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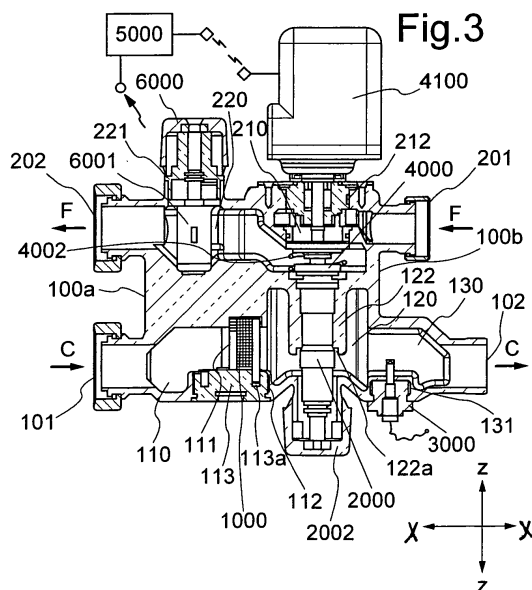
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(54) **Single-piece multifunction valve for supplying and controlling a fluid intended for user appliances such as heating devices and the like**

(57) Single-piece multifunction valve for supplying and controlling hot water (C) supplied to user appliances (U) comprising a body (100) having formed inside it: a delivery branch (RM) for the hot fluid (C) substantially formed by an inlet aperture (101) and an outlet aperture (102) to the user appliances (U); a return branch (RR) for the cold fluid (F) from the user appliances (U), substantially formed by an inlet aperture (201) for the cold water (F); an outlet aperture (202) for return of the cold fluid to the boiler (CT); said delivery branch (RM) comprising at least a filtering chamber (110) terminating in an annular seat (111) for housing a filter (1000) and communicating with the exterior by means of an aperture (112) able to be closed/opened by means of an associated plug (113); a bypass chamber (120) communicating with the exterior by means of a substantially vertical aperture (121) able to house a bypass valve (2000) provided with an obturator (2001) able to come into contact with the seat (122a) of a first end of a vertical duct (122) suitable for connecting the delivery branch (RM) to the return branch (RR) of the valve; a temperature measuring chamber (130) which communicates with the exterior by means of a substantially vertical aperture (131) formed in the bottom side (100e) of the valve body and able to house a water temperature detection probe (3000) emitting a corresponding electric signal; and said return branch comprising at least a shut-off chamber (210) for the cold water (F) of the return branch (RR) communicating with the exterior by means of a substantially vertical aperture (212) and able to house a shut-off valve (4000) provided with an obturator (4001) which can be opened/closed by means of an associated actuator

(4100) controlled by the control unit (5000); said shut-off chamber (210) being connected to the delivery branch (RM) by means of said vertical duct (122) of the bypass chamber (120) for recirculation of the fluid; a balancing chamber (220) communicating with the exterior by means of a substantially vertical aperture (221) formed in the upper side (100d) of the valve body and able to house a balancing valve (6000) provided with an obturator (6001) able to determine a greater/smaller flow of the cold return fluid.



Description

[0001] The present invention relates to a single-piece multifunction valve for supplying and controlling water intended for various user appliances.

[0002] It is known in the heating sector that there exists the technical need to distribute hot/cold water in order to supply heating and/or sanitary components and also meter the consumption of hot/cold water by the individual users for example in a block of flats.

[0003] It is also known that, for this purpose, preassembled modules have been designed, said modules comprising at least one heating branch for regulating and measuring the heat used by the heating appliance, composed of:

- a three-way valve for regulating, by means of the command received from the room thermostat, the flowrate to the user appliance;
- an adjustable bypass valve for obtaining recirculation upstream when the main path of the three-way valve is closed;
- a balancing valve for regulating the maximum flowrate which the branch uses;
- a meter for measuring the flowrate used (mounted on the flow return line);
- a heat meter with two temperature probes (one in the meter and one in the user inlet union) for calculating with the flowrate data the amount of heat used by the user;
- a filter upstream of the meter for protecting both the meter and the valve from any impurities;
- shut-off ball valves upstream and downstream.

[0004] These control circuits require the use of numerous components such as special mixing and balancing valves, a large number of relative assembly components such as pipes, unions and the like of the standard type or specially modified and suitably connected in order to achieve the desired technical effect.

[0005] Although fulfilling their function, said circuits therefore result in the need for complex preparation, assembly and regulating operations which are difficult from a technical point of view, with the need to increase the preventive checks, and are therefore also costly in economic terms.

[0006] The technical problem which is posed, therefore, is to provide a multifunction valve which is particularly suitable for being arranged between the boiler-water delivery/return risers and the circuits for supplying heating and/or sanitary user appliances, so as to allow automatic regulation of the flowrate and temperature of the water which circulates inside them and metering of the actual consumption by the user appliances.

[0007] In connection with this problem it is also required that this valve should have compact dimensions, be easy and inexpensive to produce and assemble and be able to be applied on-site in any conditions without

the need for excessive adaptation, thus reducing the complexity of preparing the distribution and/or metering circuit as a whole.

[0008] These results are achieved according to the present invention by a single-piece multifunction valve according to the characteristic features of Claim 1.

[0009] The present invention relates furthermore to a hydraulic circuit for distributing hot water to user appliances with metering of the actual consumption, provided with a single-piece multifunction valve according to the characteristic features of Claim 14.

[0010] Further details may be obtained from the following description of a non-limiting example of embodiment of the subject of the present invention provided with reference to the accompanying drawings, in which:

- Figure 1 shows a front view of the single-piece multifunction valve according to the present invention;
- Figure 2 shows a view from the user side of the valve according to Fig. 1;
- Figure 3 shows a schematic cross-section along the plane indicated by III-III in Fig. 2;
- Figure 4 shows a partially enlarged view of the cross-section according to Fig. 3 with the valve in the normal operating condition with recirculation of the hot/cold fluid to the user appliances;
- Figure 5 shows a partially enlarged view of the cross-section according to Fig. 3 with the valve in the closed condition and with recirculation of the hot fluid upstream of the delivery to the user appliances;
- Figure 6 shows a cross-section along the plane indicated by IV-IV in Fig. 1;
- Figure 7 shows a schematic cross-section along the plane indicated by VII-VII in Fig. 1; and
- Figure 8 shows a functional diagram of a circuit with valve according to the present invention for supplying heating user appliances.

[0011] As shown in Figs. 1 to 4 and assuming solely for the sake of convenience of the description three reference axes, i.e. longitudinal axis X-X, transverse axis Y-Y and vertical axis Z-Z, respectively, and an upstream-to-downstream orientation in the direction of the fluid flow from the inlet for hot water C to the hot-water outlet to the user appliances U, a multifunction valve according to the present invention comprises a single-piece body 100, inside which the following are formed: +) a delivery branch RM for the hot fluid C from the boiler CT which, in the upstream-to-downstream direction, is substantially formed by:

- an inlet aperture 101 arranged in the upstream side 100a for entry of the hot water C which is supplied from the delivery risers for the boiler water;
- a filtering chamber 110 extending substantially in the longitudinal direction X-X and terminating in an annular seat 111 able to house a filter 1000 and communicating with the exterior by means of a substan-

- tially vertical aperture 112 which is formed in the bottom side 100e of the valve body and can be closed/opened by means of an associated plug 113;
- a bypass chamber 120 communicating with the exterior by means of a substantially vertical aperture 121 formed in the bottom side 100e of the valve body and able to house a bypass valve 2000 provided with an obturator 2001 able to come into contact with the seat 122a of a first end of a vertical duct 122 suitable for connecting the delivery branch RM to the return branch RR (described in detail below) of the valve;
 - a temperature measuring chamber 130 which communicates with the exterior by means of a substantially vertical aperture 131 formed in the bottom side 100e of the valve body and able to house a water temperature detection probe 3000 sending a corresponding electric signal to a control unit 5000;
 - an outlet aperture 102 arranged in the downstream side 100b for supplying hot water C to the user appliances U;
 - + a return branch RR for the cold fluid F from the user appliances U which, in the downstream-to-upstream direction, is substantially formed by:
 - an inlet aperture 201 arranged in the downstream side 100b of the valve body for entry of the cold water F;
 - a shut-off chamber 210 substantially extending in the vertical direction Z-Z and communicating with the exterior by means of a substantially vertical aperture 212 formed in the upper side 100d and able to house a shut-off valve 4000 which can be opened/closed by means of an obturator 4001 actuated displaceably in both senses of the vertical direction Z-Z by an associated actuator 4100 in turn operated by the control unit 5000; said shut-off chamber 210 is also connected, by means of the second end of the said vertical duct 122 of the bypass chamber 120, to the delivery branch RM for recirculation of the fluid as will become clearer below;
 - a balancing chamber 220 communicating with the exterior by means of a substantially vertical aperture 221 formed in the upper side 100d of the valve body and able to house a balancing valve 6000 provided with a substantially cylindrical obturator 6001 extending in the vertical direction Z-Z and movable in both senses of the said direction so as to allow a greater/smaller flow of the cold return fluid in order to determine the necessary flow of hot fluid which can be supplied to the user appliances;
 - an outlet aperture 202 arranged in the upstream side 100a for return of the cold fluid to the boiler CT;

In more detail:

- the filter 1000 (Figs. 3 and 7) consists of a substantially cylindrical screen, the annular edge 1001 of which has two radial recesses 1002 able to come

into contact with two corresponding teeth 112 projecting radially towards the inside of the annular seat 111 so as to act as a guide for the filter and prevent relative rotation of the latter and the valve body in order to keep it directed transversely with respect to the flow and prevent it not being positioned properly during assembly or during possible disassembly for maintenance; according to a preferred embodiment it is also envisaged that the filter 1000 has a shoulder 1003 projecting radially outwards and able to be positioned inside a corresponding seat 113a of the plug 113;

- the bypass valve 2000 is of the manual type and comprises a handwheel 2002 for operating the obturator 2001 able to allow initial calibration of the maximum recirculation throughput, which can be set by means of indices (not shown) printed on the said handwheel and corresponding to predefined values of the flowrate/recirculation ratio; the obturator 2001 of the bypass valve is also coaxial with and joined to the obturator of a shut-off valve (described below) of the return branch RR of the single-piece valve so that the two obturators may be operated simultaneously in the direction Z-Z of the actuator 4100 of the shut-off valve 4000;
- the shut-off valve 4000 comprises an obturator 4001 which is biased towards the shut-off aperture 210a of the return branch RR by a spring 4002 coaxially arranged on the obturator itself so as to keep the return branch RR, and therefore the entire single-piece valve, normally closed; the obturator 4001 is, however, also connected to the shaft 4101 actuated by the actuator 4100 which, upon receiving a command from the control unit 5000, opens the shut-off valve so as to allow the flow of the cold fluid F along the return branch RR and therefore the supply of the hot fluid C along the delivery branch; when the programmed temperature is reached at the user appliances the sensor 3000 will send a "temperature reached" signal to the control unit 5000 which, in turn, will close the shut-off valve; owing to the connection of the two obturators, i.e. bypass obturator and shut-off obturator, of the return branch to the shaft of the actuator 4100, when the latter pushes in the direction Z-Z towards the delivery branch, the return duct is opened and the bypass circuit is closed; when instead the actuator is not activated, the obturator of the shut-off valve closes, being pushed by the spring, and the bypass obturator opens, keeping open an aperture, the cross-section of which is determined by the previous adjustment on the handwheel;
- the obturator 6001 of the balancing valve 6000 (Figs. 3 and 7) is formed by means of a hollow cylindrical body provided with two lugs 6002 projecting outwards and able to engage in corresponding recesses 222 able to prevent the rotation of the obturator which, operated by means of a worm screw, is able

to move only in the two senses of the vertical direction Z-Z.

[0012] Owing to the symmetrical nature of its design with respect to the longitudinal axis X-X, it will also be possible to install the valve with right-hand/left-hand sense of operation, by simply rotating it through 180° when it is inserted into the control circuit.

[0013] Fig. 8 shows a hydraulic circuit for supplying and controlling the hot water supplied to the user appliances such as heating radiators, also comprising means for metering the energy used and optimised by means of a single-piece multifunction valve according to the present invention connected by means of the apertures 101 and 202 of the upstream side to ball valves 1 and 5 which are in turn connected to the risers for delivery and return of the water from/to the boiler and by means of the apertures 102 and 201 of the downstream side to other ball valves 2 and 3 in turn connected to the delivery/return pipes of the user appliances U; an instrument 4 for measuring the flowrate, connected to the inlet 201 of the return branch RR of the valve according to the invention, is also inserted along the return branch RR.

[0014] With the structure described, operation of the single-piece multifunction valve according to the present invention takes place as follows:

- after connecting the module with the multifunction valve to the installation the following start-up operations are performed for the heating branch:
- the four shut-off ball valves 1,2,3,5 are opened;
- the actuator 4110 of the shut-off valve is set to the ON position in order to open the return branch RR of the said valve;
- when the shut-off valve opens the return duct automatically closes the bypass line, the two respective obturators being joined to the valve shaft;
- the bypass valve 200 is closed so as to be sure to close completely the said bypass;
- the maximum flowrate required by the user appliance is regulated by means of the balancing valve 6000, reading off directly the value from the meter; by way of example average flowrate values of 900 litres/hour are obtained for an average-size installation;
- the actuator 4100 of the shut-off valve 4000 is arranged in the OFF position so as to close the return branch RR of the valve by means of the thrusting action of the spring 4002 on the obturator 4001;
- when the shut-off valve closes the return branch automatically opens the vertical bypass duct 122;
- the desired recirculation flowrate is adjusted by means of the bypass valve 2000: for example 40% of the flowrate of the return branch RR namely, in the flowrate example described above, 600 litres/hour; the value is set according to the indices on the handwheel, using the index/flowrate table;
- after carrying out the operations described above,

the position of the two control handwheels of the balancing valve and the bypass valve must be locked so as to prevent accidental variations in the predefined settings; in the example of embodiment described the handwheel of the balancing valve is locked by tightening fully the end screw in order to increase the friction on the internal movable parts; the handwheel of the bypass valve is instead removed and repositioned with reference to a tooth of an internal component; in both cases the angular position of the respective shafts must not be varied so as not to lose the position of the setting performed.

[0015] It is envisaged moreover performing periodic cleaning of the filter in accordance with the following procedure:

- the four shut-off ball valves are closed;
- the plug 113 of the filter 1000 is unscrewed, collecting the water which flows out together with the dirt from the installation;
- the filter is removed if necessary and cleaned;
- the filter is reassembled and inserted into the body by engaging inside the two radial recesses 1002 the corresponding teeth 112 projecting radially towards the inside of the annular seat 111 and centring the filter inside the seat 113a formed in the plug 113;
- the plug is closed again using an operating spanner.

[0016] It is therefore clear how, as a result of the multifunction valve with single-piece body according to the present invention for controlling the supply of user appliances such as heating and/or sanitary water radiators, it is possible to reduce the overall dimensions and installation costs and provide with great ease and at a low cost complex hydraulic circuit components able to perform metering of the consumption, said circuits being therefore very compact, preassembled and with reduced dimensions.

[0017] Numerous variations may be made to the practical design of the various parts forming the valve and the orientational layouts indicated by way of example in the description provided above, without altering the functional meaning of the assembly and without departing from the scope of protection defined by the claims which follow.

Claims

1. Single-piece multifunction valve for supplying and controlling the hot water (C) supplied to user appliances (U) comprising a body (100) having formed inside it:

+) a delivery branch (RM) for the hot fluid (C) from the boiler (CT), essentially formed by:

- an inlet aperture (101) arranged in the upstream side (100a) for entry of the hot water (C) and an outlet aperture (102) arranged in the downstream side (100b) for outflow of the hot water (C) to the user appliances (U) ;

+) a return branch (RR) for the cold fluid (F) from the user appliances (U), substantially formed by:

- an inlet aperture (201) arranged in the downstream side (100b) of the valve body for entry of the cold water (F);
- an outlet aperture (202) arranged in the upstream side (100a) for return of the cold fluid to the boiler (CT) ;

characterized in that:

said delivery branch (RM) comprises at least:

- a filtering chamber (110) extending substantially in the longitudinal direction (X-X) and terminating in an annular seat (111) able to house a filter (1000) and communicating with the exterior by means of a substantially vertical aperture (112) which is formed in the bottom side (100e) of the valve body and can be closed/opened by means of an associated plug (113);
- a bypass chamber (120) communicating with the exterior by means of a substantially vertical aperture (121) formed in the bottom side (100e) of the valve body and able to house a bypass valve (2000) provided with an obturator (2001) able to come into contact with the seat (122a) of a first end of a vertical duct (122) suitable for connecting the delivery branch (RM) to the return branch (RR) of the valve;
- a temperature measuring chamber (130) communicating with the exterior by means of a substantially vertical aperture (131) formed in the bottom side (100e) of the valve body and able to house a water temperature detection probe (3000) emitting a corresponding electric signal;

and in that

said return branch comprises at least:

- a shut-off chamber (210) for the cold water (F) of the return branch (RR), substantially extending in the vertical direction (Z-Z) and communicating with the exterior by means of a substantially vertical aperture (212) formed in the upper side (100d) and able to house a shut-off valve (4000) provided with an obturator (4001) which

can be opened/closed by means of an associated actuator (4100) controlled by the control unit (5000); said shut-off chamber (210) being connected to the delivery branch (RM) by means of said vertical duct (122) of the bypass chamber (120) for recirculation of the fluid;

- a balancing chamber (220) communicating with the exterior by means of a substantially vertical aperture (221) formed in the upper side (100d) of the valve body and able to house a balancing valve (6000) provided with an obturator (6001) able to determine a greater/smaller flow of the cold return fluid.

2. Multifunction valve according to Claim 1, **characterized in that** said filter (100) consists of a substantially cylindrical screen.
3. Multifunction valve according to Claim 2, **characterized in that** the annular edge (1001) of the filter (1000) has two radial recesses (1002) able to come into contact with two corresponding teeth (112) projecting radially towards the inside of the annular seat (111).
4. Multifunction valve according to Claim 2, **characterized in that** the annular edge (1001) of the filter (1000) comprises at least one shoulder (1003) projecting radially towards the outside and able to be positioned inside a corresponding seat (113a) of the plug (113).
5. Multifunction valve according to Claim 1, **characterized in that** the shut-off valve (4000) comprises a spring (4002) coaxially arranged on the obturator (4001) and able to maintain the said thrusting force against the shut-off aperture (210a) of the return branch (RR).
6. Multifunction valve according to Claim 5, **characterized in that** it is normally closed.
7. Multifunction valve according to Claim 6, **characterized in that** the obturator (4001) is connected to the shaft (4101) of the actuator (4100) which pushes against the obturator upon receiving a command from the control unit (5000) and against the reactive force of said spring (4002).
8. Multifunction valve according to Claim 6, **characterized in that** the obturator (2001) of the bypass valve (2000) is connected to the obturator (4001) of the shut-off valve (4000) of the return branch (RR).
9. Multifunction valve according to Claim 8, **characterized in that** the bypass valve (2000) is normally open.

10. Multifunction valve according to Claim 1,
characterized in that the obturator (6001) of the
balancing valve (6000) is formed by means of a hol-
low cylindrical body. 5
11. Multifunction valve according to Claim 8,
characterized in that said obturator (6001) has two
lugs (6002) projecting outwards and able to engage
in corresponding recesses (222) in the valve body. 10
12. Multifunction valve according to Claim 9,
characterized in that said obturator (6001) is dis-
placeably operated in both senses of the vertical di-
rection (Z-Z) by means of a worm screw. 15
13. Multifunction valve according to Claim 1,
characterized in that it is symmetrical with respect
to the longitudinal axis (X-X). 20
14. Hydraulic circuit for supplying water to user appli-
ances (U), **characterized in that** it comprises at
least one single-piece multifunction valve according
to Claim 1 connected by means of the delivery ap-
erture (101) and return aperture (102) on the up-
stream side to the risers for delivery and return of 25
the water from/to the boiler and by means of the de-
livery aperture (102) and return aperture (201) on
the downstream side to the pipes for delivery/return
to/from the user appliances. 30
15. Hydraulic circuit according to Claim 12,
characterized in that it comprises ball valves (1,5)
arranged between the respective apertures
(101,202) of the upstream side and the risers for de-
livery and return of the water from/to the boiler (CT) 35
and ball valves (2,3) arranged between the respec-
tive apertures (102,201) on the downstream side and
the delivery/return pipes of the users (U).
16. Hydraulic circuit according to Claim 13, 40
characterized in that it comprises a measuring in-
strument (4) arranged between the inlet (201) of the
return branch (RR) of the single-piece valve (100)
and the associated ball valve (3) on the downstream
side of the said valve. 45

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Fig.1

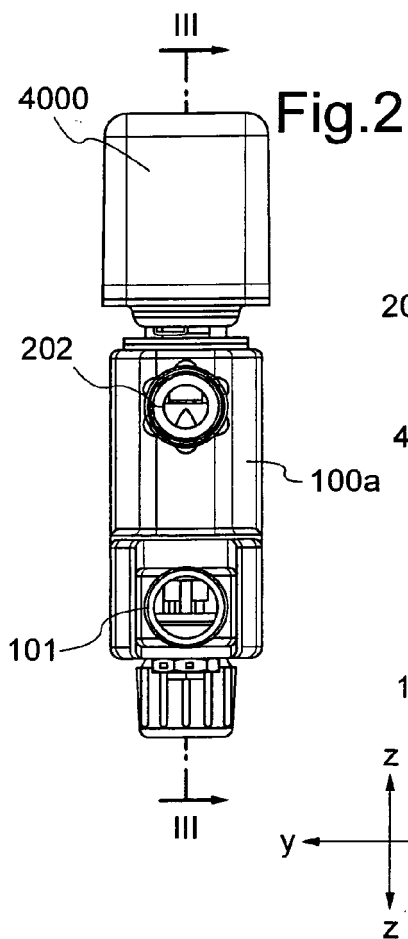
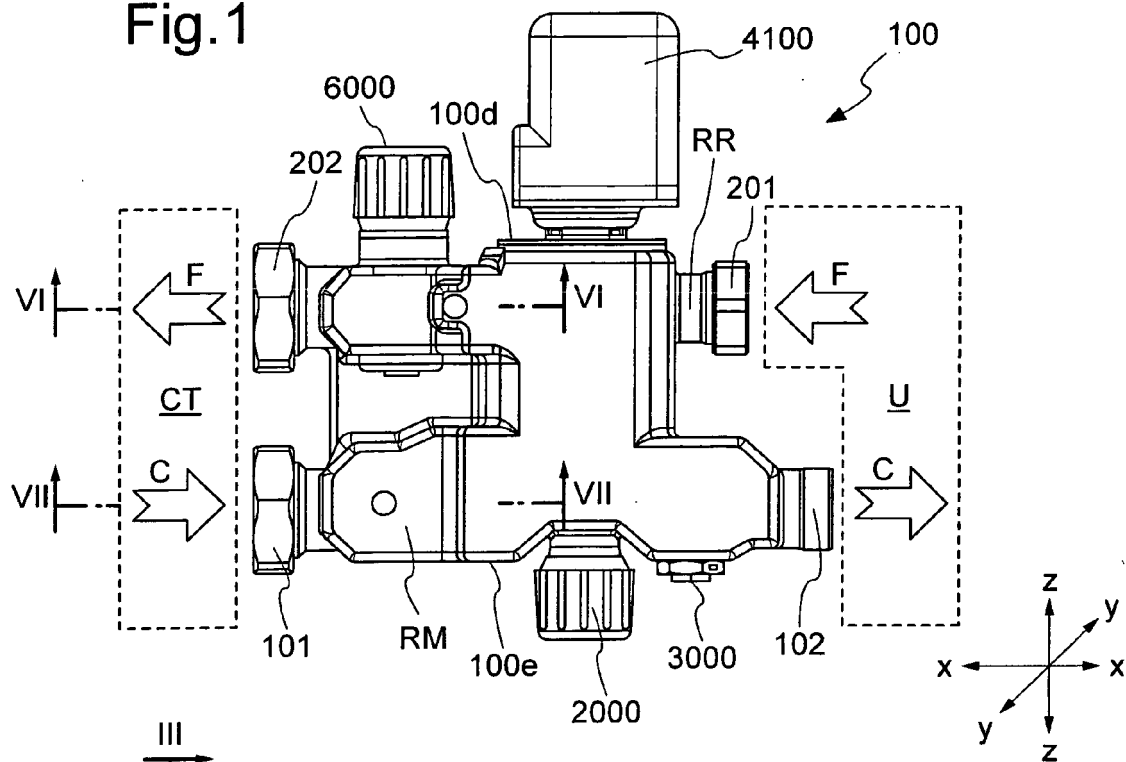


Fig.2

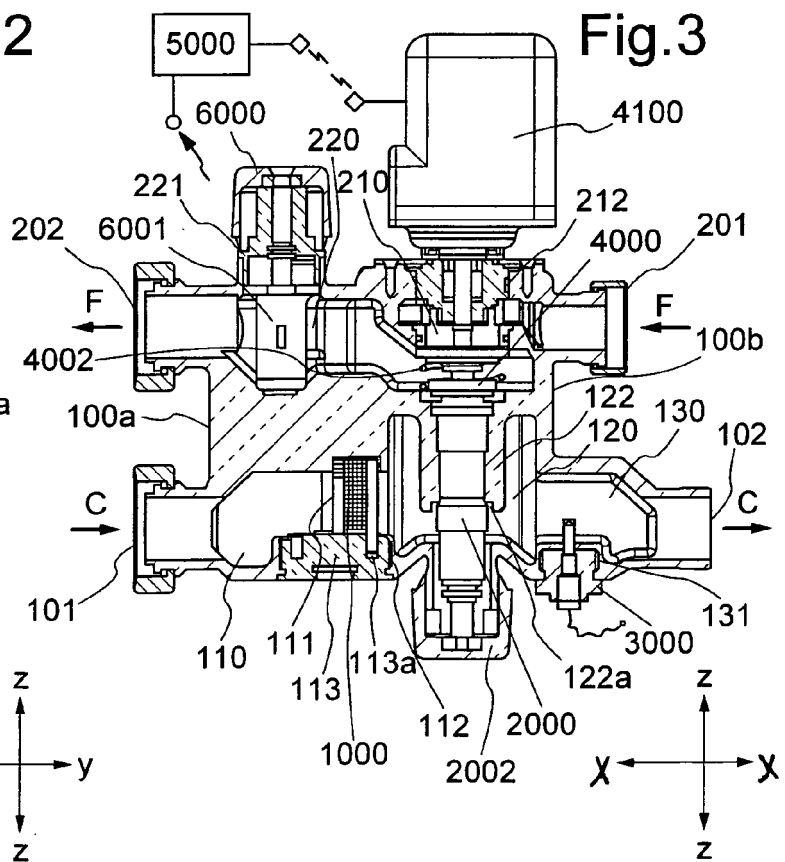


Fig.3

Fig.4

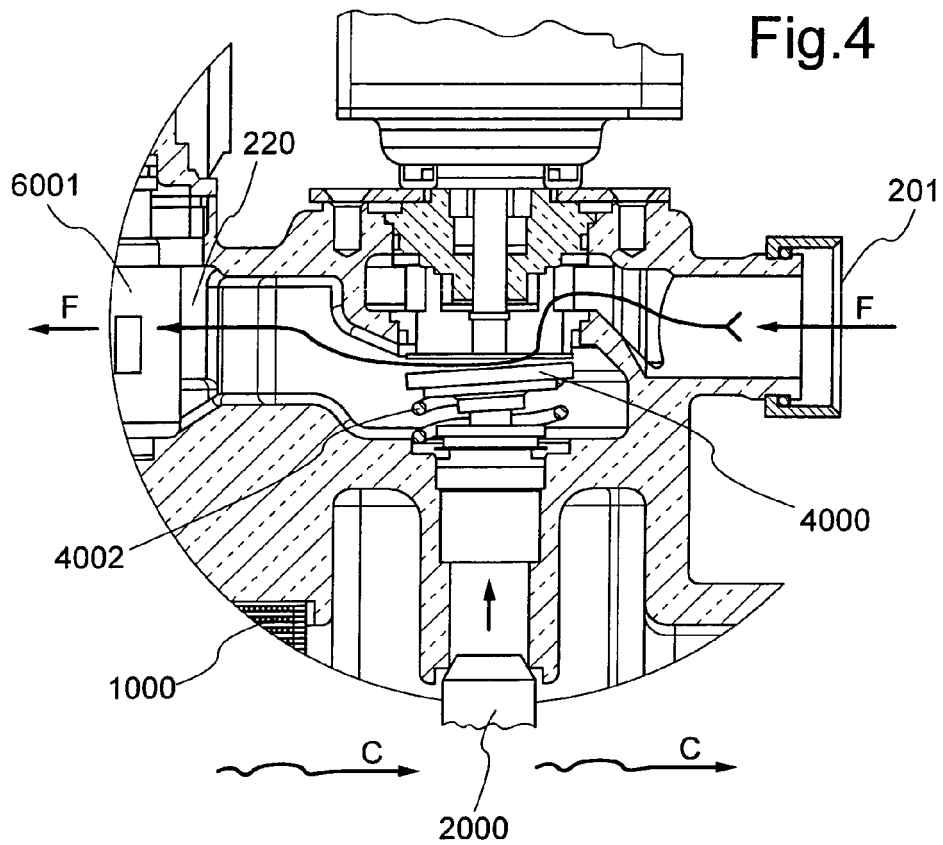
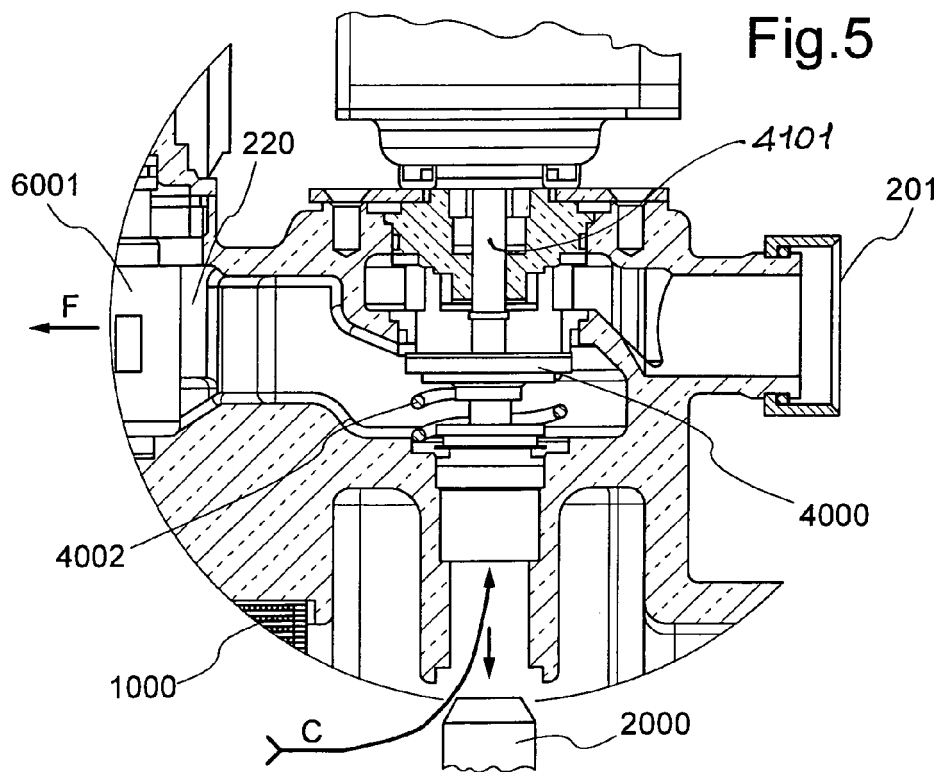


Fig.5



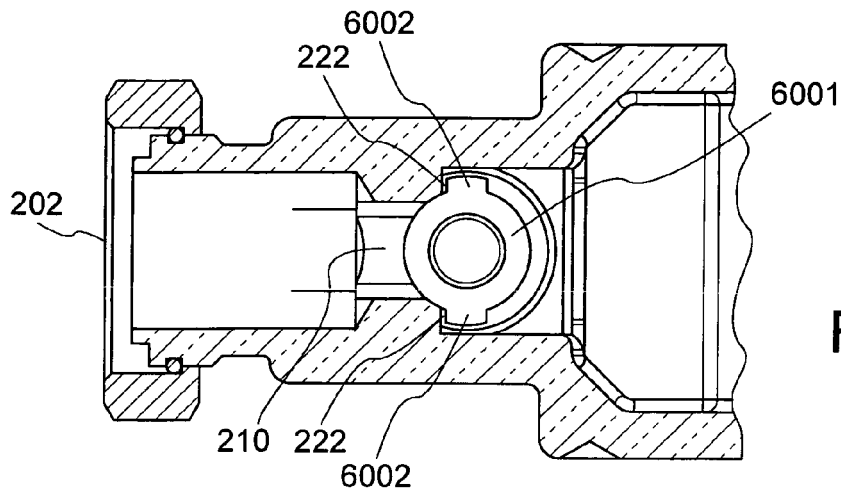


Fig.6

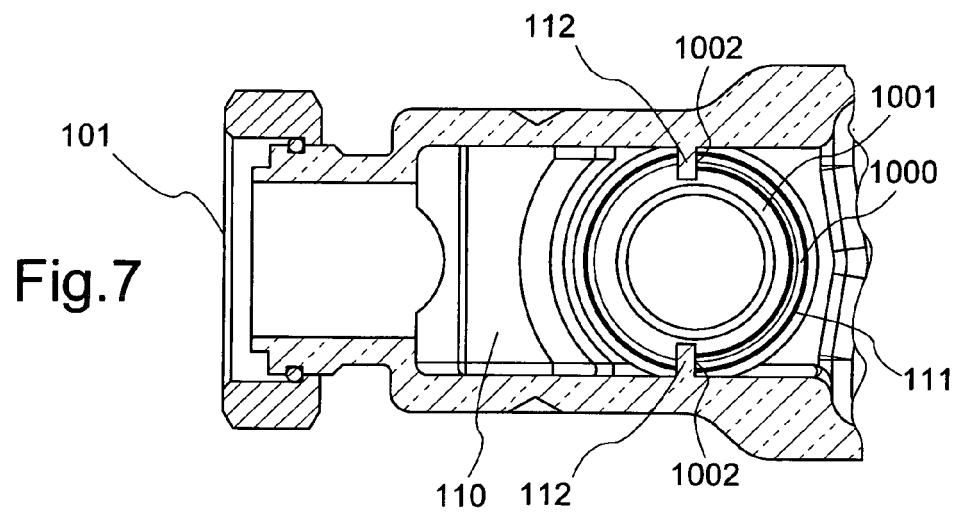


Fig.7

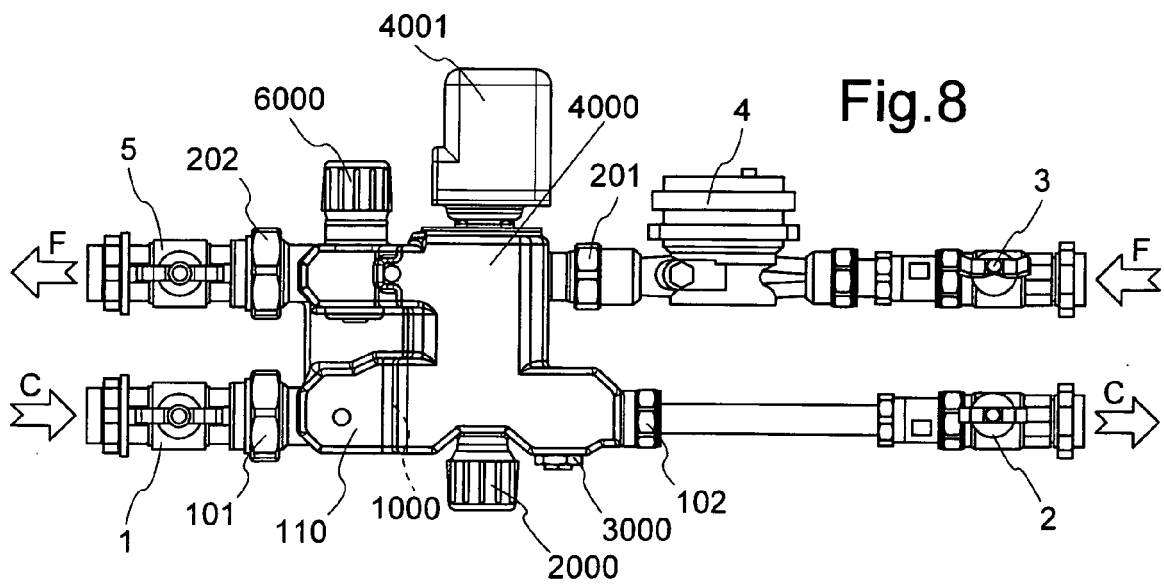


Fig.8