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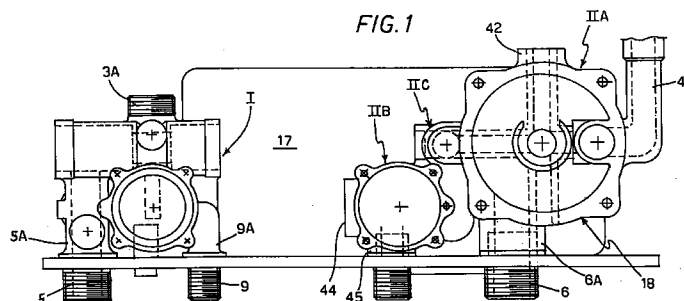
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(54) **A valve assembly with integral pump for a plant providing both heating and sanitary hot water**

(57) A valve assembly for a combined plant for providing both heating and sanitary hot water, comprising a gas burner (1), a main gas/water heat exchanger (2), a water/water heat exchanger (17) connectable through a three-way valve (4) in the circuit of the heating water, at least a radiator (R), and a pump (P) for circulating the

heating water. The assembly is made up by two sub-assemblies or valve units (I, II) both formed of a composite plastic material, with the second sub-assembly (II) incorporating said pump (P).



Description

The present invention concerns a valve assembly adapted for being used in combined plants for providing both heating and sanitary hot water, i.e. residential plants wherein the same heat source, particularly a wall-mounted gas-fired boiler, is used for heating both the water for the heat spreading elements (radiators) for heating the rooms, and the sanitary or domestic hot water for various purposes.

EP-A-0 568 122 in the name of the same applicant discloses a valve assembly formed by two sub-assemblies or valve units for a combined plants for heating and sanitary hot water comprising a gas burner, a (main) gas/water heat exchanger, a water/water heat exchanger connectable through a three-way valve into the heating water circuit, at least a radiator and a pump for circulating the heating water.

In the body of a first unit of such assembly there are formed the three-way valve, a pipe fitting for the connection with the main heat exchanger, a fitting for the connection with the radiators, an outlet fitting for the domestic water, two pipe fittings for the connection with the water/water heat exchanger, a manostat and a bypass valve with an associated outlet fitting.

In the body forming the second unit of such assembly there are formed a depression device, a pipe fitting for the connection with the radiator, an inlet fitting for the domestic water, an outlet fitting towards the pump, and two fittings for the connection with said water/water heat exchanger.

Such assembly proved to be quite effective and reliable, besides of having a small size. However, the presence of the pump mounted on the second unit prevents any further reduction of the overall dimensions of the assembly.

Moreover, from the viewpoint of the manufacturing costs and of a simple maintenance, a reduction of the brass components - the cost of which is not negligible - is highly wished. Moreover, the brass components have many limits in respect of their shape that have a negative effect on the plant final volume.

It is an object of the present invention to overcome the above illustrated drawbacks and limitations, and more particularly to realize a valve assembly or hydraulic group for building hydraulic plants of the above mentioned type that have an extremely compact construction, at the same time reducing the number of the connecting pipes between the two sub-assemblies, and that allows for an easy and simple maintenance service, and has very limited manufacturing and installation costs.

In accordance with the invention, the above objects are achieved through a valve assembly for a combined plant as claimed in claim 1.

Additional advantageous features are the objects of the dependent claims.

Generally when using metal bodies there are limitations in the valve assemblies of heating plants, not only

due to their costs, but even in respect of their practicality. The applicant, by realizing almost completely both the two sub-assemblies of composite plastic materials, has accomplished the advantage of obtaining - at low cost - configurations that are not possible or practicable when using brass, and at the same time the surprising advantage of incorporating a component (the pump) in the second unit, with an arrangement that is further advantageous in respect of the overall dimensions. Moreover thanks to the invention the number of rigid tubular connections between the parts that contribute to the overall dimensions has advantageously been reduced.

The invention will now be described with reference to the attached drawings illustrating preferred but non-limiting embodiments thereof, in which:

Fig. 1 is a front view showing the construction of the valve assembly according to the present invention; Fig. 2 is a front view of the sub-assembly I shown in Fig. 1;

Fig. 3 is a top view of the sub-assembly I shown in Fig. 1;

Fig. 4 is a cross-section view of the monolithic portion of the sub-assembly I, along line IV-IV of Fig. 2; Fig. 5 is a front view of the monolithic portion of the sub-assembly II of Fig. 1;

Fig. 6 is a cross-section view of the sub-assembly II, along line VI-VI of Fig. 5;

Fig. 7 is a side view of the sub-assembly II, cross-sectioned along line VII-VII of Fig. 5;

Fig. 8 is a perspective view of the monolithic portion of the sub-assembly II;

Figs 9 and 10 illustrate two metal portions of the second sub-assembly;

Fig. 11 schematically illustrates the working of the valve assembly according to the present invention;

Fig. 11A and 11B illustrate with more details the functional characteristics of the two hydraulic sub-assemblies of Fig. 11;

Figs 12A and 12B illustrate the construction of a bypass valve; and

Fig. 13 illustrates the internal structure of a depression device or valve.

The valve assembly according to the invention is partially similar - from the working viewpoint - to that of the above mentioned European patent n. 568 122. In the following, with reference to Figs 11, 11A and 11B, it is shortly discussed the general operation of a plant capable of supplying both heating and hot sanitary water and incorporating a valve assembly according to the invention.

The valve assembly according to the invention is connected to a plant for supplying both heating and sanitary hot water, i.e. a plant adapted to produce hot water in a closed circuit comprising heat radiators and, upon request, to erogate tap sanitary hot water for general purposes, the plant using a same primary heat source,

such as a gas burner.

The gas burner 1 heats through a (main) finned heat exchanger 2 the water in a room heating circuit with such water being circulated by a pump P. The burner is fired by a microswitch 155 controlled by a manostat or pressure switch 15 to be described hereinbelow. This heated water reaches a valve 4 of the three-way type that under normal conditions directs the water to the radiators or radiating elements, indicated as a whole by the single element R, through the fitting 5 and is returned to the pump P through a heating return fitting 6.

When sanitary hot water is requested, the three-way valve 4 closes the passage 5 towards the radiators and delivers the hot water to a second water/water heat exchanger 17 (for example of the metal sheet type) where such hot water heats the domestic water incoming from the fitting 8 (that is from the waterworks). The domestic water is then delivered through the outlet fitting (and conduit) 9 to the taps for erogating the hot water, schematically indicated by the single tap RE in the Figure.

From the constructive viewpoint, the valve assembly according to the invention is substantially formed by two sub-assemblies or valve units I and II, enclosed by dashed squares in Fig. 11, and made almost exclusively of a composite plastic material. More particularly according to the invention, each of the sub-assemblies I and II is formed as a one-piece body of molded composite plastic material in which there are formed or mounted the various components and metal fittings.

With reference to Figs 11, 11A and 11B, the first sub-assembly, or delivery distributor, comprises the three-way valve 4, a fitting 3 to be connected to the main heat exchanger 2, a fitting 5 for the connection to the radiator R, an outlet fitting 9 for the domestic water and two spigots or pipe fittings 22, 23 connecting the unit with said water/water heat exchanger 17 (of known type) formed by metal sheets stacked on each other to define alternating thin passages through which flow the hot water and the water to be heated, respectively.

In Fig. 11, for representation reasons, the connections to the exchanger 17 are shown as conduits whereas in practice both sub-assemblies are built in such a manner that the illustrated connections are mere outlets or openings having a negligible length.

The three-way valve 4, the construction of which is illustrated with more details in Fig. 11A, can be actuated either by an electric motor 12 or by a differential pressure flow valve of the diaphragm type (not shown) connected to a depression device by two tubes. In the illustrated embodiment, the motor 12 is mounted on a seat in the sub-assembly I, and secured by means 38, for example two screws or a slit ring, so as to be easily dismantled for servicing and replacing the components, if necessary.

The electric motor 12, connected to the stem of the three-way valve 4, accomplishes a rectilinear movement upon receiving a command or enabling signal S from a

manostat device 14 in the domestic water circuit, as will be described later on. As shown in Fig. 11A, within the valve 4 there are housed two actuating members 42 and 43, formed as flat bodies fixed to each other and axially urged by a return spring 44.

An opening 30, provided near the fitting 3, allows the insertion of a temperature probe, usually a thermistor (not shown).

To an additional fitting 7 of the three-way valve 4 there is connected a pressure difference manostat 15 that opens the microswitch 155 for disenabling the burner in case of lack of water in the heating plant and/or lack of pressure (pump blocking). This arrangement advantageously prevents the burner firing in the above mentioned situations which in the known plants could lead to overheating the primary exchanger before the intervention of a protection thermostatic device provided for in such known plants.

Such pressure difference manostat 15 comprises a chamber 150 connected to the fitting 7, that is divided into two parts by a diaphragm 151. One of the two parts communicates through the passage of the fitting 7 with the three-way valve, whereas the other part is connected to a point upwards the pump P through a passage 158, i.e. to a zone at a lower pressure.

A flat member or pan 152 abuts against the diaphragm 151, urged by a spring 154 and provided with a spindle 153 protruding from the chamber 150 for acting over the microswitch 155. When there is water in the plant, such water is pressurized by the pump P on the side of the valve 4, with the other side being in a depression condition, and the so generated pressure difference acts over the diaphragm 151 controlling the safety microswitch 155.

On conduit or fitting 5 there is formed a bypass valve 16, formed by a seat in which there are housed: a movable member 161 biased by a spring 162 that abuts against a spring stop 163 (see Fig. 12A).

When the pressure difference between the delivery and return sides reaches a predetermined high value, for example due to large load losses in the radiators, the bypass valve 16 is opened and a part of the water recirculates through the bypass connection tube 10A provided for ensuring always the passage of a certain amount of water towards the main exchanger 2.

As better shown in Fig. 4, the unit further provides the two openings 22 and 23 fitted with sealing rings or O-rings 70, 71 for the connection to the water/water heat exchanger 17, for the inlet of the heating water and for the outlet of the domestic water, respectively. The connection is accomplished through a stay or tie rod 73 drawing the parts near to each other and compressing the O-rings so as to realize a sealing thereof.

Continuing the functional description of the assembly (Figs 11 and 11B), Fig. 11B illustrates with more details the second sub-assembly II, enclosed in a dashed rectangle in Fig. 11. This sub-assembly comprises command and control means for the three-way valve 4. In the Figures such means comprises a pres-

sure difference manostat 25 fitted in the sanitary tube and controlling the motor 12 on the sub-assembly I, however such means can have other different constructions, such as for example a pressure-actuated diaphragm valve. The second sub-assembly II further comprises a depression device 14 and the pump P. As better illustrated hereinbelow with reference to Fig. 7, the construction of the sub-assembly II according to the invention comprises a one-piece or monolithic body 18 and a pump case or housing 19 adapted to contain the motor of the pump, both the body and the case being of a composite plastic materials, together with metal fittings 50, 60.

The components of the sub-assembly II perform the following tasks. When the tap RE for delivering hot water is opened and as long as the requested water flow rate is below a given value, such as for example 2 liters/minute, the water from the inlet fitting 8 and flowing through a short conduit 20 towards the plate heat exchanger 17, at first passes through a small hole 145 in the bored movable member 141 within the depression device 14. When the delivered water flow becomes larger, then the force of the spring 146 is overcome and the water flows also through the bored movable member 141.

The construction and the operations of the manostat 25, connected to the device 14 by two conduits 142 and 144 are similar to those of the above illustrated device 15, and also this latter is completely open at a predetermined value of the flow rate, for example 2 liters/minute.

During the water flow, the water pressure of the waterworks is applied to conduit 142, while the pressure drop is applied to conduit 144 for obtaining a signal adapted to the working of the sanitary manostat 25.

In case the three-way valve is controlled by a diaphragm valve in lieu of an electric motor, the manostat 25 is omitted and the conduits 142, 144 are connected to said diaphragm valve.

Referring now to Figs 5-8, the construction of the sub-assembly II comprises the one-piece or monolithic body 18 and a portion of case 19, both of composite plastic material, and metal members or fittings 50, 60 to be later illustrated with more details. According to the invention, only the fittings are realized as brass components and are pressing or forced into the corresponding seats or receptacles, so that in the plant installation the workman must not work on plastic materials.

The monolithic body 18 (see Fig. 8), is moulded of a composite plastic materials, and comprises the portions IIA and IIB that are connected to each other by a connecting portion IIC.

In the portion IIA, which is an integral part with the pump P, there is formed a housing recess 40 for the motor of the pump, an automatic venting duct 41 for the plant, a seat or receptacle 42 for a connection fitting (not shown) to the main heat exchanger 2, and a seat or receptacle 6A for the metal fitting 6 for the return of the heating water.

In the portion IIB there is formed a seat for the depression device 14 and the manostat 25 with two openings 44 and 45 for the depression device and the sanitary cold water fitting, respectively.

In the connecting portion IIC there are formed two openings 32 and 33 (shown by dashed lines) for the connection to the water/water heat exchanger 17, that are substantially equivalent to the already described openings 22 and 23, and a hole 46 for the connecting tap (not shown) to the heat exchanger 17.

The case 19 of the pump P can be shaped in different ways, in accordance with the type of pump being mounted in the assembly, and a further intermediate portion of composite plastic material (not shown in the drawings) could be provided for adjusting pumps with a shorter length.

Preferably the openings and the seats or receptacles for receiving a threaded metal fitting are equipped with clutches or couplings (clearly shown in Fig. 9) comprising a slit in which an elastic fork is inserted that engages a groove realized in the metal component that is housed therein. According to an alternative embodiment shown in Fig. 8, other known fastening means can be used, for example screws.

Fig. 9 illustrates the brass metal body 50 provided with conduits 56, 57 and 58 communicating with each other. The body 50 comprises the proper threaded fitting 8 for the return of the heating water, and the portion of a clutch 51 with a groove 52 for engaging the metal fork. The metal body 50 further comprises a fitting 58 (shown as not threaded in Fig. 9) for water drain, a mouthpiece 53 for a safety valve (64 in Fig. 11), and an opening 54 for the connection to a filling tap RI (see Fig. 11B). A further opening, axially aligned with the opening 54 (and not visible in Fig. 9) is provided for the connection to an expansion tank 13 shown in Fig. 11. Finally, an additional outlet 55 is provided for the connection with a thermostat.

As illustrated in Fig. 10, the metal body 60 is substantially formed by a threaded fitting for the inlet of the domestic water, a portion of clutch 61 with a groove 62 for engaging the fork, and a opening 63 for the connection to a (possible) tap for water filling.

With reference to Fig. 13, the valve or depression device 14 comprises the following axially aligned components: a plug 81, an O-ring 82, a metal network filter 83 and a bush 84. Between the filter 83 and the bush 84 there is interposed a flow regulator 85, for example set at 12 liters/minute. A spring, housed between the seat of the movable member and the movable member 85 supplies the return force.

Preferably the composite material forming the pieces 1, 2 and 6 is a thermoplastic polymeric material, for example of polyamide fibers, such as nylon filled with glass fibers or other materials, or a so called "technological" polymers such as the Rytan^R.

In general, the composite plastic material used in the assembly of the invention has a very good dimensional stability and a high resistance against chemical

attacks, as well as a low mold shrinkage in order to obtain the required dimensional precision of the components.

Although the invention has been illustrated with reference to preferred embodiments thereof, it is more generally susceptible of other different applications and modifications that are within the scope of the invention as will be evident to the skilled in the art.

Claims

1. A valve assembly for a combined plant for providing both heating and sanitary hot water comprising: a gas burner (1), a main gas/water heat exchanger (2), a water/water exchanger (17) connectable through a three-way valve (4) in the circuit of the heating water, at least a radiator (R), and a pump (P) for circulating the heating water, said assembly comprising two sub-assemblies or valve units (I, II), characterized in that both said sub-assemblies are formed of a composite plastic material, with the said second sub-assembly (II) incorporating said pump (P).
2. A valve assembly as claimed in claim 1, characterized in that the first sub-assembly (I) comprises a three-way valve (4), a fitting (3) and a fitting (5) for the connection of said three-way valve (4) with said main heat exchanger (2) and the radiator (R), respectively, an outlet fitting (9) for the domestic water and two connections (22, 23) to said water/water exchanger (17), and a bypass valve (16) mounted on said fitting (5) for the connection to the radiator (R), said first sub-assembly (I) being formed as a monolithic one-piece body of a composite plastic material.
3. A valve assembly as claimed in claim 1 or 2, characterized in that said second sub-assembly (II) comprises means (25) for actuating said three-way valve (4) of the first sub-assembly (I), a pressure difference depression device (14) connected to said actuating means (25), said pump (P), a fitting (6) for the connection to the radiator (R), a fitting (8) formed on said depression device (14) for the inlet of the domestic water, an automatic venting duct (41) of the pump, and two connections (32, 33) to said water/water exchanger (17), said second sub-assembly (II) being formed by a monolithic body (18) and by a case (19) housing the motor that drives the pump, both of which are of a composite plastic material.
4. A valve assembly as claimed in claim 3, characterized in that said first sub-assembly (I) comprises an electric motor (12) for actuating said three-way valve (4) and that said actuating means provided in the second sub-assembly (II) comprises a manostat (25) controlling said motor (12) through an electric signal (S).
5. A valve assembly as claimed in claim 3, characterized in that said first sub-assembly (I) comprises a diaphragm valve for actuating said three-way valve (4), and that said actuating means in the second sub-assembly (II) comprises two conduits (142, 144) coming out from said depression device (14) and connected to said diaphragm valve.
6. A valve assembly as claimed in claim 3, characterized in that said first sub-assembly (I) provides seats or receptacles (3A, 5A, 9A) for housing metal fittings (3, 5, 9), and that said second sub-assembly (II) provides two metal bodies (50, 60) in which are formed metal fittings (6, 7, 8).
7. A valve assembly as claimed in the preceding claims, characterized in that said monolithic body (18) of the second sub-assembly (II) comprises:
 - a first portion (IIA) that is an integral portion of said pump (P) and provides a recess (40) for receiving the motor of the pump, an automatic venting duct (41) for the plant, a seat or receptacle (42) for the fitting to the main heat exchanger (2), and a seat or receptacle (6A) for the metal fitting (6) for the return of the heating water;
 - a second portion (IIB) in which a seat is formed for said depression and pressostatic device (14) with two openings (44) for the depression device and an opening (45) for the inlet of the cold domestic water, respectively; and
 - a connecting portion (IIC) in which there are formed said two connection openings (32, 33) to the water/water heat exchanger (17), and a hole (46) for a connection stay with the heat exchanger.
8. A valve assembly as claimed in the preceding claims, characterized in that said composite material comprises a thermoplastic polymer, such as nylon filled with glass fibers.
9. A valve assembly as claimed in the preceding claims, characterized in that the said composite material comprises a technological polymer polymer, such as the Ryton.
10. A valve assembly as claimed in the preceding claims, characterized in that one (50) of said metal bodies is a brass member through which there extend communicating conduits (56, 57, 58), and comprising a threaded metal fitting (8) for the return of the heating water, the fitting (58) for the water draining, a mouthpiece (53) for a safety valve (64), and a connection opening (54) for a possible tap (RI) for water filling.

11. A valve assembly as claimed in claim 10, characterized in that the said metal body (50) further comprises a connection opening to an expansion tank (13) and an outlet (55) for the connection to a thermostat.

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12. A valve assembly as claimed in the preceding claims, characterized in that the other (60) of said metal bodies is substantially formed by a threaded fitting for the inlet of the domestic water, and comprises a clutch portion and an opening (63) for receiving the fitting to a possible tap (RI) for water filling.

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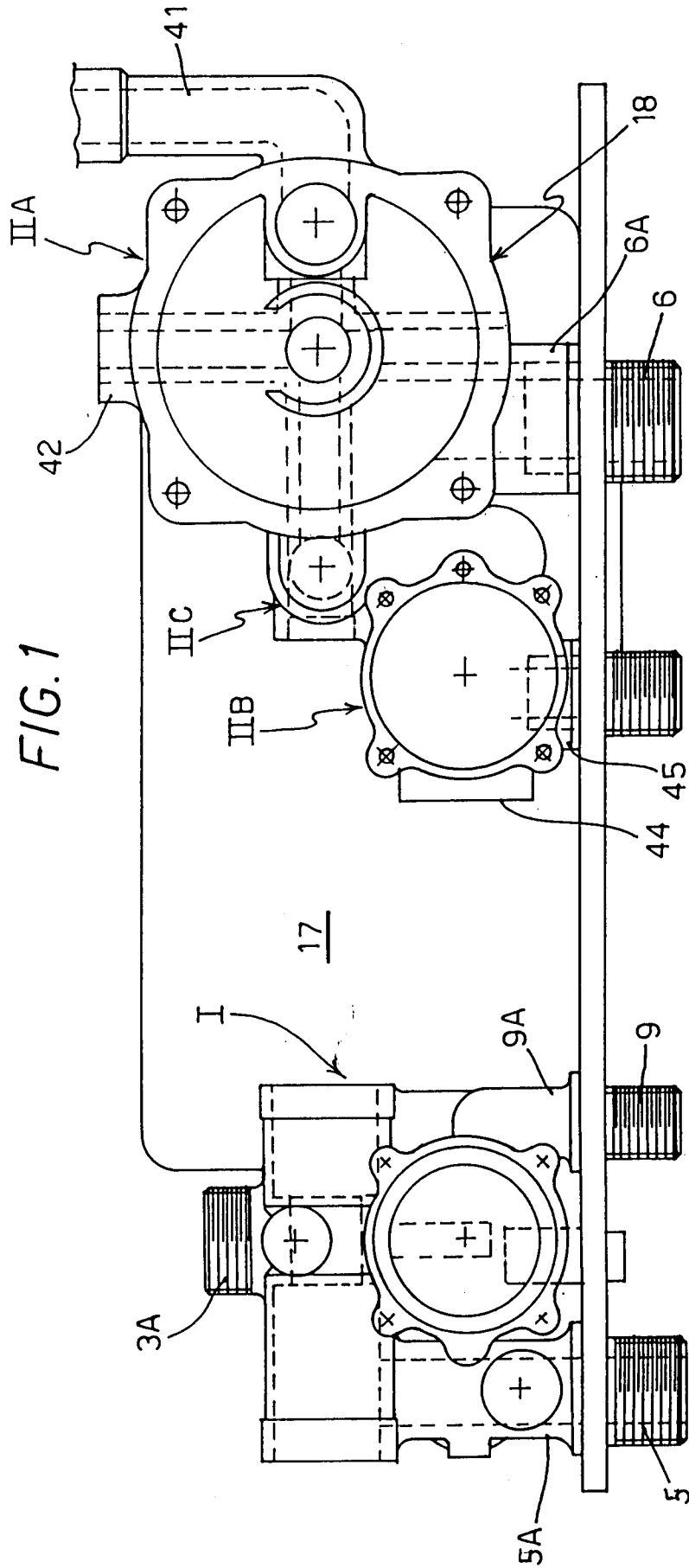
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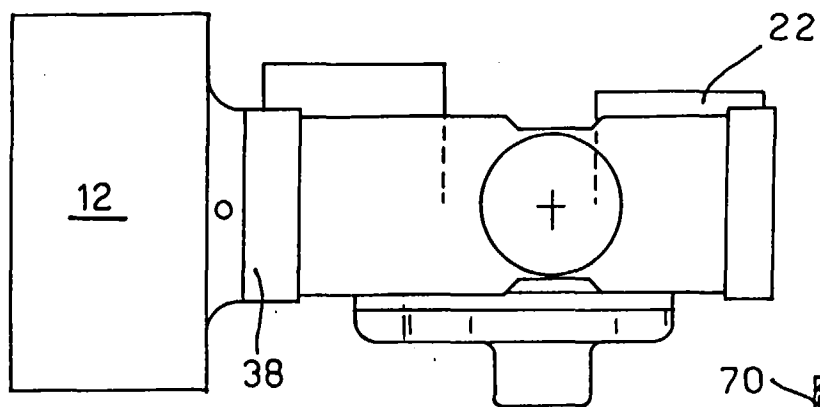
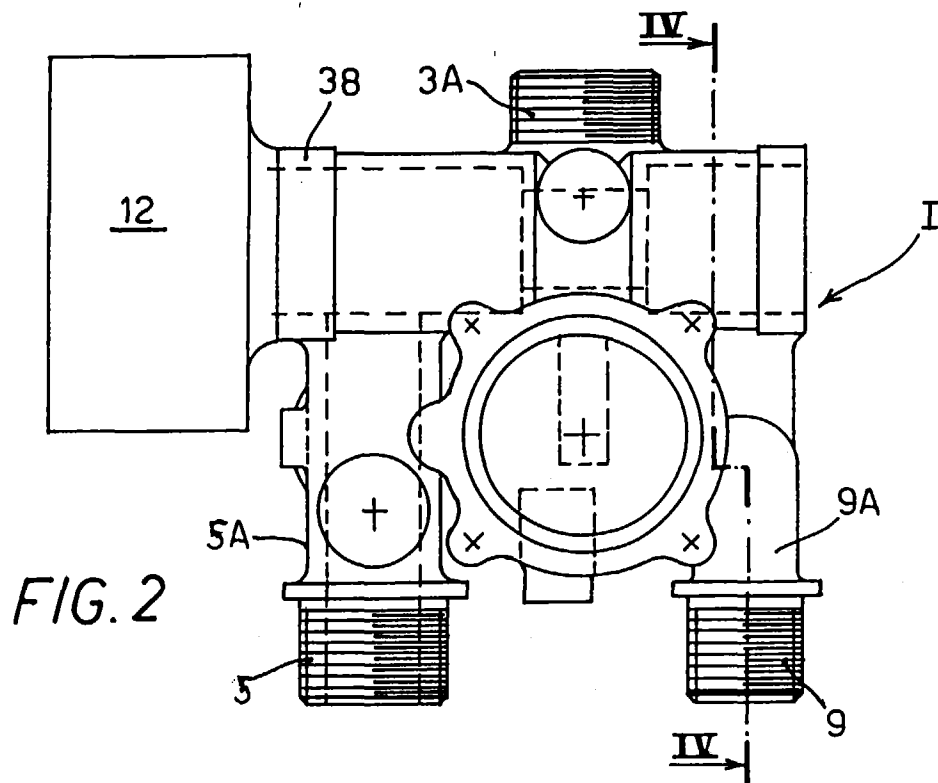
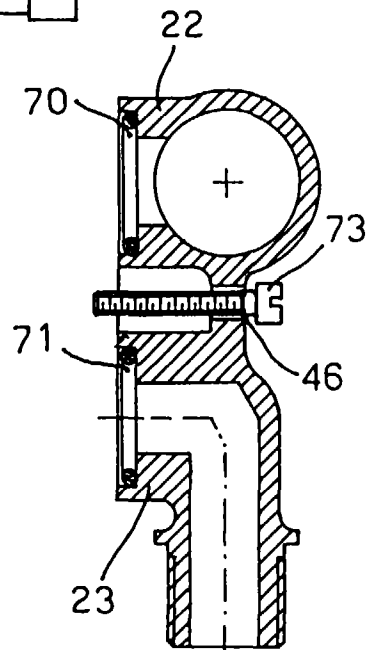


FIG. 4



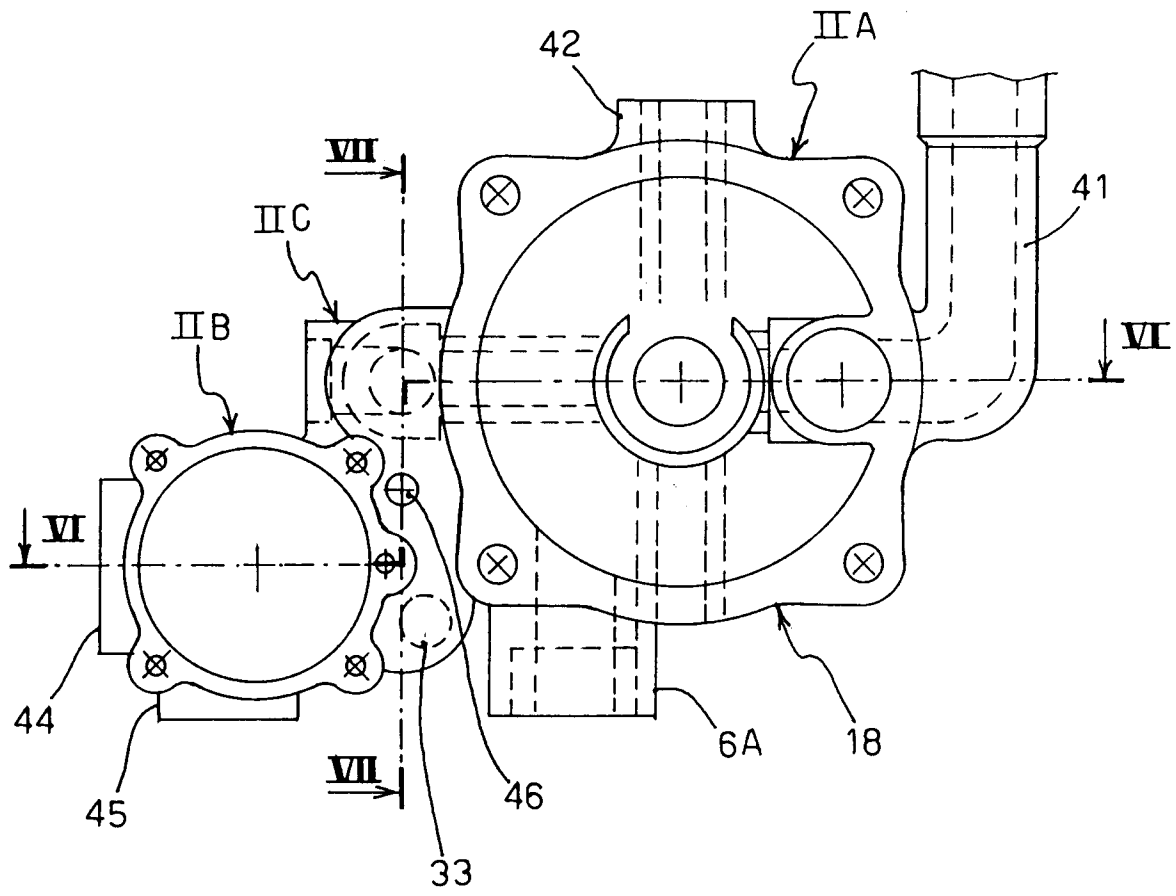
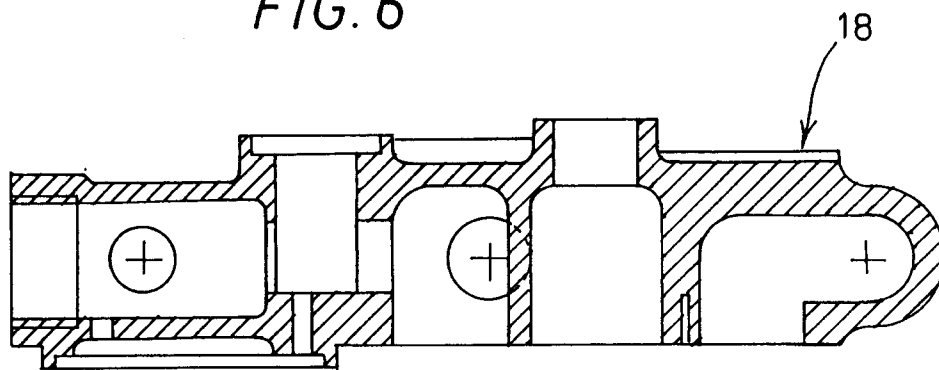


FIG. 5

FIG. 6



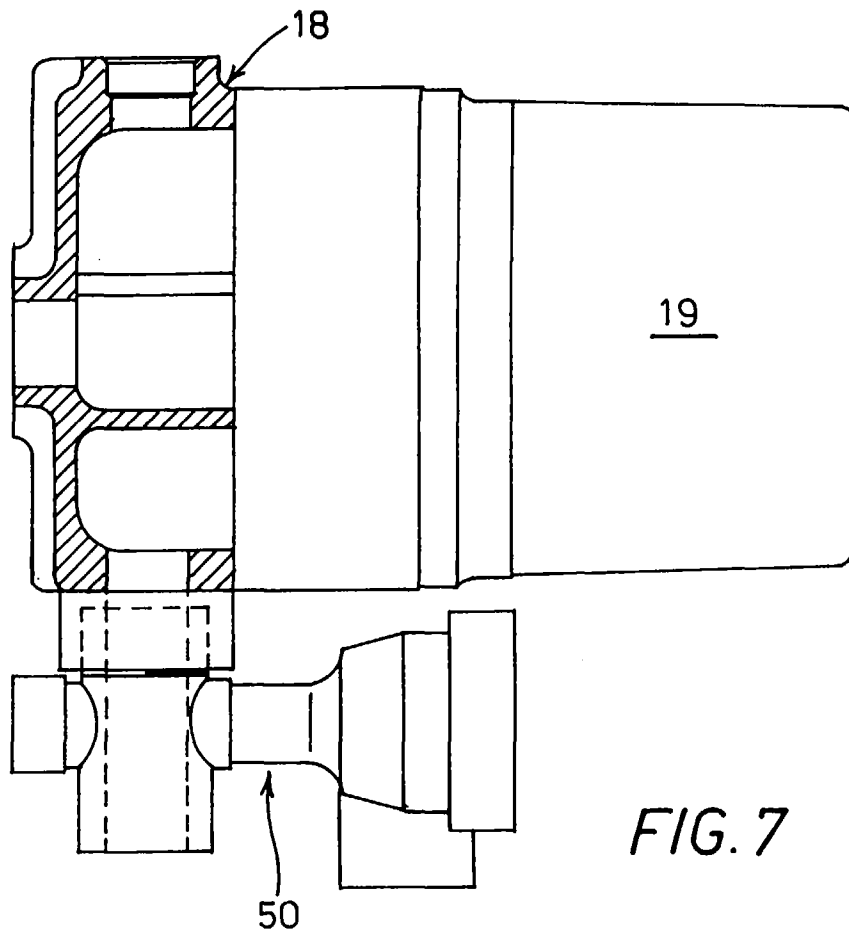


FIG. 7

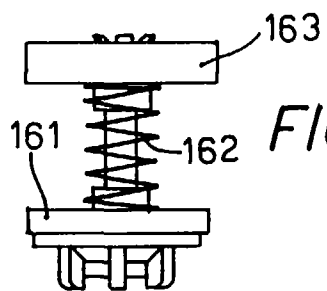


FIG. 12A

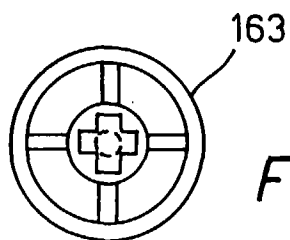


FIG. 12B

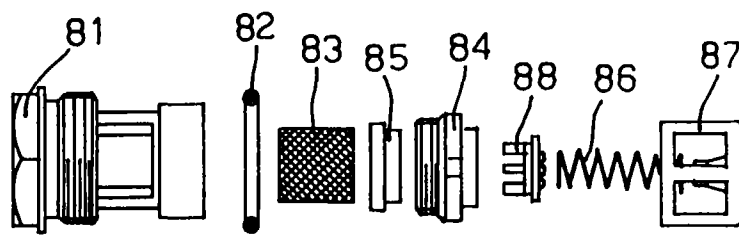
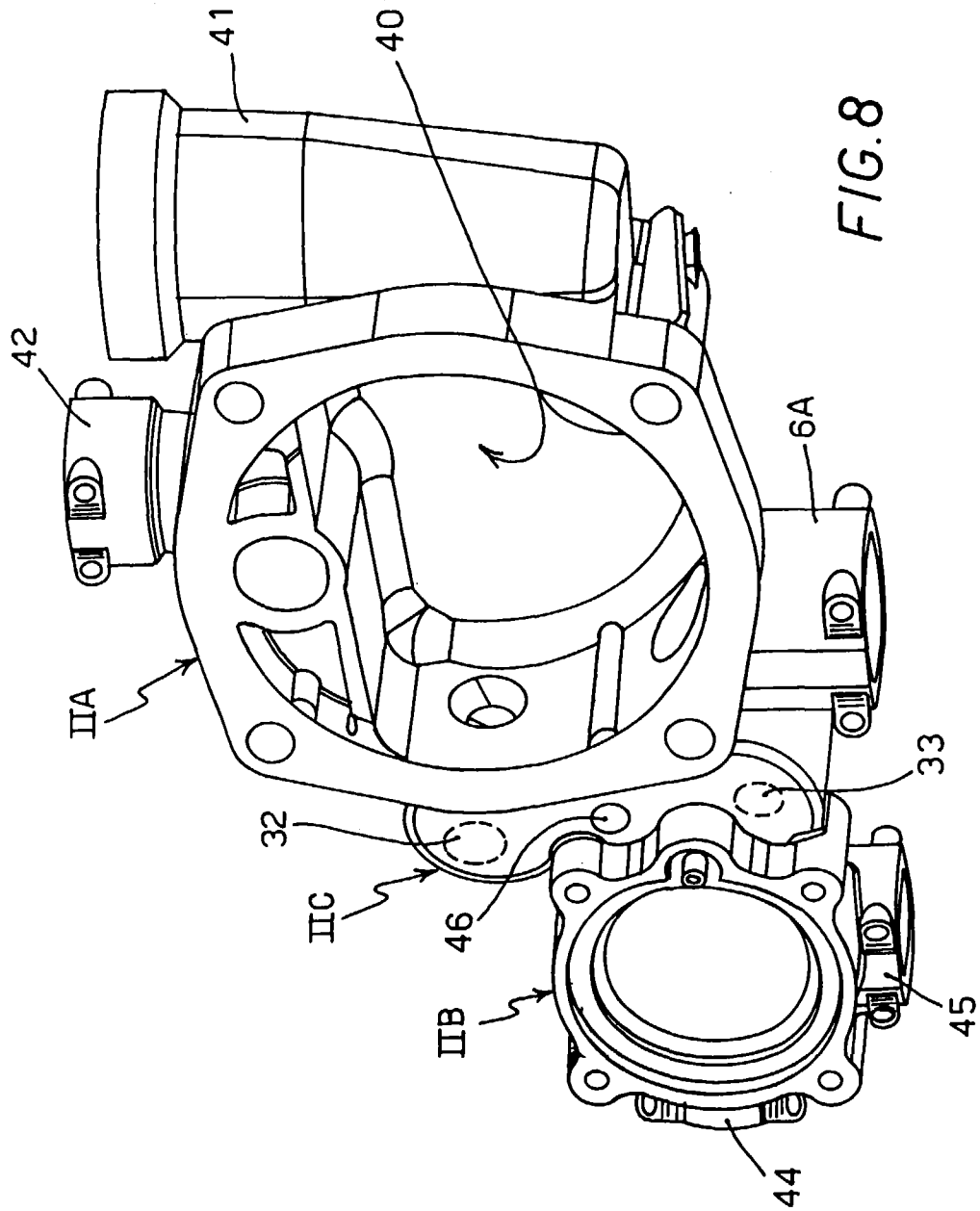


FIG. 13



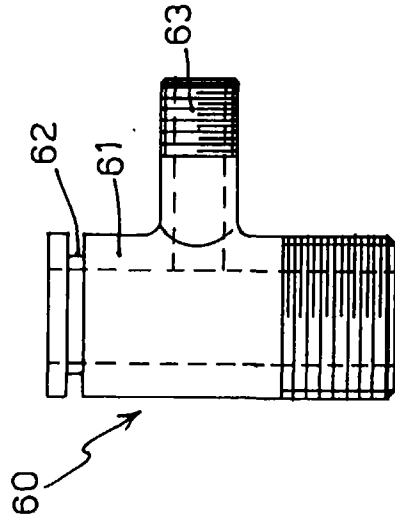


FIG. 10

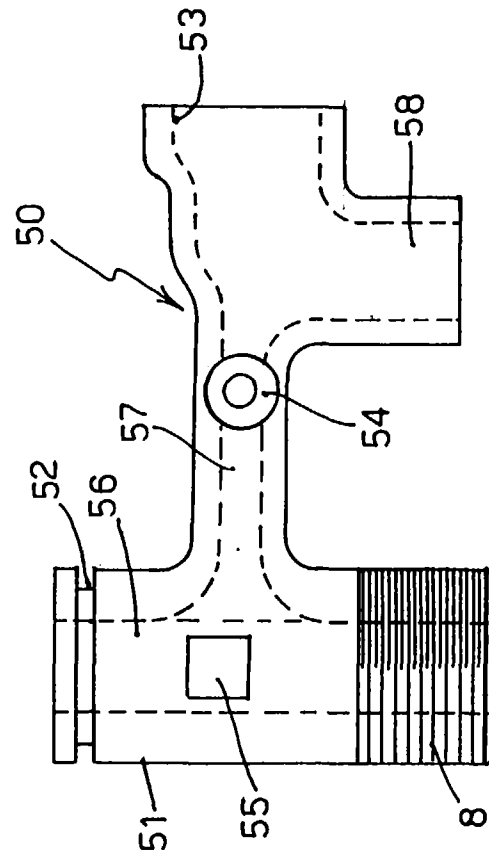
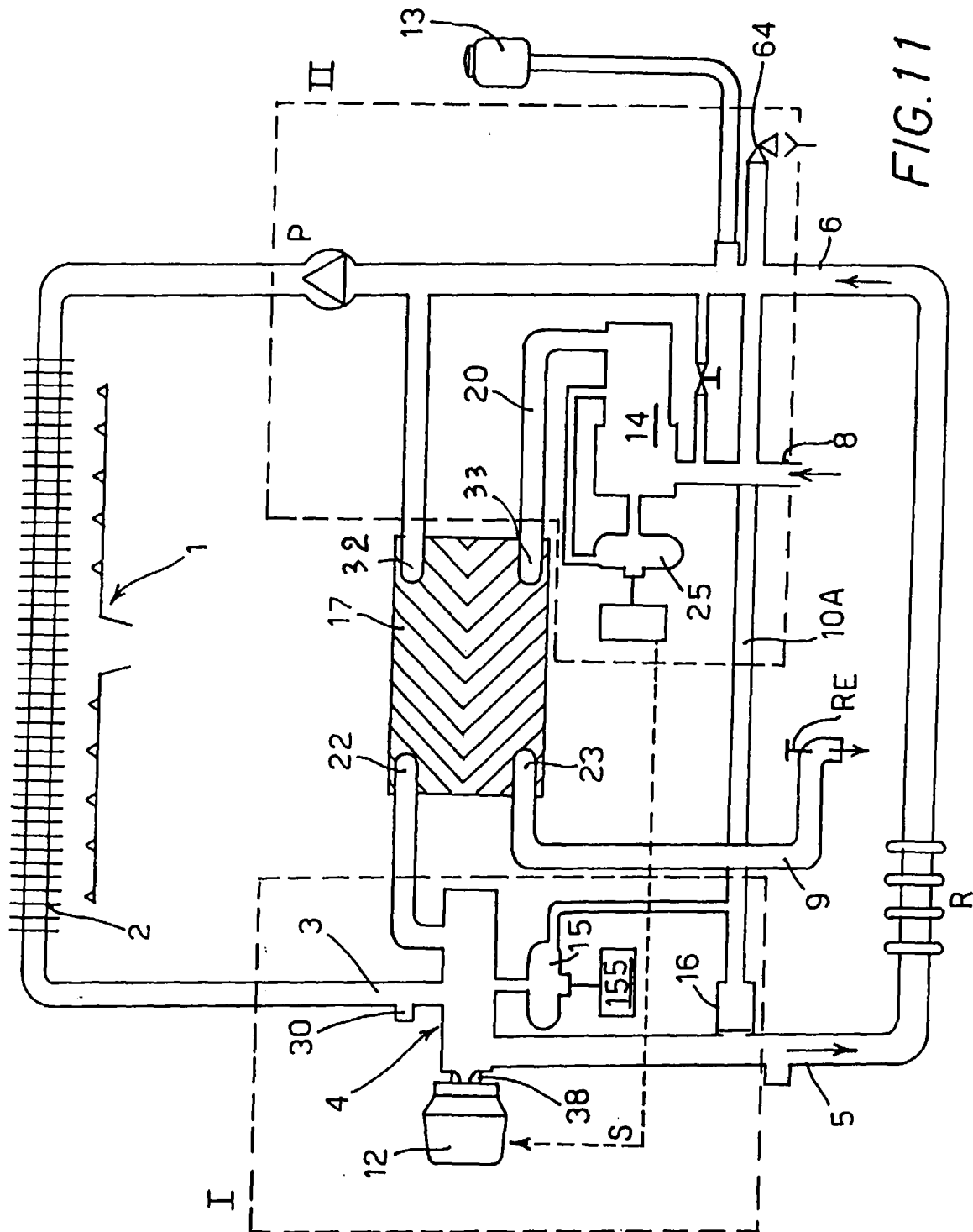


FIG. 9



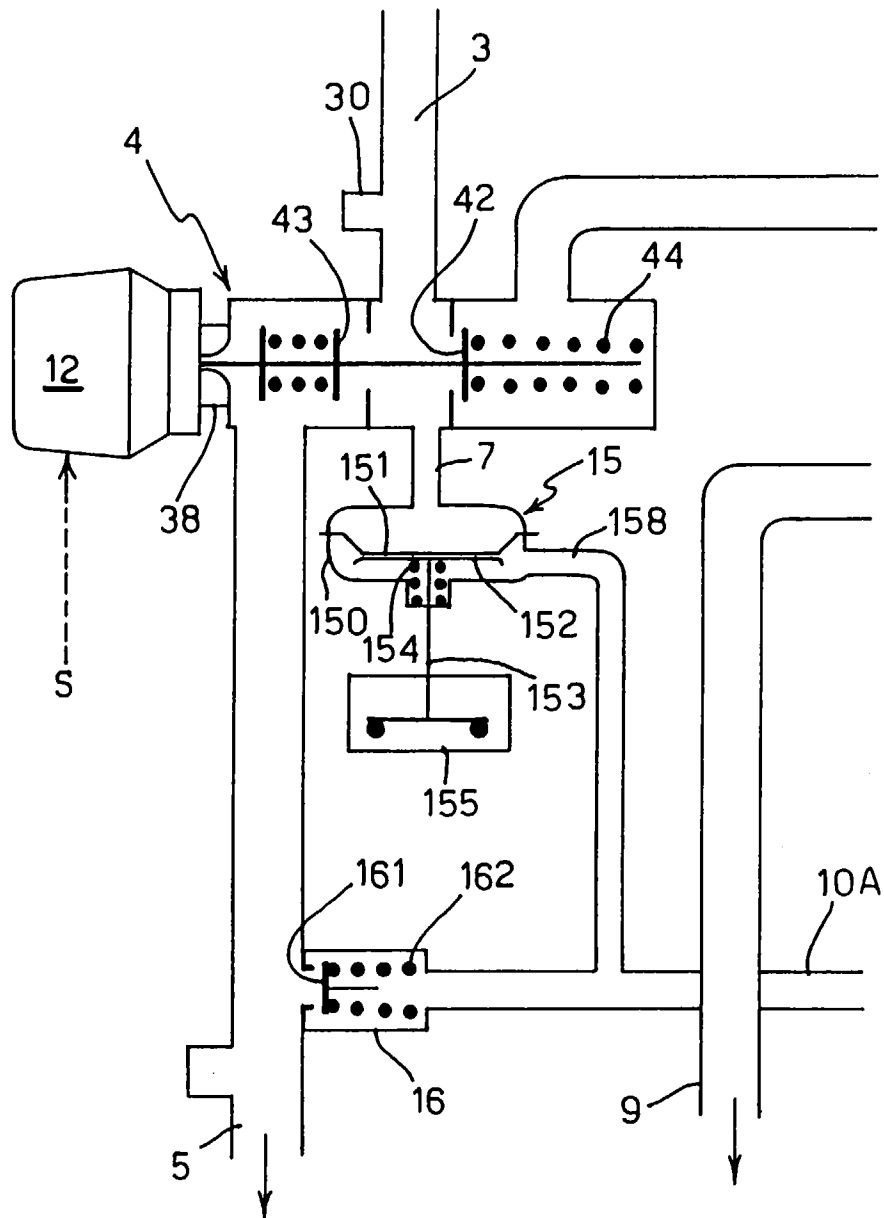


FIG.11A

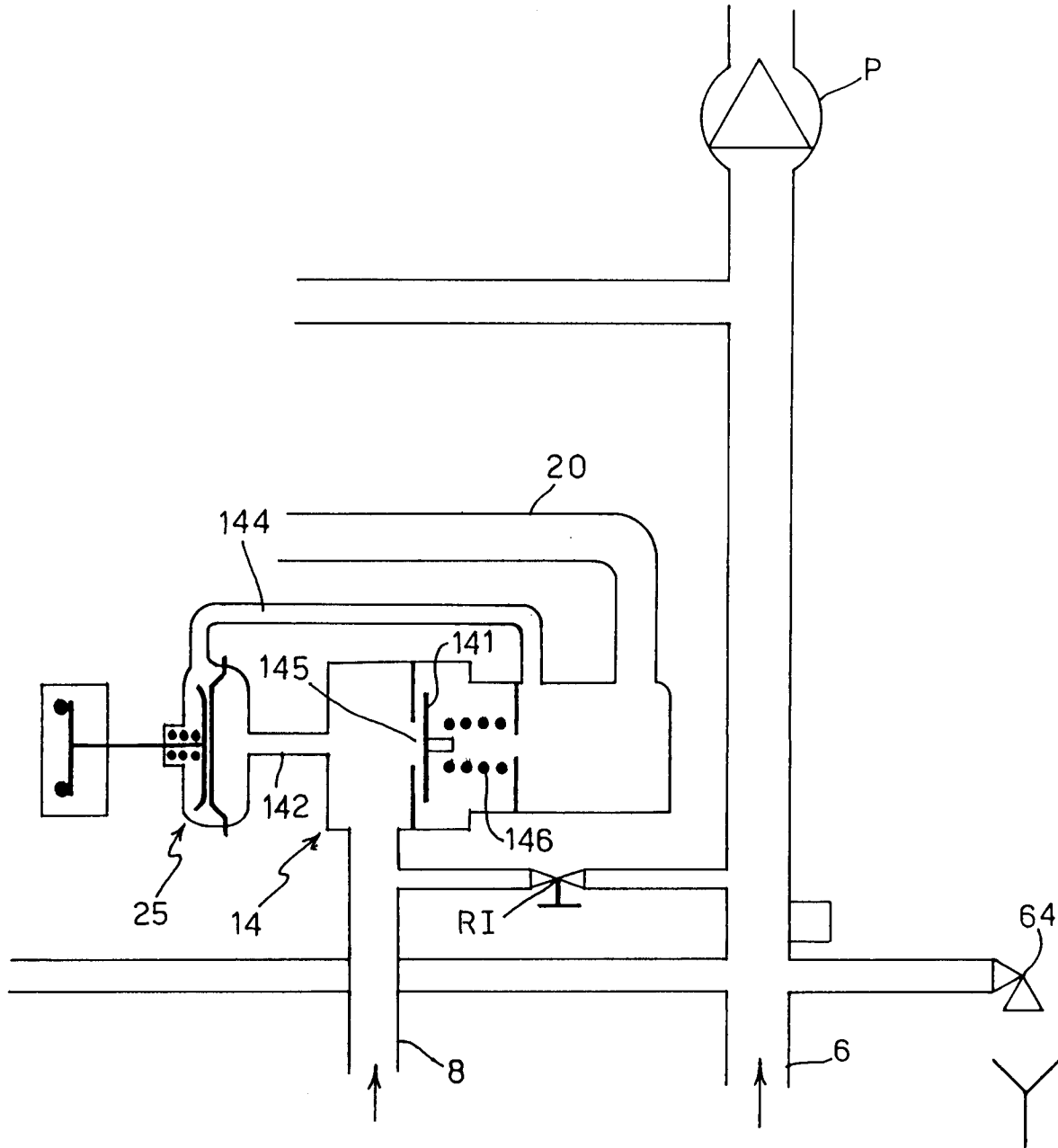


FIG. 11B