(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 468 318 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **91111669.7**

(51) Int. Cl.5: **F24F 3/06**, F24F 5/00

(22) Date of filing: **12.07.91**

(30) Priority: **27.07.90 IT 2110190**

(43) Date of publication of application:
29.01.92 Bulletin 92/05

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB IT LI LU NL SE

(71) Applicant: **RIELLO CONDIZIONATORI S.p.A.**
44, Via Roma
I-37040 Bevilacqua Verona(IT)

(72) Inventor: **Riello, Valerio Giordano**
Via Pio X
I-37045 Legnago (Verona)(IT)

(74) Representative: **Münzhuber, Robert,**
Dipl.-Phys. et al
Patentanwalt Rumfordstrasse 10
W-8000 München 5(DE)

(54) Monobloc heating and cooling system.

(57) The monobloc heating and cooling system groups in a single block the refrigerating and heating units (A,B) and comprises manifolds (D) formed of two sections (20,21) connected to each other by valving means (V). A single hydraulic circuit (17,25) is provided which connects the single block to the manifolds (D) and the manifolds (D) to the heating and cooling elements (16,15) provided for heating and cooling the rooms.

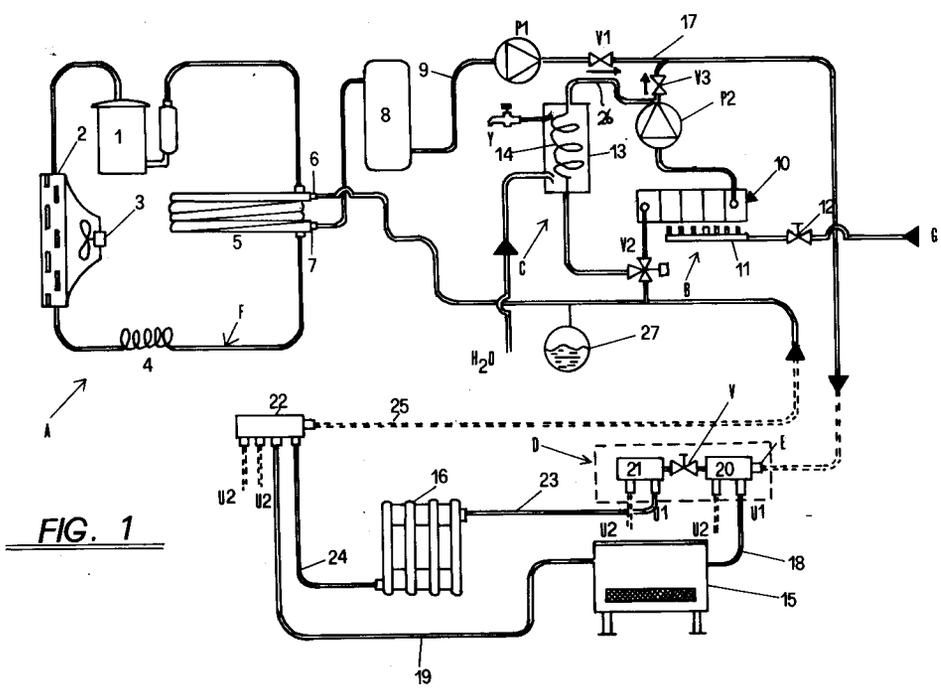

FIG. 1

EP 0 468 318 A2

The present invention generally relates to room heating and cooling systems and, more particularly, to an improved system of this kind.

It is known that, when a room is to be heated and also conditioned, two independent hydraulic circuits must be provided, namely a circuit for the circulation of hot water and a circuit for the circulation of cold water. Alternatively, a hydraulic circuit for the circulation of hot water and coolant pipes for a direct expansion cold exchanger can be provided. However, in both cases it is necessary to connect the heating and/or cooling elements by means of four pipes.

Therefore, in the self-contained systems of small capacity (for example for a single family) it is necessary to have a boiler and a water refrigerator (or a two-section apparatus in the case of the direct expansion system) each of which is provided with an own electric and hydraulic supply and with an own regulation.

During the winter season in which the room heating is necessary, all the rooms are usually to be heated, but during the summer season in which the room conditioning is necessary, some rooms, as for example the bath-rooms, store-rooms, not frequently used rooms and so on, are not conditioned. This involves operation characteristics as to the power, the pump delivery, the pressure losses, the distribution and so on, which are quite different in both the systems.

With the exception of particular regulation cases especially provided by persons very skilled in this art and having a good knowledge of the operation problems of these systems, each system has the own regulation and the switching from the heating mode of operation to the cooling mode of operation or viceversa occurs by hand, after the shut-down of one of the two systems.

If, as happens, there would be provided a single system, operating either with hot water or cold water produced by respective and separate generators which are parallel connected and by using heating elements of different kind (radiators and fancoils), there is the need of decreasing the water temperature in the fancoils or to install heat radiators having a greater surface.

This invention aims at providing a monobloc heating and cooling system which obviates the above mentioned disadvantages.

Another object of the present invention is to provide a monobloc heating and cooling system permitting the use of the same heat exchange elements as those located in the rooms to be heated and conditioned in each of two operating modes.

Still another object of the present invention is to provide a monobloc heating and coolig system of a very semplified kind and requiring only a hydraulic circuit both for the heating mode of operation and for the cooling mode of operation.

A further object of the present invention is to provide a monobloc heating and cooling system which permits an automatic switching from one operating mode to the other operating mode.

According to the invention, the room heating and cooling system comprises a water refrigerating unit, a water heating unit, if necessary a water heater for the sanitary appliances, circulation pumps, safety and control means and heating and cooling elements and is characterized in that

- the water refrigerating unit, the water heating unit, the circulation pumps, the water heater for the sanitary appliances and the safety and control means are grouped in a single block;
- manifolds are provided each of which consists of two sections connected to each other through a valving means; and
- a single hydraulic circuit is provided both for the heating mode of operation and the cooling mode of operation.

According to another feature of the present invention, said manifolds are connected to the single block and to the heating and cooling elements by means of two pipes only, one pipe for delivering the heating and cooling medium and the other pipe for returning it.

According to another feature of the present invention, in the operating mode with high temperature of the hot water, the cooling elements are provided with shutter means for operating only a portion thereof, when they are acting as heating elements.

According to a further feature of the present invention, in the operating mode with a low temperature of the hot water, the manifolds are connected in groups of two and one manifold of each group has a temperature control valve of the cooling elements so as to maintain this temperature low when they are acting as heating elements and automatically control the temperature according to the thermal load.

According to still another feature of the present invention, radiators as heating elements and fancoils as cooling and heating elements, respectively can be used for the rooms that are to be only heated or cooled and heated, respectively.

The present invention will be now described in more detail in connection to a preferred embodiment thereof, given only by way of example and therefore not intended in a limiting sense, illustrated in the accompanying drawings, wherein:

Fig. 1 diagrammatically shows a circuit of the monobloc room heating and cooling system according to the present invention;

Fig. 2 diagrammatically shows a circuit of the arrangement of the manifold according to the

invention during the operating mode with high temperature of the hot water; and

Fig. 3 diagrammatically shows a circuit of the arrangement of the manifolds according to the invention during the simultaneous operation with low temperature of the hot water in the fancoils and high temperature in the heat radiators.

As can be seen from Fig. 1, the monobloc heating and cooling system according to the present invention essentially comprises a refrigerated water generating unit or refrigerating unit A, a hot water generating unit or boiler B, a water heater C for the sanitary appliances and manifolds D of special design.

The refrigerating unit A conventionally comprises a compressor 1, a condenser 2 provided with fan 3, a laminating element 4 and an evaporator 5. The evaporator 5 has an inlet 6, an outlet 7 for the circulating water. The outlet 7 is connected to a refrigerated water accumulator 8.

The hot water generating unit B comprises a gas boiler 10 provided with burners 11 supplied by a gas source G through a gas valve 12.

The water heater C comprises a tank 13 connected to a water supply and containing a coil 14 in which the hot water coming from the gas boiler 10 circulates and which heats the water supplied thereto.

The manifolds D are formed of two separate sections 20 and 21 connected to each other through an ON-OFF valve V. They have a single inlet E which is to be connected to the hot water delivery of the boiler 10 or the cold water delivery of the accumulator 8. Both outlets are connected to the users, i.e. the heating elements and the cooling elements, for example the outlet U1 of the manifold section 20 is connected to a fancoil and the outlet U1 of the manifold section 21 is connected to a heat radiator and the outlets U2 are connected to another heat radiator and another fancoil. Although only two outlets have been shown for semplicity, it should be apparent that the outlet number is depending on the number of users provided in the system.

As can be seen from the embodiment illustrated in Fig. 1, the refrigerated water flowing from the accumulator 8 is circulated by a circulation pump P1 through the pipe 9 and then, through the pipe 17 in which an one-way valve V1 is located, is supplied to the inlet E of the section 20 of the manifold D. The outlet U1 of the manifold D is connected, through the pipe 18, to the fancoil 15, the outlet of which is connected, through a pipe 19, to a return manifold 22. The outlet U1 of the section 21 of the manifold D is connected, through a pipe 23, to the heat radiator 16, the outlet of which is also connected, through a pipe 24, to the return manifold 22. The return manifold 22 returns, through the pipe 25, the circulating water to the inlet 6 of the evaporator 5 in order that this water is again refrigerated at the correct outlet temperature.

The hot water coming from the boiler 10 is circulated by the circulation pump P2, through the pipe 26 in the water heater C. The hot water flows then through the coil 14 and returns to the boiler 10 through a three-way valve V2. The hot water is also delivered by the circulation pump P2, through an one-way valve V3, to the pipe 17 leading to the manifolds D. The pipe 25 from the return manifold 22 can be communicated with the boiler 10 through the three-way valve V2. In the return pipe 25 an expansion tank 27 is provided.

The operation of the just described system is as follows.

As already said at the beginning, in each of the rooms to be only heated a heat radiator is provided, whereas in the rooms which are also to be conditioned a fancoil is provided.

Assume now to be in the winter season, in which all the rooms are to be heated. In this case the circulation pump P1 is inoperative and the boiler 10 delivers the hot water generated thereby through the circulation pump P2, the one-way valve V3, the pipe 17, to the section 20 of manifold D, the ON-OFF valve V of which is now in open position, so that the hot water enters the manifold section 20 through the single inlet E and flowing from the outlet U1, is supplied to the fancoil 15 through the pipe 18. Because the ON-OFF valve V is open, the hot water enters also the section 21 of the manifold D and flowing from the outlet U1 is supplied, through the pipe 23, to the heat radiator 16. The water flowing from the fancoil 15 and the water flowing from the heat radiator 16 is supplied to the return manifold 22 which returns it, through the pipe 25, to the boiler 10, through the three-way valve V2 which communicates now the boiler 10 to the return pipe 25. The hot water can flow also in the water heater C and is returned to the boiler 10 through the three-way valve V2 which, when necessary, is automatically switched to communicate also the water heater C with the boiler 10.

Assume now to be in the summer season so that only the rooms provided with fancoils are to be conditioned. In this case, the boiler operates for preparing the hot water for the sanitary appliances, but it is excluded from the hydraulic circuit to the users by switching the three-way valve V2, so that the latter communicates only the water heater with the boiler. In this case, the circulation pump P1 is made operative and therefore the refrigerated water contained in the accumulator 8 is supplied through the one-way valve 1 to the section 20 of the manifold D, whereas the manifold section 21 is excluded by closing the ON-OFF valve V. The refrigerated water flows from the outlet U1 of the

section 20 of the manifold D and, through the pipe 18, is supplied to the fancoil 15 from which it flows in order to be supplied to the return manifold 22 through the pipe 19. From the return manifold 22 the water which has exchanged its refrigeration contents with the environment,is returned through to the pipe 25 to the inlet 6 of the evaporator 5 of the refrigerating unit A.

As can be seen, in order to operate the system both in the heating mode and in the cooling mode always a single hydraulic circuit is employed. It comprises two pipes one of which, namely the pipe 17, is directed to the manifold D and the other of which, namely the pipe 25, returns the circulating water to the hot water generating unit B and to the refrigerating unit A, respectively. Also the users are arranged in a single hydraulic circuit leading to manifolds D.

In Fig. 2 there is diagrammatically shown a circuit to be employed in the system according to the present invention in the heating mode of operation with high temperature of the hot water. Also in this case, all the rooms to be heated are provided with a heat radiator and the rooms to be conditioned are provided with a fancoil.

As can be seen, the hot water at the temperature of about 80°C coming from the boiler 10 and circulated by the circulation pump P2 enters, through the single inlet E, the section 20 of the manifold D and through the outlet U1 of the manifold section 20, flows in the fancoil 15 at this high temperature. In this operating mode the ON-OFF valve V is open and the hot water at a temperature of 80°C enters also the section 21 of the manifold D and through the outlet U1, flows in the radiator 16 for heating the rooms not provided with a fancoil. In this case in the fancoil 15 provided with fan 29 a two-circuit battery 28 is provided and in the pipe 18 a shutter V4 is arranged the function of which is to permit the flow of the hot water through one circuit 30 of the two circuit battery 28, thereby excluding the other circuit 31. In this manner the water circulating in the fancoil 15 is cooled so as to impart to the air flowing from the fancoil a not too high temperature, but sufficient to heat the room environment.

On the contrary, in the case that the room environment is to be conditioned, the ON-OFF valve V of the manifold D is turned off so as to exclude the manifold section 21 and the refrigerated water coming from the pipe 17 is supplied in the fancoil 15, which, in this case, has the shutter V4 open so as to supply both the circuit 31 and the circuit 30 so as to operate all the battery 28.

In Fig. 3 there is diagrammatically shown a circuit intended to be employed in the system according to the present invention in the heating operating mode with low temperature of the hot water. Here again all the rooms to be heated are provided with heat radiators, whereas the rooms to be also conditioned are provided with fancoils. In this case an integrated manifold (high-low temperature) designated by C1 is provided, which comprises two parallel arranged manifolds D one of which, namely the manifold D1, is provided with the ON-OFF valve V and the other of which, namely the manifold D2, is provided with a thermostatic valve VT for regulating the temperature of the fancoil 15. In this case the inlets E of the sections 20 of the manifolds D1,D2 are connected to each other by a pipe 32 in which a circulation pump P3 for the low temperature elements is inserted. The ON-OFF valve V is open so that the water at a temperature of 80°C entering through the inlet 33 of the section 20 of the manifold D1 flows through the manifold section 21 and is supplied, through the pipe 34, to the heat radiator 16 and the less hot water flowing therefrom enters the section 21 of the manifold D2 through the pipe 35 and is returned to the boiler through the pipe 25.

The water in the section 20 of the first manifold D1, after being mixed with the water coming from the pipe 32, is supplied to the fancoil 15 through the pipe 36 from which is then supplied to the section 20 of the second manifold D2 and circulated by the pump P3 continuously in the fancoil 15 through the pipes 32 and 36. The control thermostatic valve VT is controlled according to the temperature in the section 20 of the second manifold D2 and has the function of maintaining low the hot water temperature supplied to the fancoils and of automatically controlling it according to the thermal load.

Of course, in the summer season in which only the fancoil 15 is to be operated, the boiler 10 is disconnected, the ON-OFF valve V of the first manifold D1 is closed and the pump P3 is inoperative so that the refrigerated water coming from the accumulator 8 flows in the manifold section 20, through the fancoil 15 and from the return pipe 25 through the second manifold D2 and the valve VT which is in open position.

As can be understood from the description, the monobloc heating and cooling system according to the present invention permits both the heating elements and the cooling elements to be supplied by means of two pipes only, which extend from the refrigerated water and the hot water generating units to the special manifolds and from here, always by means of two pipes, to the users. Furthermore, the generating units are grouped in a single block which can include also the control and regulation elements arranged in a center unit and this single block can be arranged outdoor, if desired.

It should be understood that in the above described monobloc heating and cooling system the

valves can be controlled by hand or automatically by the center unit provided in the single block and also the switching from the heating operate mode to the cooling operate mode can be automatically controlled.

Furthermore, the manifolds can have a configuration different from that illustrated provided they operate in the described manner.

The above described system permits the followings advantages to be obtained:

1) Semplified construction because the monobloc heating and cooling system comprises the electric and hydraulic connections present in only one of the two systems (heating and conditioning). This permits a space recovery and offers the possibility to arrange outdoor the monobloc heating and cooling system containing the hot water and refrigerated water generating units.

2) Possibility of using the same heating and cooling elements in the rooms to be heated and conditioned in its of the two operating modes, resulting in the use of two pipes only, which extend from the hot water and cold water generating units to the manifolds and from the latter to each heating and cooling element.

3) Automatic disconnection of the heating elements in the rooms not of concern during the conditioning period.

4) Automatic adaptation to the different system characteristics in both the operating modes of the pump which circulates the heating medium because each operating mode is provided with the own pump designated for the specific purpose.

5) Automatic regulation of the water temperature during the operation in the heating mode in the heating elements adapted to low temperature.

6) Automatic and central regulation and switching of the operation.

7) Modularity and freedom of choosing the number and the type of the terminal users.

8) Possibility of arranging all the control and regulating elements in a single place, preferably in said single block.

Claims

1. Monobloc room heating and cooling system comprising a water refrigerating unit (A), a water heating unit (B), if necessary a water heater (C) for the sanitary appliances, circulation pumps (P1,P2,P3), safety and control means and heating and cooling elements (16,15), characterized in that
   - the water refrigerating unit (A), the water heating unit (B), the circulation pumps (P1,P2,P3), the water heater (C) and the safety and control means are grouped in a single block;
   - manifolds (D) are provided consisting of two sections (20,21) connected to each other through a valving means (V); and
   - a single hydraulic circuit is provided both for the heating mode of operation and the cooling mode of operation.

2. Monobloc system according to claim 1, characterized in that said manifolds (D) are connected to said single block and to said heating and cooling elements (16,15), respectively by means of two pipes only (17,25), one of which (17) delivers the heating and cooling medium and the other of which (25) is provided for the return thereof.

3. Monobloc system according to claims 1 and 2, characterized in that in the operating mode with high temperature of the hot water, said cooling elements (15) are provided with shutter means (V4) for operating only a portion thereof, when they are acting as heating elements.

4. Monobloc system according to claims 1 and 2, characterized in that in the operating mode with a low temperature of the hot water, said manifolds (D1,D2) are connected in groups of two and one manifold (D1) of each group has a temperature control valve (VT) of the cooling elements (15) so as to maintain this temperature low when they are acting as heating elements and automatically control the temperature according to the thermal load.

5. Monobloc system according to claim 1, characterized in that heat radiators (16) as heating elements and fancoils (15) as cooling and heating elements, respectively can be used for the rooms that are to be only heated or cooled and heated, respectively.

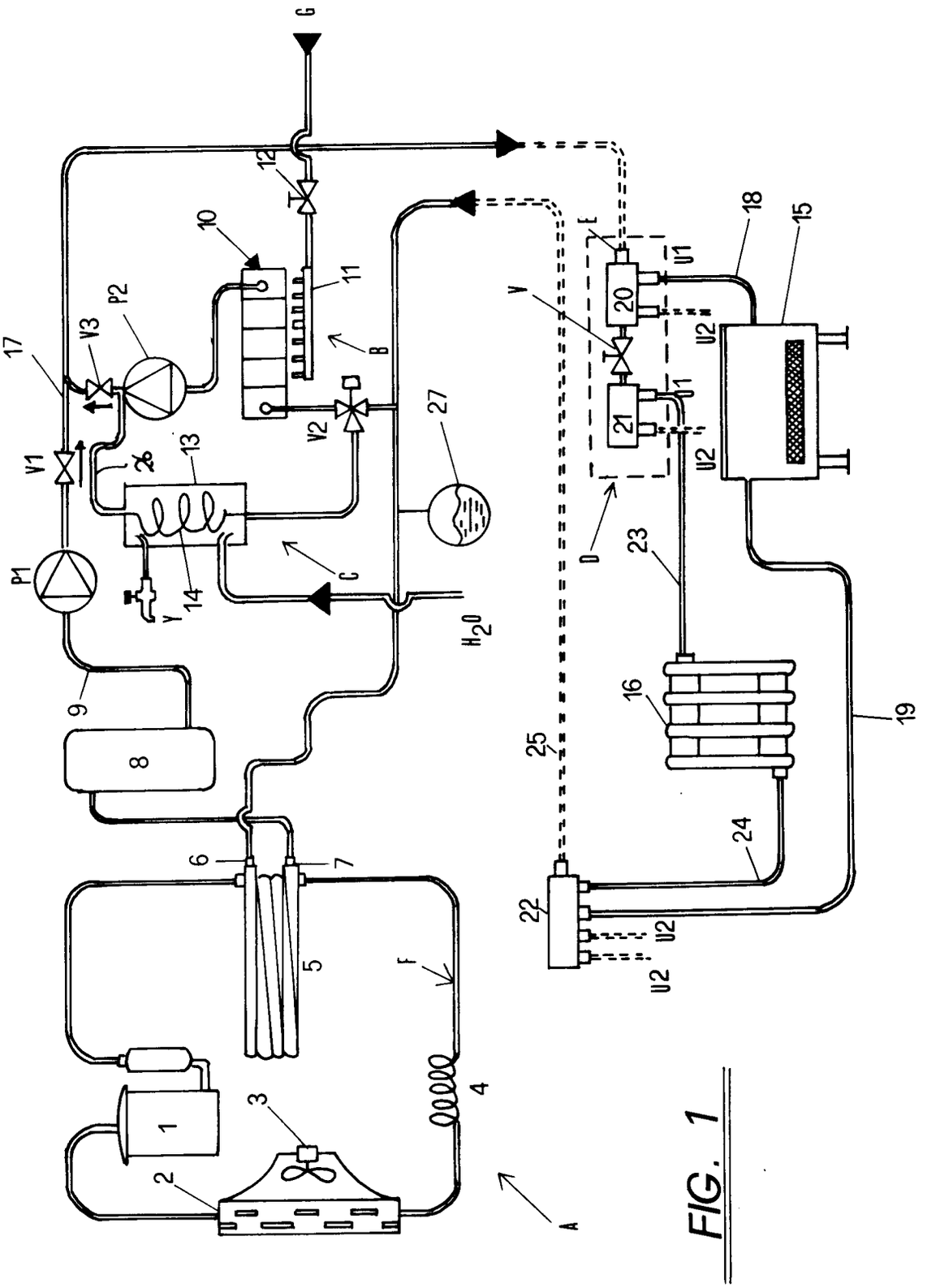
G
12
10
11
B
P2
V3
17
V1
13
14
Y
P1
9
8
6
7
5
F
4
3
1
2
A
V2
27
C
H_2O
V
E
D
U1
U2
18
15
20
21
23
16
19
25
24
22

FIG. 1

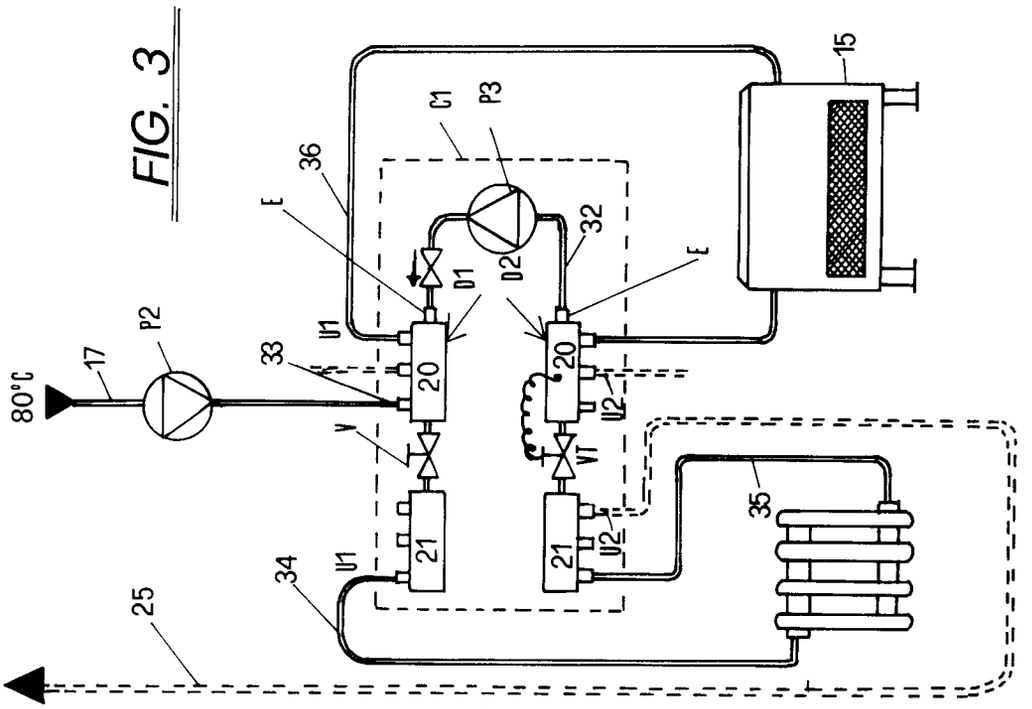
80°C
P2
17
33
U1
20
V
21
U2
34
25
D1
D2
C1
P3
36
E
32
15
VT
35

FIG. 3

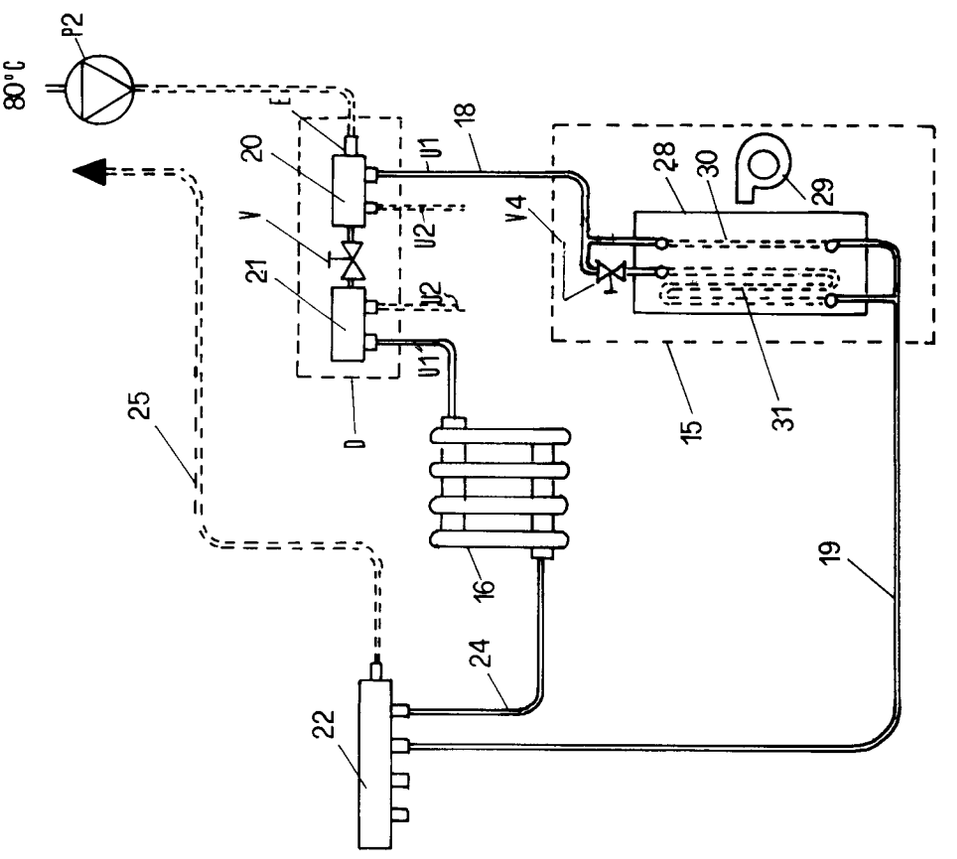
80°C
P2
E
20
U1
18
V
21
U2
D
25
16
24
22
19
V4
28
30
29
31
15

FIG. 2