



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
27.06.2012 Bulletin 2012/26

(51) Int Cl.:
D06F 58/20 (2006.01)

(21) Application number: **11192324.9**

(22) Date of filing: **07.12.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(72) Inventors:
• **Taniguchi, Mitsunori**
Osaka, 540-6207 (JP)
• **Furubayashi, Mitsuyuki**
Osaka, 540-6207 (JP)
• **Nakanishi, Kuniyuki**
Osaka, 540-6207 (JP)

(30) Priority: **21.12.2010 JP 2010283982**
21.12.2010 JP 2010283985

(74) Representative: **Schwabe - Sandmair - Marx**
Patentanwälte
Stuntzstraße 16
81677 München (DE)

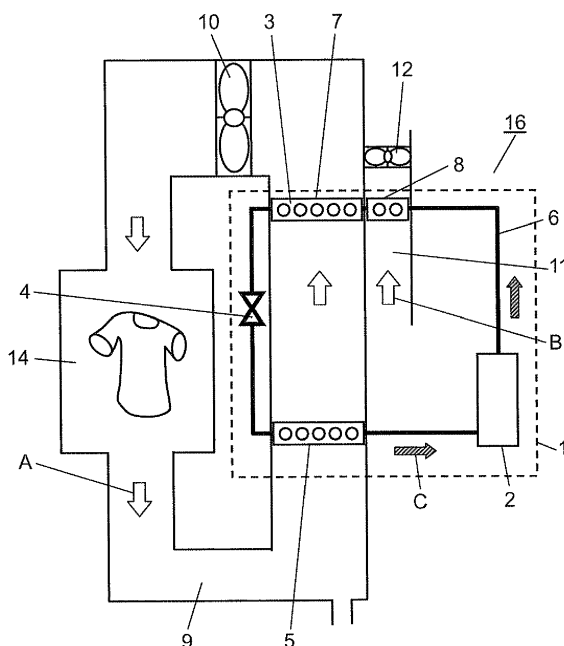
(71) Applicant: **Panasonic Corporation**
Kadoma-shi
Osaka 571-8501 (JP)

(54) **Dehumidifying and heating apparatus and clothes drying machine using the same**

(57) A clothes drying machine of the present invention includes heat pump device having compressor (2), condenser (3) having heat radiator (7) and heat exhauster (8), expansion portion (4), and evaporator (5), first air passage (9) which is provided therein with first blowing portion (10) which blows air into the heat radiator and the evaporator, the heat radiator, and the evaporator

and heats and dehumidifies the air blown by the first blowing portion, and second air passage (11) which is provided therein with second blowing portion (12) which blows air into the heat exhauster and the heat exhauster, sucks outside air by means of the second blowing portion, and exhausts part of heat in the condenser to the outside with the heat exhauster, wherein the heat radiator and the heat exhauster of the condenser are integrally provided.

FIG. 1



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a dehumidifying and heating apparatus using a heat pump device and a clothes drying machine having the apparatus.

2. Description of the Related Art

[0002] A conventional clothes drying machine having a dehumidifying and heating apparatus is disclosed, e.g., in Unexamined Japanese Patent Publication No. 2004-239549 (hereinafter referred to as "Patent Literature 1").

[0003] Hereinafter, a configuration of the conventional clothes drying machine described in Patent Literature 1 will be described with reference to Fig. 7.

[0004] Fig. 7 is a schematic diagram of the conventional clothes drying machine having the dehumidifying and heating apparatus.

[0005] As shown in Fig. 7, the conventional clothes drying machine having the dehumidifying and heating apparatus includes drying chamber 59 accommodating laundry such as clothes, and dehumidifying and heating apparatus 50. Dehumidifying and heating apparatus 50 includes heat pump device 57, air passage 58, and detection portion 62, and blows air into drying chamber 59 via air passage 58 coupled to drying chamber 59.

[0006] Heat pump device 57 includes compressor 51, condenser 52, heat exhauster 53 provided in air passage 60, expansion portion 54, and evaporator 55, and is coupled to conduit line 56 so as to circulate a refrigerant. Air passage 58 flowing the air is provided with condenser 52 heating the air, and evaporator 55 cooling and dehumidifying the air.

[0007] Heat exhauster 53 provided in air passage 60 is provided between condenser 52 and expansion portion 54, and exchanges heat of outside air blown by means of blower 61 and heat of the refrigerant flowing through heat exhauster 53. With this, part of the heat of the refrigerant is discharged to an outside of heat pump device 57, thereby reducing temperature increase of the refrigerant.

[0008] Detection portion 62 detects a refrigerant discharge temperature by means of thermistor 63 provided on conduit line 56 of heat pump device 57, which is discharged by the refrigerant from compressor 51, and controls compressor 51 and blower 61 based on a detection result.

[0009] Next, an operation of the clothes drying machine configured as above will be described below. It should be noted that arrow A of Fig. 7 indicates a flow direction of the air flowing in air passage 58, arrow B indicates a flow direction of the outside air for cooling flowing in air passage 60, and arrow C indicates a flow

direction of the refrigerant flowing in conduit line 56.

[0010] First, when the clothes drying machine starts a drying operation, compressor 51 and blower 64 provided in air passage 58 are operated. Then, the air is circutably blown into air passage 58 by means of blower 64.

[0011] Next, the air is heated by heat release from condenser 52, and becomes hot air so as to be introduced into drying chamber 59. Then, the air introduced into drying chamber 59 is brought into contact with clothes in drying chamber 59, and takes moisture from the wet clothes to dry the clothes.

[0012] At this time, the air provides an amount of heat for evaporating moisture contained in the clothes as sensible so as to become cooler. Then, the air contains water vapor having latent heat substantially equivalent to this sensible heat so as to have high-humidity air. And, an enthalpy of the air before and after the air is brought into contact with the clothes is substantially constant. The high-humidity air is cooled in evaporator 55 for the latent heat to be taken, and is condensed to be dehumidified. Thereafter, the air which is dehumidified and becomes cooler is heated in condenser 52 again.

[0013] On the other hand, in heat pump device 57, the high-temperature and high-pressure refrigerant compressed in compressor 51 has its heat taken by the air in condenser 52, and is condensed and liquefied. The refrigerant which exits from condenser 52 enters heat exhauster 53, and is exchanged heat with the outside air blown by means of blower 61, thereby exhausting part of the heat of the refrigerant.

[0014] Next, the high-pressure refrigerant is reduced pressure by means of expansion portion 54 so as to have a low temperature and a low pressure, and takes heat from the air in evaporator 55 to return to compressor 51.

[0015] Then, an amount of heat in which an amount of heat taken in evaporator 55 with the refrigerant is added with an amount of heat obtained by compression in compressor 51 is released from condenser 52. Accordingly, heat exhauster 53 is additionally provided in air passage 60 for exhausting heat, and previously exhausts an amount of heat corresponding to an input of compressor 51 to the outside, thereby balancing the amount of heat release from condenser 52 and the amount of heat taken in evaporator 55 at a fixed value. Therefore, the conventional clothes drying machine additionally requires piping which couples condenser 52 to heat exhauster 53, and piping which couples heat exhauster 53 to expansion portion 54. As a result, heat pump device 57 is made larger, so that dehumidifying and heating apparatus 50 is also made larger.

SUMMARY OF THE INVENTION

[0016] A dehumidifying and heating apparatus of the present invention includes a heat pump device having a compressor, a condenser having a heat radiator and a heat exhauster, an expansion portion, and an evaporator, a first air passage which is provided therein with a first

blowing portion which blows air into the heat radiator and the evaporator, the heat radiator and the evaporator and heats and dehumidifies the air blown by the first blowing portion, and a second air passage which is provided therein with a second blowing portion which blows air into the heat exhauster, and the heat exhauster, sucks outside air by means of the second blowing portion, and exhausts part of heat in the condenser to the outside with the heat exhauster, wherein the heat radiator and the heat exhauster of the condenser are integrally provided.

[0017] Thereby, part of the condenser is used as the heat exhauster, so that the dehumidifying and heating apparatus can be made smaller.

BRIEF DESCRIPTION OF DRAWINGS

[0018]

Fig. 1 shows a schematic diagram of a clothes drying machine having a dehumidifying and heating apparatus according to a first exemplary embodiment of the present invention;

Fig. 2 shows a partial schematic diagram of the dehumidifying and heating apparatus according to the first exemplary embodiment of the present invention;

Fig. 3 shows a perspective view of a condenser of the dehumidifying and heating apparatus according to the first exemplary embodiment of the present invention;

Fig. 4 shows a perspective view of the condenser showing another example of the dehumidifying and heating apparatus according to the first exemplary embodiment of the present invention;

Fig. 5 shows a partial schematic diagram showing another example of the dehumidifying and heating apparatus according to the first exemplary embodiment of the present invention;

Fig. 6 shows a perspective view of the condenser of the dehumidifying and heating apparatus according to a second exemplary embodiment of the present invention; and

Fig. 7 shows a schematic diagram of a conventional clothes drying machine having a dehumidifying and heating apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0019] Hereinafter, exemplary embodiments of the present invention will be described with reference to the drawings. It should be noted that the present invention is not limited by the embodiments.

FIRST EXEMPLARY EMBODIMENT

[0020] Fig. 1 is a schematic diagram of a clothes drying machine having a dehumidifying and heating apparatus according to a first exemplary embodiment of the present

invention. Fig. 2 is a partial schematic diagram of the dehumidifying and heating apparatus. It should be noted that in the following drawings, arrow A indicates a flow direction of air flowing in first air passage 9, arrow B indicates a flow direction of outside air for cooling flowing in second air passage 11, and arrow C indicates a flow direction of a refrigerant flowing in conduit line 6.

[0021] As shown in Fig. 1, the clothes drying machine includes drying chamber 14 accommodating laundry such as clothes, and dehumidifying and heating apparatus 16 coupled to drying chamber 14 via first air passage 9.

[0022] As shown in Figs. 1 and 2, dehumidifying and heating apparatus 16 includes heat pump device 1, first air passage 9, and second air passage 11.

[0023] Heat pump device 1 includes compressor 2, condenser 3, expansion portion 4, evaporator 5, and conduit line 6. Conduit line 6 in which the refrigerant circulates is coupled to compressor 2, condenser 3, expansion portion 4, and evaporator 5 of heat pump device 1. Compressor 2 compresses the refrigerant. Condenser 3 has heat radiator 7 and heat exhauster 8, heat radiator 7 and heat exhauster 8 being adjacently integrally provided. Heat radiator 7 heats the passing air by exchanging heat with the compressed refrigerant having a high temperature and a high pressure. Heat exhauster 8 exhausts part of the heat of the refrigerant of condenser 3. Expansion portion 4 includes, e.g., a capillary tube, and reduces a pressure of the high-pressure refrigerant. Evaporator 5 takes heat from the passing air by exchanging heat with the refrigerant which is reduced pressure so as to have a low pressure. Thereby, the passing air is dehumidified.

[0024] First air passage 9 is provided therein with evaporator 5, heat radiator 7 of condenser 3, and first blowing portion 10. The air blown by first blowing portion 10 in the direction indicated by arrow A is dehumidified when passing through evaporator 5, and thereafter, is heated when passing through heat radiator 7. In addition, second air passage 11 formed adjacent to first air passage 9 is provided therein with heat exhauster 8 of condenser 3 and second blowing portion 12. And, the outside air sucked by second blowing portion 12 in the direction indicated by arrow B exhausts part of heat in condenser 3 to the outside with heat exhauster 8. In other words, in dehumidifying and heating apparatus 16 of this embodiment, with one part of condenser 3 as heat radiator 7 and with the other part as heat exhauster 8, heat radiator 7 and heat exhauster 8 are integrated to configure condenser 3. Thereby, any separated heat exhausters as in the conventional art are not required to be provided, and any piping for heat exhauster connection is not required. As a result, dehumidifying and heating apparatus 16 can be made smaller.

[0025] Further, as shown in Fig. 2, partitioning plate 13 may be provided between heat radiator 7 and heat exhauster 8 to separate adjacent first air passage 9 and second air passage 11. At this time, partitioning plate 13 may be part of first air passage 9 or second air passage 11.

Thereby, mixing of the air flowing in first air passage 9 with the outside air for cooling flowing in second air passage 11 can be prevented, and partitioning plate 13 serves as a wall surface of first air passage 9 or second air passage 11 to enable condenser 3 to be made smaller.

[0026] In addition, dehumidifying and heating apparatus 16, as shown in Fig. 2, air passage area X of heat radiator 7 is made larger than air passage area Y of heat exchanger 8. This is because an amount of heat heating air, that is, an amount of heat provided to the air in heat radiator 7 is larger than an amount of heat corresponding to an input of compressor 2, that is, an amount of heat exhausted from heat exchanger 8. It should be noted that the air passage area shows an area of an inflow surface of the air which passes through each of heat radiator 7 and heat exchanger 8 by operating first blowing portion 10 and second blowing portion 12. Thereby, heating of the air in heat radiator 7 and exhausting heat of the air in heat exchanger 8 can be performed in balance, so that dehumidifying and heating apparatus 16 can be efficiently operated.

[0027] Next, a configuration of condenser 3 of dehumidifying and heating apparatus 16 of this embodiment will be described below with reference to Fig. 3.

[0028] Fig. 3 is a perspective view of the condenser of the dehumidifying and heating apparatus according to the first exemplary embodiment of the present invention.

[0029] As shown in Fig. 3, condenser 3 includes, e.g., a typical fin tube type heat exchanger having a plurality of fins 3a provided in heat radiator 7, a plurality of fins 3b provided in heat exchanger 8, and heat exchanger tube 3c including refrigerant inflow port 3d.

[0030] Fins 3a are arranged in parallel with each other at fixed intervals with respect to the inflow surface into which the air flows, indicated by arrow B of Fig. 3. Then, the air passes through fins 3a in a mutual manner to perform exchange heat. Likewise, fins 3b are arranged in parallel with each other at fixed intervals with respect to the inflow surface into which the air flows, indicated by arrow B of Fig. 3 so that they are on the same plane as fins 3a. Then, the air passes through fins 3b in a mutual manner to perform exchange heat. Fins 3a and fins 3b are formed, e.g., of a thin plate made of aluminum and on the same plane with respect to the inflow surfaces of the air.

[0031] As described above, according to this embodiment, the inflow surface of the air of heat radiator 7 provided in first air passage 9 and the inflow surface of the air of heat exchanger 8 provided in second air passage 11 are on the same plane. Thereby, an air flow direction of heat exchanger 8 is allowed to be the same as an air flow direction of heat radiator 7, so that the same high-efficiency exchange heat as heat radiator 7 can be obtained and heat exchanger 8 can be made smaller.

[0032] In addition, heat exchanger tube 3c which is conduit line 6 in which the refrigerant flows is formed, e.g., of a copper tube and in a serpentine shape, and passes through fins 3a and fins 3b in a direction orthog-

onal to fins 3a and fins 3b (a tube axis direction of heat exchanger tube 3c). And, heat exchanger 8 and heat radiator 7 of condenser 3 are integrally provided so as to be in parallel with each other in a direction vertical to the tube axis direction of heat exchanger tube 3c (a direction in parallel with the inflow surfaces into which the air flows). At this time, heat exchanger 8 is provided so as to be located in a position in which refrigerant inflow port 3d of condenser 3 is included.

[0033] An operation of heat pump device 1 of dehumidifying and heating apparatus 16 configured as above will be described with reference to Fig. 1.

[0034] The high-temperature and high-pressure refrigerant compressed in compressor 2 flows from refrigerant inflow port 3d of condenser 3 into heat exchanger 8 in a gas state. Therefore, a temperature of the refrigerant is the highest in refrigerant inflow port 3d of condenser 3. The refrigerant which flows into heat exchanger 8 is exchanged heat with the outside air which is sucked by blowing portion 12 in heat exchanger 8, so as to become cooler, and become a gas-liquid two-phase saturation state. Thereafter, the refrigerant flows into heat radiator 7, and is exchanged heat so as to become cooler, in a supercooled state in which the refrigerant is completely liquefied, and flows out from condenser 3.

[0035] On the other hand, as shown in Fig. 7, conventional dehumidifying and heating apparatus 50 is provided with heat exchanger 53 after the refrigerant exits from condenser 52, and exhausts heat of the refrigerant in a liquefied state. Therefore, when a temperature of the outside air is high, a temperature difference between the air and the refrigerant is small and an effect of exhausting heat is small. Therefore, dehumidifying and heating apparatus 50 made larger heat exchanger 53 to increase an effect of exhausting heat.

[0036] However, heat exchanger 8 of dehumidifying and heating apparatus 16 of this embodiment is provided in the position of including refrigerant inflow port 3d of condenser 3. In refrigerant inflow port 3d, flows the hot refrigerant in a gas state. Thereby, a temperature difference between the outside air and the refrigerant is made larger, so that even when heat exchanger 8 is made smaller, exhausting heat is efficiently enabled. Therefore, condenser 3 having heat radiator 7 and heat exchanger 8 can be made smaller. As a result, dehumidifying and heating apparatus 16 can be made smaller.

[0037] In addition, the high-pressure refrigerant which flows out from condenser 3 is reduced pressure by expansion portion 4 so as to have a low temperature and a low pressure, and flows from the air in evaporator 5. Thereafter, the refrigerant obtains an amount of heat from the air by heat exchanging in evaporator 5, and returns to compressor 2 again. At this time, an amount of heat obtained by evaporator 5 and an amount of heat obtained by compression of compressor 2 is released from condenser 3. However, in this embodiment, since an amount of heat corresponding to of the heat obtained in compressor 2 is previously released to the outside with heat ex-

hauster 8 of condenser 3, the amount of heat from heat radiator 7, that is, the amount of heat which is exchanged heat in heat radiator 7 is held in balance with the amount of heat obtained evaporator 5.

[0038] Hereinafter, another configuration of dehumidifying and heating apparatus 16 of this embodiment will be described with reference to Fig. 1 with Figs. 4 and 5. An example of another configuration described below is different in that conduit line 6 includes flattened tube 15.

[0039] Fig. 4 is a perspective view of the condenser showing another example of the dehumidifying and heating apparatus according to the first exemplary embodiment of the present invention. Fig. 5 is a partial schematic diagram showing another example of the dehumidifying and heating apparatus.

[0040] As shown in Figs. 4 and 5, heat exchanger tube 3c of condenser 3 which is conduit line 6 in which the refrigerant flows is formed in a serpentine shape with flattened tube 15 bent. Thereby, first air passage 9 and second air passage 11 can be partitioned by flattened tube 15, so that partitioning plate 13 is not required to be provided between heat radiator 7 and heat exhauster 8.

[0041] First, when a drying operation is started, compressor 2 and first blowing portion 10 are operated. Then, the air passes through heat radiator 7 by means of first blowing portion 10, and the air which passes through heat radiator 7 is heated by heat exchange in heat radiator 7 so as to become hot air, and is delivered into drying chamber 14. The air which is brought into contact with clothes in drying chamber 14 takes moisture from the clothes to dry the clothes.

[0042] The air which dries the clothes provides an amount of heat for taking moisture from the wet clothes as sensible heat so as to become cooler. In this time, the air contains water vapor having latent heat substantially equivalent to the sensible heat so as to have high humidity. An enthalpy of the drying air before and after the air is brought into contact with the clothes is substantially constant. The high-humidity air is cooled in evaporator 5 for the latent heat to be taken, and is condensed to be dehumidified. Then, the air dehumidified so as to have lowered absolute humidity is heated in heat radiator 7 again, and is repeatedly dehumidified and heated while circulating in first air passage 9.

[0043] In addition, when the drying operation is started, second blowing portion 12 is operated. Then, the outside air is sucked by second blowing portion 12, and exhausts part of the heat in condenser 3 to the outside by heat exhauster 8.

[0044] When a large amount of heat in heat radiator 7 is necessary immediately after the drying operation is started, second blowing portion 12 is stopped or its amount of blowing is reduced. Thereby the amount of exhausting heat in heat exhauster 8 can be reduced to increase the amount of heat in heat radiator 7. In addition, even when a temperature of the outside air is high like summer, dehumidifying and heating apparatus 16 can perform sufficient exhausting heat from refrigerant inflow

port 3d having a high refrigerant temperature.

[0045] As described above, the clothes drying machine includes the dehumidifying and heating apparatus of the present invention, so that the clothes drying machine can be made smaller.

SECOND EXEMPLARY EMBODIMENT

[0046] Fig. 6 is a perspective view of the condenser of the dehumidifying and heating apparatus according to a second exemplary embodiment of the present invention. This embodiment is different from the first exemplary embodiment in that heat exhauster 8 and heat radiator 7 of condenser 3 are provided in parallel with each other in the tube axis direction of heat exchanger tube 3c. Further, other configuration is the same as the first exemplary embodiment, the same configurations are indicated by the same reference numerals, and detailed description thereof cites the first exemplary embodiment.

[0047] As shown in Fig. 6, heat exhauster 8 and heat radiator 7 of condenser 3 are adjacently integrally provided so as to be in parallel with each other in the tube axis direction of heat exchanger tube 3c. At this time, heat exhauster 8 is provided so as to be located in the position in which refrigerant inflow port 3d of condenser 3 is included.

[0048] Fins 3e of heat radiator 7 and fins 3f of heat exhauster 8 are arranged in parallel with each other at fixed intervals with respect to the inflow surfaces into which the air flows, indicated by arrow B of Fig. 6. Then, the air passes between fins 3e and fins 3f in a mutual manner to perform exchange heat. Fins 3e and fins 3f are formed, e.g., of a thin plate made of aluminum and on the same plane with respect to the inflow surfaces of the air. In first embodiment, fins 3e and fins 3f become separated in Figs, but in this embodiment, fins 3e and fins 3f are integrally provided each other.

[0049] As described above, according to this embodiment, the inflow surface of the air of heat radiator 7 provided in first air passage 9 and the inflow surface of the air of heat exhauster 8 provided in second air passage 11 are formed on the same plane. Thereby, the air flow direction of heat exhauster 8 is allowed to be the same as the air flow direction of heat radiator 7, so that the same high-efficiency exchanging heat as heat radiator 7 is enabled and heat exhauster 8 can be made smaller.

[0050] Further, in this embodiment, the partitioning plate is not provided between heat radiator 7 and heat exhauster 8, but the present invention is not limited to this. For instance, the partitioning plate in parallel with fins 3a and fins 3b may be provided between heat radiator 7 and heat exhauster 8. Thereby, mixing of the air flowing in first air passage 9 with the outside air for cooling flowing in second air passage 11 can be prevented, and partitioning plate 13 serves as the wall surface to enable condenser 3 to be made smaller.

[0051] Further, in that heat exhauster 8 and heat radiator 7 of condenser 3 are provided in parallel with each

other in the tube axis direction of heat exchanger tube 3c, being adjacently integrally provided, as shown in Fig 4, even when heat exchanger tube 3c includes flattened tube 15, can be operated similarly.

Claims

1. A dehumidifying and heating apparatus comprising:

a heat pump device having a compressor, a condenser having a heat radiator and a heat exhauster, an expansion portion, and an evaporator;

a first air passage which is provided therein with a first blowing portion which blows air into the heat radiator and the evaporator, the heat radiator and the evaporator, and heats and dehumidifies the air blown by the first blowing portion; and

a second air passage which is provided therein with a second blowing portion which blows air into the heat exhauster, and the heat exhauster, sucks outside air by means of the second blowing portion, and exhausts a part of heat in the condenser to the outside with the heat exhauster,

wherein the heat radiator and the heat exhauster of the condenser are integrally provided.

2. The dehumidifying and heating apparatus according to claim 1, wherein an air passage area of the heat radiator is made larger than an air passage area of the heat exhauster.

3. The dehumidifying and heating apparatus according to claim 1, wherein the heat exhauster is provided on a side where the refrigerant flows of the condenser.

4. The dehumidifying and heating apparatus according to claim 1, wherein the condenser includes a heat exchanger tube formed in a serpentine shape and in which the refrigerant flows, and plural fins which are installed on the heat exchanger tube orthogonally, wherein the fins are formed on the same plane with respect to an inflow surface of the air.

5. The dehumidifying and heating apparatus according to claim 4, wherein the heat radiator and the heat exhauster of the condenser are provided in parallel with each other in a direction vertical to a tube axis direction of the heat exchanger tube.

6. The dehumidifying and heating apparatus according to claim 5, wherein the heat exchanger tube includes a flattened tube.

7. The dehumidifying and heating apparatus according to claim 4, wherein the heat radiator and the heat exhauster of the condenser are provided in parallel with each other in a tube axis direction of the heat exchanger tube.

8. A clothes drying machine comprising:

the dehumidifying and heating apparatus according to any one of claims 1 to 7, and a drying chamber accommodating laundry, wherein the first air passage of the dehumidifying and heating apparatus is coupled to the drying chamber.

FIG. 1

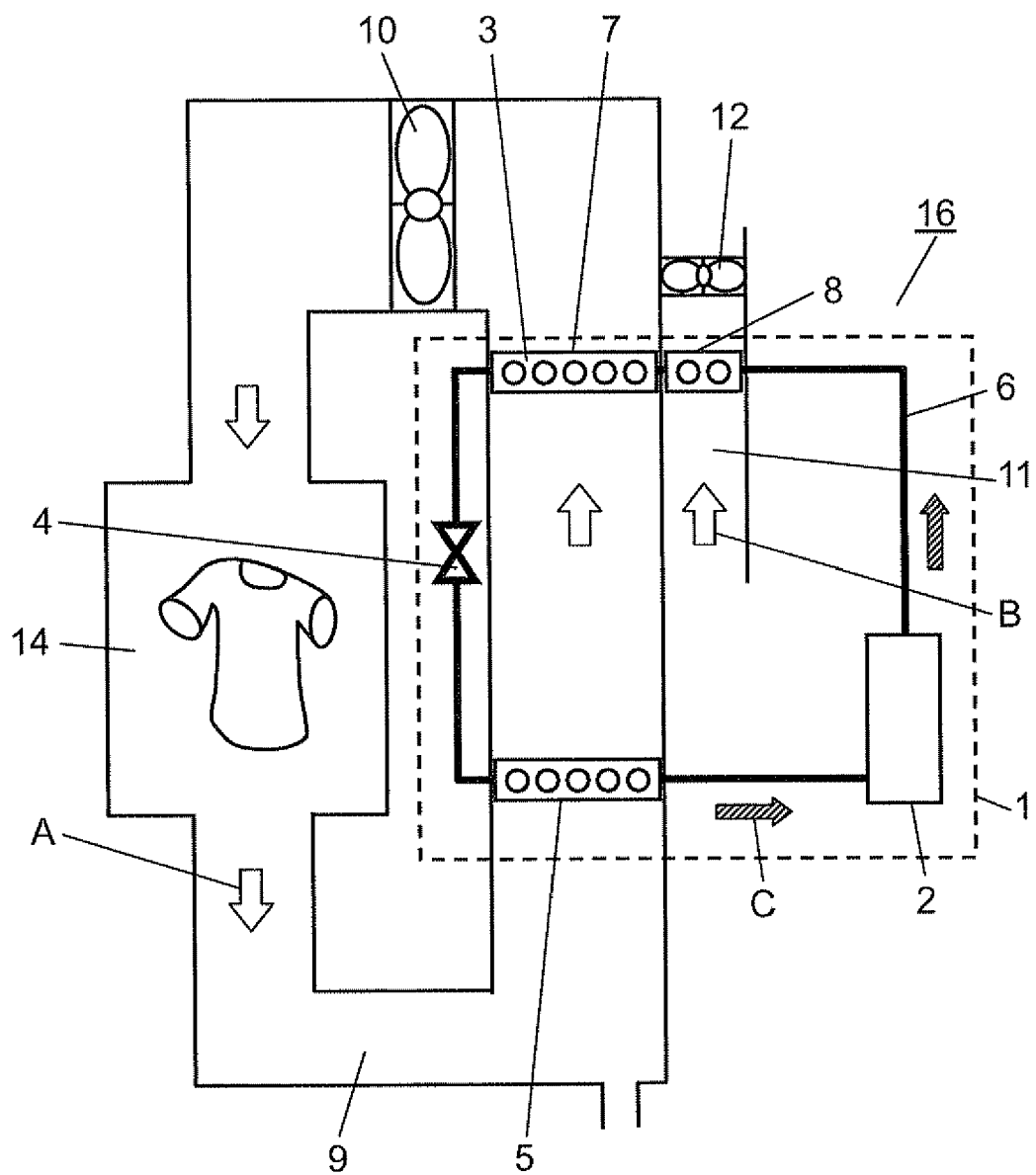


FIG. 2

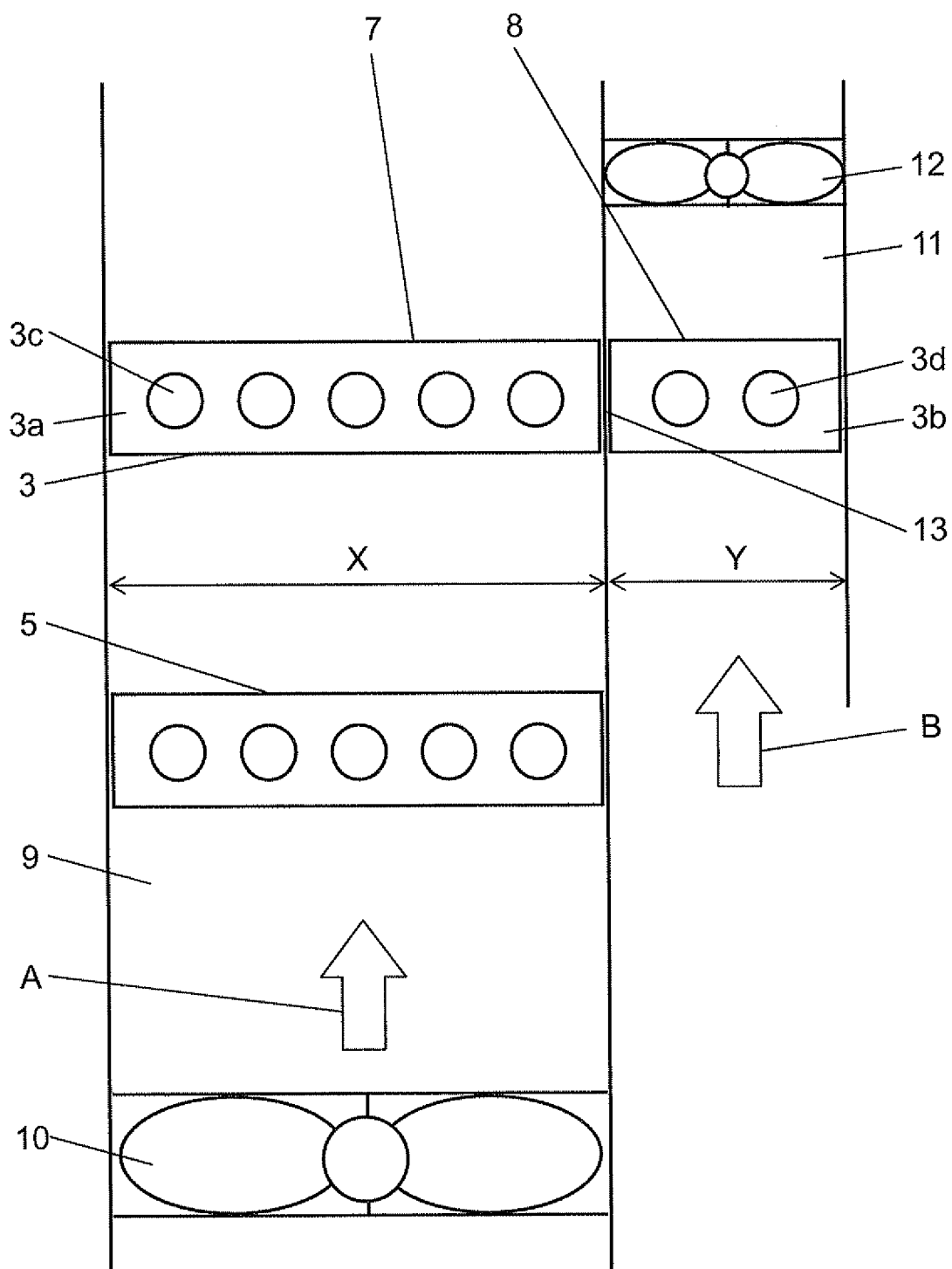


FIG. 3

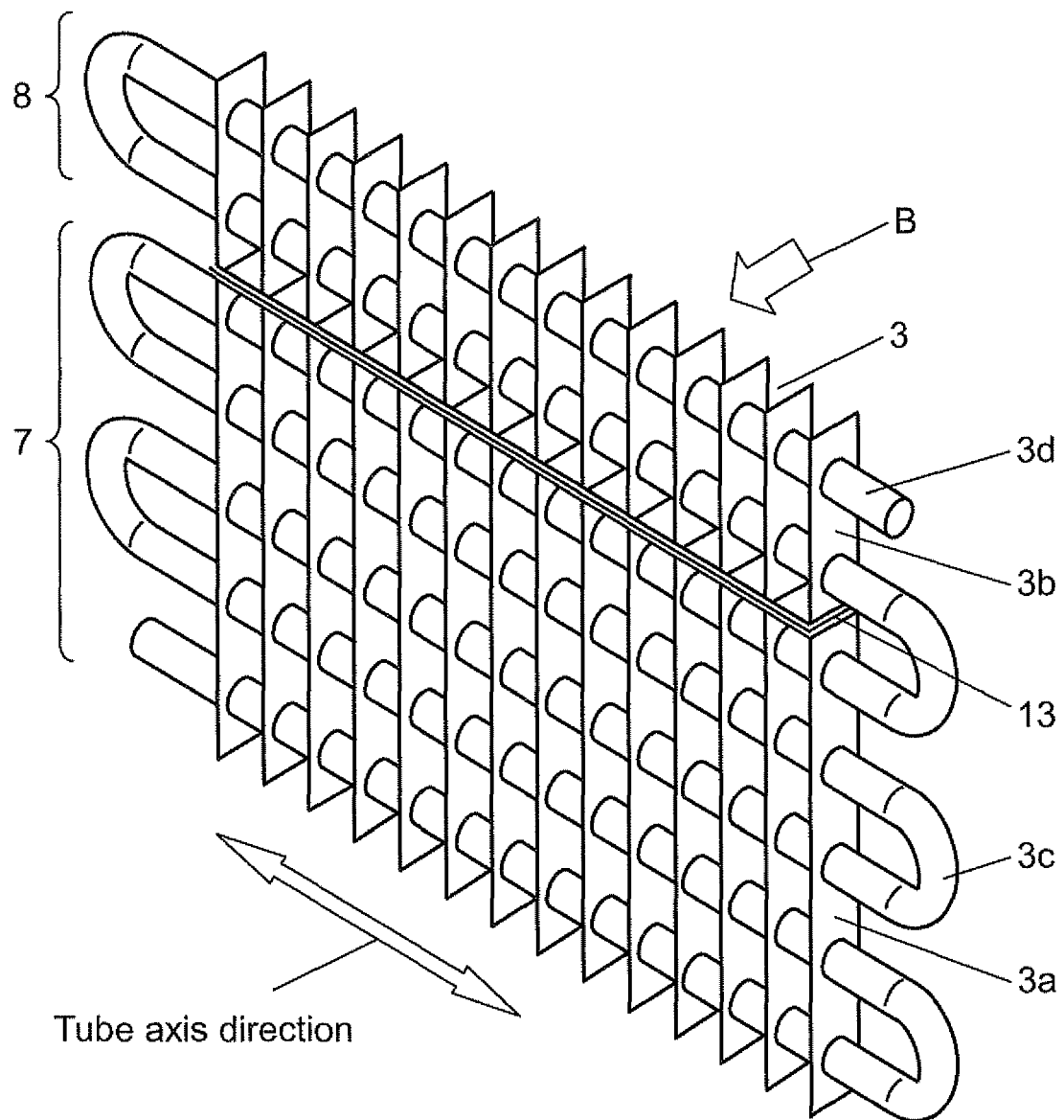


FIG. 4

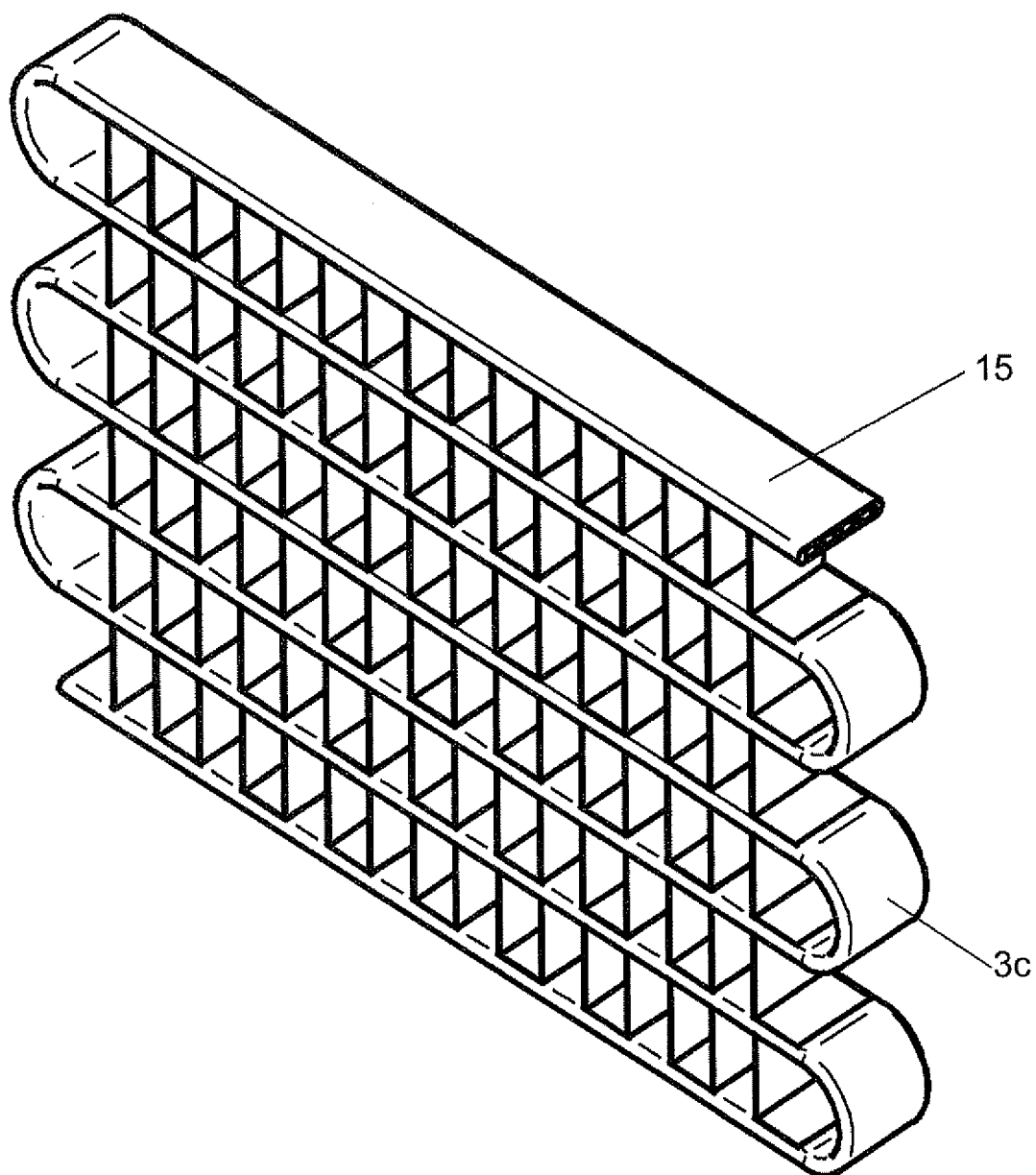


FIG. 5

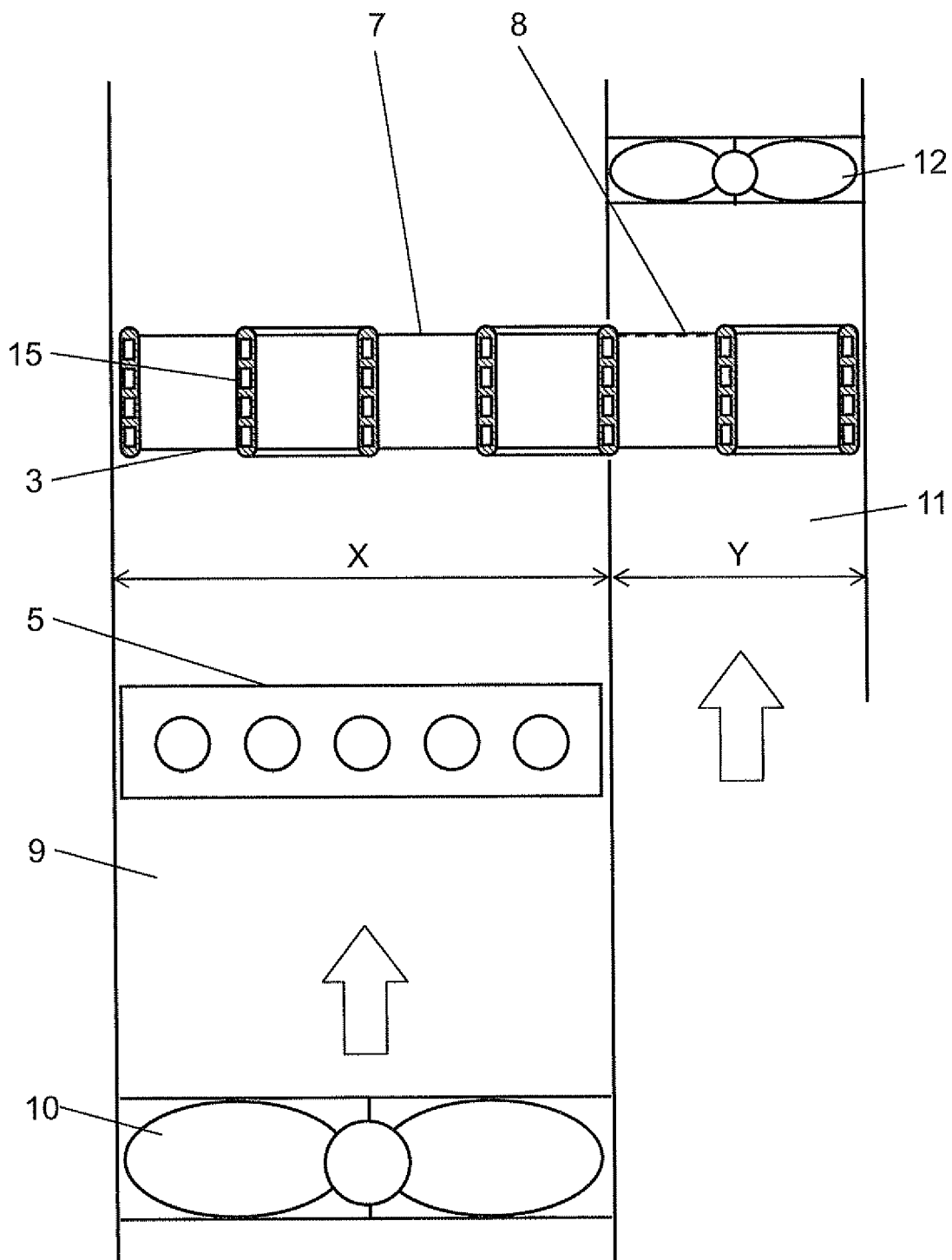


FIG. 6

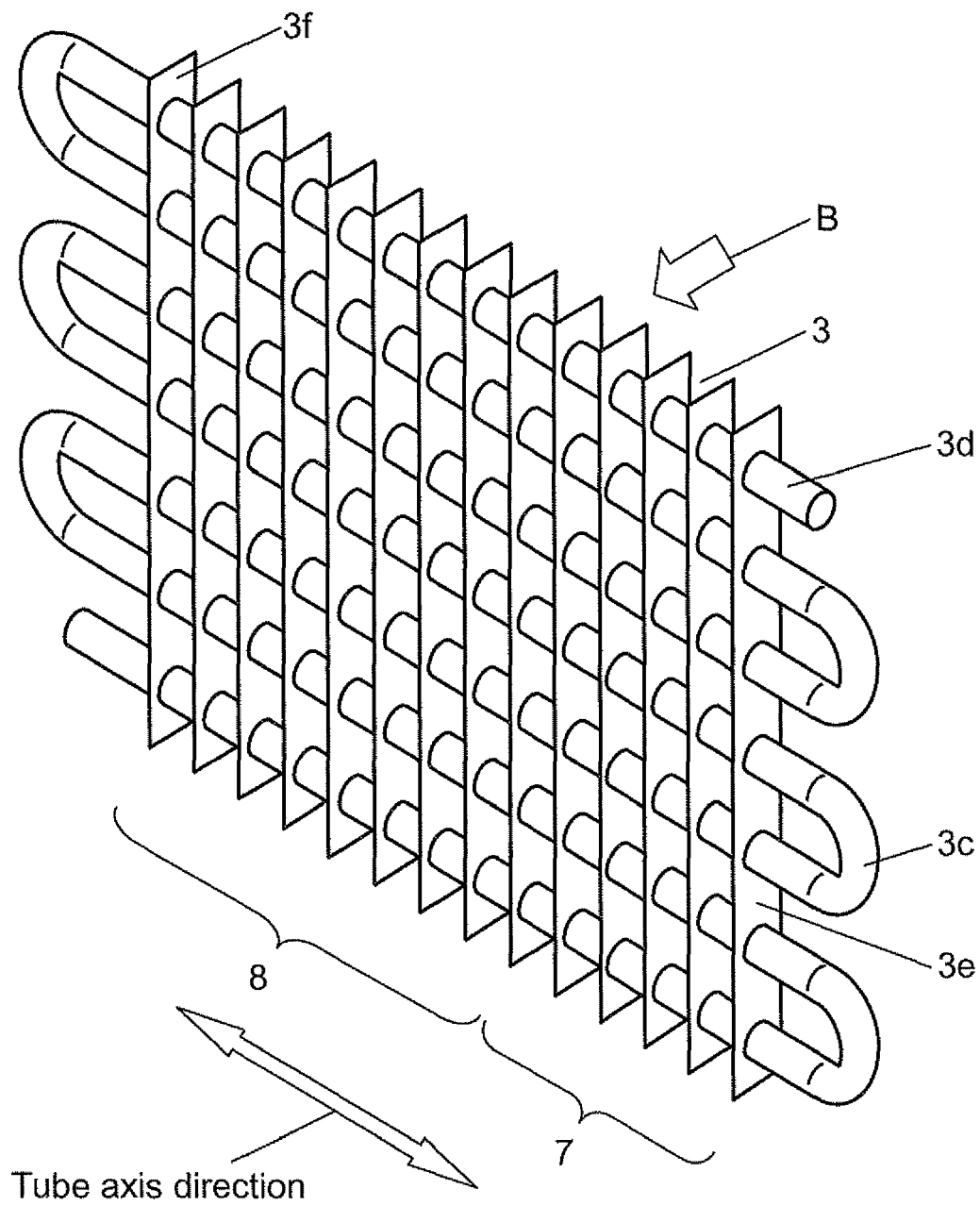
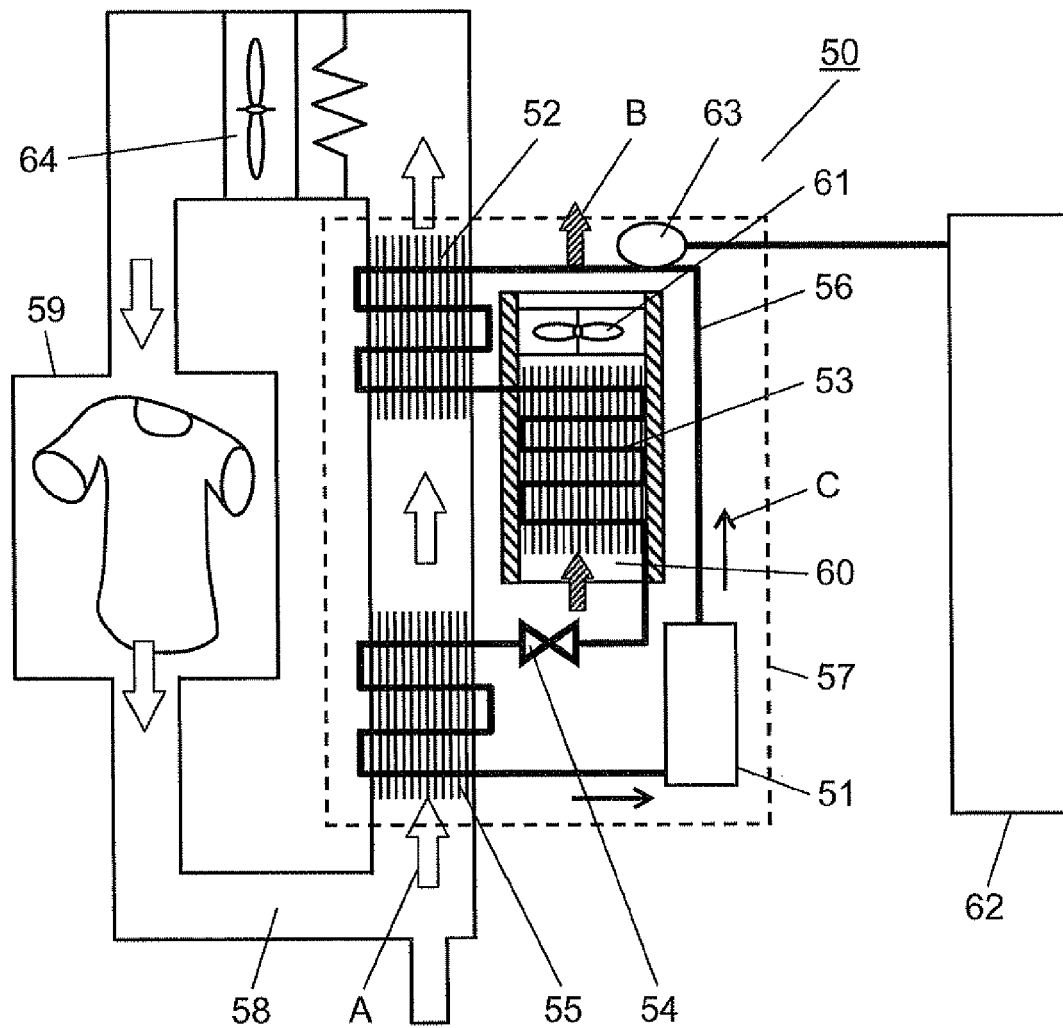


FIG. 7



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2004239549 A [0002]