TECHNICAL MANUAL

CONTROLLER

Pneumatic controller SG 6100

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INSTRUCTIONS FOR PNEUMATIC INDICATING CONTROLLER SG6100

The Pneumatic Indicating Controller SG 6100 can be used to control and indicate industrial process variables. It employs direct measuring elements for pressure and temperature and sends a modulated signal to pneumatic actuators (e.g. a control valve).

Technical data

Ambient temperature limits

service	:	-40 to +70°C.
storage	:	-50 to +80°C.

Case

dimensions	:	192 x 192 mm DIN 43700
protection grade	:	IP 55 - IEC 144
material	:	Reinforced Technopolymer

Control Unit

Motion balance

Control actions and ranges of adjustment

P	:	BP 2/200% (Kp 50/0.5)
P + I	:	BP 4/400% (Kp 25/0.25) ; Ti 0.1/25 min
Direct/Reverse acting	:	reversible by rotating the BP dial
Intrinsic Proportional Band (P+I)	:	0.5%
Drift for variation of ambient temperature within -20 and +60°C	:	≤ 0.035%/°C
Drift for variation of supply pressure within 1.2 and 1.7 bar	:	≤ 0.15%/0.1 bar
Air Supply	:	1.4 ± 0.1 bar
Air Consumption in steady state	:	400 gr/h
Output signal	:	5 to 95% of supply pressure
Scale	:	vertical, 75mm
Set Point	:	local, mechanical, with internal knob, adjustable over full scale range

Output Indicator

scale	:	0..2 bar and 0..30 psi
accuracy	:	± 2%

Measuring Elements

Accuracy (% of span)

Linearity and hysteresis	:	± 1%
Repeatability	:	≤ 0.25%
Dead zone	:	≤ 0.2%

Pressure - Vacuum - Receiver	:	AISI 316 C-type tube spring
connection	:	1/4" NPT f.
overpressure	:	25% u.s.v.
Temperature	:	mercury filled, AISI 316 st.st. bulb with;
connection	:	1/2" NPT m.
Adjustable immersion	:	350 mm. AISI 316 st.st. capillary, 3m length
Over temperature	:	see codification
Mounting	:	panel or wall
Options	:	protection IP 65
	:	capillary 6 m length

CODIFICATION

CODE NUMBER:		SG61001	o	o	o
Pneumatic Indicator Controller					
Control Action	Proportional		1		
	Proportional and Integral		2		
Standard Scale Ranges					
Vacuum	1..0 bar			1	
Pressure	0..2.5bar			2	
	0...4 bar			3	
	0...6 bar			4	
	0..10 bar			5	
	0..16 bar			6	
	0..25 bar			7	
	0..40 bar			8	
Receiver	0.2..1 bar / 0..100 linear			B	
	0.2..1 bar / 0..10 square root			C	

Temperature	**Overrange**	**Y**	
-20..+40°C	70	160	H
0..+60°C	70	160	K
0..100°C	140	105	L
0..160°C	240	75	M
0..250°C	320	75	N

Options	
without	0
capillary 6 m	1
feature as per IP 65	2
feature as per IP 65 with 6 m of capillary	3
mounting bracket for 2 inch horizontal or vertical pipe	4

Ambient temperature	:	- 40 to + 70 °C
Material case	:	Reinforced technopolymer
Protection grade	:	IP 55
Control action	:	PI BP 4-400% (Kp 25-0.25); Ti 0.1-25 min
Air supply	:	1,4 bar clean, dry and oil-free instrument air
Air consumption	:	400 gr/h
Air connections	:	1/4" NPT (internal)
Input	:	range indicated inside controller. 0 - 2.5 bar up to 0 - 40 bar -20°C to 40°C up to 0°C - 250°C 0,2 - 1,0 bar

Installation

Mounting

The mounting bracket (see fig. 1) is suitable for either wall or panel-mounting.
On request the controller can be furnished with:

- Bracket for a 2" horizontal or vertical pipe.
- Tie rods for mounting on control valve

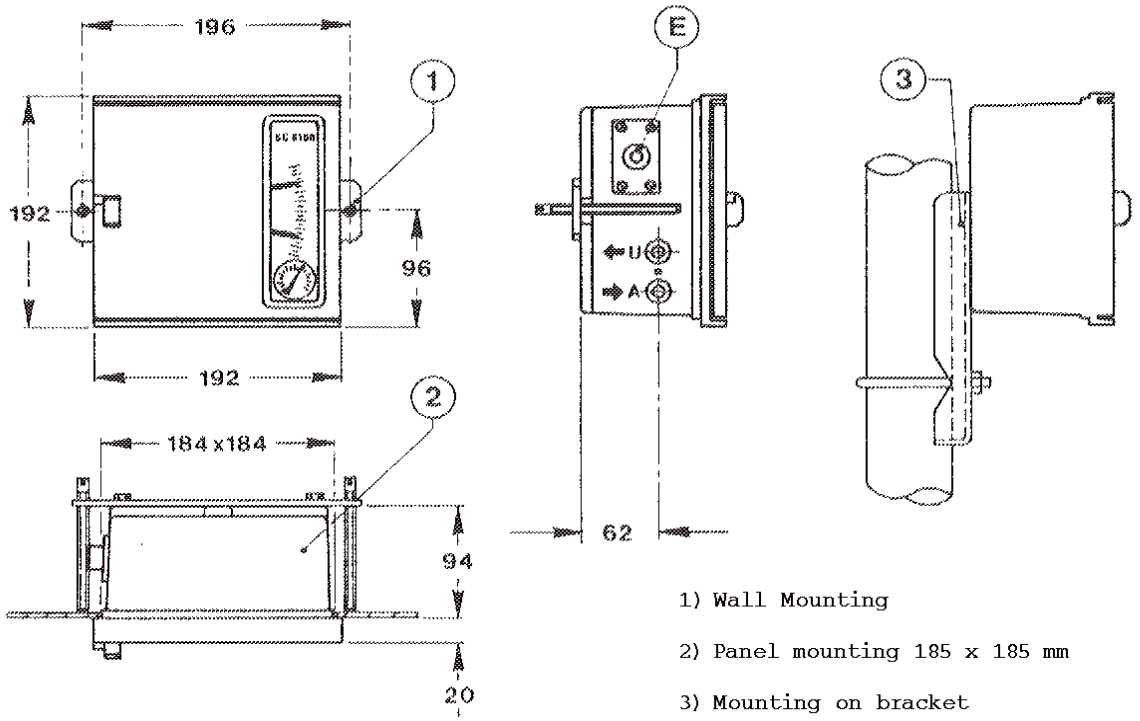


Fig. 1 - Mounting

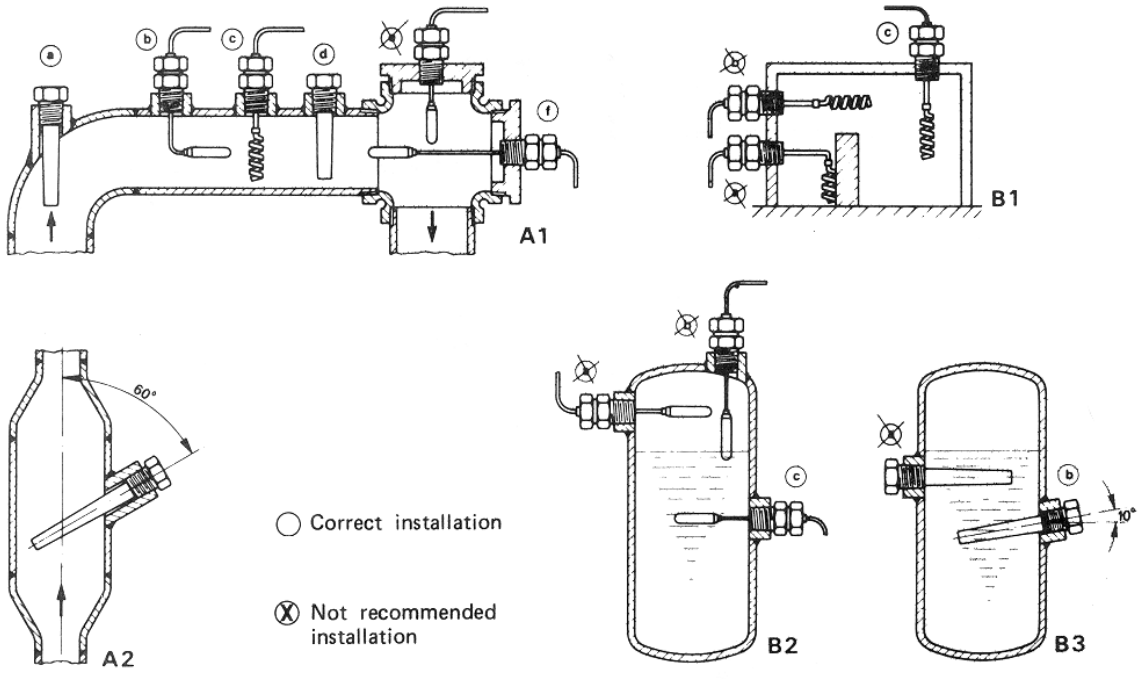
Pneumatic connections

The air supply (A) and output (U) are threaded 1/4 inch NPT internal. It is important that the air supply is clean, dry and oil-free. All air lines connections should be checked to ensure that the are free from leaks. For the reduction to 1.4 bar employ an airfilter- regulator with an output gauge. Before connecting the controller purge the supply line.

Connection of measuring element to the process

Temperature

- Install the bulb as shown in figure.
- Assure full immersion in the process of the sensing part of the bulb.
- Do not overrange the instrument.
- Do not use a naked flame to heat the bulb.
- When thermowells are used, we suggest to apply a thermal heat transfer media (liquid or metal powder) according to the temperature range.
- The radius for bending the capillary must be 25 mm minimum (Suggested: 50 mm)
- Avoid stressing the capillary during and after the installation.
- If the capillary is plain avoid courses with high temperatures (max. 60 °C)
- Do not cut the capillary tubing.



Pressure

- The instrument must be installed with block valves.
- Find out if the measuring instrument material is compatible with the process fluid.
- The pressure connection hole in pipe line or vessel should form a right angle with the fluid flow direction, otherwise the instrument will not only record the static pressure but a value also including the dynamical component.

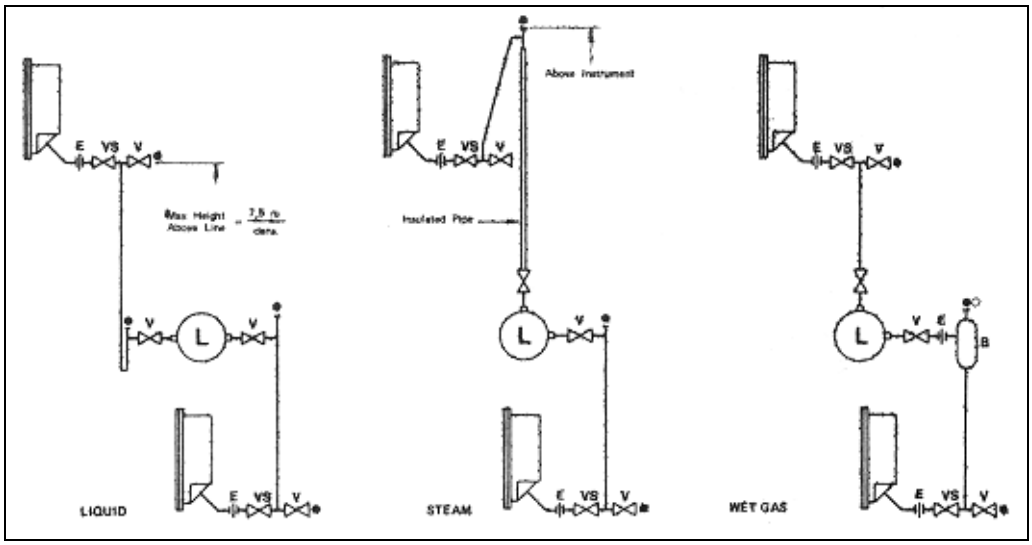


Fig. 3 - Installation of pressure controllers

L= line, **VS** = needle valves, • = plugs or points of vent or purge, **E** = pipe union, **V** = valves

Liquid pressure measurement:
Pressure connection should be made to the side of the vessel or line to prevent the intrusion of sediments and vapours into the instrument. When the instrument is mounted above the pressure connection , the height of the vertical leg to the instrument should not exceed 7.5 metres divided by the specific gravity of liquid in the leg.

Steam pressure measurement:
Pressure connection should be made one top of the vessel or pipeline when the instrument is mounted above or to the side. When the instrument is mounted below, the connection should be made to the side to enable the vapours and sediments to escape into the line or vessel.

Wet gas pressure measurements:
If the instrument is installed above the line or vessel, the pressure connection should be made on the top so that condenses or moistures can freely drain back into the line or vessel. When the instrument is installed below pipeline or vessel level mount a pot with the relative filling liquid to assure a constant level-height, the pressure connection will be to the side.
If there are pulsations a dampener should be installed. The measuring element cannot be subjected an excessive temperature of 200 °C.

To reduce the temperature of the process fluid in the measuring instrument (when needed), use a pipe coil and put pressure on the instrument slowly, taking care not to discharge the coil or on the contrary, to avoid freezing or solidification of the process fluid.
Normally the operating pressure should never exceed 2/3 of its range. For allowed overpressures we refer to the technical specification of the element.
Before putting into operation:

- Check the seal of fittings under pressure
- Vent and purge the line to remove moisture and solids
- Check the zeroing. If necessary adjust the zero for the presence of liquid head in the line.

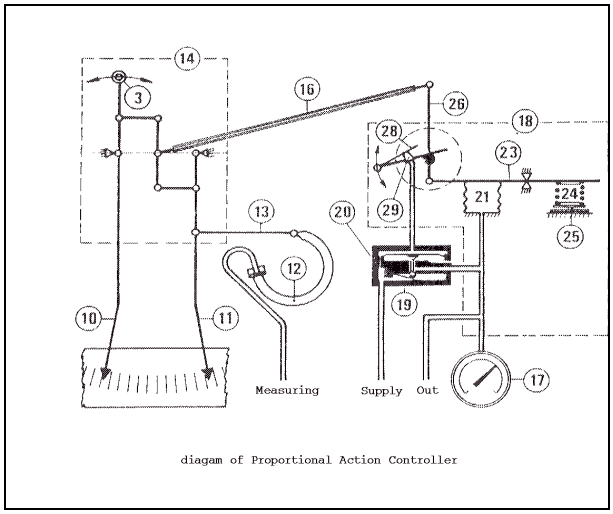
PNEUMATIC SIGNAL RECEIVERS

For the linkage with the transmitter use, preferably, new and clean copper pipes, o.d. 6 mm, i.d. 4 mm. Mount the instrument with a block needle valve. It is important that the connection between the instrument and transmitter is "leak"-free. To check for leaks apply a solution of soap water onto the connections. Before connecting the instrument purge the airline to remove moisture and solids.

Description of operation (fig. 4&5)

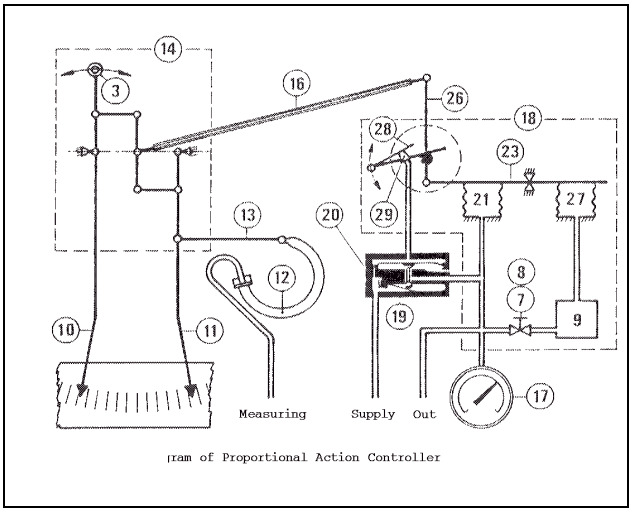
Series SG 6100 controllers are motion balance type control units. The balance position is reached and maintained by the composition of motions that are acting on a system of levers. The system senses the difference of position on the scale between the Set pointer (10) and the measured (process) index (11). This is transmitted through the lever (26) to the control unit (18). The unit send the control signal to the pneumatic control valve and therefore provides (in a typical system) to bring back:

- The measure index in **proximity** of Set pointer in controllers which have a Proportional Action (manual reset)
- The measure index in **coincidence** of Set pointer in controllers which have a Proportional plus Integral Action (automatic reset)



diagam of Proportional Action Controller

Fig. 4 - P action controller



ram of Proportional Action Controller

Fig. 5- PI action controller

Key to Figures 4 and 5

3 -	Set point adjustment and locking knob
7 -	Integral Action restrictor
9 -	Integral Action capacity
10 -	Set point index
11 -	Measured value pointer (or process pointer)
12 -	Measuring element
13 -	Measuring element link
14 -	Differential movement
16 -	Control unit link
17 -	Output gauge
18 -	Control unit (Proportional / Proportional plus Integral action
19 -	Pneumatic amplifier relay
20 -	Calibrated orifice
21 -	Follow-up bellows
23 -	Action lever
24 -	Proportional spring
25 -	Manual reset or Adjustment of the pre-load of Proportional spring
26 -	Proportional lever
27 -	Reset bellows (Integral)
28 -	Baffle
29 -	Nozzle

Adjustments

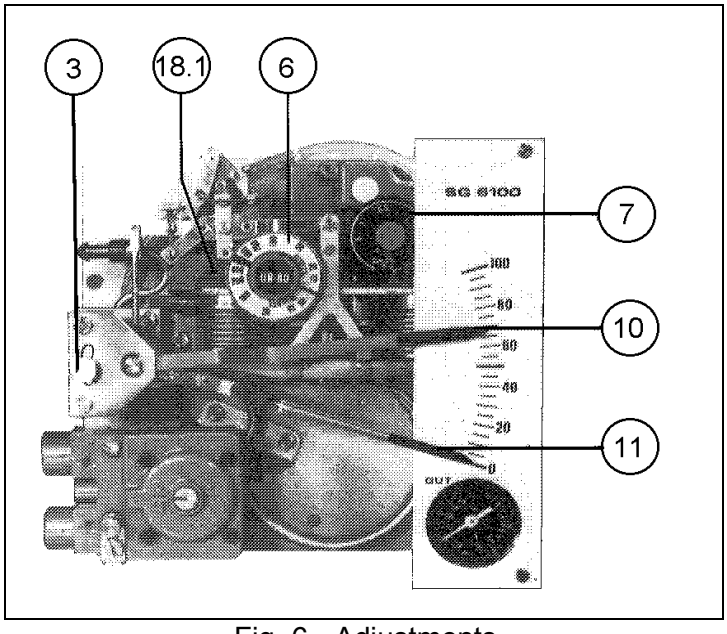


Fig. 6 - Adjustments

3 -Set point adjustment and locking knob.
6 - Proportional band (BP)
7 - Integral Action (I)
10 - Set point index
11 - Controlled variable (process) pointer.
18.1-Flexible stop plate of direct/reverse acting.

Start-up procedure

- Position the Set Pointer at the lower end of the scale using the knob (3).
- Turn on the air supply, 1.4 bar
- Open the shut-off valves around the control valve
- Adjust the Set Pointer gradually upscale until the index is at the required value.

Tuning the controller settings for optimum control

Proportional Controllers

a) Move the Set Pointer either up or down scale of the quantity omitted by process.
b) The movement causes variations in the out put signal (indicated by gauge) and in the measure (indicated by process pointer).
c) If the variations are persistent oscillations, double the BP value fixed before and return the set pointer to its original position.
d) The set pointer and process pointer may not however be coincident. If this is the case adjust the pre-load of proportional spring until the pointers are coincident.
e) If the variations obtained by b) are not persistent oscillations halve the BP value fixed before and repeat a) until persistent oscillations are obtained. Make hence the operations c) and d).

Controllers with Proportional and Integral Action

a) Close the Integral Action valve fully to maximum time
b) Adjust the proportional band in the manner described in paragraph above.
c) Set the Integral Action time to 1 minute.
d) Move the Set Pointer either up or down scale of the quantity omitted by process.
e) Verify if that causes persistent oscillations. If this is the case double the I value and return the set pointer to its original position. The coincidence between set and process pointers will be made automatically.
f) If the Set Pointer shift obtained with the operation d) does not cause persistent oscillations halve the I value until persistent oscillations are obtained. Make hence the operation e).

Maintenance

Periodic

- Clean the calibrated orifice on the output relay.
- Clean the relay.
- Clean the baffle and nozzle.

The frequency at which the above actions are taken is dependent upon the quality of the air supply which should be clean, dry and oil-free.

Cleaning of the calibrated orifice

- Partly unscrew the clamp screw (19.3) and slide the retaining plate (19.2)
- Remove the calibrated orifice (20) from its housing.
- Wash the orifice in petrol or trichlorethylene.
- Dry the orifice, replace it and tighten screw (19.3)

If the above operations are inadequate by virtue of their being excess dirt in the orifice, the orifice may be cleaned by using a wire of 0.2 mm od. or with the special cleaning wire, available at Mar-In Controls.

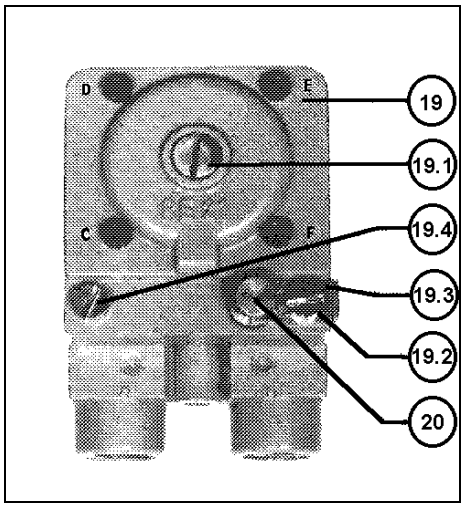


Fig. 7 - Relay with calibrated orifice

Dismantling and cleaning the output relay

Dismantling of the output relay can only be done correctly by experienced instrumentation engineers.
If there are any trouble with this relay, we recommend to replace it by a new one.

- Switch off the air supply to the instruments.
- Unscrew the screw (19.3) and (19.4). Remove the relay from the instrument.
- Unscrew the top cap (19.1).
- Unscrew the 4 screws C, D, E, F. Remove the top plate and the gasket (for replacement gasket specify code PR 7/3)
- Remove the metal diaphragm with vent baffle in its seat along with the relative gaskets.
- Replace the 4 screws C, D, E, F.
- Check that the 3 O-rings are in place in the relay manifold, replace the relay and fix it in position with the 2 screws (19.3) and (19.4).
- Centre the vent baffle pressing it against its seat with a pointed tool as shown in Fig. 8.
- Replace the top cap (19.1)
- Switch on the air supply

Dismantling the Control Unit

- Switch off the air supply
- Remove the dial of the controller
- Detach the Control Unit link (16)
- Unscrew the 2 screws which fix the Control Unit to the base of the case.
- Detach the tubes from the Control Unit, thus allowing the unit will be removed.

Cleaning the Baffle and Nozzle

- Dismount the Control Unit, as described in the previous paragraph.

- Hold the baffle away from the nozzle a small amount and using a solvent and a soft lint free cloth, clean the baffle and the nozzle tip.

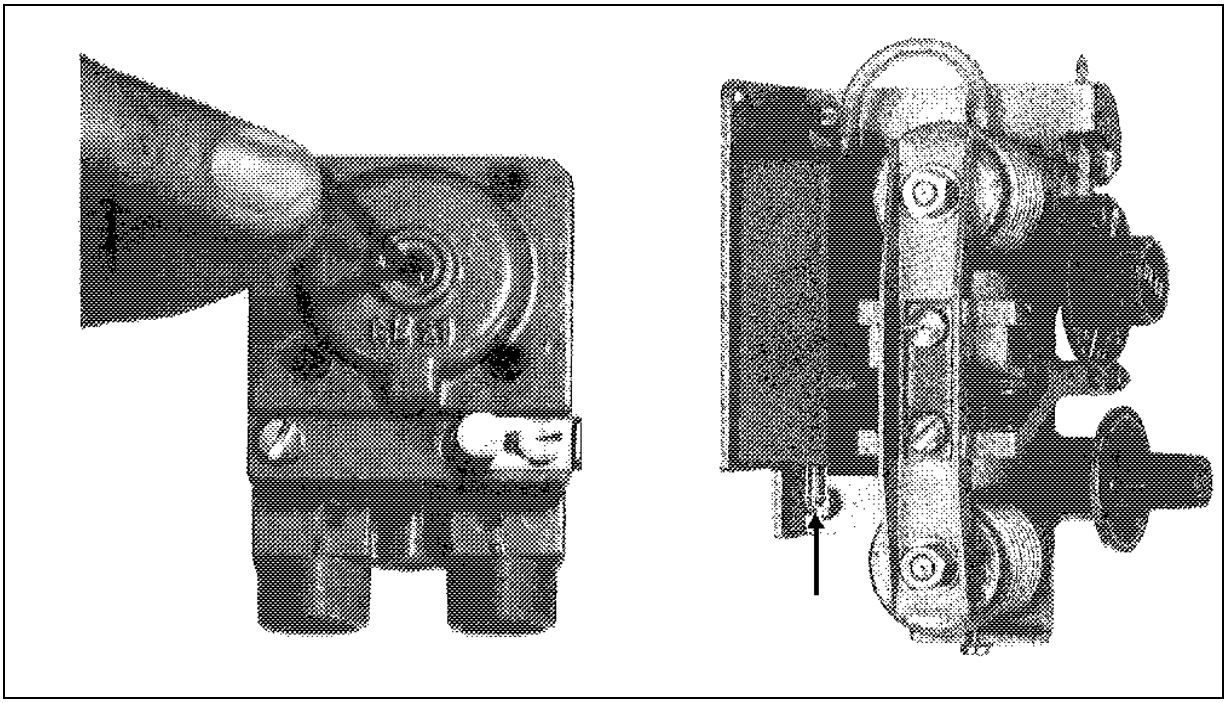


Fig.8: Centring the relay vent baffle Fig.9 - Nozzle connection

- Blow 1.4 bar compressed air into the nozzle attachment through the nozzle connection (see Fig. 9).
- Replace the Control Unit, following the procedure of the previous paragraph in reverse order.
- Checkout the alignment of controller.

Extraordinary maintenance

Alignment of the Controller

The purpose of the controller alignment is to ensure that, with the Set Pointer and Measured Value Pointer coincident, the Proportional Band Dial may be rotated from Maximum to Minimum without a significant change in the controller output.

The controllers are usually aligned so that, the Set Pointer and Measured Value Pointer coincide and with the Proportional Band setting in either Reverse or Direct Action, the output is 0,6 bar (9 psi), this being the middle of the standard 0,2 - 1 bar (3 -15 psi) range. The alignment may be made at other values by substituting the required value for the 0,6 bar (9 psi) in the following procedure:

- Disconnect the measuring element link (13) at the side of measuring element.
- Adjust the Set Pointer to approximately mid-scale, overlap the Set Pointer and Measured Value Pointer and fix the two together with tape or a clip.
- Rotate the Integral Action knob to 0.1 minute (Integral valve full open)

- Put the Proportional Band to infinity Reverse Action.
- Connect a 1.4 bar air supply to the instrument supply port.
- Imprison 0.6 ± 0.04 bar in the Integral bellows. To have that proceed as follows;
  > If the output increases slowly, await until it arrives to 0.6 bar, then turn off quickly the Integral valve (7) that is to say to rotate the Integral Action knob to 25 minutes.
  > If the output do not increase, screw in the maximum Proportional Band alignment screw (5) until the output pressure begins to increase. Arrived at 0.6 bar turn off the Integral valve.

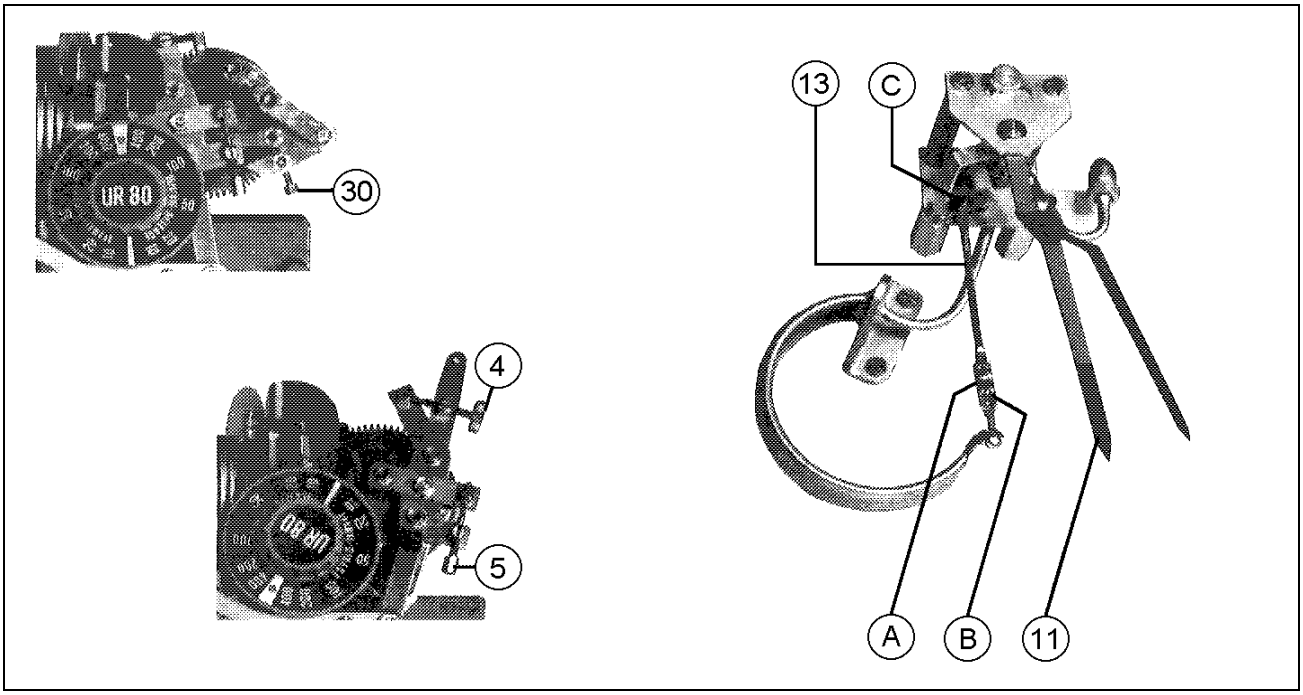


Fig. 10 - Alignment of the controller

- Put the Proportional Band Dial to 20% Reverse Action and adjust the minimum Proportional Band adjustment screw (4) to obtain 0.6 ± 0.01 bar.
- Put the Proportional Band to maximum (or infinity) Reveres Action and turn the maximum Proportional Band alignment screw (5) until the output pressure is 0.6 ± 0.04 bar.
- Repeat the preceding two operations until turning the Proportional Band Dial the output remains 0.6 ± 0.01 bar
- Put the Proportional Band to 20% Direct Action, if the output signal remains 0.6 ± 0.01 bar the alignment has been carefully carried out. If it is found that this is not so, put the Proportional Band

Dial to between 100% and 200% Direct Action and proceeds as follows:
  > If the output was less than 0.6 bar unscrew the baffle adjustment screw (30) by 1/4 turn.
  > If the output was greater than 0.6 bar screw the baffle adjustment screw (30) by 1/4 turn.
- Repeat the previous four operations (Put the Proportional Band Dial to 20% Reverse Action and ...) until the output remains 0.6 ± 0.01 bar.
- Unfasten the two pointers and replace the measuring element link.

TROUBLE SHOOTING

DEFECT	PROBABLE CAUSE IN THE CONTROLLER	PROBABLE CAUSE OUTSIDE CONTROLLER
Output too high	Controller in the wrong action. Plugged nozzle. Nozzle air tube pinched or kinked. Output air screen plugged.	Valve undersized.
Output too low	The flapper does not properly cap the nozzle. Calibrated orifice (in output relay) clogged. Controller in wrong action. Leak around Integral restrictor stem. Dirty relay stem.	Valve oversized. Leak in output line or valve actuator. Low air supply pressure.
Indication (or Recording) irregular. Poor control: measured value pointer wanders.	Proportional Band too wide. Reset time too long.	Obstructed or partially obstructed tubing between the process and the primary measuring element. Air pockets in the tubing on the process side.
Oscillations in the Control Loop. Poor control: measured value pointer cycles about setpoint.	Friction in the relay valve. Friction in the controller proportional lever. Proportional Band too narrow. Reset time too short.	Valve stem sticking. Disturbances from other processes affecting the controlling medium.
Response speed too slow.	Output relay defective. Nozzle partially blocked. Output air screen plugged. Calibrated orifice in the output relay dirty.	Tubing between the process and the primary measuring element partially obstructed.
Measured value pointer does not accurately indicate the measured value.	Measuring element link connected to wrong point pivot hole of disconnected. Measuring element out of calibration. Measuring element damaged.	Process sensing line plugged or broken.

Parts list

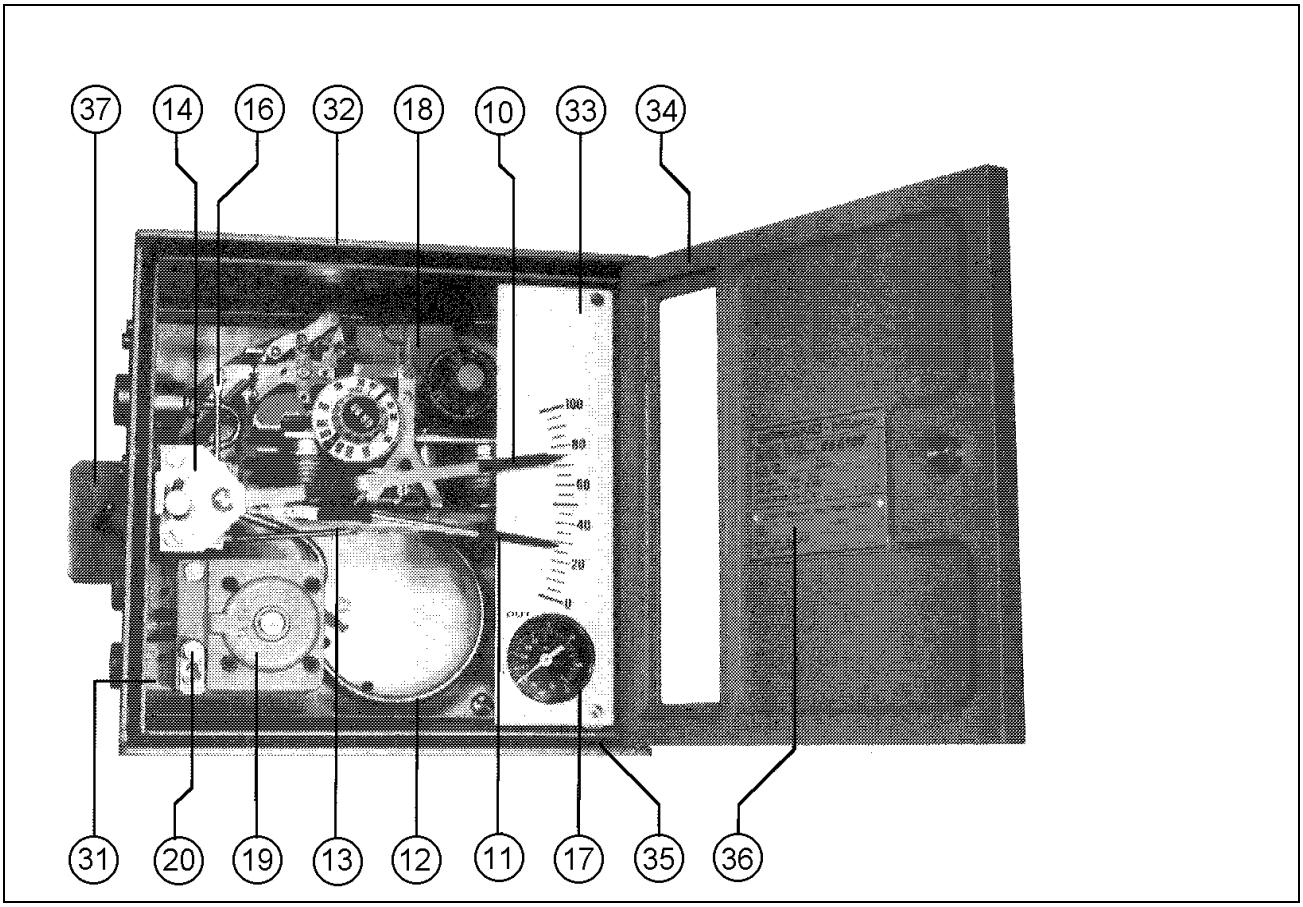


Fig.11 - Controller SG 6100

	Description	Code
10	Setpoint index	-
11	Measured value pointer	22/45
12	Measuring element	Characteristics indicated on data plate
13	Measuring element link	41-2/92
14	Movement	26-2/34
16	Control unit link	41/61
18	PI control unit	PR 8/45
*19	Pneumatic relay RE21	RE 21
*20	Calibrated orifice	F-43/39127
31	Relay base	6/10
*	Gaskets for RE21 relay	PR 7/3
32	Case	-
33	Dial	State graduation
*34	Cover	PR 8/41
35	Cover gasket	21/87
36	Data plate	-
37	Wall and panel mounting bracket	-

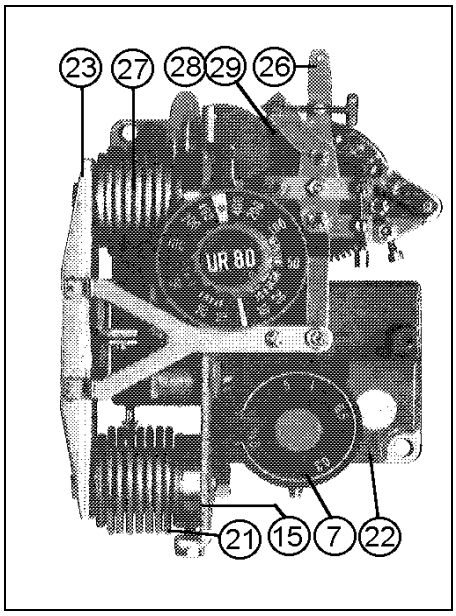


Fig. 12 - PI. control unit

7	Integral action restrictor	F-47/55034
15	Reaction unit support	
*21	Follow-up bellows	PR 8/5
22	Body	-
	Body gasket	21/22
23	Reaction lever	-
26	Proportional motion lever	23/14
*27	Integral action (reset) bellows	PR 8/4
28/29	Rotating nozzle-baffle assembly	PR 8/18
*	4 x 1 mm silicon rubber tubing	1,5 m
*	Assortment of O-rings	PR 8/42
*	Assortment of screws	PR 8/43

* indicate the recommended spare parts.