

MERCOID SERIES BB-500-3**DIFFERENTIAL PRESSURE CONTROL****INSTALLATION
INSTRUCTIONS**

Type BB-521-3, BB-541-3 — Plain Case

Type BB-523-3, BB-543-3 — Flanged Case

Type BBE-521-3, BBE-541-3 — Plain Case Enclosed in Explosion-Proof Housing

Type BBW-523-3, BBW-543-3 — Weather-Proof Housing

Contact closes upon an increase in pressure difference between two sources
Contact opens upon a decrease in pressure difference between two sources

Type BB Differential Pressure Control employs two Bourdon tubes, each responsive to a pressure condition, to operate a Mercoid mercury switch as the DIFFERENCE in pressure conditions between them "widens" or "narrows".

Type BB500-3 Series operate to "close" the switch contact as the difference widens. Controls which operate to "open" the contact as the difference widens, are Mercoid Type BB-500-2 and are described and illustrated in Bulletin No. 91.

The Type BB Differential Control has applications in many varying instrument problems such as: Indicating a difference in head pressure between two liquid levels—Starting or stopping a pump as the difference between suction and discharge pressure changes—Indicating pressure drop (differential) across a strainer or screen—Indicating pressure drop (differential) across an orifice plate—Indicating pressure difference between two pressure vessels to maintain correct process flow relation—Indicating difference in steam or air pressure between two different pressure sources—To indicate oil pressure failure in refrigeration equipment due to a difference in pressure between the oil pressure and crank case lines.

In describing the BB Control, certain terms are used which are defined herewith:

- DIFFERENTIAL PRESSURE:** The difference in pressure between two pressure sources.
- OPERATING RANGE (Working Pressure):** The normal working range of the control defining the limits of applied operating pressure to either Bourdon tube.
- WIDE OPERATING DIFFERENTIAL:** The difference between two pressures required to close the contact (say 50 p.s.i. adjusted).
- NARROW OPERATING DIFFERENTIAL:** The difference between two pressures required to open the contact (say 35 p.s.i. adjusted).
- SENSITIVITY:** The difference between the two Operating Differentials 3 and 4 shown above (15 p.s.i.).
- MAXIMUM SENSITIVITY:** The largest difference obtainable between the operating differentials 3 and 4 shown above. Maximum sensitivity must not result in the application of pressure to either Bourdon tube in excess of the Operating (working pressure) Range of the control.
- MINIMUM SENSITIVITY:** The smallest difference between the Operating Differentials 3 and 4 shown above. Each control according to its OPERATING RANGE has a minimum sensitivity setting which limits the smallest difference between Operating Differentials.

HOUSINGS

The standard control housing is equivalent to NEMA 1. The controls are, however, available in housings suitable for Class 1, Group D, or Class 2, Group E.F. and G. (hazardous locations) or in Weather-Proof Enclosures.

ELECTRICAL CAPACITY

SPST: 5A@120V. 2A@240V AC.
 2.5A@ 120V, 1A@ 240V DC; 1/8 HP @ 120/240V AC
 Single Phase, 1/10 HP @ 120/240V DC

WIRING

Wire in accordance with local electrical codes.

OPERATING RANGES***403 S.S. BOURDON TUBE ****

Working Pressure Range Psig	Range No.	Max. Surge Limits Psig	Adj. Oper. Pressure Difference Psid	Deadband Adjustable	
				Min.	Max.
30' Vac. 60	R25S	200	0.40	3	40
5-100	R6S	200	0.40	3	40
10-200	R8S	300	0.120	4	120
10-300	R9S	500	0.180	6	180
25-600	R10S	800	0.360	20	360
50-1000	R11S	1500	0.600	20	600
100-1500	R12S	2000	0.900	40	900
300-2500	R13S	3000	0.1500	50	1500
500-5000	R15S	7000	0.3000	125	3000
1000-8000	R16S	10,000	0.5000	500	5000

** Not to be used in Chloride Applications. Use 316SS Bourdon Tube.

316 S.S. BOURDON TUBE

Working Pressure Range PSI	Range No.	Max. Surge Limits Psig	Adj. Oper. Pressure Difference Psid	Adj. Sensitivity	
				Min	Max.
5-75	23E	125	0.38	3.5	38
10-100	6E	125	0.36	4	36
10-150	24E	200	0.55	5	55
10-300	9E	400	0.200	14	200
30-400	21E	450	0.275	18	275
75-800	22E	900	0.450	20	450
100-1000	11E	1200	0.500	25	500
200-2500	13E	3000	0.925	65	925

WARNING: A failure resulting in injury or damage may be caused by over-pressures, excessive vibration or pressure pulsation, excessive temperature, corrosion of pressure containing parts and movement assembly, electrical overload, or other misuse.

*ORDERING DATA: When the BB Control is used in a hydraulic system, the selection of the proper OPERATING RANGE must include the factor of flow rate, from which can be determined the maximum water hammer or surge pressure. When ordering, SPECIFY: Type Number, Operating Range (based on maximum surge pressure), Wide Operating Differential to close contact and Narrow Operating Differential to open contact (if available). This information is required for factory setting.

SERIES BB500-3 MERCOID DIFFERENTIAL PRESSURE CONTROLS

CONSTRUCTION AND OPERATION

The control mechanism is of simple construction. It has two power elements designated as the FRONT Bourdon tube and the REAR Bourdon tube. The REAR Bourdon tube supports a magnetic switch and a spring hinged arm. A permanent magnet is attached to the arm to operate the switch. The FRONT Bourdon tube supports the "adjustable operating screws" and the overtravel mechanism. As pressures in the Bourdon tubes vary and reach the set Operating Differentials, one of the "Operating Screws" will be brought into engagement with the movable hinged magnet arm and the arm (with the magnet) will be moved either toward the mercury switch to close the contact, or away from it to open the contact.

Specifically, let us assume that with the switch in the "open" contact position as shown in illustration No. 2, the "high" pressure on the FRONT Bourdon tube is 65 p.s.i. and the "low" pressure on the REAR Bourdon tube is 35 p.s.i. Should the pressure in the FRONT Bourdon tube increase, it will raise the LOWER OPERATING SCREW toward the magnet arm with the magnet in the "open" contact position. As the high side pressure continues to increase in the FRONT Bourdon tube, the LOWER OPERATING SCREW and MAGNET ARM will engage each other. The establishment of the adjusted "wide operating differential" of 50 p.s.i. (85 p.s.i. on the FRONT tube and 35 p.s.i. on the REAR tube) will move the magnet to the "closed" contact position as shown in illustration No. 4. When the pressures change on either or both of the Bourdon tubes, to equal the control SENSITIVITY of 15 p.s.i., thereby creating the "narrow differential" of 35 p.s.i., the magnet arm and UPPER OPERATING SCREW will engage each other to move the magnet into the open contact position.

When the "closed" and "open" operating differentials have been established, they will remain constant over the entire OPERATING RANGE of the instrument. The differential pressure may fluctuate beyond the wide operating differential (50 p.s.i.) which closed the contact or below the narrow operating differential (35 p.s.i.) which opened the contact, without strain on the instrument mechanism by virtue of an overtravel mechanism. (For description of overtravel mechanism see paragraph under "installation instructions").

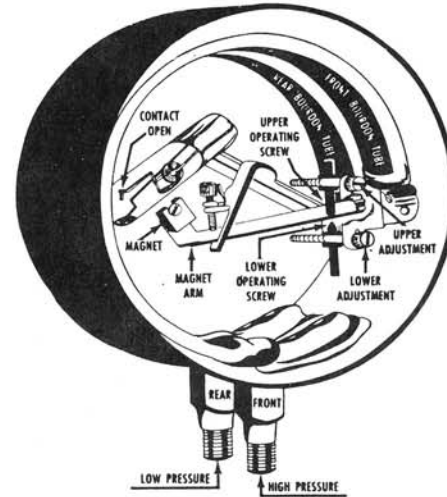


ILLUSTRATION NO. 2

TEST PUMP SET

Factory setting of each BB Control is made and recorded on the FACTORY SETTING CARD attached to each control. When the information is supplied with the order, the control is set in accordance with the customer's instructions.

Should field adjustments of the switch operating points be required, a Test Pump Set (or controllable pressure source) is recommended for this purpose.

Illustration No. 3 is a typical test pump assembly showing the BB control with gauges and valves. The test pump assembly permits making the necessary pressure conditions in each of the Bourdon tubes in order to produce the desired operating differentials required to close and open the control contact. Each Bourdon tube can be separately valved off to hold or to relieve the pressure applied to it and the adjustments described under Adjustments can easily be made.

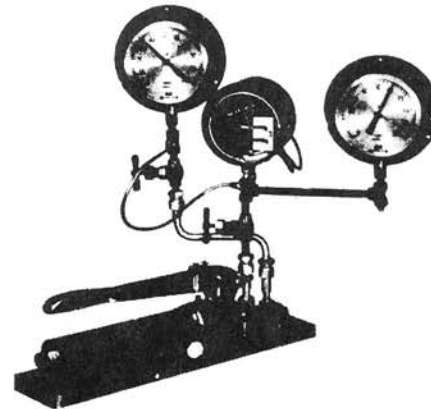


ILLUSTRATION NO. 3

INSTALLATION INSTRUCTIONS—SERIES BB500-3

Type BB Series 500-3 Differential Pressure Controls must have the High Pressure Source connected to the FRONT Bourdon tube and the Low Pressure Source to the REAR Bourdon tube (illustration No. 4).

PIPING

Install the BB Control in a vertical position. Control piping is optional, but should not be so small that it may become clogged by dirt or scale. The BB Control is provided with 1/4" N.P.T. connections.

Consideration should be given to provide for bleeding the control piping. This is considered good practice to insure accurate and positive reaction of the control to the conditions to which it is to be responsive and adjusted. The use of three-way valves may be used which will permit flushing and bleeding the lines as well as providing connections for pressure gauges for taking readings of pressure conditions and making adjustments.

Type BB Controls are built to withstand momentary surges and pulsations in fluid lines to which they are connected in excess of their Operating Range limits. Surge maximum to which they may be subjected are specified in the operating ranges.

Where the flow rate through a fluid line is high, and excessive water hammer results when the flow is cut-off, the use of dampening means such as a good commercial desurger or snubber is recommended.

Pressure snubbers should be connected directly to the instrument stem.

ADJUSTMENTS

Factory setting of each BB Control is recorded on the Factory Setting Card attached to each control. If field adjustments are required, proceed with the following instructions:

CAUTIONS: Before adjusting control to required operating points, MAGNET ARM must be in a free position. This is obtained by turning UPPER ADJUSTMENT clockwise and LOWER ADJUSTMENT counter-clockwise, until the MAGNET ARM will stay manually placed in either an "open contact" or "closed contact" position. There must be available a source of pressure to properly make adjustments. The source of pressure may be made by means of a Test Pump or controllable pressure.

OVERTRAVEL STRUCTURE AND MINIMUM SENSITIVITY: The FRONT Bourdon tube assembly with the two operating screws and adjustments, include the overtravel mechanism. The overtravel mechanism permits movement of the Bourdon tubes after the magnet arm has reached the limit of its movement to "close" and "open" the switch. Strains are thus relieved on the switch operating members should movement be imparted to the Bourdon tubes beyond the switch operating points.

In setting the switch operation for MINIMUM SENSITIVITY, the "operating screws" are both in engagement with the magnet arm (not in compression) as the arm is moved to and from the switch operating position.

It is important that care be exercised at all times when adjusting switch operation for MINIMUM SENSITIVITY that the operating screws do not simultaneously bear too firmly against the magnet arm. If both are bearing too firmly (in compression) illustration No. 6, the result will be to operate the overtravel mechanism and throw the settings out of the required adjustment.

As shown in illustration No. 5, it may be observed that when the adjustment is correct, with BOTH OPERATING SCREWS ENGAGING THE ARM (not in compression) the overtravel mechanism is CLOSED. When the operating screws have been adjusted to engage the arm TOO FIRMLY (in compression) illustration No. 6, the mechanism is "opened up" AND MUST BE CLOSED IN THE COURSE OF OPERATION before movement can be imparted to the MAGNET ARM in order to operate the switch.

TO SET "CLOSED CONTACT" POSITION: (Use actual operating pressures). Apply pressure to the REAR Bourdon tube (noting pressure on test gauge) and close valve to maintain the applied pressure.

Apply a higher pressure to the FRONT Bourdon tube (noting pressure on test gauge) and close valve to maintain the applied pressure.

The difference between the high and low pressures should represent the WIDE OPERATING DIFFERENTIAL required to close the switch contact. Place magnet arm in OPEN CONTACT position (by hand if necessary) with magnet away from mercury switch.

Turn LOWER ADJUSTMENT clockwise to cause LOWER OPERATING SCREW to engage MAGNET ARM. This is a micrometer adjustment and may take considerable turning. Proceed slowly until, as the MAGNET approaches the SWITCH, it instantly snaps into the CLOSED CONTACT POSITION. When this occurs, check setting by manually pushing magnet arm down. If, when released, it does not return to the CLOSED POSITION, continue carefully with adjustment until magnet again snaps into the CLOSED CONTACT POSITION, and will return to that position when manually pulled away. Accuracy of this adjustment may be easily determined if made on a test pump by lowering the high side pressure until the magnet arm can be pushed down to the OPEN CONTACT position after which the high side pressure can be slowly increased to close the switch contact.

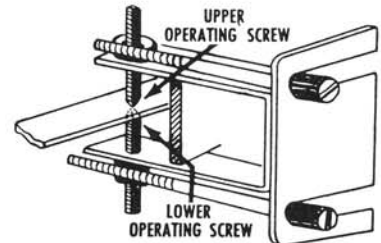
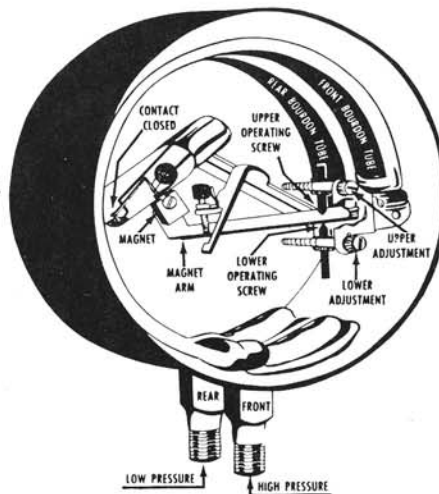
TO SET "OPEN CONTACT" POSITION AND SENSITIVITY: When the closed contact position has been set, the setting of the OPEN CONTACT position establishes the ADJUSTED SENSITIVITY of the control.

When MINIMUM SENSITIVITY is required, care should be exercised in making the OPEN CONTACT adjustment so as NOT TO SPREAD THE OVERTRAVEL MECHANISM (see paragraph under Overtravel Structure and Minimum Sensitivity) which will result in erratic and false operation. MINIMUM SENSITIVITY is obtained with BOTH OPERATING SCREWS in engagement with the MAGNET ARM (not in compression) throughout its movement. In making the OPEN CONTACT adjustment, if the UPPER OPERATING SCREW is turned down too firmly against the MAGNET ARM (in compression), an indication of this condition will be evident by a showing on the test gauge of a drift in the setting of the CLOSED CONTACT position.

(Use Actual Operating Pressures). Open valve to reduce pressure in the FRONT Bourdon tube to establish the NARROW OPERATING DIFFERENTIAL required to open the switch contact, noting pressure on test gauge. Close valve to maintain the required applied pressure. The difference between the high and low pressures should represent the NARROW OPERATING DIFFERENTIAL required to open the switch contact.

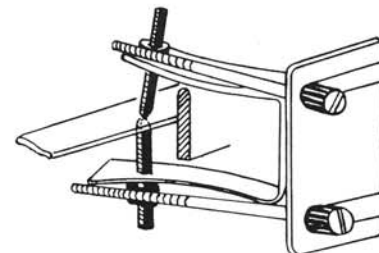
Place MAGNET ARM in the CLOSED CONTACT position (by hand if necessary) with the MAGNET close to the mercury switch. Turn UPPER ADJUSTMENT counter-clockwise to cause UPPER OPERATING SCREW to engage MAGNET ARM. Proceed slowly until the magnet instantly drops away from the mercury switch to the OPEN CONTACT position. When this occurs, check setting by manually pushing magnet arm up to the CLOSED CONTACT POSITION. If it should not drop away, continue carefully with adjustment until magnet again instantly drops away and continues to do so when manually pushed up to the CLOSED CONTACT position. Accuracy of adjustment may be easily determined if made on a test pump by increasing the high side pressure until the magnet arm is in a CLOSED CONTACT position, after which the high side pressure can be slowly decreased to OPEN the switch contact.

ILLUSTRATION NO. 4



CORRECT ADJUSTMENT FOR MINIMUM SENSITIVITY (OVERTRAVEL MECHANISM CLOSED)

ILLUSTRATION NO. 5



INCORRECT ADJUSTMENT FOR MINIMUM SENSITIVITY (OVERTRAVEL MECHANISM OPEN)

ILLUSTRATION NO. 6



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