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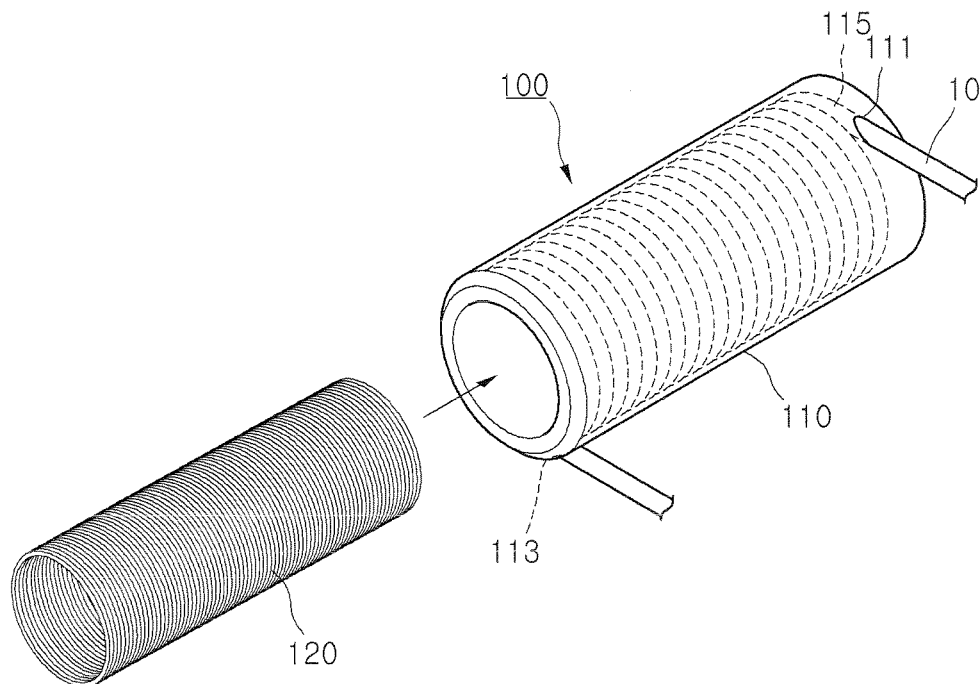
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(54) **Heating device for refrigerant**

(57) A device for heating a refrigerant is provided. A refrigerant flows through a heating member, and a coil is wound inside the heating member for heating the re-

frigerant by induction heating. Therefore, a refrigerant can be heated, and thus the temperature of the refrigerant can rapidly reach a preset target temperature.

Fig.2



Description

[0001] The present disclosure relates to an air conditioner, and more particularly, to a device for heating a refrigerant circulating in an air conditioner.

[0002] Generally, air conditioners are used as home appliances for cooling or heating a desired area through a heat-exchange cycle in which a refrigerant varies in pressure and temperature.

[0003] Fig. 1 is a schematic view illustrating a general heat-exchange cycle.

[0004] Referring to Fig. 1, the heat-exchange cycle system includes: a compressor 1 configured to compress a refrigerant to a high-temperature, high-pressure, gas-phase state; a condenser 2 configured to condense the refrigerant compressed by the compressor 1 into liquid by taking heat from the refrigerant with a cooling fan 6; capillary tubes 4 configured to expand the liquid-phase refrigerant condensed by the condenser 2 to a low-pressure liquid state by using a throttling phenomenon; a distributor 3 configured to uniformly distribute the liquid-state refrigerant condensed by the condenser 2 to the capillary tubes 4; and an evaporator 5 configured to evaporate the low-temperature, low-pressure refrigerant expanded by the capillary tubes 4 in a state where a cooling fan 7 is rotated, so as to provide cool air cooled due to latent heat of the evaporating refrigerant. The refrigerant is expanded by the evaporator 5 to a low-temperature, low-pressure gas state and is directed back to the compressor 1. That is, the cooling system (heat-exchange cycle system) of an air conditioner can cool or heat an indoor area by circulating the refrigerant through the heat-exchange cycle system constituted by compressor 1 - condenser 2 - distributor 3 - capillary tubes 4 - evaporator 5.

[0005] However, in the case of such a heat-exchange cycle of the related art, since the refrigerant circulates through the heat-exchange cycle system in a stable state, the refrigerant is not rapidly compressed to a desired pressure by the compressor 1, and thus it takes time to reach a set target temperature. That is, it takes time to cool or heat an indoor area by using an air conditioner.

[0006] Embodiments provide a device for heating a refrigerant so as to allow rapid air conditioning in an indoor area.

[0007] In one embodiment, a refrigerant heating device includes: a heating member making contact with a refrigerant tube in which a refrigerant flows; and a coil wound at the heating member for heating the refrigerant flowing through the refrigerant tube.

[0008] In another embodiment, a refrigerant heating device includes: a heating member in which a refrigerant passage is disposed; and a coil configured to heat a refrigerant flowing through the passage.

[0009] According to the present disclosure, a refrigerant can be heated for rapidly increasing the temperature of the refrigerant to a preset target temperature.

[0010] The details of one or more embodiments are

set forth in the accompanying drawings and the description below. Other features will be apparent from the description and drawings, and from the claims.

[0011] Fig. 1 is a schematic view illustrating a heat-exchange system of the related art.

[0012] Fig. 2 is a perspective view illustrating a device for heating a refrigerant according to a first embodiment.

[0013] Fig. 3 is a sectional view illustrating the refrigerant heating device of the first embodiment.

[0014] Fig. 4 is a perspective view illustrating a device for heating a refrigerant according to a second embodiment.

[0015] Fig. 5 is a perspective view illustrating a device for heating a refrigerant according to a third embodiment.

[0016] Fig. 6 is a perspective view illustrating a device for heating a refrigerant according to a fourth embodiment.

[0017] A device for heating a refrigerant will now be described with reference to the accompanying drawings according to a first embodiment.

[0018] Fig. 2 is a perspective view illustrating a device 100 for heating a refrigerant according to a first embodiment, and Fig. 3 is a sectional view illustrating the refrigerant heating device 100 of the first embodiment.

[0019] Referring to Figs. 2 and 3, the refrigerant heating device 100 of the current embodiment is configured to heat a refrigerant flowing through a refrigerant tube 10. For example, the refrigerant heating device 100 heats a refrigerant flowing through the refrigerant tube 10, which connects a compressor (not shown) and an evaporator (not shown). The refrigerant tube 10 is spirally wound inside a heating member 110 (described later).

[0020] The refrigerant heating device 100 is configured to heat a refrigerant flowing through the refrigerant tube 10, for example, by an induction heating method. For this, the refrigerant heating device 100 includes the heating member 110 and a coil 120.

[0021] The heating member 110 has a tube shape having a preset length and thickness. In the current embodiment, for example, the heating member 110 has a tube shape with a circular section. The length and thickness of the heating member 110 may be determined by the amount of heat necessary to heat a refrigerant. In addition, the length, diameter, and thickness of the heating member 110 may be determined in consideration of bending of the refrigerant tube 10. However, the shape of the heating member 110 is not limited to the above-mentioned tube shape.

[0022] A lead-in part 111 and a lead-out part 113 are provided on the outside of the heating member 110. The lead-in part 111 and the lead-out part 113 are formed by cutting outer-surface parts of the heating member 110 at positions close to both ends of the heating member 110. A refrigerant tube insertion hole 115 is formed in the heating member 110. Both ends of the refrigerant tube insertion hole 115 are connected to the lead-in part 111 and the lead-out part 113, respectively. In the current embodiment, the refrigerant tube insertion hole 115 is spirally

formed in the heating member 110. Therefore, the refrigerant tube 10 may be installed by inserting an end of the refrigerant tube 10 into the lead-in part 111 until the refrigerant tube 10 is fully inserted into the refrigerant tube insertion hole 115 and the end of the refrigerant tube 10 is led out from the lead-out part 113.

[0023] The heating member 110 is induction-heated by the coil 120 when a high-frequency current is applied to the coil 120, and at this time, heat is transferred to the refrigerant tube 10. In detail, when a high-frequency current is applied to the coil 120, an eddy current is generated in the heating member 110 due to an AC (alternating current) magnetic field generated around the coil 120, and thus, resistive heat is generated by the eddy current. At the same time, hysteresis heat is also generated by a hysteresis loss. In this way, the heating member 110 is heated. In addition, heat may be accumulated in a part of the heating member 110 located between the refrigerant tube 10 and the coil 120, that is, a part of the heating member 110 that is not actually induction-heated by the coil 120, and the accumulated heat may be transferred to the refrigerant tube 10. For this, the heating member 110 may be formed of a magnetic material such as stainless steel or iron.

[0024] Leakage prevention parts 117 are provided on both ends of the heating member 110. The leakage prevention parts 117 are provided to reduce leakage of an AC magnetic field generating around the coil 120. For this end, the leakage prevention parts 117 extend from both ends of the heating member 110 so that at least a portion of an AC magnetic field generating around the coil 120 can flow across the leakage prevention parts 117. In the current embodiment, the leakage prevention parts 117 extend from inner surfaces of both ends of the heating member 110 toward the centerline of the heating member 110 at a preset angle.

[0025] The coil 120 is disposed on the inner side of the heating member 110. In detail, the coil 120 is spirally wound and disposed on the inner side of the heating member 110. That is, the coil 120 is disposed inside the heating member 110. When a high-frequency current is applied to the coil 120, an AC magnetic field is generated around the coil 120 so that the heating member 110 can be induction-heated. In the current embodiment, the coil 120 is wound in the same direction as the refrigerant tube 10. In addition, the coil 120 may be spaced inwardly from both ends of the heating member 110 by a preset length so as to minimize leakage of an AC magnetic field.

[0026] An operation of the refrigerant heating device 100 will now be described in detail according to the first embodiment.

[0027] First, a refrigerant flows through the refrigerant tube 10. Next, a high-frequency current is applied to the coil 120 so as to heat the refrigerant flowing through the refrigerant tube 10 by using the heating member 110.

[0028] In response to the high-frequency current applied to the coil 120, an AC magnetic field is formed around the coil 120. Then, an eddy current is generated

in the heating member 110 through which the AC magnetic field flows, and then resistive heat and hysteresis-loss heat are generated due to the eddy current.

[0029] Heat generated in the heating member 110 in this way is transferred to the refrigerant tube 10 inserted in the refrigerant tube insertion hole 115. Since the refrigerant flowing through the refrigerant tube 10 is heated, the refrigerant can be compressed by a compressor up to a preset target temperature and be transferred to an evaporator.

[0030] In the current embodiment, the refrigerant tube 10 is disposed inside the heating member 110, that is, in the refrigerant tube insertion hole 115 of the heating member 110. Therefore, the heat transfer area between the refrigerant tube 10 and the heating member 110 can be maximized, and heat can be transferred from the heating member 110 to the refrigerant tube 10 more efficiently. In addition, heat is accumulated in a part of the heating member 110 that is not actually induction-heated by the coil 120, and the accumulated heat is transferred to the refrigerant tube 10.

[0031] The heating member 110 may be formed of a material such as stainless steel. In this case, the thermal expansion coefficient of the heating member 110 may be different from that of the refrigerant tube 10 which is usually made of copper. However, the refrigerant tube 10 is disposed inside the heating member 110, that is, in the refrigerant tube insertion hole 115 of the heating member 110. Therefore, although the refrigerant tube 10 shrinks due to a relatively low-temperature refrigerant flowing through the refrigerant tube 10 and the heating member 110 expands by heat, the coupling between the refrigerant tube 10 and the heating member 110 can be maintained.

[0032] When an AC magnetic field generating around the coil 120, leakage of the AC magnetic field can be reduced owing to the leakage prevention parts 117. In detail, when a high-frequency current is applied to the coil 120, an AC magnetic field is generated around the coil 120 in the length direction of the heating member 110 by Fleming's right hand rule. At this time, owing to the leakage prevention parts 117 extending in a manner such that the AC magnetic field of the coil 120 can flow across the leakage prevention parts 117, leakage of the AC magnetic field of the coil 120 to the outside of the heating member 110 can be reduced.

[0033] A device for heating a refrigerant will now be described with reference to the accompanying drawing according to a second embodiment.

[0034] Fig. 4 is a perspective view illustrating a device 200 for heating a refrigerant according to a second embodiment.

[0035] Referring to Fig. 4, in the current embodiment, the refrigerant heating device 200 includes a heating member 210, a coil 220, and caps 230.

[0036] The heating member 210 has a tube shape with a preset length and thickness. The heating member 210 may have a tube shape with a circular section. A lead-in

part 211 and a lead-out part 213 are provided on the outside of the heating member 210. A refrigerant passage 215 is spirally formed in the heating member 210 in a manner such that both ends of the refrigerant passage 215 communicate with the lead-in part 211 and the lead-out part 213. A refrigerant flowing through the refrigerant passage 215 is heated by the refrigerant heating device 200. For a flow of a refrigerant through the refrigerant passage 215, a lead-in refrigerant tube 21 is connected to the lead-in part 211, and a lead-out refrigerant tube 23 is connected to the lead-out part 213. Therefore, a refrigerant introduced into the refrigerant passage 215 through the lead-in refrigerant tube 21 can be heated while the refrigerant flows through the refrigerant passage 215, and the refrigerant can be discharged through the lead-out refrigerant tube 23.

[0037] The coil 220 is spirally wound along the inner side of the heating member 210. The coil 220 may be wound in the same or opposite direction in which the refrigerant passage 215 is formed.

[0038] The caps 230 are used to close both ends of the heating member 210. For this end, the caps 230 have a shape corresponding to the cross sectional shape of the heating member 210. In addition, the caps 230 reduce leakage of an AC magnetic field of the coil 220 to the outside of the heating member 210. That is, the caps 230 may have the same function as the leakage prevention parts 117 of the first embodiment. Lead-out holes 231 are formed through the caps 230, respectively, so that both ends of the coil 220 can be led out through the lead-out holes 231.

[0039] A device for heating a refrigerant will now be described with reference to the accompanying drawing according to a third embodiment.

[0040] Fig. 5 is a perspective view illustrating a device 300 for heating a refrigerant according to a third embodiment.

[0041] Referring to Fig. 5, in the third embodiment, a heating member 310 of the refrigerant heating device 300 is shaped like a tube having an elliptical section. Since the heating member 310 has an elliptical shape, the contact area between the heating member 310 and a refrigerant can be increased when the refrigerant heating device 300 is disposed in a place have an elliptical shape. In the third embodiment, leakage prevention parts 317 are provided on the heating member 310 to reduce leakage of an AC magnetic field generating around a coil 320.

[0042] The other elements of the third embodiment, that is, a lead-in refrigerant tube 31, a lead-out refrigerant tube 33, a lead-in part 311, a lead-out part 313, and a refrigerant passage 315, are the same as those of the second embodiment. Thus, descriptions thereof will not be repeated.

[0043] A device for heating a refrigerant will now be described with reference to the accompanying drawing according to a fourth embodiment.

[0044] Fig. 6 is a perspective view illustrating a device

400 for heating a refrigerant according to a fourth embodiment.

[0045] Referring to Fig. 6, in the fourth embodiment, a heating member 410 of the refrigerant heating device 400 is shaped like a tube having an elliptical section like the heating member 310 of the second embodiment. In the fourth embodiment, two caps 430 are used to close both ends of the heating member 410 for reducing leakage of an AC magnetic field of a coil 420. Lead-out holes 431 are formed through the caps 430 so that both ends of the coil 420 can be led out through the lead-out holes 431.

[0046] The other elements of the fourth embodiment, that is, a refrigerant tube 40, a lead-in part 411, a lead-out part 413, and a refrigerant tube insertion hole 415, are the same as those of the first embodiment. Thus, descriptions thereof will not be repeated.

[0047] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the scope of the principles of the disclosure, the drawings, and the appended claims.

[0048] According to the embodiments, during a heat-exchange cycle, a circulating refrigerant is heated by the refrigerant heating device. Therefore, load on a compressor can be reduced, and an indoor area can be cooled or heated more rapidly.

[0049] Furthermore, according to the embodiments, the refrigerant tube in which a refrigerant flows is disposed through the heating member, or the refrigerant passage is formed through the heating member so that a refrigerant can flow through the refrigerant passage. Therefore, the refrigerant can be heated by the heating member more efficiently.

[0050] Moreover, according to the embodiments, the refrigerant tube or the refrigerant passage is disposed through the heating member. Therefore, although the refrigerant tube and the refrigerant heating device have different thermal expansion coefficients, the position of the refrigerant heating device relative to the refrigerant tube is not changed. Therefore, a refrigerant flowing through the refrigerant tube can be heated by the refrigerant heating device in a state where the refrigerant heating device is stably kept at a predetermined position.

[0051] In addition, according to the embodiments, although the coil is damaged, only the damaged coil can be detached from the heating member and replaced with a new one. Therefore, the refrigerant heating device can be easily repaired and maintained.

Claims

1. A refrigerant heating device for heating a refrigerant flowing through a refrigerant tube connected between a compressor and an evaporator that consti-

tute a heat-exchange cycle system, the refrigerant heating device comprising:

a heating member configured to transfer heat to a refrigerant flowing through the refrigerant tube; and
a coil configured to heat the heating member by induction heating.

2. The refrigerant heating device according to claim 1, wherein the heating member is hollow, and the refrigerant tube is inserted in the heating member. 10
3. The refrigerant heating device according to claim 1 or 2, wherein the refrigerant tube has a spiral shape and inserted in the heating member. 15
4. The refrigerant heating device according to claim 2 or 3, wherein the coil is spirally wound at the heating member. 20
5. The refrigerant heating device according to claim 4, wherein the refrigerant tube penetrates the heating member and has a spiral shape wound around an imaginary axis, and the coil is spirally wound at the heating member around the imaginary axis. 25
6. The refrigerant heating device according to claim 1, wherein the heating member is hollow, and the coil is wound on an inner surface of the heating member, wherein the refrigerant heating device further comprises two caps configured to cover at least parts of both ends of the heating member for reducing leakage of an AC magnetic field formed around the coil. 30 35
7. The refrigerant heating device according to claim 1, wherein the heating member is hollow, and the coil is wound on an inner surface of the heating member, wherein leakage prevention parts are provided on both ends of the heating member so as to reduce leakage of an AC magnetic field formed around the coil. 40
8. The refrigerant heating device according to claim 1, wherein a passage is disposed in the heating member to allow a flow of a refrigerant. 45
9. The refrigerant heating device according to claim 8, wherein the passage is spirally disposed in the heating member. 50
10. The refrigerant heating device according to claim 9, wherein the heating member is hollow, and the coil is spirally wound on an inner surface of the heating member for heating the heating member by induction heating. 55

11. The refrigerant heating device according to claim 10, wherein the passage and the coil are spirally wound around the same imaginary center axis.
12. The refrigerant heating device according to claim 10 or 11, further comprising a leakage prevention member configured to prevent an AC magnetic field generating around the coil from leaking to an outside of the heating member.
13. The refrigerant heating device according to claim 12, wherein the leakage prevention member comprises two caps configured to cover both ends of the heating member.
14. The refrigerant heating device according to claim 13, wherein lead-out holes are formed through the caps so that both ends of the coil are led out through the lead-out holes.
15. The refrigerant heating device according to claim 12, wherein the leakage prevention member is leakage prevention parts, which extend from both ends of the heating member so that an AC magnetic field generating around the coil flows through at least portions of the leakage prevention parts.

Fig. 1

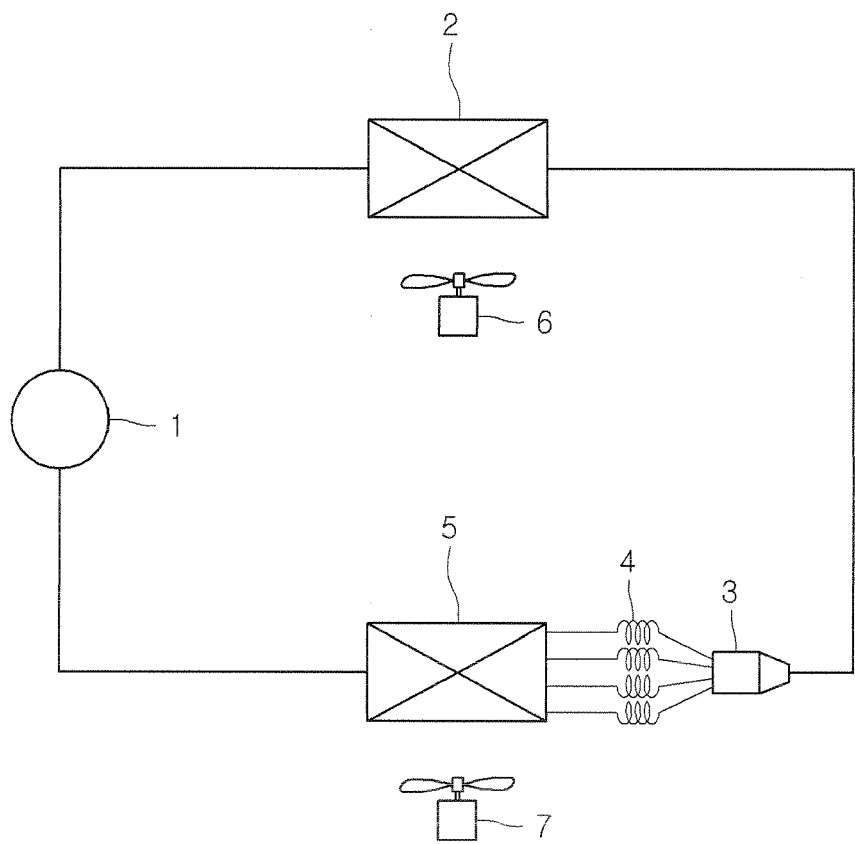


Fig.2

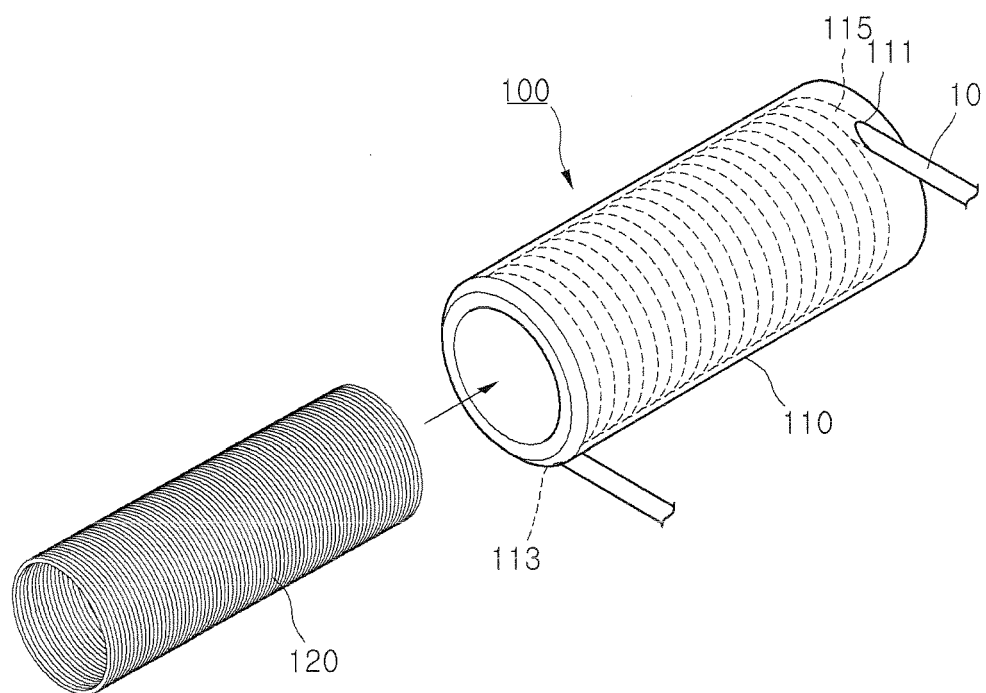


Fig. 3

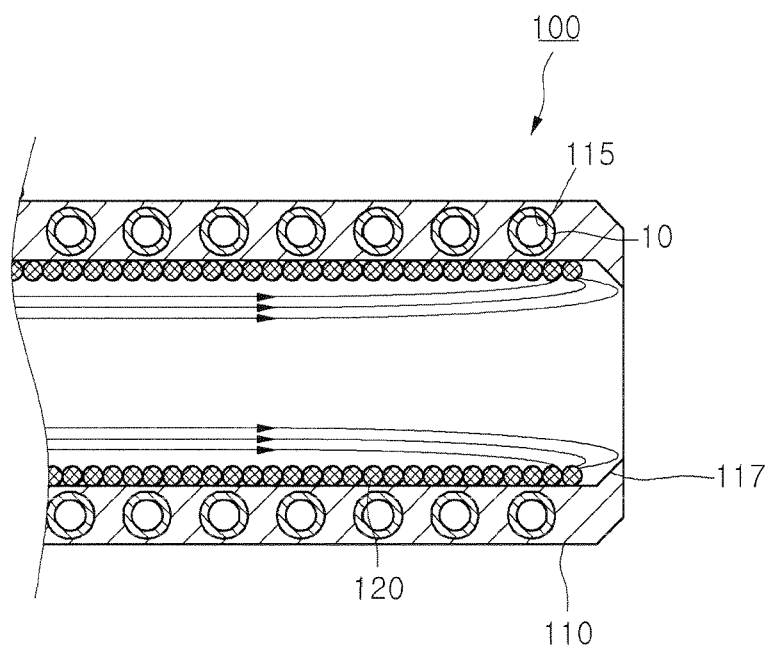


Fig. 4

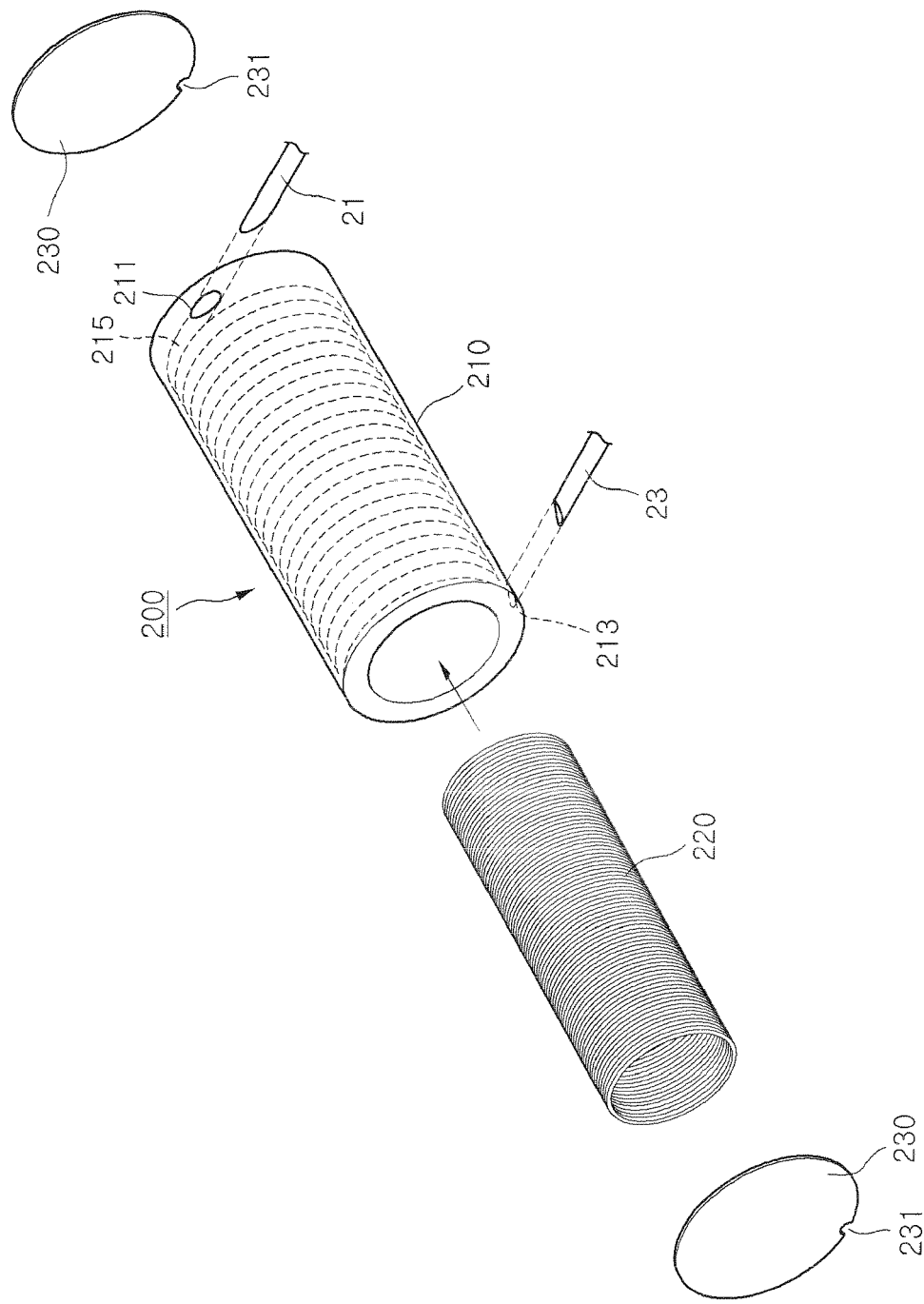


Fig. 5

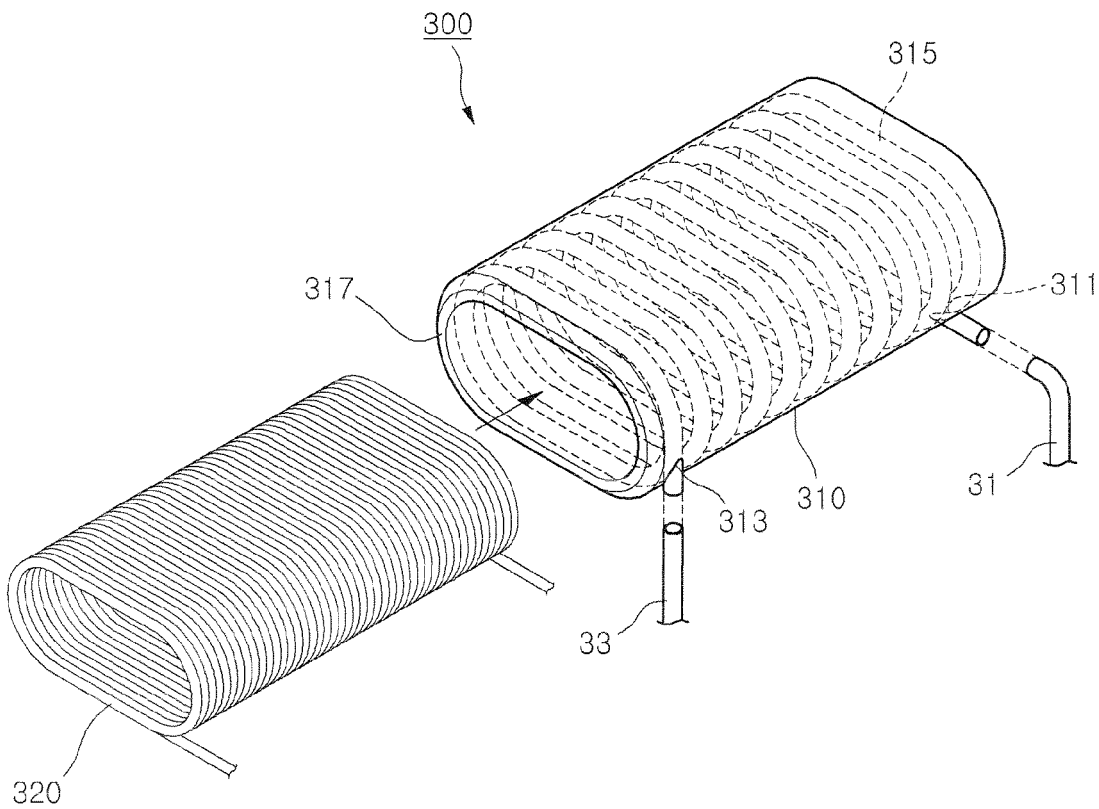
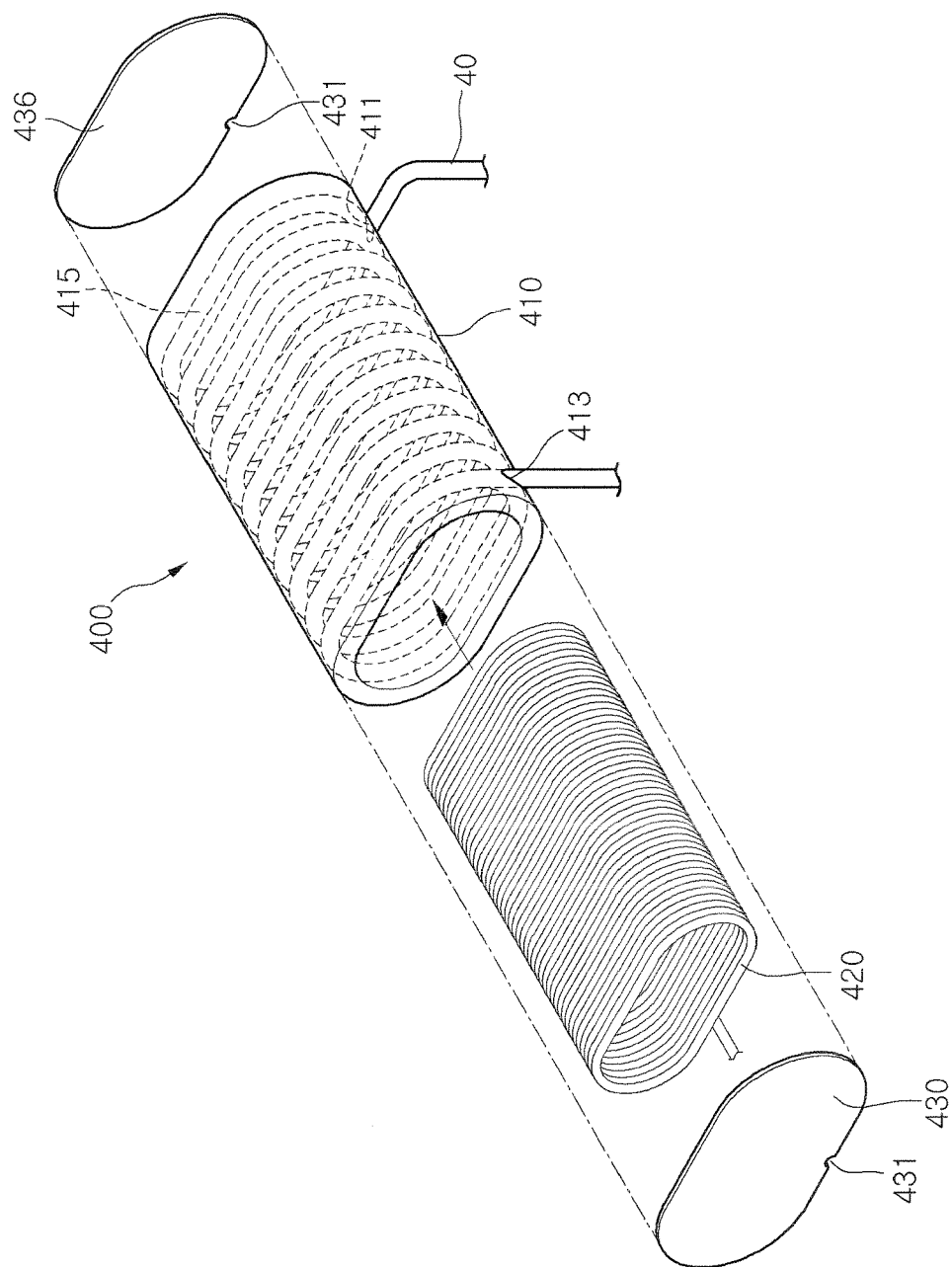


Fig. 6





EUROPEAN SEARCH REPORT

 Application Number
 EP 09 17 5197

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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			F25B H05B
2 Place of search Munich Date of completion of the search 2 February 2010 Examiner Ritter, Christoph			
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			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 09 17 5197

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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02-02-2010

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