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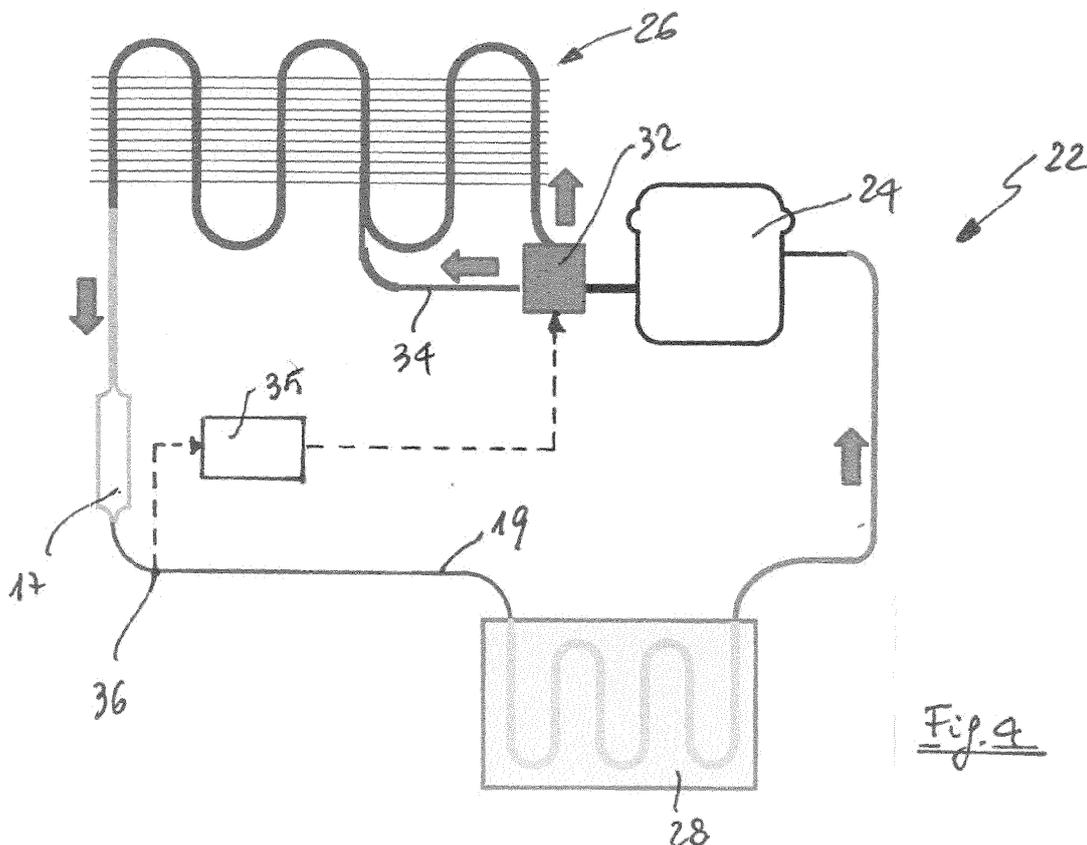
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(54) **Cooling system for a heat pump drier and heat pump drier using such cooling system**

(57) A cooling system for a heat pump drier comprises a refrigeration circuit including a compressor, a condenser and an evaporator. The refrigeration circuit com-

prises a three-way valve upstream the condenser and adapted to by-pass partially the condenser at a predetermined distance from the inlet point.



Description

[0001] The present invention relates to a cooling system for a heat pump drier, comprising a refrigeration circuit including a compressor, a condenser and an evaporator. The present invention relates also to a heat pump drier having such cooling system as well. This type of cooling system is used in recent driers due to the increased energy efficiency obtained through a heat pump. The cooling system is not only used to remove water by condensation on evaporator surface from the warm air downstream the drier drum, but also for heating air upstream the drier drum thanks to the heat released by the condenser of the cooling system.

[0002] In the overall thermal load balance of a heat pump drier the heat of the warm air is not only removed through the evaporator, but also through the condenser since heat taken by evaporator is not sufficient to reach such thermal load balance. Therefore the heat exchange through the condenser has to be increased or reduced according to the working condition of the drier.

[0003] In the known solutions, in order to properly adjust said heat balance, a fan blowing air on the condenser is used; when extra heat has to be removed (this being sensed by usual sensors in the air circuit or in the cooling circuit, for instance a temperature sensor or a pressure sensor downstream the evaporator), fan is activated or its speed increased in order to improve heat exchange on the condenser. Similarly, for solving the same problem an additional condenser is used, usually known as post-condenser. The above known solutions increase complexity of the system and therefore the overall cost thereof.

[0004] An object of the invention is to present a cooling system of the type mentioned above which does not present the above problems. Such object is obtained thanks to features listed in the appending claims.

[0005] One of the feature of the invention is to create a by-pass of a portion of the condenser, so that condenser heat exchange performances are reduced or increased simply by driving an electro-valve which directs the flow of refrigerant fluid through the by-pass or through the entire condenser. When the system requires a low heat exchange, electro-valve deviates refrigerant flow in order to by-pass part of the condenser pipes. On the other hand, when high heat exchange is required, electrovalve deviates refrigerant flow in order to include all condenser pipes. In this way cost and complexity compared to present solution are greatly reduced.

[0006] Further advantages and features according to the present invention will become clear from the following detailed description, with reference to the attached drawings, in which:

- Figure 1 is a schematic view of a heat pump drier according to prior art;
- Figure 2 is a detailed view of the heat pump circuit used in the drier of figure 1;

- Figure 3 is a schematic view of a heat pump drier according to the present invention; and
- Figure 4 is a detailed view of the heat pump circuit used in the drier of figure 3.

[0007] With reference to the drawings, with 10 it is indicated a heat pump drier having a drum 12 in which laundry to be dried is loaded. A process air circuit 14 comprises conduits for conveying air (through the driving action of a blower - not shown) from the drum to a series of heat exchangers 16, 18 and 20 before entering again the drum 12. The drier 10 comprises also a refrigeration circuit 22 having a compressor 24, a condenser 26 and an evaporator 28. The condenser 26 is preferably part of the heat exchanger 18, while the evaporator 28 is part of the heat exchanger 16. In the third heat exchanger 20 upstream the drum 12 air is heated by an electric heater (not shown) in case the heat exchanger 18 cannot guarantee the desired temperature of air entering the drum 12. In the prior art solution of figures 1 and 2, the condenser 26 is cooled by a fan 30 which is switched on or off depending on the thermal balance of the drier. The refrigeration circuit comprises also a filter 17 and a capillary 19 upstream the evaporator 28. According to the present invention (figures 3 and 4), upstream the condenser in the refrigeration circuit 22 it is placed a three-way valve 32 which can direct the flow of refrigerant towards the condenser or toward a by-bass pipe 34 which is connected to a predetermined portion of the condenser 26, i.e. at a predetermined distance from the inlet point. By driving the valve 32, by means of a control process unit 35 linked to a temperature sensor 36, it is then possible to change the heat dissipation performances in the condenser itself, allowing an easy control of thermal balance. The temperature sensor 36 is placed at the outlet of the condenser 26 upstream the capillary inlet, but it can be placed in a different position as well.

[0008] Instead of using a three way valve, it is possible to use a multi-way valve or a plurality of valves which can direct the flow of refrigerant to different by-pass pipes and to different point of the condenser, in order to allow a more granular regulation.

Claims

1. Cooling system for a heat pump drier, comprising a refrigeration circuit (22) including a compressor (24), a condenser (26) and an evaporator (28), **characterized in that** said refrigeration circuit (22) comprises a by-pass valve (32) upstream the condenser (26) and adapted to by-bass at least partially the condenser (26).
2. Cooling system according to claim 1, wherein the by-pass valve is a three-way valve connected to a by-pass conduit (34) which enter the condenser (26) at a predetermined distance from the inlet point.

3. Heat pump drier (10) comprising a drum (12), a process air circuit (14) for circulating air through the drum (12) and a cooling system having a refrigeration circuit (22) with a compressor (24), a condenser (26) and an evaporator (28), **characterized in that** said refrigeration circuit (22) comprises a by-pass valve (32) upstream the condenser (26) and adapted to by-pass at least partially the condenser (26). 5
4. Heat pump drier (10) according to claim 3, wherein the by-pass valve is a three-way valve connected to a by-pass conduit (34) which enter the condenser (26) at a predetermined distance from the inlet point. 10
5. Heat pump drier according to claim 3 or 4, wherein the process air circuit (14) comprises a portion (16) downstream the drum (12) in heat exchange relationship with the evaporator (28). 15
6. Heat pump drier according to claim 5, wherein the process air circuit (14) comprises a portion (18) upstream the drum (12) in heat exchange relationship with the condenser (26). 20
7. Heat pump drier according to any claims 3-6, wherein the refrigeration circuit (22) comprises a temperature sensor (36) connected to a control unit (35) for driving the by-pass valve (32). 25
8. Heat pump drier according to claim 7, wherein the temperature sensor (36) is placed downstream the condenser (26) and upstream the evaporator (28). 30

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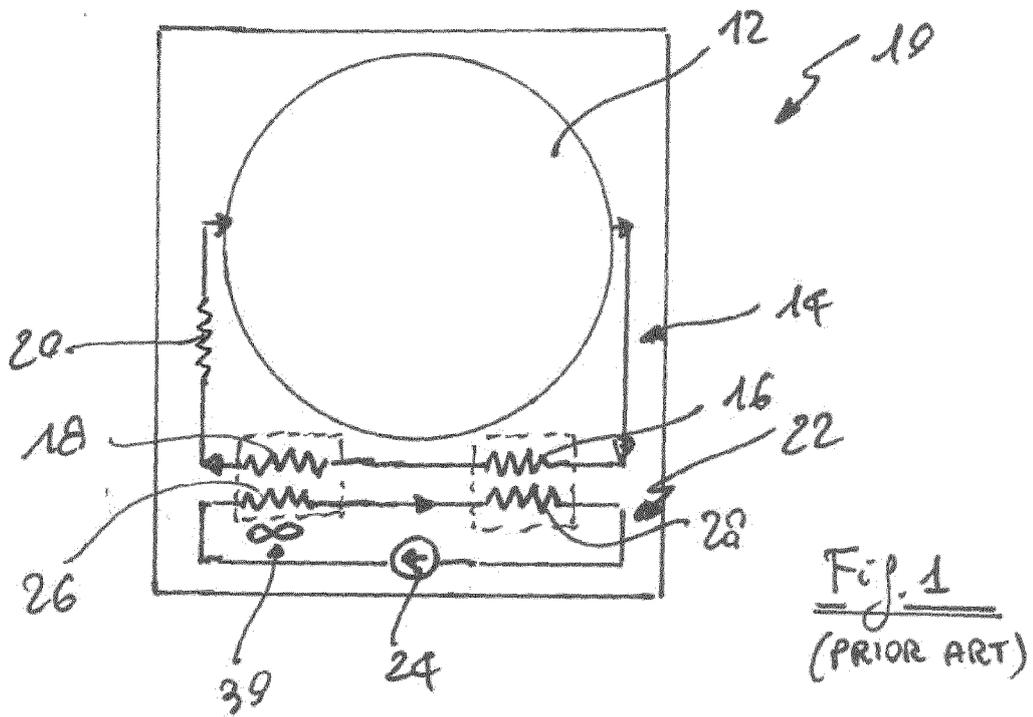


Fig. 1
(PRIOR ART)

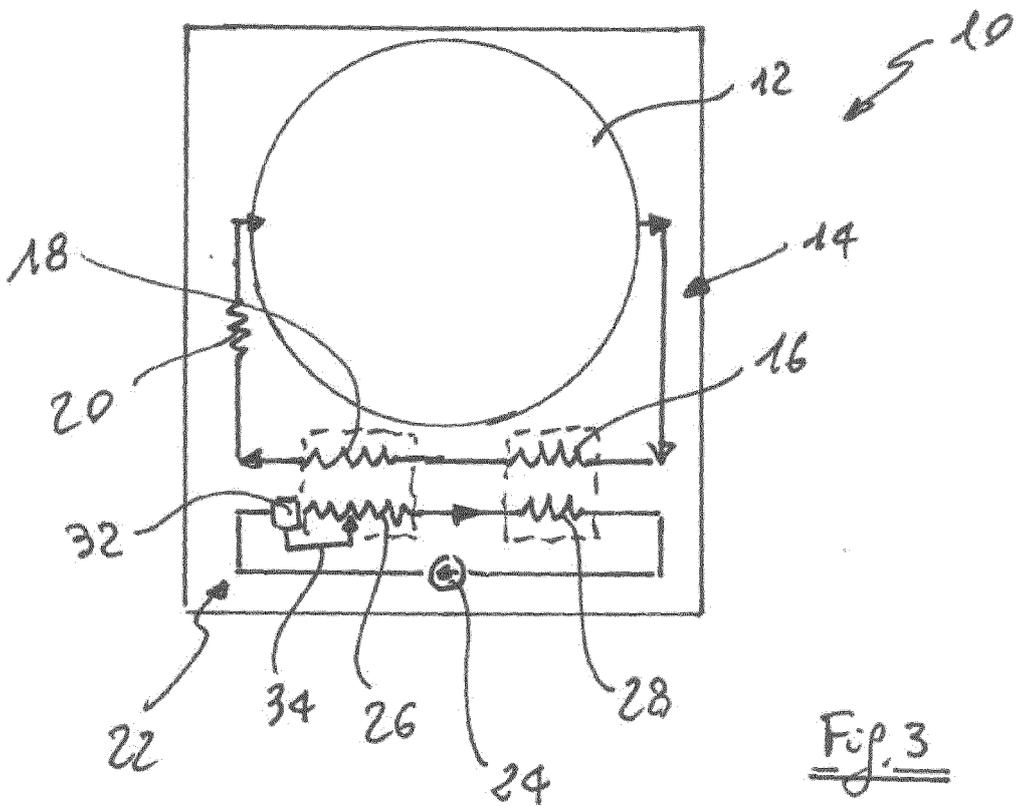


Fig. 3

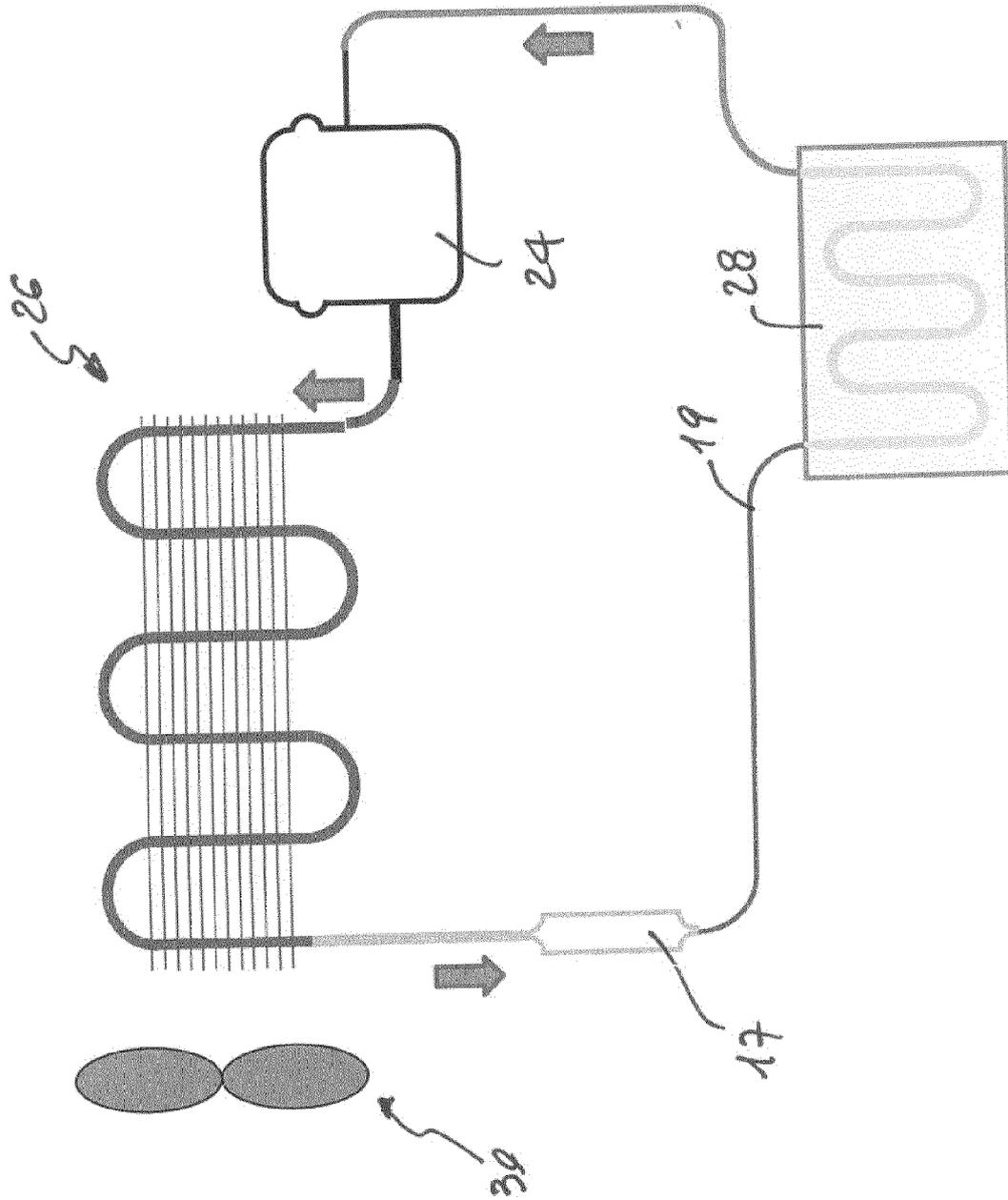
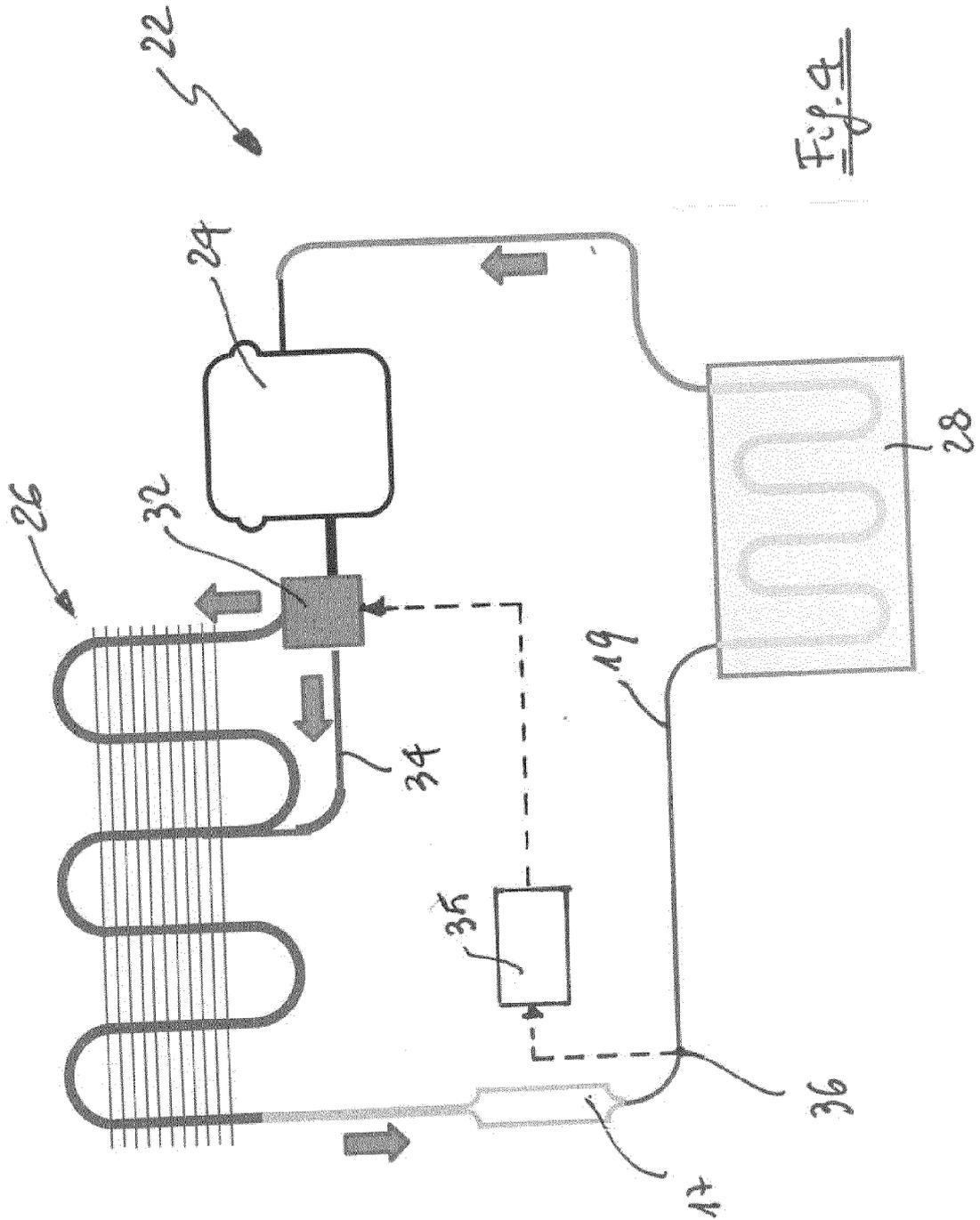


Fig. 2
(PRIOR ART)





EUROPEAN SEARCH REPORT

Application Number
EP 12 18 2905

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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
Munich		1 October 2013	Fachin, Fabiano
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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ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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