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(54) **Heat pump**

(57) A heat pump comprising a compressor circuit (1-14) including, seen in the direction of flow of the compressor circuit:

- a compressor (1);
- a primary part of a first heat exchanger, to be referred to as the condenser (4);
- an expansion valve (8); and
- a primary part of an second heat exchanger, to be referred to as the evaporator (11);

wherein the compressor (1) is connected with a subframe (4,11,15-17), which subframe (4,11,15-17) is connected, via first damping elements (18,19), with a mounting frame (20,21) which is intended to be fixedly connected to a fixed structure, wherein the first damping elements (18,19) provide vibration isolation between the subframe (4,11,15-17) and the mounting frame (20,21), wherein a control unit (73) regulates the rotational speeds of the heat source circuit pump (23), the central heating circuit pump and/or the compressor (1).

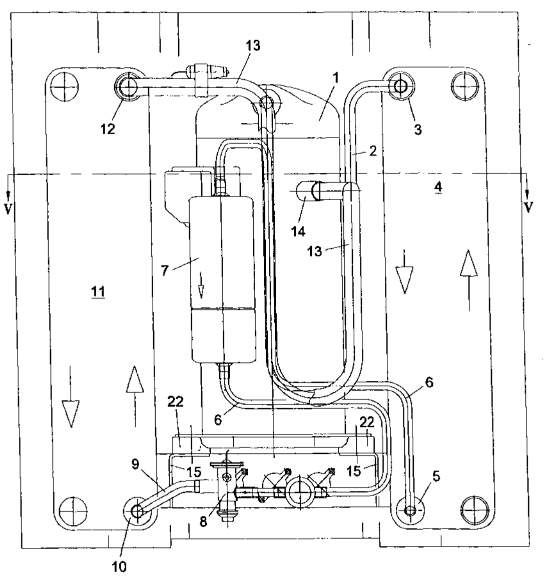

Fig. 1

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Description

[0001] The invention relates to a heat pump comprising a CH inlet stub and a CH return stub for connection to a CH pipe system of a house or the like building comprising room heating elements, as well as a heat source inlet stub and a heat source return stub for connection to a heat source pipe system comprising a heat source, wherein the heat pump includes a compressor circuit comprising, seen in the direction of flow of the compressor circuit:

- a compressor;
- a primary part of a first heat exchanger, to be referred to as the condenser;
- an expansion valve; and
- a primary part of an second heat exchanger, to be referred to as the evaporator;

wherein the evaporator includes a secondary part, which is in heat exchanging communication with the primary part of the evaporator, and wherein the condenser comprises a secondary part, which is in heat exchanging communication with the primary part of the condenser.

[0002] The abbreviation CH as used herein is understood to mean central heating.

[0003] A heat pump of this kind is known from practice. A drawback of all prior art heat pumps, however, is the fact that they occupy a great deal of space, whilst in addition they produce a considerable amount of noise. Because of this it is not possible to install the prior art heat pump in a room of a house or the like building which is also used for other purposes, such as a scullery, an attic or a kitchen, for example. In the first place, such rooms are often much too small for accommodating the heat pumps that we have known so far, and in the second place it will not be possible to use the room for other activities because of the large amount of noise that is produced by the prior art heat pump.

[0004] Another drawback of the prior art heat pump is the fact that it can only be installed by specially trained, so-called STEK engineers. The reason for this is that the pressures that prevail in the compressor circuit are so high that only specially certified engineers are allowed to carried out the required fitting operations thereon. A regular heating engineer who is qualified to install central heating boilers in houses is not allowed to carry out fitting operations on high-pressure systems of this kind. As a result, the cost of installing the prior art heat pumps is very high, since the STEK engineers charge a higher rate than the regular CH engineers. Moreover, a heat pump of the prior art type requires a precisely defined temperature difference between the medium coming from the heat source and the medium being carried to the heat source. This temperature difference depends inter alia on the flow velocity in the heat source pipe system, which flow velocity in turn depends inter alia on the flow resistance in the heat source pipe system and on the pressure difference being generated by the pump in the heat source circuit. Since the flow resistance differs with each heat source circuit, each newly installed heat pump needs to be adjusted, whereby the flow velocities both in the heat source pipe system and in the CH pipe system as well as the flow velocity of the medium in the compressor circuit must be precisely adjusted. A regular CH engineer is not capable of carrying out this kind of operations, since he has not been trained for this.

[0005] The object of the invention is to provide a heat pump by means of which the above-described problems are overcome.

[0006] In order to accomplish that objective, the invention provides a heat pump which comprises a CH inlet stub and a CH return stub for connection to a central heating pipe system of a house or the like building comprising room heating elements, as well as a heat source inlet stub and a heat source return stub for connection to a heat source pipe system comprising a heat source, wherein the heat pump includes a compressor circuit comprising, seen in the direction of flow of the compressor circuit:

- a compressor;
- a primary part of a first heat exchanger, to be referred to as the condenser;
- an expansion valve; and
- a primary part of an second heat exchanger, to be referred to as the evaporator;

wherein the evaporator includes a secondary part, which is in heat exchanging communication with the primary part of the evaporator, and wherein the condenser comprises a secondary part, which is in heat exchanging communication with the primary part of the condenser, wherein the heat pump also comprises a heat source circuit pump and with a CH circuit pump, wherein, when the heat pump is connected, the secondary part of the evaporator and the heat source circuit pump are incorporated in a heat source circuit which also comprises the heat source pipe system, and wherein, when the heat pump is connected, the secondary part of the condenser and the CH circuit pump are incorporated in a CH circuit which also comprises the CH pipe system, wherein the compressor is connected with a subframe, which subframe is connected, via first damping elements, with a mounting frame which is intended to be fixedly connected to a fixed structure, wherein the first damping elements provide vibration isolation between the subframe and the mounting frame.

[0007] What attracts attention in the first place is the fact that the CH circuit pump and the heat source circuit pump form part of the heat pump. Consequently, the installer does not need to carry out fitting operations to install these two pumps. Besides connecting the electric power supply for the heat pump as a hole, the only operations that are to be carried out by the installer are connecting the CH inlet stub and the CH return stub to the CH pipe system and connecting the heat source inlet stub and the heat source return stub to the heat source pipe system. The engineer need not worry about the electrical connection of the heat circuit pump and the CH circuit pump, therefore, since the electrical connection thereof has already been realised by the electrical connection of the heat pump as a whole. In so far as electrical or electronic connections are to be made, the risk of incorrect connections being made can be avoided by using different connectors or plugs.

[0008] A second aspect which is relevant for the heat pump as defined in claim 1 is the fact that the compressor is connected with a subframe, which is connected, via first damping elements, with a mounting frame which is intended to be fixedly connected to a fixed structure. The presence of the subframe and the first damping elements provides vibration isolation between the subframe and the mounting frame, which results in a considerable noise and vibration reduction.

[0009] In order to achieve a further noise and vibration reduction, second damping elements may be incorporated in the connection between the compressor and the subframe, which second damping elements provide vibration isolation between the compressor and the subframe.

[0010] This mounting arrangement comprising double damping provides a very good noise and vibration reduction. This makes it possible to mount or install the heat pump according to the invention in a room which is also used for other purposes, such as a kitchen, a bathroom or an attic, for example.

[0011] In order to provide a heat pump having the lowest possible weight, so that it can readily be mounted on the wall, the heat pump is according to a further embodiment of the invention characterized in that the evaporator and the condenser form an integral part of the subframe.

[0012] According to a further embodiment of the invention it is furthermore very advantageous for the heat pump to comprise flexible, vibration isolating pipe portions which, when the heat pump is connected, connect the evaporator to the heat source pipe system and the condenser to the CH pipe system. As a result of the presence of flexible, vibration isolating pipe portions, the vibration of the subframe, which is already very low in view of its damped mounting arrangement, is not transmitted to the CH and the heat source pipe systems which are connected to the fixed structure.

[0013] In order to minimize the transmission of vibrations of the source circuit pump to the outside world as well, it is according to a further embodiment of the invention very advantageous to mount the heat source circuit pump and the CH circuit pump on a subframe.

[0014] Additional noise reduction can be realised by providing the heat pump with a double-walled encasing comprising an inner casing and an outer casing. The inner casing contains the components of the compressor circuit, whilst the outer casing contains all the components of the heat pump. Possibly the inner casing can be filled with a sound insulating material, such as acoustic cellulose fibres, for example. Possibly, the water-carrying pipe portions and the heat source circuit pump, as well as the CH circuit pump can be packed in moulded plastic foam members, such as EPS, for example. Especially high-frequency vibrations which occur when water flows along metal are absorbed by such a material.

[0015] In order to enable simple maintenance of the heat pump, which maintenance can be carried out by a regular CH engineer, it is very advantageous for the heat pump to have a modular structure, wherein a compressor module comprises the compressor, the expansion valve, the condenser and the evaporator, wherein a first transport module comprises the heat source circuit pump and a heat source venting unit, wherein the first transport module is attached and connected to the evaporator by means of fittings, wherein a second transport module comprises the CH circuit pump, a CH venting unit and an electrical heating coil, wherein the second transport module is attached and connected to the condenser by means of fittings.

[0016] When the heat source circuit pump is to be replaced, for example, the engineer can simply unscrew the fittings so as to remove the first transport module and subsequently place a substitute transport module. The compressor circuit is not touched by the engineer thereby, so that these operations can be carried out by a regular CH engineer. When one of the components of the compressor module is broken, the engineer must replace the complete compressor module. The broken compressor module can then be repaired at the workshop by a specially trained engineer.

[0017] As already indicated before, one of the problems connected with the installation of the prior art heat pump is the adjustment of the various pump speeds relative to each other, such that a desired temperature difference is created in the heat source supply pipe and the heat source return pipe as well as in the CH supply pipe and the CH return pipe when the heat pump is in operation. A normally trained CH engineer is not able to realise such an adjustment.

[0018] In order to overcome this problem, the invention provides a heat pump which comprises a CH inlet stub and a CH return stub for connection to a central heating pipe system of a house or the like building comprising room heating elements, as well as a heat source inlet stub and a heat source return stub for connection to a heat source pipe system comprising a heat source, wherein the heat pump includes a compressor circuit comprising, seen in the direction of flow of the compressor circuit:

- a compressor;
- a primary part of a first heat exchanger, to be re-

ferred to as the condenser;
- an expansion valve; and
- a primary part of an second heat exchanger, to be referred to as the evaporator;

wherein the evaporator includes a secondary part, which is in heat exchanging communication with the primary part of the evaporator, and wherein the condenser comprises a secondary part, which is in heat exchanging communication with the primary part of the condenser, wherein the heat pump is also provided with a heat source circuit pump and with a CH circuit pump, wherein, in the connected condition of the heat pump, the secondary part of the evaporator and the heat source circuit pump are incorporated in a heat source circuit which also comprises the heat source pipe system, and wherein, in the connected condition of the heat pump, the secondary part and the CH circuit pump are incorporated in a CH circuit which also comprises the CH pipe system, wherein the heat pump includes a control unit and a number of temperature sensors, wherein the control unit is arranged for regulating the rotational speeds of the compressor, the heat source circuit pump and/or the central heating circuit pump on the basis of the values measured by the temperature sensors.

[0019] Once such a heat pump has been connected, the control unit of the heat pump itself controls the rotational speeds of the compressor, the heat source circuit pump and/or the CH circuit pump on the basis of the temperatures measured by the temperature sensors. The control unit can thereby adjust the rotational speeds of the various components on the basis of different parameters, with the eventual result that the heat pump will provide optimum efficiency under the circumstances.

[0020] According to a further embodiment of the invention, it is especially advantageous when a temperature sensor is mounted both in the heat source supply pipe and in the heat source return pipe, wherein the control unit is arranged for automatically adjusting the speed of the heat source circuit pump after the heat pump has been connected, so that a desired temperature difference between the two temperature sensors is obtained.

[0021] According to a further embodiment it is moreover very advantageous when a temperature sensor is mounted both in the CH supply pipe and in the CH return pipe, wherein the control unit is arranged for automatically regulating the speed of the CH circuit pump, so that a desired temperature difference between the two temperature sensors is obtained.

[0022] Possibly, the control unit can be arranged for reducing the compressor speed for specified pre-set periods in order to provide a low-noise position. It stands to reason that in order to accomplish this the control unit must comprise a clock, so that the heat pump can be set to the low-noise position each time, for example at night.

[0023] According to a further embodiment of the invention, the control unit may comprise a few safety features, by means of which it is verified whether the heat pump has been connected correctly. Thus the control unit may be arranged for verifying the direction of rotation of the compressor after connection of the heat pump and for turning off the heat pump when the detected direction of rotation is not the desired direction of rotation. Furthermore the control unit may be arranged for verifying continuously whether the power supply, in particular all phases of the electricity grid, is functioning properly, wherein the control unit is arranged for turning off the heat pump in case the power supply is not functioning properly.

[0024] Possibly, the control unit can verify and calibrate the operation of the temperature sensors at least periodically, so that the measured temperature difference between the heat source supply pipe and the heat source return pipe equals zero when the compressor is turned off and the heat source circuit pump is turned on, and so that the measured temperature difference between the CH supply pipe and the CH return pipe equals zero when the compressor is turned off and the CH circuit pump is turned on. In this manner it is possible all the same, using relatively simple temperature sensors, to ensure a very precise control of the heat pump.

[0025] For additional protection, the control unit is according to another embodiment of the invention capable of verifying whether the CH circuit pump and/or the heat source circuit pump is running by measuring the temperature differences, wherein the control unit is arranged for turning off the heat pump and locking it in that position after having established a number of times that a pump is not running, so that the heat pump can only be turned on again by actively taking steps.

[0026] The average user of conventional CH systems is accustomed to the room heating elements quickly taking on a high temperature quickly when he comes home and turns on the heating. The reason for this is that the conventional CH systems, which comprise a combustion boiler, are so-called high-temperature systems, wherein the CH water from the boiler has a temperature of about 90°. CH systems which do not comprise a heat pump do no use such a high output temperature. When a heat pump is used, the output temperature of the CH water is normally about 60°. In order to give the user the perception of a regular CH system all the same, the control unit may according to a further embodiment of the invention be arranged for reducing the speed of the CH circuit pump temporarily after the heat pump has been turned on, so as to create a higher output temperature temporarily. The available amount of energy that is supplied by the heat pump is then transmitted to less CH water per unit time, so that said water will be heated to a higher temperature. Since this means that the load on the heat pump is considerably increased, the reduction of the speed of the CH circuit pump is only possible for a short period of time.

[0027] Possibly, the heat pump can be fitted with a sanitary water heating unit, wherein the sanitary water heating unit also comprises a water transport unit, which carries the CH water that has been heated in the condenser either to the sanitary water heating unit or to the CH pipe system. Such a water transport arrangement may for example be in the form of a three-way valve. In practice the sanitary water heating unit will be supplied as a separate module, wherein the connections between the sanitary water heating unit and the water pump can simply be made by a regular CH engineer, for example by means of clamp fittings, wherein the making of an electric and/or electronic connection can take place by plugging in one or more plugs. Since the sanitary water heating unit is a separate module, it is easily to handle.

[0028] It stands to reason that not all users use up the same amount of sanitary water. Accordingly, it will be apparent that sanitary water heating units having different capacities will become available. Generally the sanitary water heating unit will be in the form of a boiler, through which a coil extends, through which coil hot water from the heat pump can be passed. A family will use a 150 litre boiler, for example, whilst a boiler capacity of 100 litres is more than enough for a single person household. In some situations a sanitary water heating unit is already present, so that it is not necessary to connect a sanitary water heating unit to the heat pump. Furthermore, different heat pumps having different capacities will become commercially available. In order to be capable of controlling all these variable types with one and the same control unit, it is according to a further embodiment of the invention very advantageous when the compressor and the sanitary water heating unit include identification means which are connected to the control unit, wherein the control unit is of a universal type which is suitable for controlling heat pump comprising compressors having different output values and sanitary water heating units having different capacities, wherein the control unit automatically selects the desired control programme on the basis of information from the identification means.

[0029] The identification means may for example be electric resistors.

[0030] As already noted above, the heat pump is preferably so compact and light in weight that it can be mounted on a wall. This makes it very easy to install the heat pump in a room which can also be used for other purposes.

[0031] According to another embodiment, the heat pump can also comprise a cooling medium inlet stub and a cooling medium return stub for connection to a cooling pipe system, wherein the heat pump is used for withdrawing heat from a medium which circulates in a cooling circuit which comprises at least the cooling pipe system and the heat source pipe system.

[0032] According to another embodiment of the invention, it is very advantageous when the heat pump includes identification means which, when a cooling pipe system is connected to the cooling medium inlet stub and a cooling medium return stub, communicate the existence of this connection to the control unit. In this manner the control unit can arrange for the house to be heated in the winter and cooled in the summer. The control unit is capable of providing a heating effect or a cooling effect on its own accord, without the user having to take any action in this regard.

[0033] Further embodiments are defined in the subclaims and will be explained in more detail hereafter with reference to the drawing.

Fig. 1 is a front view of the compressor circuit according to the invention, from which the water-carrying circuits of the heat pump have been left out;
Fig. 2 is a left-hand side view of the compressor circuit which is shown in Fig. 1;
Fig. 3 is a right-hand side view of the compressor circuit which is shown in Fig. 1;
Fig. 4 is a top plan view of the compressor circuit of Fig. 1;
Fig. 5 is a sectional view of the compressor circuit, seen along line V - V in Fig. 1;
Fig. 6 is a front view of the water-carrying part of the heat pump, from which the nonrelevant parts of the compressor circuit have been left out;
Fig. 7 is a left-hand side view of the water-carrying part of Fig. 6;
Fig. 8 is a right-hand side view of the water-carrying part of Fig. 6;
Fig. 9 is a top plan view of the water-carrying part of Fig. 6;
Fig. 10 is a sectional view along line X - X in Fig. 6;
Fig. 11 is a sectional view of a venting unit, seen along line XI - XI in Fig. 14;
Fig. 12 is a top plan view of the venting unit of Fig. 11;
Fig. 13 is a sectional view along XIII - XIII in Fig. 11;
Fig. 14 is a left-hand side view of the venting unit of Fig. 11;
Fig. 15 is a front view of a connecting piece of the second transport module, in which a heating coil is accommodated;
Fig. 16 is a top plan view of the part which is shown in Fig. 15;
Fig. 17 is a sectional view along line XVII - XVII of Fig. 15; and
Fig. 18 is a right-hand side view of the part which is shown in Fig. 15.

[0034] All the figures show different parts of one and the same embodiment of a heat pump according to the invention. The embodiment is only shown and described by way of example and merely functions to illustrate the basic concept that underlies the present invention.

[0035] Now the parts which are shown in the various figures will be designated without discussing all the figures separately. It is noted thereby that Figs. 1 - 5 in particular show the components of the compressor circuit, whilst Figs. 6 - 18 in particular relate to components that form part of a heat source circuit and a CH circuit.

[0036] Like all heat pumps, the present heat pump comprises a compressor 1. In the present embodiment the compressor 1 is a so-called scroll compressor. An outgoing pipe 2 of the compressor is connected to the inlet 3 of a primary part of a first heat exchanger, hereinafter referred to as condenser 4. The outlet 5 of the primary part of the condenser is connected to an expansion valve 8 via a pipe 6 and a filter 7. From said expansion valve 8 a pipe 9 extends to the inlet 10 of a primary part of a second heat exchanger, hereinafter referred to as evaporator 11. Outlet 12 of the primary part of evaporator 11 is connected, via a pipe 13, to an intake opening 14 of compressor 1. Present in the compressor circuit is a medium which transports heat. Preferably, an environment-friendly medium is used. The operation of the heat pump is as follows: a very cold coolant is introduced into the primary part of the evaporator as a result of the expansion that takes place in the expansion valve 8. This very cold coolant absorbs heat in the evaporator 11. This heat is supplied by a heat source, whose medium flows through the secondary part of the evaporator 11. When the coolant exits the evaporator at outlet 12, it has absorbed heat, but the temperature of the coolant is still relatively low. Strong compression of the coolant by means of compressor 1 will cause the temperature of the medium to rise considerably, so that it can be used for heating water which flows through the secondary part of condenser 4. The secondary part of condenser 4 forms part of a CH circuit when the heat pump is connected. In condenser 4, the coolant gives off part of its heat to the water that flows through the secondary part of the condenser 4, so that the temperature of the coolant will have been reduced again at outlet 5. Then the coolant is purified in filter 7, and any oil particles that may be present therein are removed. In order to achieve a substantial temperature reduction of the coolant, the coolant is passed through the expansion valve 8, in which a large pressure drop occurs, which results in a considerable temperature decrease. This process takes place continuously. The energy input is supplied by the current which is used to drive compressor 1 and by the heat which is supplied by the heat source via the secondary part of the evaporator 11. The heat source may for example be the ground water, which is present at a certain depth under the ground. The ground water will have a temperature which is higher, both in the winter and in the summer, than the temperature of the expanded medium which enters the primary part of the evaporator at inlet 10. In the heat pump of the present embodiment, a conversion efficiency of about 350% is achieved. This means that, starting from 100% electric energy input, about 3.5 times as much energy is transmitted to the CH water. Basically, it boils down to this that about 70% of the energy which is transmitted to the CH water comes from the heat source and about 30% comes from the electricity grid.

[0037] In the present embodiment the compressor 1 is mounted on a subframe. The subframe comprises a base 15, a condenser 4 and an evaporator 11 and a number of mounting parts 16, 17, which are connected to the baseplate 15 and/or the condenser 4 and/or the evaporator 11. The mounting parts 16, 17 are connected, via first damping elements 18, 19, with a mounting frame 20, 21, which is intended for being fixedly connected to a fixed structure. Due to the damped mounting arrangement of subframe 4, 11, 15, 16, 17, the compressor vibrations are hardly transmitted, if at all, to the wall on which the heat pump is mounted. Moreover, in the present embodiment the compressor 1 itself is also mounted on the baseplate 15 of the subframe via two damping elements 22. As a result, double damping of the vibrations produced by compressor 1 is achieved. What is furthermore remarkable about pipes 2, 6, 13 of the compressor circuit, which are connected to compressor 1 with one end and to evaporator 11 or condenser 4 with a second end, is that all these pipes comprise at least one U-bend, thus minimizing the transmission of vibrations from compressor 1 via said pipes to the subframe 4, 11, 15, 16, 17, since such U-bends readily allow deformation.

[0038] Hereafter reference will be made in particular to Figs. 6 - 10, which shows the so-called water-carrying parts of the heat pump, whilst the pipes of the compressor circuit have been left out. In the present embodiment, said water-carrying parts consist of two transport modules, in which several functions are integrated. In Fig. 6, the left-hand part forms the first transport module. This transport module includes a heat source circuit pump 23. From the heat source circuit pump 23 the heat source medium flows to a heat source venting unit 24, which is provided with a vent valve 25. Via the heat source vent valve 24 the heat source medium flows to the inlet 27 of the secondary part of evaporator 11 via pipe 26. Then the heat source medium flows through the secondary part of evaporator 11 to the outlet 28 of the secondary part of evaporator 11, after which it is carried to the heat source inlet stub 32 through a pipe 29, via a bend 30 which is connected to pipe portion 29 by means of a clamp fitting 31. Then the heat source medium flows through the heat source pipe system (not shown) to the heat source, where it undergoes a temperature increase, and subsequently it flows back to the heat source return stub 33. Said heat source return stub 33 is connected to pump 23 via a bend 34 and a clamp fitting 37. All these parts together constitute the heat source circuit. The heat source circuit pump 23, the heat source venting unit 34, the connecting piece 36 and the bends 30, 34 are all connected to the damped subframe (4, 11, 15 - 17). The heat source inlet stub and the heat source return stub 32, 33 are connected to the fixed structure. In order to minimize the transmission of vibrations from the subframe (4, 11, 15 - 17) to the heat source inlet stub and the heat source return stub, a flexible, vibration isolating pipe portion 38 is mounted between the bend 30 and the heat source inlet stub 32. A similar vibration isolating, flexible pipe portion is mounted between bend 34 and heat source return stub 33.

[0039] The right-hand side of Fig. 6 shows the second transport module for the CH circuit. The second transport module includes a CH circuit pump 39. From said CH circuit pump 39, the CH water is pumped into the CH pipe system via connecting piece 40, clamp fitting 41, bend 42 and CH inlet stub 43. In the CH pipe system, which comprises room heating elements, the heat of the CH water is given off. The cooled-down CH water enters the heat pump again via the CH return stub 44, and in the heat pump it is carried to the inlet 48 of the secondary part of the condenser 4 via bend 45, clamp fitting 46 and pipe portion 47. Inside condenser 4, the CH water absorbs heat which is supplied by the hot coolant of the compressor circuit, which hot coolant is present in the primary part of condenser 4. Via outlet 49 of the secondary part of condenser 4 the CH water flows, via a pipe portion 50, via a clamp fitting 51, to a CH water venting unit 52, which includes a vent valve 53. From the CH water venting unit 52 the CH water flows to pump 39 again. The main components of the second transport module, that is, CH circuit pump 39, CH water venting unit 52 and connecting piece 40, are mounted on subframe 4, 11, 15 - 17. As a result of this arrangement, the vibrations caused by the CH circuit pump 39 are not transmitted to the wall on which the heat pump is mounted. In order to prevent the transport module in its damped mounting from transmitting its movements to the fixedly disposed CH inlet stub 43 and the CH return stub 44, a flexible, vibration isolating pipe portion is mounted between bend 42 and CH inlet stub 43. A similar flexible, vibration isolating pipe portion 54 is mounted between bend 45 and CH return stub 44. This prevents the transmission of movements of the subframe 4, 11, 15 - 17 to the CH inlet stub 43 and the CH return stub 44.

[0040] Figs. 11 - 14 furthermore show in various elevational and sectional views the CH water venting unit 52. The stub 55 onto which the clamp fitting 51 is screwed is clearly shown. The water enters a first chamber 56 via stub 55 and flows via an opening 57 into a second chamber 58, in which a partition is present, which causes a the CH water to change its flow direction, which makes it possible for air bubbles that are present in the CH water to find their way into a third chamber 60 via an opening 59, from which chamber they are withdrawn from the CH water via vent valve 53. The CH water then exits the CH water venting unit via the lower outlet opening 61. The construction of the heat source venting unit 24 is entirely identical thereto. It is noted that the vent valve 53 is commercially available as standard.

[0041] Figs. 15 - 18 shows the connecting piece 40 of the second transport module. Said connecting piece 40 comprises a stub 62 for connecting the clamp fitting 41. Furthermore a stub 63 is provided with a clamp fitting 64 which is intended for fitting pump 39. Connecting piece 40 is further provided with an opening 65, through which the pipe 47 extends on which the clamp fitting 46 is mounted. A similar connecting piece 36 is provided in the first transport module for the heat source circuit. Connecting piece 40 on the CH water transport module furthermore includes a heating coil 66, which can be turned on when a very quick heating of the CH water is desired. Such a situation may for example occur when a large amount of hot sanitary water is tapped within a short period of time. Under those exceptional circumstances the heating coil 66 is capable of providing the required additional heat capacity. The ends 67, 68 of the heating coil 66 are also clearly shown in Fig. 8, and they are connected to a power source.

[0042] The control unit 73 of the heat pump is clearly shown in Fig. 6, wherein it is shown to be connected to the mounting frame 20, 21 which is fixedly connected to the wall, so that it is free from vibrations. Temperature sensors 69, 70, 71, 72 are mounted in bends 31, 35, 41, 46. Said temperature sensors 69 - 72 are in communication with the control unit 73. The control unit 73 regulates the rotational speeds of heat source circuit pump 23 and/or CH water circuit pump 39 on the basis of the temperature detected by temperature sensors 69 - 72. Possibly, the speed of compressor 1 can also be adjusted. With regard to the other functions of the control unit 73 reference is made to that which is stated in claims 14 - 21, 24 and 29, as well as to that which has been stated in the above in the introduction to the description. As already stated in the introduction, the control unit 73 is arranged for periodic verification and calibration of the temperature sensors 69 - 72. In addition, the control unit 73 functions as a protective device, since it verifies the direction of rotation of the compressor as well as the operation of the heat source circuit pump 23 and the CH circuit pump 39.

[0043] Although this is not shown in the figures, a sanitary water heating unit can be connected to the illustrated heat pump via a three-way valve. The control unit 73 thereby controls the three-way valve in such a manner that the CH water that has been heated in condenser 4 is carried to the sanitary water heating unit when hot sanitary water is requested, whilst the CH water that has been heated in the condenser 4 is carried to the CH pipe system in order to turn over the three-way valve when a room heating is requested. In addition, the various parts of the heat pump, such as the compressor 1 and the sanitary water heating unit that are possibly connected thereto may be provided with electronic identification means, so that the control unit 73 will automatically use the programme that is associated with that specific type of assembly of heat pump and sanitary water heating unit. The electronic identification means may for example be resistors which are automatically read when compressor 1 and/or the sanitary water heating unit are connected to the control unit 73.

[0044] An encasing 74 is provided, which functions to damp the sound of the heat pump even further. The figure clearly shows that the compressor module is still disposed in a separate encasing 75, which is shown is sectional view in Fig. 10. Preferably, said second encasing 75 cannot be opened by the installer of the heat pump, so that he is prevented from fiddling with the compressor circuit. The installer only has access to the water-carrying part of the heat pump. Preferably, the empty spaces in the encasing 75 are filled with a sound-damping material, such as acoustic cellulose fibres, for example.

[0045] It will be apparent that the invention is not limited to the embodiments described herein, but that various modifications are possible within the scope of the invention.

Claims

1. A heat pump comprising a CH inlet stub (43) and a CH return stub (44) for connection to a CH pipe system of a house or the like building comprising room heating elements, as well as a heat source inlet stub (32) and a heat source return stub (33) for connection to a heat source pipe system comprising a heat source, wherein the heat pump includes a compressor circuit (11 - 14) comprising, seen in the direction of flow of the compressor circuit:

   - a compressor (1);
   - a primary part of a first heat exchanger, to be referred to as the condenser (4);
   - an expansion valve (8); and
   - a primary part of an second heat exchanger, to be referred to as the evaporator (11);

   wherein the evaporator (11) includes a secondary part, which is in heat exchanging communication with the primary part of the evaporator (11), and wherein the condenser (4) comprises a secondary part, which is in heat exchanging communication with the primary part of the condenser (4), wherein the heat pump also comprises a heat source circuit pump (23) and with a CH circuit pump (39), wherein, when the heat pump is connected, the secondary part of the evaporator (11) and the heat source circuit pump (23) are incorporated in a heat source circuit which also comprises the heat source pipe system, and wherein, when the heat pump is connected, the secondary part of the condenser (4) and the CH circuit pump (39) are incorporated in a CH circuit which also comprises the CH pipe system, wherein the compressor (1) is connected with a subframe (4, 11, 15 - 17), which subframe (4, 11, 15 - 17) is connected, via first damping elements (18, 19), with a mounting frame (20, 21) which is intended to be fixedly connected to a fixed structure, wherein the first damping elements (18, 19) provide vibration isolation between the subframe (4, 11, 15 - 17) and the mounting frame (20, 21).

2. A heat pump according to claim 1, characterized in that second damping elements (22) are incorporated in the connection between the compressor (1) and the subframe (4, 11, 15 - 17), which second damping elements (22) provide vibration isolation between the compressor (1) and the subframe (4, 11, 15 - 17).

3. A heat pump according to claim 1 or 2, characterized in that the evaporator (11) and the condenser (4) form an integral part of the subframe (4, 11, 15 - 17).

4. A heat pump according to any one of the preceding claims 1 - 3, characterized in that the heat pump comprises flexible, vibration isolating pipe portions (38) which connect the evaporator (11) to the heat source inlet stub (32) and to the heat source return stub (33).

5. A heat pump according to any one of the claims 1 - 4, characterized in that the heat pump comprises flexible, vibration isolating pipe portions (54) which connect the condenser (4) to the CH inlet stub (43) and to the CH return stub (44)

6. A heat pump according to any one of the preceding claims, characterized in that the heat source circuit pump (23) and the CH circuit pump (39) are mounted on a subframe (4, 11, 15 - 17).

7. A heat pump according to any one of the preceding claims, characterized in that the pipes (2, 6, 13) of the compressor circuit, which are connected to the compressor (1) with one end and to the evaporator (11) or the condenser (4) with a second end comprise at least one U-bend, so that the transmission of vibrations is minimal.

8. A heat pump according to any one of the preceding claims, characterized in that the compressor (1), the condenser (4), the evaporator (11), the expansion valve (8), the heat source circuit pump (23) and the CH circuit pump (39) are accommodated in an encasing (74).

9. A heat pump according to claim 8, characterized in that the encasing is a double encasing comprising an inner casing (75) and an outer casing (74).

10. A heat pump according to claim 8 or 9, characterized in that the free space within the encasing (74) is filled with a sound-damping material.

11. A heat pump according to claim 10, characterized in that said sound-damping material is a cellulose filling in the form of acoustic spray fibres.

12. A heat pump according to any one of the preceding claims, characterized in that the heat pump has a modular structure, wherein a compressor module comprises the compressor (1), the expansion valve (8), the condenser (4) and the evaporator (11), wherein a first transport module comprises the heat source circuit pump (23) and a heat source venting unit (24), wherein the first transport module is attached and connected to the evaporator (11) by means of fittings, wherein a second transport module comprises the CH circuit pump (39), a CH venting unit (52) and an electrical heating coil (66), wherein the second transport module is attached and connected to the condenser (4) by means of fittings.

13. A heat pump which comprises a CH inlet stub (43) and a CH return stub (44) for connection to a central heating pipe system of a house or the like building comprising room heating elements, as well as a heat source inlet stub (32) and a heat source return stub (33) for connection to a heat source pipe system comprising a heat source, wherein the heat pump includes a compressor circuit comprising, seen in the direction of flow of the compressor circuit:

- a compressor (1);
- a primary part of a first heat exchanger, to be referred to as the condenser (4);
- an expansion valve (8); and
- a primary part of an second heat exchanger, to be referred to as the evaporator (11);

wherein the evaporator (11) includes a secondary part, which is in heat exchanging communication with the primary part of the evaporator (11), and wherein the condenser (4) comprises a secondary part, which is in heat exchanging communication with the primary part of the condenser (4), wherein the heat pump is also provided with a heat source circuit pump (23) and with a CH circuit pump (39), wherein, in the connected condition of the heat pump, the secondary part of the evaporator (11) and the heat source circuit pump (23) are incorporated in a heat source circuit which also comprises the heat source pipe system, and wherein, in the connected condition of the heat pump, the secondary part and the CH circuit pump (39) are incorporated in a CH circuit which also comprises the CH pipe system, wherein the heat pump includes a control unit (73) and a number of temperature sensors , wherein the control unit (73) is arranged for regulating the rotational speeds of the compressor (1), the heat source circuit pump (23) and/or the central heating circuit pump on the basis of the values measured by the temperature sensors (69 - 72).

14. A heat pump according to claim 13, characterized in that a temperature sensor (69, 70) is mounted both in the heat source supply pipe (30) and in the heat source return pipe (34), wherein the control unit (73) is arranged for automatically adjusting the speed of the heat source circuit pump (23) after the heat pump has been connected, so that a desired temperature difference between the two temperature sensors (69, 70) is obtained.

15. A heat pump according to claim 13 or 14, characterized in that a temperature sensor (71, 72) is mounted both in the CH supply pipe (42) and in the CH return pipe (45), wherein the control unit (73) is arranged for automatically regulating the speed of the CH circuit pump (39), so that a desired temperature difference between the two temperature sensors (71, 72) is obtained.

16. A heat pump according to any one of the claims 13 - 15, characterized in that the control unit (73) is arranged for reducing the compressor (1) speed for specified pre-set periods in order to provide a "low-noise position".

17. A heat pump according to any one of the claims 13 - 16, characterized in that the control unit (73) is arranged for verifying the direction of rotation of the compressor (1) after connection of the heat pump and for turning off the heat pump when the detected direction of rotation is not the desired direction of rotation.

18. A heat pump according to any one of the claims 13 - 17, characterized in that the control unit (73) is arranged for reducing the speed of the CH circuit pump (39) temporarily after the heat pump has been turned on so as to create a higher output temperature temporarily.

19. A heat pump according to any one of the claims 13 - 18, characterized in that the control unit (73) is arranged for verifying continuously whether the power supply, in particular all phases of the electricity grid, is functioning properly, wherein the control unit (73) is arranged for turning off the heat pump in case the power supply is not functioning properly.

20. A heat pump according to any one of the claims 13 - 19, characterized in that the control unit (73) verifies and calibrates the operation of the temperature sensors (69, 72) at least periodically, so that the measured temperature difference between the heat source supply pipe (30) and the heat source return pipe (34) equals zero when the compressor (1) is turned off and the heat source circuit pump (23) is turned on, and so that the measured temperature difference between the CH supply pipe (42) and the CH return pipe (45) equals zero when the compressor (1) is turned off and the CH circuit pump (39) is turned on.

21. A heat pump according to any one of the claims 13 - 20, characterized in that the control unit (73) verifies whether the CH circuit pump (39) and/or the heat source circuit pump (23) is running by measuring the temperature differences, wherein the control unit (73) is arranged for turning off the heat pump and locking it in that position after having established a number of times that a pump (39, 23) is not running, so that the heat pump can only be turned on again by actively taking steps.

22. A heat pump according to any one of the preceding claims, characterized in that the heat pump is fitted with a sanitary water heating unit, wherein the sanitary water heating unit also comprises a water transport unit, which carries the CH water that has been heated in the condenser (4) either to the sanitary water heating unit or to the CH pipe system.

23. A heat pump according to claim 22, characterized in that the water transport unit is a three-way valve.

24. A heat pump according to at least claims 13 and 22, characterized in that the compressor (1) and the sanitary water heating unit include identification means which are connected to the control unit (73), wherein the control unit (73) is of a universal type which is suitable for controlling heat pump comprising compressors (1) having different output values and sanitary water heating units having different capacities, wherein the control unit (73) automatically selects the desired control programme on the basis of information from the identification means.

25. A heat pump according to claim 24, characterized in that the identification means are electric resistors.

26. A heat pump according to any one of the preceding claims, characterized in that it is so compact and light in weight that it is suitable for being mounted on a wall.

27. A heat pump according to any one of the preceding claims, characterized in that a filter is incorporated (7) in the compressor circuit.

28. A heat pump according to any one of the preceding claims, characterized in that the heat pump comprises a cooling medium inlet stub and a cooling medium return stub for connection to a cooling pipe system, wherein the heat pump is used for withdrawing heat from a medium which circulates in a cooling circuit which comprises at least the cooling pipe system and the heat source pipe system.

29. A heat pump according to claims 24 and 28, characterized in that the heat pump includes identification means which, when a cooling pipe system is connected to the cooling medium inlet stub and a cooling medium return stub, communicate the existence of this connection to the control unit (73).

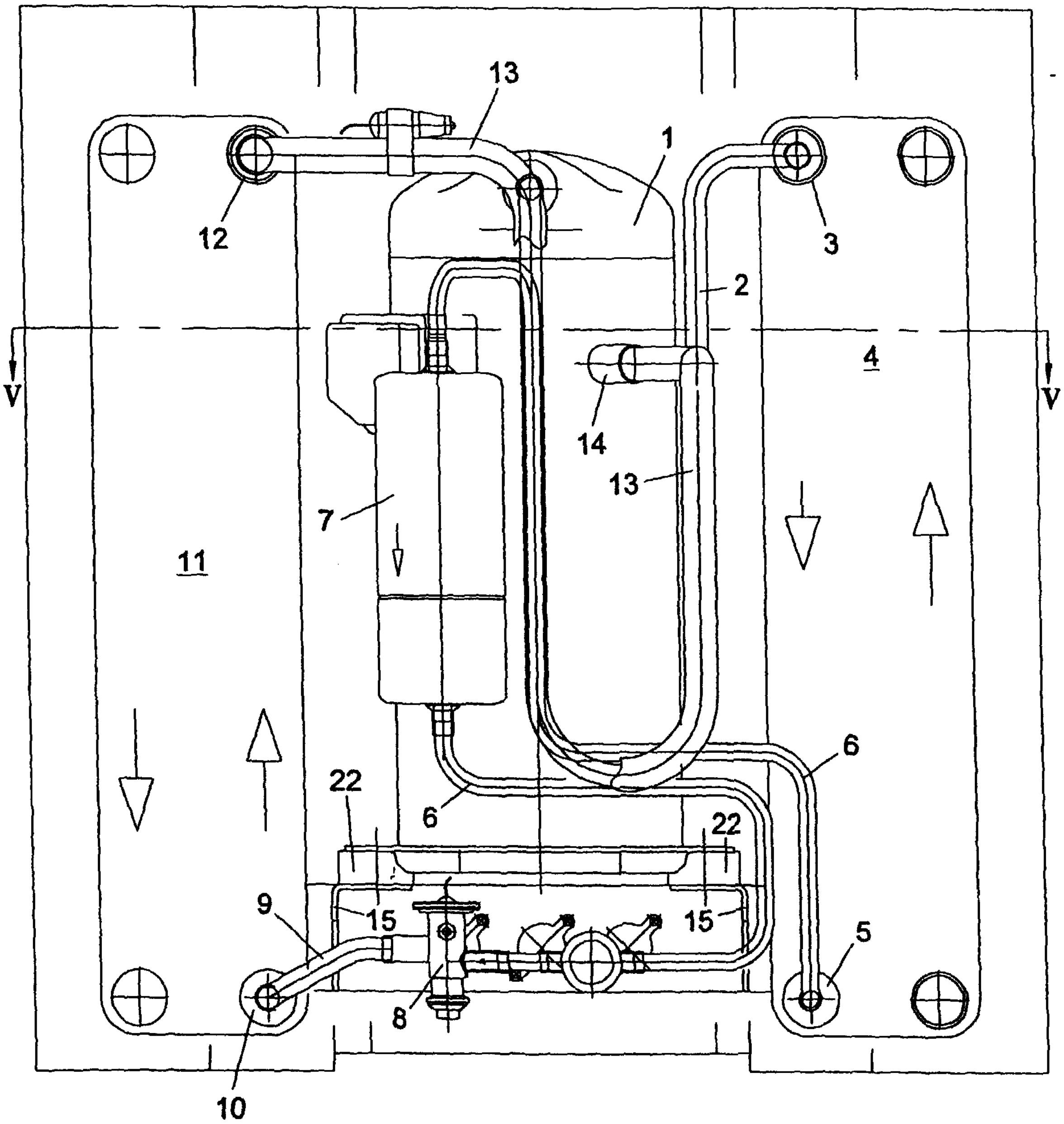

Fig. 1

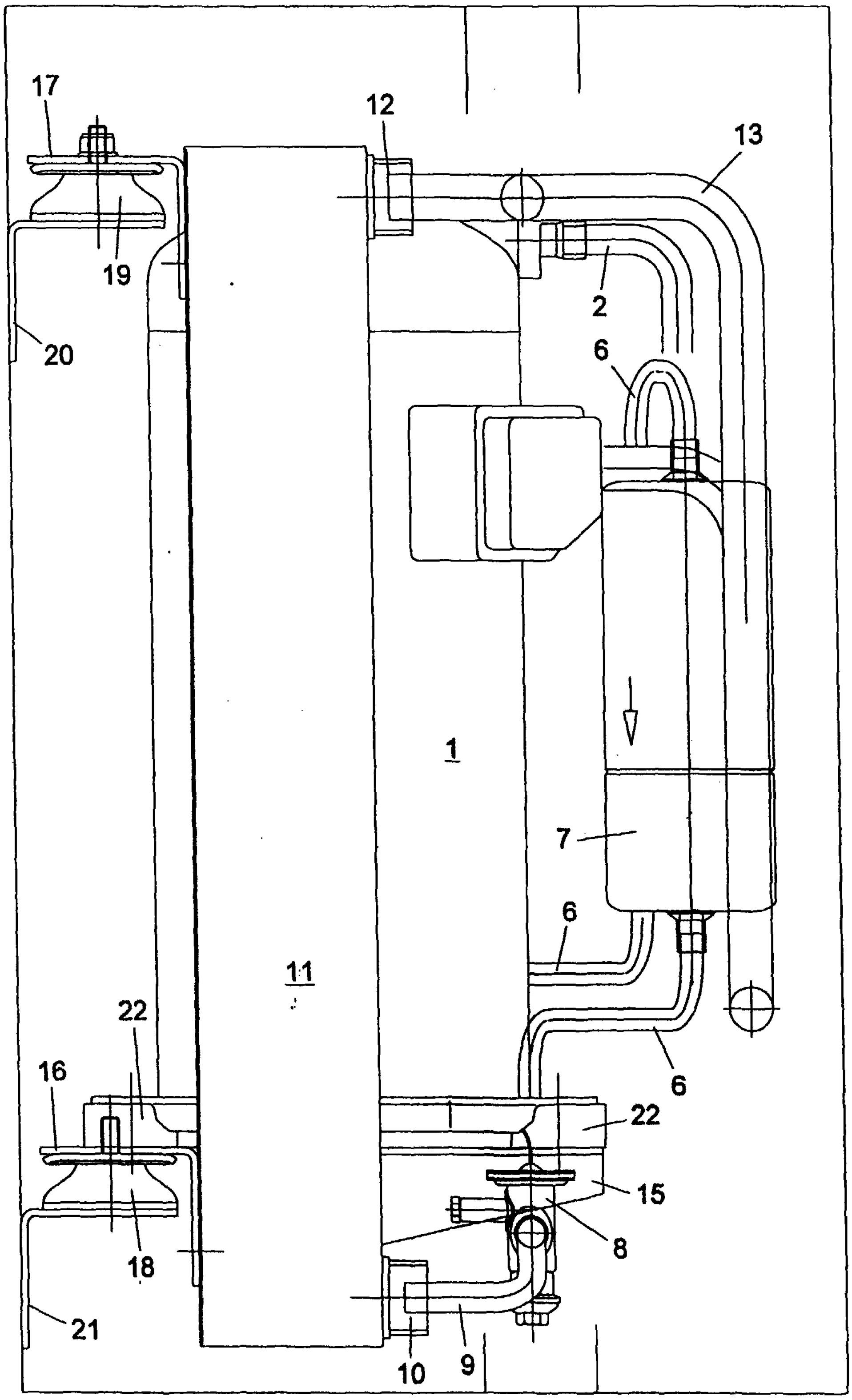

Fig. 2

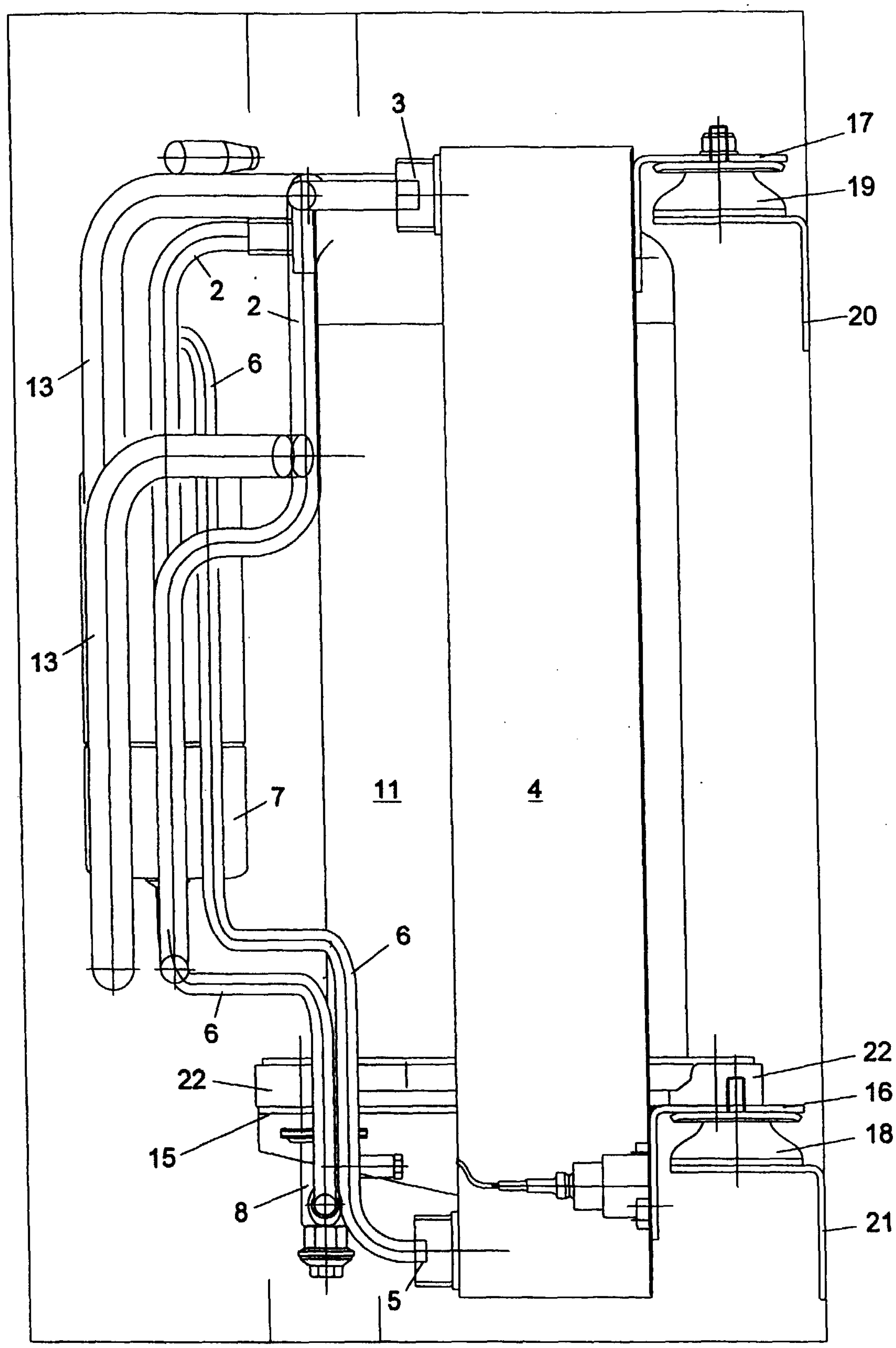

Fig. 3

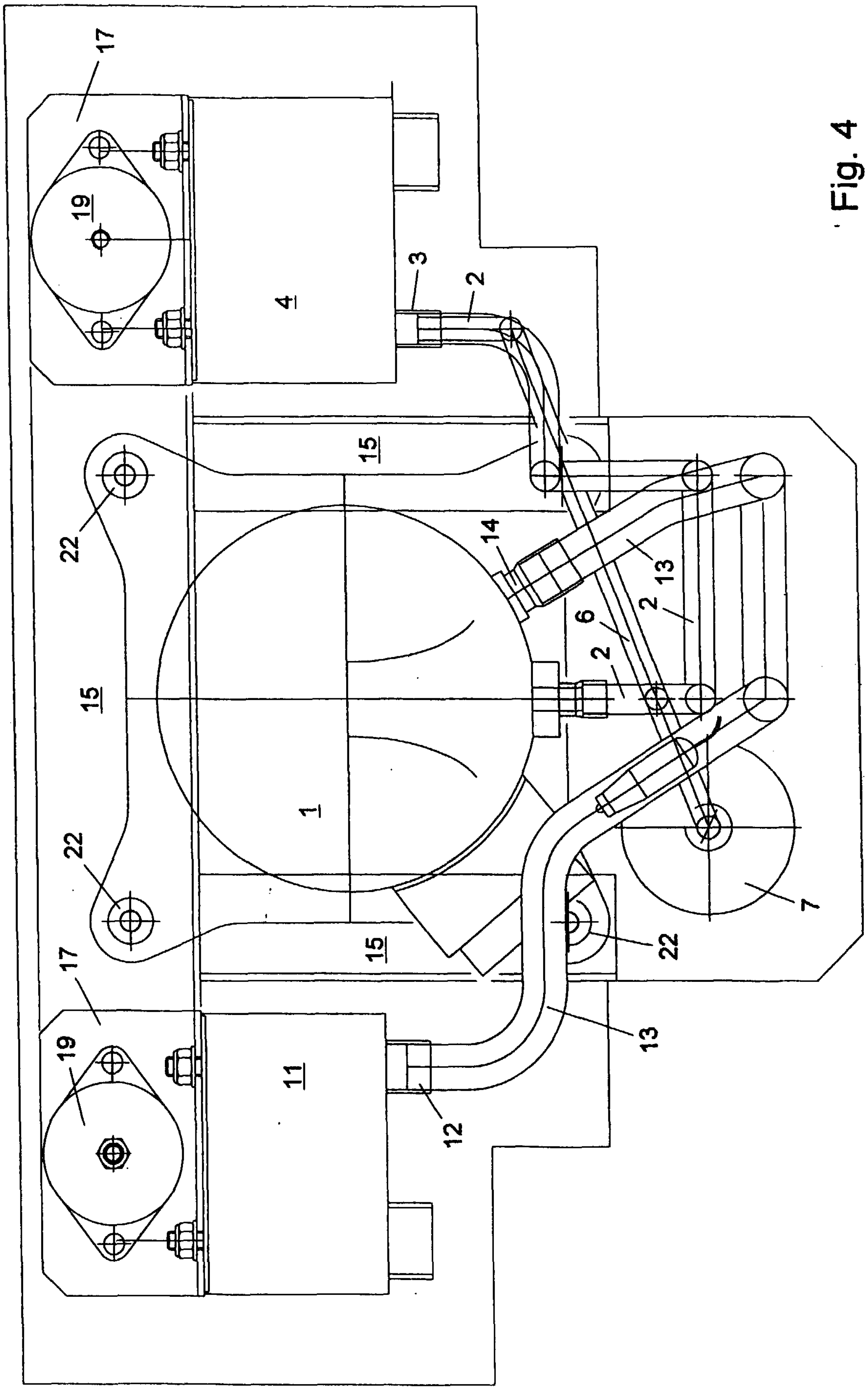

Fig. 4

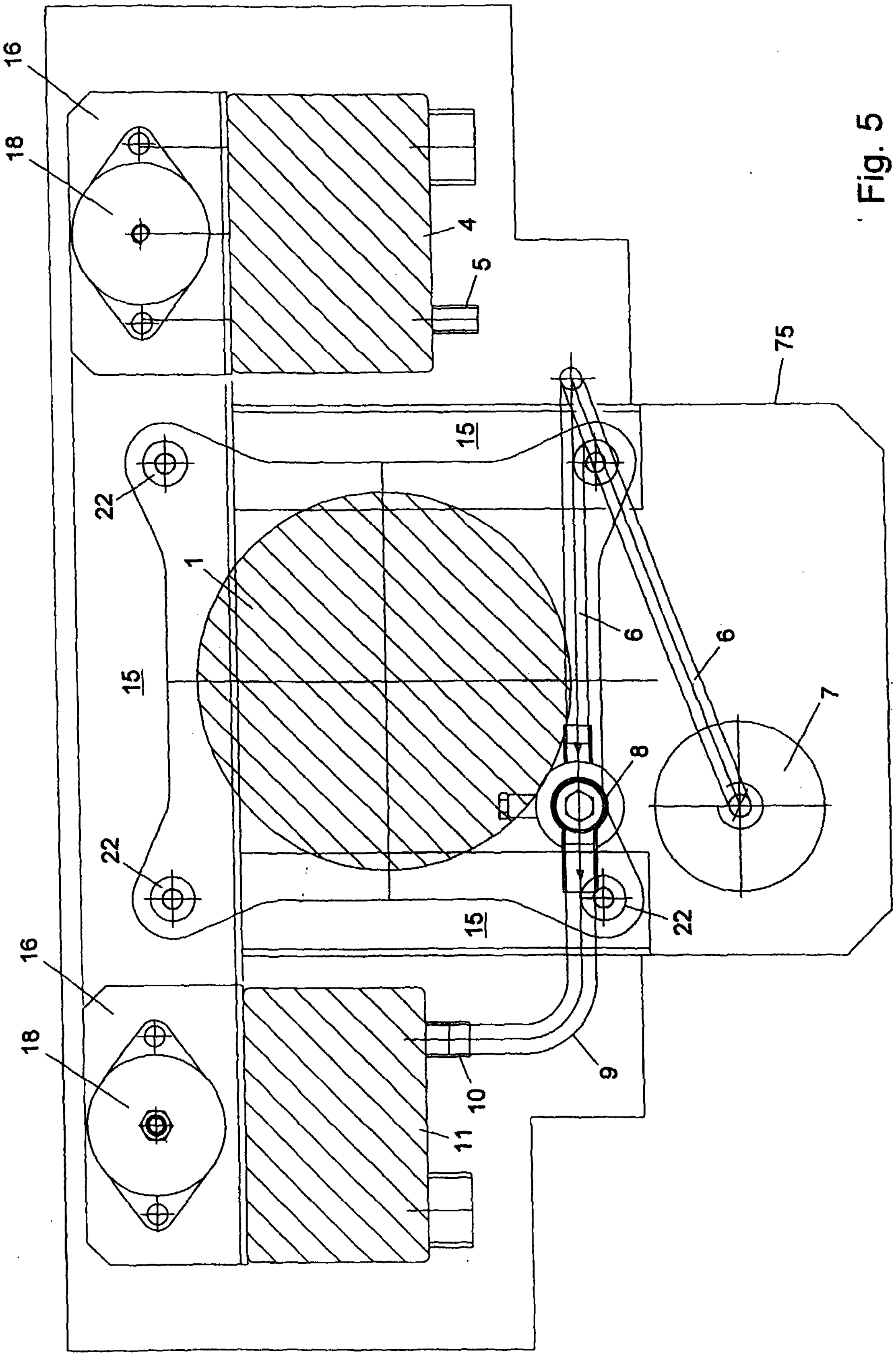

Fig. 5

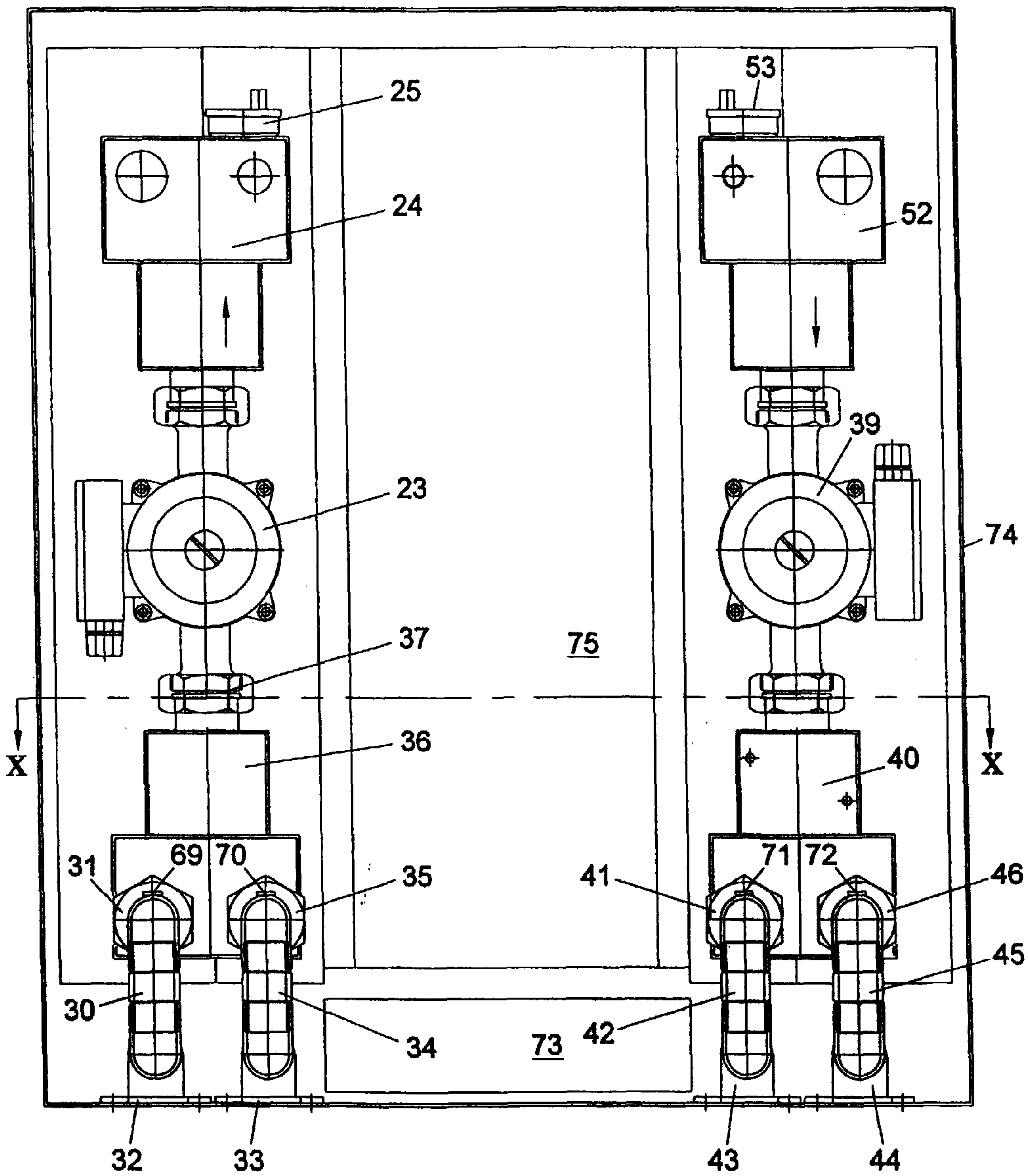
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Fig. 6

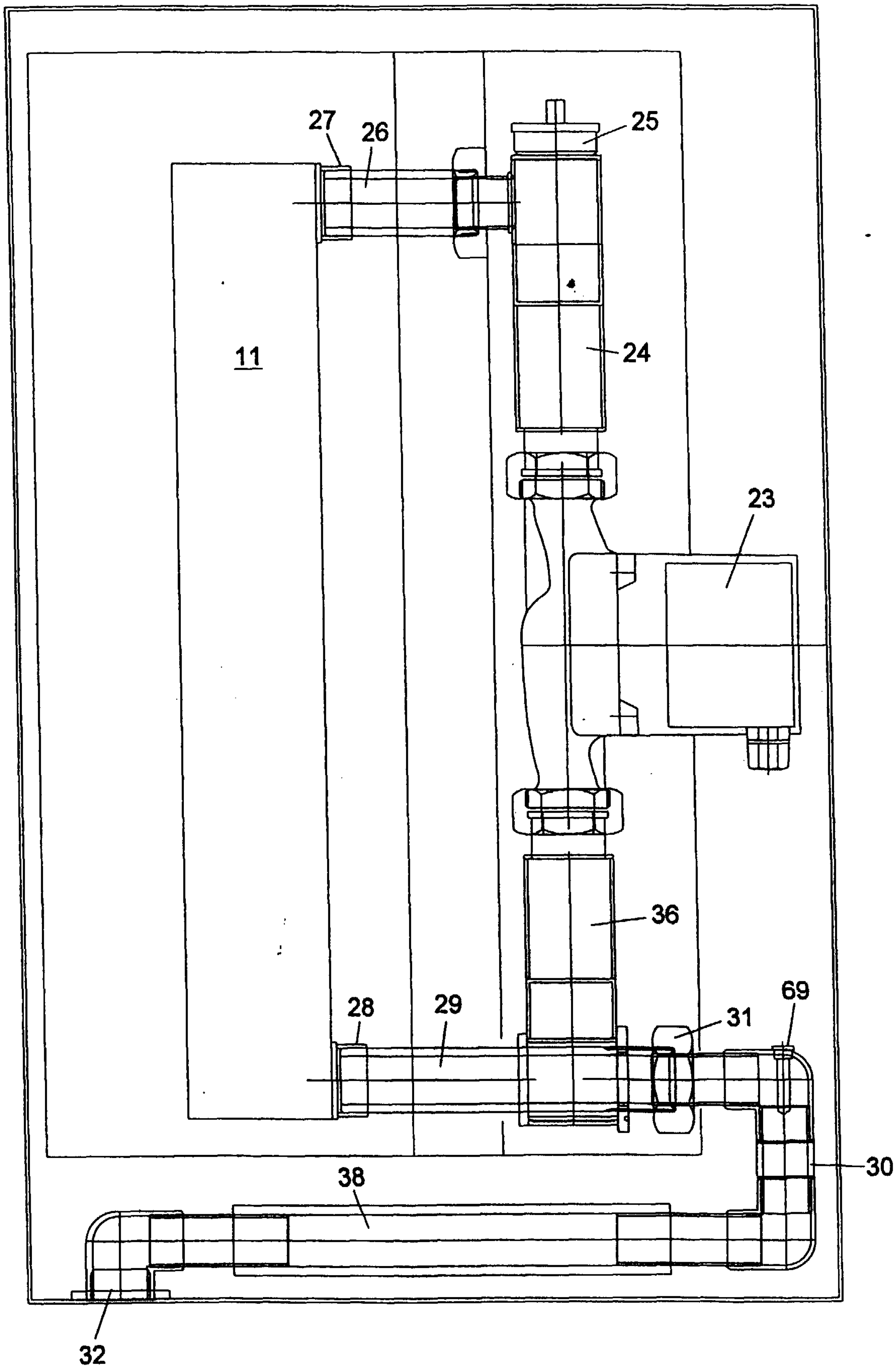

Fig. 7

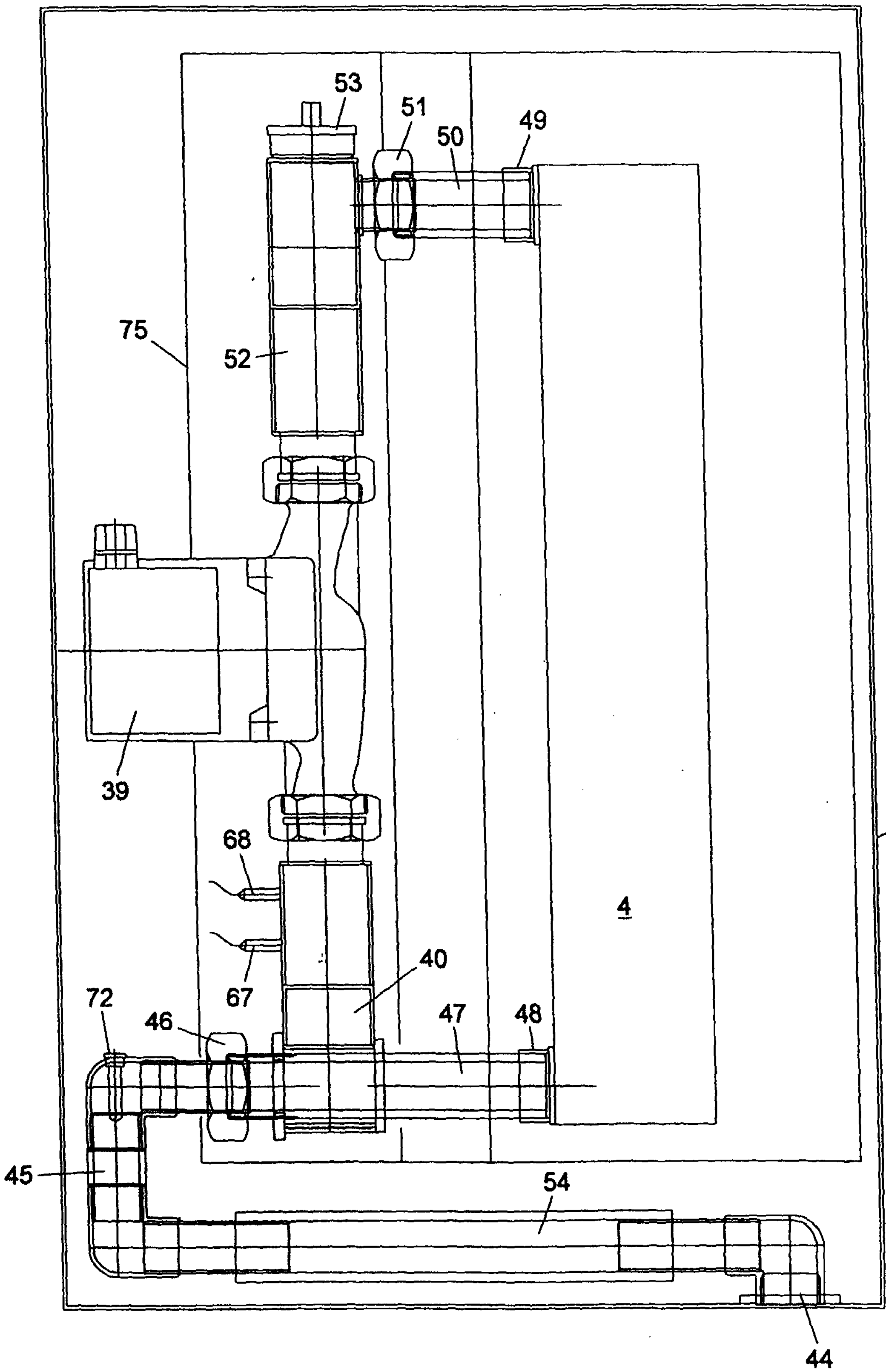

Fig. 8

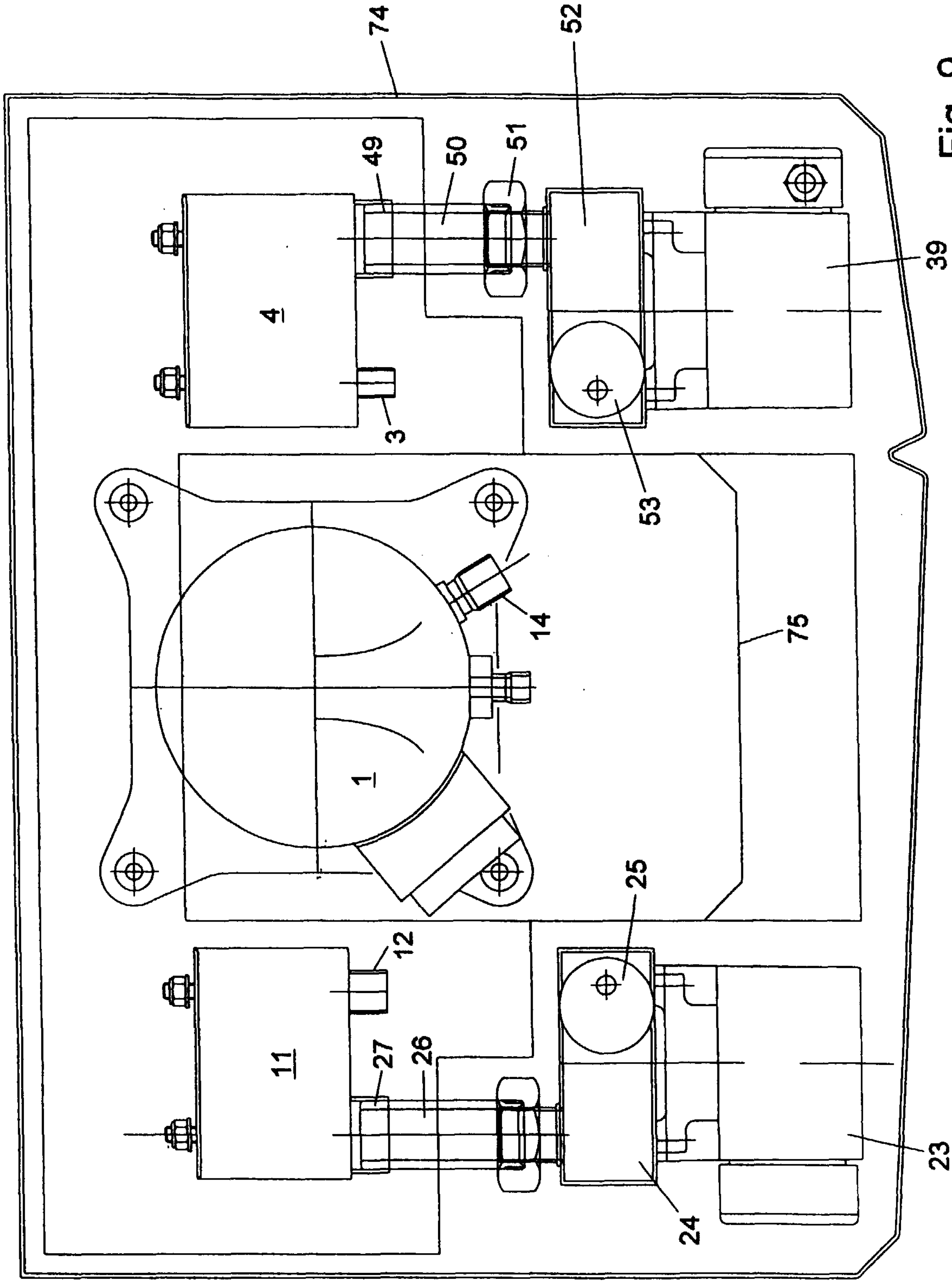

Fig. 9

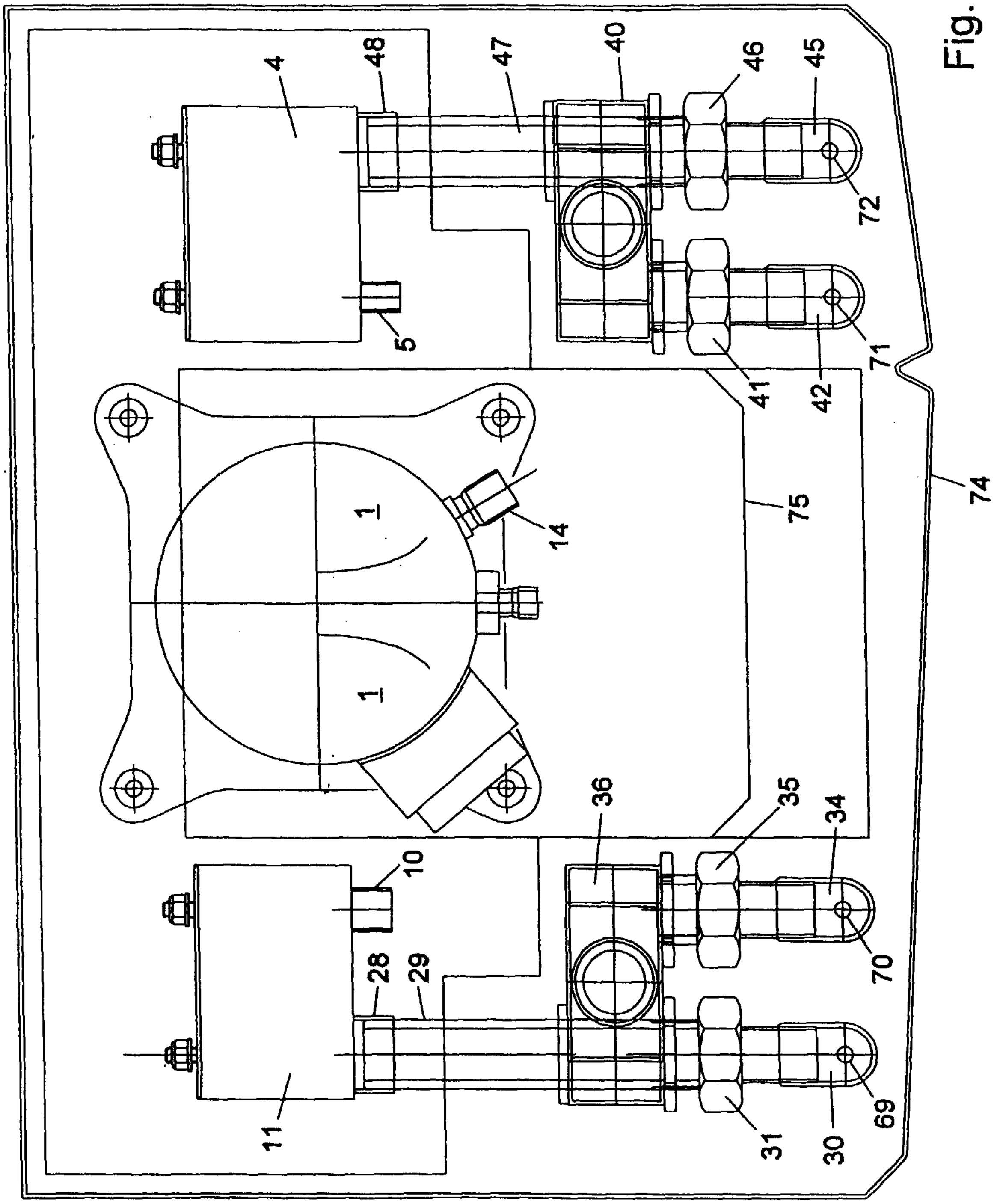
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Fig. 10

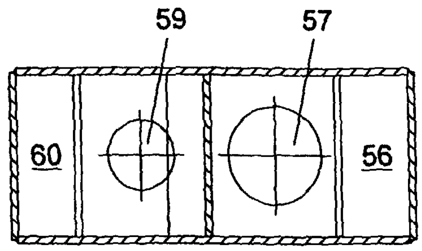

Fig. 13

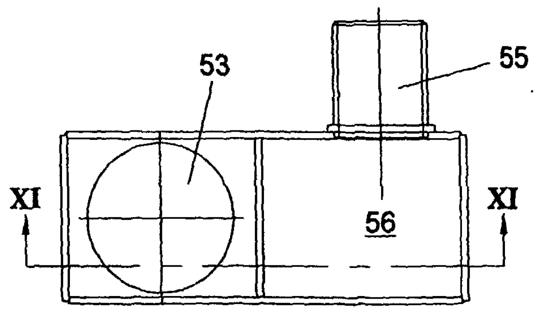

Fig. 12

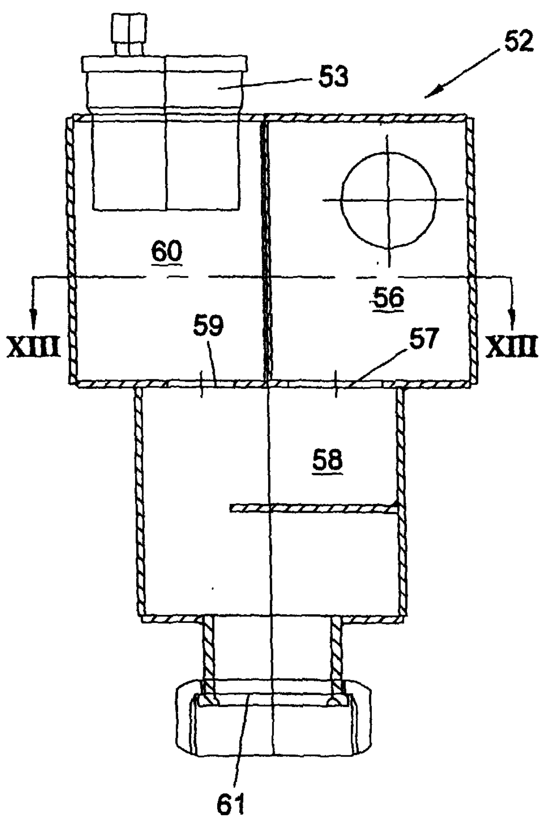

Fig. 11

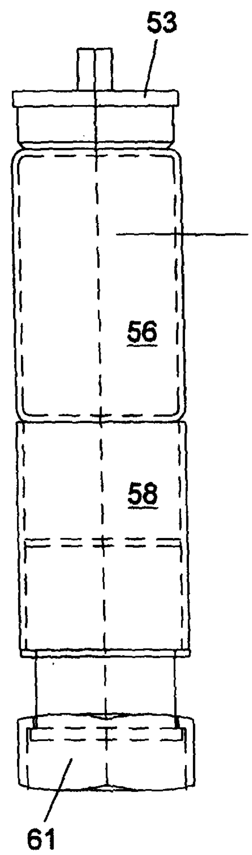

Fig. 14

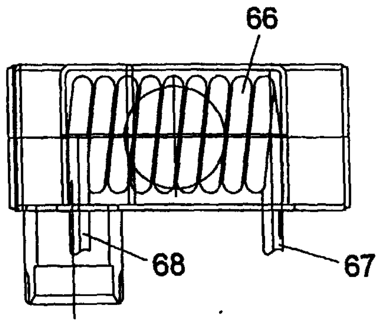

Fig. 17

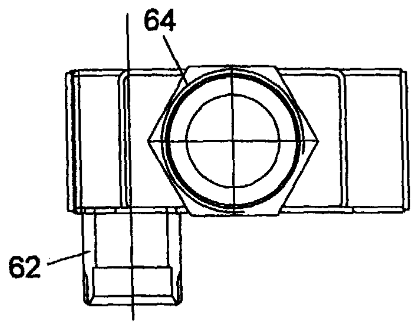

Fig. 16

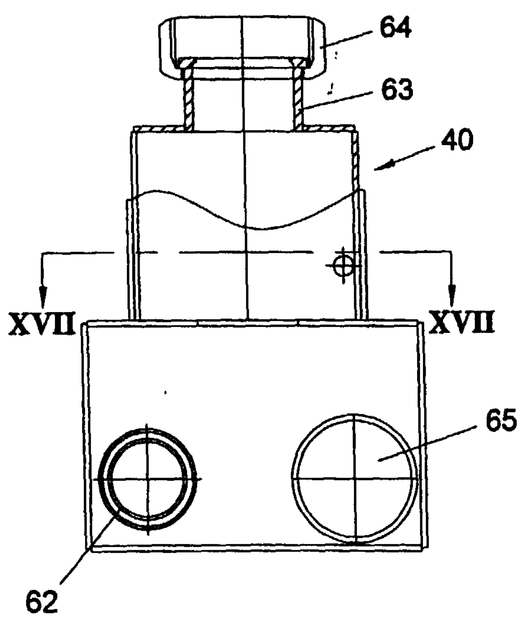

Fig. 15

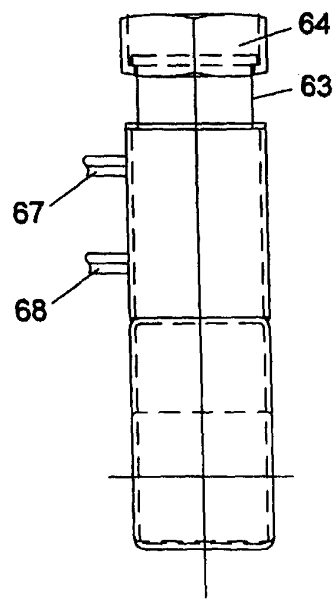

Fig. 18