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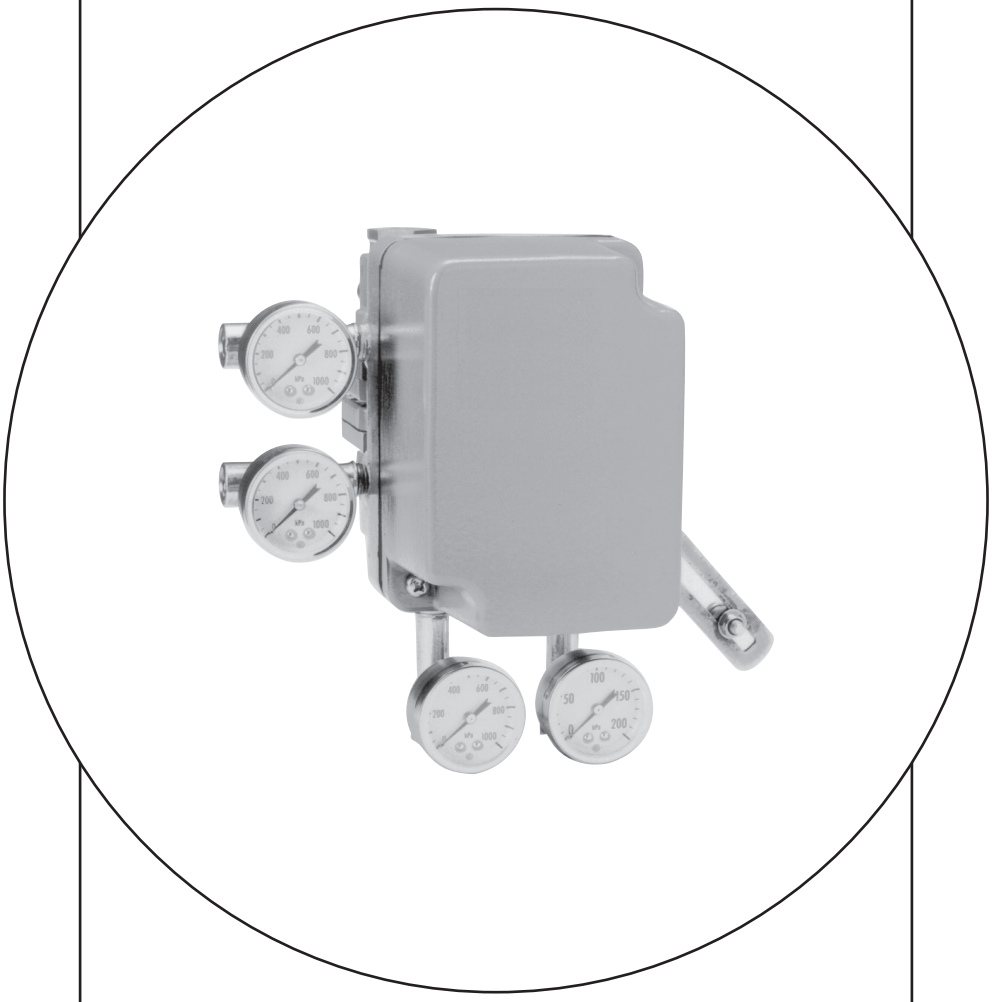
OM2-8310-0300

Double Acting
Pneumatic Valve Positioner
Model : VPP 02/VPP 03
User's Manual



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DOUBLE ACTION PNEUMATIC
VALVE POSITIONER
MODEL: VPP02 AND 03

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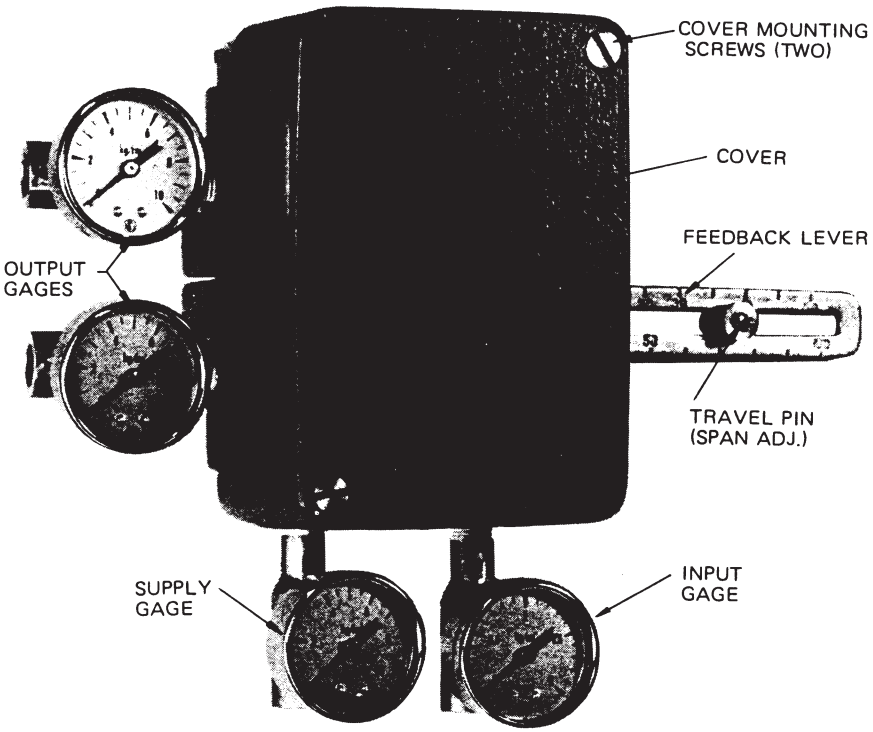
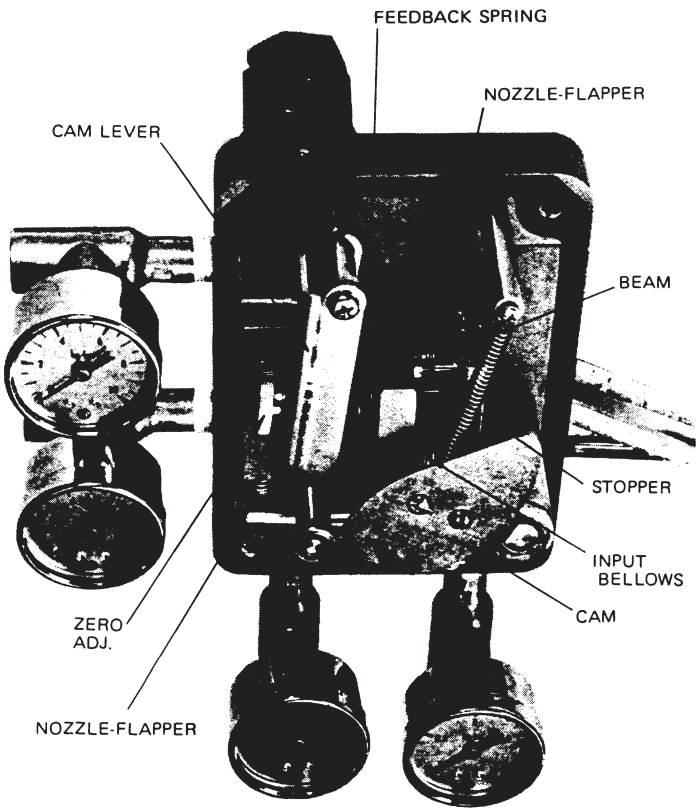
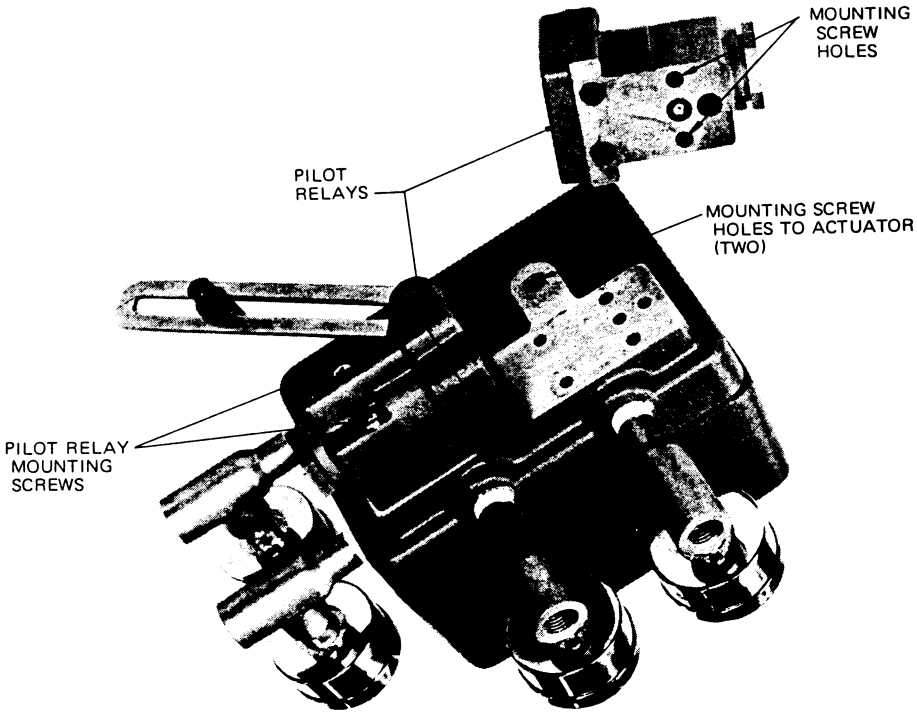
ILLUSTRATION



A. VPP Positioner, Front View



B. VPP Positioner, Interior View



C. VPP Positioner, Back View with One of Relay Being Dismantled

1. GENERAL

The Model VPP02/VPP03 Valve Positioner is used to position a double acting air cylinder, responding accurately and rapidly to the pneumatic signal received from a controller. Principal constructions are as follow:

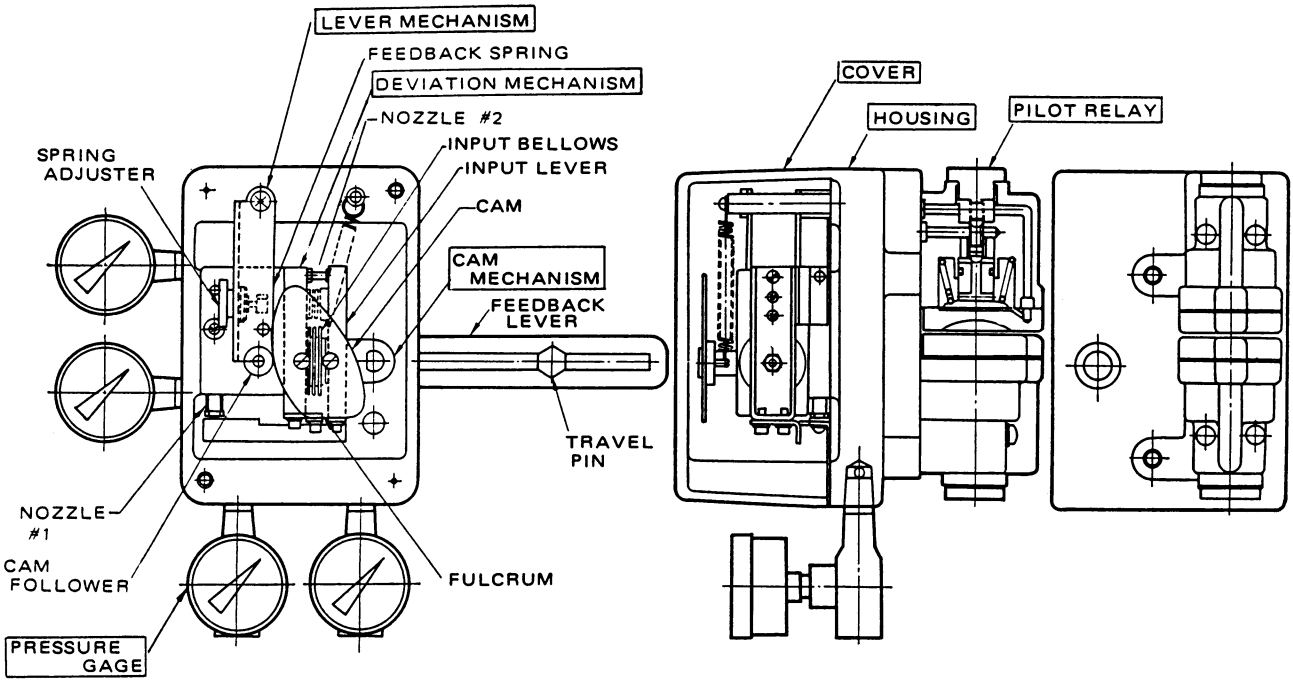
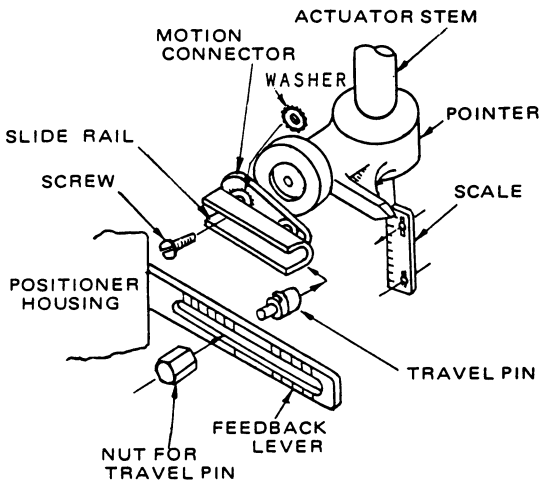


Figure 1. VPP Positioner, Composition



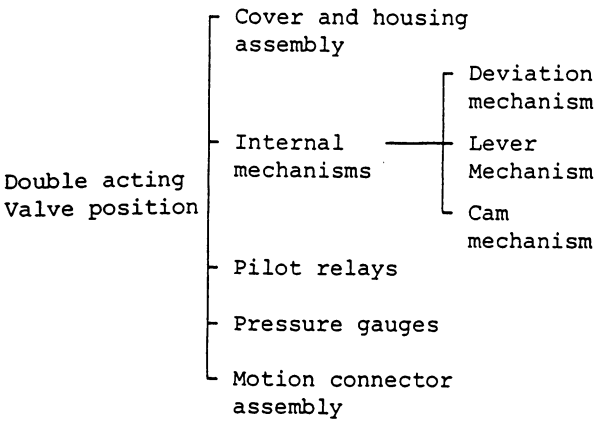


Figure 2. Vicinity of Connection between Actuator

2. PRINCIPLE OF OPERATION

The VPP positioner employs a force balance system. Referring to Fig. 1, when balancing between the force of the input bellows and that of the feedback spring is disturbed due to variation of the input fed from the controller or due to external disturbances caused to the control valve, air to the actuator of control valve is increased or decreased until the balanced state is restored and, then, provides the valve opening corresponding to the input signal.

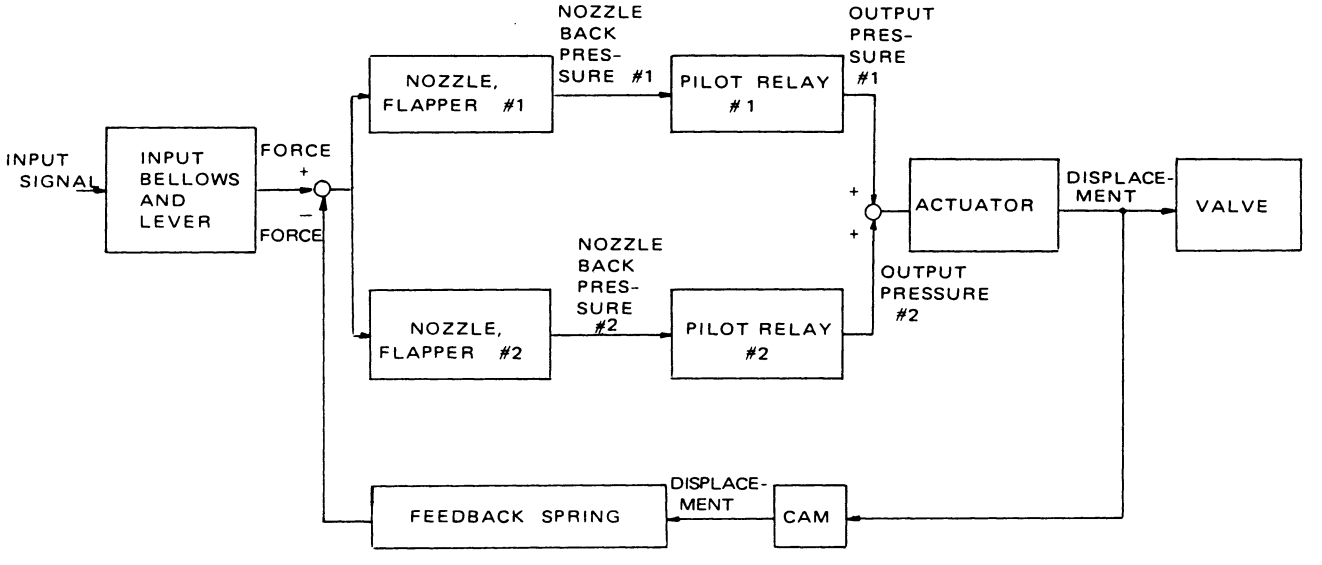


Figure 3. Block Diagram

The VPP positioner can be selected either in the direct or reverse action. The explanation here is made for the case of the direct action. For reversion of the action mode, refer to the section of "direct/reverse conversion of positioner."

If the input signal from the controller increases when the positioner is in balanced state, the input lever moves in response to the air pressure increment, nozzle #1 is closed and nozzle #2 is opened resulting in the increased back-pressure for the nozzle #1 and the reduced back-pressure for the nozzle #2. The variations of the back pressures are amplified with the pilot relay and are fed to the actuator. The air pressure variation at the actuator is converted into movement of the actuator stem (valve opening). The movement of the stem back spring so that a negative feedback is effected with respect to the torque variation caused by the input bellows and, thus, the input lever is pushed back by the actuator stem to the position corresponding to the input signal and the balanced state is attained.

When external disturbances are caused to the control valve and the actuator stem is displaced, the resultant effect is the same with that the torque being exercised on the input lever is varied and, therefore, the same automatic balancing operation is performed.

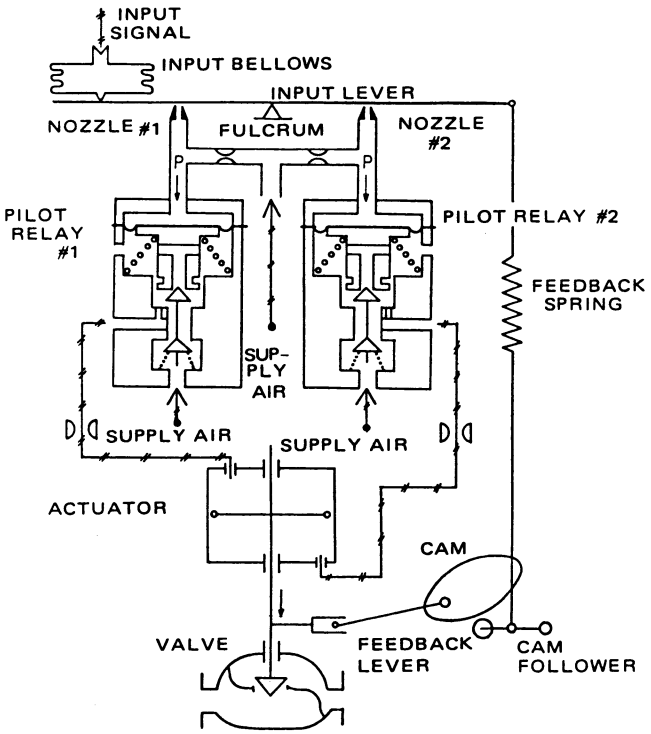


Figure 4. Schematic of VPP Positioner

3. SPECIFICATIONS

Input air pressure:	0.2 to 1.0 kgf/cm^2 0.2 to 0.6 kgf/cm^2 0.6 to 1.0 kgf/cm^2
Supply air pressure:	*1 2.0 to 3.5 kgf/cm^2 ± 5%, *2 3.6 to 7.0 kgf/cm^2 ± 5%
Stroke adjustment range:	14 to 100 mm
Cam characteristics (No. 1):	Linear
(No. 2):	Quick opening
(No. 3):	Equal percentage
Ambient temperature limit:	-30 to +80°C
Air consumption:	20 Nℓ/min (Ps = 5 kgf/cm^2)
Net weight:	Approx. 3.5 kg
Air connection:	Rc 1/4 (PT 1/4 female)
Housing:	Aluminium alloy cast, dark beige, leathertone finish
Linearity:	Less than ± 1% F.S.
Hysteresis:	Less than ± 1% F.S.
Dead band:	Less than 0.2% F.S.
Repeatability:	Less than 0.5% F.S.
Reproducibility:	Better than 1% F.S.
Supply air pressure characteristics:	± 0.5% F.S./± 0.5 kgf/cm^2

(Note) *1: For low bias pilot relay (engraved "L")

*2: For high bias pilot relay (engraved "H")

4. INSTALLATION

A. General

When the VPP positioner is ordered together with a control valve, the positioner is installed on the valve and adjusted at the factory before shipment.

In other cases, the positioner must be installed following the instructions given below. The installation work consists of three procedures of (2) installation of motion connector, (3) installation of positioner, and (4) adjustment after installation.

B. Installation of Motion Connector

Install the motion connector on the pointer using the counter-sunk screw and toothed lock-washer, loosen the fillister-head screw, adjust the slide rail to the right angle with respect to the actuator stem, and tighten the counter-sunk screw and fillister-head screw under this state.

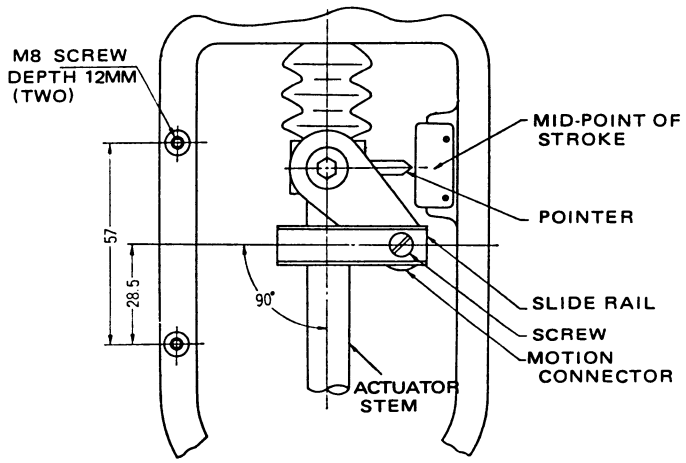


Figure 5. Installation of the Motion Connector

C. Installation of Positioner

(a) Holes for two mounting-screws (M8 screw, 57-mm interval) are drilled in the mounting-base. Install the mounting-base by means of these holes and using two hex-head screws.

(b) Install the positioner on the mounting-plate with two hex-head screws and two lock-washers. Installation can be conveniently made by using a box wrench for M8 hex-head screw.

D. Adjustment After Installation

After the motion connector and positioner and installed, make adjustment as follows:

(a) Connect air to the actuator through the pressure regulator, and adjust the pressure to the actuator so that the actuator stem is placed in the center of the stroke. If the actuator has a manual operating mechanism, move the actuator stem to the center of the stroke by means of the manual operating mechanism.

(b) Adjust the gradient of the motion connector so that both slide rail and positioner lever is positioned at the right angle with respect to the actuator stem and, under this state, tighten securely the counter-sunk screw. When this is done, the slide rail and positioner lever should be mutually parallel.

(c) Mount the travel pin on the positioner lever, and insert it in the slide rail.

E. Air Connection

Four air connections ([ISO R7 1/4"(PT 1/4) female]) are provided on the side of housing. Connections for these air connectors should be made as follows:

Mark	Meaning	Connection
I	Instrument	Controller output
S	Supply	Supply air
O	Output	Air chamber of actuator

5. ADJUSTMENT

When the positioner is ordered to be delivered being installed on the valve, it is shipped after being installed on the valve and adjusted. In other cases, adjust the positioner as described in the following:

(1) Check that, when the actuator stem is set at the center position of the stroke, the positioner lever and the slide rail are mutually parallel. If they have not been correctly installed, adjust them referring to Section 4 "INSTALLATION."

(2) Select a cam of the required characteristics (refer to Section 6 "OPERATION") and install the cam in the way that the curved cam surface which provides the required stroke is positioned in the side toward the cam follower. In this case, the arrowhead direction of the cam (the side toward the cam follower) should conform with the moving direction of the actuator stem when the pneumatic control signal is increased. For example, when both positioner and actuator are of the direct action type, the actuator stem will move downward the pneumatic control signal increases from 0.2 kgf/cm^2 to 1.0 kgf/cm^2. In the case of this example, install the cam in such way that the arrowhead side of the cam (the side toward the cam follower) is directed downward. (See Figure 6.)

(3) Move the travel pin to the point for the required stroke referring to the figures (unit in mm) marked on the positioner lever and fix the travel pin at this point.

(4) Set the pneumatic control signal at the starting pressure of the actuator (typically, at 0.2 kgf/cm^2) and adjust the spring adjuster so that the actuator stem starts moving with this pressure.

(5) Set the pneumatic control signal at the full-stroke pressure of the actuator (typically, at 1.0 kgf/cm^2) and read the stroke. If the stroke is insufficient, move the travel pin rightward; if it is too large, move the pin leftward.

(6) Repeat the procedures of (4) and (5) so that the actuator stroke becomes within the allowable range for the full range of the pneumatic control signal.

Note: When the mechanism is balanced with the actuator stem set at an intermediate position, a normal indication is that the pressure of the actuator air chamber is approximately one-half of the air supply pressure. When the actuator air chamber pressure is too small, adjust it by adjusting the gap between the nozzle and flapper which are located at lower left as viewed from the front. To adjust the gap, rotate the nozzle. As the gap is made larger, the pressure becomes smaller; as it is made smaller, the pressure becomes larger.

6. OPERATION

A. Cam Selection

The VPP positioner is shipped with the linear characteristic cam (1) unless otherwise specified. Other available characteristics are as with cams (2) and (3) as shown in Figs. 2 and 3. Application and selection of these cams are explained below.

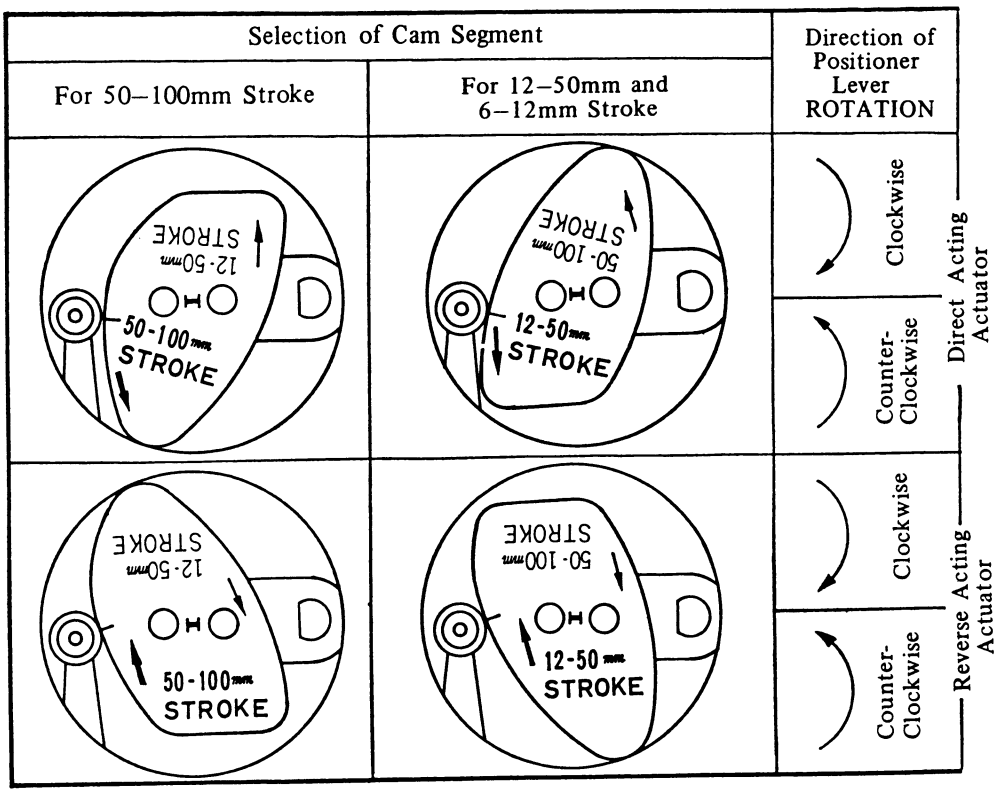


Figure 5. Cam Installation

(a) Cam Application

In general, a valve plug of which flow characteristics are suitable for the conditions of a process is employed. So, in order that the valve opening is proportional to the control signal, cam (1) — linear characteristics — is most commonly used.

With a butterfly valve — the characteristics of which are determined by the valve construction —, flow characteristics most suitable for the conditions of the process may not be obtained. In such a case, a special cam is employed to improve the flow characteristics. For example, in case that a reverse-acting actuator is installed on a valve which operates in the normally-closed mode.

While the flow characteristic of the valve are as shown in Fig. 8-A, flow characteristic of equal percentage may be required by the conditions of the process. In such a case, cam (3) will be selected from a group of curves of normally closed valves. Through combination of the selected cam with the valve, quasi-equal-percent characteristic as shown in Fig. 8-C can be obtained.

For combination with a direct-acting actuator for the normally open mode, cam (2) which is of the reverse characteristic of the above must be selected.

(b) Cam Selection

Cam selection must be made in the following procedure.

(1) Determine the flow characteristic of the control valve.

(2) Find whether the control valve is normally open or normally closed.

(3) Referring to Fig. 7 select a cam which will provide the flow characteristic suitable for the process.

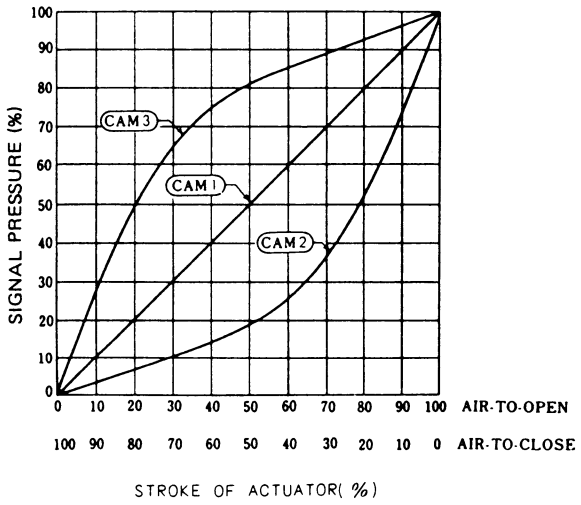


Figure 6. Cam Characteristics

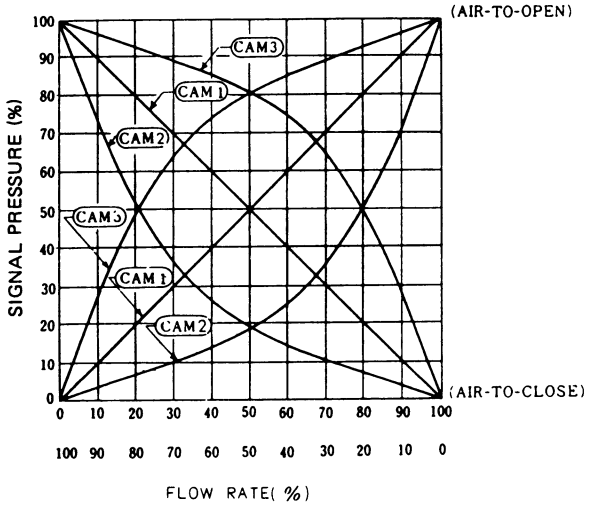


Figure 7. Cam and Flow Characteristics (For linear plug)

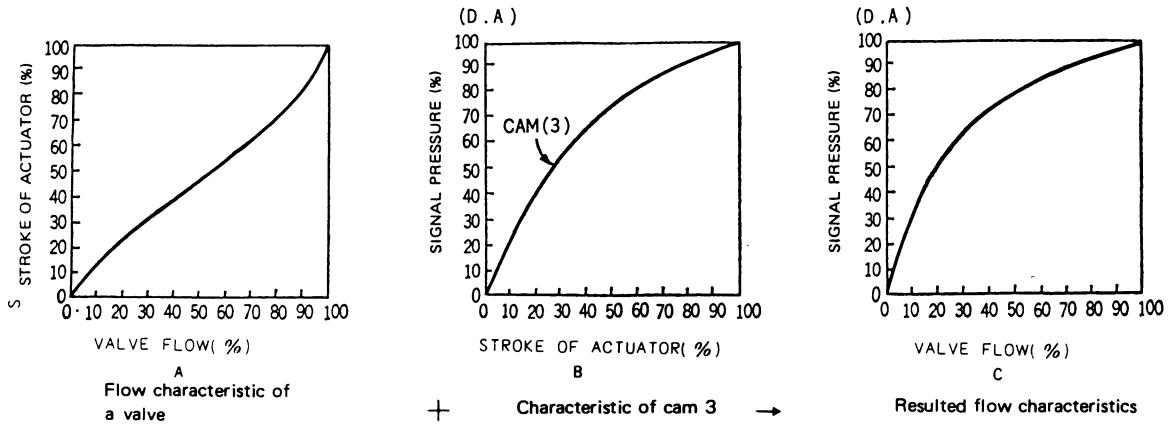


Figure 8. Application of Cam

B. Direct/Reverse Switching of Positioner

For switching between direct action and reverse action of the positioner, proceed as follows:

(a) Interchange the two pipes which connect the positioner with the actuator. (Reverse the relationship between the positioner output connection and the cylinder of actuator.)

(b) Change the mounting direction of the cam so that the arrow mark directs the reverse direction. (Refer to Section ("ADJUSTMENT.")

(c) Adjust the start point and strike. (Refer to "ADJUSTMENT.")

C. Change of Positioner Range

Three feedback springs are available for individual control pressure ranges as tabulated below. In the case of split range, a proper one must be selected referring to the table.

Table of Feedback Springs

Control pressure range	Color code
0.2 to 1.0 kgf/cm^2	Green
0.2 to 0.6 kgf/cm^2	Orange
0.6 to 1.0 kgf/cm^2	White

When cam (1) — linear characteristics — is installed, range change can be made simply by adjusting the start point and stroke. For example, up to maximum 50 mm stroke, a standard spring of 0.2 to 1.0 kgf/cm^2 can be used as a split split spring of 0.2 to 0.6 kgf/cm^2 or 0.6 to 1.0 kgf/cm^2 or other range.

7. MAINTENANCE

(a) As for the supply air, use clean and dry air.

(b) The parts* which have been moved for adjustment must be tightened securely after the adjustment is over.

* Motion connector, counter-sink screw, fillister-head screw, travel pin, etc.

Each of the zero adjustment and nozzle is provided with a self-lock consisting of a leaf spring and a coil spring, and need not be tightened.

(c) When the gap between nozzle and flapper had been disturbed and the pressure under the balanced state of the actuator has become abnormal, move inward or outward the nozzle (located lower left as viewed from the front) so that the above pressure at no load becomes approximately a half of the supply air pressure. The pressure increases as the gap between nozzle and flapper is decreased, and vice versa.

(d) The pilot relay should not be disassembled by the customer. When the pilot relay has become malfunctioning, the overall pilot relay should be replaced. The pilot relay can be removed after undoing the two clamping-screws.

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