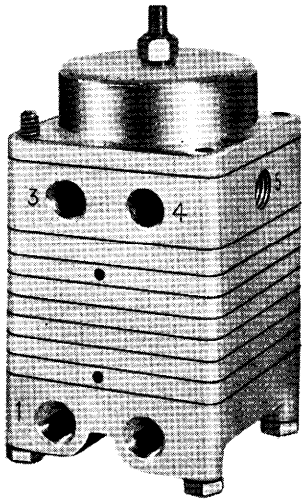


INSTRUCTIONS

FOR

INSTALLATION AND OPERATION

SUMMATION RELAY

Model CR104 - A3 and A5

SECTION I – GENERAL INFORMATION

A. Description

The model CR104 Summation Relays are proportioning units designed for use in industrial controls systems where the application requires delivery of a control pressure which is the sum and/or differences of two to five pneumatic signal pressures introduced into the unit. For further details, see Page 2 –

Model CR104-A3 is 3 point relay (add 2, subtract 1 signal).

Model CR104-A5 is 5 point relay (add 3, subtract 2 signals).

B. Specifications

DESIGN DATA

Function: Provides summation of two to five input signal pressures with 1.0% full range accuracy.

Input Range: 0–20 psig nominal.
50 psig maximum.

Output Range: 0–20 psig nominal.
50 psig maximum

Supply Pressure:
30 psig nominal.
60 psig maximum (normally at least 5 psi greater than P_C).

Biasing Adjustment: +18, –10 psi.

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

Overload Protection:
100 psig will not damage unit.

Connections:
1/4" female NPT.

Weight:
CR104-A3 – 2.1 pounds.
CR104-A5 – 2.3 pounds.

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

INSTRUCTION MANUAL NUMBER

P-2171

Specifications (Continued)

PERFORMANCE DATA

Ultimate Sensitivity: 0.1% of full range.

Linearity: 0.5% of full range.

Hysteresis: 0.5% of full range.

Supply Pressure Effect:
Change in output for a 5 psig supply pressure
CR104-A5 – 0.5% of full range.
CR104-A3 – 1.0% of full range.

Ambient Temperature Effect:
Change in output for a 50° F. rise in ambient temperature – 0.25%.

Full Output Capacity:
Output . . . . . 2.75 SCFM
Exhaust . . . . . 3.5 SCFM

Consumption: Maximum, 6 SCFH.

Load Effect (Air Flow to cause 1.0 psi drop):
CR104-A3 – 0.75 SCFM.
CR104-A5 – 0.9 SCFM.

Consumption: Maximum, 6 SCFH.

Repeatability: 0.5% of full range.

FUNCTION:

The operation of the three signal unit, Model CR104-A3, is described by the equation:

$$P_C = P_5 + P_3 - P_1 \pm F_S$$

The operation of the five signal unit (Model CR104-A5) is described by the equation:

$$P_C = P_3 + P_5 + P_6 - P_1 - P_4 \pm F_S$$

Where: P_C is output or control pressure
P_1, P_6, P_3, P_4 and P_5 are input signal pressures. (The subscript refers to ports marked in Figures 1 and 2.
F_S is the biasing spring force.

For example, if each of the signal pressures is 5 psi and the biasing spring is preset at 0 force:

(For CR104-A5)

$P_C = P_3 + P_5 + P_6 - P_1 - P_4 \pm F_S$
$P_C = 5 + 5 + 5 - 5 - 5 \pm 0$
$P_C = 5$

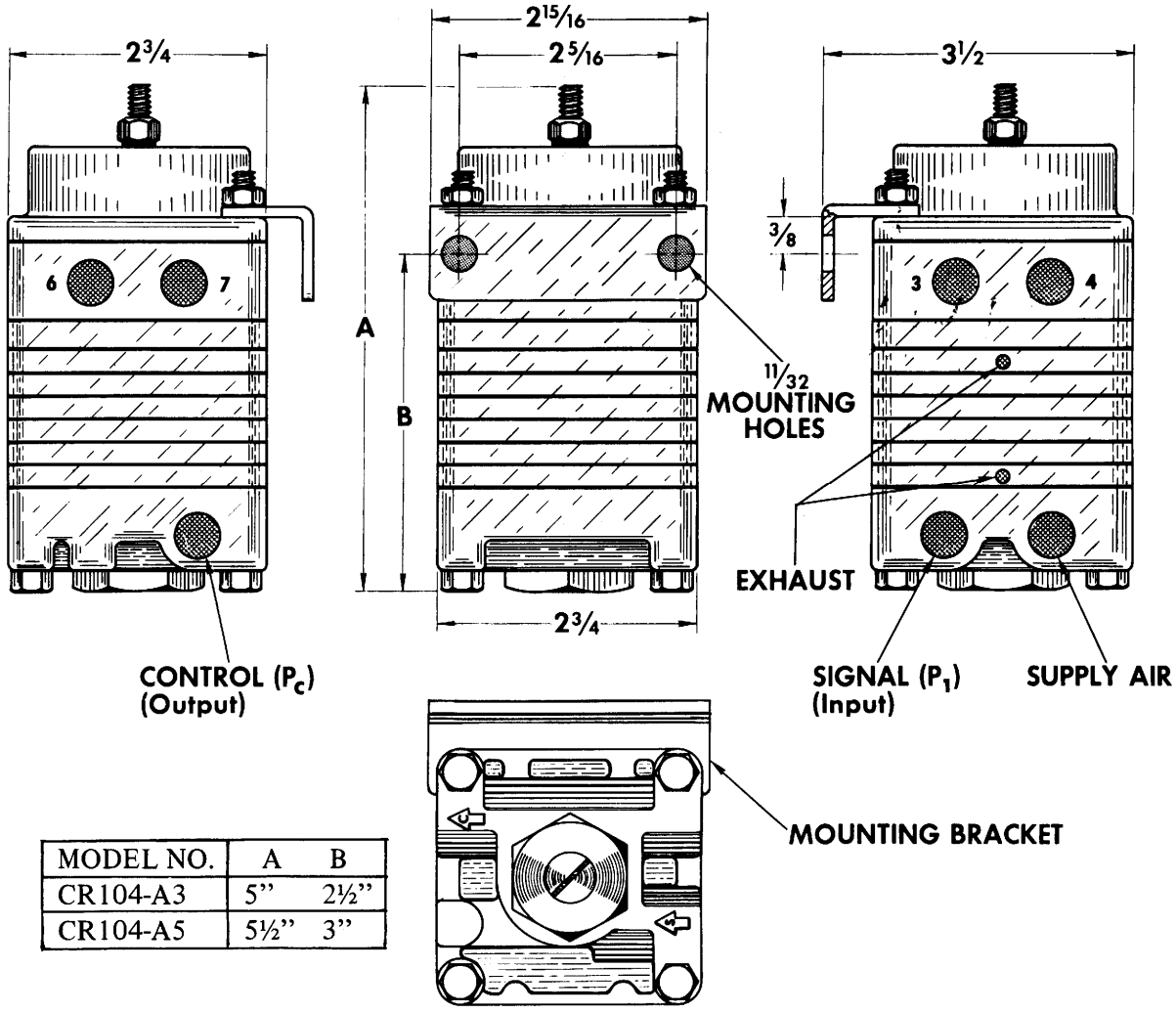
(For CR104-A3)

$P_C = P_5 + P_3 - P_1 \pm F_S$
$P_C = 5 + 5 - 5 \pm 0$
$P_C = 5$

By omitting some of the signals (leaving them at atmospheric pressure) equations with fewer inputs can be solved as follows:

MODEL	ADD	SUBTRACT	EQUATION	0 PSI SIGNALS
CR104-A3	2	0	$P_C = P_5 + P_3 \pm F_S$	P_1
CR104-A3	1	1	$P_C = P_5 - P_1 \pm F_S$	P_3
CR104-A5	2	1	$P_C = P_3 + P_5 - P_1 \pm F_S$	P_6, P_4
CR104-A5	3	0	$P_C = P_3 + P_5 + P_6 \pm F_S$	P_4, P_1
CR104-A5	1	2	$P_C = P_3 - P_1 - P_4 \pm F_S$	P_5, P_6
CR104-A5	3	1	$P_C = P_3 + P_5 + P_6 - P_1 \pm F_S$	P_4

Table 1



MODEL NO.	A	B
CR104-A3	5"	2½"
CR104-A5	5½"	3"

Figure 1

A. 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 male thread. DO NOT GET PIPE COMPOUND OR SHELLAC INSIDE RELAY!

B. Mounting

When installing the relay, do not remove the plastic protector plugs from the connections until ready to install fittings. Do not remove any metal pipe plugs!

The relay may be mounted in any position. Although 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 1/4" bolts, toggle bolts, or wood screws as required by the installation. Bracket may be removed or inverted by removing two nuts.

C. Connections

All port openings are 1/4" FPT. Make air connections to the proper ports as shown in Figure 1. The input signal pressures (P_1, etc.) are connected to tapped inlets numbered to correspond; i.e., P_1 connects to inlet (1), P_2 connects to inlet (2), etc. *The air supply must be clean and regulated (use filter regulator No. 97478), and must not exceed 60 psi.*

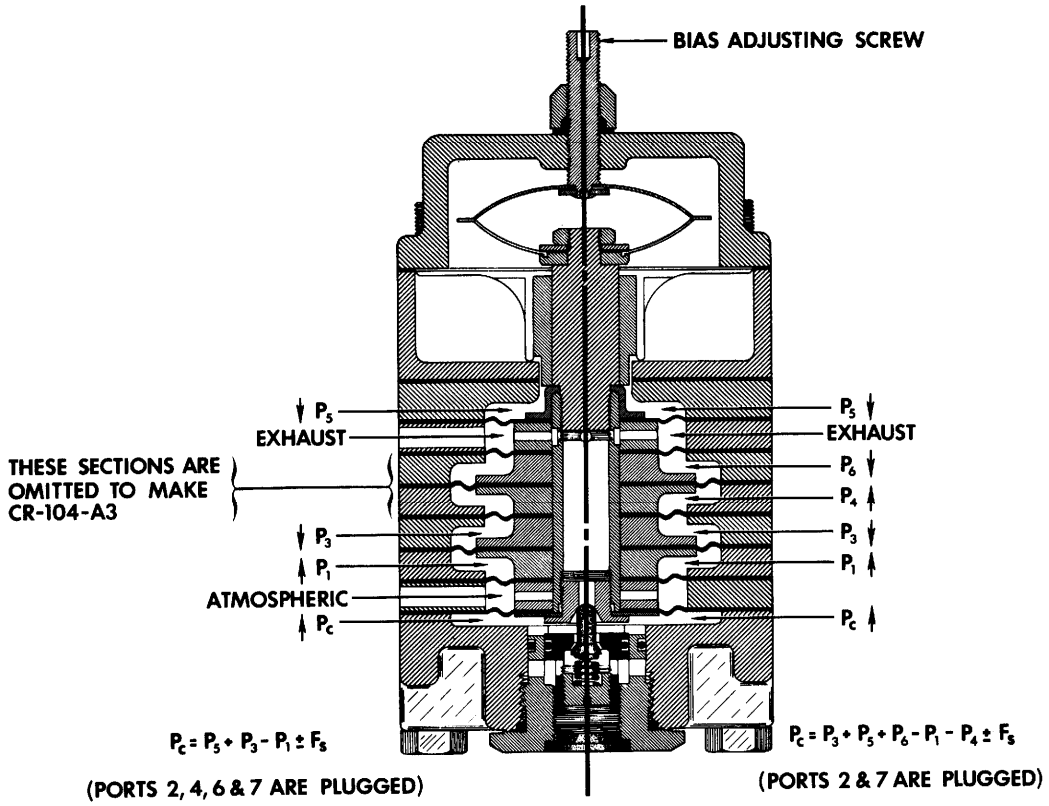


Figure 2

The operation of the five-signal unit may be described by the equation:

$$P_C = P_3 + P_5 + P_6 - P_1 - P_4 \pm F_S$$

and the operation of the three-signal unit may be described by the equation:

$$P_C = P_5 + P_3 - P_1 \pm F_S$$

where $-P_C$ is the control pressure; P_1, P_6, P_3, P_4, and P_5 are the signal pressures introduced into the unit; and F_S is the biasing spring force. The effective areas of the diaphragms are in a ratio of 1:2 throughout. Therefore, if each of the signal pressures were 5 psig and the biasing spring was exerting zero force:

$$P_C = P_3 + P_5 + P_6 - P_1 - P_4 \pm F_S$$

$$P_C = 5 + 5 + 5 - 5 - 5 \pm 0$$

$$P_C = 5 \text{ psig}$$

With 5 psig introduced through each of the signal ports, the output pressure would be 5 psig.

Refer to the illustration. As a result of the effective areas of the diaphragms; P_5 will create a downward force upon the center assembly, P_6 downward, P_4 upward, P_3 downward, and P_1 upward. The downward motion of the center assembly will close the exhaust portion of the valve and open the lower surface of the valve, permitting main air to flow into the control chamber. This pressure in the control chamber will increase until it balances the summation of forces upon the center assembly. As it approaches the balance point, it will move the center assembly upward, closing the lower portion of the valve and throttling off the flow of main air. When the summation of signal pressures and biasing spring force become less than the control pressure, the center assembly will rise, seating the lower portion of the valve and moving away from the upper portion of the valve. This exhausts the control pressure until it again balances the summation of forces.

SECTION IV – ADJUSTMENTS

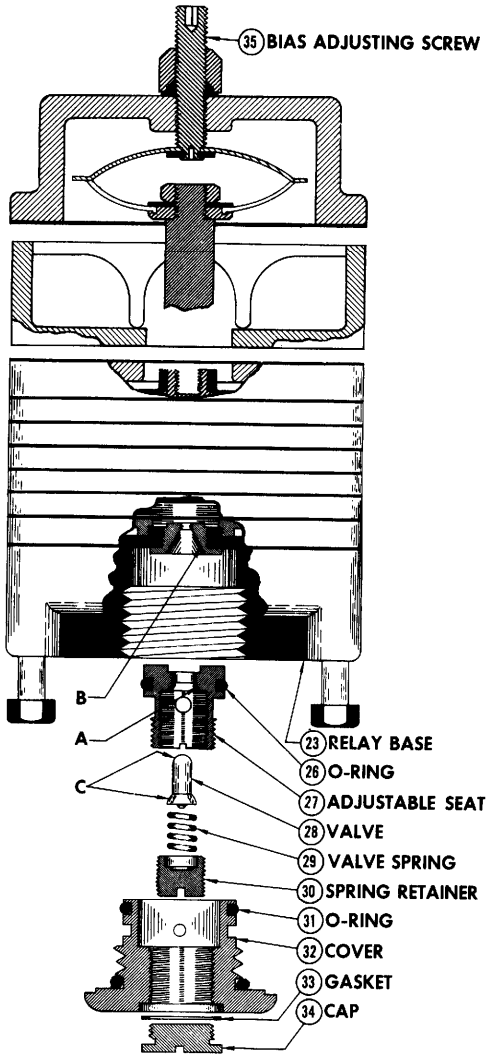


Figure 3

In all adjustment, calibration, or checking procedures, pressure gages of known accuracy level of 1/2% or better, or mercury manometers should be used.

A. BIAS (zero shift) ADJUSTMENT

1. To raise "ZERO":

   With normal supply pressure applied, and all signal pressures at atmosphere (0 psi), turn the Bias Adjusting Screw (35) clockwise until the output or control pressure (P_C) equals the desired "bias" or shift of the "zero" point.

2. To Lower "ZERO":

   If negative (–) bias or zero shift is required, proceed as follows: Apply a signal pressure to P_5 slightly higher than the desired negative bias, and leave other signals at zero psi. Adjust Bias Adjusting Screw (35) counterclockwise until output (P_C) is the difference between P_5 and the required negative bias. Example: Desired bias = –5 psi. Apply P_5 = 10 psi. Adjust until $P_C = P_5 - F_S = 10 - 5 = 5$ psi.

B. CALIBRATION

The accuracy of output pressures as a function of the sum (or difference) of input pressures can be adjusted as follows:

1. Set the bias at zero as follows: With air supply at 30 psi, apply 10 psi to P_5 and 5 psi to P_4 (other signals 0 psi). Control output should be 5 psi. If necessary, turn bias adjusting screw until output (P_C) is exactly 5 psi.

2. Apply exactly 3 psi to each of the signals P_1, etc. Control output pressure (P_C) should be 3 psi for either model.

3. Apply exactly 15 psi to each of the signals. Output (P_C) should be 15 psi ± 0.2 psi.

4. If necessary, remove Cap (34) and repeat Steps 2 and 3 above, adjusting Valve Seat (27) until correct control pressure P_C is obtained at both 3# and 15# signal levels. The final setting must be checked after Cap (34) has been replaced.

SECTION V – 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 (28) and the Valve Seats (A and B in Figure 3). 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 minimum output pressure or if the exhaust appears to be leaking: See Figure 3.

1. Remove the Cap (34) and Spring Retainer (30) by unscrewing from the Cover (32).* The Valve (28) is then free to fall out. Be careful not to drop the Valve Spring (29) or the Valve (28).

* Note position of spring retainer (30) before removing so that it can be replaced in approximately the same position.

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 Cap (34) is tight; check the Cap (34) for external leakage.
5. Adjust per Section IV if needed.

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

SECTION VI – REPAIR

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

1. Inspect the 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). These surfaces must be clean and smooth with no scars or surface irregularities.
4. Inspect Diaphragms (15) for holes or worn spots which might permit air leakage.
5. Install the complete cover assembly in the Base (23) and make sure that the Valve Spring (29) is seating the Valve (28) properly.
6. Replace any worn or defective parts and reassemble the relay. DO NOT USE ANY GASKET SHELLAC, PIPE COMPOUND OR OTHER 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

OPERATION	MODEL NO.
Add three, Subtract two	CR104-A5
Add two, Subtract one	CR104-A3

1. Identify your relay by Model or Catalog Number and description.
2. Order replacement parts by name and number from:

Robertshaw Industrial Products Division
1602 Mustang Drive
Maryville, Tennessee 37801

Repair Parts

DETAIL	NAME	PART NO.
1	Locknut (hex)	27942-A1
2	Cover	27930-B1
3	Spring Assembly	81249-A1
4	Hex Nut	27939-A1
5	Washer	27947-A1
6	Washer	27946-A1
7	Gasket	28566-A1
8	Stem	28559-A1
9	Spacer	29707-B1
10	Multiple Input Case	28562-A1
11	Gasket	28567-A1
12	Transfer Plate	28573-A1
13	Top Spacer	28555-A1
14	Tube	Tab
15	Balancing Diaphragms	28561-A1 Tab
16	Exhaust Ring	28558-A1
17	Exhaust Plate (2 Req'd)	28572-A1
18	Diaphragm Ring	28560-A1 Tab
19	Pressure Plate	28571-A1 Tab
20	Pressure Plate	28569-A1 Tab
21	Exhaust Seat	28557-A1
22	Support Ring	28565-A1
23	Base	27668-B1
24	Screw	Tab
25	Screw	Tab
26	O-Ring	29357-A1
27	Adjustable Seat	29352-A1
28	Valve	26059-A1
29	Valve Spring	29359-A1
30	Spring Retainer	29354-A1
31	O-Ring	29358-A1
32	Cover	29353-A1
33	Gasket	29356-A1
34	Cap	29355-A1
35	O-Ring	26734-A1

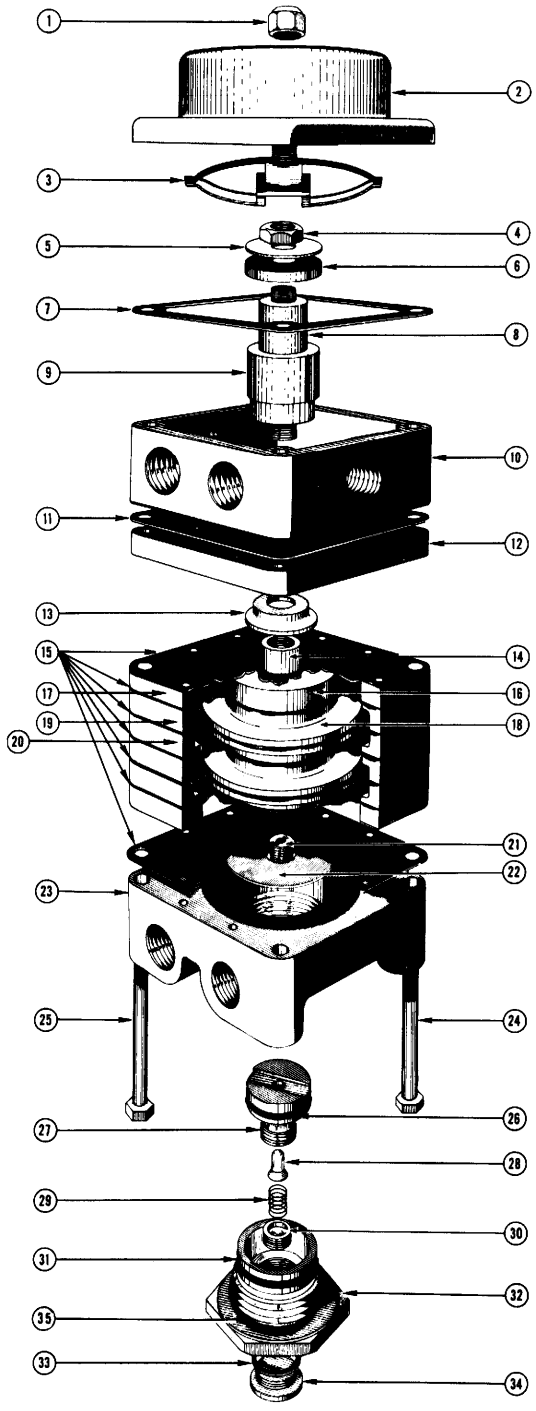


Figure 4

Tabulation

MODEL	DETAIL		
	24 (2 Req'd)	25 (2 Req'd)	18
CR104-A5	28275-A10	28275-A5	4 req.
CR104-A3	28275-A9	28275-A6	2 req.

MODEL	DETAIL				
	14	17	15	19	20
CR104-A5	28556-A5	3 req.	7 req.	1 req.	3 req.
CR104-A3	28556-A6	1 req.	5 req.	---	2 req.

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