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INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS FOR FAIRCHILD MODEL 85-D MULTI-STAGE RELAY

GENERAL INFORMATION

The Model 85D Spring Bias Relay provides an output pressure which is a function of signal pressure plus set bias. Thus, output pressure can never be less than the bias pressure which is set into the instrument.

Specifications Model 85D Multi-Stage Relay

Flow capacity 14 SCFM
 100 psig [7.0 BAR] (700 kPa) supply; (23.8 m³/HR)
 20 psig [1.5 BAR] (150 kPa) psig set

Exhaust capacity 2.5 SCFM
 downstream pressure 5 psig (4.3 m³/HR)
 [.35 BAR] (35 kPa) above set pressure

Maximum Supply Pressure 250 psig [17.0 BAR] (1700 kPa)

Pressure Change Under Flow Conditions Less than 1/4"
 Set pressure 20 psig [1.5 BAR] (.63 cm) W.C. from
 (150 kPa) supply 100 psig dead-end service to
 [7.0 BAR] (700 kPa) 10 SCFM (17 m³/HR)

Recommended Operating supply pressure 150 psig
 [10 BAR] (1000 kPa)

Pressure Change due to
 Supply Pressure Condition Less than .2 psig
 [.014 BAR] (1.4 kPa) for
 100 psig [7.0 BAR] (700 kPa) change

Air Consumption Less than .1 SCFM (.17 m³/HR)

Ambient temperature limits -40°F to +200°F
 (-40°C to 93.3°C)

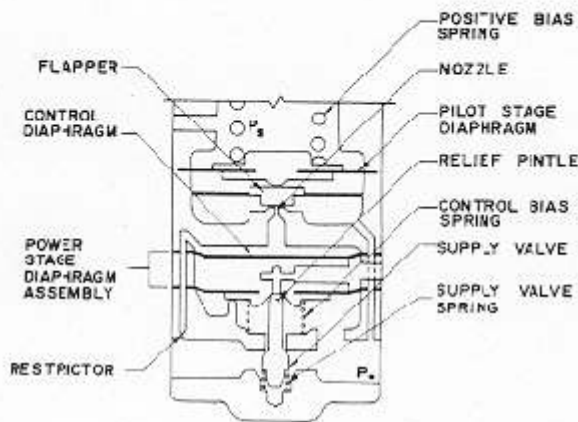
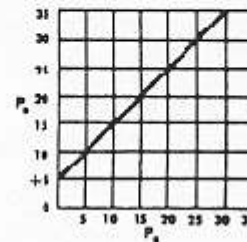
PRINCIPLES OF OPERATION

The basic mathematical expression for this instrument is: $P_o = P_s + K$

A typical curve of output pressure versus signal pressure with a bias of +5 psig is shown.

The ratio of output pressure change to signal pressure change is 1:1 in standard units.

NOTE: Model 85D must be used on instrument air only.

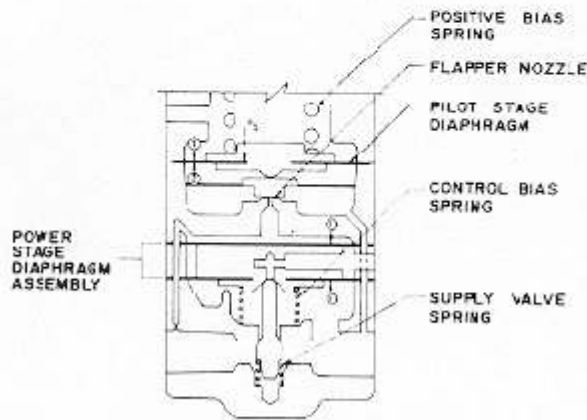


Pilot operation is a method of achieving greater sensitivity of control than that in a single stage where spring force is applied directly to control a diaphragm assembly. By utilizing a flapper nozzle which has very fine pressure control capability and minimum flow, a valve which has a large flow capacity and which by itself would not have sensitive pressure control capability for large flows can be controlled. The Model 85D is a pilot operated, positive bias relay.

With supply pressure turned off and the adjusting knob turned completely out, allowing the positive bias spring to be relaxed, the supply valve and relief pintle are seated because of the upward force of the supply valve spring on the valve assembly. When supply air is introduced to the inlet port, air will flow through the stainless steel filter and restriction to the top of the power stage diaphragm assembly, through the nozzle and will flow to the downstream side of the relay. The action of the control bias spring furnishes the differential pressure across the nozzle to allow flow. When the knob of the Model 85D relay is adjusted to a specific set point the positive bias spring exerts a force against the pilot stage diaphragm. Signal P_s exerts pressure against the pilot stage diaphragm area. The combined force is equal to the pressure P_s acting over the effective diaphragm area plus the force due to the positive bias spring. The resultant pressure P_o equals $P_s + K$ where P_o is output pressure, P_s is signal pressure and K is the spring constant. This condition is not achieved until output pressure reaches the desired set point. Until then the combined force moves the flapper against the pilot stage nozzle and the nozzle flow is reduced. The nozzle back pressure increases and acts on the power stage diaphragm. This force acts against the control bias spring force, the supply valve spring force, and the force due to downstream pressure acting on the bottom of the control diaphragm driving the power stage diaphragm assembly down, opening the supply valve and allowing air to flow to the outlet port.

Downstream (outlet) pressure is transmitted to the pilot chamber and exerts pressure on the underside of the pilot diaphragm. The increase in pressure on the pilot diaphragm causes the diaphragm to move upward against the force of signal pressure acting on the effective diaphragm area and the positive bias spring force. This

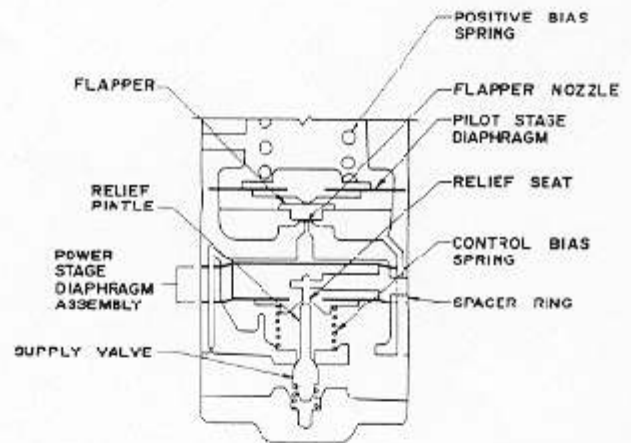
force moves the pilot diaphragm assembly upward, allowing the flapper to move upward and venting the nozzle to downstream. The flapper comes to a position so as to maintain a nozzle back pressure which acts downward on the power stage diaphragm, balancing the upward force of the downstream pressure on the control diaphragm and the force of the control bias and supply valve springs. Downstream air pressure acts on the bottom of the power stage diaphragm assembly, moving the assembly upward, allowing the supply valve to throttle, maintaining output pressure.



When set point is reached, the force acting on the bottom of the power stage diaphragm assembly is in balance with the forces acting on the top of the assembly. At this point the force (1) due to downstream pressure acting against the bottom of the power stage diaphragm assembly plus the control bias spring and supply valve spring forces and the force (2) due to flapper nozzle back pressure acting on the top of the power stage diaphragm assembly are in balance. The force (2) due to downstream pressure acting on the bottom of the pilot stage diaphragm and the force (2) due to the sum of signal pressure acting on the top of the pilot diaphragm and the positive bias spring force are in balance.

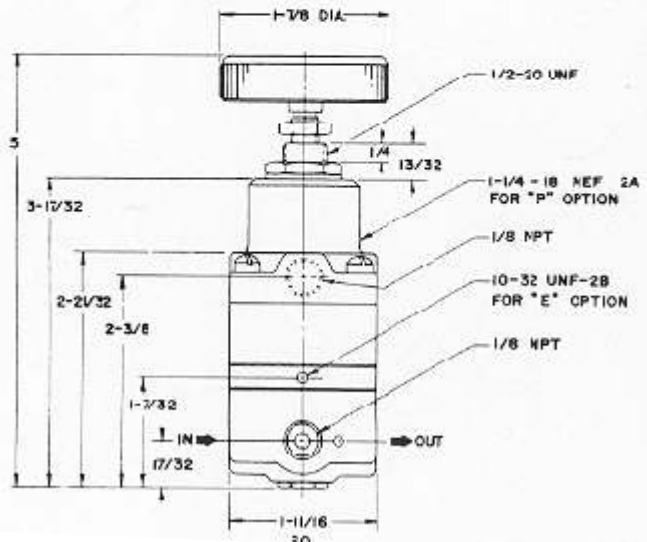
If downstream pressure starts to rise above set point, the increased pressure is transmitted through the channel to the pilot chamber and exerts pressure on the underside of the pilot stage diaphragm. As the pilot diaphragm moves upward, air is vented through the flapper nozzle reducing the pressure on the top of the power stage diaphragm assembly to a low value. Downstream pressure acts on the underside of the pilot stage diaphragm assembly. The increased pressure assisted by the control bias seat spring, forces the power stage diaphragm assembly to move upward allowing the relief seat to move away from the relief pinile. Exhaust takes place through the vent in the spacer ring.

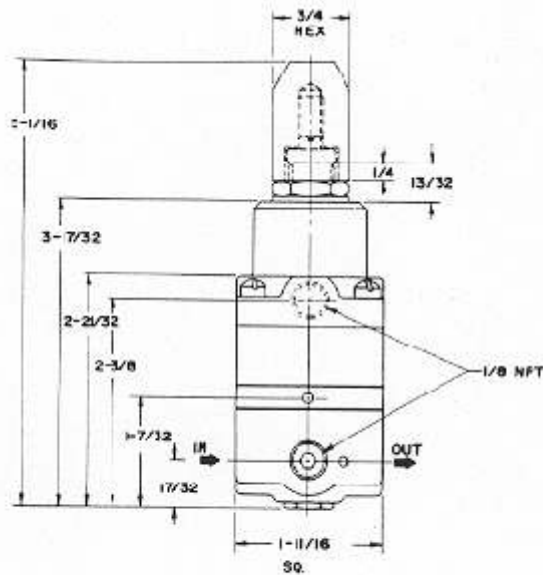
If downstream pressure falls below set point, the reduced pressure is communicated to the pilot chamber. Since the combined force due to P_s acting on top of the pilot diaphragm and the positive bias spring force is now greater than the force due to the reduced pressure acting in the bottom of the pilot stage diaphragm, the diaphragm will move down against the flapper and close off the flapper nozzle. The increased nozzle back pressure will act on the top of the power stage diaphragm and will force the diaphragm assembly to move down, opening the supply valve and preventing decay of pressure below set point.



INSTALLATION

Clean all pipe lines to remove dirt and scale before installation is made. Apply minimum amount of pipe compound to male threads of air line only. Start with third thread back and work away from end of line to avoid possibility of getting compound into the relay. Install relay in air line; body is fitted with $\frac{1}{8}$ " NPT for inlet and outlet connections. Relay can be mounted in any position without affecting its operation. Inlet and outlet connections are labeled (look for arrows denoting direction of flow on underside of unit) and should be tightened securely. Avoid undersized fittings that will limit flow through the relay and cause pressure drop downstream.





NOTE: The Model 85D must be used on oil free air. The use of a filter to remove dirt and entrained liquid in the air line ahead of the relay is required for correct performance. If an air line lubricator is used, it must be located downstream beyond the relay in order to avoid interference with the relay performance.

	STD	OPTIONS	STANDARD UNIT	
		E	U	T
Spacer Ring	EB-10682-1	EB-16682-2		
Body and Valve Assembly	EB-13680-1		EB-13680-2	
Body	EB-9531-1		EB-9531-5	
Bonnet Assembly	EB-9536-5		EB-9536-10	
Knob Assembly	EB-1142-1			
Cap				EB-11029
Range Screw				EB-8159-14
Nut				EB-1120

	STD	OPTIONS	LARGE PORT UNIT
		E	U
Spacer Ring	EB-16682-1	EB-16682-2	
Body and Valve Assembly			
1/4 NPT	EB-16616-1		EB-16616-3
3/8 NPT	EB-16616-2		EB-16616-4
Bonnet Assembly	EB-9536-5		EB-9536-10

	STD	OPTIONS		
		T	P	PU
Knob Assembly	EB-1142-1			
Cap		EB-11029		
Screw		EB-8159-14		
Nut		EB-1120		
Bonnet Assembly	EB-9536-5			
Jam Nut			EB-9536-7	EB-9536-11
			EB-9552-3	EB-9552-3

ADJUSTMENT

There are no field adjustments required.

OPERATION

Relieve pressure on range spring before putting the 85D into service for the first time. To operate turn the adjusting screw slowly in a clock-wise direction until required downstream pressure is obtained. Turned in this direction, the screw compresses the range spring causing

increased output pressure. For decreased output pressure, turn the screw counterclockwise. In addition to the range spring the 85D may be controlled by a pressure signal into the bonnet that will add to the spring induced output pressure.

MAINTENANCE

It will not be necessary to perform maintenance of a routine nature on this unit if oil free air is used.

TROUBLESHOOTING

Problem:	Check:
Leakage	Body screw tightness Diaphragm
High Bleed	Relief pintle and relief seat for damage or contamination
Difficult to Adjust	Adjusting screw and ball

REPAIR PARTS LIST

A repair parts kit EA-16603-7, 8, 9 is available for maintenance of the Standard Model 85D relay.
A repair parts kit EA-16603-1 is available for maintenance of the Large Port Model 85D relay.

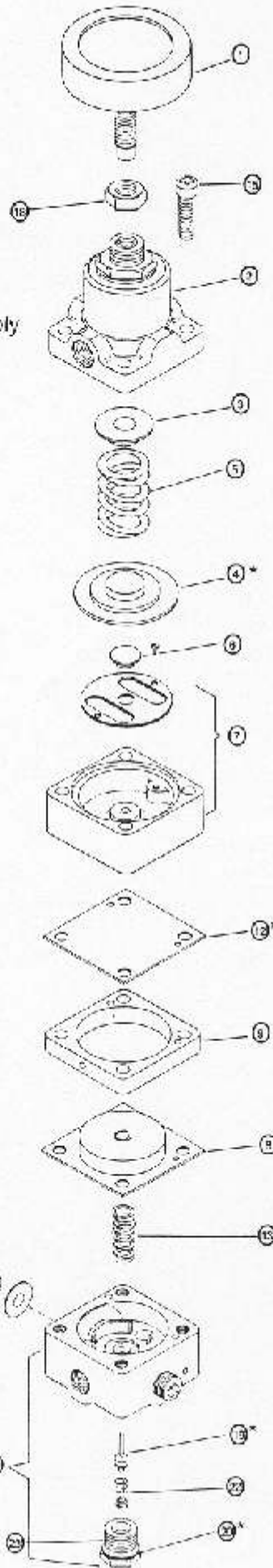
Body	Port
EB-16618-1	¼ NPT
EB-16618-2	⅜ NPT
EB-16618-3	¼ BSPT
EB-16618-4	⅜ BSPT

Index.	Part No.	Description
1	EB-1142-1	Knob Assembly
1A	EB-11029	Cap
1B	EB-8159-14	Screw
2	See Table	Bonnet Assembly
3	EB-11020	Spring Seat
4	EB-12191	Diaphragm Assembly
5	EB-9321-()	Spring
6	EB-9547	Anvil
7	EB-9530-3	Pilot Body Assembly
8	EB-13681	Diaphragm Assembly
8A	EB-16681-6	Diaphragm Assembly
9	See Table	Spacer Ring
10	See Table	Body and Valve Assembly
*11	EB-9348-3	Orifice Assembly
*11A	EB-9348-5	Crifica Assembly
*12	EB-12926-1	Diaphragm
*13		Spring
13A	EB-11580	Spring
15	EB-1032-2B	Screw
18	EB-1120	Nut
*19	EB-13674	Pintle
*20	EB-130-012-1-70	O Ring
*22	EB-9212	Conical Spring
23		Plug

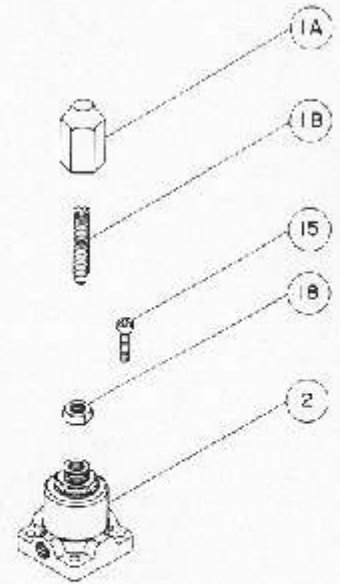
⊙ EA-16603-1 Kit Components for 1/4" and 3/8" port unit

* EA-16603-7 for 1/8" port unit
 16603-8 for 1/4" port unit
 16603-9 for 3/8" port unit

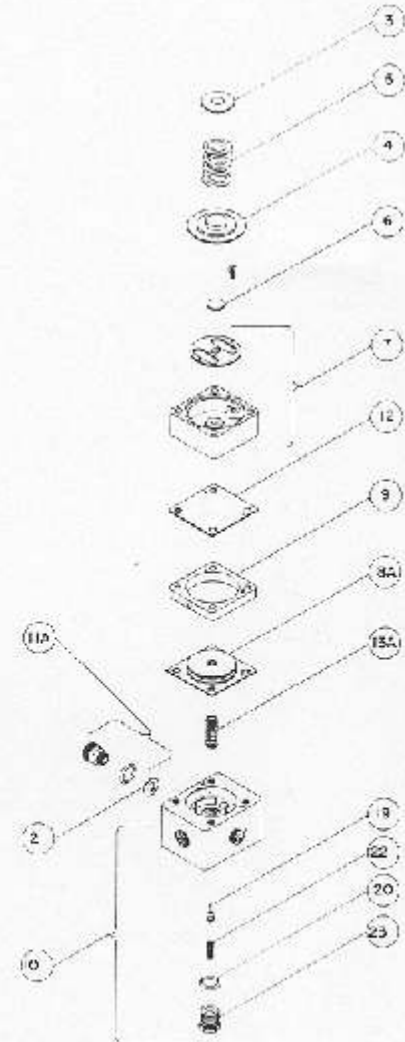
Standard Unit



Tamper Proof Unit



Large Port Unit



SERVICE KIT INSTALLATION

All Units

1. Check parts in the EA-14637 or EA-16603-1 Service Kit against the parts marked with an asterisk in the exploded view and the associated table.

For Standard Unit

2. Loosen lock nut (18) and turn out Knob Assembly (1) to relieve tension on spring (5).

For Tamper Proof (T) Unit

2. Remove Cap (1B), loosen Nut (1A) and turn out Range Screw (1B) to relieve spring tension.

All Units

3. Remove four bonnet screws (15). Caution: Spring (13) is in compression. Screws should be removed carefully, allowing the spring to expand. Set aside spring (13), spring (5) and spring seat (3) after removing Bonnet Assembly (2). Lift Diaphragm Assembly (4), Pilot Body Assembly (7), Diaphragm (12), Spacer Ring (9) and Diaphragm Assembly (8) from Body and Valve Assembly (10).

4. Remove any pipe fittings on body parts.

5. Remove Orifice Assembly (11) and Gasket (21) from Body and Valve Assembly (10).

6. Unscrew Plug (23) from Body (10). Remove and discard pintle (19) and retain Conical Spring (22).

7. Replace O ring (20) on Plug (23) with O ring from kit. Lubricate with silicone grease. Place conical Spring (22) wide end down, into cup of plug (23). Clean Body Assembly (10) and (7) with a suitable solvent. Blow dry with compressed air.

8. Turn Body (10) over, so that plug end faces up.

9. Place pintle (19) from kit into plug end of body (10), valve end up. Hold the pintle securely which extends from the opposite end of body (10) and insert conical spring (22) and plug (20) into the plug end of body (10). Screw the Plug (23) into Body (10) until it is tight. Caution: Insure that short end of pintle (19) fits into top of conical spring (22).

10. Secure Orifice Assembly (11) and Gasket (21) from kit. Place gasket (21) over threaded portion of Orifice Assembly (11) and screw the assembly into the port on Body (10) opposite port marked GAUGE.

11. Place Spacer Ring (9) on Body (10) making sure that six holes in the Spacer Ring match the six holes in Body (10).

12. Secure Diaphragm (12) from kit and place it on top of Spacer Ring (9), making sure that six holes in the Diaphragm (12) match the six holes in the Spacer Ring (9).

13. Place the Pilot Body Assembly (7) on top of Diaphragm (12), making sure that the six holes on the bottom of Pilot Body Assembly (7) match the six holes in Diaphragm (12). Check that anvil (7) is seated in the center hole of the spring Plate.

14. Secure Diaphragm Assembly (4) from kit and place it in the recess of Pilot Body Assembly (7), so that the Spring Retainer faces up.

15. Place Spring (5) over the spring retainer on Diaphragm Assembly (4).

16. Place Spring Cap (3) over Spring (5) with recess in Spring Cap (3) facing up. Lubricate recess with Molycote G.

17. Position Bonnet Assembly (2) over the Pilot Body Assembly (7) so that signal port in the bonnet assembly (2) is over the port marked with the arrow pointing into the unit. NOTE: Output port is on the side opposite Spacer Ring (9) which has the vent hole.

18. Grasp the Spacer Ring (9) firmly and lift up, being careful that all parts above it remain in alignment. Set the stacked parts aside.

19. Secure Spring (13) from the kit and place it in the cup on Body (10), directly over the pintle (19).

20. Secure Diaphragm Assembly (8) from the kit and place it on top of Spring (13), making sure that holes in the Diaphragm match the six holes in Body (10), when the spring (13) is compressed.

21. Carefully place the assembled stack set aside in step 18 on top of the diaphragm assembly (8), making sure large piston is on top and that the six holes in the Spacer Ring (9) match the holes in Diaphragm Assembly (8). Compress the spring (13) and insert four screws (15) into the Bonnet Assembly (2), until several threads are engaged on each screw.

22. Carefully tighten opposite screws until Spring (13) is compressed. Caution: Insure that the screws do not cut the diaphragms as they are being tightened.

23. Complete tightening of the screws (15). Lubricate Knob Assembly screw (1) with Molycote G. For Tamper Proof Unit, replace Cap (1B) on regulator.

24. Reinstall the relay in accord with installation instructions in the IOM and follow instructions in the Operation Section for placing the relay back into service.

LEGAL NOTICE:

The information set forth in the foregoing Installation, Operation and Maintenance Instructions shall not be modified or amended in any respect without prior written consent of Fairchild Industrial Products Company. In addition, the information set forth herein shall be furnished with each product sold incorporating Fairchild's unit as a component thereof.

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