Pneumatic Valve Positioner
Pneumatic motion transmitter
Type 765-2

SAMSON

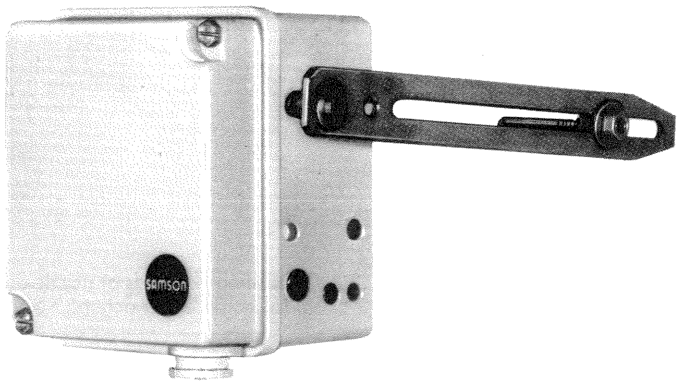

Figure 1 · Type 765-2

1. Assembly and method of operation

The pneumatic positioner assures a preselected relationship between the valve stem position (controlled variable) and the controller output signal (signal input). It compares the output signal of a pneumatic or electropneumatic control device to the control valve position and controls the output pressure connected to the pneumatic actuator.

The positioner essentially consists of a lever with shaft and measurement spring, the diaphragm and the pneumatic control system with nozzle, flapper plate and amplifier.

On request additional manometers for output pressure and input pressure can be delivered.

For controlling limit signals the positioner is combinable with the limit switch Type 746 by an intermediate piece.

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Mounting and operating instruction
EB 8352 E

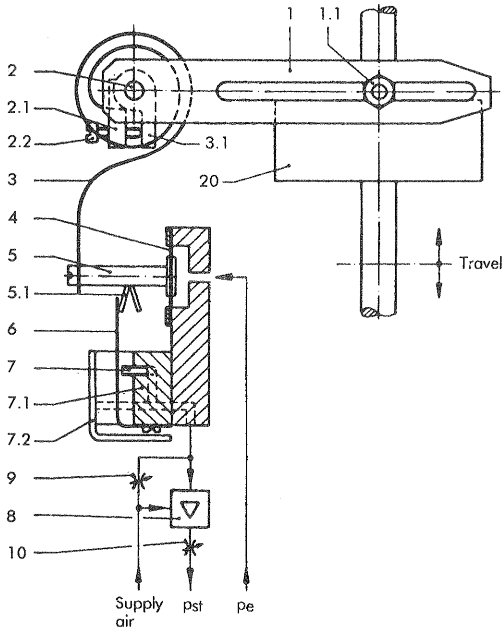
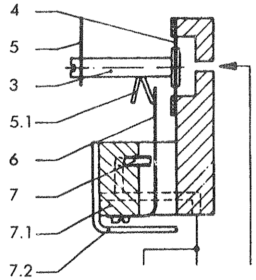


Figure 2 · Schematic of the positioner



2.1 Mounting positions of nozzle and flapper for "direct action" >>

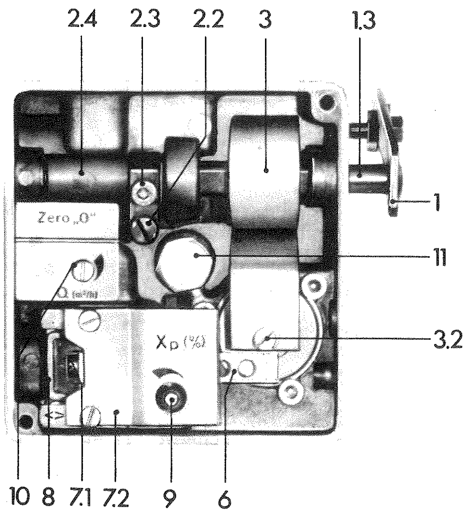


Figure 3 · Positioner without cover

Legends for figure 2 and 3

1.	Lever for valve travel
1.1	Pin
1.3	Spacer bush
2	Shaft
2.2	Zero adjusting screw
2.3	Attachment screw
2.4	Take off device
3	Measurement spring
3.1	Take off ring
3.2	Attachment screw
4	Diaphragm
5	Coupling
5.1	Feeler pin
6	Flapper plate
7	Nozzle
7.1	Nozzle block with operating direction symbol
7.2	Cover plate
8	Amplifier
9	Xp-adjustment
10	Volume adjustment
11	Mounting screw
20	Plate (attached to valve stem)

The positioner operates on the force balance principle. The controlled variable x is the position of the final control element, particularly the travel of a control valve. The input w is the output signal of a pneumatic controller. The output y of the positioner is the air pressure p_{st}.

For every position of the valve there is a corresponding torsion of the measuring spring (3). Whenever the actuator or valve stem plate (20) and the pin (1.1) move, the lever (1) and other transfer elements (2.1, 2.2, 3.1) cause the spring (3) to rotate and the spring torsion is altered.

The input, a signal (p_e) in the standard pneumatic range, produces a force on the diaphragm (4) which is balanced by the torsion load of the spring (3). If the signal p_e changes, then the feeler pin (5.1) moves. The flapper plate (6) follows this motion and influences the nozzle (7).

The supply air is piped to the pneumatic amplifier (8) and flows via the X_p-throttle (9) and the nozzle (7) against the flapper plate (6). A change in either the signal input or the actuator position causes a pressure change before and after the amplifier. The output pressure p_{st} controlled by the amplifier (8) flows through the adjustable volume throttle (10) to the pneumatic actuator.

Adjustable needle valves (9 and 10) are used for optimization and stabilization of the position-control-loop.

The lever (1) and the measuring spring (3) contained within the positioner are adaptable to the desired valve travel and the span of the input signal.

2. Attachment

The attachment parts with the product number 1.400-5745 are used for attachment of the positioner to cast frame valves and additionally the attachment kit with the product number 1.400-5342 is required for rod valves (spaces bolts).

Before actual attachment of the positioner, the coordination of the positioner and actuator must be laid down, as the positioner is fitted either to the right or left of the valve. Please note the corresponding illustrations 6 to 9 in section 4.1.

2.1 Attachment to cast frame type valve (Fig. 4)

Screw the plate (20) with screws (21) to the coupling clamp (22) of the valve. Unscrew the cover of the positioner and attach the device to the frame of the valve with mounting screw (11).

2.2 Attachment to rod type valve (Fig. 5)

Screw plate (20) with screw (21) in off-centre position on the travel indicator (24) of the valve stem (23).

Place the mount (28) and the clamp (26) onto the rod and shift it until the plate centre (20) and mount hold are flashed at half valve travel. Mount the positioner with attachment screw (11) to the mount.

2.3 Housing cover

After attachment of the positioner, make sure that, when the valve is fitted, the vent stopper on the housing points downwards.

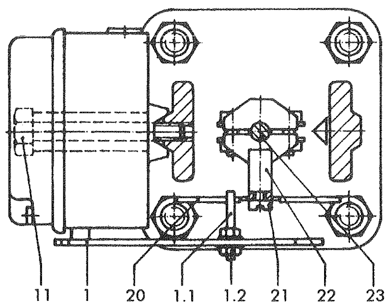


Figure 4 · Attachment in the case of cast frame version (e.g. type 240)

1	Lever
1.1	Pin
1.2	Nut
11	Mounting screw
20	Plate
21	Screw
22	Coupling
23	Valve stem
24	Travel indicator
25	Indicator
26	Clamp
27	Valve rod (stabled)
28	Mount

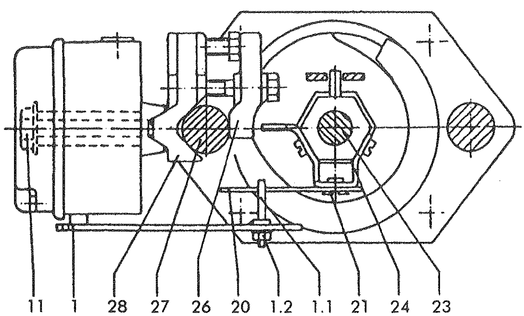


Figure 5 · Attachment in the case of rod type valve (e.g. type 201)

3. Air connections

The air connections are designed in the form of hose with NPT 1/4 thread. The normal types of screw connections for metal and copper pipes or for plastic hoses can be used. Before connection of the air-lines, blow through these well. The output pressure is conveyed to the upper or underside of the actuator in accordance with figures 6 to 9.

Important: The supply pressure should be set to 0.4 bar above the end value of signal pressure range (p_{st}) of actuator (see serial plate)

4. Operation

4.1 Coordination of positioner and actuator

The position of attachment is dependent on the type of actuator, of input signal and of the operating direction. The mounting of the positioner has to be arranged according to Fig. 7 to 10.

Each subsequent conversion such as, for example reversing of operating direction of the positioner or reversing of the actuator, "spring force extends" to "spring force retracts" actuator stem or vice versa, also means an alteration of the positioner's place of attachment.

4.1.1 Determination and reversion of the operating direction (figures 6 to 9 and figure 11)

For an increase in the input pressure p_e (signal input), the output pressure p_{st} may increase (direct action >>) or may decrease (reverse action < >). This is exactly the same for a decreasing input signal p_e; in the case of direct action >>, a decreasing output pressure is obtained and an increasing output pressure is obtained in the case of reverse action < >.
There are lateral markings for the operating direction (>> and < >) on the nozzle block (7.1). One of the two markings indicates which operating direction has been set.
If the desired operating direction (figures 6 to 9) does not agree with the visible marking or if the operating direction is to be altered, proceed as follows: unscrew both screws (7.3) of the covering plate whilst holding the nozzle block. Remove the cover plate.
Once again place the nozzle block (7.1) in position shifted by 180 ° and secure this. It is absolutely necessary to ensure the correct position of the nozzle block with the flapper plate to the feeler pin of the coupling (5) as shown in figure 11. If, after laying down coordination, the operating direction is to be reversed, the positioner must be screwed onto the other side of the valve. Ensure correct positioning of lever (1) and plate (20).

Actuator: Spring force extends actuator stem **FA**

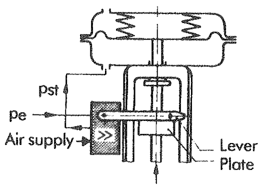


Figure 6 · operating direction >>
attached on the left

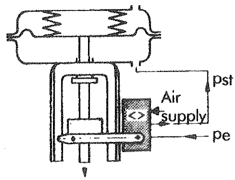


Figure 7 · operating direction < >
attached to the right

Actuator: Spring force retracts actuator stem **FE**

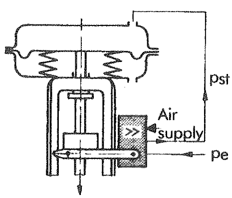


Figure 8 · operating direction >>
attached to the right

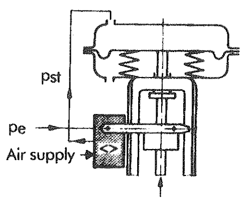
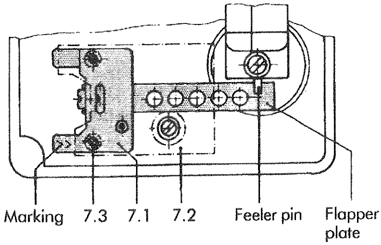


Figure 9 · operating direction < >
attached to the left

Increasing/increasing operating direction
Flapper plate below the feeler pin

7.1 Nozzle block
7.2 Cover plate
7.3 Screw



Increasing/decreasing operating direction
Flapper plate above the feeler pin

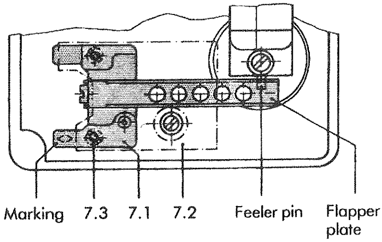


Figure 10 · Reversal of the nozzle block

4.2 Start of operation and signal input span

The mounted lever und the installed measurement spring (1, 2 oder 3) of the positioner are assigned to the valve travel and the span of the input signal Δp as shown in table below.

Normaly the input span is 0.8 bar. A signal input span of 0.4 bar is only required for split range operation. The range can be altered by subsequently replacing (section 4.5) the measurement spring.

When adjusting the positioner, the travel must be adapted to the signal input and vice versa. In the case of a signal input span Δp of 0.8 bar (e.g. from 0.2...1 bar), the travel must also pass through its complete range of 0...100 %. The start of operation is then at 0.2 and the end value at 1 bar.

During split-range operation, the actuator operates with the smaller-signal input span Δp of 0.4 bar. In this case, the start of operation is either at 0.2 bar or at 0.6 bar and, accordingly, the end value is at 0.6 or 1 bar.

The start of operation is set with the screw (2.2), the signal input span and thus the end value is set with pin (1.1). For adjustment, the control signal input E must be linked to a compressed air source with a maximum of 1.5 bar via a signal pressure regulator and a control manometer and the supply air input Z must be linked to an air supply.

Important: Because the start of operation depends on the adjusted air supply, the **Zero** must be checked within the installation under operating conditions. Correct, if necessary.

Lever mm	Travel mm	Signal input (bar) Span	Range	Measuring spring
I	8...20	0.8	0.2...1	1
		≤ 0.4	0.2...0.6 0.6...1	2
157	14...36	0.8	0.2...1	2
		≤ 0.4	0.2...0.6 0.6...1	3
	30...75	0.8	0.2...1	3
II	14...26	0.8	0.2...1	1
		≤ 0.4	0.2...0.6 0.6...1	2
210	26...50	0.8	0.2...1	2
		≤ 0.4	0.2...0.6 0.6...1	3
	55...100	0.8	0.2...1	3

4.3 Adjustment at valve

4.3.1 Adjustment of P-band (X_p) and air delivery Q

First set signal input range to 50 % and adjust Zero adjusting screw (2.2) that travel has 50 %.

By adjusting the X_p-throttle as a function of air supply pressure must be considered according to diagramm fig. 11. Normaly adjustment should be at X_p = 3 %. For air supply pressure between 1.4 and 4 bar the throttle is to open about 1 rev. (n=1).

Test tendeny towards oscillation and regulating speed of the valve by means of momentary pressing the measurement spring (3) against fixing. If valve does still overshoot, first throttle air supply of positioner by means of volume throttle (10) according to desired running-in behavior.

After this, if necessary readjust X_p-throttle, don't pass the limits in diagramm fig. 11. Otherwise the positioner does'nt remove air enough and the valve can't reach the Zero-position (e.g. closing position).

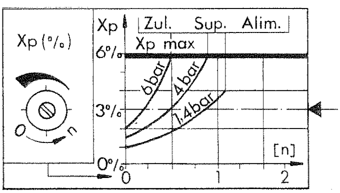


Fig. 11 · Adjustment of X_p-throttle

Note:

The X_p- and **Q**-adjustment must always be set before adjusting Zero (start of operation) and Span.
Subsequent change causes zero shift!

4.3.2 Adjustment of start of operation (Zero) and signal input range (Span) with actuator: actuator stem extends FA

Start operation (Zero) (e.g. 0.2 bar)

Adjust the input pressure to a 0.2 bar start of operation by the signal pressure regulator. Turn screw (2.2) until the valve stem thus begins to move from its rest position (observe the valve stem with travel indicator). Remove the input pressure from the regulator and slowly increase once again. Check whether the valve stem begins to move at exactly 0.2 bar and, if necessary, correct this.

Signal range (Span)
Upper range value e.g. 1 bar

Once the start of operation has been adjusted, increase the input pressure with regulator to 1 bar. At the end value of exactly 1 bar, the valve stem must be at a standstill and must thus have passed through 100 % travel. If the end value is not correct, the pin (1.1) must be shifted as follows for correction:

Shift to the lever end
→ travel increases
Shift to the point of rotation
→ travel decreases

After correction, remove the input pressure and increase this once again. First of all check the beginning of operation and then the end value. Repeat correction until both values are correct.

Attention: When Zero and Span have been adjusted, check if the actuator is without pressure (see pressure gauge indication of attachment block, otherwise connect a pressure gauge for testing in signal pressure line). With an input signal 0.2 bar and with operating direction >> or with 1 bar and with operating direction <>, the pressure gauge must indicate 0 bar. Correct Zero accordingly!

4.3.3 Adjustment of start of operation (Zero) and signal input range (Span) with actuator: actuator stem retracts FE

Attention: With actuators **FE** and with upper value of the pneumatic signal (1 bar) and operating direction >> or with lower value of the pneumatic signal (0.2 bar) and operating direction <>, the diaphragm chamber must be provided with an output pressure large enough to shut the control valve tight when there is an upstream system pressure. (The required output pressure can be read off the label on the control valve).

The **required output pressure** is calculated as follows:

$$\textbf{requ. output pressure}\ [\text{bar}] = \frac{d^2 \cdot \pi \cdot \Delta p}{4 \cdot A} + F_{be} + 0.4$$

d = Seat diameter [cm]
Δp = Differential pressure p1 – p2 [bar]
A = Actuator area [cm^2]
F_{be} = Upper signal pressure range value of the actuator [bar]

If there are no specifications, calculate as follows: required output pressure = upper range value + 1 bar.

Start of operation (e.g. 1 bar)
Set the input signal to 1 bar by the pressure regulator. Turn the zero screw (2.2) until the control valve is just leaving the initial position. Increase the input signal and slowly lower it to 1 bar. Check if the control valve starts moving with exactly 1 bar. Correct Zero accordingly.

Signal range (Span)
Upper range value e.g. 0.2 bar

When the start of operation has been set, adjust the input signal to 0.2 bar by the pressure regulator. With exactly 0.2 bar, the plug stem must stand still and have passed the travel by 100 % (observe the travel indication at the valve!). If the upper range value is not-correct, the pin (1.1) must be shifted for correction purposes.

After correction have been made, set the input signal to 1 bar again. Turn the zero screw (2.2) once more until the pressure gauge at attachment block indicates the **required output pressure.** (If no attachment block is mounted, fit a test gauge into the signal pressure line).

4.4 Replacement of the measurement spring (figure 3)

If the range is to be altered or converted to split range operation, the measurement spring must be replaced as follows:

First of all unscrew screw (3.2) from the measurement spring, then release the screw (2.3) and remove the lever with shaft.

Replace the measurement spring, then place the lever with shaft through the measurement spring and bush with zero point adjustment (2.4). Secure the measurement spring with screw (3.2). Shift the bush and shaft towards each other so that the screw (2.3) meets the flattened part of the shaft. Secure screw (2.3); there should be a play of 0.1...0.2 mm between the lever (1), the spacer bush (1.3), the measurement spring (3) and the housing.

5. Use of the positioner as pneumatic motion transmitter (figure 12)

In this application, the travel of a controlled valve or another device is measured and converted into an output signal (p_A) from 0.2...1 bar or 1...0.2 bar. Refer to figure 11 for attachment.

Note: The visible marking of operating direction on the nozzle block must always be set to reverse action <>.

The relation of 0...100 % valve travel to the output signal 0.2...1 bar (or 1...0.2 bar) is laid down during the setting of start of operation (screw 2.2) and end value (pin 1.1). Operations then correspond with those in section 4.3.

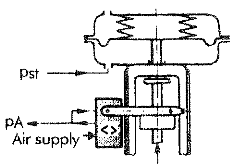
6. Attachment of two devices (as positioner and motion transmitter)

If two devices are to be attached, first of all the place of attachment of the positioner must be laid down in accordance with figure 6 to 9.

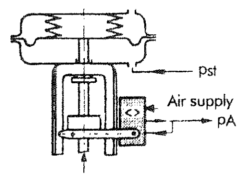
It is then only possible to attach the motion transmitter to the other side of the valve. If the relationship of the input pressure p_{st} to the output signal p_A (figure 12) does not agree with the required relationship, the motion transmitter must be shifted by 180 °. The valve travel is then transferred via plate (20) from the attached assembly to the other side of the valve stem (refer to figure 13 and fig. 4).

Actuator: Spring force extends actuator stem **FA**

p_{st} increasing/p_A increasing (0.2...1 bar)

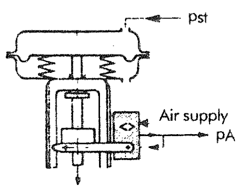


p_{st} increasing/p_A decrasing (1...0.2 bar)



Actuator: Spring force retracts actuator stem **FE**

p_{st} increasing/p_A increasing (0.2...1 bar)



p_{st} increasing/p_A decreasing (1...0.2 bar)

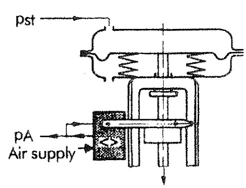


Figure 12 · Pneumatic motion transmitter

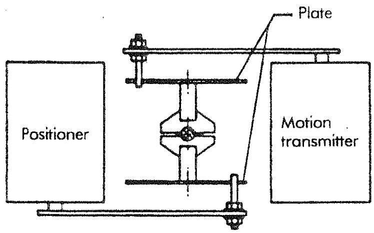


Figure 13 · Schematic for attachment

In order to enable attachment of the plate to the valve stem, the coupling (22) must be removed and the clamp without stay must be replaced by a clamp with stay (order no. 0300-0324). If the coupling consists of clamps without stays having an indicator, then an additional angle (order no. 0300-0994) must be mounted for the second plate.

7. Accessories, attachment parts

7.1 Accessories

		order number
Measurement spring 1		1190-0736
Measurement spring 2		1190-0737
Measurement spring 3		1190-0738
Lever I 157 mm		1190-2983
Lever II 210 mm		1190-3916
Pressure gauge attachment block, stainless	for pressure gauge (bar, psi) connection 1/4-18 NPT	1400-5333
	for pressure gauge (bar, psi) ISO 228-G 1/4	1400-5335
Attachment block	without pressure gauges (USA-version) raccord 1/8-27 NPT and 1/4-18 NPT	1400-5338

7.2 Attachment components

Attachment kit for cast frame valves in accordance with Namur	1400-5745
Attachment kit for cast frame and rod type valves in accordance with Namur, rod diameter 18...35 mm	1400-5745 and 1400-5342

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