



(11)

EP 1 731 858 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.12.2006 Bulletin 2006/50

(51) Int Cl.:
F25D 17/02 (2006.01) F25D 16/00 (2006.01)

(21) Application number: **05425419.8**

(22) Date of filing: **10.06.2005**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR**
Designated Extension States:
AL BA HR LV MK YU

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(54) A compensation device for a cooling plant

(57) The present invention relates to a compensation device (40) for a cooling plant (1). The plant comprises at least one forced cooling device (8,8b) and at least one non forced cooling device (30). The compensation device

is suitable for cooperating with the forced cooling device and with the non forced cooling device for variable cooling in a forced manner to satisfy the need for cooled fluid of a user (2,2a,2b).

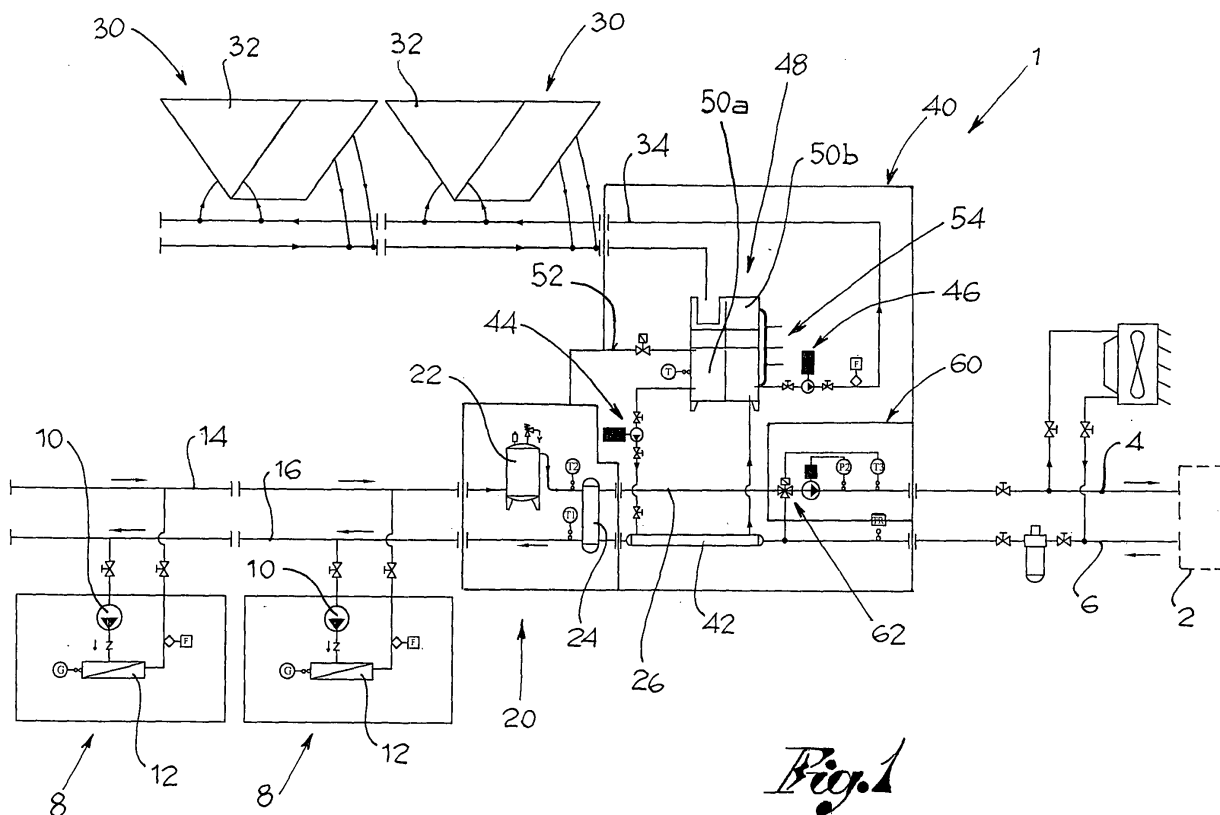


Fig. 1

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Description

[0001] . The present invention relates to a compensation device for a cooling plant designed, in particular, but not exclusively, for use in industrial fields.

[0002] . In the sector of cooling plants, especially if designed for industrial use, the problem related to the saving of energy is particularly felt. For this reason, numerous attempts are made to obtain plants that can satisfy the needs of the users to which they are connected, at the same time lowering the energy users.

[0003] . The object of the present invention is to realise a compensation device for a cooling plant that can lower the energy user of the plant, whilst allowing the plant to satisfy the needs of the users connected.

[0004] . Such object is achieved with a compensation device obtained according to claim 1. The dependent claims describe other embodiments.

[0005] . The features and advantages of the compensation device according to the present invention shall be recognised from the following description of an example of embodiment, given by way of example, which is not limiting, according to the accompanying drawings, wherein figures from 1 to 8 show diagrams of embodiments of a plant comprising a compensation device according to the present invention.

[0006] . A cooling plant suitable for cooling a fluid to be cooled is globally indicated with reference numeral 1.

[0007] . The plant 1 is fluidically connected to a user 2 that needs cooled fluid, in general with a fixed temperature interval.

[0008] . The user 2 is, for example, a press, in which the cooled fluid cools the die and/or the counterdie. In this application, the user generally requires cooled fluid with a temperature of between 15 degrees centigrade and 25 degrees centigrade. According to a variation, the user 2 is a hydraulic device in which the cooled fluid cools the work fluid, for example oil. Generally, in this last application, the user requires cooled fluid with a temperature of between 35 degrees centigrade and 45 degrees centigrade.

[0009] . The plant 1 is connected to the user 2 by a delivery line 4 in which the cooled fluid circulates, which is designed to supply the user, and by a return line 6 in which the fluid to be cooled circulates, heated by the user.

[0010] . The plant 1 comprises at least one forced cooling device 8 cooperating with dissipation means. Said cooling device 8 is suitable for being fed with said fluid to be cooled and lowering the temperature of said fluid to be cooled principally by operating said dissipation means, obtaining a fluid cooled in a forced manner.

[0011] . According to an embodiment, said forced cooling device 8 is an air condensed chiller. For example, said air condensed chiller comprises a pump 10, a plate-type evaporator 12, an anti-ice probe G and an evaporator flow stat F.

[0012] . According to a preferred embodiment, said dissipation means comprise a ventilator driven by a motor,

which is, for example, electric.

[0013] . In other words, said forced cooling device 8 is suitable for cooling said fluid to be cooled using externally provided energy, for example by means of an electric motor and the like.

[0014] . The forced cooling device 8 is fluidically connected to a delivery line for forced cooling 14, into which the fluid cooled in a forced manner is sent, and to a return line for forced cooling 16, from which the fluid to be cooled is fed to said device 8.

[0015] . The plant 1 also comprises an accumulation and distribution device 20 suitable for accumulating said fluid cooled in a forced manner and distributing said fluid cooled in a forced manner to the users. Moreover, according to an embodiment variation, said device 20 is suitable for receiving said fluid to be cooled from the users to distribute it to said devices 8 for forced cooling.

[0016] . According to a preferred embodiment, said accumulation and distribution device 20 comprises a tank 22 suitable for accumulating said cooled fluid.

[0017] . Moreover, said device 20 comprises a separator 24 suitable for distributing said cooled fluid to the users. Said tank 22 is fed by said delivery line 14 for forced cooling. Said tank 22 feeds said separator 24. Said separator 24 feeds at least one delivery line 26 to a mixing point with said fluid cooled in a forced manner.

[0018] . Moreover, said separator 24 is suitable for receiving said fluid to be cooled from the users to distribute it to said devices 8 for forced cooling. Said separator 24 feeds said return line 16 for forced cooling.

[0019] . Moreover, said accumulation and distribution device 20 preferably comprises a temperature probe T1, which intercepts said return line for forced cooling. Moreover, said accumulation and distribution device 20 comprises a temperature probe T2, which intercepts said supply line from the tank 22 to the separator 24.

[0020] . Moreover, said plant 1 comprises at least one non forced cooling device 30. Said cooling device 30 is suitable for being fed with said fluid to be cooled and lowering the temperature of said fluid to be cooled principally by exposing said fluid to be cooled to the atmosphere, obtaining a fluid cooled in a non forced manner.

[0021] . According to a preferred embodiment, said device 30 comprises at least one discharger 32, for example in the form of a finned battery, in which the fluid to be cooled is cooled by exposure to the air.

[0022] . In other words, contrary to what is described for the forced cooling device 8, said non forced cooling device 30 enables the heat of the fluid to be cooled to be discharged into the atmosphere, without the intervention of motors to drive pumps and the like.

[0023] . Said discharger 32 is preferably drainable. In other words, when not in use, the fluid contained in the discharger 32, suitably positioned at a fixed height, is drained, for example to prevent the fluid from freezing.

[0024] . Said discharger 32 is fed by said fluid to be cooled by a return line for non forced cooling 34 and feeds a delivery line for non forced cooling 36 with said fluid

cooled in a non forced manner.

[0025] . Moreover, the plant 1 comprises a compensation device 40 suitable for being connected to said forced cooling device 8 and to said non forced cooling device 30 to cool variable quantities of fluid to be cooled in a forced manner to satisfy the need for cooled fluid of said user 2.

[0026] . The compensation device 40 comprises a collector 42 fluidically connected to said return line 6, to said return line for forced cooling 16, to said delivery line for non forced cooling 36 and to said return line for non forced cooling 34.

[0027] . In particular, said collector 42 is fed by said return line 6 and by said delivery line for non forced cooling 36 and feeds said return line for forced cooling 16 and said return line for non forced cooling 34.

[0028] . According to a preferred embodiment, said compensation device 40 comprises an inverter circulator for non forced cooling 44 set along said delivery line for non forced cooling 36.

[0029] . According to a further preferred embodiment, said compensation device 40 comprises an inverter circulator for non forced cooling 46 and, preferably, a flow stat F, set along said return line for non forced cooling 34.

[0030] . Moreover, said compensation device 40 preferably comprises at least one tank 48 introduced at the fluidic connection between said collector 42 and said non forced cooling device 30.

[0031] . Said tank 48, defined by one single side wall, preferably comprises two areas: a first cold area 50a and a second hot area 50b, which are separated from each other, for example by means of a separator or a wall.

[0032] . Said cold area 50a feeds said collector 42 and is fed by said delivery line for non forced cooling 36. Said hot area 50b is fed by said collector 50b and feeds said return line for non forced cooling 34.

[0033] . Moreover, said compensation device 40 is preferably connected to a filling line 52, on which an electric valve is preferably set for filling the plant, in particular for filling the tank 48, even more in particular, for filling the cold area 50a.

[0034] . Moreover, said compensation device 40 preferably comprises means for detecting the level of fluid 54, suitable for detecting the quantity of fluid circulating in the plant, for example suitable for detecting the level of fluid in a tank.

[0035] . According to a preferred embodiment, said detection means are suitable for detecting an operating level, an alarm level and a maximum level inside the tank 48, in particular inside the hot area 50b of said tank.

[0036] . Moreover, said compensation device 40 preferably comprises means for detecting the temperature T, for example cooperating with said tank 48, in particular with said cold area 50a for detecting the temperature of the fluid. In particular, said means for detecting the temperature T are suitable for detecting an alarm temperature and a set temperature.

[0037] . According to a preferred embodiment, said

compensation device 40 comprises mixing means 60 suitable for mixing said cooled fluid in a forced manner with fluid at a temperature greater than the temperature of the fluid cooled in a forced manner to obtain a cooled fluid with a temperature suitable for the user needs.

[0038] . According to a preferred embodiment, said mixing means 60 are fluidically connected to said return line 6, to said delivery line towards a mixing point 26 and to said delivery line 4.

[0039] . In particular, said mixing means 60 are fed by said return line 6 and by said delivery line to a mixing point 26 and feed said delivery line 4.

[0040] . Said mixing means 60 preferably comprise a three way modulating mixing valve, controlled, for example, by a temperature detector T3 set along the delivery line 4.

[0041] . Moreover, said mixing means comprise an inverter circulator controlled by a pressure transducer P2.

[0042] . During normal working of the plant 1, the user feeds the plant with the fluid to be cooled by the return line 6. Said fluid to be cooled is partially drawn to feed the mixing valve 62. The remaining part of the fluid to be cooled feeds the collector 42. In the collector 42, the fluid to be cooled mixes with the fluid cooled in a non forced manner, obtaining an intermediate cooled fluid. The intermediate cooled fluid is sent, in part, to the non forced cooling device 30, for example first passing through the tank 48, in particular through the hot area 50b.

[0043] . The non forced cooling device 30 cools said intermediate fluid to be cooled, obtaining the fluid cooled in a non forced manner, which is guided to feed the collector 42, for example after passing through the tank 48, in particular through the cold area 50a.

[0044] . The remaining part of the intermediate cooling fluid is sent to the forced cooling device 8, for example after passing through the accumulation and distribution device 20, for example through the separator 24.

[0045] . The forced cooling device 8 cools said intermediate fluid to be cooled obtaining the fluid cooled in a forced manner.

[0046] . The fluid cooled in a forced manner is sent to the mixing valve 62, for example after passing through the accumulation and distribution device 20, in particular after being accumulated in the tank 22 and after being passed through the separator 24.

[0047] . In other words, during operation of the plant 1, the fluid on which said forced cooling device 8 operates is a fluid that is already partially cooled by mixing the fluid to be cooled with the fluid cooled in a non forced manner, obtaining said intermediate fluid to be cooled.

[0048] . According to said procedure, the forced cooling device 8, operating for example with electric energy, only operates to cool said intermediate fluid for a non-refrigeratable part only by using the non forced cooling device 30.

[0049] . For example, in a region with a hot climate, during the hottest hours of a day or in the hottest seasons, the temperature of the fluid cooled in a non forced manner

is too high due to the poor cooling action that can be obtained only with the non forced cooling devices, so, if mixed with the fluid to be cooled, you obtain an intermediate fluid to be cooled, which requires a considerable use of the forced cooling device 8 in order to be brought to the temperature required for a cooled fluid.

[0050] . On the contrary, in a region with a cold climate, during the coolest hours of the day or in the cold seasons, the temperature of the fluid cooled in a non forced manner is low due to the strong cooling action that can be obtained with the non forced cooling devices, so, if mixed with the fluid to be cooled, you obtain an intermediate fluid to be cooled, which does not require the use of the forced cooling device 8 in order to be brought to the temperature required for a cooled fluid.

[0051] . Alternatively, as is generally the case, in a region with a temperature climate, during the cooler hours of the day or in the milder seasons, the temperature of the fluid cooled in a non forced manner is sufficiently low due to the good cooling action that can be obtained only with the non forced cooling devices, so, if mixed with the fluid to be cooled, you obtain an intermediate fluid to be cooled, which only requires limited use of the forced cooling device 8 in order to be brought to the temperature required for a cooled fluid.

[0052] . Figure 2 represents an embodiment variation of a plant according to the present invention.

[0053] . In accordance with figure 2, the plant 1 is suitable for supplying a first cooled fluid to a first user 2a, for example with a temperature included in a first range of temperatures, and a second cooled fluid to a second user 2b, for example with a temperature included in a second range of temperatures.

[0054] . According to said embodiment variation, said compensation device 40 comprises a direct delivery line 4b, which feeds said first user 2a with fluid cooled in a non forced manner. Moreover, said compensation device 40 comprises a direct return line 6b fed by said fluid to be cooled from said first user 2a.

[0055] . Said direct delivery line 4b is fluidically connected to said tank 48, in particular to said cold area 50a, whilst said direct return line 6b is fluidically connected to said tank 48, in particular to said hot area 50b.

[0056] . Said compensation device 40 preferably also comprises an inverter circulator 70, cooperating with a pressure transducer P1, set along said direct delivery line 4b.

[0057] . Figure 3 represents a further embodiment of the plant 1 according to the present invention.

[0058] . In accordance with figure 3, the plant 1 comprises a water condensed forced cooling device 8b.

[0059] . Said device 8b comprises a primary circuit fed by said return line for forced cooling 16 and feeds said delivery line for forced cooling 14.

[0060] . For example, the primary circuit comprises a pump, a plate-type evaporator, an anti-ice probe G and an evaporator flow stat F.

[0061] . Moreover, said device 8b comprises a sec-

ondary circuit fed by said direct delivery line 4b of the compensation circuit 40 and feeds said direct return line 6b of said compensation circuit 40.

[0062] . Said primary circuit and said secondary circuit cooperate together, for example, by means of a gas cycle, to cool said fluid to be cooled.

[0063] . Figure 4 shows a further variation of the plant according to the present invention.

[0064] . According to figure 4, the plant 1 is suitable for being connected to a first user 2a and to a second user 2b and, also comprises an air condensed forced cooling device 8b.

[0065] . The compensation device 40 comprises a direct delivery line to the user 4c and a direct delivery line to the cooling 4d. Furthermore, the compensation device 40 comprises said direct return line 6b.

[0066] . Figure 5 represents a further embodiment variation of said plant according to the invention.

[0067] . According to figure 5, said accumulation and distribution device 20 comprises a delivery line to the departments 80 and a return line from the departments 82, connected to a further user, for example for conditioning the areas of the departments such as offices, warehouses and the like.

[0068] . Said delivery line to the departments 80 is fed by said separator 24 and said return line from the departments feeds said separator 24.

[0069] . Figure 6 represents a further embodiment variation of the plant according to the present invention.

[0070] . In accordance with figure 6, said mixing means 60 comprise a moderate cooling delivery line 4e, which feeds said mixing valve 62.

[0071] . Said moderate cooling delivery line comprises a mixing point, where an additional non forced delivery line 4f and an additional forced delivery line 4g converge.

[0072] . Said additional non forced delivery line 4f is fed with fluid cooled in a non forced manner, for example drawn from said cold area 50a of the tank 48.

[0073] . Said additional forced delivery line 4g is fed with fluid cooled in a forced manner, for example drawn from said separator 24.

[0074] . Figure 7 shows a further embodiment variation of the plant according to the present invention.

[0075] . In accordance with figure 7, said compensation device 40 comprises an emergency device 80. Said emergency device 80 comprises a by-pass delivery line 82, which connects the delivery line 4 of the second user 2b to the delivery line 4 of the first user 2a, wherein the temperature of the fluid in the delivery line 4 of the second user 2b is lower than the temperature of the fluid in the delivery line 4 of the first user 2a. Furthermore, said emergency device 80 comprises a by-pass return line 84, which connects the return line 6 of the first user 2a to the return line 6 of the second user 2b.

[0076] . Figure 8 represents a further embodiment variation of the plant according to the present invention.

[0077] . In accordance with figure 8, the tank 48 of the compensation device 40 is an underground tank.

[0078] . In accordance with a feature of the present invention, the compensation device 40 is a module that is separable and connectable, according to the needs, to said forced cooling device 8, 8b, to said non forced cooling device 30 and to said users 2, 2a, 2b.

[0079] . For example, said compensation device comprises the tank 48 defined by the side wall and comprising the areas 50a, 50b. The delivery and/or return lines towards the forced and non forced cooling devices and towards the users are contained along the side wall. The collector 42 is also contained. The mixing means are also contained.

[0080] . Innovatively, the compensation device, according to the present invention, makes an energy saving, since it alters the amount of the action of the forced cooling devices, which absorb electric energy, or deriving from fuels, based on the effectiveness of the non forced cooling devices.

[0081] . In other words, the effectiveness of the forced cooling devices is more reduced the greater the possibility is to cool a fluid by exposure to the atmosphere.

[0082] . According to a further advantageous feature, the compensation device is made as an independent module, suitably connectable and disconnectable, according to the needs.

[0083] . Also advantageously, the compensation device allows the water dischargers to drain, preventing the water from freezing.

[0084] . According to a further advantageous feature, the accumulation and distribution device is also made in the form of an independent module, and can be connected and disconnected, according to the needs.

[0085] . Also advantageously, the forced and non forced cooling devices are also made in the form of independent modules, and can be connected and disconnected, according to the needs.

[0086] . It is clear that a man skilled in the art can make several changes and adjustments to the device described above in order to meet specific and incidental needs, all falling within the scope of protection defined in the following claims.

Claims

1. Compensation device (40) for a cooling plant (1) of a fluid to be cooled, said plant being connectable to at least one user (2,2a,2b), said user to be fed with a cooled fluid, wherein said plant comprises:

- at least one forced cooling device (8,8b) cooperating with dissipation means, wherein said cooling device is suitable for lowering the temperature of a fluid on which it operates principally by driving said dissipation means, obtaining a fluid cooled in a forced manner;
- at least one non forced cooling device (30), wherein said cooling device is suitable for low-

ering the temperature of a fluid on which it operates principally by exposing said fluid to the atmosphere, obtaining a fluid cooled in a non forced manner;

said compensation device being **characterised in that** it is suitable for cooperating with said forced cooling device and with said non forced cooling device for variable cooling in a forced manner to satisfy the need for cooled fluid of said user.

2. Compensation device according to claim 1, comprising a collector (42) fed by said fluid cooled in a non forced manner and by said fluid to be cooled to obtain an intermediate fluid to be cooled, wherein said collector can be connected to a return line for forced cooling (16) to feed said intermediate fluid to be cooled to said forced cooling devices (8,8b).

3. Device according to claim 3, wherein said collector can be connected to a return line for non forced cooling (34) to feed said intermediate fluid to be cooled to said non forced cooling devices (30).

4. Device according to claim 2 or 3, wherein said collector (42) can be connected to a delivery line for non forced cooling (36) to be fed with said fluid cooled in a non forced manner.

5. Device according to any one of the claims from 2 to 4, also comprising a tank (48) fluidically connected to said collector (42) and to said non forced cooling devices (30).

6. Device according to claim 5, wherein said tank (48) comprises a cold area (50a) fed by said non forced cooling devices (30) and which feeds said collector (42) and a hot area (50b), which feeds said non forced cooling devices (30) and is fed by said collector (42).

7. Device according to claim 5 or 6, wherein said tank (48) is connected to a filling line (52) for filling the fluid in the plant.

8. Device according to any one of the previous claims, also comprising mixing means (60) suitable for mixing said fluid cooled in a forced manner with fluid at a temperature greater than the temperature of the fluid cooled in a forced manner to obtain a cooled fluid with a temperature suitable for the needs of user.

9. Device according to claim 8, wherein said mixing means comprise a three-way mixing valve (62).

10. Device according to any one of the previous claims, comprising a direct delivery line (4b) to feed a first

user 2a with fluid cooled in a non forced manner and a direct return line (6b) to be fed by said fluid to be cooled from said first user 2a.

11. Device according to claim 10, wherein said direct delivery line (4b) is a moderate cooling delivery line (4e) in which an additional non forced delivery line (4f) that can be fed by said non forced cooling devices (30) converges with an additional forced delivery line (4g) that can be fed with fluid cooled in a forced manner. 5 10
12. Cooling plant (1) comprising at least one compensation device (40) made in accordance with any one of the previous claims. 15
13. Plant according to claim 12, wherein said plant also comprises a distribution and accumulation device (20). 20
14. Plant according to claim 12 or 13, wherein said forced cooling devices (8) comprise air condensed chillers.
15. Plant according to any one of the claims from 12 to 14, wherein said forced cooling devices (8) comprise water condensed chillers. 25
16. Plant according to any one of the claims from 12 to 15, wherein said non forced cooling devices (30) comprise dischargers (32). 30

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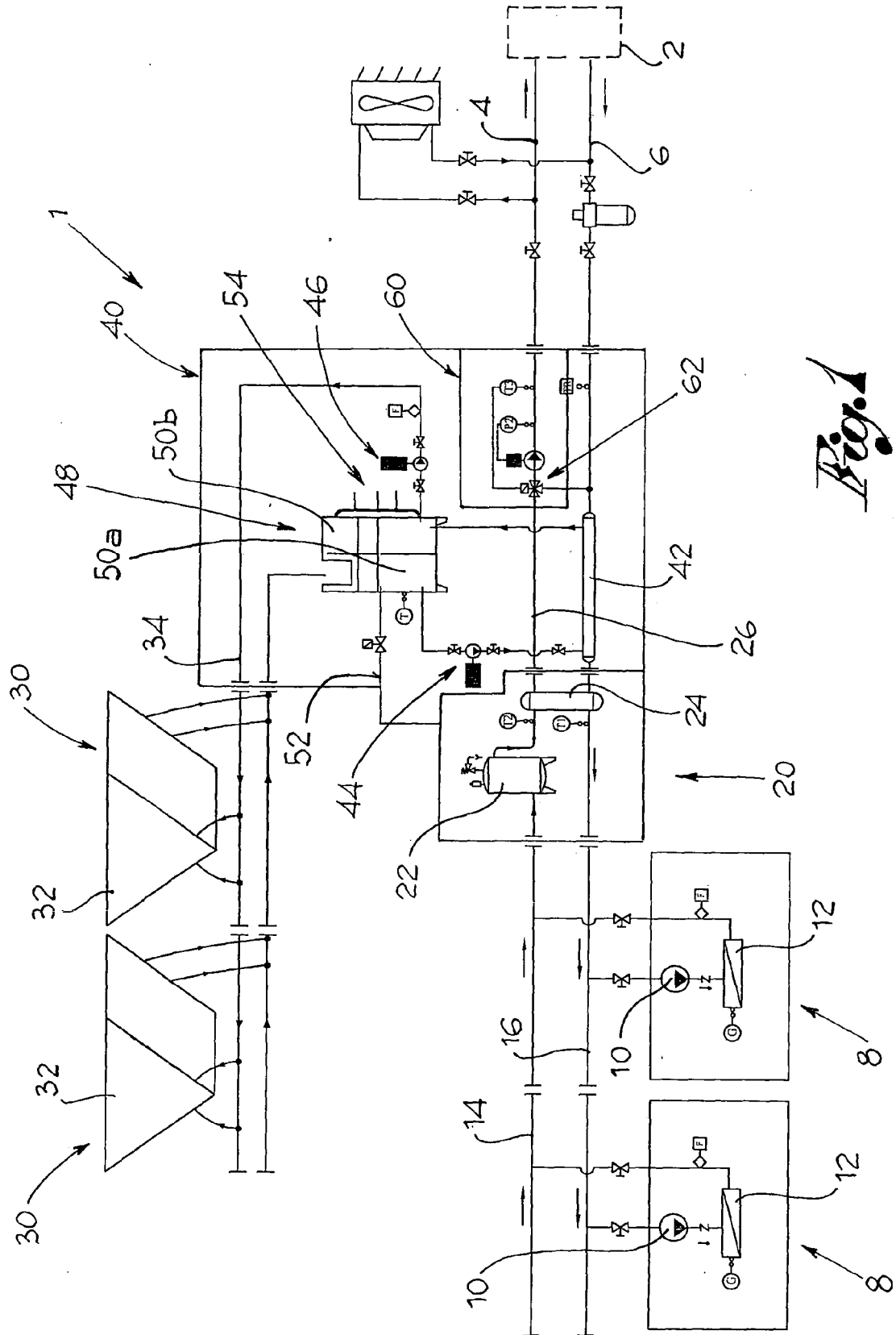


Fig. 1

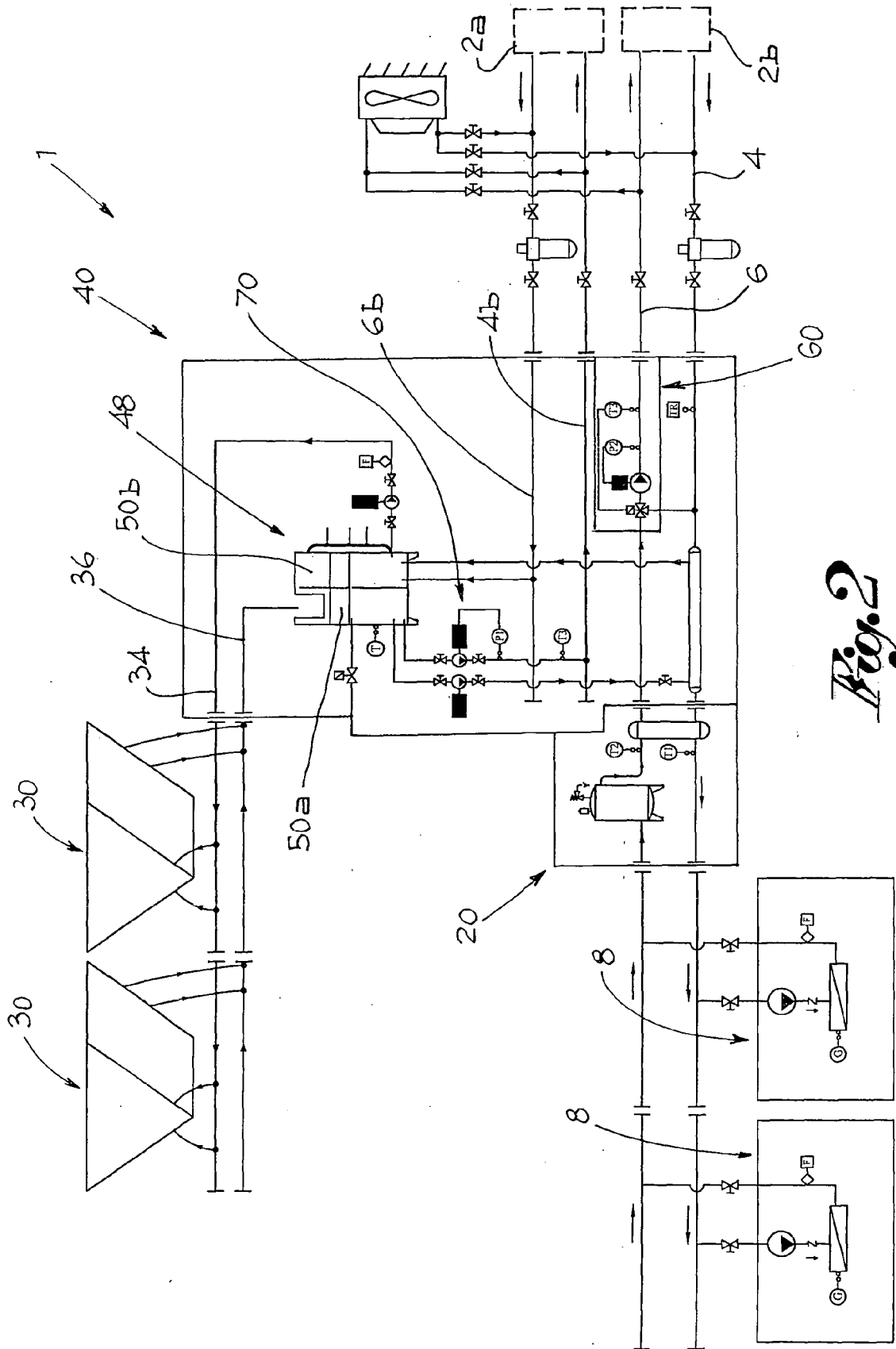


Fig. 2

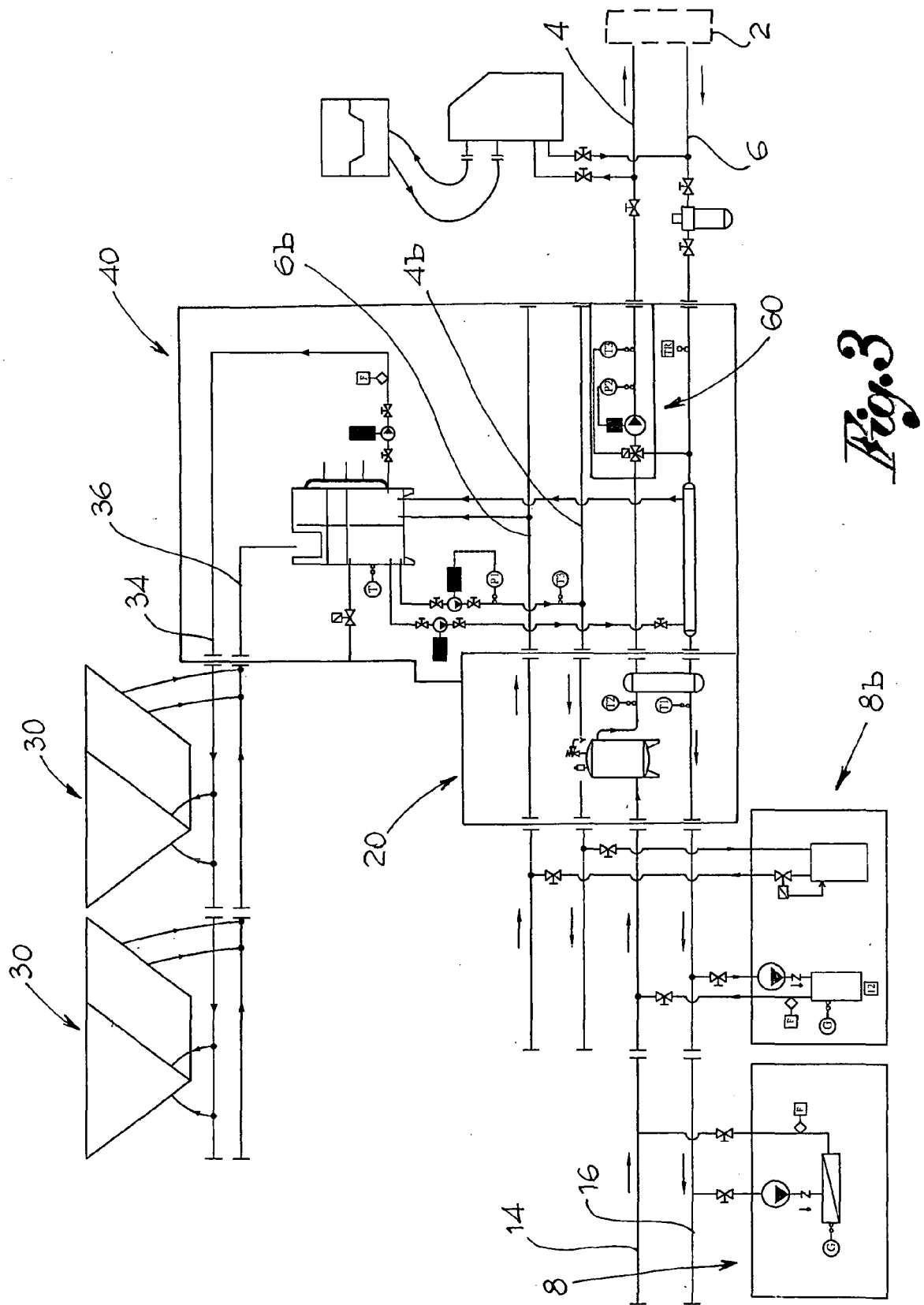


Fig. 3

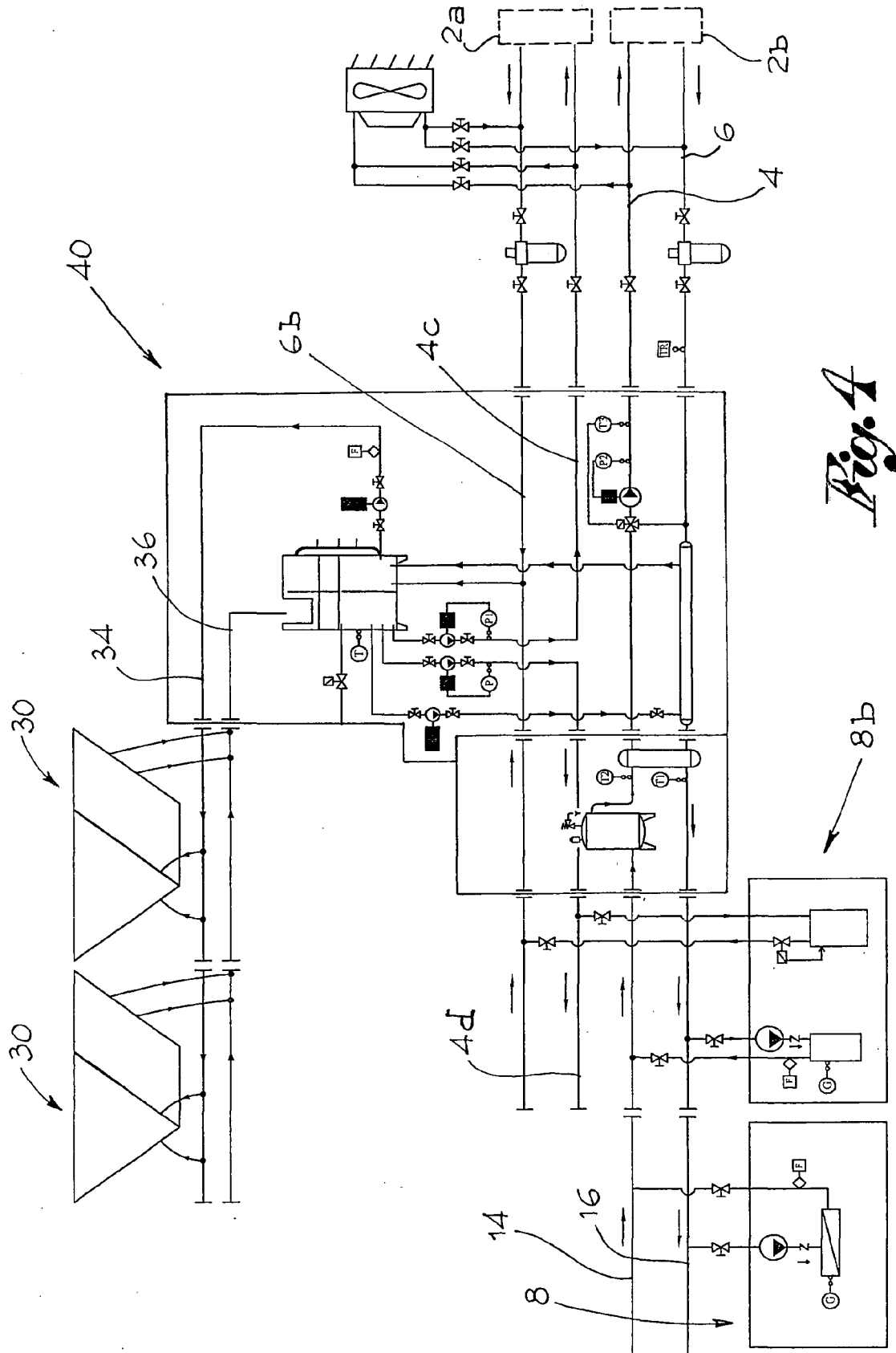


Fig. 4

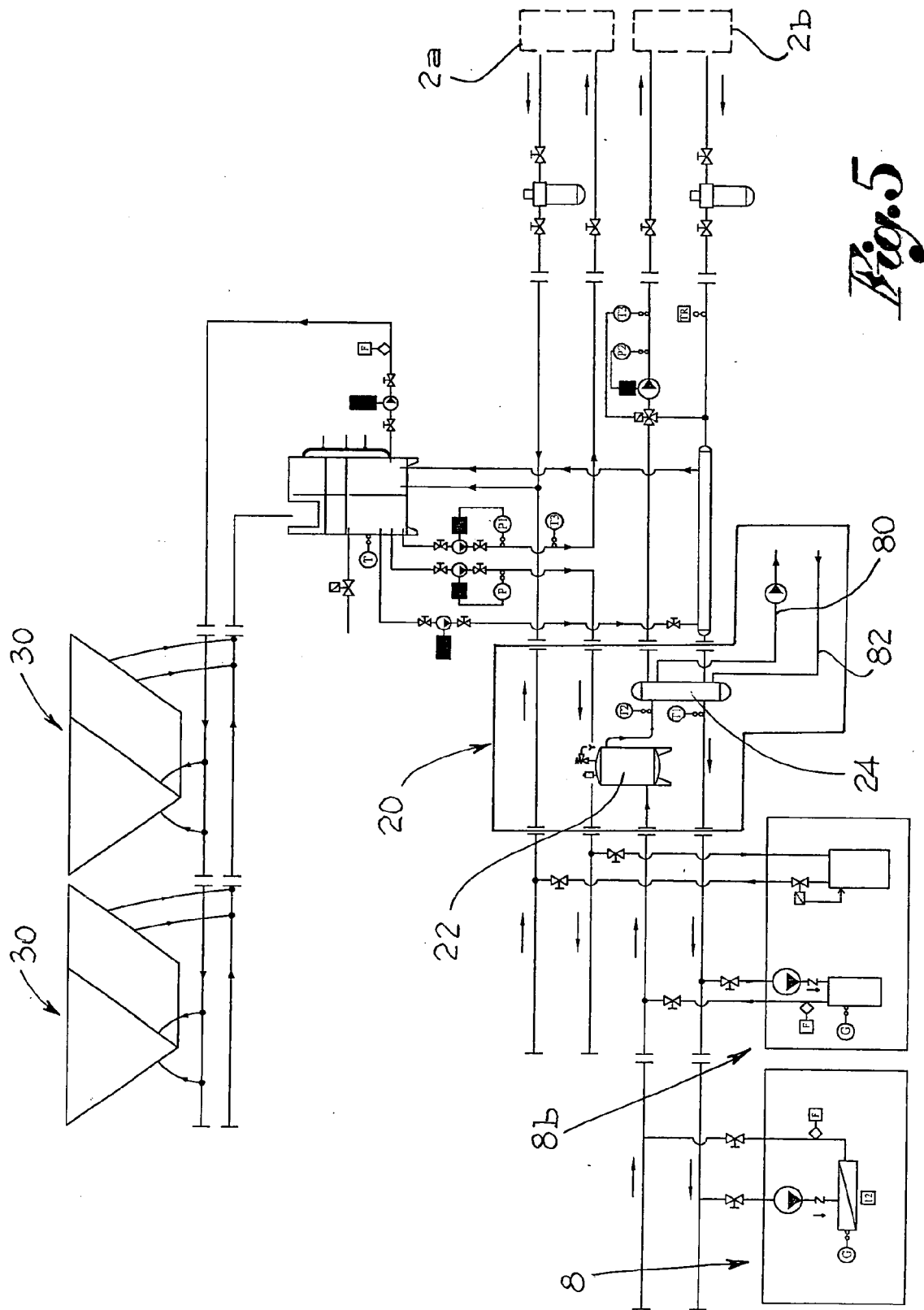
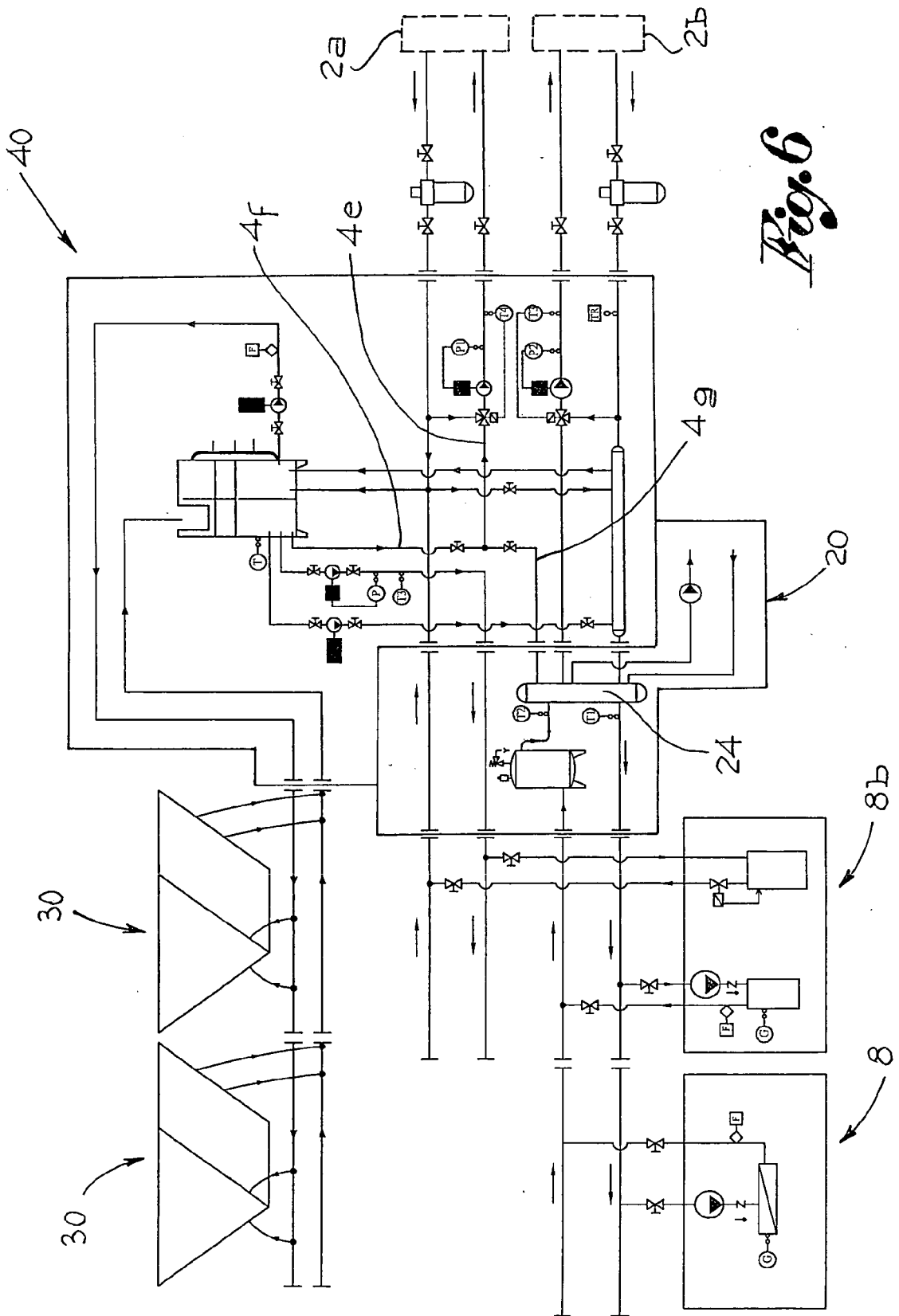


Fig. 5



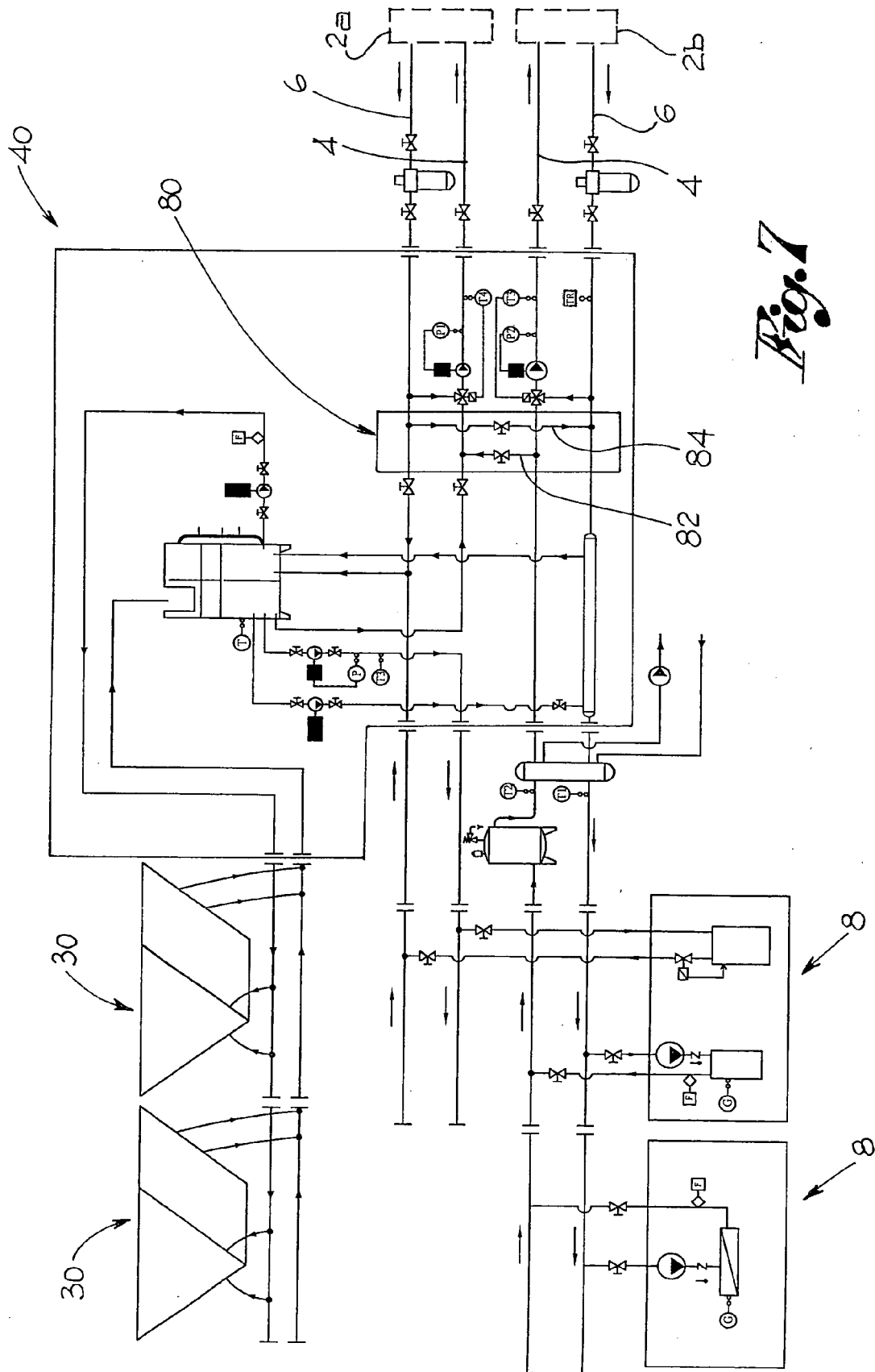


Fig. 7

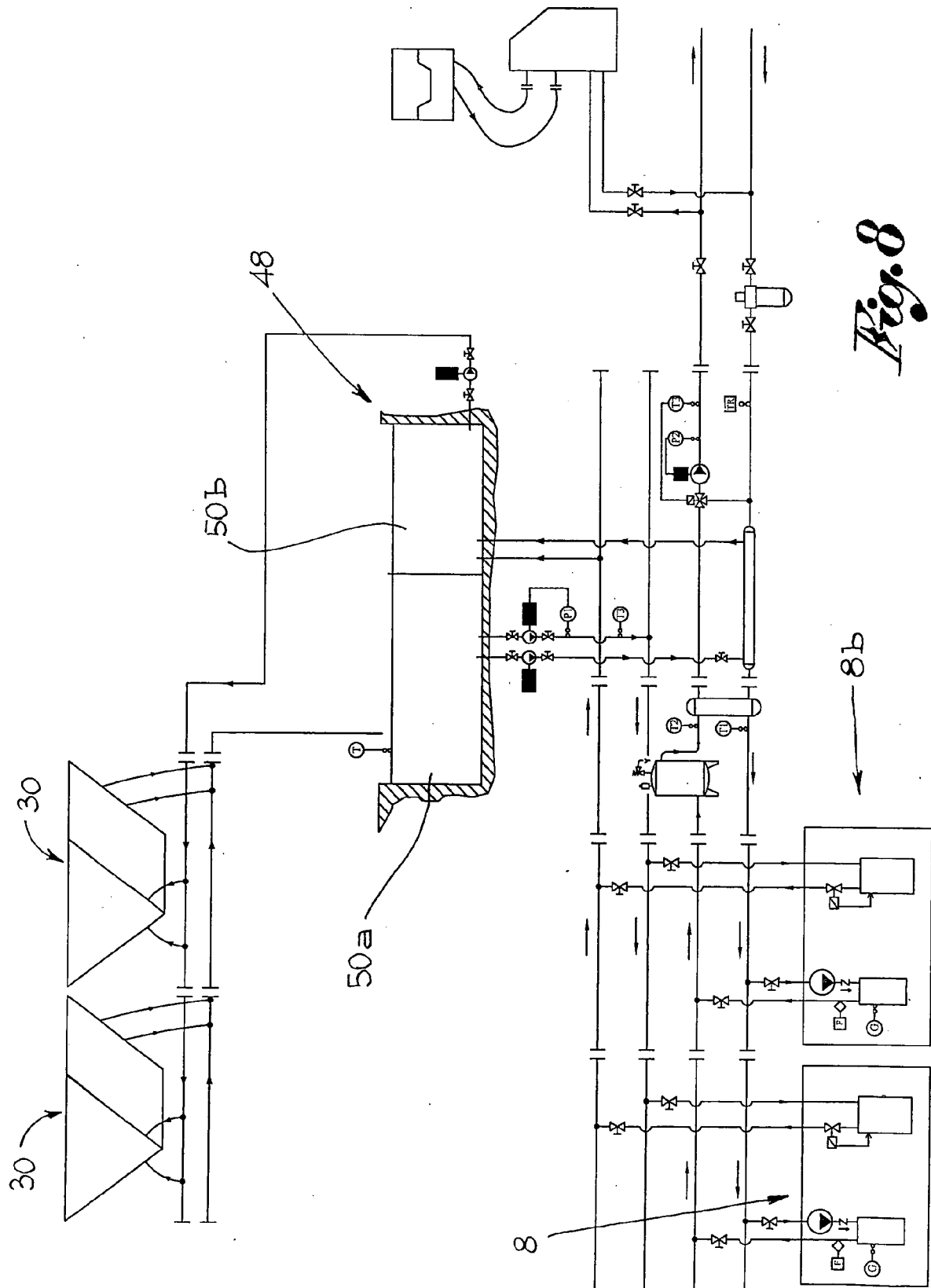


Fig. 8



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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 28 November 2005	Examiner De Graaf, J.D.
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Place of search The Hague		Date of completion of the search 28 November 2005	Examiner De Graaf, J.D.	
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Application Number
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 28 November 2005	Examiner De Graaf, J.D.
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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28-11-2005

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