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(54) **Heat-pump clothes drying machine**

Wäschetrockner mit Wärmepumpe

Sèche-linge avec pompe à chaleur

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## Description

**[0001]** The present invention refers to a heat-pump clothes drying machine and, in particular, to such a machine for home use.

**[0002]** Clothes drying machines of this kind are generally known to carry out a treatment process of the drying air which is based on the utilization of a heat pump that is substantially constituted by a refrigerating circuit including a motor-driven compressor, a condenser, an expansion valve and an evaporator. The condenser and the evaporator of this refrigerating circuit are usually arranged in the flow path of the drying air, upstream of the rotating drum of the machine, which holds the clothes to be dried.

**[0003]** Further component parts, such as appropriate heating elements to heat up the working media (refrigerant medium and drying air), condensate wells or traps, and the like, may be provided to the purpose of improving the efficiency of the machine and keep the energy usage thereof as low as possible.

**[0004]** Clothes drying appliances of this kind are described, for instance in the patent publications EP 999302, DE 19638865, EP 467188, DE 3407439, EP 197132, DE 4409607, DE 4304226, DE 3113471. The inventions disclosed in these publications are in all cases clearly directed at bringing about improvements of a fluid-dynamic, and not electro-mechanical, nature in view of reaching the above cited efficiency and energy-usage purposes.

**[0005]** The purpose of the present invention is on the contrary to rationalize both the construction and the operation of a heat-pump clothes drying machine through a particular integration of the component parts thereof, so as to reduce the number of the same component parts, facilitate the assembly thereof to a maximum extent, provide a real modularity in view of an application to appliances having different specifications and ratings. Conclusively, the purpose is to make the application of the heat-pump technology in this kind of appliances much more expedient by overcoming the problems of considerable space requirements, energy usage and costs that have actually restricted the success of such an application hitherto.

**[0006]** According to the present invention such an aim is reached in a heat-pump clothes drying machine in which, as a main feature as recited in the appended claims, the motor used to drive the rotating drum holding the clothes to be dried is also connected with the fan circulating the drying air and the fan used to cool down the compressor of the refrigerating circuit.

**[0007]** Anyway, features and advantages of the present invention may be more readily understood from the description that is given below by way of nonlimiting example with reference to the accompanying drawings, in which:

- Figure 1 is a simplified view of the operating schematics of the clothes drying machine according to the present invention;
- Figure 2 is a perspective front-angle view of the component parts assembled on the base of the machine illustrated in Figure 1; and
- Figure 3 is a perspective rear-angle view of the functional assembly of the machine illustrated in Figure 1; and
- Figure 4 is a top view of a construction detail of the machine illustrated in Figure 1.

**[0008]** The clothes drying machine according to the present invention is normally contained in an outer casing, which is not shown in the Figures in view of simplifying the description. Inside such an outer casing there is supported a drum 10 (Figure 3), which is adapted to rotate about a horizontal axis and in which the clothes to be dried are loaded.

**[0009]** The clothes drying process is carried out by means of a heat-pump circuit (Figure 1) essentially comprising a compressor 11, a condenser 12, an expansion valve 13, an evaporator 14. The moisture-laden hot air, that forcedly leaves the drum 10, is caused to flow in the first place through the evaporator 14 and, in the second place, through the condenser 12 (arrows F in Figure 1), so as to completely remove the moisture from said air before letting it again into the drum 10.

**[0010]** Such a circulation of the flow of drying air takes preferably place under pressure. In the described example, it is brought about by means of a fan 15, or the like, which is arranged downstream of the condenser 12 and upstream of the rotating drum 10 of the clothes drying machine.

**[0011]** A first important feature of the present invention lies in the rationalization of the assembly and the utilization of the various component parts of the machine. The drum 10 is in fact driven by an electric motor 16, through a belt transmission 17 (Figure 1), whereas the compressor 11 is provided with a cooling fan 18. As a result, the motor 16 is mounted on the base of the machine (Figure 2), in an axial alignment with the compressor 11, in such a manner as to enable the fan 18 to be fitted directly on to the shaft of the motor 16, to the extremity of which there is connected the belt 17. Furthermore, to the opposite extremity of the shaft of the motor 16 there is connected a belt 19, through which also the fan 15 for the circulation of the drying air is driven. All of the above cited component parts are therefore mounted on the base of the machine, thereby allowing for a preassembly thereof that provides a very compact sub-assembly. This translates in turn into a reduction in the number of component parts required, as well as a simplification in the construction of the entire machine, thereby introducing a rationalization effect also in the maintenance and servicing operations that may be pos-

sibly required.

**[0012]** A further improvement that has been added to the functional assembly of the clothes drying machine lies in the fact that the evaporator 14 is split into two elements 14a and 14b in parallel with each other (Figure 4) so as to reduce the pressure drop which the refrigerant medium is subject to when flowing therethrough. In addition, both the evaporators 14 and the condenser 12 are made of bent aluminium tubing, thereby enabling further advantages to be obtained over traditional aluminium-copper heat exchangers. The inside diameter of the tubes can in fact be reduced, thereby reducing also the charge, ie. amount of working medium in the circuit of the heat pump. At the same time, the recyclability of the whole assembly is greatly improved owing to the reduction in the variety of materials to be recovered.

**[0013]** The rationalization effect in the construction and the operating reliability of the clothes drying machine according to the present invention are further enhanced by integrating, in the rear wall 20 of the outer casing (Figure 3), the diffuser 21 for the drying air circuit. This diffuser 21 is made in the form of a single box-like body of plastic material that is inserted in said rear wall and forms the chamber of the fan 15 along with the conduit connecting the latter with the inlet of the drum 10. Furthermore, also the belt transmission between the shaft of the motor 16 and the shaft of the fan 15 may be enclosed and protected in said integrated rear wall 20. It is in this way possible to further reduce the pressure drop in the drying air circuit with beneficial effects on the level of noise generated by the machine.

## Claims

1. Heat-pump clothes drying machine, in the outer casing of which there is enclosed a drum (10) that holds the clothes to be dried and is rotatably driven by a motor (16), as well as a refrigerating circuit with a compressor (11), a condenser (12), an expansion valve (13) and an evaporator (14), **characterized in that** the motor (16) used to drive the drum (10) is also connected to a first fan (15), which circulates the drying air, as well as to a second fan (18) that cools the compressor (11).

2. Heat-pump clothes drying machine according to claim 1, **characterized in that** the component parts of the refrigerating circuit (11-14) and the motor (16) are all mounted on the base of the machine in the form of a pre-assembled subassembly.

3. Heat-pump clothes drying machine according to claim 1 or 2, **characterized in that** the evaporator (14) is split into two elements (14a, 14b) arranged in parallel to each other.

4. Heat-pump clothes drying machine according to any of the claims 1 to 3, **characterized in that** a diffuser (21) for the drying air is integrated in the rear wall (20) of the outer casing of the machine and comprises the chamber of the first fan (15) and the conduit connecting the latter with the drum (10).

## Patentansprüche

1. Wäschetrockner mit Wärmepumpe, in dessen Außengehäuse eine Trommel (10) eingeschlossen ist, die die zu trocknende Wäsche enthält und von einem Motor (16) in Rotationsbewegung versetzt wird, des weiteren ein Kühlkreislauf mit einem Kompressor (11), einem Kondensator (12), einem Expansionsventil (13) und einem Verdampfer (14), **dadurch gekennzeichnet, dass** der zum Antrieb der Trommel (10) benützte Motor (16) auch mit einem ersten Ventilator (15) verbunden ist, der die Trokkenluft zirkuliert, und mit einem zweiten Ventilator (18), der den Kompressor (11) kühlt.

2. Wäschetrockner mit Wärmepumpe nach Anspruch 1, **dadurch gekennzeichnet, dass** die Bauteile des Kühlkreislaufs (11-14) und der Motor (16) sämtlich an der Basis der Maschine in Form einer vormontierten Baugruppe montiert sind.

3. Wäschetrockner mit Wärmepumpe nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** der Verdampfer (14) in zwei Elemente (14a, 14b) unterteilt ist, die parallel zueinander angeordnet sind.

4. Wäschetrockner mit Wärmepumpe nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** ein Diffuser (21) für die Trockenluft in der Rückwand (20) des Außengehäuses der Maschine integriert ist und die Kammer des ersten Ventilators (15) und die Leitung umfasst, die Letzteren mit der Trommel (10) verbindet.

## Revendications

1. Sèche-linge à pompe à chaleur, dans le boîtier extérieur duquel est enfermé un tambour (10) qui contient le linge à sécher, et qui est entraîné de manière rotative par un moteur (16), ainsi qu'un circuit réfrigérant ayant un compresseur (11), un condenseur (12), une vanne de détente (13) et un évaporateur (14), **caractérisé en ce que** le moteur (16) utilisé pour entraîner le tambour (10) est également connecté à un premier ventilateur (15), lequel fait circuler l'air de séchage, ainsi qu'à un second ventilateur (18) qui refroidit le compresseur (11).

2. Sèche-linge à pompe à chaleur selon la revendica-

tion 1, **caractérisé en ce que** les parties constitutives du circuit réfrigérant (11 à 14) et le moteur (16) sont tous montés sur la base de la machine sous la forme d'un sous-ensemble pré-assemblé.

**3.** Sèche-linge à pompe à chaleur selon la revendication 1 ou 2, **caractérisé en ce que** l'évaporateur (14) est divisé en deux éléments (14a, 14b) agencés en parallèle l'un par rapport à l'autre.

**4.** Sèche-linge à pompe à chaleur selon l'une quelconque des revendications 1 à 3, **caractérisé en ce qu'**un diffuseur (21) pour l'air de séchage est intégré dans la paroi arrière (20) du boîtier extérieur de la machine, et comporte la chambre du premier ventilateur (15) et le conduit connectant ce dernier au tambour (10).

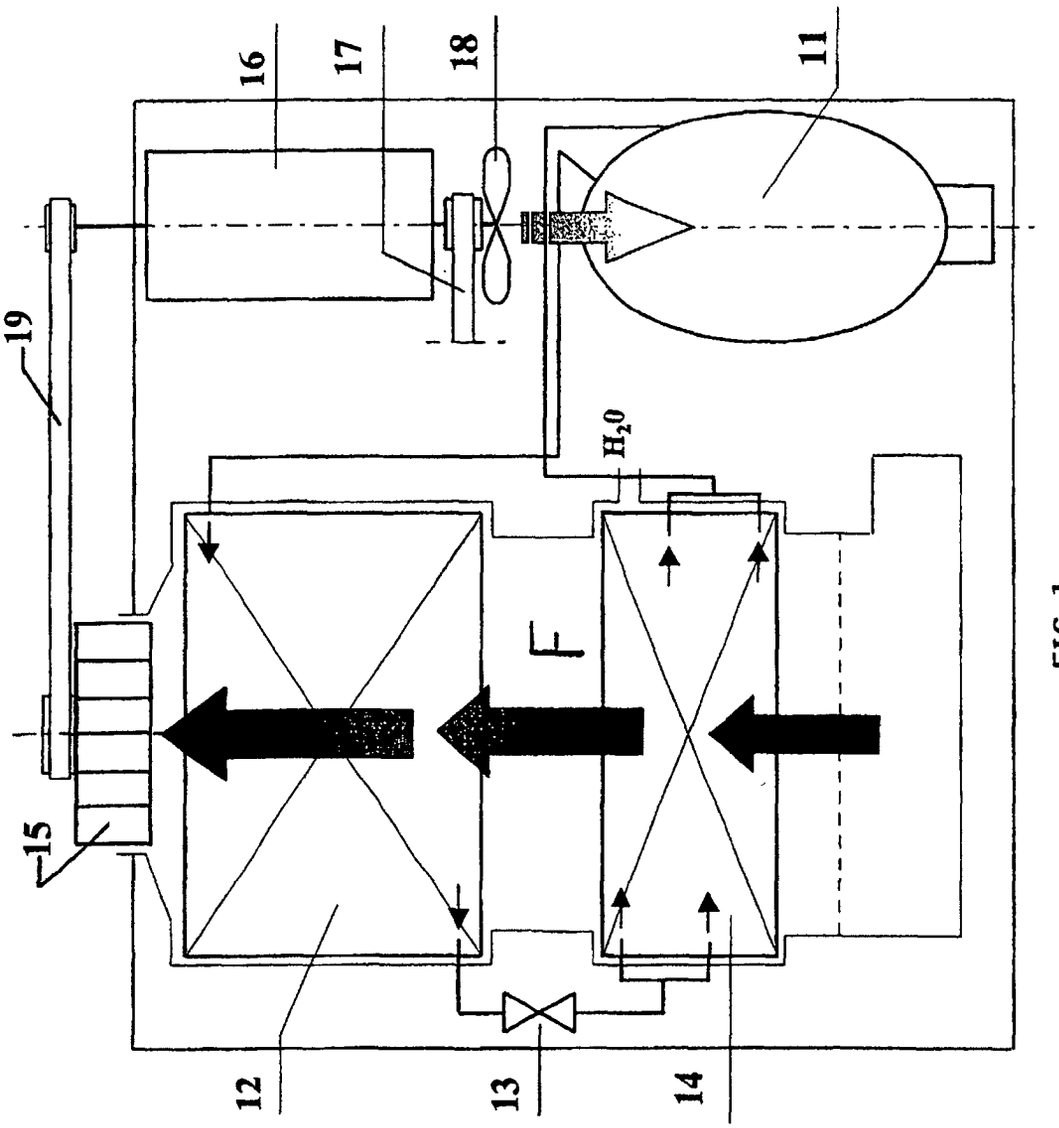



FIG.1

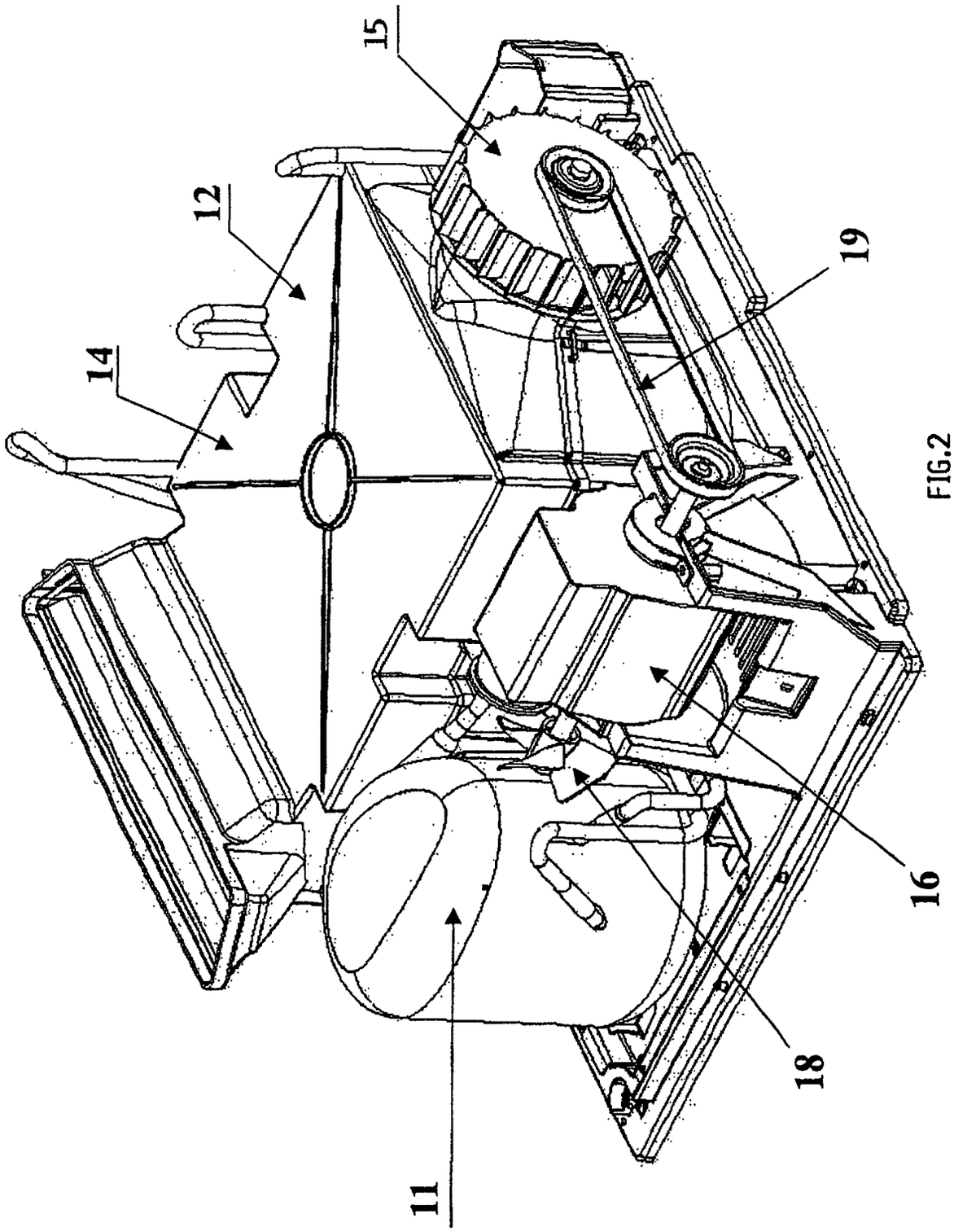



FIG.2

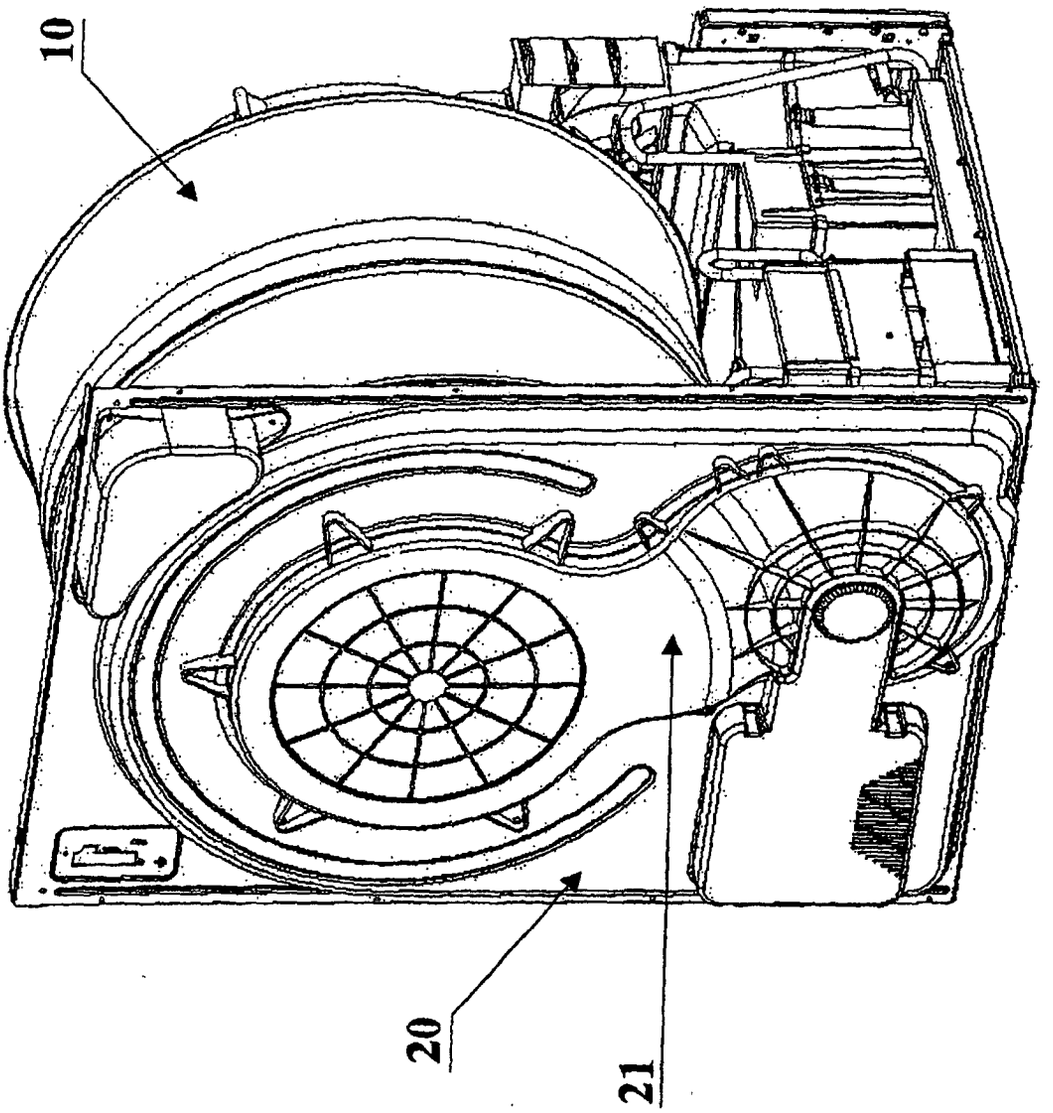



FIG.3

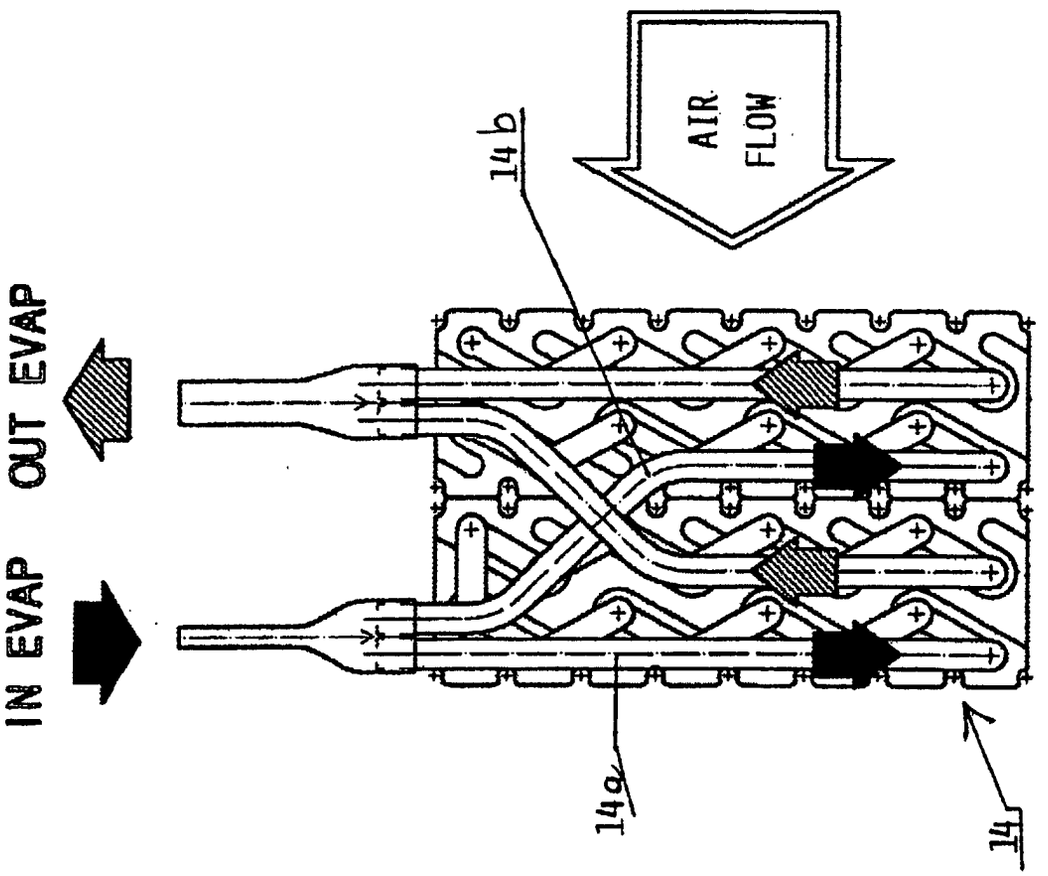



FIG.4