

MT-182-E

ENGLISH

PRESSURE
REGULATOR

Aperval 101



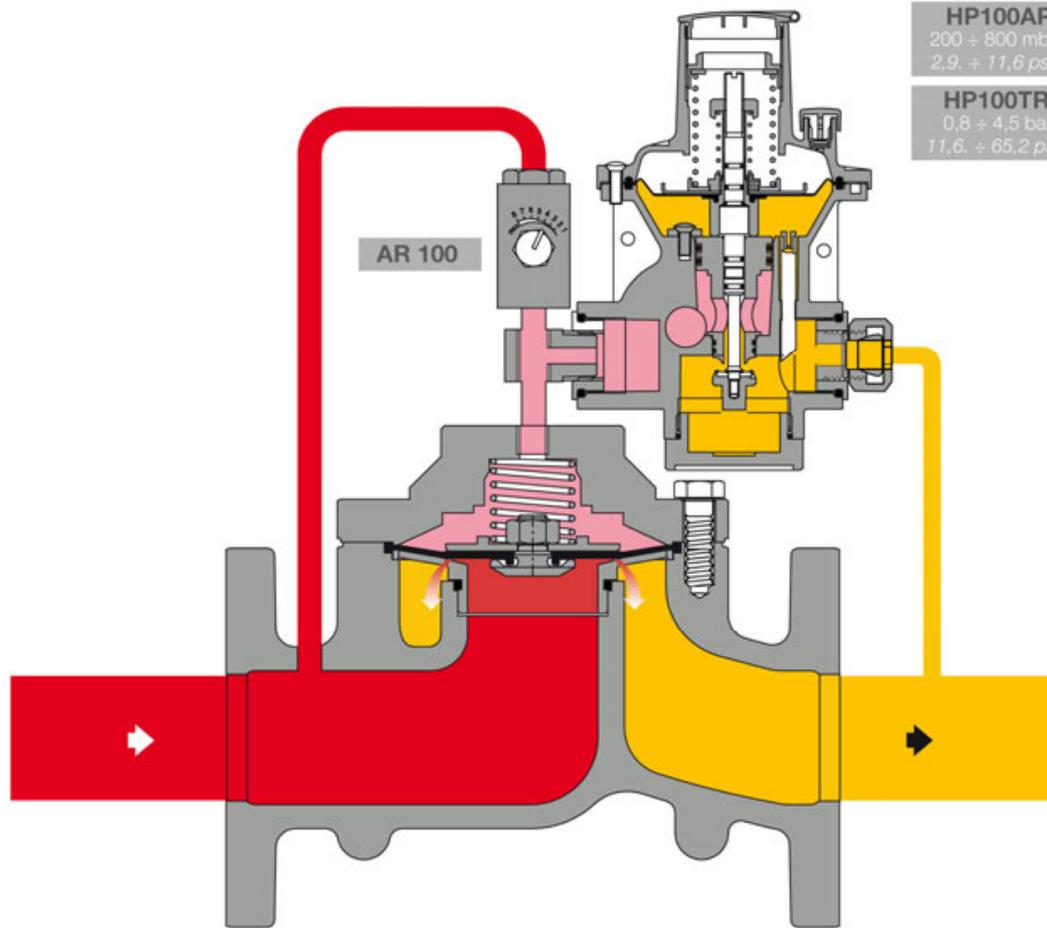
TECHNICAL MANUAL

INSTALLATION, COMMISSIONING
AND MAINTENANCE INSTRUCTIONS

 Pietro
Fiorentini®

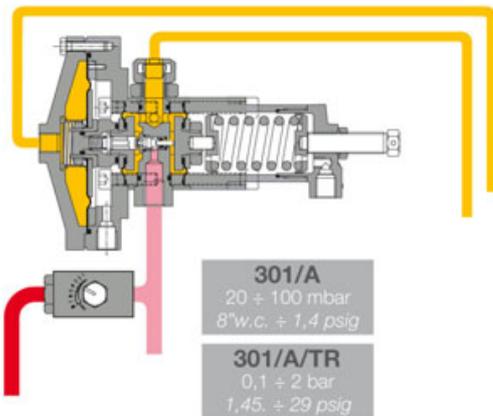
Aperval 101

Pressure Regulator



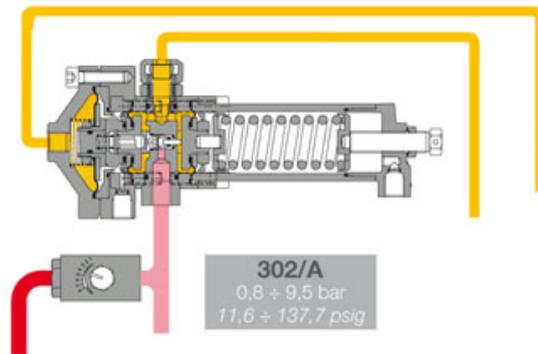
HP100AP
 200 ÷ 800 mbar
 2,9 ÷ 11,6 psig

HP100TR
 0,8 ÷ 4,5 bar
 11,6 ÷ 65,2 psig



301/A
 20 ÷ 100 mbar
 8" w.c. ÷ 1,4 psig

301/A/TR
 0,1 ÷ 2 bar
 1,45 ÷ 29 psig



302/A
 0,8 ÷ 9,5 bar
 11,6 ÷ 137,7 psig

■ INLET PRESSURE ■ OUTLET PRESSURE ■ CONTROL PRESSURE

PRECAUTION

GENERAL PRECAUTION

The apparatus described in this manual is a device subject to pressure installed in systems under pressure.

The apparatus in question is normally installed in systems for transporting flammable gases (natural gas, for example).

PRECAUTION FOR THE OPERATORS

Before proceeding with installation, commissioning or maintenance, operators must:

- Examine the **safety provisions** applicable to the installation in which they must work;
- Obtain the **authorisations** necessary for working when required;
- Use the necessary means of **individual protection** (helmet, goggles, etc.);
- Ensure that the area in which they operate is fitted with the means of **collective protection** envisaged and with the necessary **safety indications**.

HANDLING

The handling of the apparatus and of its components must only be carried out after ensuring that the lifting gear is adequate for the **loads to lift** (lifting capacity and functionality). The apparatus must be handled using the **lifting points** provided on the apparatus itself.

Motorised means must only be used by the persons in charge of them.

PACKING

The packing for transportation of equipment and of relevant spare parts are designed and shaped to avoid damage to any part during transportation, warehousing and handling activities. Therefore the equipment and spare parts shall be kept into their packing until their installation in the final site. After packing is open, check that no damage occurred to any goods. If damage occurred inform the supplier and keep packing for any verification.

INSTALLATION

The installation of the pressure regulator has to occur in compliance with the provisions (laws or standards) in force in the place of installation.

Natural gas plants have to show features in compliance with the law provisions and standard requirements in force in the place of installation or at least in compliance with standards EN 12186 or EN 12279. In detail, it is necessary to meet the provisions of paragraphs 6.2, 7.5.2, 7.7, 9.3 of the standard EN 12186 and 6.2, 7.4, 7.6, 9.3 of the EN 12279 standard. The installation in compliance with such standards minimizes the risk of fire hazard and the formation of potentially explosive atmospheres.

The valve is not equipped with external pressure limitation devices; therefore, it has to be installed making sure that the operating pressure of the assembly on which it is installed does not exceed the maximum allowable pressure (PS).

Therefore, the user, as deemed necessary by the same, shall install on the assembly suitable pressure limitation systems, as well as provide the plant with suitable relief or drain systems in order to discharge the pressure and fluid contained in the plant before proceeding with any inspection and maintenance activity.

If the installation of the apparatus requires the application of **compression fittings** in the field, these must be installed following the **instructions of the manufacturer** of the fittings themselves. The choice of the fitting must be compatible with the use specified for the apparatus and with the specifications of the system when envisaged.

COMMISSIONING

Commissioning must be carried out by **adequately trained personnel**. During the commissioning activities, the personnel not strictly necessary must be ordered away and the no-go area must be properly signalled (signs, barriers, etc.).

Check that the settings of the apparatus are those requested; if necessary, reset them to the required values in accordance with the procedures indicated in the manual.

When commissioning, the risks associated with any discharges into the atmosphere of flammable or noxious gases must be assessed.

In installations in natural gas distribution networks, the risk of the formation of explosive mixtures (gas/air) inside the piping must be considered.

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1.0 INTRODUCTION

The scope of this manual is to provide the essential information for the installation, commissioning, disassembly, re-assembly and maintenance of APERVAL 101 regulators.

It is also appropriate to provide a brief illustration of the main features of the regulator and of its accessories.

1.1 MAIN FEATURES

The **APERVAL 101** pressure regulator is a regulator for medium and low pressure.

The **APERVAL 101** is a "fail open" type regulator and therefore opens in the event of:

- rupture of the main diaphragm;
- no feed in the pilot circuit.

The main specifications of this regulator are:

- Design pressure: up to 17 bar for cast iron version
up to 18,9 bar for cast steel version
- Working temperature range: $-20^{\circ}\text{C} + 60^{\circ}\text{C}$
- Ambient temperature: $-20^{\circ}\text{C} + 60^{\circ}\text{C}$
- Inlet pressure range **bpu**: 0,5 to 18,9 bar
- Regulating range possible **Wd**: $20 \div 9500$ mbar (depending on the pilot installed)
- Minimum differential pressure: 0,48 bar
- Precision class **AC**: up to 2,5 (depending on the operative conditions)
- Closing pressure class **SG**: $5 \div 1,5$ (depending on the operative conditions).

1.2 OPERATION OF THE PRESSURE REGULATOR WITH SERIES 300 PILOT (fig.1)

In the absence of pressure, the main diaphragm **20** is maintained in the closed position by the spring **45** and rests on the seat of the valve with grill **13**. The seal is guaranteed by the contact between the valve seat **13** and the diaphragm **20**. In normal working conditions, the following forces act on the diaphragm **20**:

- downwards: the load of the spring **45**, the thrust deriving from the control pressure **Pc** in the control chamber **A** and the weight of the mobile assembly;
- upwards: the thrusts deriving from the upstream pressure **Pu**, the downstream pressure **Pd** and the remaining dynamic components.

The control pressure **Pc** is obtained by drawing gas at the pressure **Pu** directly upstream from the diaphragm **20**. The gas is filtered by the filter incorporated in the **AR100** flow regulating valve. The pressure **Pc** is governed by the pilot which regulates its value. The regulation is obtained from the comparison of the load of the setting spring **22** and the thrust on the diaphragm **42** deriving from the downstream pressure. If during operation, for example, there is a drop in the downstream pressure **Pd** below the set point (as a result of an increase in the flow demand or of a reduction of the upstream pressure), a state of imbalance of the mobile assembly **5** is created and leads to an increase in the opening of the obturator **17** and therefore a reduction of the control pressure **Pd**. As a result, the diaphragm **20** moves upwards increasing the opening of the regulator until the downstream pressure reaches the set point again.

On the other hand, when the downstream pressure rises beyond the set point (as a result of a reduction in the demand or with the increase in the upstream pressure), the obturator **17** closes and therefore the pressure **Pc** reaches the value of the upstream pressure **Pe**. In these conditions, the diaphragm **20** goes to the closed position. In normal working conditions, the obturator **17** is positioned in such a way that the pressure **Pc** above the diaphragm **20** is such as to maintain the downstream pressure around the selected value.

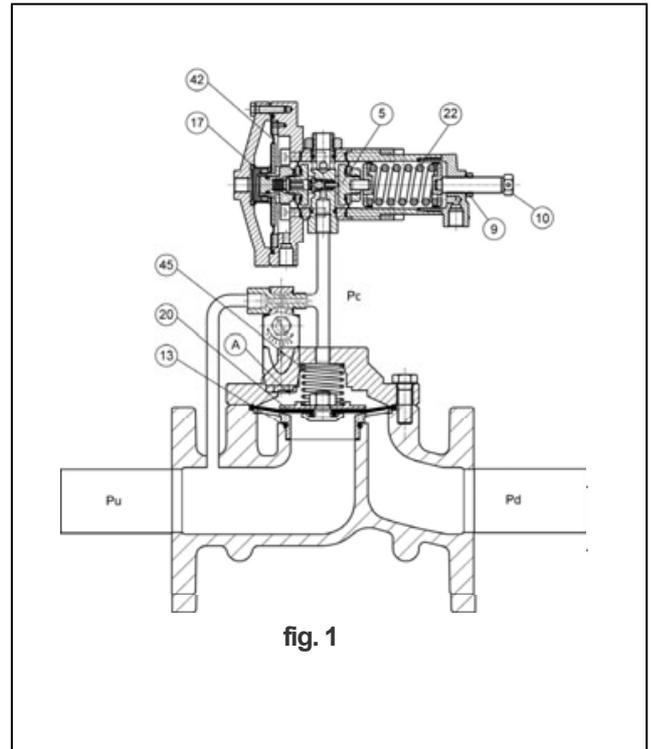


fig. 1

1.3 OPERATION OF THE PRESSURE REGULATOR WITH SERIES HP100 PILOT (fig.2)

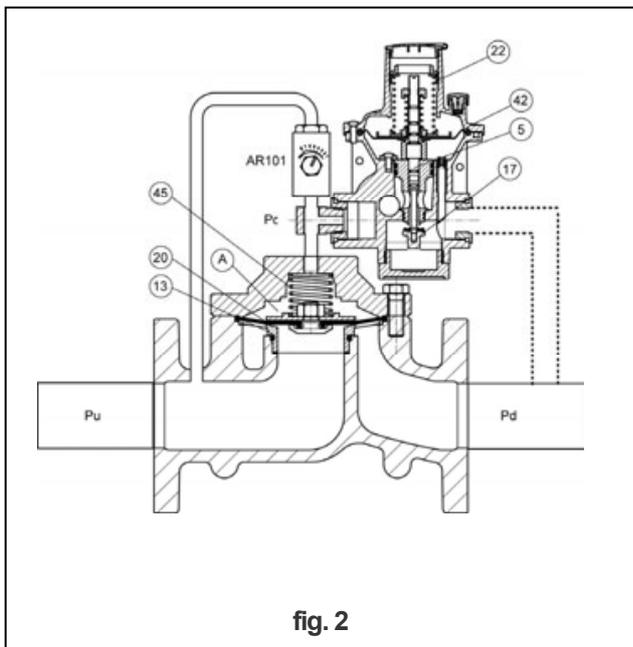
In the absence of pressure, the main diaphragm **20** is maintained in the closed position by the spring **45** and rests on the seat of the valve with grill **13**. The seal is guaranteed by the contact between the valve seat **13** and the diaphragm **20**. In normal working conditions, the following forces act on the diaphragm **20**:

- downwards: the load of the spring **45**, the thrust deriving from the control pressure **Pc** in the control chamber **A** and the weight of the mobile assembly;
- upwards: the thrusts deriving from the upstream pressure **Pu** and downstream pressure **Pd** and the remaining dynamic components.

The control pressure **Pc** is obtained by drawing gas at the pressure **Pu** directly upstream from the diaphragm **20**; the gas is filtered by the filter incorporated in the **AR100** flow regulating valve. The pressure **Pc** is governed by the pilot which regulates its value. The regulation is obtained from the comparison of the load of the setting spring **22** and the thrust on the diaphragm **42** deriving from the downstream pressure

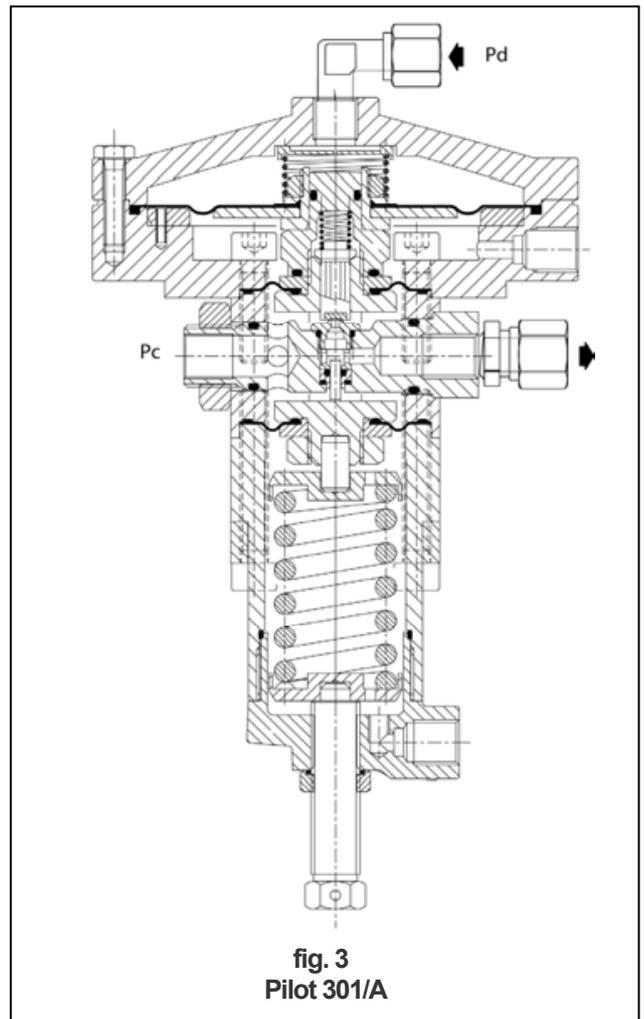
If during operation, for example, there is a drop in the downstream pressure P_d below the set point (as a result of an increase in the flow demand or of a reduction of the upstream pressure) a state of imbalance of the mobile assembly 5 is created and leads to an increase in the opening of the obturator 17 and therefore a reduction of the control pressure P_c . As a result, the diaphragm 20 moves upwards increasing the opening of the regulator until the downstream pressure reaches the set point again.

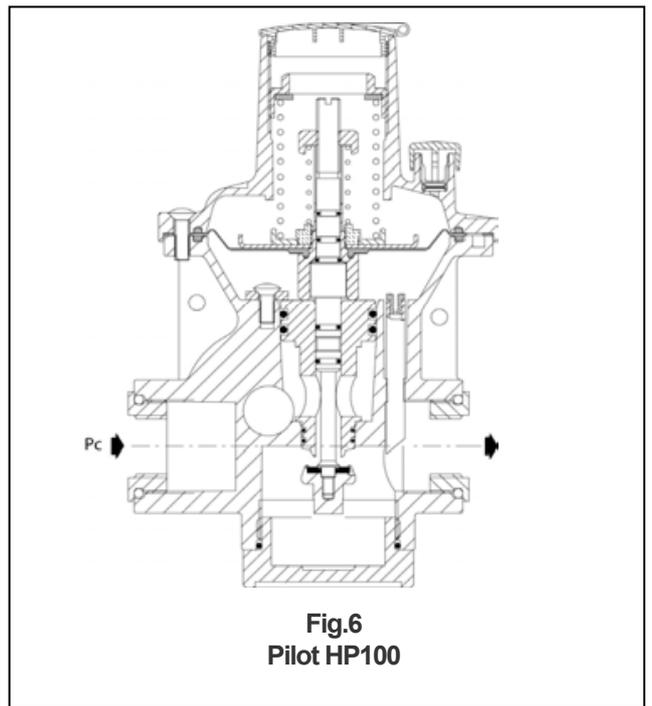
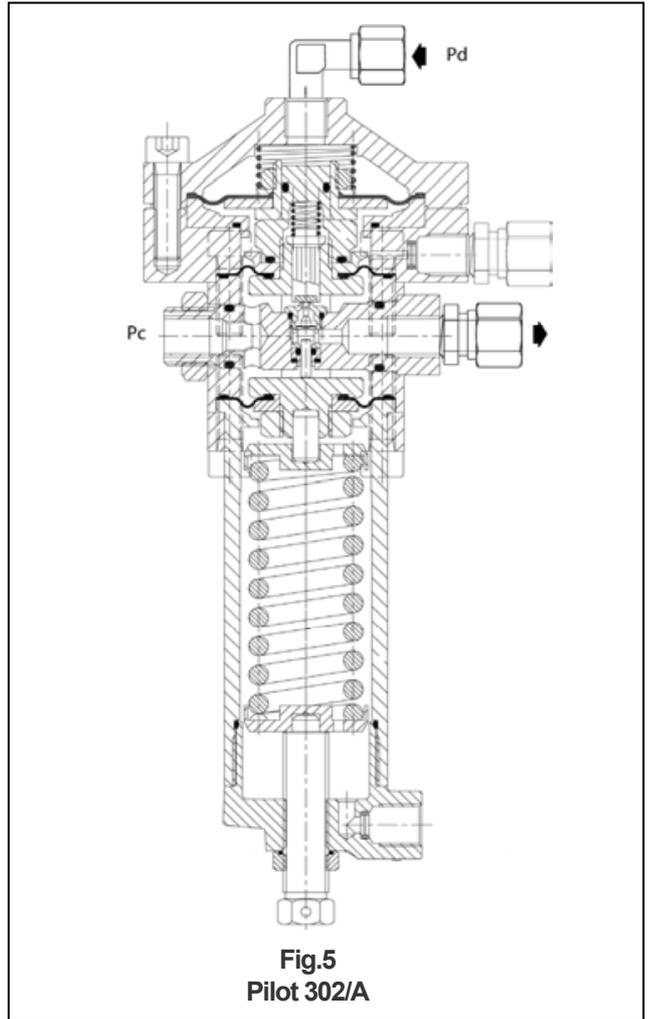
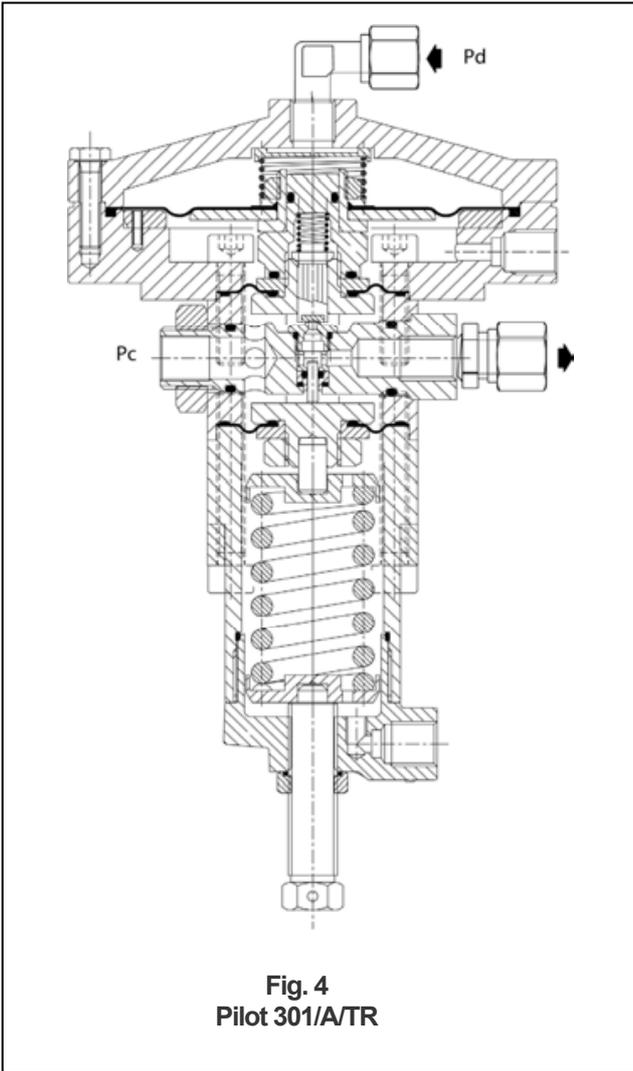
On the other hand, when the downstream pressure rises beyond the set point (as a result of a reduction in the demand or with the increase in the upstream pressure), the obturator 17 closes and therefore the pressure P_c reaches the value of the upstream pressure P_e . In these conditions, the diaphragm 20 goes to the closed position. In normal working conditions, the obturator 17 is positioned in such a way that the pressure P_c above the diaphragm 20 is such as to maintain the downstream pressure around the selected value.



1.4 PILOTS

Pressure Regulators **Aperval 101** use following types of pilots:
301/A setting range **Wd**: from 20 to 100 mbar (8" w.c. to 1,45 psig)
301/A/TR setting range **Wd**: from 01 to 2 bar (1,45 to 29 Psig)
302/A setting range **Wd**: from 0,8 to 9,5 bar (11,6 to 137,75 Psig)
HP 100AP setting range **Wd**: from 200 to 800 mbar (2,9 to 11,6 Psig)
HP 100TR setting range **Wd**: from 0,8 to 4,5 bar (11,6 to 137,75 Psig)





1.5 AR/100 REGULATING VALVE

Pilots series 300 are equipped with regulation valve AR 100

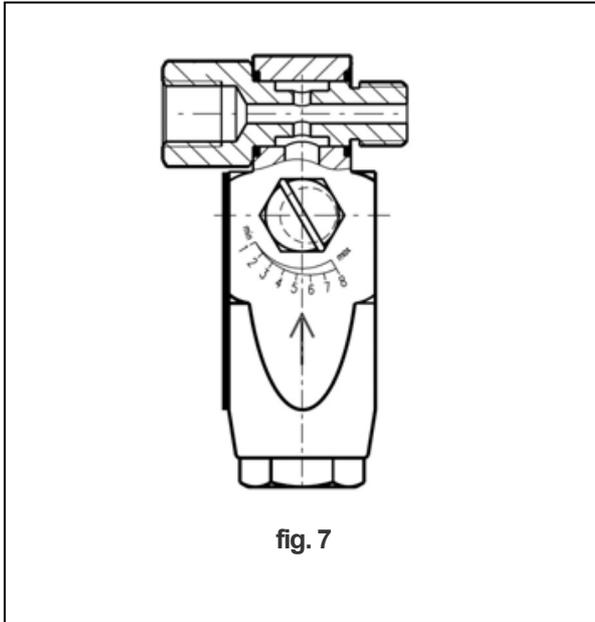


fig. 7

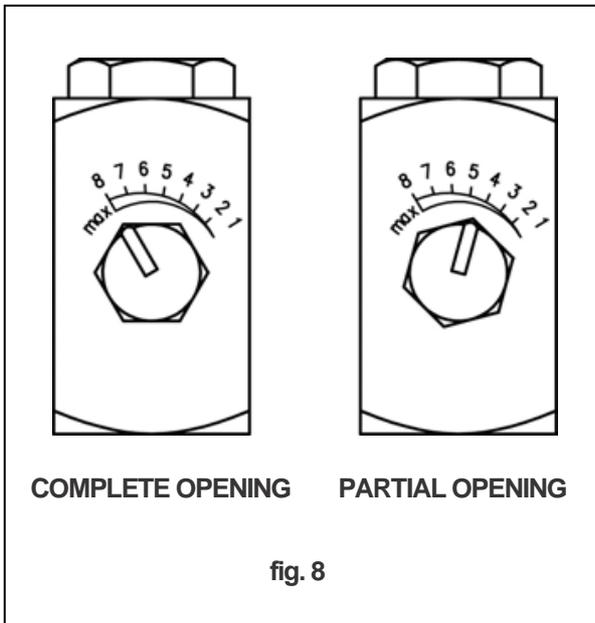


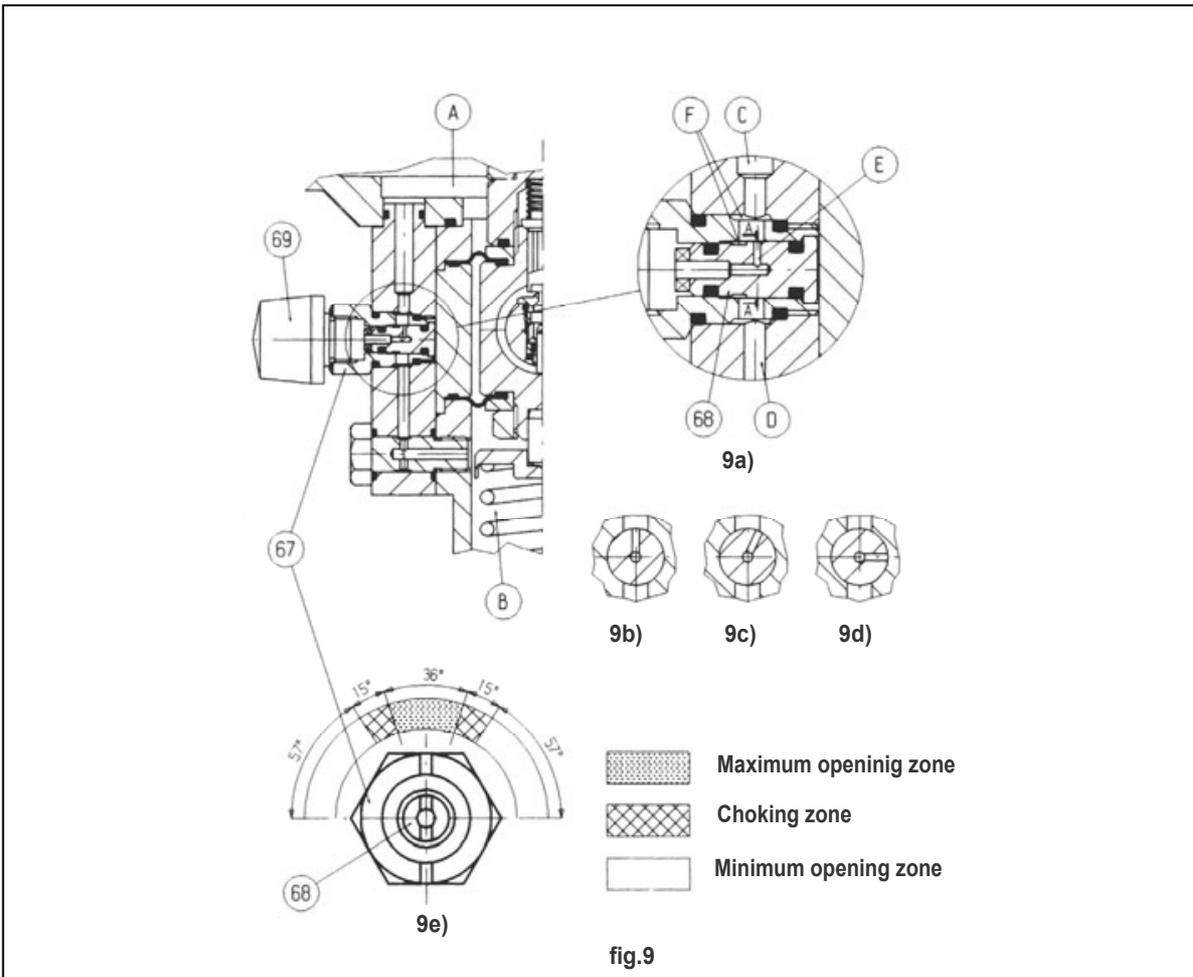
fig. 8

1.6 DAMPER DEVICE

The 301/A and 301/A/TR pilots are provided with a damper device (fig. 9) on the line which puts the two chambers at atmospheric pressure into communication.

The purpose of this device is to appropriately "throttle" the ventilation in the chambers towards the atmosphere so as to reduce any pressure oscillation phenomena in the transitory adjustment phases (e.g. variations of the flow demand). Its operation is now described briefly. The two chambers A and B are constantly in communication through the apertures C and D and the annular chambers F (fig. 9a). The ventilation of these chambers towards the atmosphere takes place through the aperture E in the nozzle 68. By turning the nozzle appropriately using a screwdriver, it is possible to choke the opening of this aperture, passing from a maximum value (fig. 9d) to a minimum value (fig. 4d). The degree of choking can be read from the outside by means of the notches on the connection fitting 67 and the nozzle 68 (fig. 9e). When the notches are aligned or, in any case, within the maximum opening zone shown in the figure, the opening of the aperture E is completely free (fig. 9b).

In the zone indicated as "choking", the opening starts to be reduced gradually (fig. 9c) and finally reaches the minimum value in correspondence with the minimum opening zone (fig. 9d). In this final condition, the section of the passage is given exclusively by the extremely reduced clearance between the fitting 67 and the nozzle 68. The pilot is normally supplied with the damper set in the choking zone. A test should be carried out however before the start-up, unscrewing the knob 69 and controlling the position of the notches. The setting can be adjusted by turning the nozzle 68 clockwise or anti clockwise indifferently, bearing in mind that with the maximum opening the probability of pumping is maximum while with the minimum opening we get the highest outlet pressure variations during the transitory phases.



1.7 Tab 1: SETTING SPRINGS

SPRING CHARACTERISTICS					PILOT 301/A	
Code	Color	De	Lo	d	Setting range (mbar)	
2700680	BROWN	35	60	2,3	5 ÷ 21	
2700830	RED/BLACK	35	60	2,5	16 ÷ 50	
2700920	WHITE/YELLOW	35	60	2,8	36 ÷ 82	
2701040	WHITE/ORANGE	35	60	3	75 ÷ 100	

SPRING CHARACTERISTICS					PILOT 301/A/TR	
Code	Color	De	Lo	d	Setting range (mbar)	
2701040	WHITE/YELLOW	35	60	3	100 ÷ 195	
2701260	WHITE	35	60	3,5	180 ÷ 440	
2701530	YELLOW	35	60	4	380 ÷ 850	
2701790	YELLOW/BLACK	35	60	4,5	750 ÷ 1250	
2702070	ORANGE	35	60	5	1100 ÷ 2000	

SPRING CHARACTERISTICS					PILOT 302/A2	
Code	Color	De	Lo	d	Setting range (mbar)	
2701800	YELLOW	35	100	4,5	800 ÷ 1500	
2702080	ORANGE	35	100	5	1300 ÷ 2500	
2702290	RED	35	100	5,5	2300 ÷ 4400	
2702460	GREEN	35	100	6	4000 ÷ 6500	
2702660	BLACK		100	6,5	6000 ÷ 9500	

SPRING CHARACTERISTICS					HP100AP
Code	Color	De	Lo	d	Setting range (mbar)
2701183		34	63	3,2	200 ÷ 350
2701532		34	65	4	350 ÷ 800

SPRING CHARACTERISTICS					HP100TR
Code	Color	De	Lo	d	Setting range (mbar)
2701532		34	65	34	800 ÷ 1500
2701776		34	68	34	1500 ÷ 2500
2702059		34	65	34	2500 ÷ 4500

De = Ø external diameter d = Ø Wire diameter i = n. active coils Lo = Length

2.0 INSTALLATION

2.1 GENERAL

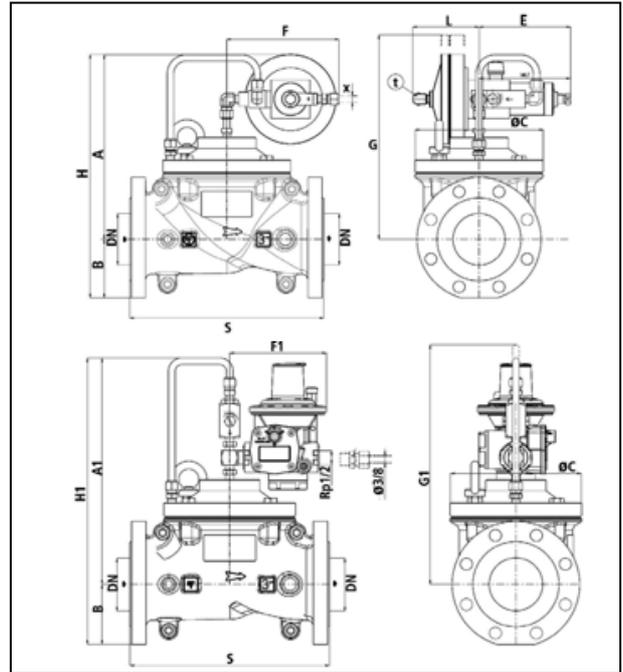
Pressure regulator does not require any supplementary upstream safety accessory for protection against overpressure compared with its design pressure **PS**, when upstream reducing station is sized for a max downstream incidental pressure

MI Pd ≤ 1,1 PS

Before installing the regulator it is necessary to ensure that:

- the regulator can be inserted in the space provided and that subsequent maintenance operations will be sufficiently practicable;
- the upstream and downstream piping is at the same level and capable of supporting the weight of the regulator;
- the inlet/outlet flanges of the piping are parallel;
- the inlet/outlet flanges of the regulator are clean and the regulator itself has not been subject to damage during transport;
- the piping upstream has been cleaned to expel residual impurities such as welding scale, sand, paint residues, water, etc.

The usually foresee arrangement is one indicated in fig. 10.

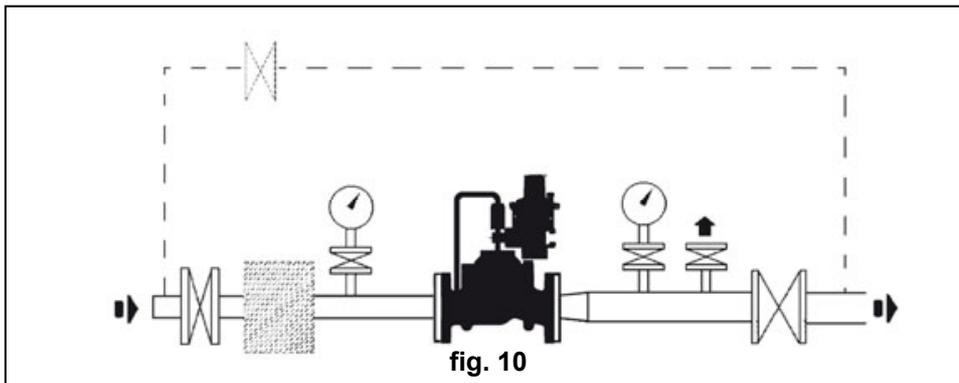


Tab. 2: Overall dimensions in mm

Type	DN	Inches	S	A	A1	ANSI 150	PN 16	ØC	E	F	F1	G	G1	H	H1	L
Aperval 101	50	2"	254	261	305	75	81	162	165	170	148	285	330	341	386	105
Aperval 101	80	3"	298	290	340	91	96	197	165	170	140	335	385	386	436	105
Aperval 101	100	4"	352	345	390	110	105	290	165	170	140	405	450	455	500	105

Tab. 3: Pesi in KGF

DN	inches	ANSI 125RF with HP series Pilots	125FF-150FF with 300 series Pilots	PN 16 with HP series Pilots	PN 16 with 300 series Pilots
50	2"	21	22	22	23
80	3"	29	30	32	33
100	4"	61	62	57	58



2.2 CONNECTING THE DEVICE

The connections between the apparatus and the main piping must be made using stainless steel or copper pipe with minimum internal diameter of 8 mm., in case a pilot series HP is used, it is necessary to have a drainpipe with DN 3/8".

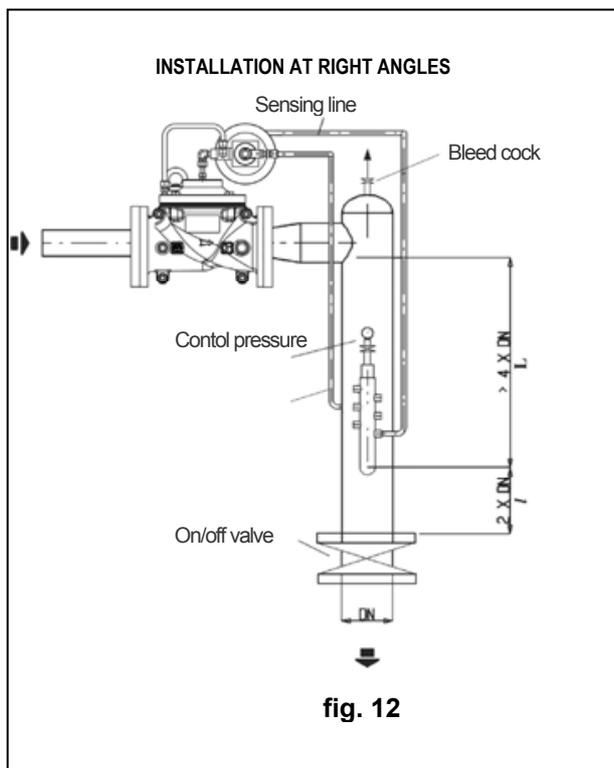
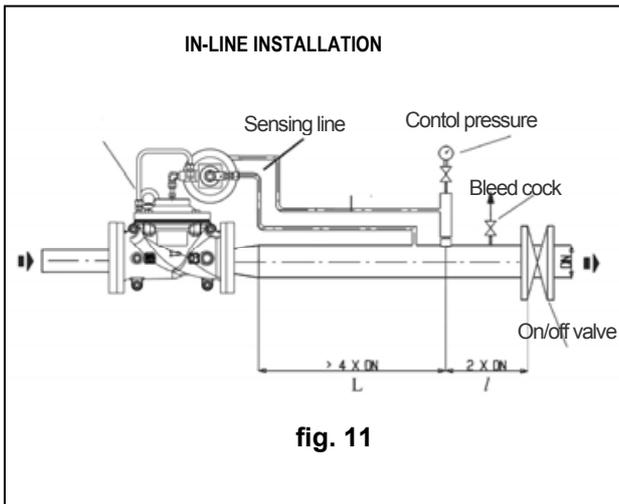
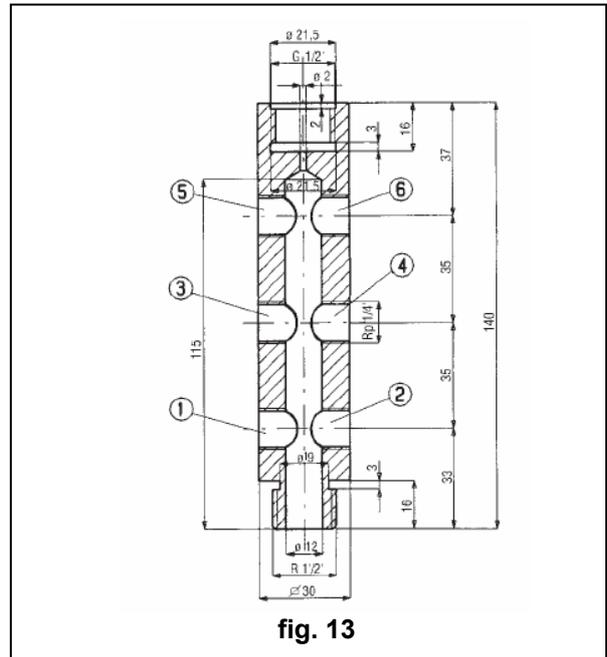


Fig. 13: Detail of multiple Take-off



- 1 and 2 Connect to regulators heads
- 3 and 4 Connect to pilots
- 5 and 6 Connect to accelerator and slam-shut

The installation of a multiple plug on a plant has its aim in in taking from a single point all the pressure impulse signals that go to the different reduction- safety devices and to their accessories.

The regulator must be installed in the line with **the arrow on the body pointing in the gas flow direction**. It is indispensable for good regulation that the position of the downstream pressure take-offs and the speed of the gas at the takeoff point respect the values given in tables 4. When the regulator is used in gas pressure reduction stations it must be installed at least according to the requirements envisaged in EN 12186 standards. Any possible gas leakage at any point, due to diaphragm or sensor malfunction or breakage, must be channelled according to EN 12186 standards. or EN 12279.

The following is recommended so as to prevent the accumulation of impurities and condensate in the lines of the pressure take-offs:

- a) the lines themselves must slope down towards the downstream piping connectors with a slope of about 5-10%;
- b) the connectors on the piping must always be welded on the top of the piping itself and there must be no burr or inward protrusions in the hole in the piping.

Tab.4
The speed of the gas must not exceed the following values in the piping downstream from the regulator:
V_{max} = 30 m/s for P_d > 5 bar
V_{max} = 25 m/s for 0,5 > P_d < 5 bar
V_{max} = 15 m/s for P_d < 0,5 bar

2.3 DOWNSTREAM VOLUME REQUIRED FOR INSTALLATION

In the case of a service regulator of the ON-OFF type (stopping or starting of burners), you should remember that though the **APERVAL 101** apparatus is classified as being of the fast reaction type, it requires an appropriately dimensioned volume of gas between the apparatus itself and the burner so as to partly absorb the pressure swings caused by fast flow rate variations.

3.0 MODULARITY

4.1 RELIEF VALVE

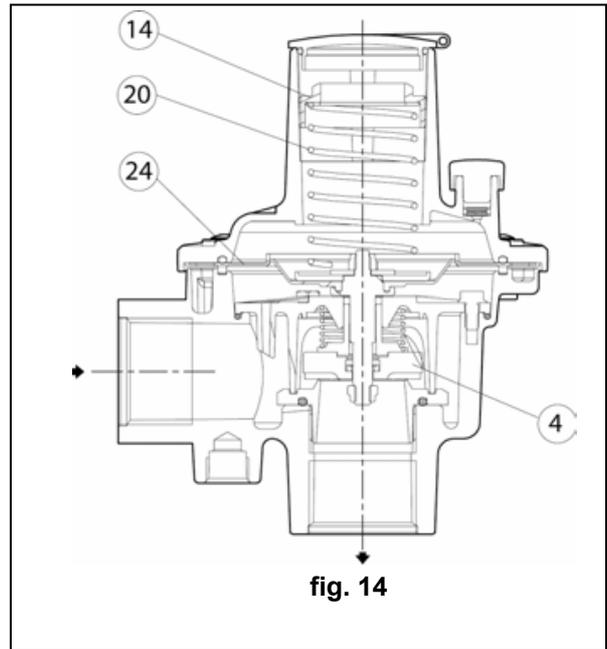
The relief valve is a safety device which releases a certain quality of gas to the exterior when the pressure at the control point exceeds the set-point as a result of short-lasting events such as, for example, the very fast closing of the on/off valves and/or overheating of the gas with zero flow rate demand. The release of the gas to the exterior can, for example, delay or block the intervention of the slam-shut valves for transitory reasons deriving from damage to the regulator.

Obviously the quantity of gas released depends on the extent of the overpressure with respect to the set-point.

The different models of relief valves available are all based on the same operating principle which is illustrated below with reference to the valve **VS/AM 65** (fig. 14). It is based on the contrast between the thrust on the diaphragm **24** deriving from the pressure of the gas to control and the thrust from the setting spring **20**. The weight of the mobile assembly, the static thrust and the residual dynamic thrust on the obturator **4** also contribute to this contrast. When the thrust deriving from the pressure of the gas exceeds that of the setting spring, the obturator **4** is raised and a certain quality of gas is released as a result.

As soon as the pressure drops below the set-point, the obturator returns to the closed position.

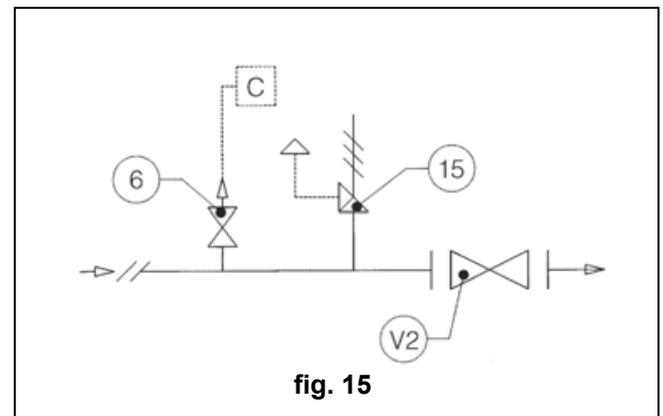
Proceed as indicated below to control and adjust intervention of the relief valve.



3.1.1 DIRECT INSTALLATION IN THE LINE (fig. 15)

When the relief valves fitted directly in the line that is, without the interposition of an on/off valve, we recommend proceeding as follows:

- 1) Ensure that the downstream on/off valve **V2** and the bled cock **6** are closed;
- 2) To increase pressure in the downstream pipe until the envisaged intervention value in one of the following ways:
 - If allowed by the spring installed on the pilot (see chart 1), increase the setting of the same pilot until the desired value is reached;
 - Connect a stand-by controlled pressure to the atmosphere drain tap **6** and set it to the desired value.
- 3) Check intervention of the relief valve and adjust it if necessary by turning the internal adjustment ring **14** appropriately (clockwise to increase the set-point, anticlockwise to reduce it)



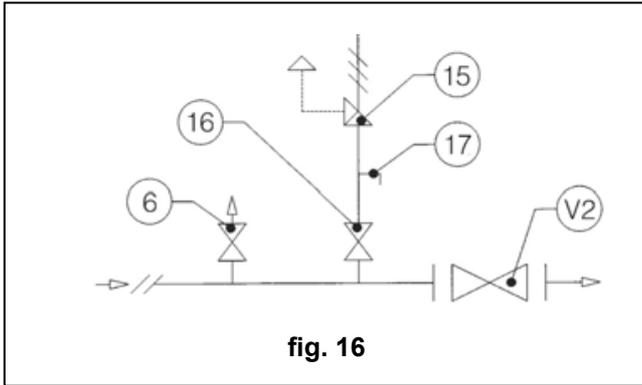


fig. 16

3.1.2 INSTALLATION WITH ON-OFF VALVE (fig. 16)

- 1) Close the on/off valve 16;
- 2) connect a controlled auxiliary pressure to the take-off 17 and increase it slowly to the envisaged intervention value;
- 3) check the intervention of the relief valve and adjust it if necessary by turning the internal adjustment ring 14 appropriately (clockwise to increase the set-point, anticlockwise to reduce it).

4.0 IN LINE MONITOR

The monitor is an emergency regulator whose function is to come into service instead of the main regulator when failure of the latter causes the downstream pressure to reach the point set for monitor intervention.

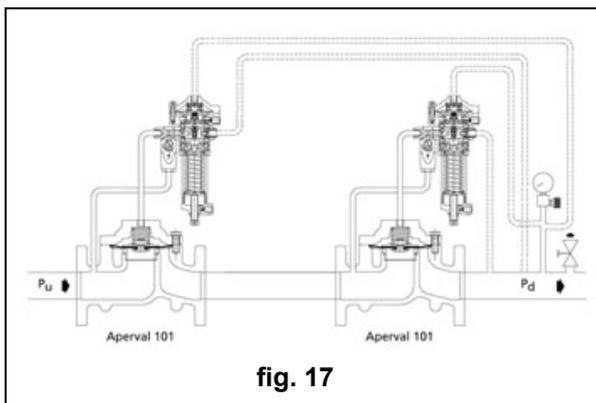


fig. 17

5.0 START UP

5.1 GENERAL

After installation, check that the inlet/outlet on/off valves, any by-pass and the bleed cock are closed.

Before commissioning, you must ensure that the conditions of use comply with the characteristics of the apparatuses.

These characteristics are recalled by the symbols on the specification plates applied to each apparatus (fig. 18).

We recommend actuating the opening and closing valves very slowly. The regulator could be damaged by operations which are too fast.

APPARATUS SPECIFICATION PLATES

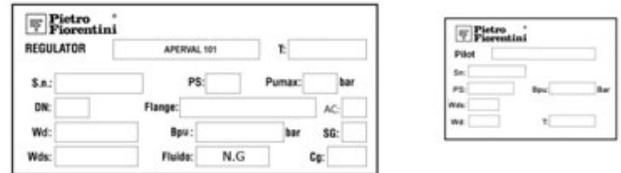


fig. 18

The list of symbols used and their meanings are listed below:

CE = According to 97/23/CE PED Directive

Pumax= maximum operating pressure at the inlet of the apparatus.

bpu= range of variability of the inlet pressure of the pressure regulator in normal operating conditions.

PS= maximum pressure for which the body and its inner metallic partition walls are designed in accordance with the strength requirements in this document.

Wds= setting range of the pressure regulator which can be obtained using the parts and the setting spring fitted at the moment of testing (that is without changing any components of the apparatus).

Wd= setting range of the pressure regulator which can be obtain using the setting springs indicated in the associated tables and also by changing some other part of the apparatus (reinforced gasket, diaphragm, etc.).

Cg and KG = experimental coefficient of critical flow.

AC= regulation class.

SG= closing pressure class.

AG= intervention accuracy.

Wdso= range of intervention for the over pressure of slam-shut which can be obtain using the setting spring fitted at the moment of testing.

Wdo= range of intervention for the over pressure of slam-shut which can be obtain using the setting springs indicated in the tables.

Wdsu= range of intervention for pressure decrease of slam-shut which can be obtain using the setting spring fitted at the moment of testing.

Wdu= range of intervention for pressure decrease of slam-shut which can be obtain using the setting springs indicated in the tables.

5.2 GAS INPUT, CONTROL OF EXTERNAL TIGHTNESS AND SETTING

The pressurization of the equipment shall be performed very slowly. Should not any stabilization procedure be carried out, it is recommended to keep gas speed in the feeding piping at a value equal to 5 m/sec during pressurization.

To protect the apparatus from damage, the following operations must never be carried out:

- Pressurization through a valve located downstream from the apparatus itself.
- Depressurization through a valve located upstream from the apparatus itself.

External tightness is guaranteed if no bubbles form when a foam medium is applied on the element under pressure.

The regulator and any other apparatuses (slam-shut, monitor) are normally supplied already set for the desired set-point. It is possible for various reasons (e.g., vibration during transport) for the settings to be changed while remaining within the values permitted by the springs used.

We therefore recommend checking the settings using the procedures illustrated below.

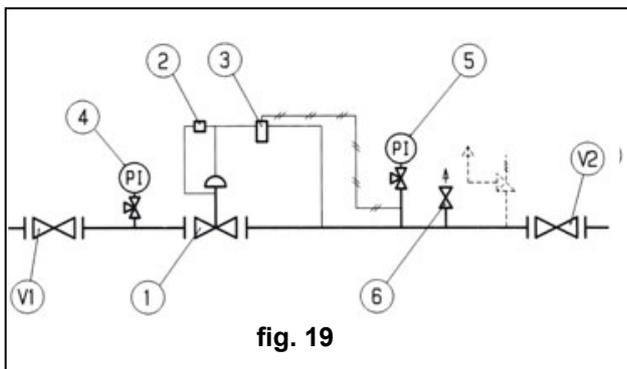
Table 5 give the recommended set-point for the apparatuses in the various installation arrangements. The figures in these tables can be useful both when checking existing set-point and for modifying them should this become necessary later.

In installation consisting of two lines, we suggest commissioning one line at a time, starting from the one with the lower set-point, known as the "reserve" line. The set-point of the apparatuses in the line will obviously deviate from those specified in the table 5.

Before commissioning the regulator you must check that all the on/off valves (inlet, outlet, any by-pass) are closed and that the gas is at a temperature which will not lead to malfunction..

5.3 COMMISSIONING THE REGULATOR (fig.19)

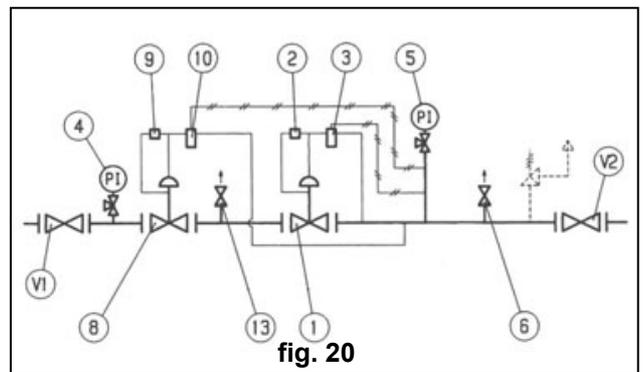
If there is also a relief valve in the line, refer to par. 3.1 to check it.



- 1) Partially open the atmosphere drain tap 6.
- 2) Open the AR100 valve in position 8.
- 3) Open the inlet on-off valve V1 very slowly.
- 4) By means of the pressure gauge 5, check that the pressure does not exceed the maximum value permitted by the setting spring fitted in the pilot. If necessary suspend the operation by closing V1 and completely reduce the load of the spring by turning screw 10 anticlockwise (fig. 22). Reopen valve V1 slowly.

- 5) Control the damper device of the pilot 3 as illustrated in paragraph 1.6.
- 6) Choke the AR100 valve.
- 7) Adjust the setting by alternately adjusting the AR100 valve and the 30./... pilot so that the value of the set pressure is obtained with the minimum opening possible of the AR100 valve; then block the screw 10 of the pilot with the provided nut 9.
- 8) Close the bleed cock 6 and check that the downstream pressure, after a period of increase, stabilizes and at a value slightly higher than that of closure of the pilot/regulator combination. Otherwise eliminate the causes of the internal leakage.
- 9) Using a foam substance, check the tightness of all the joints between the on-off valves V1 and V2.
- 10) Very slowly open the downstream on-off valve V2 to obtain the complete filling of the pipe. If at the beginning of this operation the pressure in the pipe is much lower than the set point, the opening of this valve should be choked so as not to go beyond the maximum flow rate value for the installation.
- 11) If pumping phenomena arise in normal working conditions, it is necessary to repeat the operations in point 7 so as to readjust the setting, increasing the opening of the AR100 valve, or that of the pilot damper device. If, on the other hand, there is an excessive reduction of the regulated pressure with an increase in flow, repeat the above operations with a smaller opening of the AR100 valve.

5.4 COMMISSIONING THE REGULATOR WITH IN LINE MONITOR (fig.20)



- 1) Partially open the atmosphere drain tap 6.
- 2) Open the AR100 9 valve of the monitor in position 8.
- 3) Close the AR100 2 valve of the service regulator in position 1.
- 4) Open the inlet on-off valve V1 very slowly.
- 5) Completely increase the setting of the pilot 3..
- 6) Control the damper device of the pilot 10 as illustrated in paragraph 1.6.
- 7) Check, via pressure gauge 5, that downstream pressure gets stabilized at the envisaged monitor setting value. Adjust it acting alternatively on regulation bolt of the pilot 10 and on regulation valve AR100 9, so that the setting pressure is the pressure reached with the minimal opening possible of the valve AR100.
- 8) Open valve AR100 2 of the main regulator in position 8.
- 9) Slowly decrease the setting of the pilot 3 until the chosen value for the functioning regulator is reached.
- 10) Repeat the operations in point 8 for the pilot 3 and the valve 2..

- 11) Wait until the downstream pressure settles at the desired value and adjust it as described in point 9.
- 12) Close the atmosphere drain tap 6 and check that downstream pressure, after an increase - stage, gets stabilized at a value slightly higher than the closure value of the pilot / monitor system. On the contrary erase the causes generating the internal leak.
- 13) Using a foam substance, check the tightness of all the joints between the on-off valves V1 and V2.
- 14) Very slowly open the downstream on-off valve V2 to obtain the complete filling of the pipe.
- 15) If at the beginning of this operation the pressure in the pipe is much

lower than the set point, the opening of this valve should be choked so as not to go beyond the maximum flow rate value for the installation.

- 16) If pumping phenomena arise in normal working conditions, it is necessary to repeat the operations in point 7 so as to readjust the setting, increasing the opening of the AR100 valve, or that of the pilot damper device. If, on the other hand, there is an excessive reduction of the regulated pressure with an increase in flow, repeat the above operations with a smaller opening of the AR100 valve.

Setting of on-line apparatuses consisting of regulators Aperval 101+ Monitor + Relief valves		
Regulator set-point (Pds) mbar	Monitor Set-point	Relief valve Set point
5 < Pds ≤ 12	Pds + 5 mbar	28 mbar
12 < Pds ≤ 15		
15 < Pds ≤ 19		
19 < Pds ≤ 24		Pds x 1.8
24 < Pds ≤ 30		Pds x 1.55
30 < Pds ≤ 60		Pds x 1.4
60 < Pds ≤ 80	Pds x 1.15	Pds x 1.3
80 < Pds ≤ 110		
110 < Pds ≤ 200		
200 < Pds ≤ 400	Pds x 1.12	Pds x 1.3
400 < Pds ≤ 800		
800 < Pds ≤ 1000	Pds x 1.05	Pds x 1.16
1000 < Pds ≤ 2500		
2500 < Pds < 5000		
5000 < Pds < 6000		Pds x 1.15
5000 < Pds < 7700		
7700 < Pds < 8100		
8100 < Pds < 9500		

6.0 TROUBLE-SHOOTING

The problems of various kinds which could arise over time are highlighted below. They derive from phenomena associated with the conditions of the gas as well, of course, as the natural ageing and wear of the materials. It must be remembered that all operations on the apparatuses must be carried out by highly qualified personnel with appropriate knowledge of the subject.

Tampering with the apparatuses by unsuitable personnel relieves us from all responsibility of any kind.

You must therefore train your maintenance personnel or avail yourself of the service centres officially authorised by us.

6.1 Tab. 7 APERVAL 101 REGULATOR (fig. 23, 28, 29)

PROBLEM	POSSIBLE CAUSE	APPARATUS	REMEDY
No tightness at Q=0	Valve seat [13] damaged	Regulator (fig.21)	Replace
	Diaphragm [20] damaged		Replace
	O-ring [37] damaged		Replace
	O-ring [40] damaged		Replace
	Dirt or foreign bodies in the sealing area		Clean
	Obturator [39] damaged	Pilot 30./... (fig. 22-23-24-25-26)	Replace
	O-ring [54] damaged		Replace
	O-ring [55] damaged		Replace
O-ring [56] damaged	Replace		
Pumping	Opening too small	AR100 (fig.28)	Increase opening
	Excessive damper opening	Pilot 30./... (fig.22-23-24-25-26)	Decrease opening
	Reduced downstream volume		Increase volume
	Incorrectly sensing line position		Change position
Pd reduction with Q increase	Opening too great	AR100 (fig.28)	Decrease opening
Pd pressure increases with Q>0	Diaphragm [20] broken	Regulator (fig.21)	Replace
	Dirt or foreign bodies in the sealing area		Clean
	Diaphragm [16] broken	Pilot 30./... (fig. 22-23-24-25-26)	Replace
	Diaphragm [42] broken		Replace
	Obturator [17] damaged		Replace
	Filter [5] clogged	AR100(fig.28)	Change position

7.0 MAINTENANCE

7.1 GENERAL

Before carrying out any operation it is important to ascertain that the regulator has been cut off both upstream and downstream and that the pressure has been discharged in the sections of piping between the regulator and the on/off valves.

The maintenance operations are closely associated with the quality of the gas transported (impurities, humidity, gasoline, corrosive substances) and with the efficiency of the filtering.

Preventive maintenance should be carried out at intervals which, if not established by regulations, depend on:

- the quality of the gas transported;
- the cleanliness and conservation of the piping upstream from the regulator: in general, for example, when starting the equipment for the first time, more frequent maintenance is required because of the precarious state of cleanliness inside the piping;
- the level of reliability required from the regulation system.

Before starting the disassembly operations on the apparatus you should check that:

- a set of recommended spares is available. The spares must be original **Fiorentini** ones, bearing in mind that the more important ones such as diaphragms are marked.
- A set of wrenches is available as specified in table 7.

For a proper maintenance the recommended spare parts are unequivocally identified by labels indicating:

- The No of assembly drawing SR of the apparatus for which the spare parts are suitable,
- The position showed in the assembly drawing SR of the apparatus.

N.B. The use of non-original components relieves Pietro Fiorentini S.p.A. of all responsibility.

In the maintenance is carried out by your own authorized personnel, we recommend putting reference markings, before the disassembly, on those parts which could have directional or reciprocal positioning problems when reassembling. Finally, we would remind you that O-Rings and sliding mechanical components (rods, etc.) must be lubricated, before the re-assembly, with a fine **layer** of silicone grease.

7.2 APERVAL 101 REGULATOR MAINTENANCE PROCEDURE

PROGRAMMED PREVENTIVE MAINTENANCE

Procedure for the disassembly, complete replacement of the spare parts and reassembly of the APERVAL pressure regulator.



PRELIMINARY OPERATION

- A. Put the regulator in safety conditions;
- B. Ensure that upstream and downstream pressure are 0.

DISASSEMBLING AND RE-ASSEMBLY

7.3 APERVAL 101 PRESSURE REGULATOR (fig. 22-23-24-25-26)

- 1) Unplug the fitting between the regulators and the outlet pressure plug (impulse plug)



- 2) Remove the pilot from the regulator



- 3) Remove the fixing bolts of the high cap (4) from the main body (1)



- 4) Remove the high cap (4)



- 5) Take out the diaphragm group and separate the single parts (20 – 14 and 30)



- 6) Remove the grill from the body (13)



- 7) Remove the O-Ring (40) from the grill (13)



To re-install the regulator you can carry out the operations described for the dismantling, in the opposite way.
 Before re-installing the sustain elements (o-rings, diaphragm, etc...), it is necessary to check their integrity and if that is the case to replace them.
 Check the good conditions of the grill.

7.4 DISASSEMBLING UNIT 301/A PILOT

A) Separate the flow regulation valve AR 100 from the pilot



7.4.1 PILOT 301/A

1) Loosen and remove the fixing bolts of the cap higher than the flange



2) Remove the high cap together with the o'ring, the spring and the diaphragm with appropriate disc



3) Loosen and remove the fixing bolts of the flange to the body



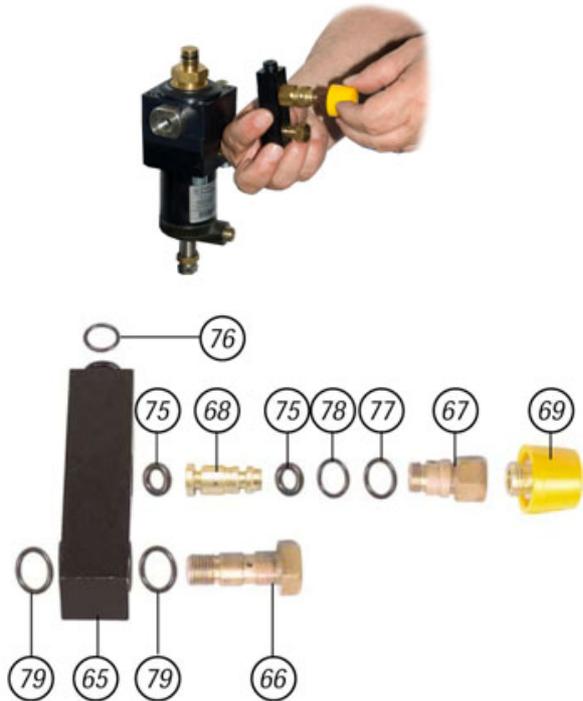
4) Remove the flange from the body



5) Loosen completely the fixing bolt of the DAMPER device from the body of the pilot



6) Remove the DAMPER device



(65) support, (66) bolt, (66) fitting, (68) injector, (69) relief cap.
 (75 - 76 - 77 - 78 - 79) O-ring

7) Totally unscrew the support



8) Remove the support and the diaphragm



9) Remove the diaphragm and the spring



10) Loosen the blocking nut and totally unscrew the pilot regulation bolt



11) Unscrew the cap



- 12) Remove the cap together with the spring and the spring guide



- 13) Unscrew / remove the fixing bolts of the muffler to the body



- 14) Separate the muffler



- 15) Unscrew the fixing nut



- 16) Remove the nut together with the disc and the diaphragm



- 17) Unscrew and remove the conic-sealed fitting from the valve seat group



- 18) Unscrew the fixing nut of the valve seat group to the body



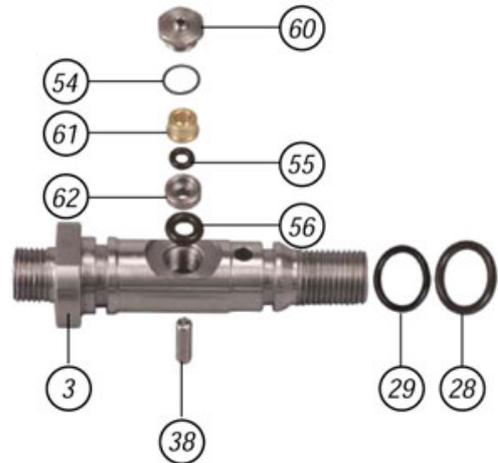
- 19) Remove from the body the valve seat group and the diaphragm support pos. 5



- 20) Unscrew the valve seat from the valve seat group



- 21) Remove the valve seat and the inside components



(3) valve seat group, (38) cylindrical connector, (57) modular piston, (60) valve seat, (69) connector, (62) guide. (28 – 29 – 54 – 55 – 56) O-ring

- 22) Carefully check the good conditions of the valve seat and particularly modular piston.
 23) Replace all components being part of the Replacement Kit

To reassemble the pilot you can run the other way around the operations described for the disassembling process

Peculiar Notes

- A) In disassembling and reassembling the valve seat group please ensure that the valve seat does not get bruised.
- B) In reassembling the mobile group please ensure that the diaphragm support is centered with the valve seat group.

7.5 DISASSEMBLING UNIT 302/A PILOT

A) Separate the flow regulation valve AR 100 from the pilot



7.5.1 PILOT 302/A

1) Loosen the blocking nut and unscrew completely the pilot regulation bolt



2) Unscrew the cap



3) Remove the cap together with the spring and the spring guide



4) Unscrew and remove the fixing bolts of the muff to the body



5) Separate the muff from the body



6) Unscrew the fixing nut



7) Remove the nut together with the disc and the diaphragm



8) Loosen and remove the fixing bolts of the head cap to the flange



9) Remove the head cap



10) Remove the spring and the diaphragm



11) Remove the ring



- 12) Loosen and remove the fixing bolts of the flange to the valve body



- 13) Remove the flange from the valve body



- 14) Unscrew the diaphragm support



- 15) Remove the diaphragm support together with the spring and remove the o-rings



- 16) Remove the diaphragm together with the spring



- 17) Remove the valve seat group fitting



- 18) Unscrew and remove the fixing nut of the valve seat group to the valve body



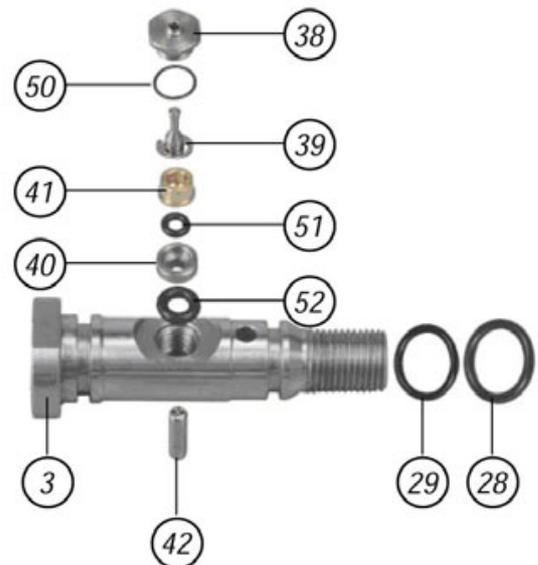
- 19) Separate the valve seat group from the valve body and the diaphragm support



- 20) Unscrew the valve seat from the valve seat group



- 21) Remove the valve seat and the inside components



(3) valve seat group, (38) valve seat, (39) modular piston, (40) guide, (41) connector, (42) cylindrical pin.
(28 – 29 – 50 – 51 – 52) O-ring

- 22) Carefully check the good conditions of the valve seat and particularly of the modular piston
- 23) Replace all components being part of the Replacement Kit

To reassemble the pilot you can run the other way around the operations described for the disassembling process.

Peculiar Notes

- C) In disassembling and reassembling the valve seat group please ensure that the valve seat does not get bruised.
- D) In reassembling the mobile group please ensure that the diaphragm support is centered with the valve seat group.

7.6 DISASSEMBLING AR/100 FLOW REGULATING VALVE

- 1) Unscrew the cap



- 2) Remove the cap from the body



- 3) Remove the filter from the body



- 4) Unscrew the bolts



- 5) Remove the bolts from the body

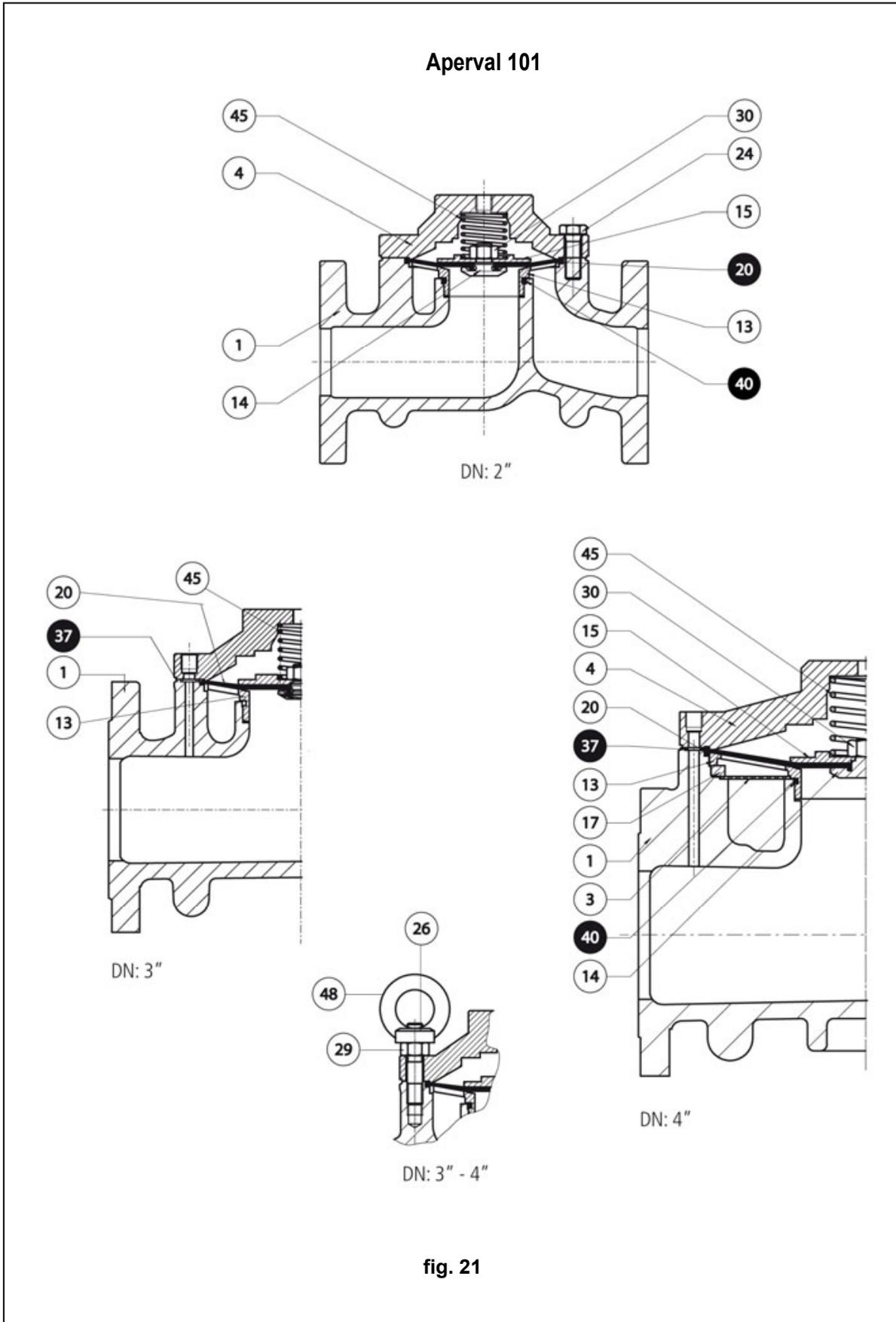


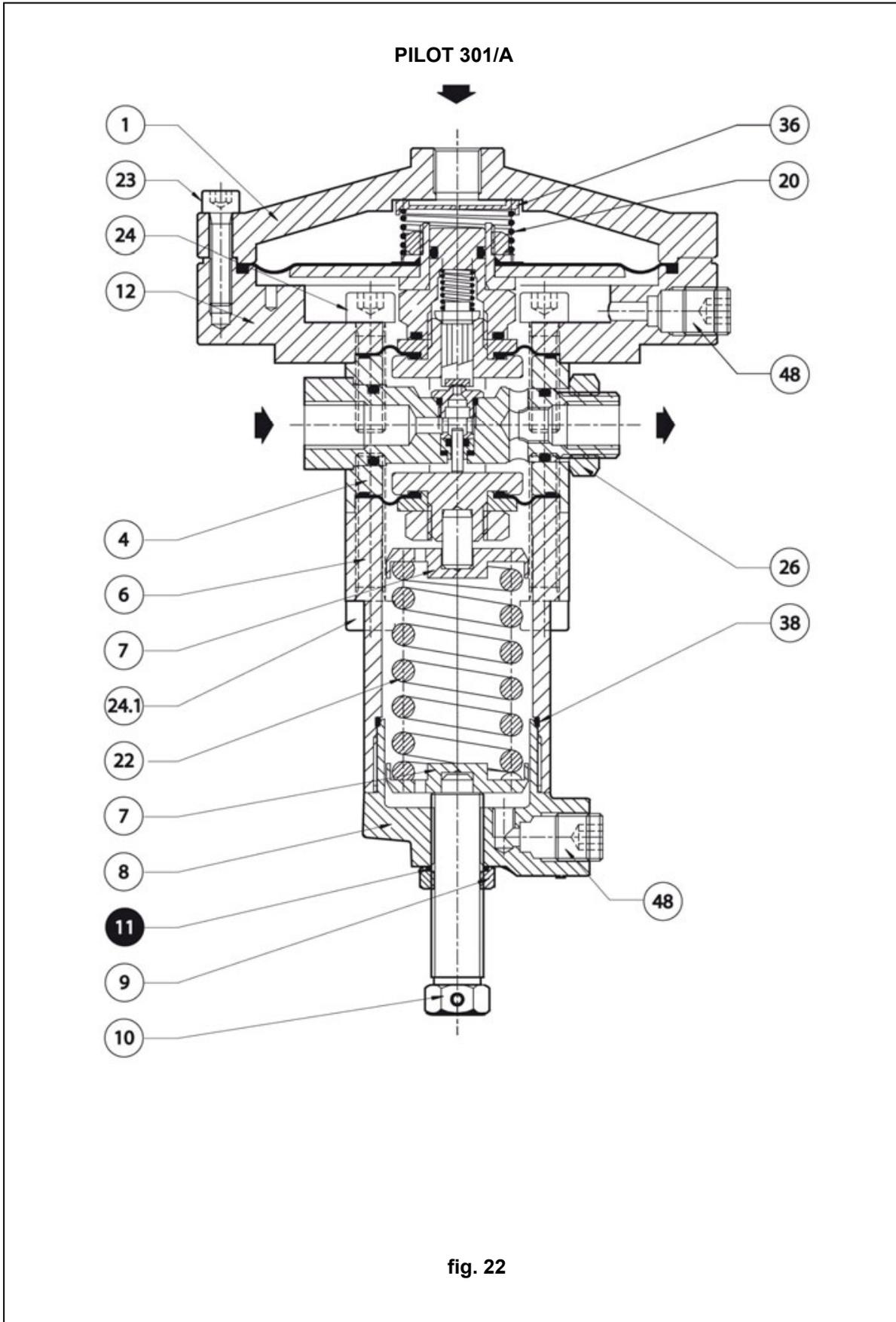
- 6) Remove the o-rings



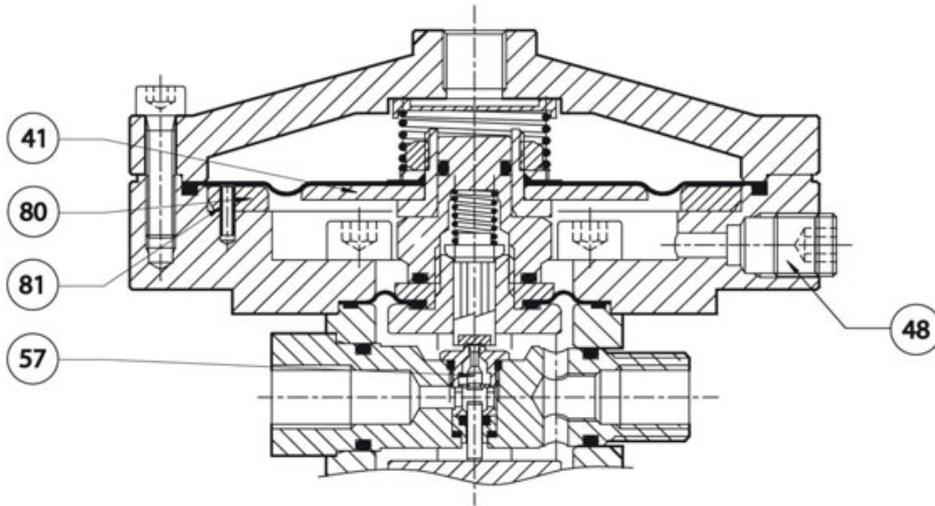
- 7) Replace all components being parts of the Replacement Kit.

To reassemble the valve you can run the described operations the other way around

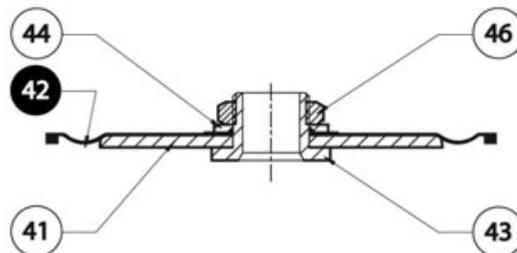




Version head 301/A/TR



Unit "A" Diaphragm



Unit "B" Valve

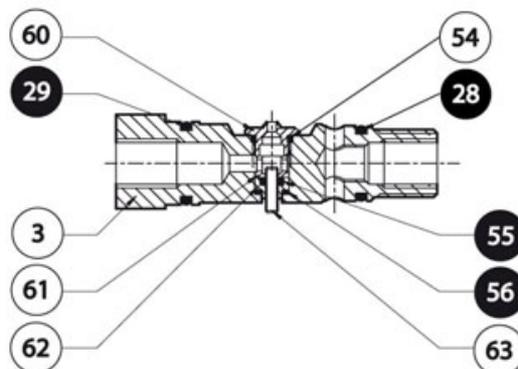
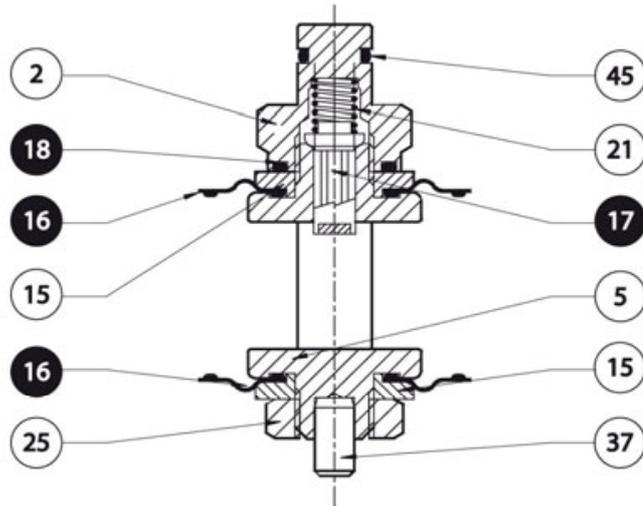


fig. 23

Unit "C" Obturator



Unit "D" Dumper

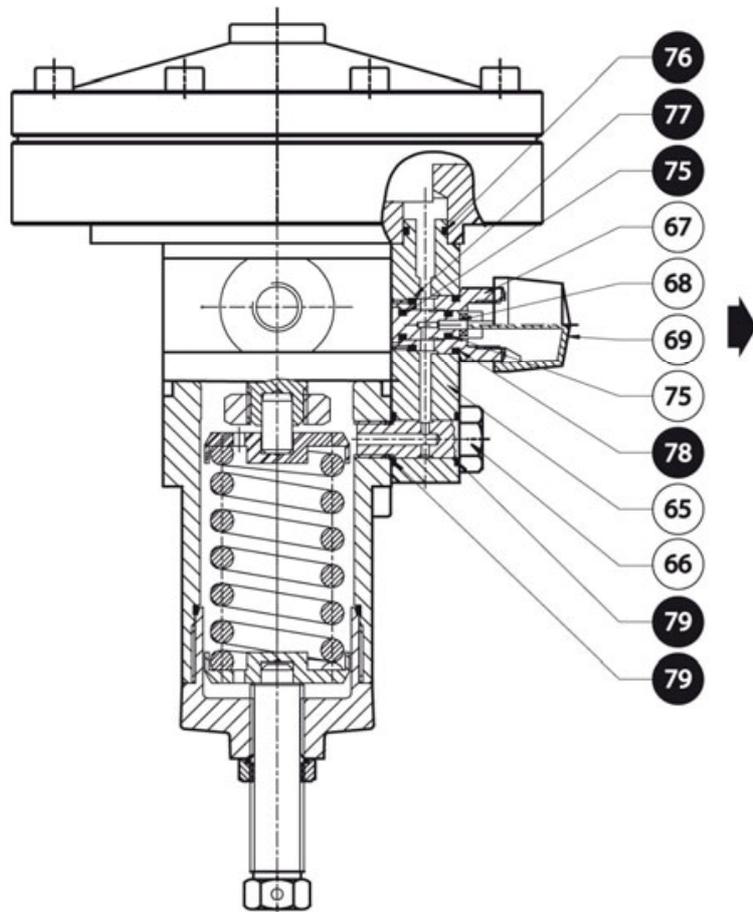
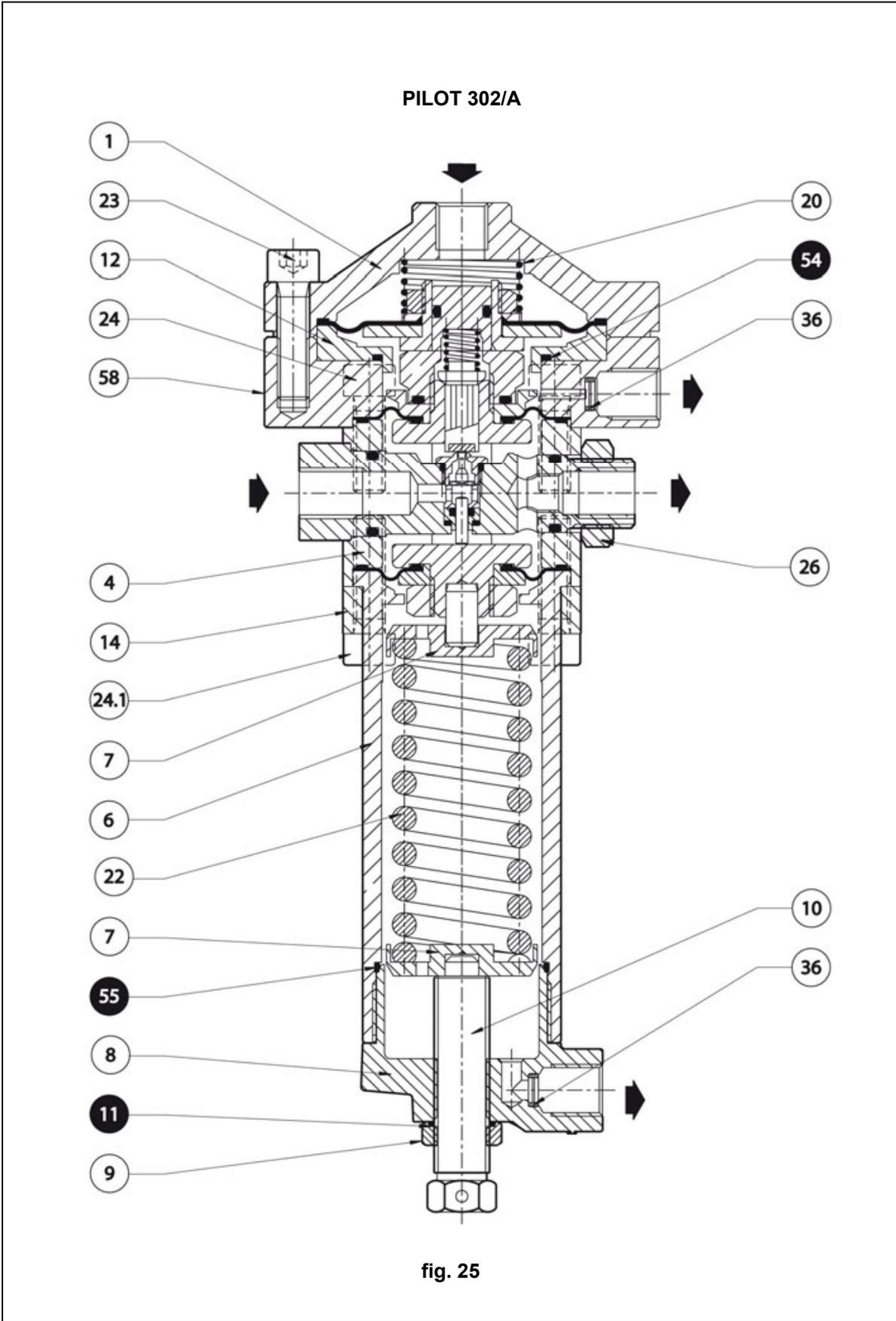
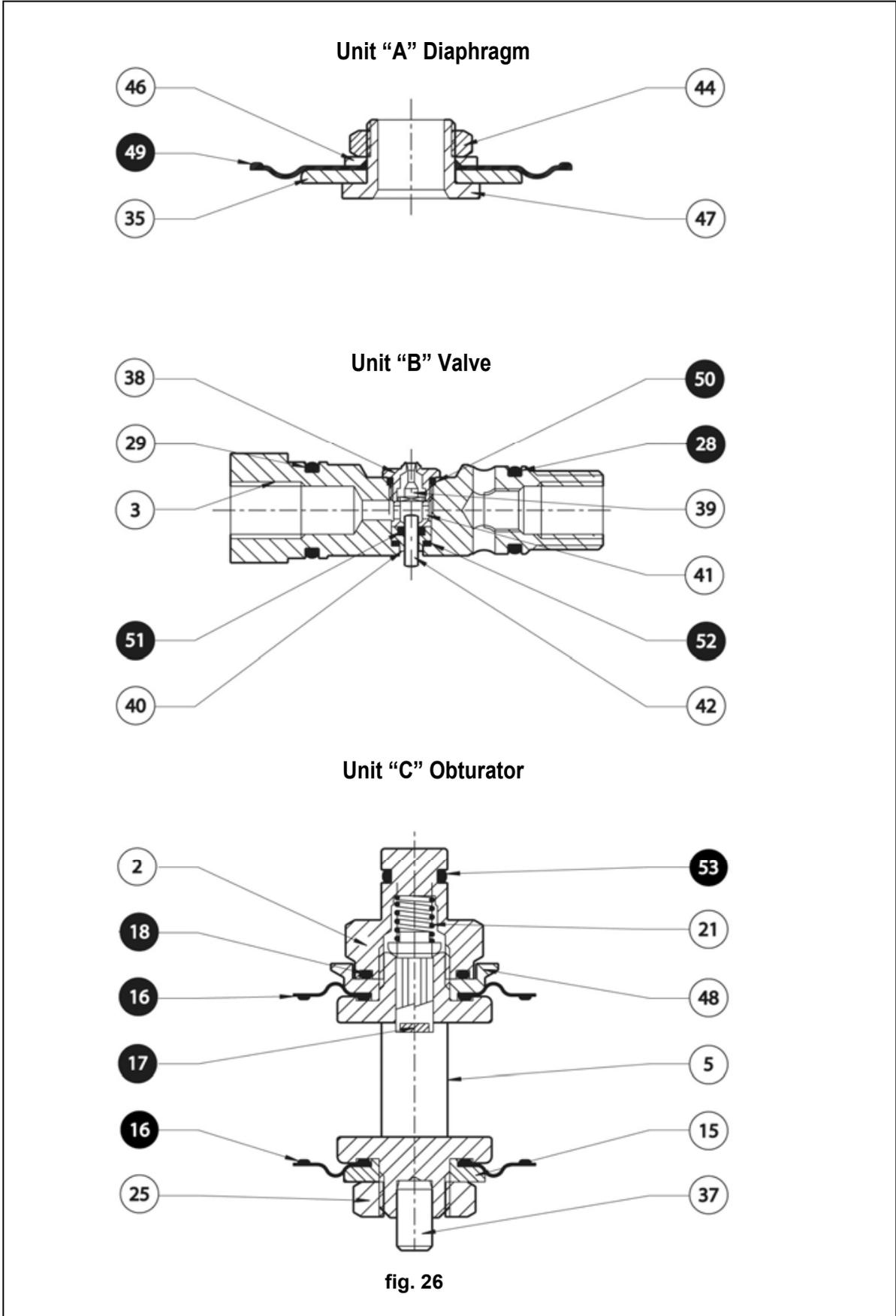


fig. 24





PILOT HP100

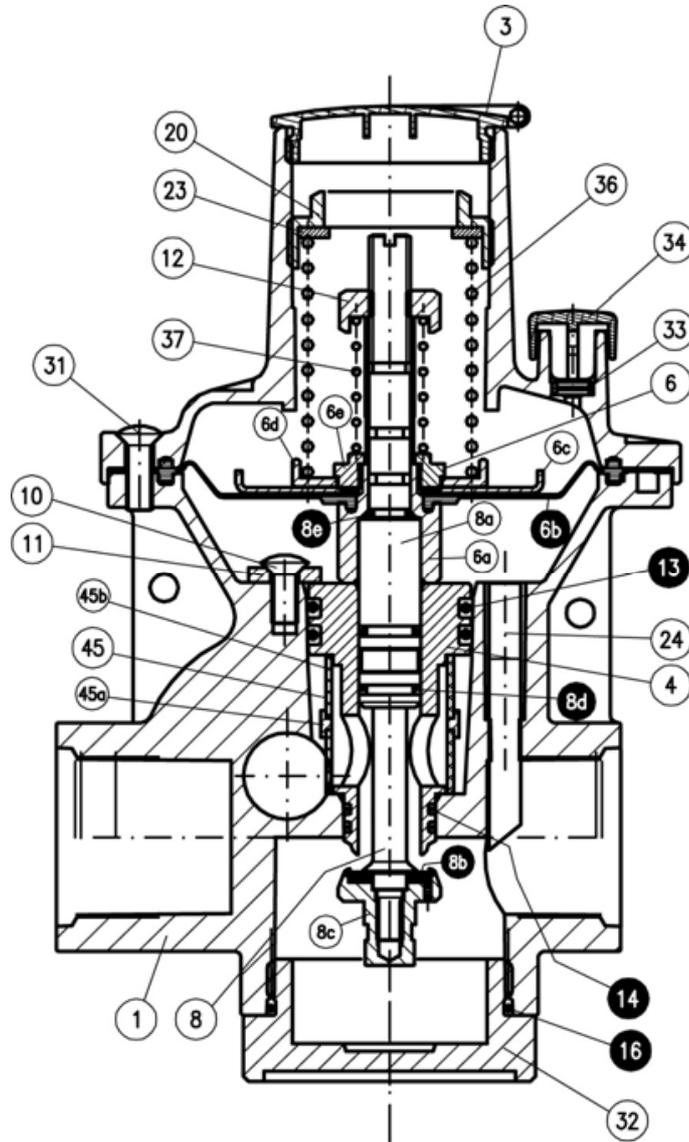
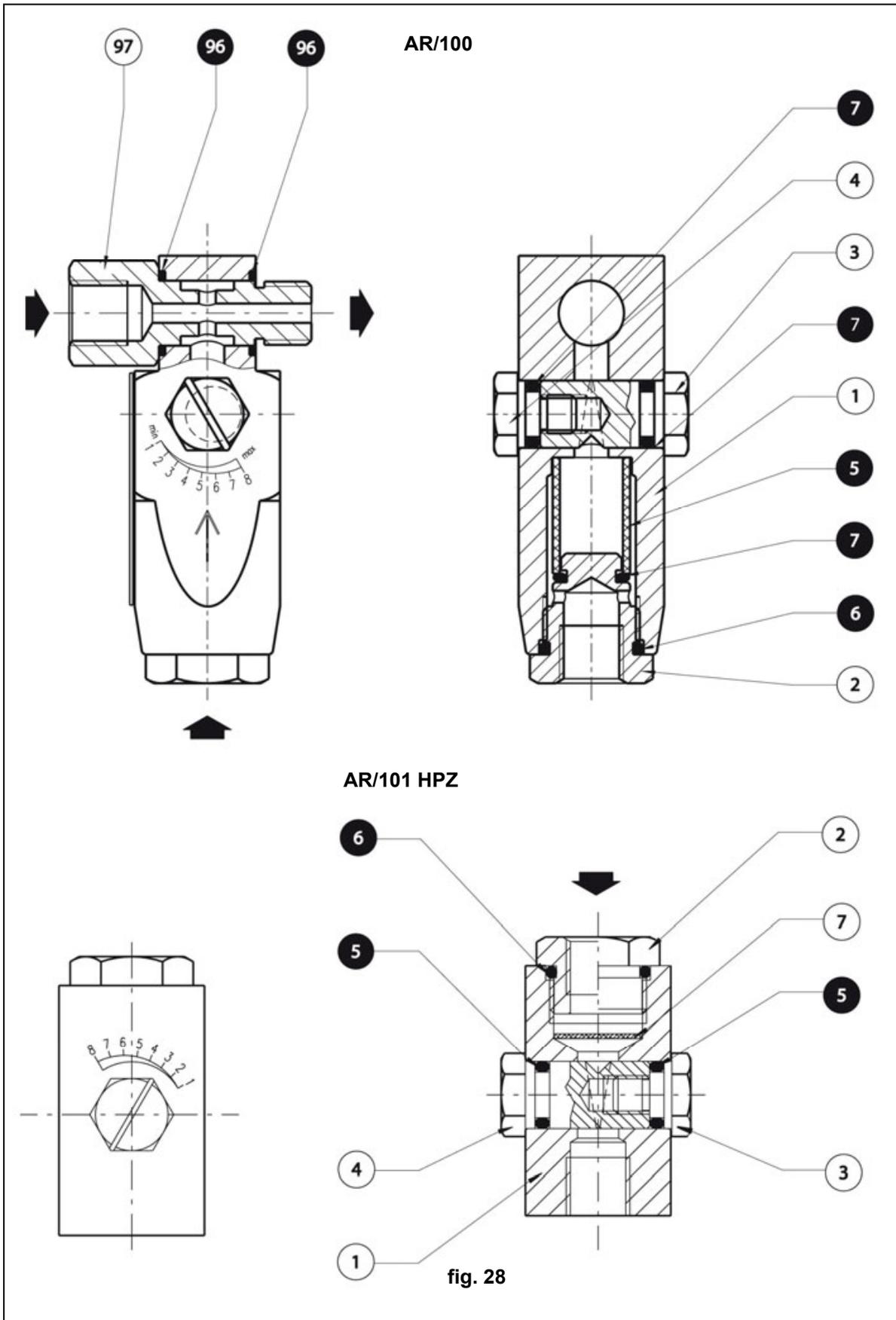


fig. 27



8.0 FINAL OPERATION

8.1 CHECKING THE TIGHTNESS AND SETTING

- 1) Very slowly open the on/off valve upstream from the regulator and, using a foam solution or the like, check:
 - the tightness of the external surfaces of the regulator and of the pilot;
 - the tightness of the internal surfaces of the regulator and of the pilot;
- 2) Check the tightness of the regulator.
- 3) Open a bleed cock the atmosphere downstream from the regulator to create a small gas flow.
- 4) Fix the pilot regulation bolt until the desired set-point value is reached.
- 5) Close the bleed cock to the atmosphere.

8.2 START UP

- 1) Very slowly open the downstream on/off valve and, if necessary, adjust the regulator setting by adjusting the the pilot screw.

Tab. 7 MAINTENANCE WRENCHES FOR APERVAL 101 (+LA...) PRESSURE REGULATOR

		
Combination spanner	Adjustable spanner	Box spanner
8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-41	30	8-9-10-11-12-13-14-15-16-17-18-19-20-24-26-27-36-46
		
Hexagon or allen Key	Philips screwdriver	Flat head screwdriver
3-4-5-6-7-8-19	Ch PH 0 x 100 - PH 1x125 – PH 2x150	0,5x3x75 1,2x6,5x125
		
Circlip pliers		
Cod.10÷25 19÷60		



Pietro Fiorentini S.p.A.
via E.Fermi 8/10
I-36057 Arcugnano (VI) Italy

Tel. +39 0444 968.511
Fax. +39 0444 960.468

www.fiorentini.com

via Rosellini 1
I-20124 Milano
Italy

Tel. +39 02 696.14.21
Fax. +39 02 688.04.57

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