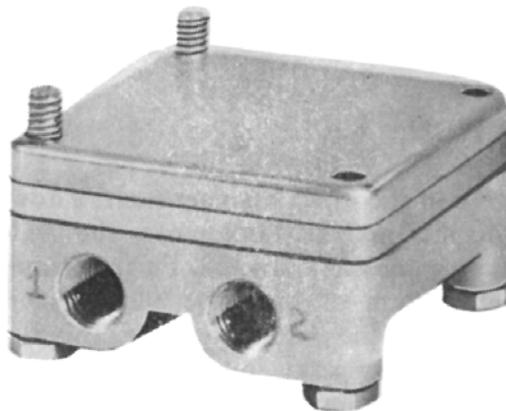


INSTRUCTION MANUAL

FOR

Ratio Relay

CR-100 - Series A/B



Note to installer: Before installing, read instructions carefully and record model number. After installing, give this manual to operating personnel or see that it is filed for future reference.

Robertshaw

Industrial Products Division
1602 Mustang Drive
Maryville, Tennessee 37801
Phone: (865) 981-3100 Fax: (865) 981-3168

INSTRUCTION MANUAL NUMBER

P-2165

Rev. B

NOTES:

SECTION I - GENERAL INFORMATION

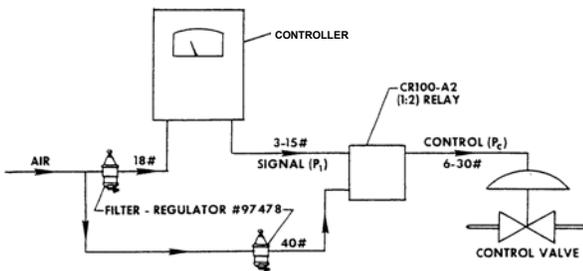
A. DESCRIPTION:

The Model CR100, Series A and B, Ratio Relays comprise a group of proportioning units designed for use in industrial pneumatic control systems where the application requires amplifying or reducing the volume of control air in a pre-determined ratio. They are available in input (P_1) to output (P_C) ratios (K) of 1:1.5 through 1:6 and 1.5:1 through 6:1. The relay components are made of steel and aluminum, and the diaphragms are Buna-N on nylon.

$$P_C = K P_1$$

B. TYPICAL APPLICATION:

Increase signal range from controller to control valve which requires higher pressure at valve.



C. SPECIFICATIONS:

DESIGN DATA

INPUT-OUTPUT RATIOS:

Amplifying (Multiplying) Relays

Model No.	Ratio*
99936-F6	1:1.5
CR100-A2	1:2
CR100-A3	1:3
CR100-A4	1:4
CR100-A5	1:5
CR100-A6	1:6

Reducing (Dividing) Relays

Model No.	Ratio*
99936-J1	1.5:1
CR100-B2	2:1
CR100-B3	3:1
CR100-B4	4:1
CR100-B5	5:1
CR100-B6	6:1

*Ratio - Input signal (P_1) to output control signal (P_C).

INPUT PRESSURE (P_1) 25 psig (1.8 bar) maximum
for amplifying,
90 psig (6.3 bar) maximum
for reducing

OUTPUT PRESSURE (P_C) 50 psig (3.5 bar) maximum

SUPPLY PRESSURE..... 60 psig (4.2 bar) Maximum
(Should always be at least
10 psig (0.7 bar) greater
than output pressure.)

OVERLOAD PROTECTION 100 psig (7 bar) will not
damage unit

ACTION.....Proportional

AMBIENT TEMPERATURE LIMITS.....-40° F to 180° F
(-40° C to 82° C)

CONNECTIONS 1/4" female NPT for
input, output and supply,
1/16" NPT for exhaust

WEIGHT..... 1.0 lb (0.45 kg)

PERFORMANCE DATA

ULTIMATE SENSITIVITY0.1% of full range

LINEARITY 1% of full range

HYSTERESIS.....± 0.5% of full range

REPEATABILITY0.5% of full range

ACCURACY Actual ratio of P_1 to P_C : Within
5% full range, of specified ratio

SUPPLY PRESSURE EFFECT:

Change in output pressure for 5 psig (0.35 bar) supply
pressure change, less than 1% of full range

AMBIENT TEMPERATURE EFFECT:

Change in output for a 75° F (24° C) ambient
temperature change - 0.5% of full range

AIR CONSUMPTION 7.0 SCFH maximum

FOR MAXIMUM FLOW:

Supply Output Capacity 3.0 SCFM nominal
Exhaust Output Capacity 5.0 SCFM nominal

LOAD EFFECT - AIR FLOW TO CAUSE 1 PSIG (0.07 BAR) PRESSURE DROP:

Amplifying 1.7 SCFM
Reducing..... 2.9 SCFM

SECTION II - INSTALLATION

A. GENERAL:

Be sure that all pipes and fittings used are clean, free of chips, dirt and moisture. If pipe compound or shellac are used, apply a small amount above the second or third male thread. **DO NOT GET PIPE COMPOUND OR SHELLAC INSIDE RELAY.**

B. MOUNTING:

When installing the relay do not remove the "Caplugs" from the connections until ready to install fittings.

The relay may be mounted in any position. Due to its size and

weight, it may be supported by the air lines. If more secure mounting is desired, use the mounting bracket furnished as shown in Figure 1. Use two 1/4" bolts, toggle bolts or wood screws as required by the installation. Bracket may be removed if not used.

C. CONNECTIONS:

The input, supply and output ports are 1/4" female NPT. The exhaust port is 1/16" NPT. Make the air connections to the proper ports as shown in Figure 1. The exhaust port (not shown) is located on the underside of the relay. The air supply must be clean and regulated (use filter - regulator #97478) and must not exceed 60 psig (4.2 bar).

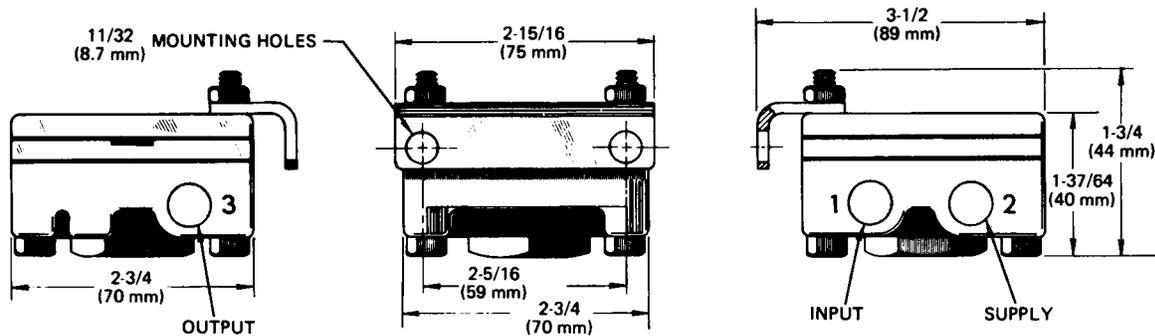


Figure 1

SECTION III - OPERATION

The control (output) pressure is proportional to the signal (input) pressure as the effective area of the signal diaphragm is to the effective area of the control diaphragm. Figure 2 shows a diagram of a 1:6 relay.

Air pressure in the signal chamber exerts a downward force on the input diaphragm. This force moves the center assembly down, closing the exhaust valve. Further movement opens the lower portion of the valve allowing the supply air pressure to enter the control chamber. This air acts on the control diaphragm and also passes out through the control air port. Since the effective area of the signal diaphragm, in this case, is six times as large as the effective area of the control diaphragm, it will take six times as much control pressure to balance the unit. As the increasing control air pressure approaches the balance point, the center assembly will begin to rise, permitting the valve to close, throttling the flow of supply air. When the control air pressure balances the signal air pressure both surfaces of the valve will be closed and the relay will be in balance.

A further increase in the signal pressure will cause the lower portion of the valve to open until the control pressure again balances the signal pressure. A decrease in the signal air pressure will allow the control pressure to force the center assembly upward, opening the exhaust valve until the control pressure balances the signal pressure.

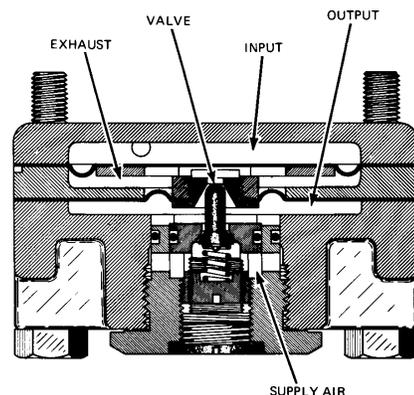


Figure 2

SECTION IV - MAINTENANCE

The simplified design of this relay makes routine maintenance unnecessary. However, should the air or air lines be dirty, it may be necessary to clean the surfaces of the valve and valve seats. If continued difficulty is experienced from dirt, moisture, oil, etc., suitable filters should be provided in the supply lines.

If the control pressure does not go to minimum output pressure or zero, or if the exhaust appears to be leaking, see Figure 3 and follow the instructions below:

1. Remove the Cap (34) and Spring Retainer (30) by unscrewing from the Cover (32). Note position of Spring Retainer (30) before removing so that it can be replaced in approximately the same position. The Valve (28), Valve Spring (29) and Gasket (33) are now free to fall out. Be careful not to drop them.
2. Using a CLEAN, soft brush, cloth or paper, wipe off the valve seats (A) and (B).
3. Inspect both Hemispherical Surfaces (C) of the Valve (28) for dirt, chips, etc. If any scars or imperfections are apparent, the Valve (28) should be replaced.
4. Replace the Valve (28), Valve Spring (29), Spring Retainer (30), Gasket (33) and Cap (34). Be sure that the Spring Retainer (30) is in the same position as it was in before disassembly, approximately one turn below being flush with end of Adjustable Seat (27) and that the Cap (34) is tight.

5. Apply air pressure to supply and signal ports. Check the Cap (34) for external leakage. Check for proper control pressure. If adjustment is necessary refer to Section V.

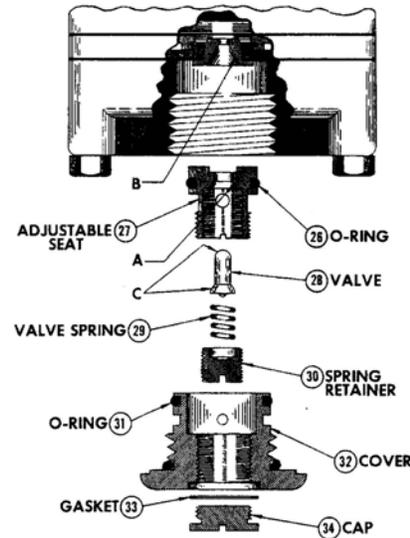


Figure 3

DO NOT USE ANY GASKET SHELLAC, PIPE COMPOUND OR ANY OTHER SEALANT.

SECTION V - ADJUSTMENT

Relays are factory adjusted do not require any adjustments when installed. However, relays that have been rebuilt will require adjustment. To adjust the relay refer to Figure 3 and follow the instructions below:

1. Apply air pressure to supply and signal ports. Check the Cap (34) for external leakage. Check for proper control pressure.

2. Remove Cap (34) and slightly rotate Adjustable Seat (27) clockwise to increase control pressure or counterclockwise to reduce control pressure. Replace Cap (34) and Gasket (33).
3. Recheck for leaks and proper control pressure.
4. Repeat Steps 2 and 3 as necessary.

SECTION VI - REPAIR

If the procedure outlined in Section IV fails to restore proper operation, refer to Figure 3 and Figure 4, 5 or 6, as applicable, and follow the instructions below:

1. Inspect air passages for dirt.
2. Inspect the Valve (28) surfaces for bumps, scars or other irregularities. The Hemispherical Surfaces (C in Figure 3) must be smooth and regular.
3. Inspect the Valve Seats (A and B in Figure 3). The surfaces must be clean and smooth with no scars or surface irregularities.
4. Inspect Diaphragms (2 and 7) for holes or worn spots which might permit air leakage.

CAUTION: If cleaning is required, do not subject the Diaphragms (2 and 7) to cleaning fluids or solvents.

5. Replace any worn or defective parts.
6. Assemble the Valve (28), Spring (29) and Spring Retainer (30) into the Adjustable Seat (27). The end of the Spring Retainer (30) should be one turn below being flush with the end of the Adjustable Seat (27).
7. Reassemble relay. O-rings should be lubricated sparingly with a suitable o-ring grease.

CAUTION - DO NOT USE ANY GASKET SHELLAC, PIPE COMPOUND OR ANY OTHER SEALANT.

8. Apply air pressure to supply and signal ports and check for leaks. Proceed to Section V for adjustment.

REPAIR PARTS			
ITEM	DESCRIPTION	PART NUMBER	QUANTITY
1	TOP PLATE	027671A0001	1
2*	INPUT DIAPHRAGM	027589B0001	1
3	EXHAUST PLATE	SEE TABULATION	1
*	EXHAUST SEAT ASSEMBLY (contains items 4 thru 8)	SEE TABULATION	1
4	ADJUSTING CAP	Not sold separately	1
5	ADJUSTING RING	Not sold separately	1
6	ADJUSTING RING	Not sold separately	1
7	BALANCING DIAPHRAGM	Not sold separately	1
8	EXHAUST VALVE PLATE	Not sold separately	1
9	BASE	027668C0001	1
10	CAP SCREW, 1/4-20 X 1-3/4	036617E2800	2
11	CAP SCREW, 1/4-20 X 1-1/2	036617E2600	2
24*	O-RING	036240N0119	1
*	VALVE ASSEMBLY (contains items 26 thru 32)	081650A0001	1
26	O-RING	036240N0014	1
27	ADJUSTABLE SEAT	029352A0001	1
28	VALVE	026059C0001	1
29	VALVE SPRING	029359A0001	1
30	SPRING RETAINER	029354A0001	1
31	O-RING	036240N0018	1
32	VALVE COVER	029353A0001	1
33*	GASKET	029356A0001	1
34*	CAP	029355A0001	1
35	MOUNTING BRACKET (not shown)	029139A0001	1
36	HEX NUT, KEPS, 1/4-20 (not shown)	036603A0019	2

Note: Repair kits are available for rebuilding relays. Repair kits contains parts marked thus*.

TABULATION				
MODEL NO.	RATIO	REPAIR KIT	EXHAUST SEAT ASSY	ITEM 3
99936-F6	1:1.5	083405A0014	099938D0007	028571B0006
CR100-A2	1:2	083405A0009	099938D0002	028571B0001
CR100-A3	1:3	083405A0010	099938D0003	028571B0002
CR100-A4	1:4	083405A0011	099938D0004	028571B0003
CR100-A5	1:5	083405A0012	099938D0005	028571B0004
CR100-A6	1:6	083405A0013	099938D0006	028571B0005
99936-J1	1.5:1	083405A0027	099938E0001	028571C0006
CR100-B2	2:1	083405A0022	099939B0001	028571C0001
CR100-B3	3:1	083405A0023	099939B0002	028571C0002
CR100-B4	4:1	083405A0024	099939B0003	028571C0003
CR100-B5	5:1	083405A0025	099939B0004	028571C0004
CR100-B6	6:1	083405A0026	099939B0005	028571C0005

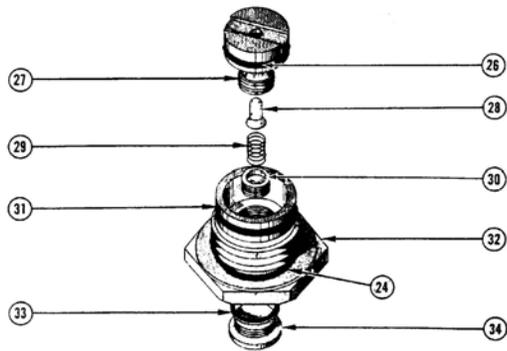
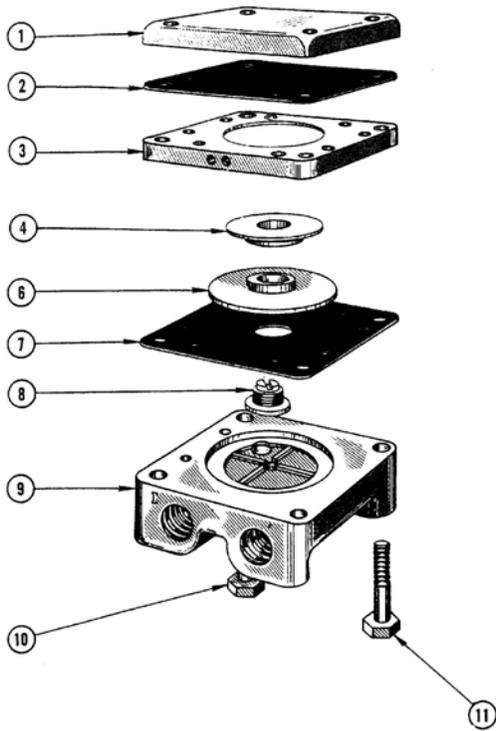


Figure 4
REDUCING RELAY

Item 5 (not shown) required for 1.5:1 ratio. Refer to Figure 5 for location.

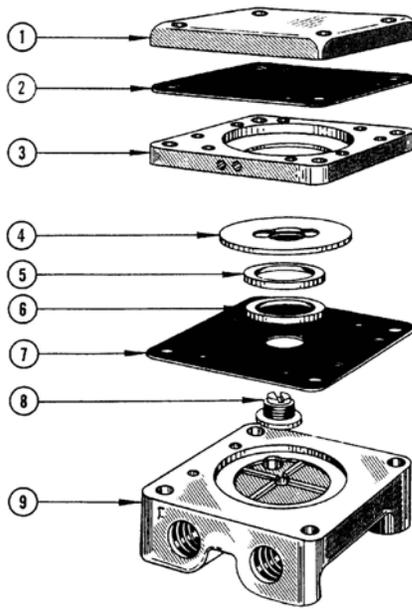


Figure 5
AMPLIFYING RELAY
1.5:1 through 5.1 Ratios

Item 5 not used on 5:1 ratio.

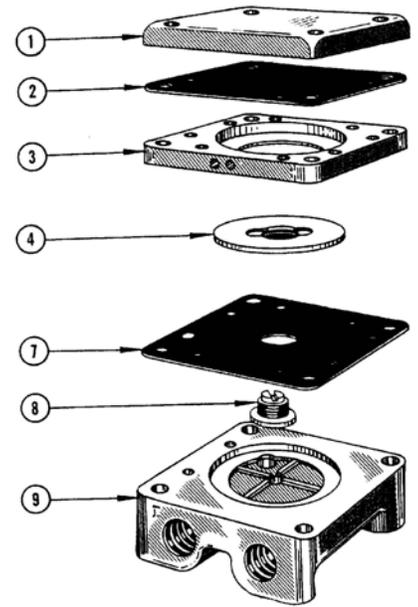


Figure 6
AMPLIFYING RELAY
1:6 Ratio

Note: Items 10 through 34 are not shown in Figures 5 and 6. These items are the same as shown in Figure 4.



Robertshaw

Industrial Products Division

U.S.A and Canada

Robertshaw Industrial Products Division

1602 Mustang Drive

Maryville, Tennessee 37801

Telephone: (865) 981-3100 Fax: (865) 981-3168

<http://www.robertshaw.thomasregister.com>

<http://www.robertshawindustrial.com>

Exports

Invensys Appliance Controls

1701 Byrd Avenue

P.O. Box 26544

Richmond, Virginia 23261-6544

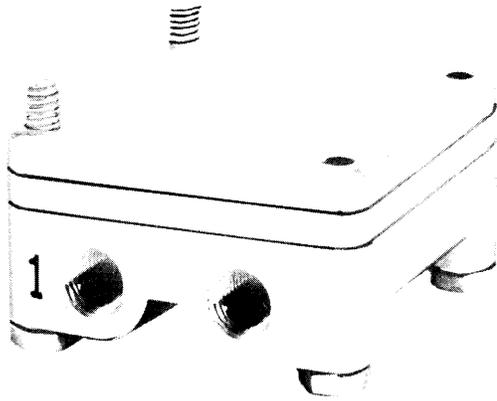
Telephone: (804) 756-6500 Fax: (804) 756-6561

QN-213 (12/03)

Printed in U.S.A.

**INSTRUCTIONS
FOR
INSTALLATION AND OPERATION**

**Model No. CR100-A1
VOLUME BOOSTER
RELAY**



NOTE TO INSTALLER: Before installing, read instructions carefully, and record model number. After installing, give this folder to operating personnel or see that it is filed for future reference.

Section I — GENERAL INFORMATION

DESCRIPTION

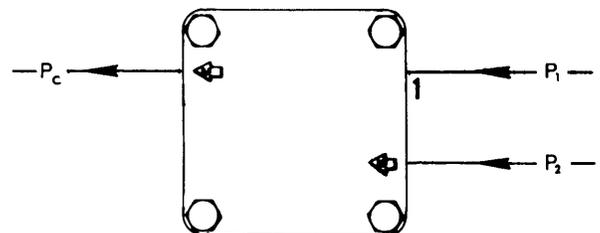
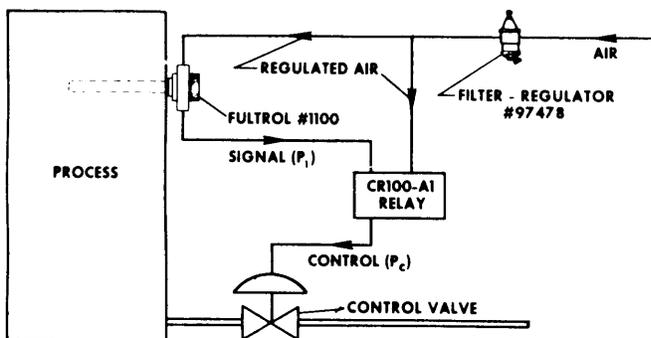
The Model CR100-A1 is a Pneumatic Volume Booster Relay designed to amplify the volume of the input signal air pressure (P_1).

$$P_c = P_1$$

TYPICAL APPLICATIONS

To improve the response time of a control circuit by increasing the air volume output from a simple "non-relay" controller to a control valve.

Connections used on CR100-A1 Relay when used as a low pressure selector.



SPECIFICATIONS

Design Data

Function: 1:1 relay within 1% of full range.

Input Pressure Range (P_i):

0 to 18 psig normal.

0 to 50 psig maximum.

Supply Pressure:

Normal — 30 psig.

Maximum — 60 psig (should always be at least 10 psi greater than P_c).

Ambient Temperature Limits: -40°F. to 180°F.

Ratio: Ratio of input (P_i) to output (P_c) — 1:1.

Action: Proportional.

Overload Protection: 100 psig will not damage unit.

Connections: 1/4" female NPT.

Weight: 1.0 pound.

Performance Data

Ultimate Sensitivity: .01 in H₂O.

Linearity: .3% full range.

Hysteresis: .3% full range.

Repeatability: .1% full range.

Supply Pressure Effect: Change in output pressure for 5 psig supply pressure change — 4 in. H₂O.

Ambient Temperature Effect: Change in output for a 75°F. rise in ambient temperature — 0.20% of full range.

Capacity: 4.0 SCFM.

Load Effect (air flow to cause 1 psig drop): 2.6 SCFM.

Consumption: Maximum — 6.0 SCFH.

Section II — INSTALLATION

GENERAL

Be sure that all pipe fittings used are clean, free of chips, dirt and moisture. If pipe compound or shellac is used, apply a small amount above the second or third thread.

CAUTION: Do not get pipe compound or shellac inside relay!

MOUNTING

When installing the relay, do not remove the "Caplugs" from the connections until ready to install fittings.

The relay may be mounted in any position. Due to its size and weight, it may be supported by the air lines. If more secure mounting is desired, use the mounting bracket furnished as shown in Figure 1. Use two 1/4" bolts, toggle bolts, or wood screws as required by the installation. Bracket may be removed or inverted by removing two nuts.

CONNECTIONS

All port openings are 1/4" female NPT. Make the air connections to the proper ports as shown in Figure 1. *The air supply must be clean and regulated (use filter-regulator #97478) and must not exceed 50 psi.*

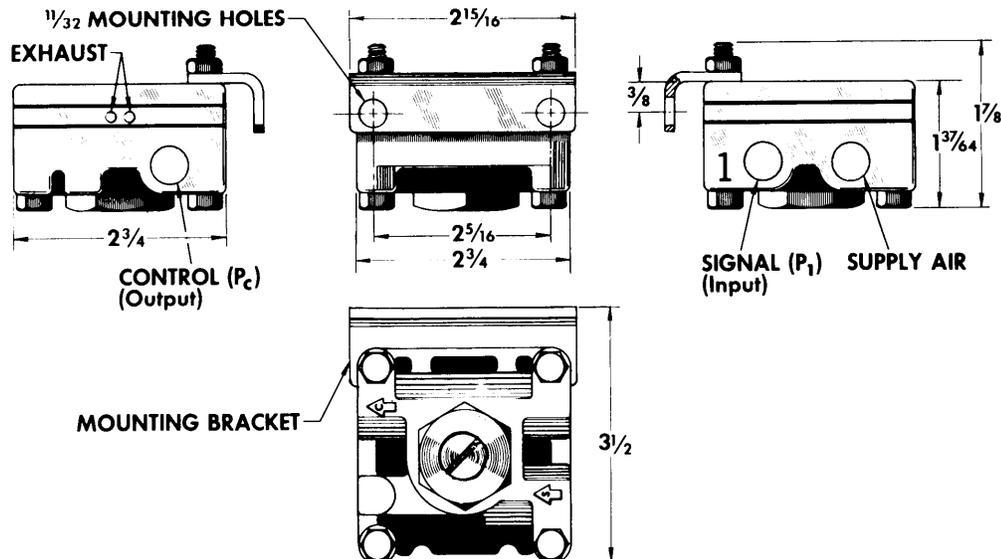


Figure 1

Section III — OPERATION

Air pressure in the signal chambers exerts a downward force on the input diaphragm. This force moves the center assembly down, closing the exhaust valve. Further movement opens the lower portion of the valve allowing the supply air pressure to enter the control chamber. This air acts on the control diaphragm and also passes out through the control air port. As the increasing control air pressure approaches the signal air pressure, the center assembly will rise, permitting the valve to close throttling the flow of supply air. When the control air pressure equals the signal air pressure both surfaces of the valve will be closed and the relay will be in balance.

A further increase in the signal pressure will cause the lower portion of the valve to open until the control air pressure again equals the signal air pressure. A decrease in signal air pressure will allow the control air pressure to force the center assembly upward, opening the exhaust valve until the control pressure is equal to the signal pressure.

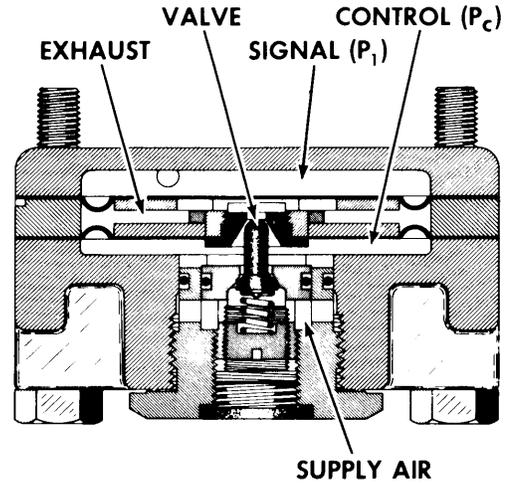


Figure 2

Section IV — ADJUSTMENT

The ratio of signal to control pressure may be adjusted by adjusting Valve Seat (17) as follows (see Figure 3):

1. Apply a supply pressure of 30 psig. Apply a signal pressure of 3 psig, and note control pressure.
2. Increase the signal to 15 psig, and again note control pressure.
3. The difference between the control pressure noted in

- Step 1 and Step 2 should be 12 psig \pm .2 psig.
4. If necessary, remove Cap (13) and adjust Valve Seat (17).
5. Repeat Steps 1, 2 and 4 until the correct ratio is obtained. The unit may be adjusted while operating with the Cap removed, but the final setting must be checked after the Cap (13) has been replaced.

Section IV — MAINTENANCE

The simplified design of the relay makes routine maintenance unnecessary. However, should the air or the air lines be dirty, it may be necessary to clean the surfaces of the valve and the valve seats. If continued difficulty is experienced from dirt, moisture, oil, etc., suitable filters should be provided in the supply lines.

If the control pressure does not go to zero, or if the exhaust appears to be leaking: See Figure 3.

1. Remove the Cover (12) by unscrewing from the Relay Base (8).
2. Disassemble the cover assembly as shown in Figure 3.
3. Using a CLEAN soft brush, cloth, or paper, wipe off Valve Seats A and B.
4. Inspect both Hemispherical Surfaces (C) of Valve (10) for dirt, chips, etc. If any scars or imperfections are apparent, the Valve (10) should be replaced.
5. Reassembly the cover assembly as in Figure 3. Be sure the Valve Cover (12) is tight. Following the procedure outlined in Section IV, adjust the Valve Seat (17), replace the Cap (13) and check the Cap (13) and Cover (12) for leakage.

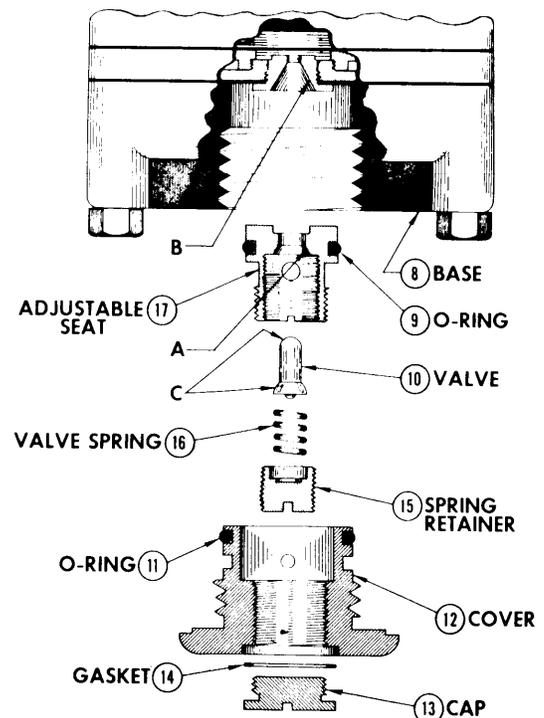


Figure 3

Do not use any gasket shellac, pipe compound or other sealant.

Section VI — REPAIR

If the procedure outlined in Section V fails to restore proper operation, disassemble the relay as shown in Figure 4.

1. Inspect air passages for dirt.
2. Inspect the Valve (10) surfaces for bumps, scars or other irregularities. The hemispherical surfaces must be smooth and regular.
3. Inspect the valve seats (A and B in Figure 3). These surfaces must be clean and smooth with no scars or surface irregularities.
4. Inspect Diaphragms (2) and (7) for holes or worn spots which might permit air leakage.
5. Install the complete Cover assembly in the Base (8) and make sure that the Valve Spring (16) is seating the valve properly.
6. Replace any worn or defective parts and reassemble the relay. **DO NOT USE ANY GASKET SHELLAC, PIPE COMPOUND, OR SEALANT!**
7. With Supply and Signal air pressures connected, check the unit for external leakage.

CAUTION: If cleaning is required, do not subject the diaphragms to cleaning fluids or solvents.

ORDERING INFORMATION

1. Identify your relay by Model or Catalog No. and description.
2. Order replacement parts by name and number from:

Robertshaw Industrial Products Division
 1602 Mustang Drive
 Maryville, TN 37801
 Phone: (865) 981-3100 Fax: (865) 981-3168

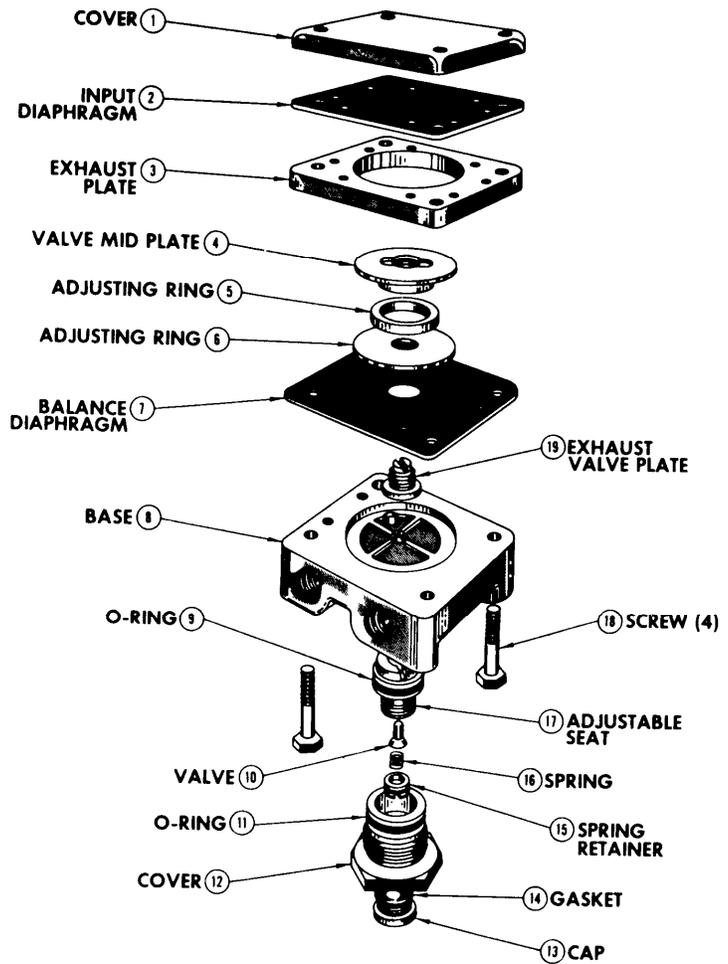


Figure 4

Robertshaw

Industrial Products Division

U.S.A. and Canada

Robertshaw Industrial Products Division
 1602 Mustang Drive
 Maryville, TN 37801
 Telephone: (865) 981-3100 Fax: (865) 981-3168
<http://www.robertshaw.thomasregister.com>
<http://www.robertshawindustrial.com>

Exports

Invensys Appliance Controls
 2809 Emerywood Parkway
 P.O. Box 26544
 Richmond, Virginia 23261-6544
 Telephone: (804) 756-6500 Fax: (804) 756-6561