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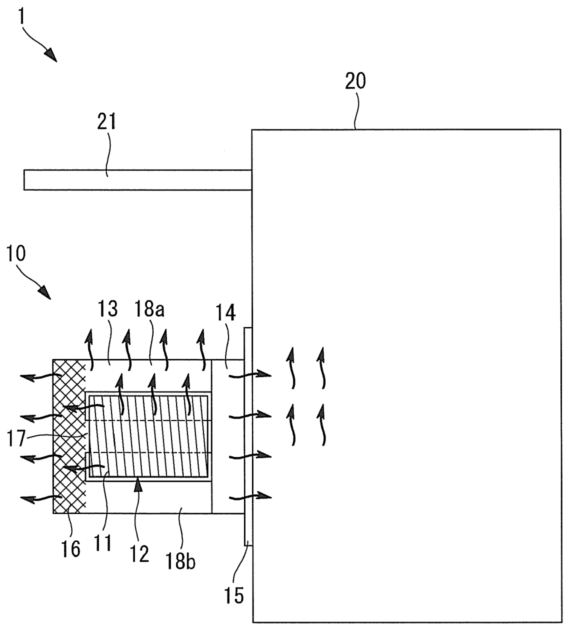
(54) **REACTOR AND OUTDOOR UNIT**

(57) Provided is a reactor that can prevent deterioration of a fixing part. The reactor (10) includes: a coil (12) composed of a wound wire (11); a first core (13) incorporating the coil (12); the second core (14) facing the first core (13) and generating less heat than the first core (13); and a base plate (15) to which the second core (14) is fixed. The first core (13) is an E-core, and the second core (14) is an I-core. Also, an outdoor unit 1 includes: a control box (20) in which electric components are stored and installed; and the reactor (10) fixed to an outer surface of the control box (20) via the base plate (15).

FIG. 1



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Description

[Technical Field]

[0001] The present invention relates to a reactor that is used, for example, for an air conditioner, in particular a packaged air conditioner, and to an outdoor unit using the reactor.

[Background Art]

[0002] An outdoor unit of a conventional air conditioner includes a reactor disposed in an electric component module (e.g., see Patent Literature 1). The reactor used for such an outdoor unit is typically composed of cores and a wound wire, and the cores typically consist of an E-shaped core and an I-shaped core as disclosed in Patent Literature 2.

[Citation List]

[Patent Literature]

[0003]

[PTL 1]
Japanese Unexamined Patent Application, Publication No. 2010-175224
[PTL 2]
Japanese Unexamined Patent Application, Publication No. Hei 8-148353 (the Publication of Japanese Patent No. 2652525)

[Summary of Invention]

[Technical Problem]

[0004] Heat generated from a reactor has been a conventional problem in disposing the reactor in a control box of an outdoor unit. Referring to Figs. 3 to 5, the problem of heat generated from the reactor will be explained in more detail. Fig. 4 is a front view of a partial internal structure of an outdoor unit in a reference example. The outdoor unit 101 includes a control box (sheet metal) 120, in which electric components are stored and installed, and a reactor 110 installed inside the control box 120. The reactor 110 includes a coil 112 composed of a wound wire 111, a first core 113 incorporating the coil 112, a second core 114 facing the first core 113 and generating less heat than the first core 113, and a base plate 115.

[0005] Referring to Fig. 3, structures of the first core 113 and the second core 114 will be explained in more detail. Fig. 3 is a front view of the reactor 110. As shown in Fig. 3, in the reactor 110, a first core 113 is an E-core having an E-shape, and a second core 114 is an I-core having an I-shape. The first core 113 includes a center leg 117 at the center of a base 116. The center leg 117 is inserted and fitted in the coil 112. Further, respective ends of the base 116 are provided with outer legs 118a, 118b that are parallel to the center leg 117 and slightly longer than the center leg 117.

[0006] Surfaces of the outer legs 118a, 118b facing the second core 114 make direct contact with the second core 114, and an air gap 119 is formed in the center of the second core 114 with the first core 113. Also, a surface of the base 116 facing the base plate 115 is fixed to the base plate 115 by welding. As shown in Fig. 4, the reactor 110 is fixed and installed inside the control box 120 via the base plate 115.

[0007] In this outdoor unit 101, large current flows through the reactor 110, which causes the reactor 110 to generate heat (refer to wavy arrows in Fig. 4). Also, comparing the first core 113 and the second core 114, the first core 113 has a higher magnetic flux density due to the presence of the aforementioned air gap 119. This results in a higher loss density, making the first core 113 apt to increase its temperature. In particular, the base 116 is the most heat generating part in the first core 113 (the part indicated by cross-hatching in Fig. 4). To deal with this heat, as shown in Fig. 4, the base 116 of the first core 113 is fixed to the base plate 115 by welding, and the base plate 115 is fixed inside the control box 120. This allows heat generated in the first core 113 to be transmitted to the base plate 115, then to the control box 120, and finally released out of the control box 120.

[0008] Since the reactor 110 is an essential component for controller configuration, the reactor 110 is incorporated in a controller ASSY (assembly). To release heat generated in the first core 113 out of the control box 120, the reactor 110 is often implemented inside the control box 120 as shown in Fig. 4. However, due to the base 116, which is the most heat generating part, being fixed to the base plate 115, there is a problem of deterioration of the fixing part caused by the influence of heat. Another problem is that heat generated in the wound wire 111 and other components stays inside the control box 120.

[0009] In view of the above, a method is reported by which the reactor 110 is fixed to an outer surface of the control box 120 via the base plate 115, like an outdoor unit 101' of Fig. 5. However, even though the reactor 110 is installed on the outer surface of the control box 120 as shown in Fig. 5, the base 116 is still fixed to the base plate 115. This causes heat generated in the first core 113 to be transmitted to the fixing part and the inside of the control box 120. As such, no fundamental solutions to preventing deterioration of the fixing part have been reported to date.

[0010] An object of the present invention, which has been made in view of the above circumstances, is to provide a reactor that can prevent deterioration of the fixing part.

[Solution to Problem]

[0011] To solve the above problem, the present invention adopts the following solutions.

[0012] The present invention provides a reactor including: a coil composed of a wound wire; a first core incorporating the coil; a second core facing the first core and generating less heat than the first core; and a base plate to which the second core is fixed.

[0013] The reactor of the present invention has the second core with less heat generation fixed to the base plate. Typically, the first core with high heat generation is fixed to the base plate. However, fixing the first core to the base plate causes heat to be directly transmitted from the first core to the fixing part, which may deteriorate the fixing part. In contrast, fixing the second core with less heat generation to the base plate as in the present invention causes heat to be hardly transmitted from the first core to the fixing part. This can prevent deterioration of the fixing part.

[0014] In the reactor, the first core is preferably an E-core, and the second core is preferably an I-core.

[0015] When the first core is an E-core and the second core is an I-core, the E-core has a higher magnetic flux density due to an air gap between the center of the second core (I-core) and the first core (E-core). This results in a higher loss density, making the E-core apt to increase its temperature. Meanwhile, the reactor of the present embodiment has the I-core with less heat generation fixed to the base plate. Thus, heat from the E-core with relatively high heat generation is hardly transmitted to the fixing part, effectively preventing deterioration of the fixing part caused by heat from the E-core.

[0016] The present invention further provides an outdoor unit including: a control box in which electric components are stored and installed; and the aforementioned reactor fixed to an outer surface of the control box via the base plate.

[0017] In the outdoor unit of the present invention, the reactor is disposed outside of the control box. Thus, heat generated from the wound wire and other components of the reactor is less likely to stay inside the control box. Further, the reactor is fixed to the outside of the control box via the base plate to which the second core is fixed. That is, the first core with high heat generation is located most distant from the control box. Accordingly, heat generated from the first core reaches the control box only after passing through the second core and the base plate, and as such the heat is hardly transmitted to the control box. This can minimize the effect of heat from the reactor on the control box, allowing for easy thermal design inside the control box. Moreover, since the first core with high heat generation is externally exposed, the first core can be cooled by air.

[0018] In the outdoor unit, the first core is preferably provided with a cooling mechanism.

[0019] With the cooling mechanism composed of a refrigerant pipe and the like being provided to the first core, heat dissipation capability of the first core (and the reactor as a whole) can be improved. This allows for downsizing the reactor.

[Advantageous Effects of Invention]

[0020] The reactor of the present invention has the second core with less heat generation fixed to the base plate. This causes heat from the first core to be hardly transmitted to the fixing part, preventing deterioration of the fixing part.

[Brief Description of Drawings]

[0021]

Fig. 1 is a front view of a partial internal structure of an outdoor unit according to a first embodiment of the present invention.

Fig. 2 is a front view of a partial internal structure of an outdoor unit according to a second embodiment of the present invention.

Fig. 3 is a front view of a reactor.

Fig. 4 is a front view of a partial internal structure of an outdoor unit in a reference example.

Fig. 5 is a front view of a partial internal structure of an outdoor unit in another reference example.

[Description of Embodiments]

[0022] Hereinafter, embodiments of a reactor and an outdoor unit according to the present invention will be described with reference to the drawings.

(First Embodiment)

[0023] A first embodiment of the present invention will be described below with reference to Fig. 1.

[0024] Fig. 1 is a front view of a partial internal structure of an outdoor unit according to the present embodiment.

[0025] As shown in Fig. 1, the outdoor unit 1 according to the present embodiment includes a control box (sheet metal) 20 in which electric components are stored and installed, and a reactor 10 fixed to an outer surface of the control box 20. Further, a ceiling 21 is provided to an upper part of the control box 20 so as to cover the reactor 10. The reactor 10 includes a coil 12 composed of a wound wire 11, a first core 13 incorporating the coil 12, a second core 14 facing the first core 13 and generating less heat than the first core 13, and a base plate 15.

[0026] The first core 13 is an E-core having an E-shape, and the second core 14 is an I-core having an I-shape. The first core 13 includes a center leg 17 at the center of a base 16. The center leg 17 is inserted and fitted in the coil 12. Further, respective ends of the base 16 are provided with outer legs 18a, 18b that are parallel to the center leg 17 and slightly longer than the center leg 17. Surfaces of the outer legs 18a, 18b facing the second core 14 make direct contact with the second core 14.

[0027] A surface of the second core 14 facing the base plate 15 is fixed to the base plate 15 by welding, and the reactor 10 is fixed and installed onto an outer surface of the control box 20 via the base plate 15.

[0028] With the above configuration, the present embodiment provides the following functions and effects.

[0029] As described above, the reactor 10 of the present embodiment has the second core 14, which generates less heat, fixed to the base plate 15. Typically, the first core 13, which generates more heat, is fixed to the base plate 15. However, fixing the first core 13 to the base plate 15 causes heat to be directly transmitted from the first core 13 to the fixing part, which may deteriorate the fixing part. In contrast, fixing the second core 14 with less heat generation to the base plate 15 as in the present embodiment causes heat to be hardly transmitted from the first core 13 to the fixing part. This can prevent deterioration of the fixing part.

[0030] Also, when the first core 13 is an E-core and the second core 14 is an I-core, the E-core 13 has a higher magnetic flux density due to an air gap between the center of the second core (I-core) 14 and the first core (E-core) 13. This results in a higher loss density, making the E-core 13 apt to increase its temperature. Meanwhile, the reactor 10 of the present embodiment has the I-core 14 with less heat generation fixed to the base plate 15. Thus, heat from the E-core 13 with relatively high heat generation (in particular, from the base 16 indicated by cross-hatching in Fig. 1) is hardly transmitted to the fixing part, effectively preventing deterioration of the fixing part caused by heat from the E-core 13.

[0031] In the outdoor unit 1 of the present embodiment, the reactor 10 is disposed outside of the control box 20. Thus, heat generated from the wound wire 11 and other components of the reactor 10 is less likely to stay inside the control box 20. Further, the reactor 10 is fixed to the outside of the control box 20 via the base plate 15 to which the second core 14 is fixed. That is, the first core 13 with high heat generation is located most distant from the control box 20. Accordingly, heat generated from the first core 13 reaches the control box 20 only after passing through the second core 14 and the base plate 15, and as such the heat is hardly transmitted to the control box 20 (refer to wavy arrows in Fig. 1). This can minimize the effect of heat from the reactor 10 on the control box 20, allowing for easy thermal design inside the control box 20. Moreover, since the first core 13 with high heat generation is externally exposed, the first core 13 can be cooled by air.

[0032] In the outdoor unit 1 of the present embodiment, the ceiling 21 is provided to the upper part of the control box 20 so as to cover the reactor 10 (in particular, one side of the outer leg 18a of the reactor 10). During rainy weather, for example, the ceiling 21 can receive rainwater falling from above, protecting the reactor 10 against water.

(Second Embodiment)

[0033] Next, a second embodiment of the present invention will be described with reference to Fig. 2.

[0034] Basic configurations of the present embodiment are basically the same as those of the first embodiment, and a difference from the first embodiment lies in that the base 16 of the first core 13 is provided with a cooling mechanism 22 in the present embodiment. Accordingly, in the present embodiment, an explanation will be given of this difference and other redundant explanations will be omitted.

[0035] The same components as those of the first embodiment are denoted by the same reference numerals and redundant explanations thereof will be omitted.

[0036] Fig. 2 is a front view of a partial internal structure of an outdoor unit 1' according to the present embodiment. As shown in Fig. 2, the base 16 of the first core 13 is provided with the cooling mechanism 22 on its surface opposite from that facing the control box 20. The cooling mechanism 22 is composed of a refrigerant pipe.

[0037] With the above-described configuration, the present embodiment provides the following functions and effects.

[0038] With the cooling mechanism 22 composed of a refrigerant pipe and the like being provided to the first core 13 as described above, heat dissipation capability of the first core 13 (and the reactor 10 as a whole) can be improved. This allows for downsizing the reactor 10.

[0039] The installing position of the cooling mechanism 22 is not limited to the base 16 of the first core 13 as described above; for example, the cooling mechanism 22 may be provided on the outer leg 18a or 18b of the first core 13.

[0040] Although the above two embodiments have exemplarily described the first core 13 as an E-core and the second core 14 as an I-core, the shapes of the first core 13 and the second core 14 are not limited to these. For example, the first core 13 and the second core 14 may be a U-core having a U-shape.

[Reference Signs List]

[0041]

1, 1'	Outdoor unit
10	Reactor
11	Wound wire
12	Coil
13	First core (E-core)
14	Second core (I-core)
15	Base plate
16	Base
17	Center leg
18a, 18b	Outer leg
20	Control box (sheet metal)
21	Ceiling
22	Cooling mechanism

Claims

1. A reactor (10) comprising:

a coil (12) composed of a wound wire (11);
a first core (13) incorporating the coil (12);
a second core (14) facing the first core (13) and generating less heat than the first core (13); and
a base plate (15) to which the second core (14) is fixed.

2. The reactor according to claim 1, wherein the first core (13) is an E-core, and the second core (14) is an I-core.

3. An outdoor unit (1) comprising:

a control box (20) in which electric components are stored and installed; and
the reactor (10) of claim 1 or 2, the reactor (10) being fixed to an outer surface of the control box (20) via the base plate (15).

4. The outdoor unit (1) according to claim 3, wherein the first core (13) is provided with a cooling mechanism (22).

FIG. 1

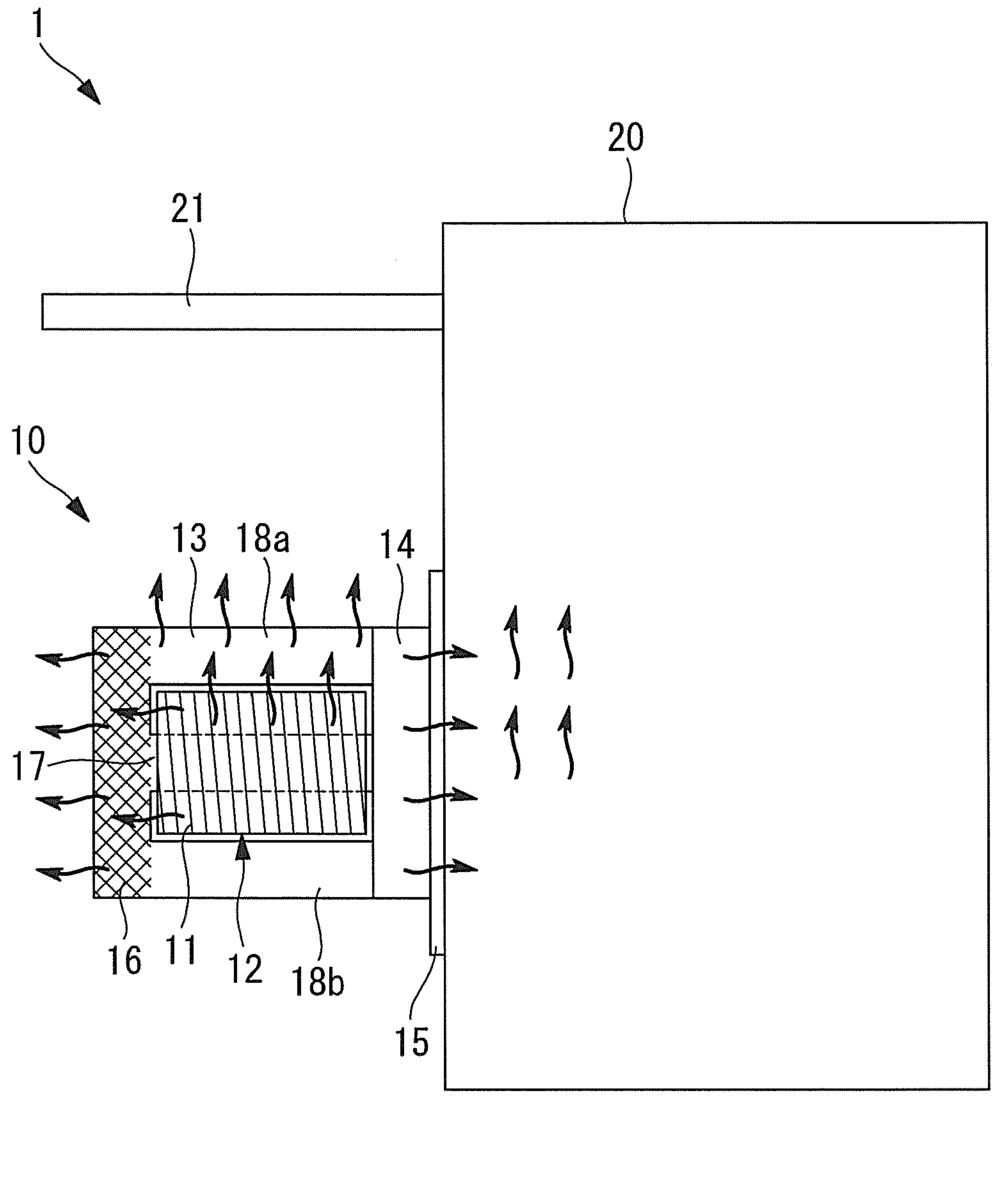


FIG. 2

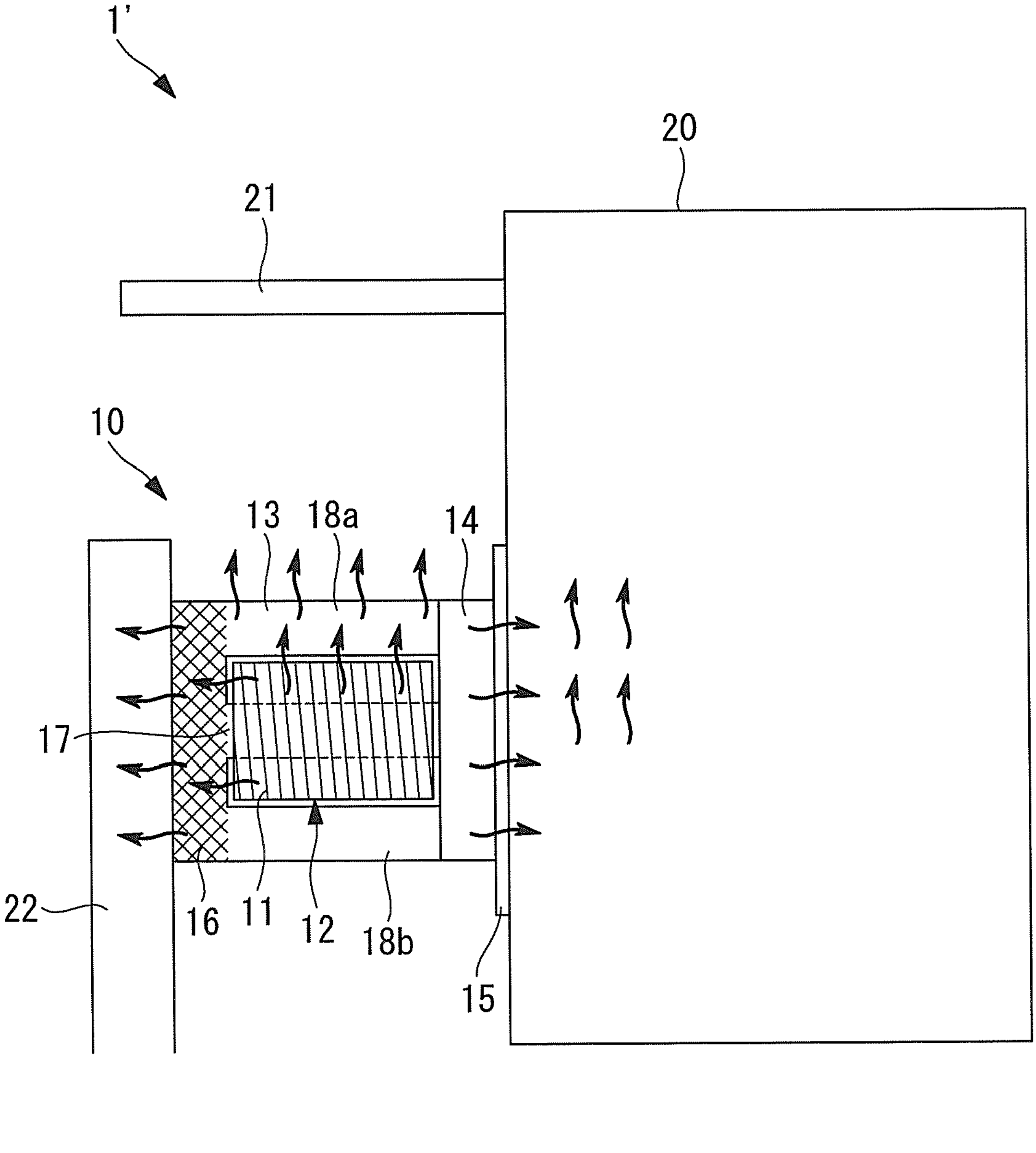


FIG. 3

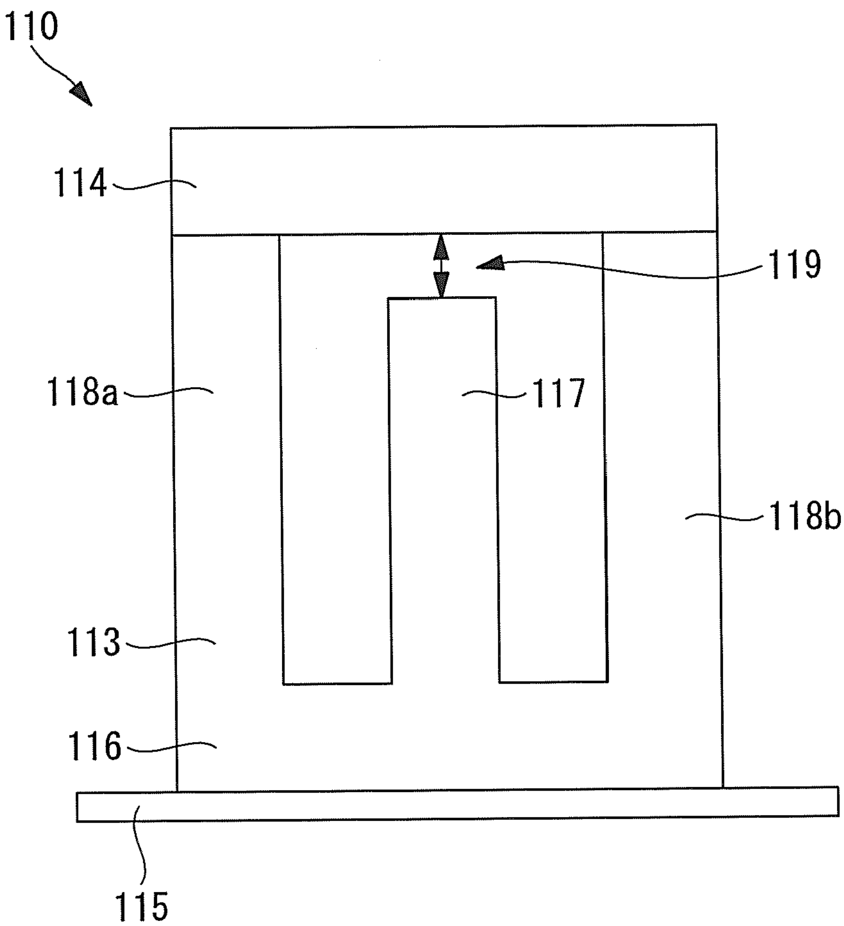


FIG. 4

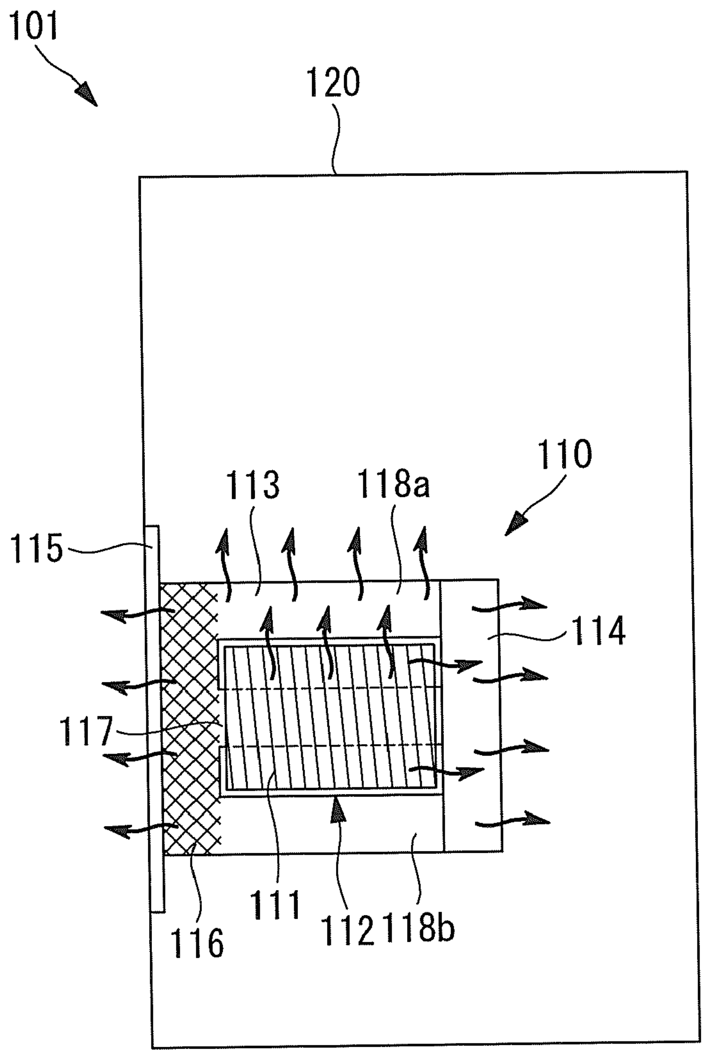
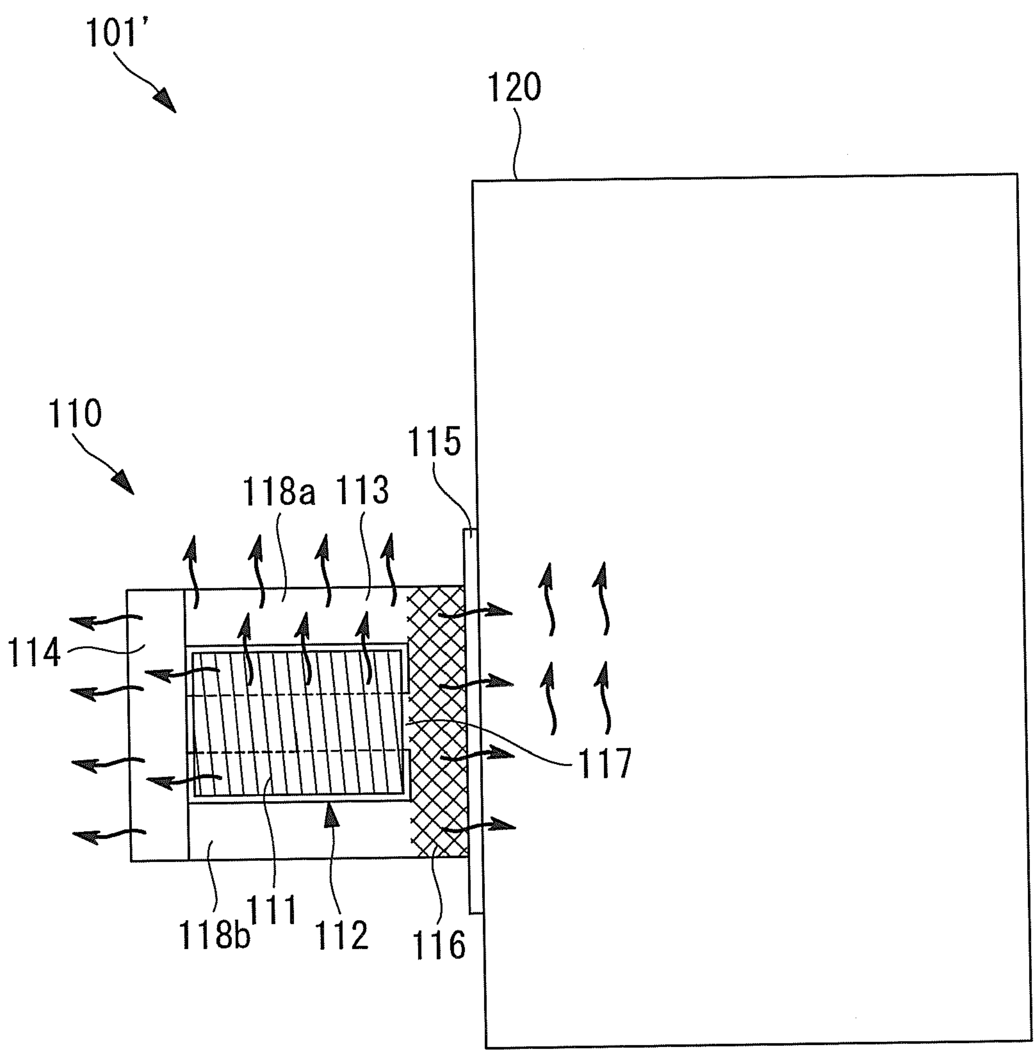


FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 19 15 8218

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	JP H03 218002 A (DAIKIN IND LTD) 25 September 1991 (1991-09-25) * abstract; figure 1 * * claim 1 * -----	1,2 3	INV. H01F27/26 F24F1/22 ADD. H01F3/10 H01F27/08 F24F1/24
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Y	WO 2017/022023 A1 (MITSUBISHI ELECTRIC CORP [JP]) 9 February 2017 (2017-02-09) * figure 4 * * paragraph [0017] * * paragraph [0041] * -----	3,4	
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The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
Munich	28 June 2019	Brächer, Thomas

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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