the diaphragms to maintain spacing.

If the pilot pressure (Port 3) is less than the spring pressure, the SP970C or D functions as a regulator with the disc in contact with both diaphragms (Fig. 41B). The spring pressure holds the exhaust closed until the branchline pressure at Port 2 rises to the spring setting. It then begins venting through Port 4. When the pilot pressure exceeds the spring pressure, the spring is isolated and the pilot pressure controls the exhaust port (Fig. 41C and 41D).

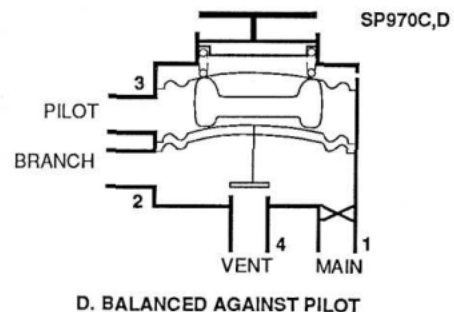
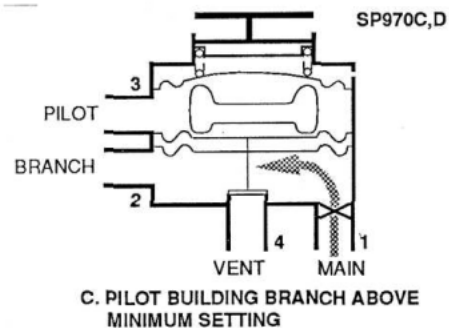


Fig. 41. SP970C and D Operation.

APPLICATION

Figure 42A shows a typical manual position application using the three-port SP970A or B. This control system manually positions a damper between open and closed. Turning the setpoint position knob clockwise increases the branchline pressure to the damper actuator and opens the damper. Turning the setpoint position knob counterclockwise decreases the branchline pressure and closes the damper.

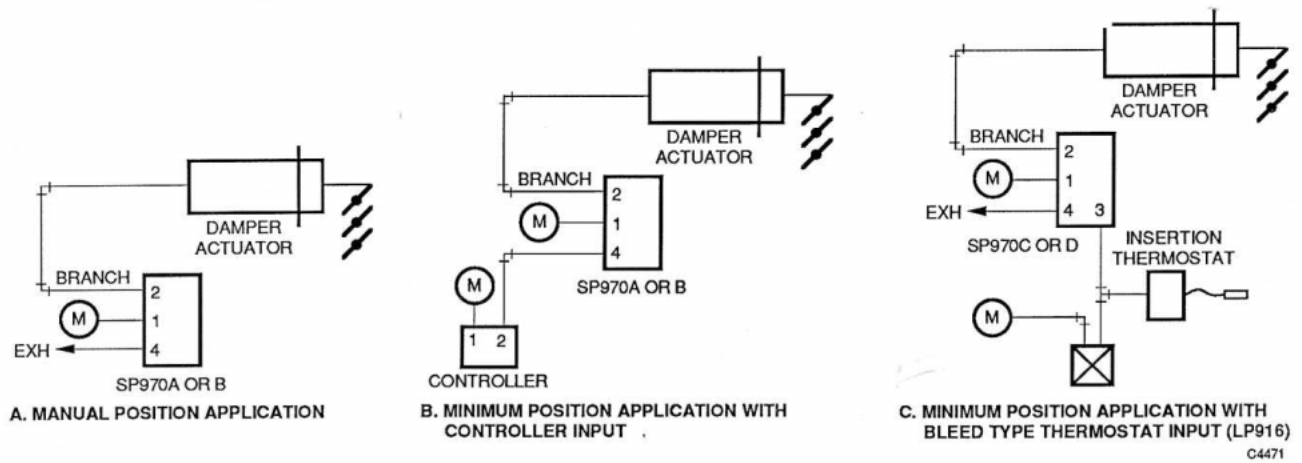
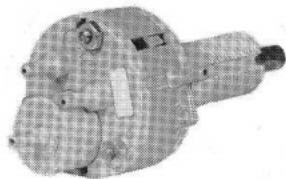


Fig. 42. SP970A-D Typical Application.

The three-port SP970A or B can also be used with a controller for automatic damper positioning with minimum position (Fig. 42B). When the external signal is less than the knob setting, the spring maintains the branchline pressure as previously described. When the external signal rises above the knob setting, air from the signal flows directly to the branch. During steady-state conditions, the external automatic controller must be capable of exhausting the air flowing through the exhaust/pilot Port 4.

Figure 42C shows a typical four-port SP970C or D application. The minimum position switch keeps the pneumatic actuator at a minimum position until the thermostat calls for more cooling. The thermostat then controls the actuator.

14003238-004 BIASING REPEATER RELAY



R3423

14003238-004

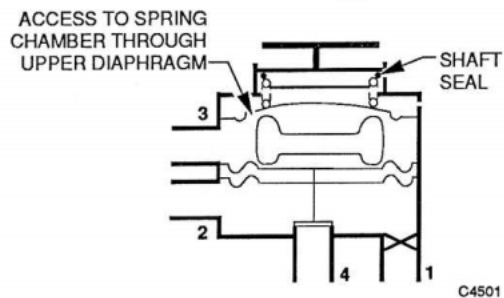
GENERAL

The 14003238-004 Biasing Repeater Relay is a spring-biased diaphragm comparator used to add a positive bias to a selected pneumatic control signal. The Biasing Repeater Relay is used in the CP984A Velocitrol Velocity Transmitter and in the control circuitry recommended in the Airflow Control Systems Application Guide 77-5063.

OPERATION

Biasing Repeater Relay construction and operation are similar to the SP970C and D, with the following differences.

The Biasing Repeater Relay has a seal added to the adjustment shaft and an air passage added through the upper diaphragm (Fig. 43), which allow the pilot pressure to be added to the spring force. The spring provides a maximum output (bias) of approximately 7 psi (48 kPa) maximum, equivalent to approximately 60 percent of sensor span.



C4501

Fig. 43. 14003238-004 Biasing Repeater Relay Operation.

APPLICATION

Figure 44 shows a typical application for the Biasing Repeater Relay. The Biasing Repeater Relay adds a constant value (in Fig. 44, representing cfm) to the return

airflow cfm. As a result, the dual-input controller operates in a balanced condition with the return cfm less than the supply cfm, resulting in a constant fixed differential between supply and return airflows.

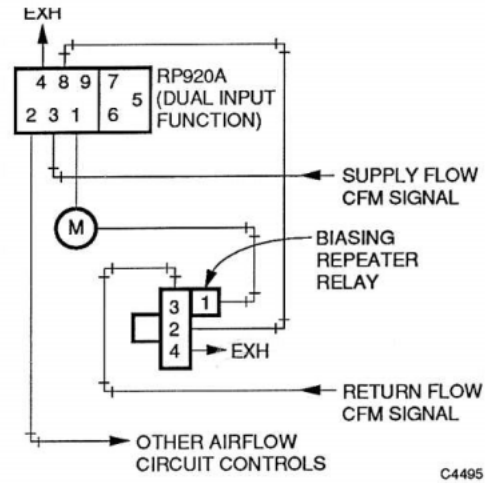
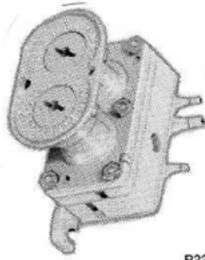


Fig. 44. 14003238-004 Biasing Repeater Relay Typical Application.

14003617-002 MINIMUM/MAXIMUM PNEUMATIC SIGNAL LIMITER



14003617-002

GENERAL

The 14003617-002 Minimum/Maximum Pneumatic Signal Limiter ("Signal Limiter") is a spring-biased diaphragm comparator that provides "floor", "ceiling", or both floor and ceiling limits for bleed-type modulated pneumatic control signals.

OPERATION

Air from the main line pressure supply (Port 1) passes through the primary restriction to the minimum and maximum Pressure Reducing Valves (PRVs) (Fig. 45). The minimum PRV prevents the variable input at Port 3 from dropping below an adjustable minimum of 0 to 7 psi (0 to 48 kPa). The maximum PRV acts as a relief valve, preventing the output from exceeding an adjustable maximum of 3 to 15 psi (21 to 103 kPa).

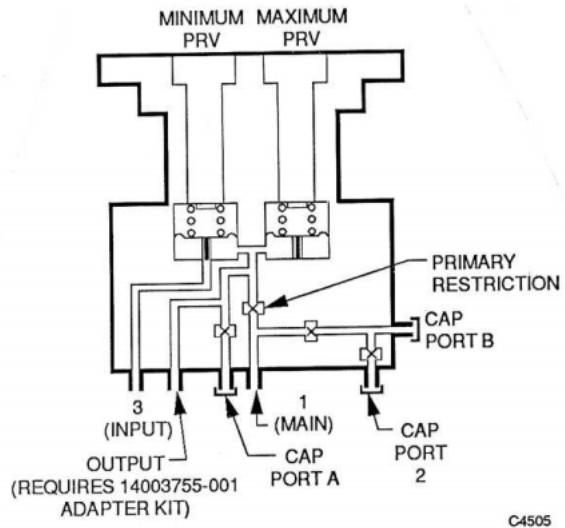


Fig. 45. 14003617-002 Minimum/Maximum Pneumatic Signal Limiter Operation.

APPLICATION

Figure 46 shows a typical application for the Signal Limiter. The output from the bleed-type duct thermostat is transmitted to the Signal Limiter, which places a floor and ceiling on the thermostat input. The limited output signal is then flow-amplified by the RP970, providing a pressure-limited, high-capacity signal to the valve or damper actuators.

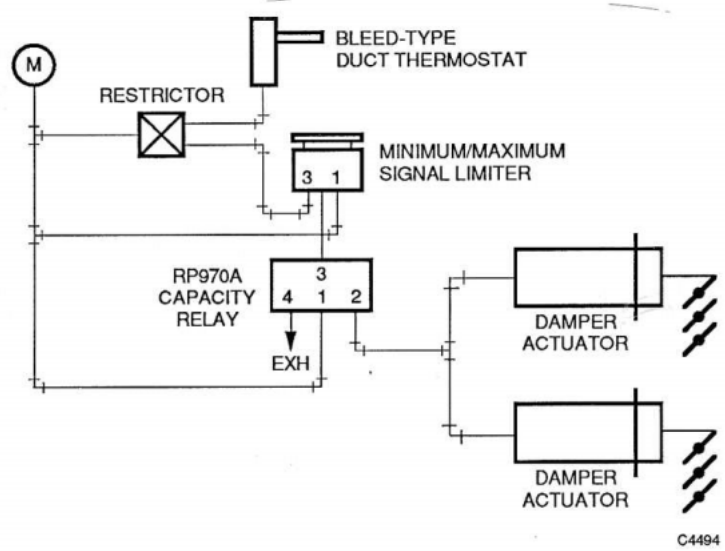


Fig. 46. 14003617-002 Minimum/Maximum Pneumatic Signal Limiter Typical Application.

Honeywell

Home and Building Control
Honeywell Inc.
Honeywell Plaza
P.O. Box 524
Minneapolis, MN 55408-0524

Home and Building Control
Honeywell Limited-Honeywell Limitée
740 Ellesmere Road
Scarborough, Ontario
M1P 2V9

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