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(72) Inventor: De' Longhi, Giuseppe
31100 Treviso (IT)

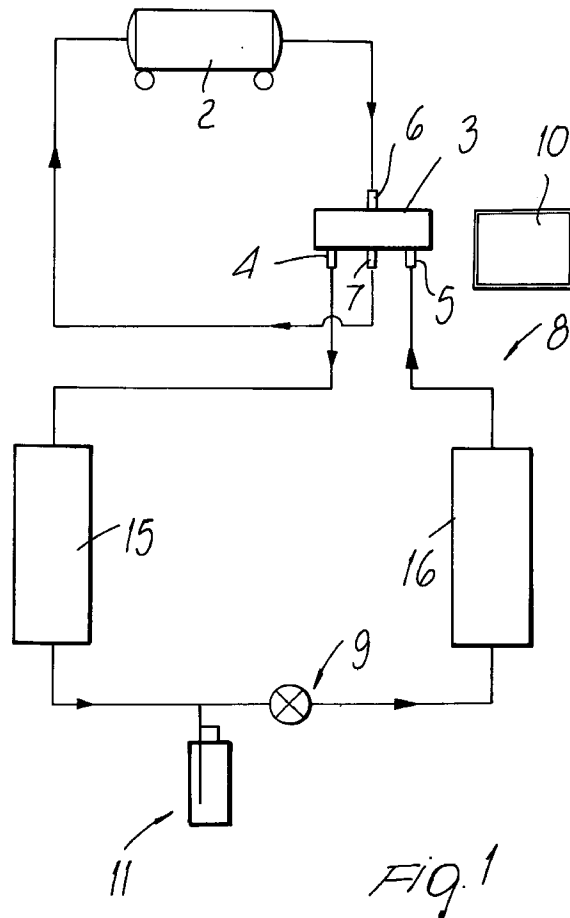
(74) Representative:
Rapisardi, Mariacristina
Ufficio Brevetti Rapisardi S.r.l.,
Largo V Alpini, 15
20145 Milano (IT)

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(71) Applicant: DE' LONGHI S.p.A.
31100 Treviso (IT)

(54) Machine for producing hot or cold air or water by means of a refrigerant

(57) Machine for producing hot or cold air or water by means of a refrigerant, includes one reversible refrigeration circuit (8) comprising one variable lamination member (9) for varying the lamination in said reversible refrigeration circuit (8) and for controlling the refrigeration cycle as the internal and external ambient temperature and humidity of the room to be conditioned vary.



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Description

[0001] The present invention relates to a machine for producing hot or cold air or water by means of a refrigerant.

[0002] Conventional air-water machines or unit, in the versions cold only or heat pump, for producing hot or cold air or water for conditioning an ambient generally comprise a compressor, two heat exchangers, an electric fan, a liquid separator, a liquid receiver, a cycle inverter valve (usually a four way valve), two refrigerator circuits that entail, among others, the use of two unidirectional valves or stop valves and two expansion members for the refrigerant.

[0003] In this manner it is possible to manage the internal fluidodynamic system of the machine in order to make it operate as a heat pump, for example during winter, or as a cooler, for example during summer, thereby varying the quantity of refrigerant inside the machine.

[0004] In other words, by inverting the direction of the refrigerant flow, it is possible, in winter, to use an exchanger as a condenser thereby producing heat, and to use the other exchanger as evaporator, while in summer the condenser is used as an evaporator and the evaporator is used as a condenser.

[0005] As the quantity of refrigerant used in the unit is different when producing heat with respect of when producing cold, i.e. the quantity is less in "winter" and greater in "summer", these machines must have a double and/or separate refrigeration circuits (liquid line-low pressure), operated separately by lamination members, stop or one way valves, leading to a refrigerant receiver.

[0006] From the above, it is apparent that these machines have a rather complex construction and are therefore not entirely reliable. Furthermore, besides being very expensive, because of their complex construction, these conventional machines require a difficult maintenance and a great quantity of refrigerant which has to fill two separate circuits.

[0007] Also, in these conventional machines, the reversible refrigeration cycle is not optimally controlled and reacts slowly as the ambient temperature and humidity vary.

[0008] An aim of the present invention is to eliminate the above cited prior art drawbacks.

[0009] An object of the invention is to provide a machine for producing hot or cold air or water by means of a refrigerant, having such an extremely simplified structure to be extremely reliable in operation.

[0010] A further object of the invention is to provide a machine for producing hot or cold air or water by means of a refrigerant, which, by having a simplified construction, accordingly has an easier maintenance and a smaller spare part supply requirement.

[0011] A further object of the invention is to provide a machine for producing hot or cold air or water by means of a refrigerant, which can operate with any type of gas and adapting to the gas virtually immediately.

[0012] A further object of the invention is to provide a machine for producing hot or cold air or water by means of a refrigerant, having a reduced cost and still operating better than conventional machines.

5 [0013] Still a further object of the invention is to improve the energetic effect (obtained hot or cold energy divided by spent energy) using smaller quantities of natural or artificial refrigerants thereby reducing their direct or indirect pollution.

10 [0014] The above aim and objects and other objects that will be more apparent hereinafter, are achieved by a machine for producing hot or cold air or water by means of a refrigerant, characterized in that it comprises one reversible refrigeration circuit comprising one variable lamination member for varying the lamination in said reversible refrigeration circuit and for controlling the refrigeration cycle in a faster and optimized manner as the internal and external ambient temperature and humidity of the room to be conditioned vary.

20 [0015] Further characteristics and advantages of the invention will be more apparent by the following description of an embodiment of the invention, illustrated, by way of example in the enclosed drawings in which

25 FIG. 1 show an operation diagram of the machine according to the invention for producing heat, i.e. operating, for example, during winter;

30 FIG. 2 show the operation diagram of the machine of FIG. 1 when the machine operates for cooling the room, i.e. operating, for example, during summer;

35 FIG. 3 is a side schematic view of the container adapted to collect and release automatically the refrigerant to the one refrigeration circuit of the machine according to the invention;

FIG. 4 shows a varied embodiment of the container shown in FIG. 3, according to the invention;

40 FIGs. 5 and 6 show an open type rather than closed type of the circuit shown in FIGs. 1 and 2, with different positions of the container 1 and of valve 9.

45 [0016] With reference to the above figures, the machine, also known as "chiller", for producing hot or cold air or water by means of a refrigerant comprises, in a per se known manner, a compressor 2 wherein a refrigerant, of any type according to the needs, enters at low pressure and exits at high pressure to be fed, for example, to a four way valve 3.

50 [0017] The four way valve 3 operates as a cycle inverter valve switching the flow of refrigerant from the conduit 4, as explained in detail later, in order to make the refrigeration cycle operate as a heat pump, returning from conduit 5 or, viceversa, as shown in FIG. 2, the inflow from conduit 5 and the return flow from conduit 4, in case of cooling of the ambient, i.e. during the "sum-

mer" operation.

[0018] Conduit 6 of the four way valve will be the inflow conduit while conduit 7 of the four way valve will be the return flow conduit of the refrigerant to the compressor.

[0019] The machine according to the invention comprises one reversible refrigeration cycle of either type closed or open (split system), globally designated by the reference numeral 8, adapted to provide a reversible refrigeration cycle for producing hot or cold air or water for conditioning an ambient.

[0020] The control of the reversible refrigeration cycle is effected by a variable lamination member adapted to vary the lamination in the reversible refrigeration circuit, namely a lamination valve 9 arranged in the refrigeration circuit and controlled by an electronic circuit 10 in order to control the refrigeration cycle more rapidly and optimally with respect to a double refrigeration circuit system of the prior art, as the internal and external temperature and humidity of the ambient vary.

[0021] The machine according to the invention also comprises collecting means for collecting a selected quantity of refrigerant from the refrigeration circuit and an automatic release means for automatically releasing a selected quantity of refrigerant inside the refrigeration circuit.

[0022] In particular, the refrigerant automatic collecting and release means comprise a container 11 connected to the refrigeration circuit through first and second conduits, respectively designated by reference numerals 12 and 13.

[0023] Container 11 is connected to the refrigeration circuit 8 in an area globally designated by reference numeral 14 and which is comprised between a first exchanger 15 and lamination valve 9.

[0024] Lamination valve 9 is associated with refrigeration circuit 8 in a position comprised between container 11 and a second heat exchanger 16.

[0025] More in detail, first conduit 12 is associated with second conduit 13 with its portion which is external to the container 11 and extends inside the container 11 down to its bottom 18.

[0026] Second conduit 13 is associated with the container at its upper portion 19 opposite to the bottom 18 and is connected to the refrigeration circuit in the area 14.

[0027] Area 14 of the refrigeration circuit is defined by a portion of a first pipe 20 associated with the first exchanger 15 and arranged coaxially around a portion of a second pipe 21 of the refrigeration circuit connected to the lamination valve 9 in order to form an annular chamber 22 which communicates with the second conduit 13.

[0028] In this manner, as explained in greater detail later, in the area 14, when freon or any other gas circulates in a direction going from the lamination valve 9 to the first exchanger 15, it generates a vacuum adapted to draw a selected quantity of refrigerant from container 11 into the first pipe 20.

[0029] In case of cycle inversion, i.e. when the refrigerant exits the first exchanger 15 in the direction of the lamination valve 9, the refrigerant is forced to enter the second conduit 13 and therefrom into the container 11 which is, at least in a first phase, at a lower pressure.

[0030] Then, a selected quantity of refrigerant will continue to flow into the container 11 by gravity.

[0031] The above will be better understood with reference to the above described drawings.

10 [0032] In particular, FIG. 1 shows the refrigeration circuit adapted to provide hot water or air for example during the winter season.

15 [0033] In this case, freon, or any other gas, exits conduit 4 and follows an anti-clockwise flow direction entering the first exchanger 15 which in this case operates as a condenser.

[0034] From condenser 15, the refrigerant enters first pipe 20, having a larger diameter with respect to second pipe 21, so that in area 14, where the two pipes are mutually coaxial and form the annular chamber 22, a selected quantity of refrigerant enters second conduit 13 and therefrom into the container 11 which, at least in a first phase, is at a lower pressure.

25 [0035] Then, during the working cycle, the refrigerant enters container 11 by gravity to fill it with a selected quantity equivalent to the quantity of refrigerant that is not required during the "winter" operation.

[0036] The valve 9 is automatically adjusted by means of the electronic circuit 10 in order to always provide a high efficiency of the machine with any type of refrigerant used in the machine.

30 [0037] Then, the refrigerant flows from the valve 9 to the second exchanger 16, which in this case operates as an evaporator, and then flows back through the conduit 5 into the compressor.

35 [0038] Viceversa, as illustrated in FIG. 2, when the refrigeration circuit operates for cooling the room, the refrigerant exits conduit 5 and enters the second exchanger 16, which in this case operates as a condenser, and then flows through the lamination valve 9, which is associated to a distributor 30 according to a first embodiment. Distributor 30 of the refrigerant has a fixed lamination member 32 (FIG. 3) which is bypassed by a bypass conduit 31 for the "winter"- "summer" reversing of the cycle.

45 [0039] According to a second embodiment of the invention, distributor 30 may not have the fixed lamination member 32 and the bypass conduit 31.

50 [0040] The lamination valve 9 will be regulated by the electronic circuit 10 and, passing in the area 14 of the refrigeration circuit, flowing out of the second pipe 21 a depression inside the annular chamber 22 will draw the selected quantity of refrigerant from the container 11 through the first conduit 12 and the second conduit 13.

55 [0041] First conduit 12 initially draws at first oil and then refrigerant liquid and then refrigerant gas, from container 11, in order to ensure lubrication of the compressor.

[0042] Once the selected quantity of refrigerant is fed into the refrigeration circuit, the refrigeration circuit can cool the ambient and therefore operate in the "summer" period with more refrigerant than in the "winter" period.

[0043] The refrigerant then enters the first exchanger 15, which in this case operates as an evaporator, and then flows back to the compressor 2 through the conduit 4.

[0044] FIG. 4 shows a different embodiment from that illustrated in FIG. 3 which however operates in the same manner.

[0045] In this case, the pipes connecting the first exchanger to the valve and to the container are still partially mutually coaxial but extend linearly rather than with a double bend, as in the embodiment illustrated in FIG. 3.

[0046] Furthermore, the length of the coaxial portion of the pipes is greater and the second pipe 21 has a plurality of holes 30 in the area entering the first exchanger 15, allowing a better distribution of the refrigerant inside the exchanger.

[0047] The above described machine according to the invention has a further important advantage: it keeps the water, inside the hydraulic apparatus associated with the machine, at a constant temperature without requiring one or more water reservoirs or an inverter for the compressor.

[0048] In particular, this is achieved by modulating the pump of the hydraulic apparatus (not illustrated in the drawings) in order to vary the water capacity according to the users and at the same time to vary the quantity of refrigerant in the refrigeration circuit by modulating the lamination valve 9.

[0049] In particular, the modulation of the pump and of the lamination valve 9 by means, for example, of a PLC or of said electronic circuit 10, allows to keep the water temperature constant flowing out of the exchangers 15 or 16 during the operation of the refrigeration circuit both in winter (hot water) and in summer (cold water).

[0050] By means of the electronic circuit 10 or the PLC, it is possible to establish when and how to vary the water and refrigerant capacities by detecting the temperature of the water flowing out of the exchangers 15 and 16, and the temperature gap between the inlet and the outlet of the exchangers and the overheating temperature in the compressor 2 inlet in order to ensure that the refrigerant enter the compressor in the gaseous state.

[0051] It has been seen in practice that the machine according to the invention is particularly advantageous in that it can operate with any suitable type of natural and/or artificial refrigerant, it has an extremely simplified mechanical construction providing a greater reliability and less maintenance and has a lower cost.

[0052] The machine according to the invention may have numerous modifications and variations within the scope of the claims. All the details may be substituted with technically equivalent elements.

[0053] The materials employed, as well as the dimensions, may be any according to the specific needs and the state of the art.

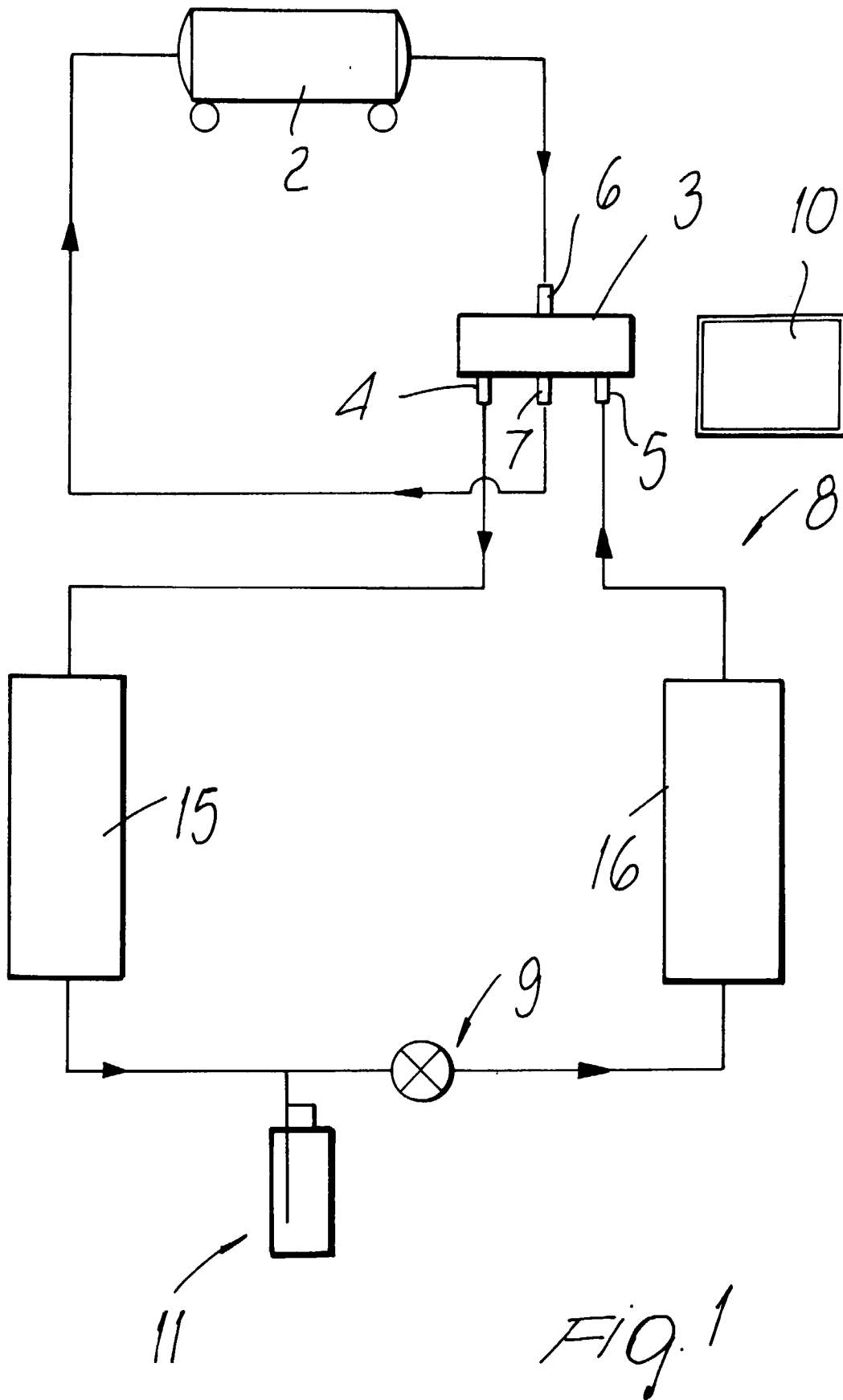
5 Claims

1. Machine for producing hot or cold air or water by means of a refrigerant, characterized in that it comprises one reversible refrigeration circuit comprising one variable lamination member for varying the lamination in said reversible refrigeration circuit and for controlling the refrigeration cycle in a faster and optimized manner as the internal and external ambient temperature and humidity of the room to be conditioned vary.
2. Machine, according to claim 1, characterized in that it comprises automatic collecting and release means for a selected quantity of refrigerant from and into said refrigeration circuit.
3. Machine, according to claim 1 or 2, characterized in that said variable lamination member is a lamination valve arranged in said refrigeration circuit and controlled by an electronic circuit.
4. Machine, according to one or more of the preceding claims, characterized in that said automatic collecting and release means comprise a container connected to said refrigeration circuit through first and second conduits.
5. Machine, according to one or more of the preceding claims, characterized in that said container is connected to said refrigeration circuit in its area comprised between a first exchanger and said lamination valve, said lamination valve being comprised between said container and a second exchanger.
6. Machine, according to one or more of the preceding claims, characterized in that said first conduit is associated with said second conduit outside said container and extends inside said container down to the bottom of said container.
7. Machine, according to one or more of the preceding claims, characterized in that said second conduit is associated with said container in its upper portion opposite to said bottom.
8. Machine, according to one or more of the preceding claims, characterized in that said area of said refrigeration circuit has a portion in a first pipe associated with said first exchanger and coaxially arranged around a portion of a second pipe which is associated with said lamination valve in order to form an annular chamber communicating with said

second conduit.

9. Machine, according to one or more of the preceding claims, characterized in that said first and second exchanger alternatively operate as a condenser or an evaporator for producing hot or cold water or air according to the flow direction of the refrigerant established by switching a four way valve. 5
10. Machine, according to one or more of the preceding claims, characterized in that said container alternatively operates in depression for releasing said refrigerant inside said refrigeration circuit and initially in depression and then by gravity for collecting said refrigerant from said refrigeration circuit. 10 15
11. Machine, according to one or more of the preceding claims, characterized in that it comprises variation means for varying the water capacity of the hydraulic apparatus associated with said machine and the refrigerant capacity of said refrigeration circuit for maintaining the water inside said hydraulic apparatus at a constant temperature. 20
12. Machine, according to one or more of the preceding claims, characterized in that said variation means comprises at least one modulated pump of the hydraulic apparatus and at least said lamination valve in order to vary the capacity of the water in said hydraulic apparatus and the capacity of refrigerant inside said refrigeration circuit, according to the requirements. 25 30
13. Machine, according to one or more of the preceding claims, characterized in that said pump and said lamination valve are modulated by means of a PLC or by said electronic circuit for keeping the water temperature constant flowing out of the exchangers during the operation of the refrigeration circuit both in winter and in summer. 35 40
14. Machine, according to one or more of the preceding claims, characterized in that it comprises detecting means for establishing when and how to vary the water and refrigerant capacities by detecting the temperature of the water flowing out of the exchangers, the temperature gap between the inlet and the outlet of the exchangers and the overheating temperature in the compressor inlet in order to ensure that the refrigerant enter the compressor in the gaseous state. 45 50

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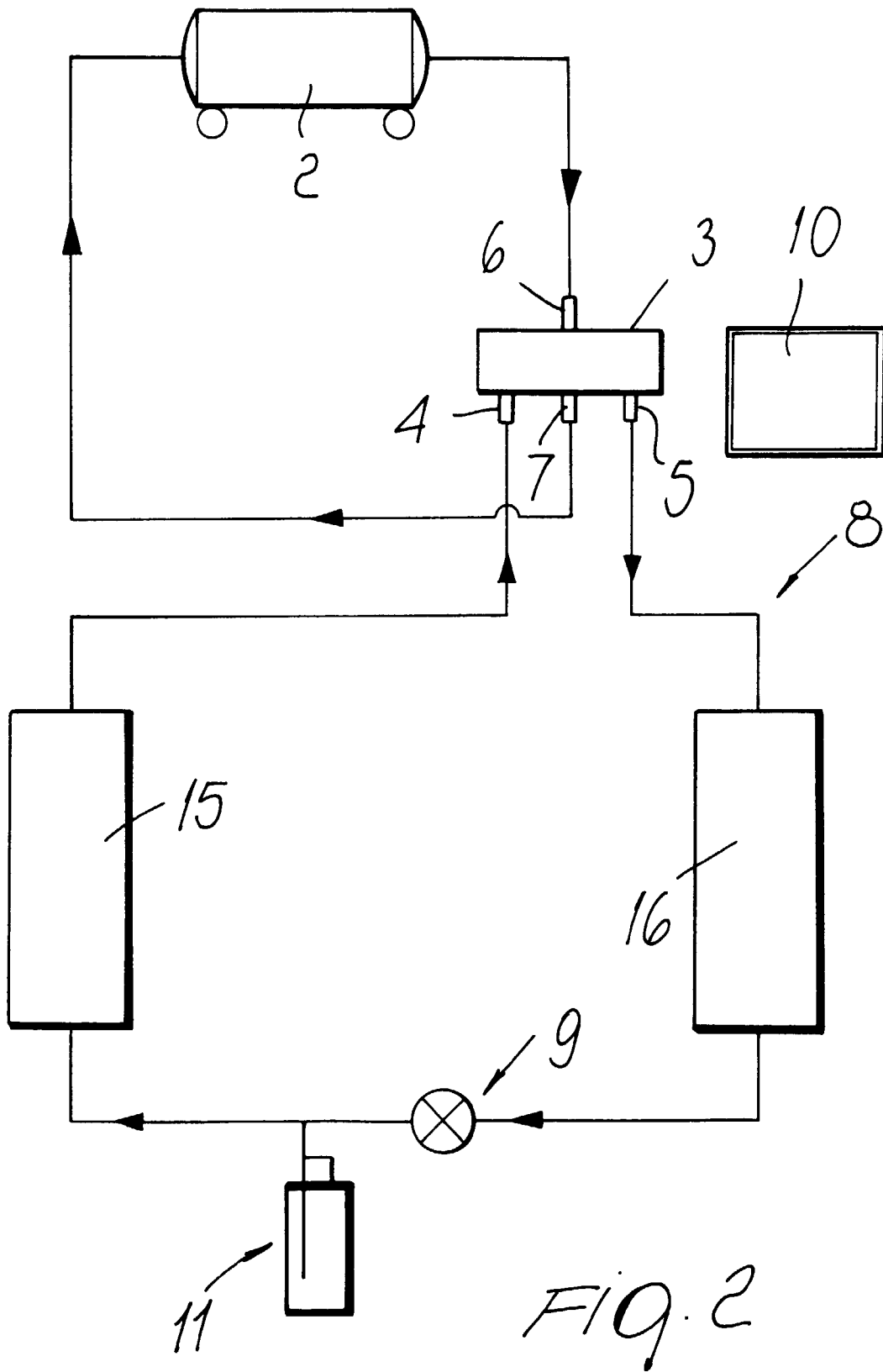


FIG. 2

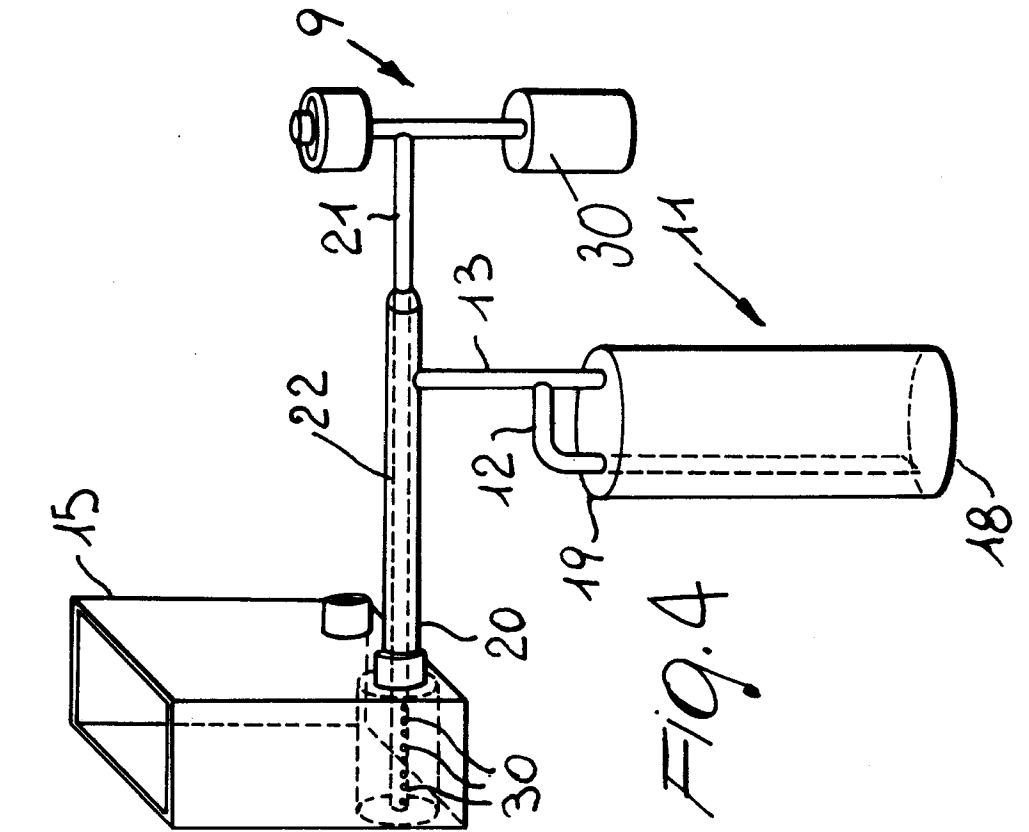


FIG. 4

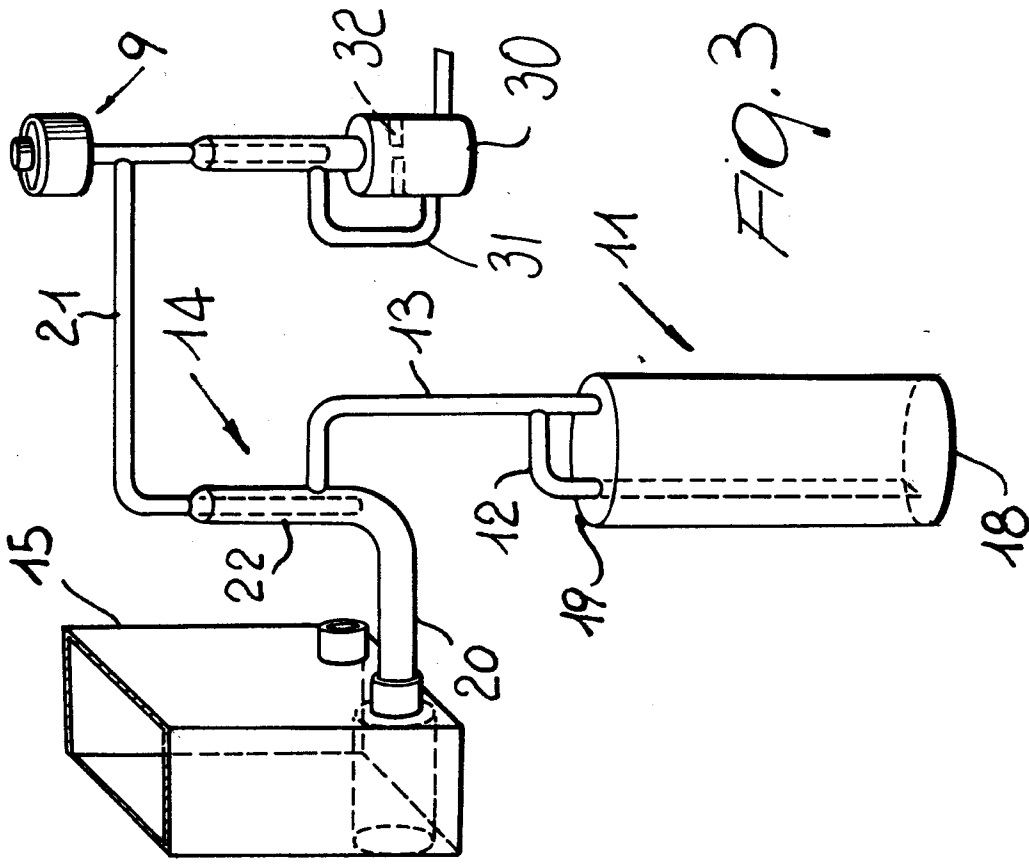


FIG. 3

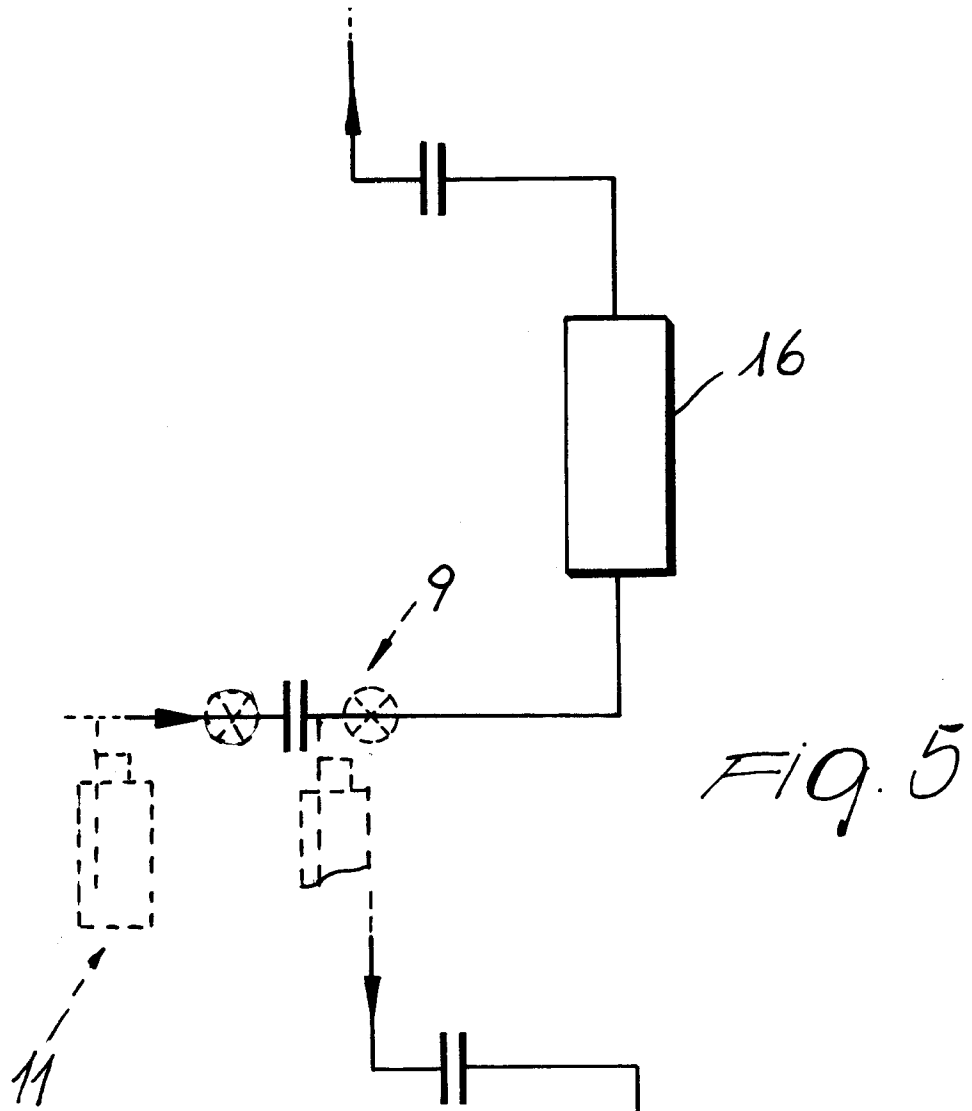


FIG. 5

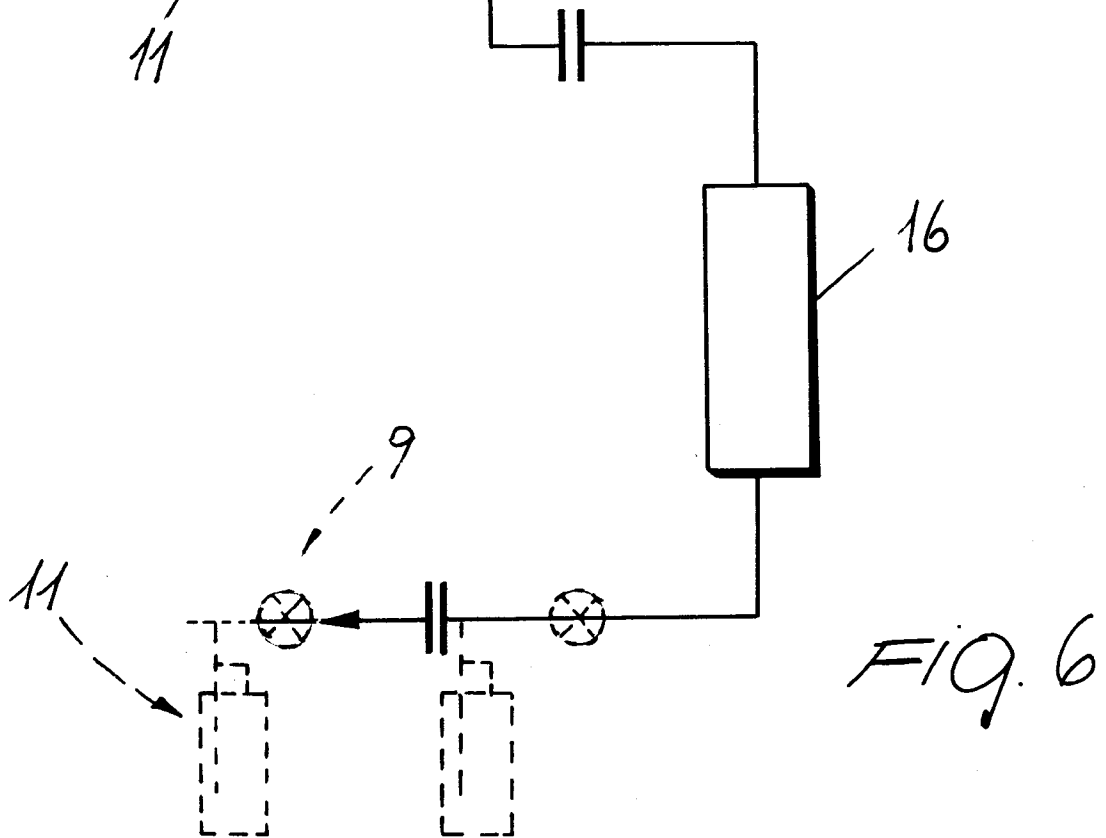


FIG. 6



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Application Number
EP 99 10 7860

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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		26 July 1999	Boets, A
CATEGORY OF CITED DOCUMENTS			
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CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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