SPRIANO FLUID MECHANICS Srl

Proportional and Proportional-Integral Pneumatic Controllers Series SG6100 Installation and Maintenance Instructions

IMPORTANT
SAFETY INFORMATION:
PLEASE READ CAREFULLY:

For use in potential explosive atmosphere, the maximum process fluid temperature must be suitable for environment where this potential explosive atmosphere is present.
For the device maintenance in potential explosive atmosphere, we recommend the usage of tools which do not produce and / or propagate sparks.

Hazards to be considered when installing/using/ maintaining

1. Access
Ensure safe access and if necessary a safe working platform before attempting to work on the product. Arrange suitable lifting gear if required.

2. Lighting
Ensure adequate lighting, particularly where detailed or intricate work is required e.g. electrical wiring.

3. Hazardous liquids or gases in the pipeline
Consider what is in the pipeline or what may have been in the pipeline at some previous time.
Consider: flammable materials, substances hazardaous to health, extremes of temperature.

4. Hazardous environment around the product
Consider, explosion risk areas, lack of oxygen (e.g. tanks, pits) dangerous gases, extremes of temperature, hot surfaces, fire hazard (e.g. during welding), excessive noise, moving machinery.

5. The system
Consider the effect on the complete system of the work proposed. Will any proposed action (e.g. closing isolating valves, electrical isolation) put any other part of the system or any other workers at risk? Dangers might include isolation of vents or protective devices or the rendering ineffective of controls or alarms.
Ensure isolation valves are turned on and off in a gradual way to avoid system shocks.

6. Pressure systems
Ensure that any pressure is isolated and safety vented to atmospheric pressure. Consider double isolation (double block and bleed) and the locking and/or labelling of valve shut. Do not assume the system is de-pressurized even when the pressure gauge indicates zero.

7. Temperature
Allow time for temperature to normalise after isolation to avoid the danger of burns.

8. Tools and consumables
Before starting work ensure that you have suitable tools and/or consumables available. Use only genuine Spriano replacement parts.

9. Protective clothing
Consider whether any protective clothing is required, to protect against the hazards of, for example, chemicals, high/low temperature, noise, falling objects, dangers to eyes/face.

10. Permits to work
All works must be carried out or be supervised by a suitable competent person. Where a formal permit to work system is in force it must be complied with. Where there is no such system, it is recommended that a responsible person knows what work is going on and where necessary arrange to have an assistant whose primary responsibility is safety. Post warning notices if necessary

11. Electrical work
Before starting work study the wiring diagram and wiring instructions and note any special requirements.
Consider particularly: mains supply voltage and phase, local mains isolation, fuse requirements, earthing, special cables, cable entries/cable glands, electrical screening.

12. Commissioning
After installation or maintenance ensure that the system is fully functioning. Carry out tests on any alarms or protective devices.

13. Disposal
Unwanted equipment should be disposed of in a safe way

14. Returning products
Customers and stockists are reminded that under EC Health, Safety and Environmental Law, when returning products to Spriano they must provide information on any hazards and the precautions to be taken due to contamination residues or mechanical damage which may present a health, safety and environmental risk.
This information must be provided in writing including Health and Safety data sheets relating to any substances identified as hazardous.

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Note: The products supplied by Spriano are classified as components and are not generally affected by the Machinery Directive 89/392/EEC.

Notes
These instructions are for all series SG6100 proportional (P) and proportional integral (PI) pneumatic controllers.
Where not differently specified (par. A-B-C-D-E-F-G-N-O), instructions are given for all types of controllers.
The paragraph (H) is relatad only to proportional controllers wilst paragraph (I) to proportional-integral controllers. Paragraphs (L-M) are related to all types with specific points for each type.

A - INSTALLATION OF CONTROLLER (Fig. 1-2-3)
Series SG6100 pneumatic controllers are fitted with two fixing plates with screws and a support providing simple panel or wall mounting of instrument case.
Panel mounting is obtained by placing the instrument into a proper panel cut-out and securing by means of the auxiliary fixing plates screws. Panel cut out dimensions are shown in fig. 1.
Wall mounting can be likewise easily carried out by building a simple supporting structure consisting of a steel section fixed on the wall (fig. 2). The instrument will be mounted on the above structure by means of the support shown at fig. 3 indicating also the centre to centre distances between the fixing screws.
Mounting can be alternatively executed **on a vertical pipe stand** (2" size) as shown in fig. 2.
Particular care must be given to the choice of suitable location for mounting the instruments, making certain that they will be not subject to vibration, exposed to corrosive vapours, humidity or temperatures outside the minimum and maximum permitted limits.
(—15°C and + 65°C).

MONTAGGIO A QUADRO — *PANEL MOUNTING*

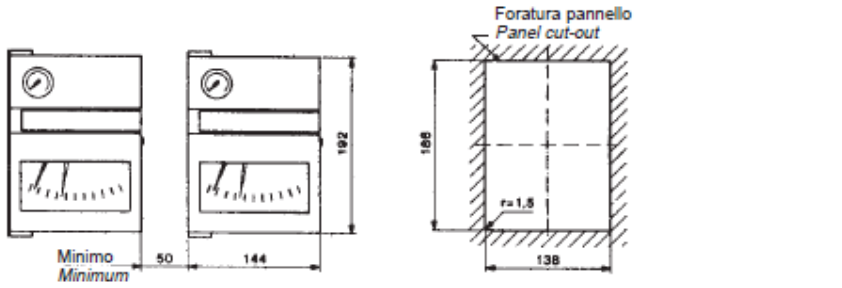
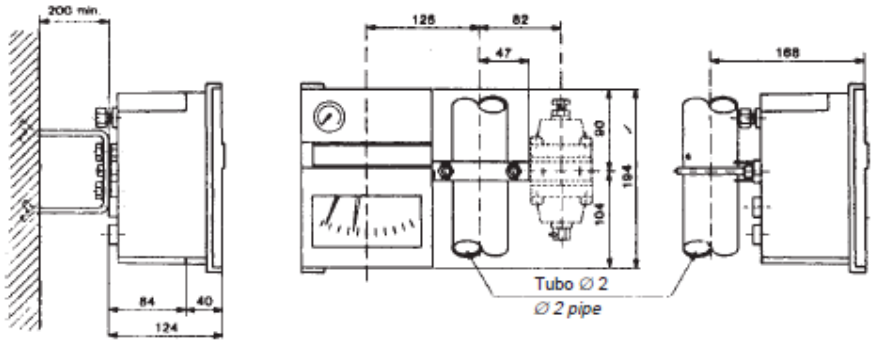


Fig. 1

MONTAGGIO A PARETE O SU SUPPORTO TUBOLARE — *WALL OR PIPE STAND MOUNTING*



La staffa per montaggio su supporto tubolare può essere di tipo prolungato permettendo anche l'applicazione del filtro riduttore.
The mounting support can be of extended type also allowing for air regulator clamping.

Fig. 2

B - CONNECTIONS
Pneumatic connections of controllers are fitted on back of the instrument case and are idendfied by reference letters.
E - Air inlet (air supply at 20 psi-1.4 bar)
U - Air outlet (output controf signal)
I - Air integral (pneumatic connection to integral action bellows)
M_1- Inlet transmitter (pneumatic connection to transmitter if any).
M_2 - Set point (optional connection for pneumatic set point).
Standard pneumatic connections are 1/4" size NPT female with the exception of the air integral connection (I) that is 1/8" NPT female.
The process connection is 1/4" NPT female for pressure controller
Pressure transmitters can be fitted with separators and flanged connections.

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DIMENSIONI DI INGOMBRO E ATTACCHI

DIMENSIONS AND CONNECTIONS

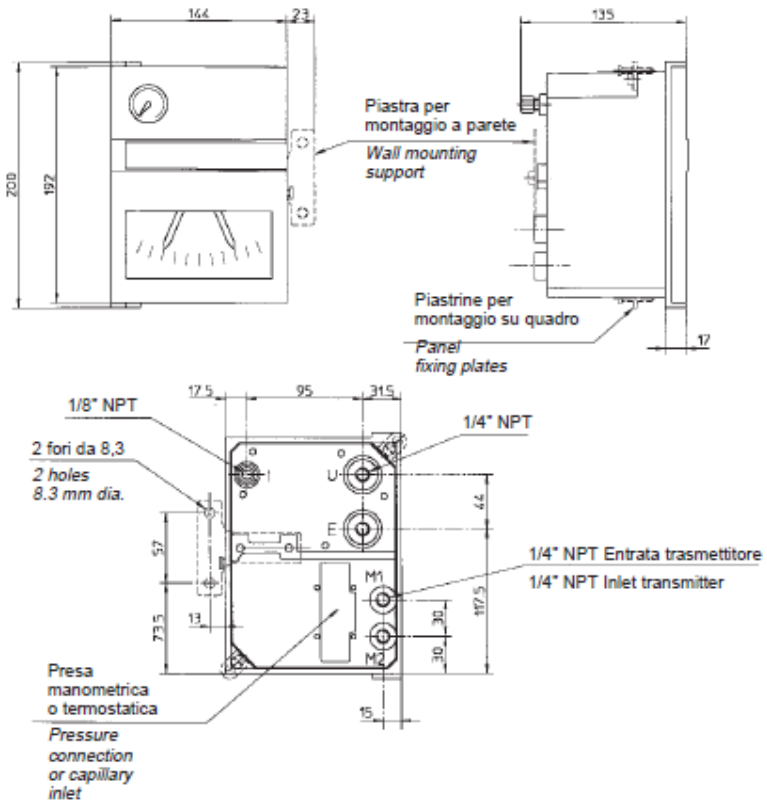

Fig. 3

C - PIPING TO AIR SUPPLY MAIN LINE

Safe and satisfactory operation of pneumatic instruments is strictly dependent on the purity and dryness of compressed air supply.

Pneumatic controllers have to be supplied with air at 20 psi (1.4 bar) constant pressure.

It is strongly recommended to fit a suitable filter on the air inlet of each controller however this is usually supplied as an integral part of the auxiliary air pressure regulator (part. 8 on fig. 4;).

Troubles due to possible presence of rust in the compressed air will be prevented by using non ferrous materials like nylon or copper for pneumatic piping and compression fittings; the use of tubing with 4 mm internal size is advisable.

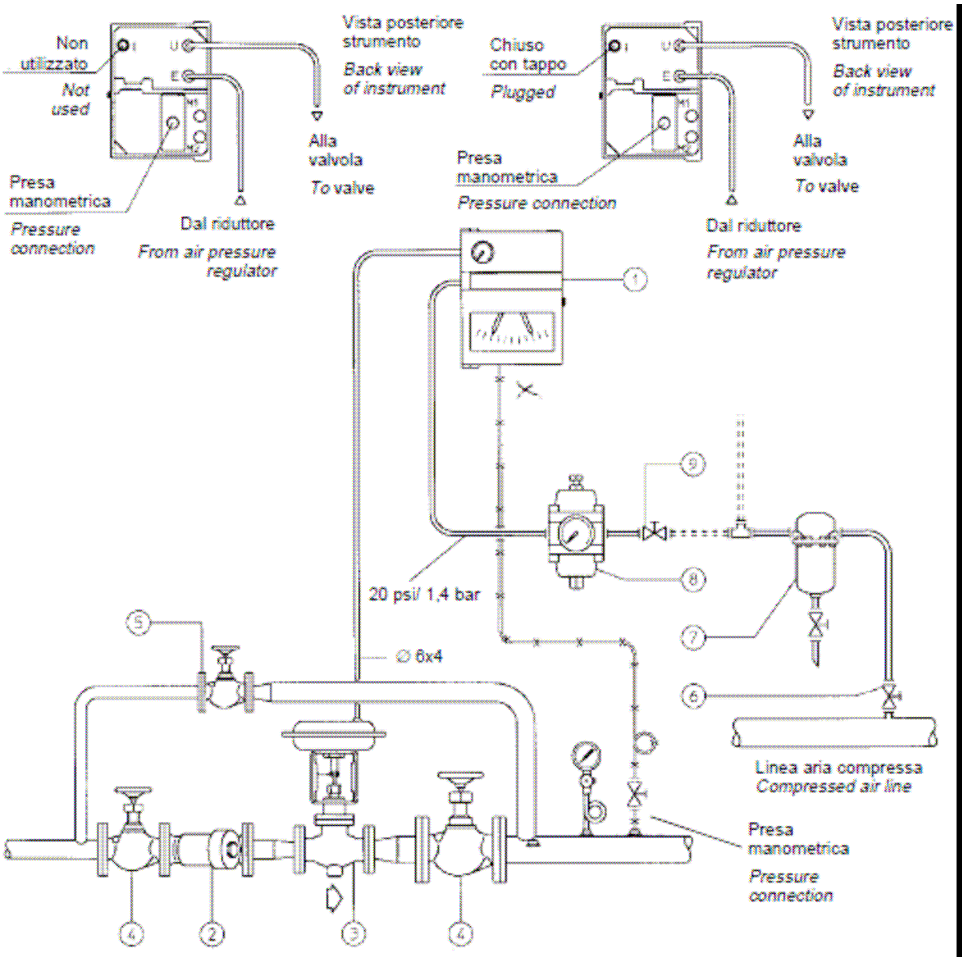

Fig. 4 - Schema tipico di installazione dei regolatori ad azione P e PI.
Fig. 4 - Typical installation of P and PI pneumatic controllers.

The air supply line to each single instrument should be taken from the top side of the air header and should slope down from the instrungent so that condensed moisture cannot drain into it, a 2% minimum slope is recommended.
A humidity separator (7.4) installed before the air filter regulator will provide preliminary removal of water and oil carried by the air.
For correct operation of filter-regulator (8.4) the air supply pressure must not be less than 2.8-3 bar. Lt is not advisable to use a single pressure regulator for supplying air to several instruments because sudden changes in air consumption due to simultaneous operation of more than one instrument could compromise the correct performance of every single controlter. (It is acceptable to use one pressure regulator every two instruments).

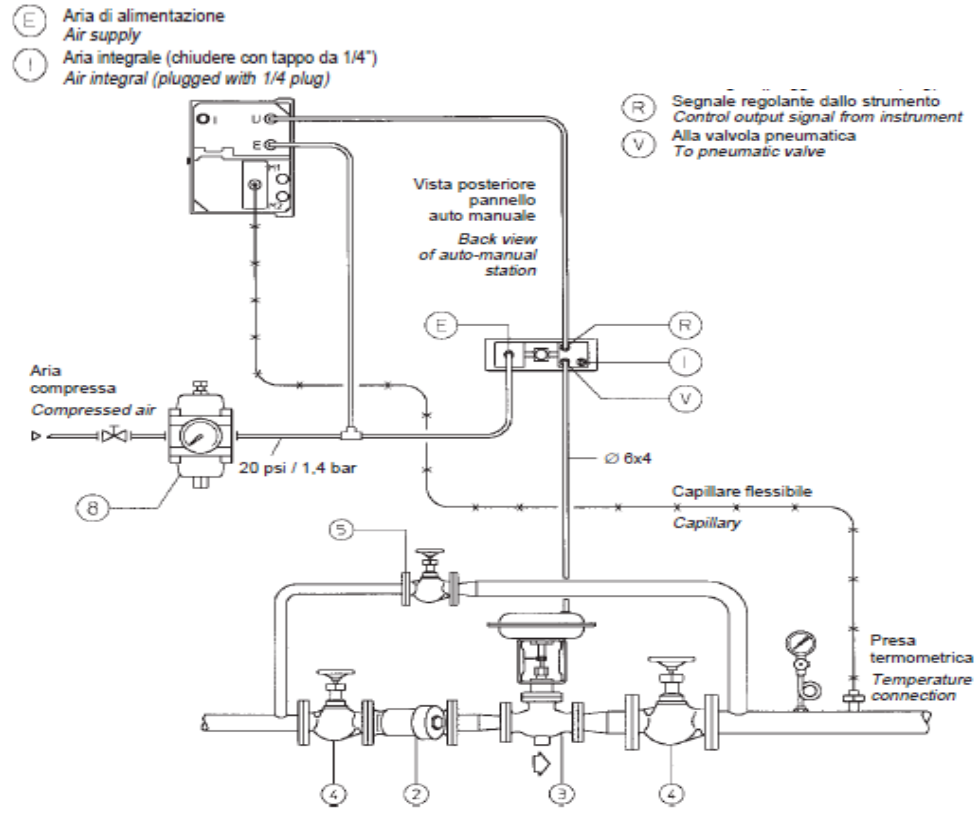

Fig. 5 - Schema tipico di installazione dei regolatori ad azione P con pannello di commutazione auto -manuale.
Fig. 5 - Typical installation of P action pneumatic controllers fitted with auto-manual station.

D - PNEUMATIC PIPING TO CONTROL VALVE

The pneumatic control output from the controllers is a standard 3 to 15 psi (or 0.2 to 1 bar) signal.
Signal must be conveyed to the pneumatic control valve (3) by means of a copper or nylon tubing as shown in fig. 4.
It is essential that this signal line is perfectly airtight, because even the slightest leakage of air could modify the characteristics of the control action.
It is therefore recommened that tightness of fittings and connections of the line are carefully checked with water and soap solution or with special spray compounds.
Before installing the pneumetic control valve, make sure that process pipework is clean; if possible blow it with compressed air or steam.
A pipe strainer (2) installed upstream of control valve will prevent dirt from obstructing valve internal passages. For installations requiring continuous operation it is advisable that two isolating valves (4) and a by-pass valve (5) are fitted, as shown in fig. 4, to enable periodic maintenance of control valve. This by-pass valve arrangement allows temporary manual control of the process, should the control valve be removed.
By-pass valve should not be installed when the pneumatic valve is responsible for safety shutoff service in addition to the control function.
Isolation stop valves (4), upstream and downstream control valve, must be of the same size as the process piping.
By-pass valve should preferably be of the same size as the main control valve, thus making manual control easier.
When installing control valve make sure that valve flow direction shown by an arrow on valve body corresponds to fluid direction in the process line. Pneumatic piping arrangement is shown in fig. 4. On the back of controller case, same references for the various connections shown in pneumatic connections scheme are indicated.
For control signal piping arrangement to pneumatic valve when **an auto-manual station is used**, see paragraph E making reference to fig. 5 for controllers with proportional action only and to fig.6 for proportional-integral action controllers.

E - PNEUMATIC PIPING OF PROPORTIONAL AND PROPORTIONAL INTEGRAL CONTROLLERS INSTALLED WITH AUTO-MANUAL STATION

The auto-manual station is used when the ability to switch from automatic control to temporary manual process control is required or alternatively when automatic start-up of a control loop is proving difficult. The auto-manual station consists of a two-position switch (automatic/ manual), a regulating knob and a gauge indicating output signal pressure from manual regulator.
Pneumatic connections are shown in fig. 5 for controllers with proportional action only and in fig. 6 for proportional-integral action controllers.
The same letters shown on schemes for pneumatic connections are indicated on the back of the instrument cases.
Connection I of auto-manual station must be plugged with a 1/4" NPT screwed plug when fitted on an only proportional instrument.
Only for proportional integral controllers, a back connection is provided to connect integral action bellow with connection I of auto-manual station, that obviously must not be plugged.

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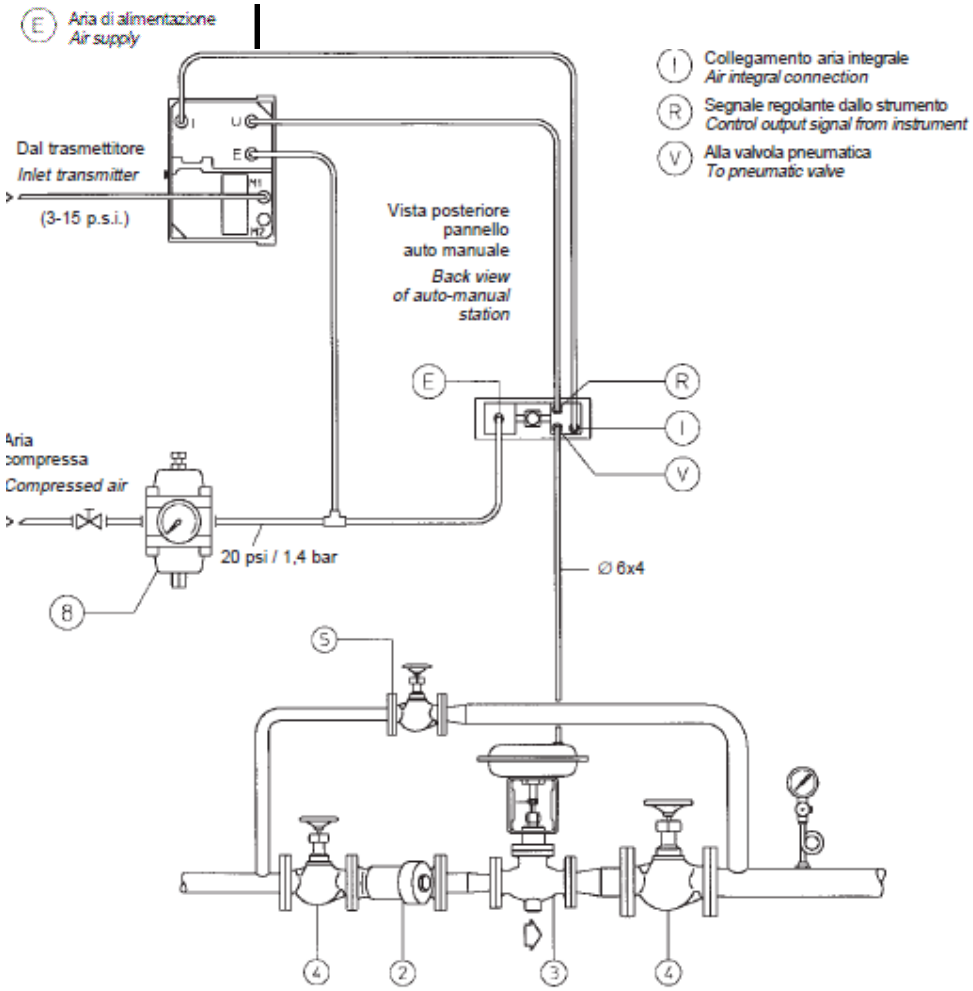

g. 6 - Schema tipico di installazione dei regolatori ad azione PI con pannello di commutazione auto-manuale
g. 6 - Typical installation of PI action pneumatic controllers fitted with auto-manual station.

The controllers are factory arranged to operate without the auto-manual station; for this purpose the connection between the control signal and the integral needle valve is done inside the controller through the plastic pipe (A.7).
When the controller is fitted with an auto-manual station, the internal connection must be locktighed up to the stop, the screw (B.7) controlling in the same time that the plaque (C.7) correctly presses the plastic pipe (A.7) so to prevent the air flow. The outlet control signal will reach the integral needle valve through the auto-manual station.

F - PRELIMINARY CHECK
When commissioning no particular operations are required as the instruments are delivered fully calibrated. Nevertheless transport can upset the factory calibration done during the final test, for these reasons a preliminary check is advisable.
Zero setting of the measuring system; a check will be done on a single point of the scale to control the correspondence of the instrument indicated value (black pointer) to the one measured with a reference pressure or temperature gauge.
The test can be done also on a limit value of the scale but it is better to perform the checking at a value near to the required controller set-point.
Should the indicated value on the controller scale be different from the measured value, an adjustment of the black pointer will be necessary.
Adjustment must be done by turning the **slowly and carefully** turnbuckle connecting link (E.8);
the operation must be done using the little spanner issued and performed to coincide with the two values.

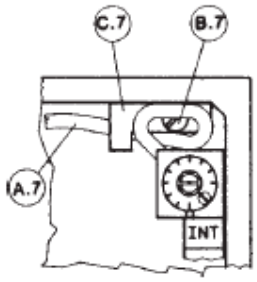

Fig. 7 - Dispositivo di blocco aria integrale

Fig. 7 - Device to close integral air connection.

G - DIRECTION OF CONTROL ACTION (fig. 9-10)
Action of Series 600 controllers can be easily changed from direct (output signal increases when process variable increases) to reverse (output signal increases when process variable decreases) or vice versa, by simply positioning proportional band adjusting device using knob (D). Setting of control action and proportional band adjustment are therefore achieved whithout modification of levers or linkages.

H - INITIAL COMMISSIONING OF PROPORTIONAL CONTROLLER (fig. 4-5-9-13)
When controller is fitted with an auto-manual station this has to be switched to automatic operetions (symbol).
Temporarily open drain valve of air filter regulator (8) to completely discharge condensate; adjust regulator output pressure to feed controller with air at 20 psi. Make sure there are no air leakages in the pneumatic piping to control valve.
By means of knob (F) position red pointer (G) on required set point value on instrument scale. Operating the graduated dial (D) adjust proportional band at the average value of 20% and make sure that control action (direct or reverse) is that really required: **reverse action** means that output signal increases when process variable decreases; **direct action** means that output signal increases when process variable increases.
When pneumatic valve (3) is fitted with a by-pass hand valve make sure that valve (5) is tightly closed and that the downstream isolating valve (4) is fully open. Smoothly and gradually open the manual and isolating valve (4) upstream the pneumatic control valve (3) until black measuring pointer approaches red pointer on the desired value. Proceed in the same way until the valve reaches its fully open position.
Should the black pointer start to cycle with continuous oscillations referred to the red pointer, progressively and gradually increase the width of proportional band beyond its initial setting.
If there is no hunting, slowly and gradually reduce the width of proportional band (not less than 10%) until a slight oscillation appears and then increase proportional band again to ensure a sufficient control stability.
To make sure that a correct proportional band value has been chosen, an artificial disturbance can be simulated by rapidly offsetting the red pointer of few millimeters.
If oscillations are observed, slightly increase the proportional band and repeat the checking until stability is reached.
The best setting is the narrowest proportional band compatible with the process stability at any expected load of the process.
Having completed the suggested procedure, it is possible that the black indicating pointer does not exactly coincide with the red pointer of set-point. To eliminate such offset **gradually** rotate the screw (H) of manual reset (setting).
This final adjustment is however justified only when process load is expected to remain rather constant in the time and must be always performed with the prevailing load. After every rotation of the manual reset screw wait for few minutes before carring out another correction in order to permit the plant stabilization.
Note: control instability and cycling in the loop could be originated by excessive friction in the pneumatic valve (stick-slip stroking) or by oversized valve (valve constantly working in almost closed position). Therefore should continuous oscillations arise, having performed all the operations of items 1 to 9, carefully check the pneumatic valve.

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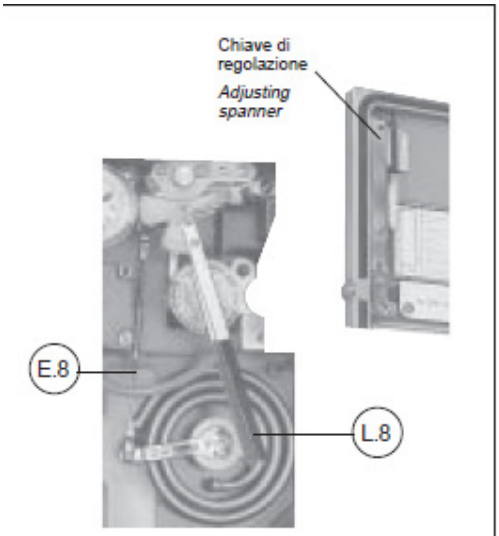

Fig. 8 - Elemento di misura della variabile controllata.
Fig. 8 - Measuring element of the controlled variable.

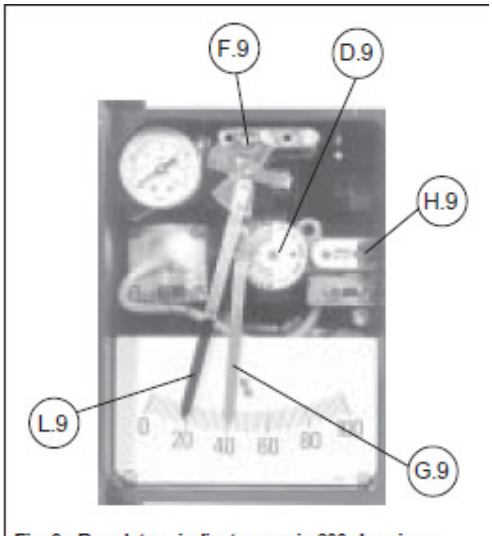

Fig. 9 - Regolatore indicatore serie 600 da azione proporzionale.
Fig. 9 - Series 600 Proprortional indicating controller.

Starting a proportional controller fitted with auto-manual station when already commissioned
This procedure to start a proportional controller fitted with an auto-manual station implies that proportional band and manual reset of instrument have been previously adjusted as per previous items.
Switch the auto-manual station to manual control by positioning switch knob on mark .
Close the pneumatic control valve by turning the pressure regulator knob of auto-manual station.
Completely open both isolating valve (4) upsteam and downstream the pneumatic valve, make sure that the by-pass valve (5) is tightly closed.
Slowly rotate the pressure regulator knob to gradually open the pneumatic valve until the black measuring pointer of controlled variable will exactly coincide with the red set point pointer.
Switch the auto-manual station to automatic control by positioning the knob on mark .
Switching from automatic to manual control can be done by adjusting the outlet signal from station (indicated by station manometer) at the same pressure of automatic signal (indicatad by the manometer of controller) and then switching the station from automatic to manual control.

I - INITIAL COMMISSIONING OF PROPORTIONAL INTEGRAL CONTROLLERS (fig. 4-6-10-14)
When the controller is fitted with an auto-manual station this has to be switched to automatic operations
Temporarily open drain valve of air filter regulator to completely discharge condensate, adjust air regulator output pressure to feed the controller with air at 20 psi.
Make sure there are no air leakages in the pneumatic piping to control valve.

By means of the knob (F) position the red pointer (G) on set point value on instrument scale.
By means of the graduated dial (D) adjust the proportional band at 20% and make sure that control action (direct or reverse is that really required.
Rotate the screw (I) of integral action to adjust the index of automatic reset at 2.
If the pneumatic valve (3) is fitted with a by-pass valve make sure that the valve (5) is tightly shut off and the downstream isolating valve (4) is fully open.
Gradually open the manual isolating valve (4) upstream the pneumatic control valve until the black measuring pointer will slightly stroke beyond the red pointer previously positioned on desired control value.
Wait until the black pointer, due to integral action, automatically returns to line up with the red pointer. Gradually and always in small steps, furtherly open the manual valve (4) awaiting each time that the black poin- ter returns to coincide again with the red pointer.
Proceed in the same way until valve (4) will reach its fully open position.
Should the control loop start to cycle with continuous oscillations of black pointer, gradually and in steps increase the proportional band value beyond 20% to initial width.
In the case that cycling should not decrease even by widening proportional band, readjust the automatic reset (integral) action by rotating the screw (I) in order to reduce number of repeats per minute (the index must be positioned on lower values). Never decrease to values below 0.5. If control loop looks stabilized without oscillations of the controlled variable **gradually** reduce the proportional band width until small oscillations arise and than widen the proportional band in order to ensure a sufficient safety margin of control stability: never decrease below 10%.
A small increase of the automatic reset speed could also be convenient, by rotating the screw (I) of integral action in order to increase a little the repeats per minute up to the maximum acceptable reset speed that still does not raise control cycling.
To make sure that correct adjustment of both proportional band and integral action have been done, an arfificial process disturbance can be simulated by rapidly shifting of about 5 millimeters the red pointer of desired value.
Should this raise oscillations, slightly and gradually widen proportional band until control stability is restored. Best settings lo optimize an automatic control loop, are the narrowest possible proportional band and the fastest integral, compatible with process stability at any expected load.
Note: Control instability and cycling could also be originated by excessive friction in the pneumatic valve (stick-slip stroking) or by oversized valve (valve constantly working in almost closed position).

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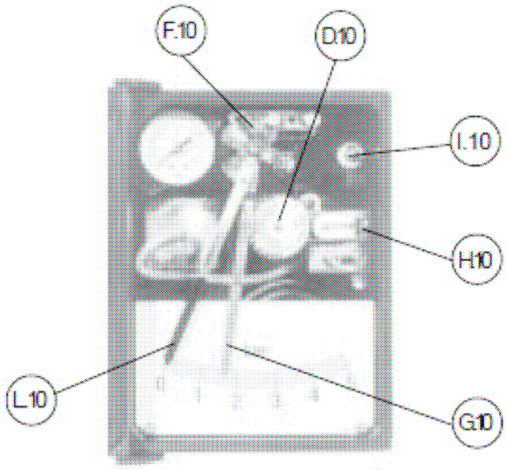

Fig. 10 - Regolatore indicatore serie 600 ad azione proporzionale-integrale

Fig. 10 - Series 600 proportional integral indicating controller

Starting an already commissioned proportionalintegral controller with auto-manual station
The procedure for starting a proportional-integral controller fitted with an auto-manual station implies that proportional band and manual reset of instrument have been previously adjusted as for precedent items.
Switch the auto-manual station to manual control by positioning switch knob on mark .
Close the pneumatic control valve by turning the pressure regulator knob of auto-manual station.
Completely open both isolating valves (4) upstream and downstream the pneumatic valve, make sure that the by-pass valve (5) is tightly shutoff.
Slowly rotate the pressure regulator knob to gradually open pneumatic valve until the black measuring pointer will exactly coincide with the red pointer of desired value.
Wait few minutes until process control stabilizes and then switch the auto-manual station to automatic control by positioning knob on mark .
The transfer from automatic to manual control can be done by adjusting the outlet signal from station (indicated by the station manometer) at the same pressure of automatic output signal (to be read on outlet manometer of controller) and then switching station from automatic to manual control.

L - CHECKING OPERATION AND ALIGNMENT OF CONTROLLER (fig. 9-10-11-12-13-14-15)
Supply instrument with air at 20 psi (1.4 bar).
Place the red pointer (G) to coincide with black one (L), positioning it, if possible, around the centre of the scale.

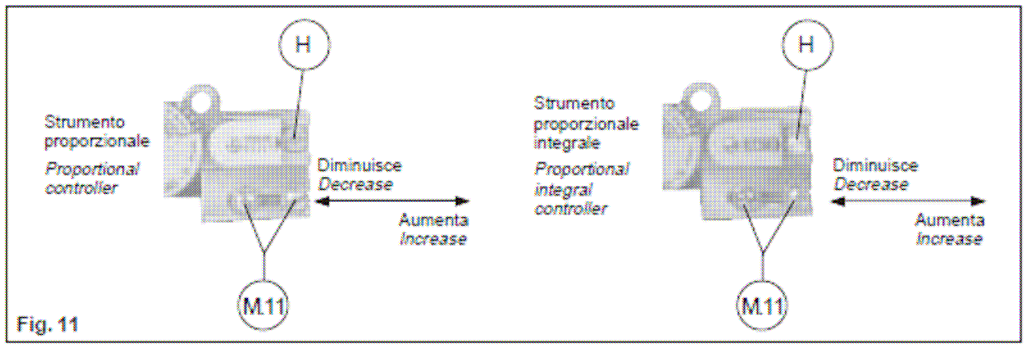

Fig. 11

For PI controllers:
Acting on graduated dial (D) let coincide the index of proportional band adjusting device with the vertical fine dividing direct from reverse action sectors (proportional band width theoretically infinite).
Check that the outlet control signal is 9 psi, should be different slightly loosen the two screws (M.11) and **gradually** move the plaque supporting the nozzle/flapper assembly until a 9 psi output control signal is obtained.
Operating on dial (D) adjust proportional band respectively at 10% direct action and 10% reverse action and check whether control signal remains at 9 psi with a maximum deviation of 0.5 psi. **If affirmative controller is properly aligned.**
Should the control signal deviate from 9 psi when adjusting proportional band as indicated at item 5 with a same difference but of opposite sign (plus and minus) on direct and reverse action - ex.: signal is 11 psi (9 + 2) on reverse action and 7 psi (9 - 2) on direct action - turn the screw (H) **gradually** to adjust the signal at 9 psi.
Move then proportional band to 10% value on direct action and verify that output signal is 9 psi**: if affirmative controller is properly aligned.**
Should the control signal deviate from 9 psi when adjusting proportional band as indicated, presenting a deviation of opposite sign and with different width on reverse action with respect to direct action - ex.: signal is 12 psi (9 + 3) in direct action and 8 psi (9 - 1) in reverse action – adjust at 10% **on direct action** the proportional band; if on this position the deviation is **higher than on reverse action** (see previous ex.), operate on flapper nut (N.12), turning it clockwise until to eliminate half of deviations algebraic addition;

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referring to present example turn the nut until reaching a signal of 11 psi: Tightening the flapper nut, the control signal decreases.
Should the deviation be **lower on reverse** than on direct action, turn the nut (N. 12) anticlockwise.
After every operation on flapper as described at item 7, perform again the checking, as per items 3, 4, 5, 6.
On **PI action controller** the reset screw (H) "setting" is protected by a threaded plug: before starting the setting procedure of the pneumatic control unit take out this protection unscrewing it. **For PI controllers,** before item 3, perform the following operations: adjust red (G) and black pointer (L) a little shifted and the screw (I) and the connected index on an high value (5-6), set the proportional band at a value giving an output signal of 9 psi. After about 1 minute of stability turn completely integral action screw (I) adjusting it on 0 rep./min; the result is to close in the integral action bellow a pression of 9 psi.

M - ROUTINE MAINTENANCE OF P AND PI CONTROLLERS (fig. 13-14-15)
For the routine maintenance of the controllers proceed as per following directions:
Daily drain the air filter fitted on air supply line by temporarily opening the bottom discharge cock so that water, oil and other impurities which are the main reason of irregular operation of instrument, will be completely cleared out.
Periodically clean the amplifying relay (fig.15) giving attention to the **capillary orifice** that must be free from any impurity, clogged or dirty orifices whichprevent the normal air flow will endanger the instrument functionality.
The capillary orifice set (P.15) can be reached by loosening screw (Z.15) and rotating locking plate (Y.15). Insert the threaded part of the cleaner provided and take out the capillary orifice, taking care with the sealing O-rings (OR 2007).
Clean the part first with the steel wire provided with the cleaner, then with a strong blast of compressed air. When re-fitting the capillary orifice set, make sure that the two sealing O-rings (O.15) are positioned properly (see fig.15).

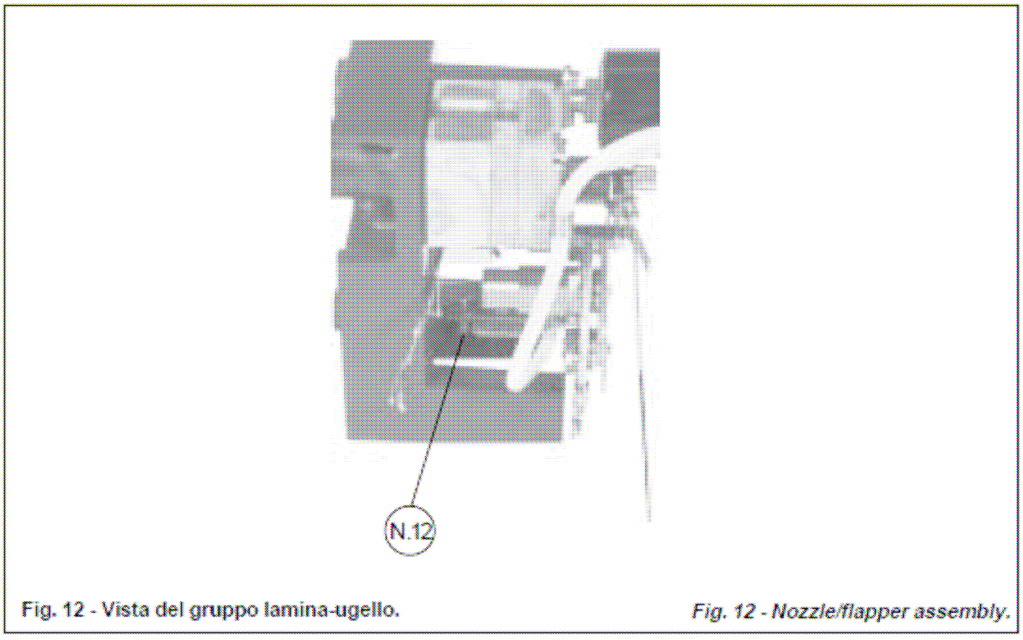

Fig. 12 - Vista del gruppo lamina-ugello. *Fig. 12 - Nozzle/flapper assembly.*

Keep the pneumatic control valve in good working conditions in order to avoid frictions or clearances which could interfere with a satisfactory control. It is suggested to follow the normal maintenance instructions for pneumatic valves.
Periodically clean the pneumatic nozzle: remove the pneumatic piping (S) from the amplifying relay paying attention not to damage it with the retaining spring.
Blow clean air at low pressure (1-2 bar) into the tube to eliminate the presence of water or oil and dirty from the nozzle and the tube itself. Performing this operation keep the flapper plate away from the nozzle by setting the instrument proportional band at 10% on direct action and keeping the measuring index at the beginning of the scale and positioning the set-point red index at the end of the scale.
Entrainment of oil and condensate in the compressed air supply could also make it necessary for cleaning of diaphragm and inner parts of **pneumatic relay.**
To disassemble the relay, after having removed it from base plate by unscrewing the two slot screws (Q.15), unscrew the two hex. socket screws (R.15).
When reassembling the relay, care must be given to a correct positioning of mounting holes on diaphragms and gaskets and to reference marks externally (NZ) engraved on each component; at completed assembly reference marks must coincide with the reference marked on the base plate.

N - TROUSLES SHOOTING
Unless reasons of incorrect operation are evident it is recommended to pay attention to pneumatic pipings and connections. In most cases this will enable location of the trouble. Clogged tubings, leaking connections, control valves in poor conditions, besides inadequate air pressure supply are some of the possible causes giving troubles. If above checks do not reveal the source of trouble, attention is to be given to the instrument control unit as per following directions:

Instance 1 - Symptom: **Control of action poor or absent, output signal constantly low or zero.**

Possible cause
a) Lack of air supply.
b) Wrong sensi of action.
c) Orifice (P.15) dirty or clogged.
d) Diaphragm of control valve actuator perforated

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or leaking.
e) Air leaks in the unit control pipings.

Remedy
Supply air at 20 psi (1.4 bar).
Reverse sense of action.
See paragraph M.
Check and replace diaphragm if necessary.
Check and replace piping if necessary.

Instance 2 - Symptom: **Control output signal constantly high irrespective of position of measuring pointer in relation to set point.**

Possible cause
a) Nozzle clogged or dirty.
b) Loss of air through gasket (O.15) of orifice set

Remedy
See paragraph M.
Replace O-ring gaskets.
See paragraph M.

Instance 3 - Symptom: **Control point drifting from desired value.**

Possible cause
a) Excessive width of proportional band.
b) Low speed of integral action (only for PI controllers).
c) Capillary orifice (P.15) partially clogged

Remedy
Restrict proportional band.
Increase number of reparts per minute.
See paragraph M.

Instance 4 - Symptom: **Residual offset cannot be eliminated.**

Possible cause
a) Wrong setting of manual reset screw (H.13) **(P controller)**
b) Integral action neecge valve (I.14) clogged **(PI controller)**

Remedy
Adjust manual reset, see paragraph H
Clean or replace needle valve.

Instance 5 - Symptom: **Control oscillation.**

Possible cause
a) Wrong values of proportional band or integral action.
b) Friction in the control valve.
c) Oversized control valve.
d) Frictions in the controller linkages.

Remedy
Readjust proportional band or integral action according to process characteristics.
See paragraph H and I.
Eliminate friction with adequate maintenance. Check valve size in relation to controlled fluid and operating conditions.
Eliminate frictions by cleaning.

O - REPLACEMENT AND CALIBRATION OF THE MEASURING SYSTEM
Replacement of the measuring element.
Operating requirement or accidental damages may demand the replacement of the measuring element. The angular movement of the new measuring system can differ from the previous one: replacement must be always followed by an accurate control and calibration as described in the following paragraphs. For the replacement act as follows and make reference to fig. 16 for the thermometric or manometric element and to fig.17 for the pneumatic receiving unit.
Remove the instrument indicating scale loosening the two fixing screws and disconnect the link (E) from the arm (T) acting delicately on the retaining spring and pulling the jointing ball out of his seat.
Loosen the retaining screws (U.16) fixing the measuring system to the instrument case bottom and remove the system itself extracting it through the rear of the case, when the measuring element is a pneumatic receiving unit disconnect the pneumatic piping (S.17) from the relay, loosen the two fixing screws (U.17) and remove the unit from the instrument case.
Install the new measuring element fixing it into position by tightening the screws.
Adjust the measured variable (temperature or pressure, etc.) at a value near to the centre of the indicating scale (ex. at 50 with a 0 to 100 indicating scale) and, loosening the two screws (V.16), set the driving arm (T.16) in an horizontal position; tighten again the screws keeping the position.
Restore the connection between the link (E) and the arm (T); paying attention to introduce correctly the jointing ball into its seat; verify this connection is done using the right hole on the arm (W) indicated by leaving it clear by the red coating or specified with the spare supply; in

this latest case the information is done indicating the order number of the hole from the free side of the arm.
Procede to control and calibration following the instruction of the next section describing the setting procedure

Calibration of the measuring system
1) Zero setting.
Checking will be done on a single point of the scale so verify the corrispondence of the instrument indicated value to the one measured with a reference pressure or temperature gauge.
The test can be done also on a limit value of the scale (zeroing) but it is better to perform the checking at a value near to the supposed working point on the plant.
Should the indicated value on the instrument scale be different from the measured value, an adjustment of the pointer must be done turning **slightly and gradually** the 3 mm turnbuckle of the connecting link (E.16 o 17) between the measuring element and the index system.
The operation must be performed up to the coincidence of the two values.
2) Calibration of the measuring range.
It must be done on two different measured points (normally the zero and the 100% of the scale) verifying the correspondence of the instrument indicated value to the effective measured value.
Make reference to fig. 16 or 17.
The measuring range span is related to the ratio between the length of the arm (T.16 or 17), connected with the measuring element, and the length of the lever (W.16 or 17) linked to the indicating black pointer.
As the lever (W) length not adjustable it will be necessary to act on the arm (T) as follows.
Make reference to fig.16 when the measuring element is a thermometric or manometric spring and to fig.17 when pneumatic receivers are involved.
2.a) Making reference to a calibration instrument adjust the measured variable to a value corresponding to the zero of the indicating scale and check the correspondence between the pointer (L) and the graduation of the scale beginning; errors and differences if any must be eliminated acting on the tumbuckle of the link (E).
2.b) Raise the measured variable to a value corresponding to the 100% of the instrument range, should the index position not correspond to the end scale indication, loosen the screws (X) and change slightly the lever length of arm (T): reduce the length when the instrument indication is lower than the variable value or increase gradually the length if the indication is higher than the measured variable.
Tighten the screws (X) when coincidence is reached.
2.c) Repeat the scale “zero “ setting as per item 2.a).
2.d) Adjust again the measured variable at a value corresponding to 100% of the scale and perform again the checking as per item 2.b).
2.e) Repeat the procedure until the instrument indications are correct in both the scale end, “zero” and 100% of range

RECOMMENDED SPARE PARTS

Description Ordering Code
Set of gaskets, diaphragms and orifice
Feedback bellows assembly
Integral bellows essembly
Gauge set
Amplifying relay set
Note - When ordering spare parts please always specify.
- instrument **serial number**
- description of the part as per above list

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