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(71) Applicant: **Toshiba Lifestyle Products & Services Corporation**
Kawasaki-shi, Kanagawa 210-8543 (JP)

(72) Inventors:
- **HAYASHI, Hidetake**
  Kawasaki-shi
  Kanagawa 210-8543 (JP)
- **NOGUCHI, Akihiro**
  Kawasaki-shi
  Kanagawa 210-8543 (JP)
- **NISHIMURA, Kousei**
  Kawasaki-shi
  Kanagawa 210- 8543 (JP)

(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

(54) REFRIGERATOR

(57) A refrigerator 1 of an embodiment performs heat exchange of a refrigerating cycle 21 by using a multi-flow type condenser 12 having a flat tube 14 that is formed into a flat shape in which a plurality of flow paths in which a refrigerant flows are formed inside the flat tube 14, and a header 13 that is an inlet or an outlet for the refrigerant to the flat tube 14.

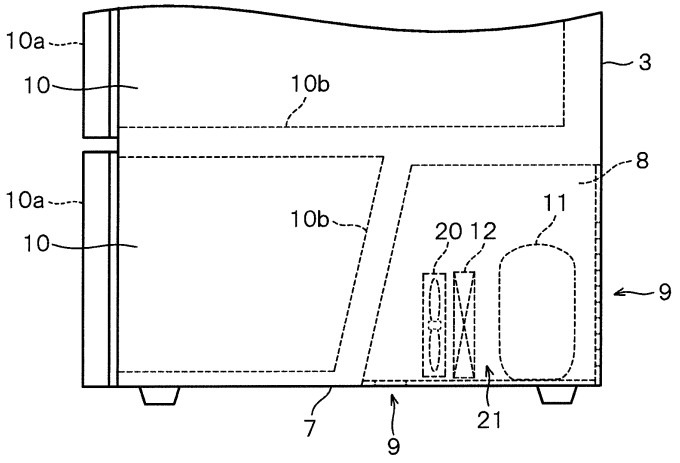

FIG.2

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Description

Technical Field

[0001] Embodiments of the present invention relate to a refrigerator.

Background Art

[0002] A refrigerator includes a refrigerating cycle configured with a compressor and a condenser. The compressor and condenser are installed in a so-called machine room, generate heat during operation, and therefore, are cooled by a cooling fan. For example, Patent Literature 1 proposes to efficiently cool the compressor, the condenser and the like in the machine room by devising disposition of the exhaust port.

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Patent Laid-Open No. 2014-238219

Summary of Invention

Technical Problem

[0004] Incidentally, in recent years, increasing the capacity of the storage rooms such as a refrigerated room has been desired. At this time, in order to increase the capacity without causing increase in size of the main body, the machine room is relatively reduced in size. As a result, a large condenser cannot be installed in the machine room, and the measures such as securing a necessary heat radiation amount by additionally providing a heat radiation pipe on the back side of the refrigerator, for example, have been necessary.

[0005] Therefore, a refrigerator that can increase in capacity of a storage room and can ensure a necessary heat radiation amount in a refrigerating cycle is provided.

Solution to Problem

[0006] A refrigerator of an embodiment performs heat exchange of a refrigerating cycle by using a multi-flow type condenser having a flat tube that is formed into a flat shape in which a plurality of flow paths in which a refrigerant flows are formed inside the flat pipe, and a header which is an inlet or an outlet for the refrigerant to the flat tube.

Brief Description of Drawings

[0007]

[Figure 1] Figure 1 is a view schematically illustrating a refrigerator of an embodiment.

[Figure 2] Figure 2 is a view schematically illustrating a machine room provided in a main body.

[Figure 3] Figure 3 is a view schematically illustrating a condenser in structure example A.

[Figure 4] Figure 4 is a view schematically illustrating a flow of a refrigerant in structure example A.

[Figure 5] Figure 5 is a view schematically illustrating a mounting mode of a connecting tube in structure example A.

[Figure 6] Figure 6 is a schematically illustrating a structure of a condenser in structure example B.

[Figure 7] Figure 7 is a view schematically illustrating a flow of a refrigerant in structure example B.

[Figure 8] Figure 8 is a view schematically illustrating a mounting mode of a connecting tube in structure example B.

[Figure 9] Figure 9 is a view schematically illustrating a structure of a condenser in structure example C.

[Figure 10] Figure 10 is a view schematically illustrating a flow of a refrigerant in structure example C.

[Figure 11] Figure 11 is a view schematically illustrating a mounting mode of a connecting pipe in structure example C.

[Figure 12] Figure 12 is a view schematically illustrating a structure of a condenser in structure example D.

[Figure 13] Figure 13 is a view schematically illustrating an installation orientation of the condenser.

[Figure 14] Figure 14 is a view schematically illustrating a component disposition example in the machine room in installation example A.

[Figure 15] Figure 15 is a view schematically illustrating an example of the installation orientation of the condenser in installation example A.

[Figure 16] Figure 16 is a diagram schematically illustrating a component disposition example in the machine room in installation example B.

[Figure 17] Figure 17 is a view schematically illustrating an example of the installation orientation of the condenser in installation example B.

[Figure 18] Figure 18 is a view schematically illustrating a component disposition example in the machine room in installation example C.

[Figure 19] Figure 19 is a view schematically illustrating an example of the installation orientation of the condenser in installation example C.

[Figure 20] Figure 20 is a view schematically illustrating a component disposition example in the machine room in installation example D.

[Figure 21] Figure 21 is a view schematically illustrating an example of the installation orientation of the condenser in installation example D.

[Figure 22] Figure 22 is a view schematically illustrating an installation example of a cooling fan and a condenser in another example.

[Figure 23] Figure 23 is a view schematically illustrating another structure of the condenser.

[Figure 24] Figure 24 is a view schematically illustrating an example of the installation orientation of the condenser at a time of dropping defrosting water.
[Figure 25] Figure 25 is a view schematically illustrating another disposition example of the machine room.
[Figure 26] Figure 26 is a view schematically illustrating another disposition example of the condenser.
[Figure 27] Figure 27 is a view schematically illustrating a disposition example of a heat insulating member.
[Figure 28] Figure 28 is a view illustrating another disposition example of the condenser in plan view.
[Figure 29] Figure 29 is a view illustrating another disposition example of the condenser in side view.
[Figure 30] Figure 30 is a view schematically illustrating another structure of a parallel type condenser.
[Figure 31] Figure 31 is a view schematically illustrating another structure of a meandering type condenser.
[Figure 32] Figure 32 is a view schematically illustrating a disposition mode to a machine room.
[Figure 33] Figure 33 is a view schematically illustrating another structure of the parallel type condenser.
[Figure 34] Figure 34 is a view schematically illustrating another structure of the meandering type condenser.
[Figure 35] Figure 35 is a view schematically illustrating another structure of the cooling fan and an installation mode of the condenser.
[Figure 36] Figure 36 is a view schematically illustrating another structure of the condenser.

Description of Embodiments

[0008] Hereinafter, embodiments will be described with reference to Figure 1 to Figure 21.

[0009] As illustrated in Figure 1, a refrigerator 1 has a main body 2 thereof formed into a substantially rectangle. The main body 2 has a back plate 3, a left side plate 4, a right side plate 5, a ceiling plate 6 and a bottom plate 7 (refer to Figure 2), and a front is opened. Opening in the front of the main body 2 is opened and closed by a door 10a (refer to Figure 2). The back plate 3, the left side plate 4, the right side plate 5, the ceiling plate 6 and the bottom plate 7 each has a structure using, for example, a vacuum heat insulating panel, a foamed polyurethane, or using them in combination, though not illustrated, and has a structure thermally insulating a storage room 10 (refer to Figure 2) from an outside of the refrigerator 1.

[0010] Hereinafter, in the present specification, as illustrated in Figure 1, explanation will be made with a direction along the gravity in a state in which the refrigerator 1 is installed described as a up-and-down direction, with a direction from the left side plate 4 to the right side plate 5 in a state in which the refrigerator 1 is seen from a front described as a left-and-right direction, and a direction from the door 10a to a back plate 3 side described as a front-and-back direction.

[0011] A machine room 8 is provided in a lower part in the main body 2. In the back plate 3, the left side plate 4, the right side plate 5 and the bottom plate 7, opening portions 9 communicating with an inside of the machine room 8 are formed in positions corresponding to the machine room 8. The respective opening portions 9 function as suction ports for sucking air into the machine room 8 from outside, or exhaust ports for discharging air to outside from inside the machine room 8, when a cooling fan 20 (refer to Figure 2) is operated. Whether the opening portions 9 function as the suction ports or function as the exhaust ports is determined by a position of the cooling fan 20 in the machine room 8. Note that the opening portion 9 may be a simple slit, may be worked into a louver shape or the like, or may be provided with a dust filter or the like.

[0012] As illustrated in Figure 2, a compressor 11, a condenser 12, the cooling fan 20 and the like are installed in the machine room 8. These compressor 11 and condenser 12 configure a refrigerating cycle 21 with an evaporator not illustrated. In the present embodiment, as the cooling fan 20, an axial flow fan is adopted. In the machine room 8, other components than the compressor 11, the condenser 12 and the cooling fan 20 are also installed, though not illustrated. Further, as a matter of course, a control unit that controls the entire refrigerator 1 including the compressor 11, the condenser 12, the cooling fan 20 and the like is also provided in the main body 2.

[0013] The storage room 10 such as a vegetable room, for example, is provided in front of the machine room 8, and is opened and closed by the pull-out type door 10a. Further, above the machine room 8, the storage room 10 such as a freezer compartment, for example, is provided, and is opened and closed by the pull-out type door 10a. Further, though not illustrated, the storage room 10 such as a refrigerated room, for example, is provided above the main body 2, and is opened and closed by the rotating door 10a, for example. The machine room 8 and the respective storage rooms 10 are partitioned by heat insulating partition walls 10b because the compressor 11 and the condenser 12 generate heat.

[0014] In the present embodiment, a so-called multi-flow type condenser is used as the condenser 12 which is installed in the machine room 8. The multi-flow type condenser 12 is configured such that flat tubes 14 are connected between the headers 13 as illustrated in Figure 3 and the like, and a plurality of flow paths are provided in parallel in each of the flat tubes 14, though details will be described later. Hereinafter, the configuration will be described as a parallel type for convenience. Further, as the multi-flow type condenser 12, there is a condenser having a configuration in which the headers 13 are connected with the single flat tube 14 which meanders as illustrated in Figure 4 and the like. Hereinafter, the con-

figuration will be referred to as a meandering type for convenience. Further, among the respective flat tubes 14, heat radiation fins 15 are provided.

[0015] Next, an operation of the above described configuration will be described.

[0016] As can be imagined from Figure 2, for example, in order to increase a storage amount without causing increase in size of the main body 2, that is, in order to increase the storage room 10 in capacity, the machine room 8 needs to be reduced in size relatively. However, if the machine room 8 is reduced in size, the capacity of the machine room 8 decreases, so that a large component that can ensure a sufficient heat radiation amount cannot be installed. Consequently, in order to ensure a necessary heat radiation amount, for example, measures such as providing a heat radiation pipe additionally on the back side, for example, are taken.

[0017] In relation to this, in the present embodiment, the multi-flow type condenser 12 is adopted. Because the multi-flow type condenser 12 has a large surface area even though it is small in size, the multi-flow type condenser 12 can ensure a sufficient heat radiation amount, and can be installed in the machine room 8 reduced in size.

[0018] Incidentally, when the condenser 12 is installed, there are a plurality of points to keep in mind. For example, since the other components are also installed in the machine room 8 as described above, a disposition place for the condenser 12 may be restricted by positions of the other components, positions of the opening portions 9 and the like. Further, especially in the case of the refrigerator 1, the storage rooms 10 such as the refrigerated room and the freezer compartment are provided, so that it is necessary to restrain an influence of generated heat on the storage rooms 10. Further, in an actual manufacturing process, it is necessary to consider ease of connection to piping 17 (refer to Figure 5 and the like) that will be described later or the like.

[0019] That is, when the multi-flow type condenser 12 is installed into the refrigerator 1, it is not sufficient that the condenser 12 is compact, but originality and ingenuity are required in the installation place and the installed orientation. Hereinafter, a plurality of structures (structure examples A to D) of the condenser 12 will be described first, and thereafter, preferable installation examples (installation examples A to D) in the structure examples A to D will be described.

<Structure example A: parallel type structure in which a refrigerant flow is in one direction>

[0020] Structure example A which is a parallel type structure in which a flow of the refrigerant is in one direction will be described with reference to Figure 3 to Figure 5. Hereinafter, the condenser 12 of structure example A will be referred to as a condenser 12A for convenience by adding a suffix "A". Note that when common explanation is made in respective structure examples, explanation is made without attaching the suffix, and the same can be said of the respective structure examples that will be described later.

[0021] As illustrated in Figure 3, in the condenser 12A, a plurality of flat tubes 14 are provided in parallel between the two cylindrical headers 13. The respective flat tubes 14 has a plurality of flow paths formed inside thereof, and the respective flow paths communicate with the respective headers 13. Therefore, in the flat tubes 14, the refrigerant flows in parallel. Due to the structure like this, the condenser 12A is referred to as of a multi-flow type or a parallel-flow type.

[0022] The refrigerant that flows into one of the headers 13 which is at the inlet side flows in the flat tube 14 and reaches the other header 13 which is at the outlet side. At this time, the heat radiation fins 15 provided among the respective flat tubes 14 by forming, for example, a thin metal plate into a corrugated shape are in contact with the respective flat tubes 14, and therefore release heat of the respective flat tubes 14. Hereinafter, a site where the respective flat tubes 14 and the heat radiation fins 15 are disposed will be referred to as the main body portion 12a for convenience. The main body portion 12a can be regarded as having an outer edge substantially in a thin rectangular parallelepiped as a whole.

[0023] Hereinafter, a width direction of the main body portion 12a, that is, a direction from the one header 13 to the other header 13 will be referred to as an X-axis in Figure 3. Further, a height direction of the main body portion 12a, that is, a direction in which the cylindrical header 13 extends will be referred to as a Y-axis in Figure 3. Further, a thickness direction of the main body portion 12a, that is, a direction orthogonal to the X-axis and the Y-axis respectively will be referred to as a Z-axis. Further, directions of arrows indicating the X-axis, the Y-axis and the Z-axis in Figure 3 are positive directions, and explanation will be made by assigning the positive directions with the main body portion 112a as the reference with "+", and assigning negative directions that are opposite directions to the positive directions with "-".

[0024] Connecting tubes 16 are respectively provided in the respective headers 13. The connecting tube 16 is provided to perform connection with the piping 17 (refer to Figure 5), and is firmly connected to the header 13, but a side that is connected to the piping 17 is formed into a pipe shape capable of curving and bending, for example, and is connected to the piping 17 by brazing, for example. Hereinafter, the connecting tube 16 at the inlet side for the refrigerant will be referred to as an inlet side connecting tube 16a for convenience, and the connecting tube 16 at an outlet side for the refrigerant will be referred to as an outlet side connecting tube 16b for convenience. In this case, an orientation of the inlet side connecting tube 16a is substantially in an X- direction, and an orientation of the outlet side connecting tube 16b is substantially in an X+ direction.

[0025] In the case of the condenser 12A like this, as

illustrated in Figure 4 by being simplified, the refrigerant flowing in from the inlet side connecting tube 16a flows in the respective flat tubes 14 toward the other header 13 as shown by the arrow F from the header 13 provided with the inlet side connecting tube 16a, and flows out from the outlet side connecting tube 16b. That is, in the case of the condenser 12A, the flow of the refrigerant is in one direction. At this time, the refrigerant is in a gaseous state when flowing into the inlet side connecting tube 16a, and is in a liquid state when flowing out from the outlet side connecting tube 16b by being condensed by the condenser 12.

[0026] Consequently, in the condenser 12, a temperature of the header 13 which is at the inlet side is relatively high, and a temperature of the header 13 which is at the outlet side is relatively low. Further, in the flat tube 14, a temperature at the inlet side is the highest, and the temperature becomes lower toward the outlet side. That is, in the main body portion 12a of the condenser 12 including the headers 13, a temperature distribution occurs.

[0027] When restrictions due to the installation place and the orientation for installation are not taken into consideration, the degrees of freedom of the orientations of the inlet side connecting tube 16a and the outlet side connecting tube 16b are considered to be relatively high. Specifically, as shown by the solid lines and the broken lines in Figure 5, the inlet side connecting tube 16a can be provided in various orientations such as the X- direction, Y+ direction, Z+ direction, and Z- direction with respect to the main body portion 12a. Similarly, the outlet side connecting tube 16b can be provided in various orientations such as the X+ direction, Y+ direction, Z+ direction, and Z-direction with respect to the main body portion 12a.

[0028] That is, the condenser 12 has the connecting tubes (the inlet side connecting tube 16a, the outlet side connecting tube 16b) that are formed to have such a length that the connecting tubes protrude from the main body portion 12a in which the flat tubes 14 are disposed, and are connected to the external piping 17. The connecting tubes (the inlet side connecting tube 16a, the outlet side connecting tube 16b) may extend parallel to the flat tubes 14, or may extend perpendicularly to the flat tubes 14. Further, the inlet side connecting tube 16a and the outlet side connecting tube 16b may differ in orientation to the flat tubes 14, or may differ in direction to protrude from the main body portion 12a. This can be said of the meandering type condenser 12 (refer to Figure 9 and Figure 12) that will be described later and the like.

[0029] Note that though not illustrated in the drawings, the inlet side connecting tube 16a and the outlet side connecting tube 16b do not have to be strictly orthogonal or parallel to these directions, that is, the respective axes, but may be inclined to some degree, or may be oblique greatly with respect to the respective axes. Further, the outlet side connecting tube 16b can be provided in a region R illustrated in Figure 5, but in this case, the inlet and the outlet are close to each other, so that the refrigerant is unlikely to flow uniformly in all the flat tubes 14, and therefore, in the case of the condenser 12A, it is desirable to provide the inlet side connecting tube 16a and the outlet side connecting tube 16b diagonally as much as possible.

[0030] However, the piping 17 that is connected to each of the connecting tubes 16 corresponds to the orientation of the connecting tube 16 near the condenser 12. Consequently, when the inlet side connecting tube 16a is provided to extend in the X- direction, and the outlet side connecting tube 16b is provided to extend in the X+ direction as in Figure 5, for example, the piping 17 is connected from the X-direction, so that when the size including the piping 17 is considered, an actual installation space required at the time of installing the condenser 12A is required to some extent in the X-direction, that is, in the width direction of the main body portion 12a.

[0031] Likewise, when the inlet side connecting tube 16a is provided to extend in the Z+ direction, for example, the installation space is required to some extent in the Z-direction, that is, a thickness direction of the main body portion 12a. That is, the installation space is restricted by the orientations of the respective connecting tubes 16.

<Structure example B: parallel type structure in which flow of refrigerant is in two directions>

[0032] Parallel type structure example B in which the flow of the refrigerant is in two directions will be described with reference to Figure 6 to Figure 8.

[0033] As illustrated in Figure 6, the condenser 12B is in common to the condenser 12A in basic structure, and a plurality of flat tubes 14 are provided between the two cylindrical headers 13. In each of the flat tubes 14, a plurality of flow paths are formed inside thereof, and the respective flow paths communicate with the respective headers 13. Consequently, in the flat tube 14, the refrigerant flows in parallel. Further, among the respective flat tubes 14, the heat radiation fins 15 are provided.

[0034] However, in the case of the condenser 12B, one of the headers 13 is provided with both the inlet side connecting tube 16a and the outlet side connecting tube 16b, and a sealing portion 13a is provided between the inlet side connecting tube 16a and the outlet side connecting tube 16b. The sealing portion 13a seals an inside of the cylindrical header 13. That is, the sealing portion 13a divides the inside of the single cylindrical header 13 into two ranges. Further, the sealing portion 13a makes the number of flat tubes 14 at the inlet side relatively large, and makes the number of flat tubes 14 at the outlet side relatively small. This is because the refrigerant is in a gaseous state and has a large volume at the inlet side, whereas at the outlet side, the refrigerant is condensed to be in a liquid state and has a small volume. Thereby, efficiency can be enhanced.

[0035] In the case of the condenser 12B like this, as illustrated in Figure 7 by being simplified, a gaseous refrigerant flowing in from the inlet side connecting tube

16a flows in the respective flat tubes 14 which are located at the inlet side connecting tube 16a side from the sealing portion 13a toward the other header 13, thereafter passes inside the other header 13, flows in an opposite direction in the respective flat tubes 14 located at the outlet side connecting tube 16b side from the sealing portion 13a, and thereafter flows out from the outlet side connecting tube 16b, as shown by the arrows F. That is, in the case of the condenser 12B, the flow of the refrigerant is in the two directions. Hereinafter, the condenser 12 of the structure like this will be referred to as a turning-back type for convenience.

[0036] In the case of the condenser 12B, if the restrictions due to the installation place and the orientation for installation are not taken into consideration, the degree of freedom of the orientations of the inlet side connecting tube 16a and the outlet side connecting tube 16b is relatively high. More specifically, as shown by the solid lines and the broken lines in Figure 8, the inlet side connecting tube 16a can be provided in various orientations such as the X- direction, Y+ direction, Z+ direction, and Z-direction with respect to the main body portion 12a. Likewise, the outlet side connecting tube 16b can be provided in various orientations such as the X- direction, Y+ direction, Z+ direction, and Z- direction with respect to the main body portion 12a.

[0037] In the case of the condenser 12B, the piping 17 which is connected to each of the connecting tubes 16 corresponds to the orientation of the connecting tube 16 near the condenser 12, so that the installation space is restricted by the orientations of the respective connecting tubes 16. Note that though not illustrated, the inlet side connecting tube 16a and the outlet side connecting tube 16b may be inclined to some degree, or may be oblique greatly with respect to the respective axes.

<Structure example C: meandering type structure in which headers are provided at same side>

[0038] A meandering type structure in which the headers 13 are provided at the same side, that is, structure example C in which the inlet and the outlet for the refrigerant are disposed at the same side with respect to the main body portion 12a will be described with reference to Figure 9 to Figure 11.

[0039] As illustrated in Figure 9, in a condenser 12C, the single flat tube 114 is provided to meander between the two relatively compact cylindrical headers 13. In the flat tube 14, a plurality of flow paths are formed inside thereof, and the respective flow paths communicate with the respective headers 13. That is, in the meandering type condenser 12C, the single flat tube 14 is folded in the thickness direction and connects the inlet and the outlet. In this case, in the flat tube 14, the refrigerant flows in parallel. Further, in spaces of the folded flat tube 14, the heat radiation fins 15 are provided. Further, in the case of the condenser 12C, the header 13 at the inlet side and the header 13 at the outlet side are provided by being located at a same side with respect to the main body portion 12a.

[0040] In the case of the condenser 12C like this, as illustrated in Figure 10 by being simplified, the gaseous refrigerant flowing in from the inlet side connecting tube 16a flows in the flat tube 14 toward the other header 13, and flows out from the outlet side connecting tube 16b, as shown by the arrows F. Note that as the orientation of the header 13, an orientation horizontal to the flat tube 14, an orientation coaxial with the flat tube 14 and the like are conceivable other than the orientation perpendicular to the flat tube 14 as in Figure 9, but the header 13 itself is relatively small in the case of the condenser 12C, so that the orientations of the connecting tubes 16 are considered to be the main cause of the problem of the space.

[0041] In the case of the condenser 12C, if the restrictions due to the installation place and the orientation for installation are not taken into consideration, the degree of freedom of the orientations of the inlet side connecting tube 16a and the outlet side connecting tube 16b are relatively high. More specifically, as shown by the solid lines and the broken lines in Figure 11, the inlet side connecting tube 16a can be provided in various orientations such as the Z+ direction, the X- direction, the Y+ direction, the Y- direction, and the Z- direction, with respect to the main body portion 12a. Likewise, the outlet side connecting tube 16b can be provided in various orientations such as the Z+ direction, the X- direction, the Y+ direction, the Y-direction and Z- direction, with respect to the main body portion 12a.

[0042] In the case of the condenser 12C, the piping 17 which is connected to each of the connecting tubes 16 corresponds to the orientation of the connecting tube 16 near the condenser 12, so that the installation space is restricted by the orientations of the respective connecting tubes 16. Note that though not illustrated, the inlet side connecting tube 16a and the outlet side connecting tube 16b may be inclined to some degree, or may be oblique greatly with respect to the respective axes.

<Structure example C: meandering type structure in which headers are provided at diagonal sides>

[0043] A meandering type structure in which the headers 13 are provided at diagonal sizes, that is, structure example D in which the inlet and the outlet for the refrigerant are disposed on a diagonal line with respect to the main body portion 12a will be described with reference to Figure 12.

[0044] As illustrated in Figure 12, a condenser 12D is substantially common to the condenser 12C, but the two cylindrical headers 13 are provided in positions diagonal to the main body portion 12a.

[0045] In the case of the condenser 12D, if the restrictions due to the installation place and the orientation for installation are not taken into consideration, the degree of freedom of the orientations of the inlet side connecting

tube 16a and the outlet side connecting tube 16b are relatively high. More specifically, the inlet side connecting tube 16a can be provided in various orientations such as the Z+ direction, the X- direction, the Y+ direction, the Y- direction, and the Z- direction, with respect to the main body portion 12a. Likewise, the outlet side connecting tube 16b can be provided in various orientations such as the Z+ direction, the X+ direction, the Y+ direction, and Z-direction, with respect to the main body portion 12a.

[0046] In the case of the condenser 12D, the piping 17 which is connected to each of the connecting tubes 16 corresponds to the orientation of the connecting tube 16 near the condenser 12, so that the installation space is restricted by the orientations of the respective connecting tubes 16. Note that though not illustrated, the inlet side connecting tube 16a and the outlet side connecting tube 16b may be inclined to some degree, or may be oblique greatly to the respective axes.

[0047] The condensers 12 shown in the above described structure examples A to D have various orientations to install. For example, in the case of the condenser 12A, a state in which the condenser 12A is installed with a height direction of the main body portion 12a along the gravity direction, that is, a state in which the headers 13 are along the gravity direction, and the flat tubes 14 are horizontal to an installation surface is conceivable as illustrated in Figure 13(a). Note that in Figure 13, illustration of the connecting tube 16 is omitted.

[0048] Further, as illustrated in Figure 13(b), a state in which the condenser 12A is installed with a width direction of the main body portion 12a along the gravity direction, that is, a state in which the headers 13 are horizontal to the installation surface, and the flat tubes 14 are along the gravity direction is conceivable. Further, as illustrated in Figure 13(c), a state in which the condenser 12A is installed with the thickness direction of the main body portion 12a along the gravity direction, a state in which the condenser 12A is installed with the thickness direction of the main body portion 12a oblique to the gravity direction as illustrated in Figure 13(d) and the like are conceivable. Note that though not illustrated, a state (refer to Figure 20) in which the condenser 112A is installed with the headers 13 oblique to the gravity direction is also conceivable.

<Installation example A>

[0049] Hereinafter, an installation example A will be described with reference to Figure 14 and Figure 15.

[0050] Figure 14 illustrates the installation example A, and schematically illustrates a state of the machine room 8 seen from above. In the installation example A, the condenser 12 is installed so that the main body portion 12a is substantially parallel to the storage room 10 in front of the machine room 8. In this case, outside air is sucked from the opening portion 9 provided in the bottom plate 7 and cools the condenser 12, and thereafter, the air is discharged from the opening portion 9 provided in the left side plate 4 while cooling the compressor 11.

[0051] First, as described above, the storage rooms 10 are provided in front of and above the machine room 8, so that an influence of the radiated heat from the condenser 12 on the storage rooms 10 is desirably small. In this case, a distance to the storage room 10 at a front side of the machine room 8 is the same, so that it is conceivable to consider the influence on the storage room 10 (refer to Figure 2) at an upper side of the machine room 8.

[0052] Further, since the condenser 12 condenses the gaseous refrigerant into a liquid state as described above, the outlet side connecting tube 16b is desirably located at a lower part. Further, the right side plate 5 exists at a right side in the drawing of the condenser 12, so that it is difficult to ensure a space at the right side of the condenser 12. Further, in order to reduce the size of the machine room 8, it is not preferable that the space upward of the condenser 12 increases.

[0053] In view of these matters for consideration, as illustrated in Figure 15(a) it is preferable to install the condenser 12A, for example, so that the headers 13 are along the gravity direction, provide the inlet side connecting tube 16a at the header 13 at the right side in the drawing of the main body portion 12a to extend in the Z+ direction (at a front side vertical to the sheet surface), and provide the outlet side connecting tube 16b at the header 13 at the left side in the drawing to extend in the Z+ direction shown by the solid line or the X- direction (left side in the drawing) shown by the broken line. Note that Figure 15 schematically illustrates a state seen from arrow XV in Figure 14.

[0054] By installing the condenser 12A in the state like this, the influence of generated heat on the storage room 10 at the upper side of the machine room 8 can be restrained, as compared with the case where the headers 13 are disposed up and down (refer to Figure 13(b)). Further, since the inlet side where the temperature becomes relatively high is disposed at the outer side, influence of generated heat on not only the storage room 10 but also the other components in the machine room 8 can be restrained more.

[0055] Further, since the inlet side connecting tube 16a is disposed at the upper side, and the outlet side connecting tube 16b is disposed at the lower side, the flow of the refrigerant which transitions from the gaseous state to the liquid state is not hindered by the gravity. Further, since a space relatively exists at the lower side in the drawing of the condenser 12 in Figure 14, so that the installation space is easily ensured, and it becomes easy to connect the piping 17. That is, in the case of the condenser 12A, disposition as illustrated in Figure 15(a) is considered to be preferable.

[0056] Further, in the case of the condenser 12B, for example, as illustrated in Figure 15(b), it is desirable to install the condenser 12B, so that the headers 13 are along the gravity direction, provide the inlet side connecting tube 16a at the header 13 at the right side in the

drawing so that the inlet side connecting tube 16a extends in the Z+ direction, and provide the outlet side connecting tube 16b at a lower side with the sealing portion 13a therebetween so that the outlet side connecting tube 16b extends in the Z+ direction.

[0057] By installing the condenser 12B in the state like this, the installation space is ensured without hindering the flow of the refrigerant while the influence on the storage room 10 by the generated heat from the condenser 12 is restrained, so that similar effects to the above described condenser 12A can be obtained such as being able to easily connect the piping 17. That is, in the case of the condenser 12B, installation orientation and the structure as illustrated in Figure 15(b) is considered to be preferable.

[0058] Further, in the case of the condenser 12C, for example, as illustrated in Figure 15(c), the condenser 12C can be installed so that the respective headers 13 are located at the right side plate 5 side, the inlet side connecting tube 16a can be provided at the header 13 at an upper portion at the right side in the drawing of the main body portion 12a so as to extend in the Z+ direction, and the outlet side connecting tube 16b can be provided at the header 13 at a lower portion at the right side in the drawing of the main body portion 12a to extend in the Z+ direction.

[0059] By installing the condenser 12 in the state like this, the installation space is ensured without hindering the flow of the refrigerant while the influence on the storage room 10 by the heat generated from the condenser 12 is restrained, so that similar effects to the above described condenser 12A can be obtained, such as being able to easily connect the piping 17. That is, in the case of the condenser 12C, the installation orientation and the structure as illustrated in Figure 15(c) are considered to be preferable.

[0060] Further, in the case of the condenser 12D, for example, as illustrated in Figure 15(d), the condenser 12D can be installed so that the headers 13 are located at the right side plate 5 side and a side diagonal to the right side plate 5 side, the inlet side connecting tube 16a can be provided at the header 13 at the upper portion at the right side in the drawing of the main body portion 12a so as to extend in the Z+ direction, and the outlet side connecting tube 16b can be provided at the header 13 at a lower portion at the left side in the drawing of the main body portion 12a to extend in the Z+ direction.

[0061] By installing the condenser 12D in the state like this, the installation space is ensured without hindering the flow of the refrigerant while the influence on the storage room 10 by the generated heat from the condenser 12 is restrained, so that similar effects to the above described condenser 12A can be obtained, such as being able to easily connect the piping 17. That is, in the case of the condenser 12D, the installation orientation and the structure as illustrated in Figure 15(d) are considered to be preferable.

<Installation example B>

[0062] Hereinafter, an installation example B will be described with reference to Figure 16, Figure 17 and Figure 26.

[0063] Figure 16 illustrates the installation example B, and schematically illustrates a state of the machine room 8 seen from above. In the installation example B, the condenser 12 is installed so that the main body portion 12a is substantially perpendicular to the storage room 10 in front of the machine room 8. In this case, outside air is sucked from the opening portions 9 which are provided in the bottom plate 7 and the right side plate 5 and cools the condenser 12, and thereafter the air is discharged from the opening portion 9 provided in the left side plate 4 while cooling the compressor 11. In other words, this is a state in which the cooling fan 20 is disposed at a most upstream side in the flow of the air, the condenser 12 is disposed at a downstream side of the cooling fan 20, and the compressor 11 is disposed at a further downstream side of the condenser 12.

[0064] In this case, it is conceivable that the influence by the generated heat becomes smaller when the inlet side of the condenser 12 is separated from the storage room 10 at the front side of the machine room 8. Further, the back plate 3 exists at a lower side in the drawing of the condenser 12, so that it is considered to be difficult to ensure the installation space at the lower side in the drawing of the condenser 12.

[0065] In view of these matters for consideration, for example, in the case of the condenser 12A, it is preferable to install the condenser 12A so that the headers 13 are along the gravity direction and the header 13 at the inlet side is at the front side in the drawing (at the lower side illustrated in Figure 16), and provide the inlet side connecting tube 16a and the outlet side connecting tube 16b to extend in the Z+ direction (right side in the drawing) as shown by the solid line or the Z- direction (left side in the drawing) shown by the broken line, as illustrated in Figure 17(a). That is, it is preferable to provide the connecting tubes (the inlet side connecting tube 16a and the outlet side connecting tube 16b) in such a manner that the connecting tubes extend parallel to the air blowing direction of the cooling fan 20. Note that Figure 17 schematically illustrates a state seen from arrow XVII in Figure 16, and in Figure 17(a), the orientation of the header 13 is schematically illustrated by the broken line. Further, in order to show whether the header 13 is at the front side or a back side in the drawing, whether the header 13 is at the front side or the back side is schematically shown in a mode in which the connecting tube 16 is connected to the header 113 shown by the broken line.

[0066] By installing the condenser 12A in the state like this, the inlet side where the temperature becomes relatively high is disposed at the back plate 3 side while the influence of the generated heat on the respective storage rooms 10 at the front side and the upper side of the machine room 8 is restrained, so that the influence of the

generated heat on not only the storage rooms 10 but also the other components in the machine room 8 can be further restrained. Further, the inlet side connecting tube 16a is disposed at the upper side, and the outlet side connecting tube 16b is disposed at the lower side, so that the flow of the refrigerant that transitions to a liquid state from the gaseous state is not hindered by the gravity.

[0067] In this case, the cooling fan 20 is provided in a space (S) formed by the inlet side connecting tube 16a and the outlet side connecting tube 16b, that is, in a range less than a length of each of the inlet side connecting tube 16a and the outlet side connecting tube 16b that protrude from the main body portion 12a. Note that it is needless to say that the cooling fan 20 has such a size as to be housed in the space (S).

[0068] Thereby, space saving can be achieved. Further, a space relatively exists at the right side in the drawing of the condenser 12 in Figure 16, so that the installation space is easily ensured, and it becomes easy to connect the piping 17. Further, when the inlet side connecting tube 16a and the outlet side connecting tube 16b are provided to extend in the Z- direction (left side of the drawing), the cooling fan 20 can be provided at that side, that is, at the left side in the drawing of the main body portion 12a. That is, in the case of the condenser 12A, disposition as illustrated in Figure 17(a) is considered to be preferable.

[0069] Further, for example, in the case of the condenser 12B, it is preferable to install the condenser 12B so that the headers 13 are along the gravity direction, and provide the inlet side connecting tube 16a and the outlet side connecting tube 16b at the header 13 which is on the front side of the drawing so that the inlet side connecting tube 16a and the outlet side connecting tube 16b extend in the Z+ direction (right side in the drawing) as illustrated by the solid line or in the Z- direction (left side in the drawing) as illustrated by the broken line, as illustrated in Figure 17 (b) .

[0070] By installing the condenser 12 in the state like this, the installation space is ensured without hindering the flow of the refrigerant while the influence on the storage rooms 10 by the generated heat from the condenser 12 is restrained, so that similar effects to the above described condenser 12A can be obtained, such as being able to easily connect the piping 17 and being able to achieve space saving. That is, in the case of the condenser 12B, the installation orientation and the structure as illustrated in Figure 17(b) are considered to be preferable.

[0071] Further, in the case of the condenser 12C, for example, as illustrated in Figure 17(c), it is preferable to install the condenser 12C so that the respective headers 13 are located at the back plate 3 side, provide the inlet side connecting tube 16a at the header 13 at the upper portion in the drawing of the main body portion 12a, and provide the outlet side connecting tube 16b at the header 13 at the lower side in the drawing of the main body portion 12a so that the inlet side connecting tube 16a and the outlet side connecting tube 16b extend in the Z+ direction shown by the solid line or in the Z- direction (left side in the drawing) shown by the broken line.

[0072] By installing the condenser 12 in the state like this, the installation space is ensured without hindering the flow of the refrigerant while the influence on the storage room 10 by the generated heat from the condenser 12 is restrained, so that similar effects to the above described condenser 12A can be obtained, such as being able to easily connect the piping 17 and being able to save space. That is, in the case of the condenser 12C, the installation orientation and the structure as illustrated in Figure 17(c) are considered to be preferable.

[0073] Further, in the case of the condenser 12D, for example, as illustrated in Figure 17(d), it is preferable to install the condenser 12D so that the header 13 at the inlet side is located at the back plate 3 side and the header 13 at the outlet side is located at a diagonal side thereof, provide the inlet side connecting tube 16a at the header 13 at the upper portion in the drawing of the main body portion 12a and provide the outlet side connecting tube 16b at the header 13 at the lower part in the drawing of the main body portion 12a so that the inlet side connecting tube 16a and the outlet side connecting tube 16b extend in the Z+ direction shown by the solid line, or the Z- direction (left side in the drawing) shown by the broken line.

[0074] By installing the condenser 12 in the state like this, the installation space is ensured without hindering the flow of the refrigerant while the influence on the storage rooms 10 by the generated heat from the condenser 12 is restrained, so that similar effects to the above described condenser 12A can be obtained, such as being able to easily connect the piping 17 and being able to save space. That is, in the case of the condenser 12D, the installation orientation and the structure as illustrated in Figure 17(d) are considered to be preferable.

[0075] Note that the installation example B also applies to a state in which the compressor 11, the cooling fan 20 and the condenser 12 are disposed from the left side in the drawing as illustrated in Figure 26, in other words, in a state in which the condenser 12 is disposed at a most upstream side in the flow of air, the cooling fan 20 is disposed at a downstream side of the condenser 12, and the compressor 11 is disposed at a further downstream side of the cooling fan 20.

<Installation example C>

[0076] Hereinafter, an installation example C will be described with reference to Figure 18 and Figure 19.

[0077] Figure 18 illustrates the installation example C and schematically illustrates a state of the machine room 8 seen from above. In the installation example C, the condenser 12 is installed so that the main body portion 12a is parallel to the bottom plate 7. In this case, outside air is sucked from the opening portion 9 provided in the bottom plate 7 and cools the condenser 12, and thereafter

the air is discharged from the opening portions 9 provided in the left side plate 4 and the back plate 3 while cooling the compressor 11.

[0078] In this case, the condenser 12 is relatively close to the storage room 10 at the front side of the machine room 8, so that it is conceivable that the influence by the generated heat is smaller when the inlet side of the condenser 12 is separated as much as possible. Further, the heat insulating partition wall 10b exists at an upper side in the drawing of the condenser 12, so that it is considered to be difficult to ensure the installation space at the upper side in the drawing of the condenser 12.

[0079] In view of these matters for consideration, for example, in the case of the condenser 12A, it is preferable to install the condenser 12A so that the headers 13 are substantially perpendicular to the gravity direction, and the header 13 at the inlet side is at the front side in the drawing (at the lower side in the drawing in Figure 18), and provide the inlet side connecting tube 16a and the outlet side connecting tube 16b so that the inlet side connecting tube 16a and the outlet side connecting tube 16b extend in the Z+ direction (upper side in the drawing) as shown by the solid lines, as illustrated in Figure 19(a). Note that Figure 19 schematically illustrates a state seen from the arrow XIX in Figure 18, and Figure 19(a) schematically illustrates the orientation of the header 13 by the broken line. Further, in order to show whether the header 13 is at the front side or a back side in the drawing, whether the header 13 is at the front side or the back side in the drawing is schematically shown by a mode in which the connecting tube 116 is connected to the header 13 shown by the broken line.

[0080] By installing the condenser 12A in the state like this, an influence of the generated heat on the storage room 10 at the front side of the machine room 8 can be restrained. Further, air that cools the header 13 at the inlet side where the temperature becomes relatively high is discharged to outside, so that the influence of the generated heat on the other components in the machine room 8 can be further restrained. In this case, in order to promote the flow of the refrigerant, the header 13 at which the inlet side connecting tube 16a is provided may be inclined more upward slightly than the header 13 at which the outlet side connecting tube 16b is provided (refer to Figure 13(d)).

[0081] Further, the cooling fan 20 is provided in the space (S) formed by the inlet side connecting tube 16a and the outlet side connecting tube 16b. Thereby, space saving can be achieved. Further, it is conceivable that connection of the piping 17 is facilitated from above the condenser 12. That is, in the case of the condenser 12A, disposition as illustrated in Figure 19(a) is considered to be preferable.

[0082] Further, for example, in the case of the condenser 12B, it is preferable to install the condenser 12B so that the headers 13 are substantially perpendicular to the gravity direction, and provide the inlet side connecting tube 16a and the outlet side connecting tube 16b at the header 13 which is on the front side in the drawing so that the inlet side connecting tube 16a and the outlet side connecting tube 16b extend in the Z+ direction, as illustrated in Figure 19(b). By installing the condenser 12B in the state like this, the installation space is ensured without hindering the flow of the refrigerant while the influence on the storage room 10 by the generated heat from the condenser 12 is restrained, so that similar effects to the above described condenser 12A can be obtained, such as being able to easily connect the piping 17 and being able to save space. That is, in the case of the condenser 12B, the installation orientation and the structure as illustrated in Figure 19(b) are considered to be preferable.

[0083] Further, in the case of the condenser 12C, for example, as illustrated in Figure 19(c), it is preferable to provide the inlet side connecting tube 16a at the header 13 at the right side in the drawing of the main body portion 12a, that is, the side separated from the storage room 10, and provide the outlet side connecting tube 16b at the header 13 at the left side in the drawing of the main body portion 12a, that is, the side close to the storage room 10, so that the inlet side connecting tube 16a and the outlet side connecting tube 16b extend in the Z+ direction. By installing the condenser 12 in the state like this, the installation space is ensured without hindering the flow of the refrigerant while the influence on the storage room 10 by the generated heat from the condenser 12 is restrained, so that similar effects to the above described condenser 12A can be obtained, such as being able to easily connect the piping 17 and being able to save space. That is, in the case of the condenser 12C, the installation orientation and the structure as illustrated in Figure 19(c) are considered to be preferable.

[0084] Further, in the case of the condenser 12D, for example, as illustrated in Figure 19(d), it is preferable to provide the inlet side connecting tube 16a and the outlet side connecting tube 16b at the header 13 at the front side in the drawing of the main body portion 12a, that is, the side separated from the storage room 10 so that the inlet side connecting tube 16a and the outlet side connecting tube 16b extend in the Z+ direction. By installing the condenser 12 in the state like this, the installation space is ensured without hindering the flow of the refrigerant while the influence on the storage room 10 by the generated heat from the condenser 12 is restrained, so that similar effects to the above described condenser 12A can be obtained, such as being able to easily connect the piping 17 and being able to save space. That is, in the case of the condenser 12D, the installation orientation and the structure as illustrated in Figure 19(d) are considered to be preferable.

<Installation example D>

[0085] Hereinafter, installation example D will be described with reference to Figure 20 and Figure 21.

[0086] Figure 20 illustrates an installation example D and schematically illustrates a state of the machine room

8 seen from a side. In the installation example D, the condenser 12 is installed substantially at a side close to an upper end of the heat insulating partition wall 10b so that the main body portion 12a is along an inclined portion of the heat insulating partition wall 10b. Further, the condenser 12 is installed at a side close to the right side plate 5, though not illustrated. In this case, outside air is sucked from the opening portion 9 provided in the bottom plate 7 and cools the condenser 12.

[0087] In this case, in the condenser 12, distances between the headers 13 and the storage room 10 in front of the machine room 8 are constant, whereas distances between the headers 13 and the storage room 10 at an upper portion of the machine room 8 differ depending on the positions of the headers 13. Consequently, in the case of the installation like this, it is conceivable that the influence by the generated heat on the storage rooms 10 can be restrained by providing the headers 13 at a lower side. On the other hand, if the header 13 at the inlet side is disposed at the lower side in the drawing, that is, the lower side in the gravity direction, there arises the fear of inhibiting the flow of the refrigerant.

[0088] In view of these matters for consideration, for example, in the case of the condenser 12A, it is preferable to dispose the condenser 12A so that the headers 13 are along the heat insulating partition wall 10b, provide the inlet side connecting tube 16a at the header 13 which is at the right side in the drawing of the main body portion 12a and at the side close to the side plate so that the inlet side connecting tube 16a extends in the Z+ direction (substantially the front side in the drawing), and provide the outlet side connecting tube 16b at the header 13 at the left side in the drawing of the main body portion 12a so that the outlet side connecting tube 16b extends in the Z+ direction (substantially the front side in the drawing) shown by the solid line, or in the X- direction (left side in the drawing) shown by the broken line, as illustrated in Figure 21(a). Note that Figure 21 schematically illustrates a state seen from the back side of the refrigerator 1.

[0089] By installing the condenser 12A in the state like this, the influence of the generated heat on the storage room 10 at the upper side of the machine room 08 can be restrained. At this time, when the condenser 12A is assumed to be seen from the side, the state is substantially as in Figure 19(a), and the cooling fan 20 is disposed in the space (S) formed by the inlet side connecting tube 16a and the outlet side connecting tube 16b. Thereby, space saving can be achieved. That is, in the case of the condenser 12A, disposition as illustrated in Figure 21(a) is considered to be preferable.

[0090] Further, for example, in the case of the condenser 12B, it is preferable to install the condenser 12B so that the headers 13 are along the heat insulating partition wall 10b, and provide the inlet side connecting tube 16a and the outlet side connecting tube 16b at the header 13 which is on the right side of the drawing so that the inlet side connecting tube 16a and the outlet side connecting tube 16b extend in the Z+ direction, as illustrated in Figure 21(b). Further, in this case, it is also preferable to dispose the cooling fan 20 in the space (S) formed by the inlet side connecting tube 16a and the outlet side connecting tube 16b.

[0091] By installing the condenser 12 in the state like this, the installation space is ensured without hindering the flow of the refrigerant while the influence on the storage room 10 by the generated heat from the condenser 12 is restrained, so that similar effects to the above described condenser 12A can be obtained, such as being able to easily connect the piping 17 and being able to save space. That is, in the case of the condenser 12B, the installation orientation and the structure as illustrated in Figure 21(b) are considered to be preferable.

[0092] Further, in the case of the condenser 12C, for example, as illustrated in Figure 21(c), it is preferable to provide the inlet side connecting tube 16a at the header 13 at the right side in the drawing of the main body portion 12a, and provide the outlet side connecting tube 16b at the header 13 at the left side in the drawing of the main body portion 12a so that the inlet side connecting tube 16a and the outlet side connecting tube 16b extend in the Z+ direction. By installing the condenser 12 in the state like this, similar effects to the above described condenser 12A can be obtained, such as being able to save space, without hindering the flow of the refrigerant while the influence on the storage room 10 by the generated heat from the condenser 12 is restrained. That is, in the case of the condenser 12C, the installation orientation and the structure as illustrated in Figure 21(c) are considered to be preferable.

[0093] Further, in the case of the condenser 12D, for example, as illustrated in Figure 21(d), it is preferable to provide the inlet side connecting tube 16a at the header 13 at the right side in the drawing of the main body portion 12a so that the inlet side connecting tube 16a extends in the Z+ direction, and provide the outlet side connecting tube 16b at the header 13 at the right side in the drawing of the main body portion 12a so that the outlet side connecting tube 16b extends in the Z+ direction shown by the solid line or in the X- direction (left side in the drawing) shown by the broken line. By installing the condenser 12 in the state like this, similar effects to the above described condenser 12A can be obtained, such as being able to save space, without hindering the flow of the refrigerant while the influence on the storage room 10 by the generated heat from the condenser 12 is restrained. That is, in the case of the condenser 12D, the installation orientation and the structure as illustrated in Figure 21(d) are considered to be preferable.

[0094] Note that in the installation example D, the state in which the condenser 12 is close to the right side plate 5 is assumed, but in the case of a state in which the condenser 12 is close to the left side plate 4, the orientations of the inlet side connecting tube 16a and the outlet side connecting tube 16b can be set in the opposite way of thinking to the respective examples described above.

[0095] In this way, the refrigerator 1 of the present embodiment adopts the condensers 12 of different structures in accordance with the installation positions in the machine room 8.

[0096] According to the embodiments described above, effects as follows can be obtained.

[0097] The refrigerator 1 performs heat exchange of the refrigerating cycle 21 by using the multi-flow type condenser 12 having the flat tube 14 that is formed into a flat shape and has a plurality of flow paths in which a refrigerant flows formed inside thereof, and the headers 13 to be the inlet or the outlet for the refrigerant to the flat tube 14. Thereby, the multi-flow type condenser 12 is small in size with high performance, and therefore can be installed in the machine room 8 which is reduced in size. Accordingly, a necessary amount of radiated heat can be ensured by the condenser 12 installed in the machine room 108.

[0098] Further, the multi-flow type condenser 12 can expect a heat radiation effect by about twice to three times as compared with those of the same volume, so that a heat radiation pipe that is conventionally provided is unnecessary and the structure can be simplified, and manufacturing cost can be reduced. Further, heat leak to the storage rooms is reduced, and contribution can be made to energy saving.

[0099] The condenser 12 may be disposed so that the direction in which the flat tube 14 extends is horizontal to an installation surface of the refrigerator 1, may be disposed so that the direction in which the flat tube 14 extends is perpendicular to the installation surface, may be disposed so that the main body portion 12a is horizontal to the installation surface, or may be disposed so that the main body portion 12a inclines to the installation surface. That is, an installation orientation of the condenser 12 can be set in accordance with the shape of the machine room 8, and the balance with the other components in the machine room 8. Thereby, the degree of freedom of installation can be enhanced.

[0100] The refrigerant flows into the condenser 12 in the installed state, from the upper side. Thereby, the refrigerant which is condensed to be in a liquid state moves downward by the gravity, so that the refrigerant can be efficiently liquefied, that is, the performance of the refrigerating cycle 21 can be enhanced.

[0101] The condenser 12 is disposed in the orientation in which the inlet side for the refrigerator separates from the storage room 10. Thereby, the storage room 10 or the heat insulating partition wall 10b can be restrained from being warmed by the generated heat from the condenser 12, and heat leak can be reduced.

[0102] The condenser 12 is disposed in the machine room 8 provided in the main body 2 of the refrigerator 1. In the machine room 8, the opening portions 9 for cooling the compressor 11 are provided, and introduction and discharge of outside air are facilitated. Consequently, by providing the condenser 12 in the machine room 8, cooling of the condenser 12 and discharge of the air that is heated by cooling the condenser 12 can be performed efficiently.

[0103] The condenser 12 has the connecting tube 16 which is the inlet or the outlet for the refrigerant, and is formed to have such a length as to protrude from the main body portion 12a in which the flat tube 14 is disposed to the X direction, the Y direction or the Z direction. The cooling fan 20 which cools the condenser 12 is smaller than the outer shape of the main body portion 12a, is formed to be thinner than the protruded length of the connecting tube 16, and is disposed in the space (S. space) formed between the main body portion 12a and the tip ends of the connecting tubes 16.

[0104] Thereby, the cooling fan 20 can be installed in the space that is always necessary when the condenser 12 is installed, and space saving can be achieved.

[0105] Further, the multi-flow type condenser 12 is reduced in size and has high performance as described above, can effectively perform heat exchange with a relatively small amount of air, and therefore, can be sufficiently cooled by even the cooling fan 20 which is housed in the space (S) formed by the main body portion 12a and the connecting tubes 16.

(Other embodiments)

[0106] The present invention is not limited to what are illustrated in the above described embodiments, and can be arbitrarily modified or expanded as follows, for example, within the range without departing from the scope of the present invention.

[0107] In the above described embodiments, the example in which the one condenser 12 is cooled by the cooling fan 20 is shown, but a configuration in which two or more condensers 12 are cooled by the one cooling fan 20 may be adopted as illustrated in Figure 22, for example. In this case, as illustrated in Figure 22(a), for example, the condenser 12 may be disposed obliquely to the air blowing surface of the cooling fan 20 so that blown air from the cooling fan 20 may hit the respective condensers 12 as shown by arrows Y. Further, as illustrated in Figure 22(b), the condensers 12 may be disposed so as to overlap the air blowing surface so that the blown air from the cooling fan 20 may hit the respective condensers 12. Further, as illustrated in Figure 22(c), a plurality of condensers 12 may be disposed side by side at the air blowing surface.

[0108] By providing the plurality of condensers 12 in this way, the ability of the refrigerating cycle 21 can be enhanced, and space saving can be achieved by cooling the plurality of condensers 12 with the one cooling fan 20. In this case, condensers of a parallel type or condensers of a meandering type may be respectively provided, or condensers of a parallel type and condensers of a meandering type may be mixed together.

[0109] In the embodiments, the condenser 12 having the one main body portion 12a is illustrated, but as illustrated in Figure 23, for example, the condenser 12 having

a plurality of main body portions 12a may be used. Thereby, the ability of the refrigerating cycle 21 can be enhanced without causing excessive increase in size of the condenser 12. By them, the surface area of the condenser 12 can be earned, or the condenser 12 can be thinned, so that the space occupied by the condenser 12 can be decreased. Further, the heat radiation efficiency can be also enhanced.

[0110] Note that in Figure 23, the two main body portions 12a are shown, but three or more main body portions 12a may be included. Further, instead of piling the main body portions 12a over each other as in Figure 23, an angle may be provided between the main body portions 12a. Further, the plurality of main body portions 12a may be connected in series, or may be connected in parallel.

[0111] In the embodiments, the example in which the condenser 12 is cooled by the cooling fan 20 is shown, but as illustrated in Figure 24, a configuration in which defrosting water (W) is dropped from above the condenser 12 may be adopted. Note that the defrosting water is water that is generated when frost adhering to a cooler not illustrated is melted. Thereby, the condenser 12 can be efficiently cooled by the defrosting water.

[0112] At this time, if the orientation of the condenser 12 is set so that flat tube 14 is along the gravity direction, the defrosting water is urged to flow down along the flat tube 14 by the gravity and cooling water can efficiently cool the condenser without accumulating in the heat radiation fins 15.

[0113] In this case, a configuration may be adopted, in which the defrosting water is dropped to the main body portion 12a from a front, that is, from the direction of the Z-axis mentioned in the embodiments. Further, a configuration in which the defrosting water (W) is always dropped may be adopted, or a configuration in which the defrosting water (W) is regularly dropped may be adopted. Thereby, clogging of the heat radiation fins 15 due to dust or the like can be prevented.

[0114] The configuration of the refrigerator 1 illustrated in the embodiments is only an example, and the functions and dispositions may be different, such as the number of storage rooms 10 differing, and the freezer unit being provided at the lowermost part. Further, for example, Figure 2 and the like schematically illustrate the configurations and structures, and for example, the sizes, the installation places and the like of the compressor 11, the condenser 12, the cooling fan 20, the opening portions 9 and the like are not necessarily in the relations as illustrated in the drawings.

[0115] Further, as illustrated in Figure 25, the refrigerator 1 in which the machine room 8 is provided at an upper portion in the main body 2 may be adopted. That is, the shape and disposition in the main body 2, of the machine room 8 is not limited to what are illustrated in the embodiments. In the case of Figure 25, the condenser 12 is installed to be in the installation orientation substantially illustrated in Figure 17(a) when seen from the left side plate 4 side by facing the header 13 at the inlet side to the upper portion, and facing the header 13 at the outlet side to the lower portion, whereby the influence on the storage room 10 can be restrained, and space saving can be achieved.

[0116] Further, as illustrated in Figure 27, a heat insulating member 30 that closes a space between the condenser 12 and the heat insulating partition wall 10b or at least a part of the space, may be provided between the condenser 12 and a wall portion of an installation place where the condenser 12 is provided, for example, the heat insulating partition wall 10b of the machine room 8. Thereby, transmission of heat to the storage room 10 from the condenser 12 can be restrained in the case in which it is necessary to dispose the inlet side connecting tube 16a where the temperature is relatively high at the heat insulating partition wall 10b side for reasons of piping, for example. Note that the heat insulating member 30 may be provided in the space at an upper side of the condenser 12.

[0117] By providing the heat insulating member 30 in a mode of closing the space between the condenser 12 and the heat insulating partition wall 10b in this way, inflow of air to the space between the condenser 12 and the heat insulating partition wall 10b can be restrained. In other words, it becomes possible to effectively concentrate blown air from the cooling fan 20 onto the condenser 12. Thereby, the condenser 12 can be efficiently cooled.

[0118] Further, as illustrated in Figure 28, the condenser 12 may be disposed in a state in contact with the wall portion in the installation place where the condenser 12 is provided, for example, the heat insulating partition wall 10b in the machine room 8. In this case, it is desirable to dispose the outlet side connecting tube 16b where the temperature is relatively low at a heat insulating partition wall 10b side. Thereby, transmission of the heat to the storage room 10 from the condenser 12 can be restrained. Further, by disposing the condenser 12 in the state in contact with the heat insulating partition wall 10b, inflow of the air to the space between the condenser 12 and the heat insulating partition wall 10b can be restrained, and the blown air from the cooling fan 20 concentrates on the condenser 12 effectively, so that the condenser 12 can be efficiently cooled. In this case, the above described heat insulating member 30 may be provided in the space other than a contacting site.

[0119] Further, when the machine room 8 is provided in the upper part of the main body 2 as in Figure 25 described above, the condenser 12 may be disposed in a state in which a top and a bottom of the condenser 12 are in contact with a wall portion on a ceiling side and a wall portion on a refrigerator inside. In this case, transmission of heat to the storage room 10 can be restrained by disposing the outlet side connecting tube 16b where the temperature is relatively low at the refrigerator inside, and heat radiation from a front side can be also promoted by bringing the inlet side connecting tube 16a where the

temperature is relatively high into contact with the ceiling side.

[0120] In each of the embodiments, the condenser 12 in which the main body portion 12a is formed into a substantially thin rectangular parallelepiped is illustrated, but the main body portion 12a may be in another shape.

[0121] For example, as illustrated in Figure 30, in the parallel type condenser 12, the main body portion 12a may be formed into a shape in which a part of the main body portion 12a inclines by disposing the header 13 at the inlet side obliquely or the like by changing the lengths of the flat tubes 14. Alternatively, as illustrated in Figure 31, in the meandering type condenser 12, the main body portion 12a may be formed into a shape in which a part of the main body portion 12a inclines by changing the length at which the flat tube 14 is turned back, that is, a turn length.

[0122] In the case of the condenser 12 in which at least a part of the main body portion 12a like this inclines, the space in the machine room 8 can be effectively used by causing an inclined site to be along the wall portion of the machine room 8, as illustrated in Figure 32, for example. In other words, a dead space can be decreased, and it becomes possible to increase the storage room 10, for example.

[0123] Further, as illustrated in Figure 33, in the turning-back type condenser 12, the main body portion 12a may be formed into a stepped shape by making the header 13 at the upper portion of the left side in the drawing which is at the inlet side and the header 13 at the lower portion of the left side in the drawing which is at the outlet side separate bodies, and by changing the lengths of the flat tubes 14 between the header 13 at the inlet side and the header 13 at the outlet, and the header 13 at the right side in the drawing at the turning-back side. Alternatively, as illustrated in Figure 34, in the meandering type condenser 12, the main body portion 12a may be formed into a stepped shape by setting the turn length of the flat tube 14 at two stages, for example. Alternatively,

[0124] With the condenser 12 having a step in at least a part of the main body portion 12a as above, other machine components and piping components not illustrated can be avoided, for example, and the installation space can be effectively used. Further, the main body portion 12a may be in a shape having both an inclination and a step, or may be in an odd shape other than a rectangular parallelepiped, such as a shape that is a substantially U-shape or a C-shape that is partially recessed. In the case of the odd shape like this, the other machine components and piping components can be avoided, and the installation space can be effectively used.

[0125] In the embodiments, the example in which the axial flow fan is adopted as the cooling fan 20 is shown, but a centrifugal fan may be adopted as the cooling fan. In the case of the centrifugal fan, air flows outward in the radial direction from a center of the cooling fan 20. Thereby, as illustrated in Figure 35, for example, when a plurality of condensers 12 are provided, the condensers 12 are disposed side by side in a circumferential direction to face the cooling fan 20, and thereby the plurality of condensers 12 can be cooled with the one cooling fan 20.

[0126] In this case, as illustrated in Figure 36, the main body portion 12a of the condenser 12 may be formed into a curved surface shape along the outer shape of the cooling fan 20, in this case, in an arch shape. Thereby, by the flow of the air flowing outward in the radial direction from the center of the cooling fan 20, the condenser 12 can be efficiently cooled. Further, by elongating the main body portion 12a in the circumferential direction, a height dimension of the condenser 12 can be reduced, and space saving can be achieved.

[0127] The respective embodiments are presented as examples, and do not intend to restrict the scope of the invention. These novel embodiments can be carried out in various other modes, and various omissions, replacements and modifications can be made within the range without departing from the gist of the invention. The present embodiments and modifications of the embodiments are included in the scope and the gist of the invention, and are included in the invention described in the claims and the range equal to the invention.

Claims

1. A refrigerator configured to perform heat exchange of a refrigerating cycle by using a multi-flow type condenser having a flat tube that is formed into a flat shape, in which a plurality of flow paths in which a refrigerant flows are formed inside the flat tube, and a header that is an inlet or an outlet for the refrigerant to the flat tube.

2. The refrigerator according to claim 1, wherein the condenser is disposed so that a direction in which the flat tube extends is horizontal to an installation surface of the refrigerator.

3. The refrigerator according to claim 1, wherein the condenser is disposed so that a direction in which the flat tube extends is perpendicular to an installation surface of the refrigerator.

4. The refrigerator according to any one of claims 1 to 3, wherein the condenser is disposed to be horizontal to an installation surface of the refrigerator.

5. The refrigerator according to any one of claims 1 to 3, wherein the condenser is disposed to be inclined to an installation surface of the refrigerator.

6. The refrigerator according to any one of claims 1 to 5, wherein the condenser has a plurality of main body portions that are sites in each of which the flat tube is disposed.

7. The refrigerator according to claim 6, wherein the condenser has a plurality of the main body portions in parallel.

8. The refrigerator according to claim 6, wherein the condenser has a plurality of the main body portions in series.

9. The refrigerator according to any one of claims 6 to 8, wherein in the condenser, the main body portions overlap each other.

10. The refrigerator according to any one of claims 1 to 9, wherein in a state in which the condenser is installed, the refrigerant is caused to flow in from an upper side of the condenser.

11. The refrigerator according to any one of claims 1 to 10, wherein the condenser is disposed such that an inlet side for the refrigerant is disposed in an orientation in which the inlet side is separated from a storage room.

12. The refrigerator according to any one of claims 1 to 11, wherein the condenser is disposed in a machine room provided inside a main body of the refrigerator.

13. The refrigerator according to any one of claims 1 to 12, wherein the condenser is disposed at an upper side in a main body of the refrigerator.

14. The refrigerator according to any one of claims 1 to 13, further comprising:

a cooling fan that cools the condenser, wherein the condenser has a connecting tube that is formed to have such a length as to protrude from a main body portion in which the flat tube is disposed, and is connected to external piping, the cooling fan is formed to be smaller than an outer shape of the main body portion, and to be thinner than the protruded length of the connecting tube, and is disposed in a space formed between the main body portion and a tip end of the connecting tube.

15. The refrigerator according to any one of claims 1 to 14, wherein defrosting water is dropped from above the condenser.

16. The refrigerator according to claim 15, wherein the defrosting water is dropped regularly.

17. The refrigerator according to any one of claims 1 to 16, wherein the condenser has a connecting tube that is formed to have such a length that the connecting tube protrudes from a main body portion in which the flat tube is disposed and is connected to external piping, and the connecting tube extends parallel to the flat tube.

18. The refrigerator according to any one of claims 1 to 16, wherein the condenser has a connecting tube that is formed to have such a length that the connecting tube protrudes from a main body portion in which the flat tube is disposed and is connected to external piping, and the connecting tube extends perpendicularly to the flat tube.

19. The refrigerator according to any one of claims 1 to 16, wherein the condenser has connecting tubes that are formed to have such a length that the connecting tubes protrude from a main body portion in which the flat tube is disposed and are connected to external piping, at an inlet side and an outlet side for the refrigerant respectively, and the connecting tubes extend parallel or perpendicularly to the flat tube, and differ in orientation to the flat tube, at the inlet side and the outlet side.

20. The refrigerator according to any one of claims 1 to 19, wherein the condenser has connecting tubes that are formed to have such a length that the connecting tubes protrude from a main body portion that is a site in which the flat tube is disposed and are connected to external piping, at an inlet side and an outlet side for the refrigerant respectively, and the connecting tubes differ in direction to protrude from the main body portion, at the inlet side and the outlet side.

21. The refrigerator according to any one of claims 1 to 20, further comprising:

a cooling fan that cools the condenser, wherein the condenser has a connecting tube that is formed to have such a length that the connecting tube protrudes from the main body portion that is a site in which the flat tube is disposed and is connected to external piping, and the connecting tube extends parallel to an air blowing direction of the cooling fan.

22. The refrigerator according to any one of claims 1 to 21, further comprising:

a heat insulating member that is provided between the condenser and a wall portion in an installation place in which the condenser is provided, and closes at least a part of a space between the condenser and the wall portion.

23. The refrigerator according to any one of claims 1 to 22,
wherein the condenser is of a parallel type or a turning-back type in which a plurality of the flat tubes are disposed in parallel, and a main body portion that is a site in which the flat tubes are disposed is formed into a stepped shape, an inclined shape or a shape including both a step and an inclination, by changing lengths of the flat tubes.

24. The refrigerator according to any one of claims 1 to 22,
wherein the condenser is of a meandering type in which the one flat tube is folded in a thickness direction and connects the inlet and the outlet, and a main body portion that is a site in which the flat tube is disposed is formed into a stepped shape, an inclined shape or a shape including both a step and an inclination by changing turn lengths of the flat tube.

25. The refrigerator according to any one of claims 1 to 24, further comprising:

a cooling fan that cools the condenser,
wherein the fan is a centrifugal fan.

26. The refrigerator according to claim 25,
wherein the condenser is formed into a curved surface shape along an outer shape of the fan.

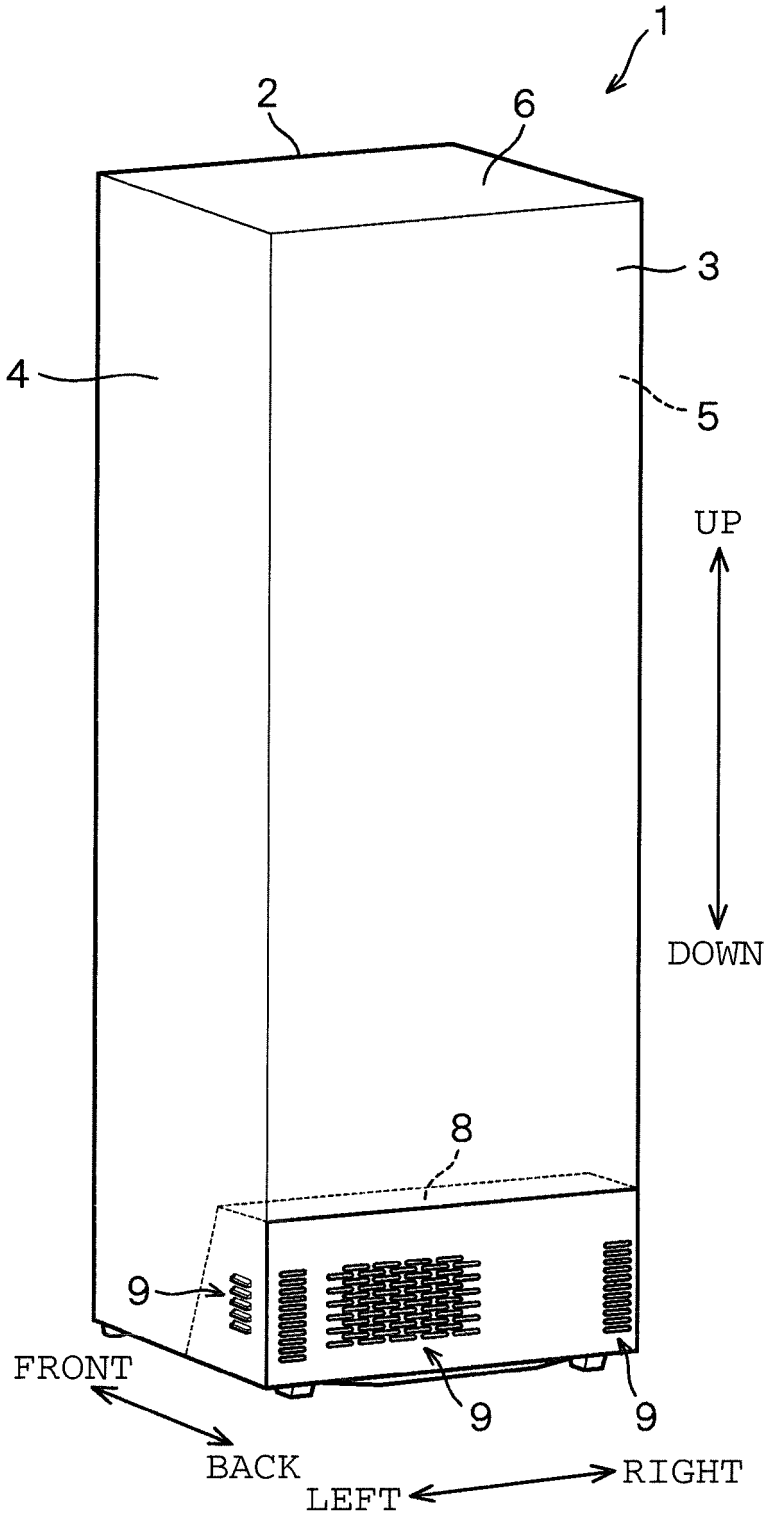


FIG.1

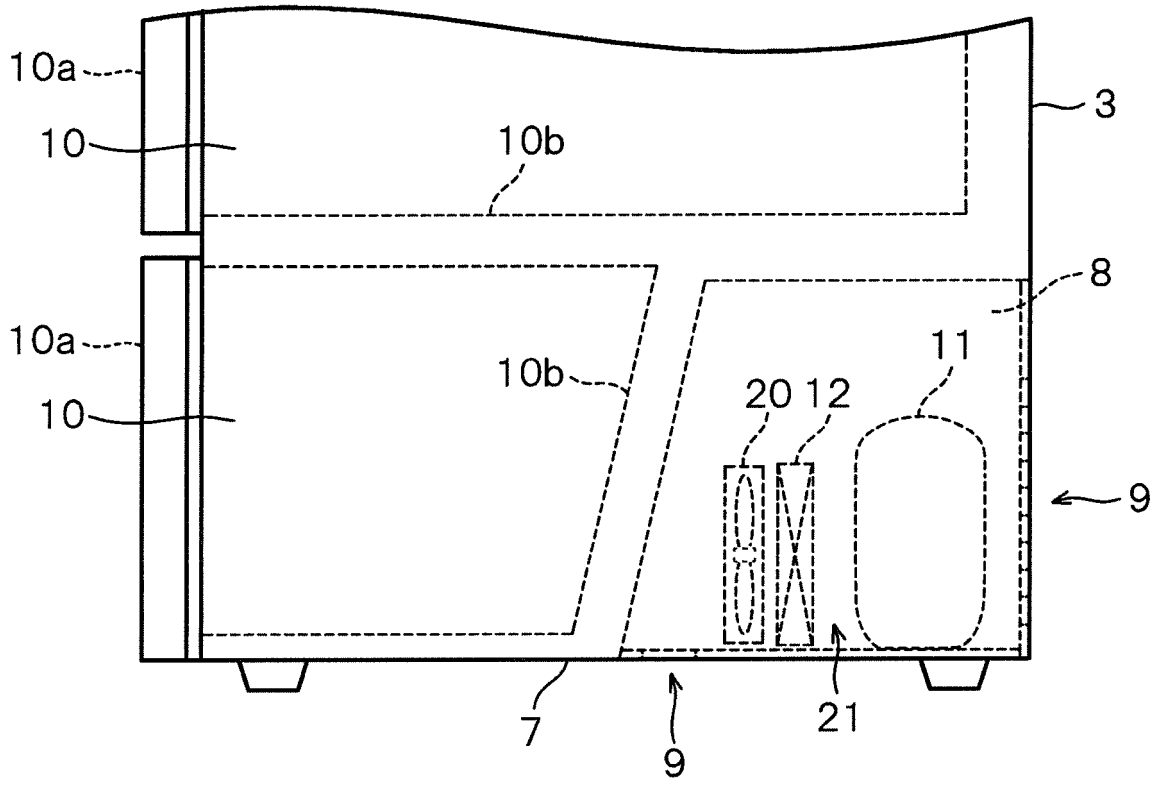


FIG. 2

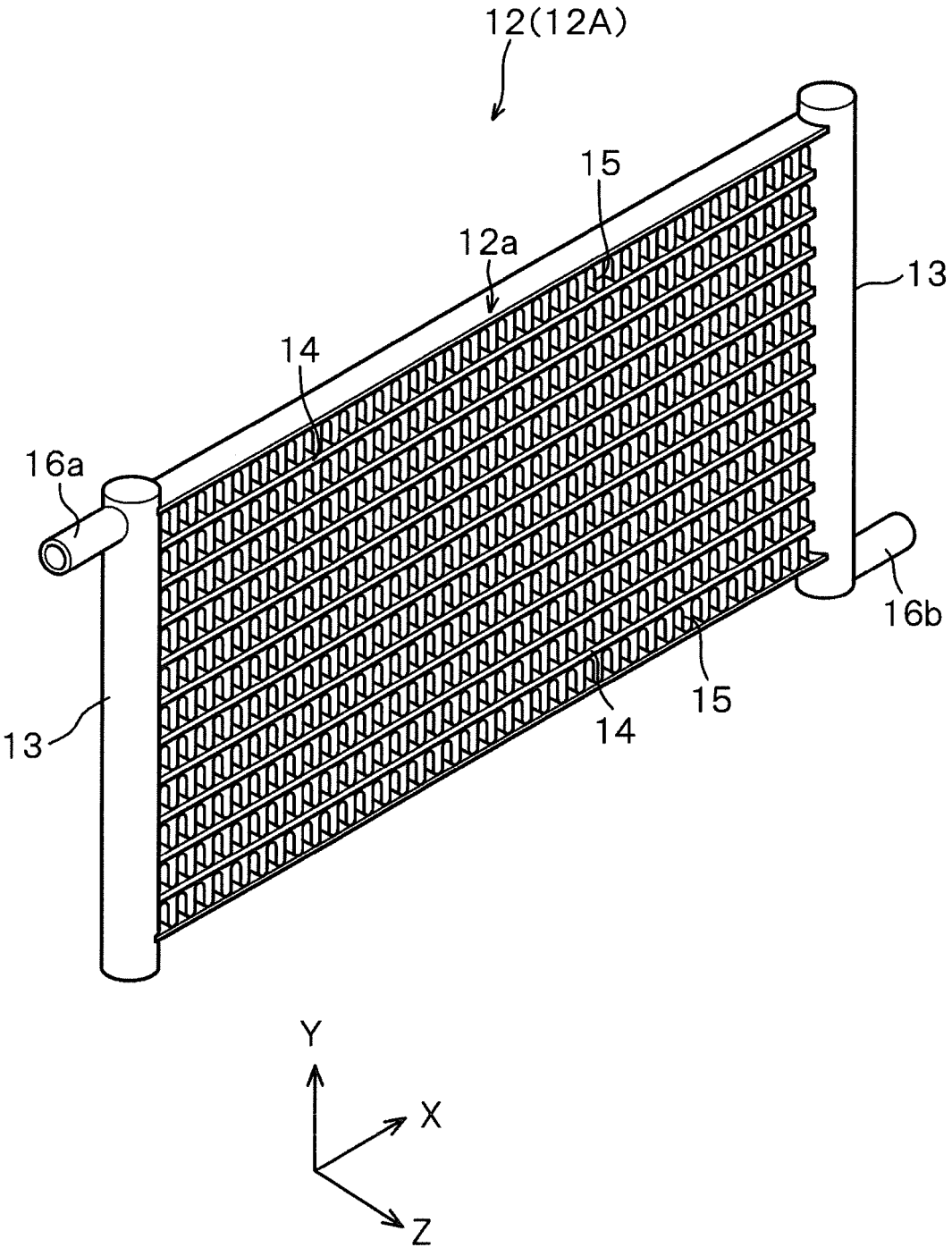


FIG.3

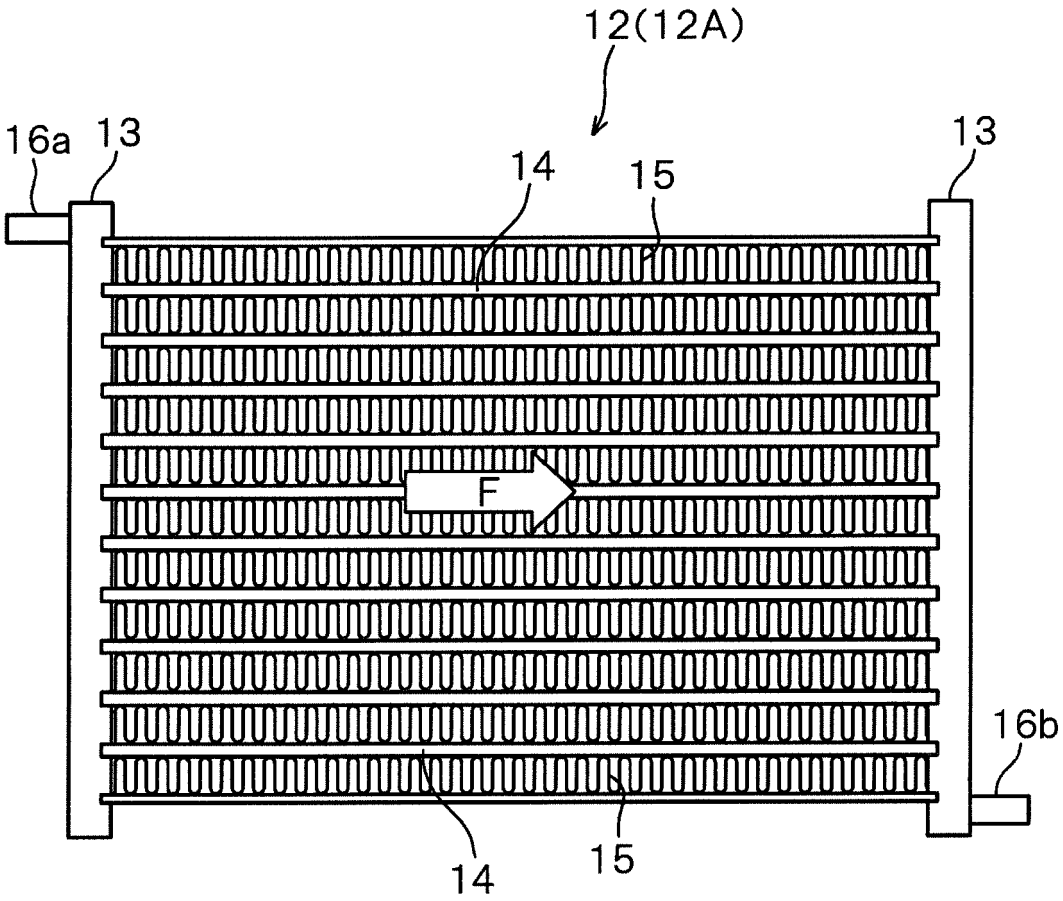


FIG. 4

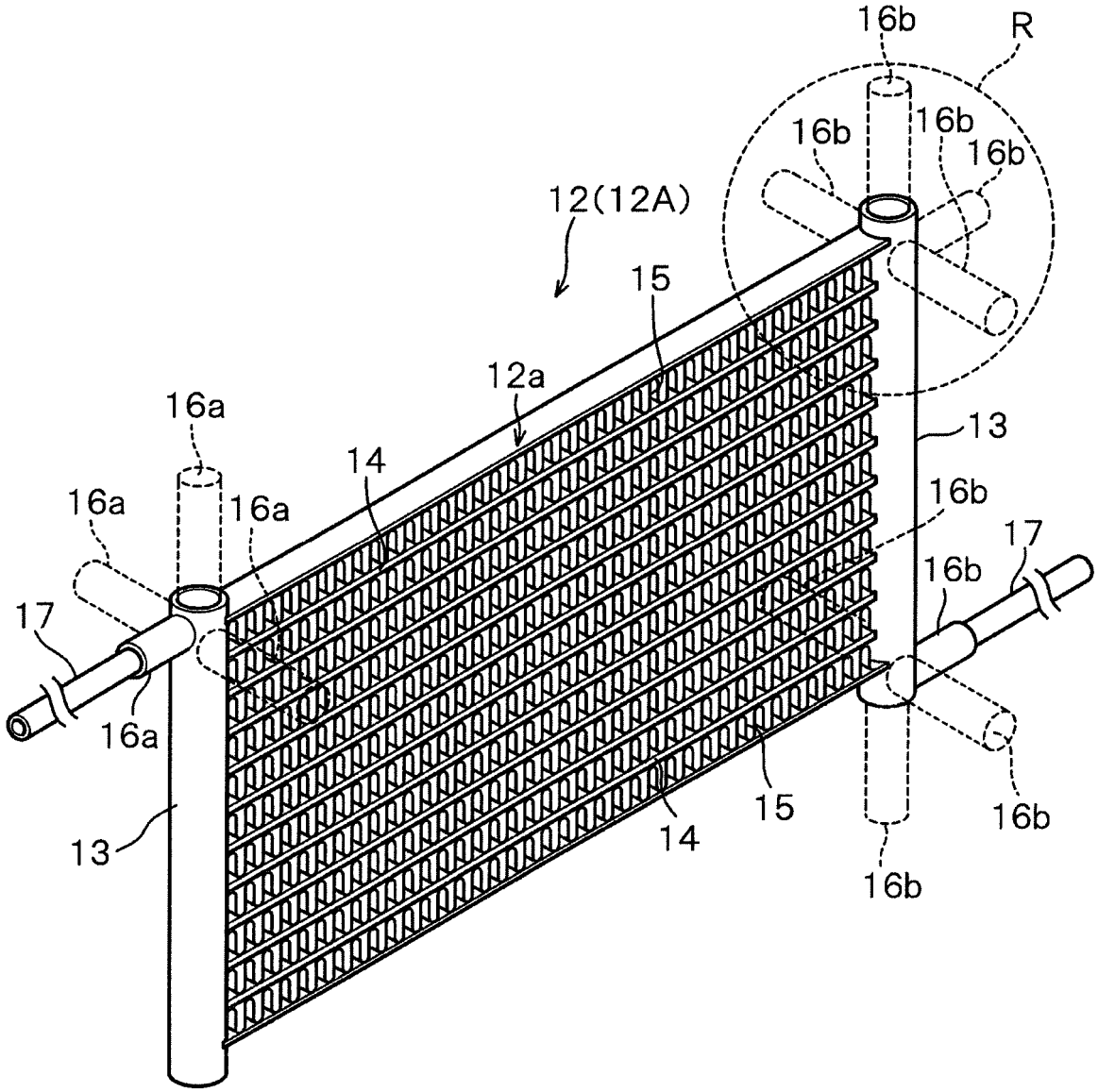

16b
R
16b
16b
16b
12(12A)
15
12a
16a
13
14
16b
16a
16a
17
16b
17
16a
16b
13
15
14
16b

FIG.5

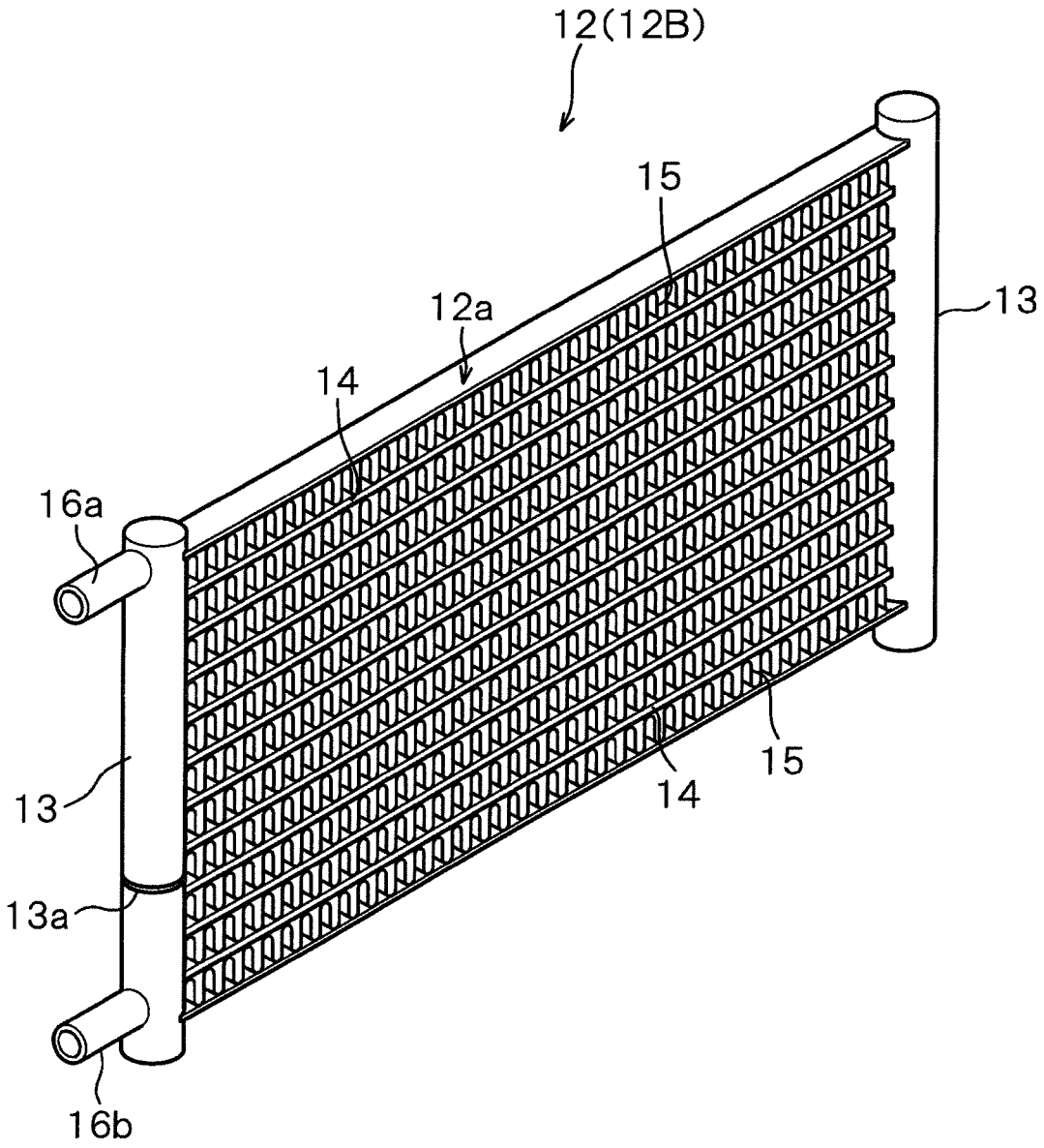


FIG. 6

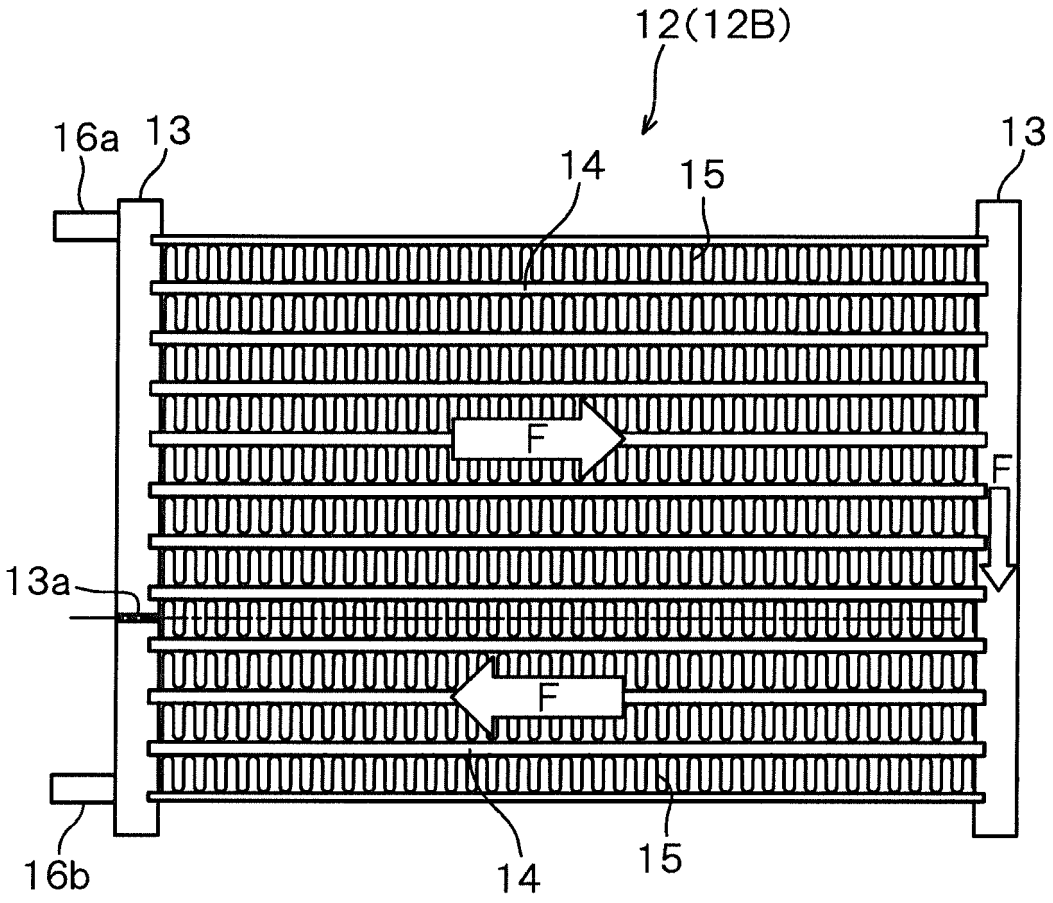


FIG.7

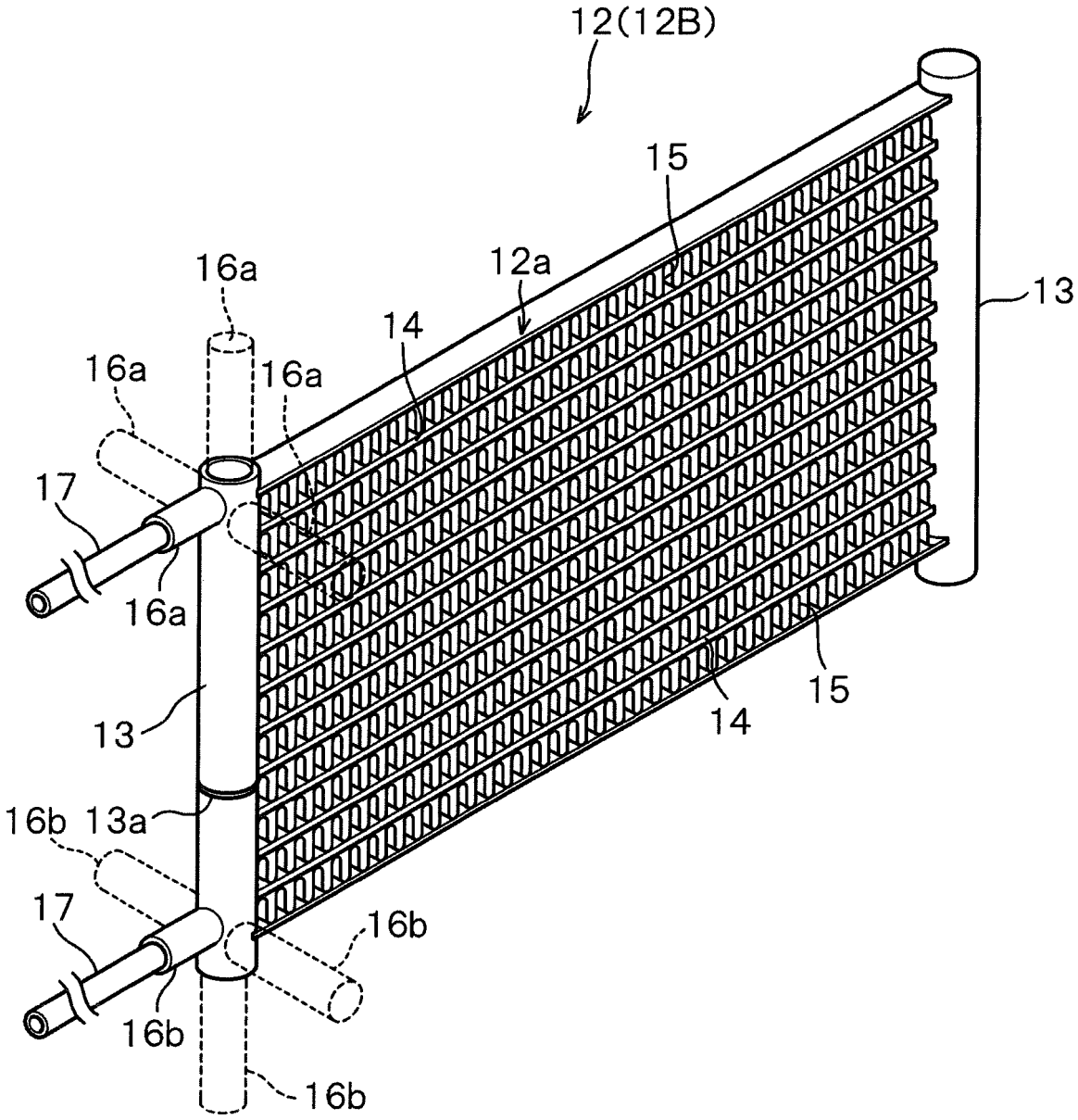

12(12B)
15
16a
12a
13
14
16a
16a
17
16a
13
16b
13a
17
16b
16b
16b
14
15

FIG. 8

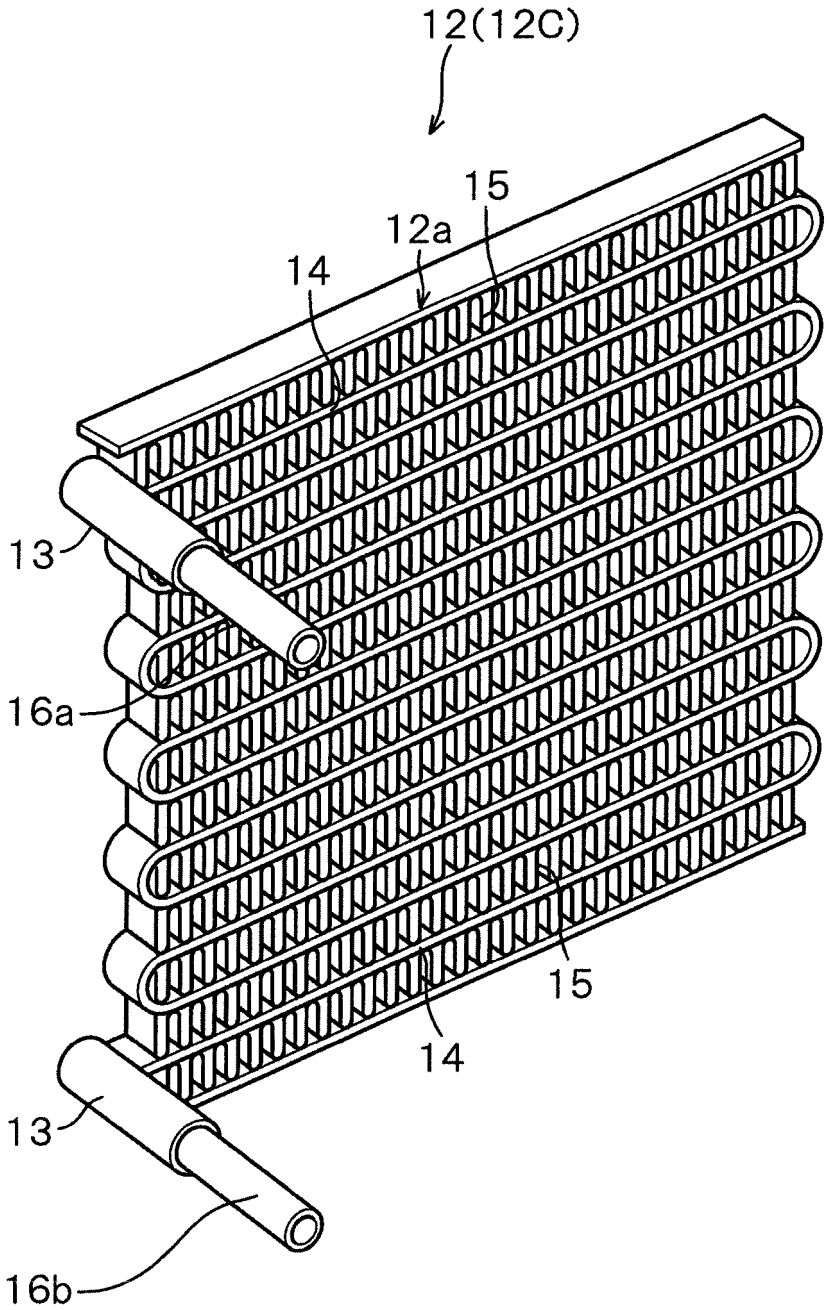


FIG. 9

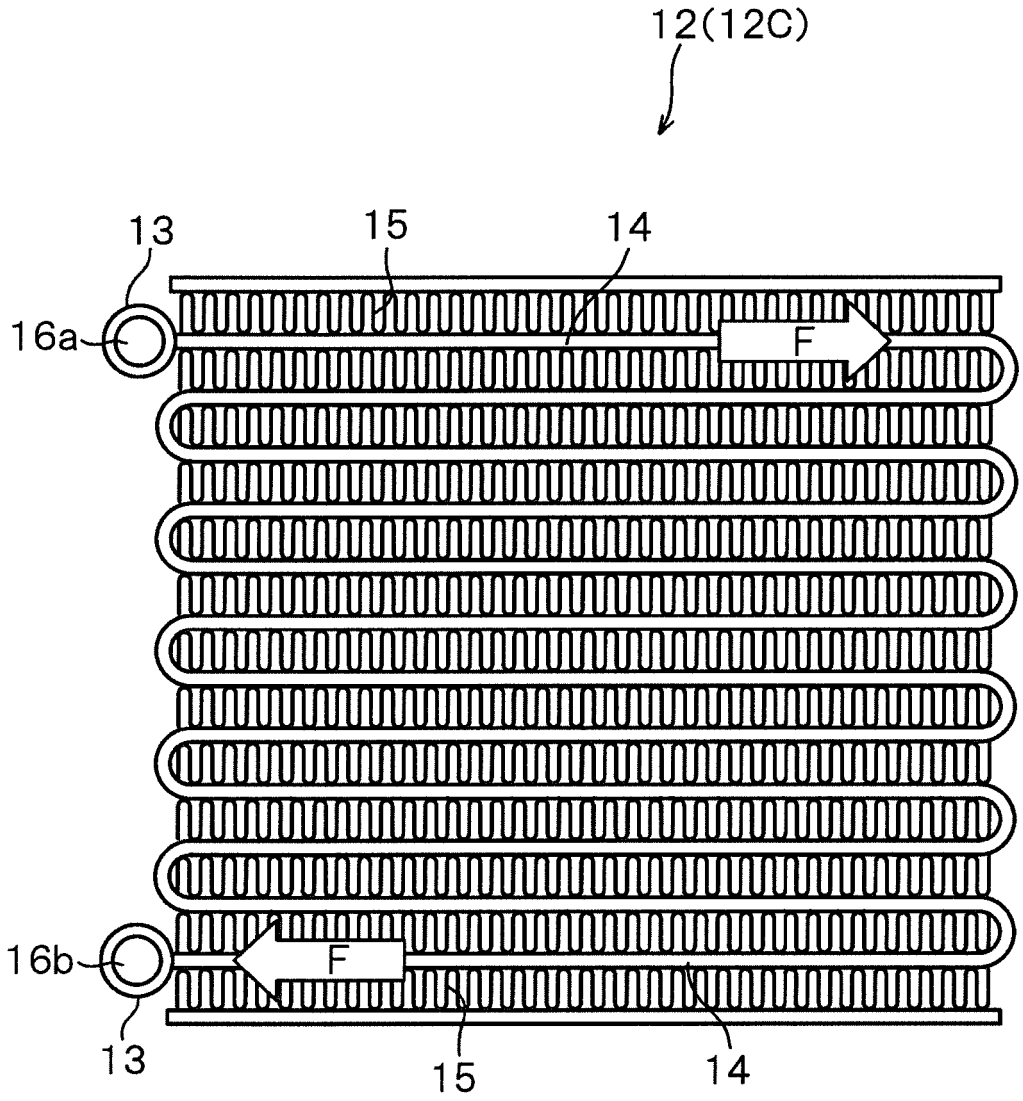


FIG.10

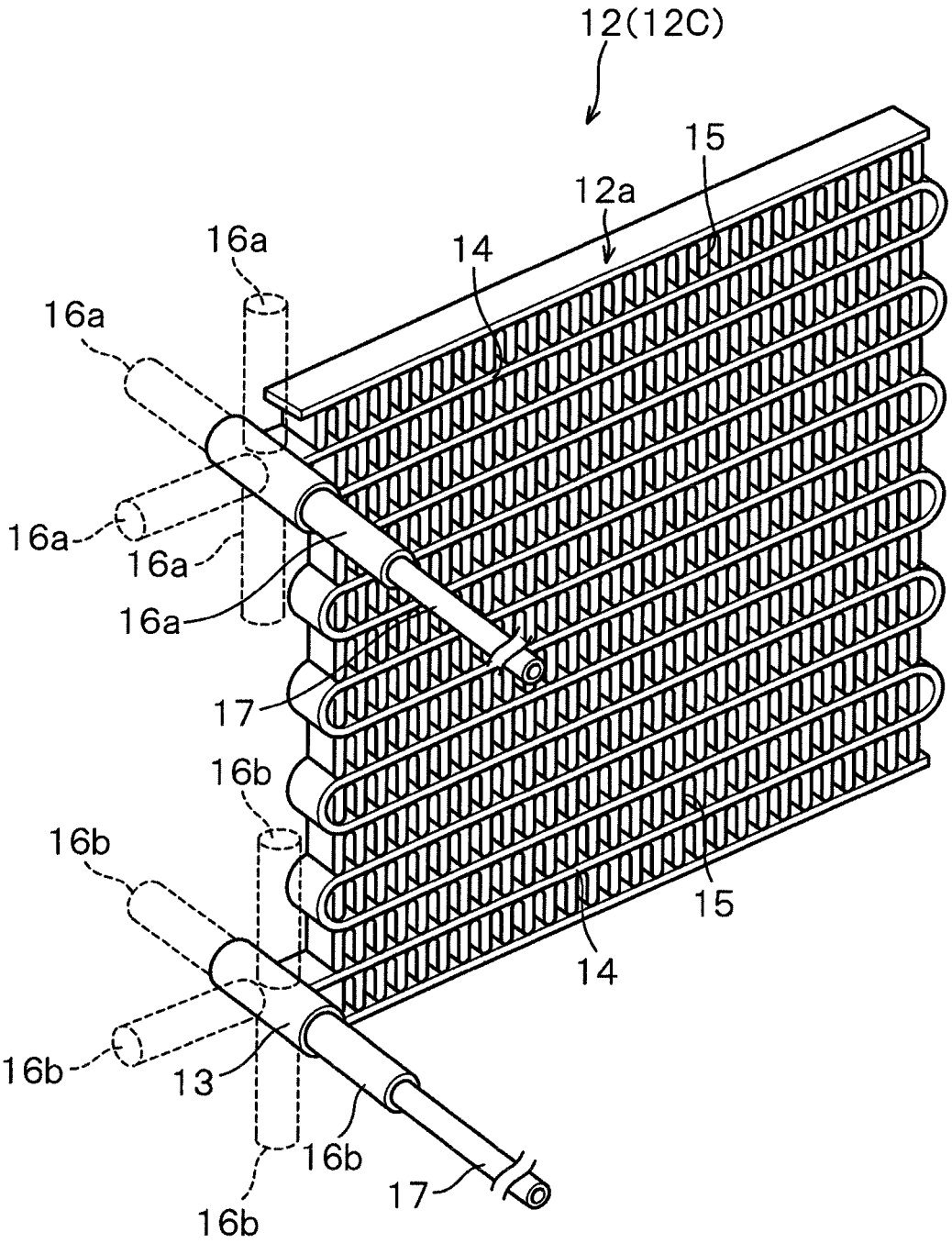

12(12C)
15
12a
16a
14
16a
16a
16a
16a
17
16b
16b
15
14
16b
13
16b
16b
17

FIG.11

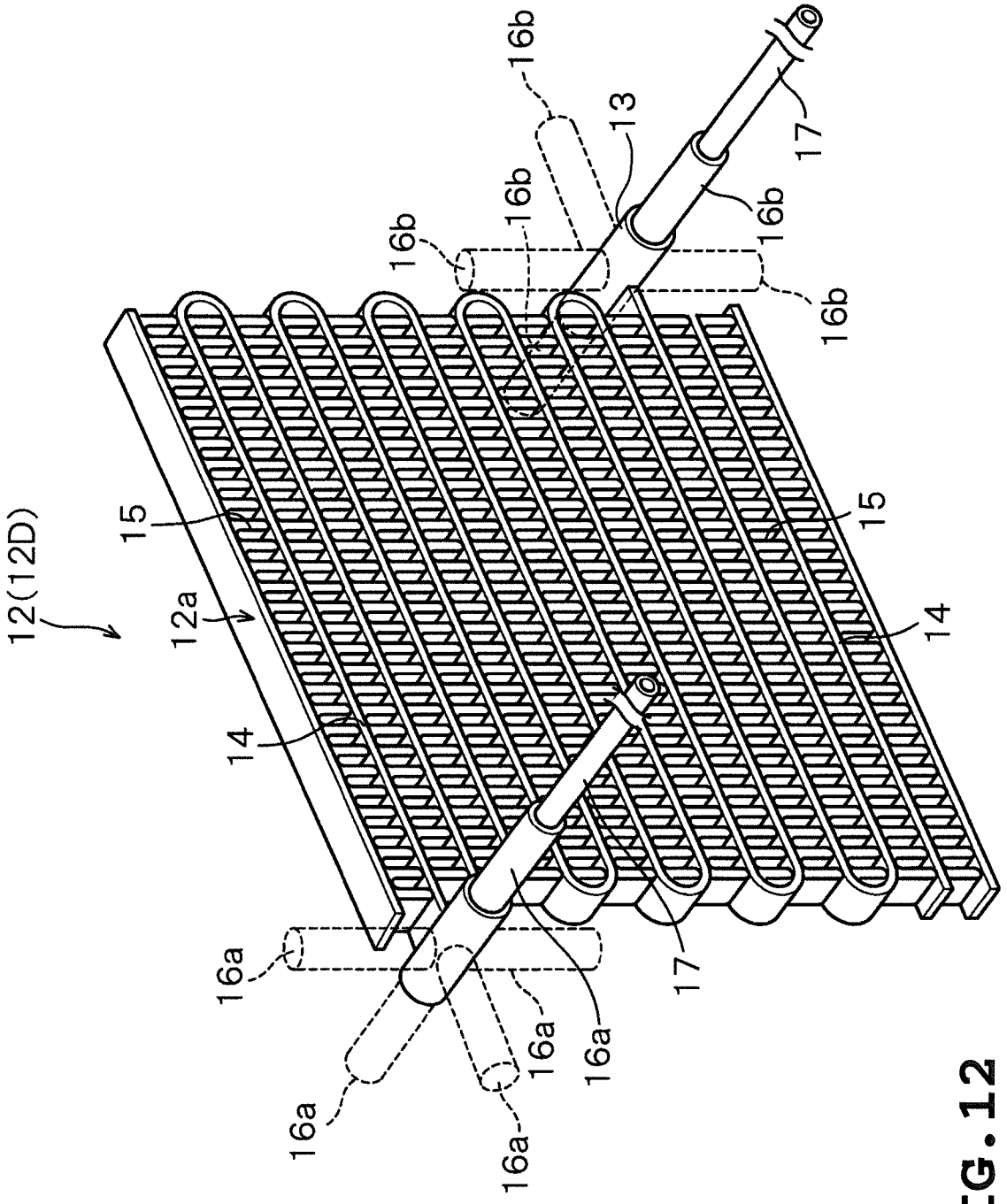

12(12D)
12a
15
15
14
14
16b
16b
16b
16b
16b
13
17
17
16a
16a
16a
16a
16a

FIG.12

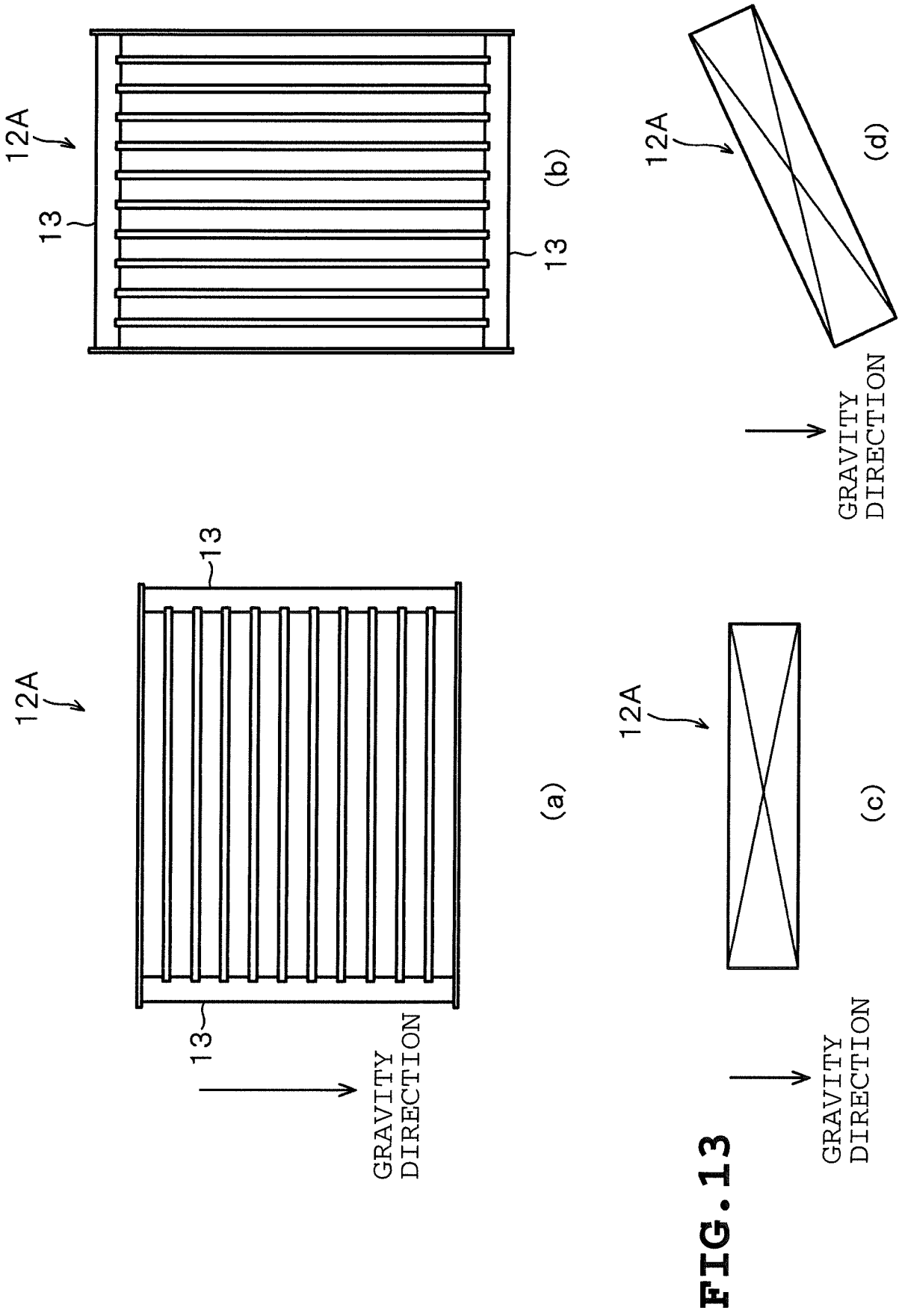

12A
13
13
(b)
12A
(d)
GRAVITY DIRECTION
13
12A
13
GRAVITY DIRECTION
(a)
12A
(c)
GRAVITY DIRECTION

FIG.13

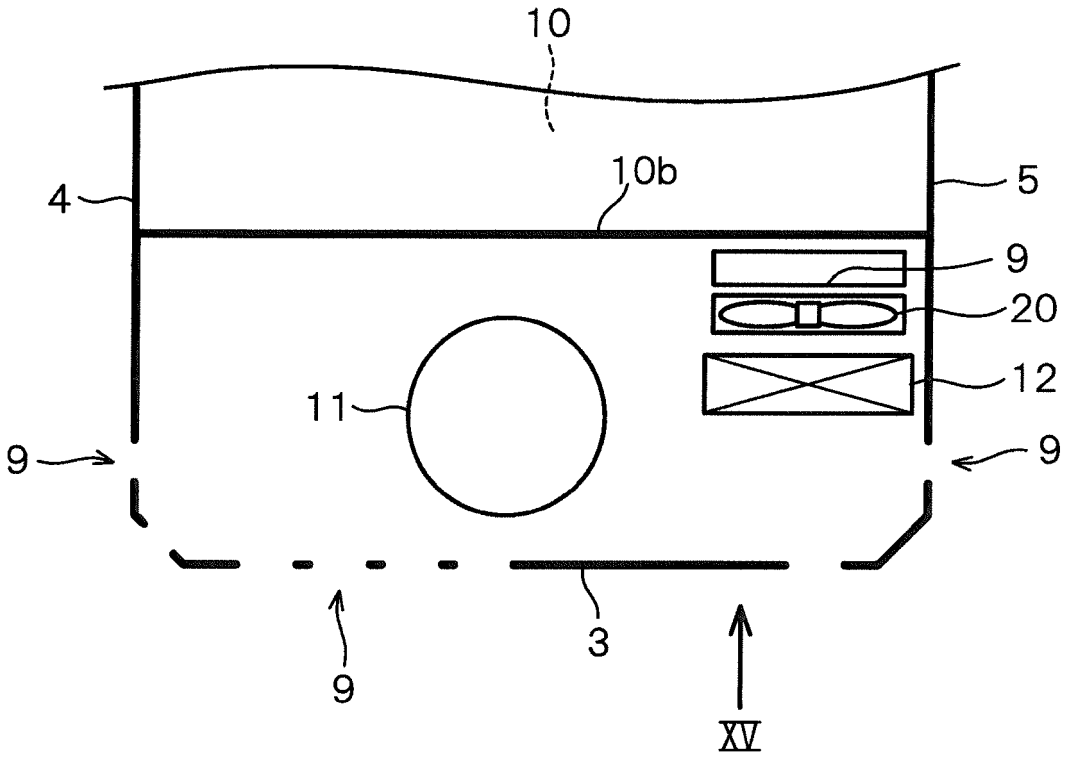


FIG.14

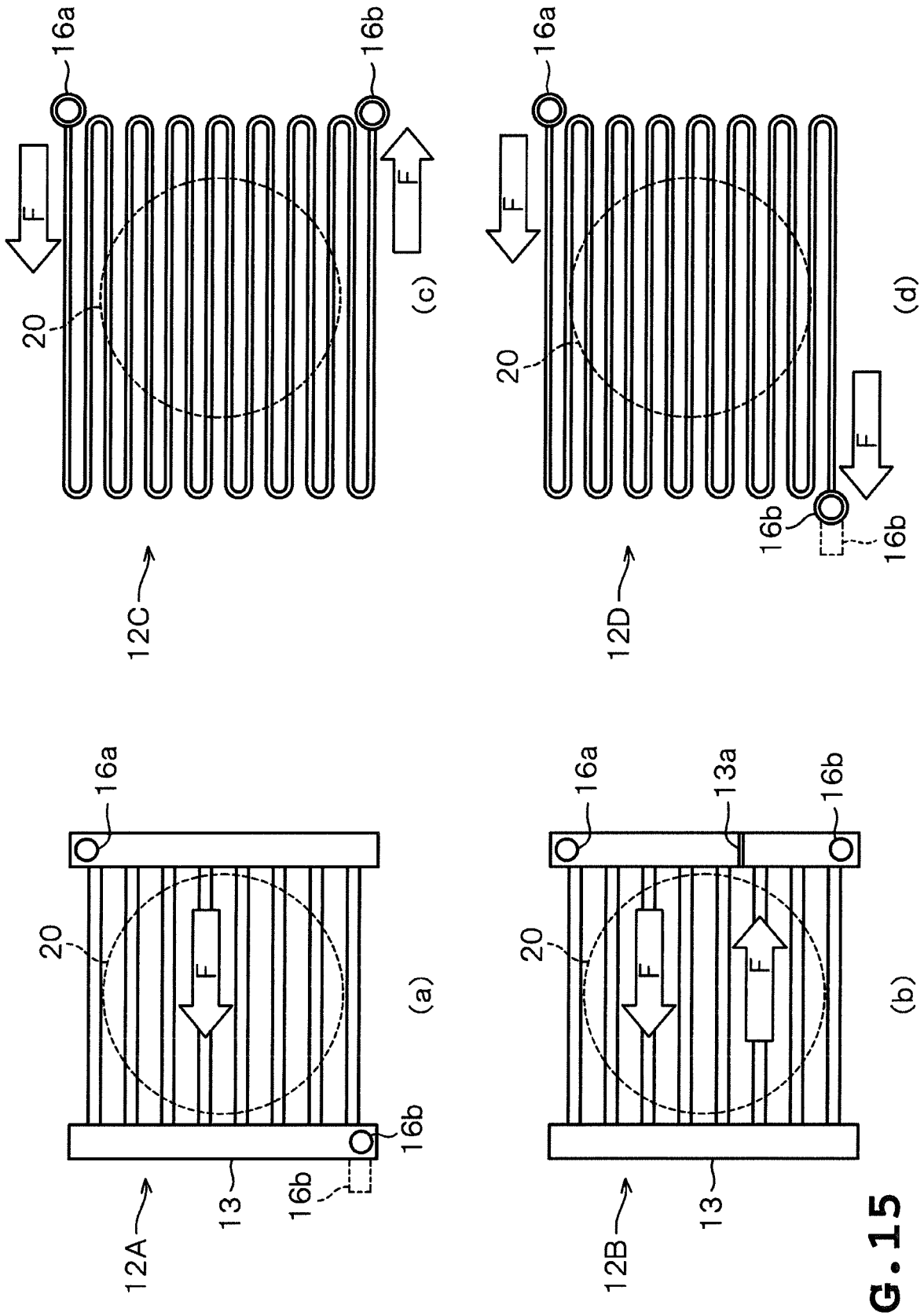

16a
16b
F
20
(c)
12C
16a
16b
F
20
(d)
12D
16a
16b
F
20
(a)
12A
13
16b
16a
13a
16b
F
F
20
(b)
12B
13

FIG.15

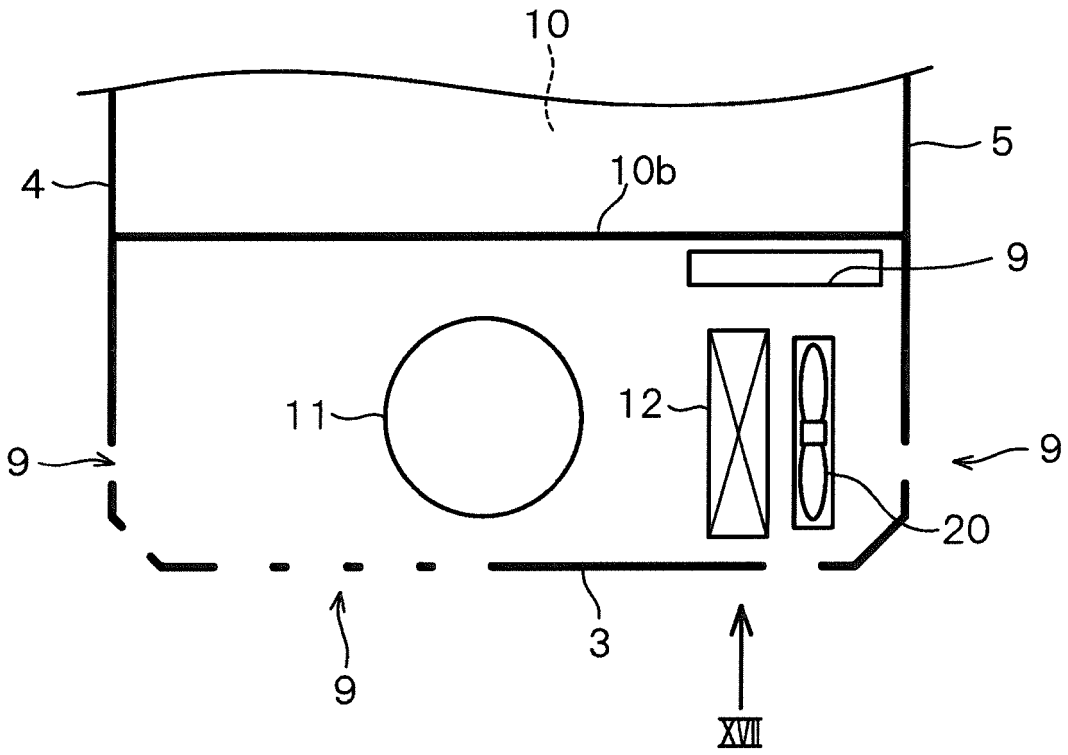


FIG.16

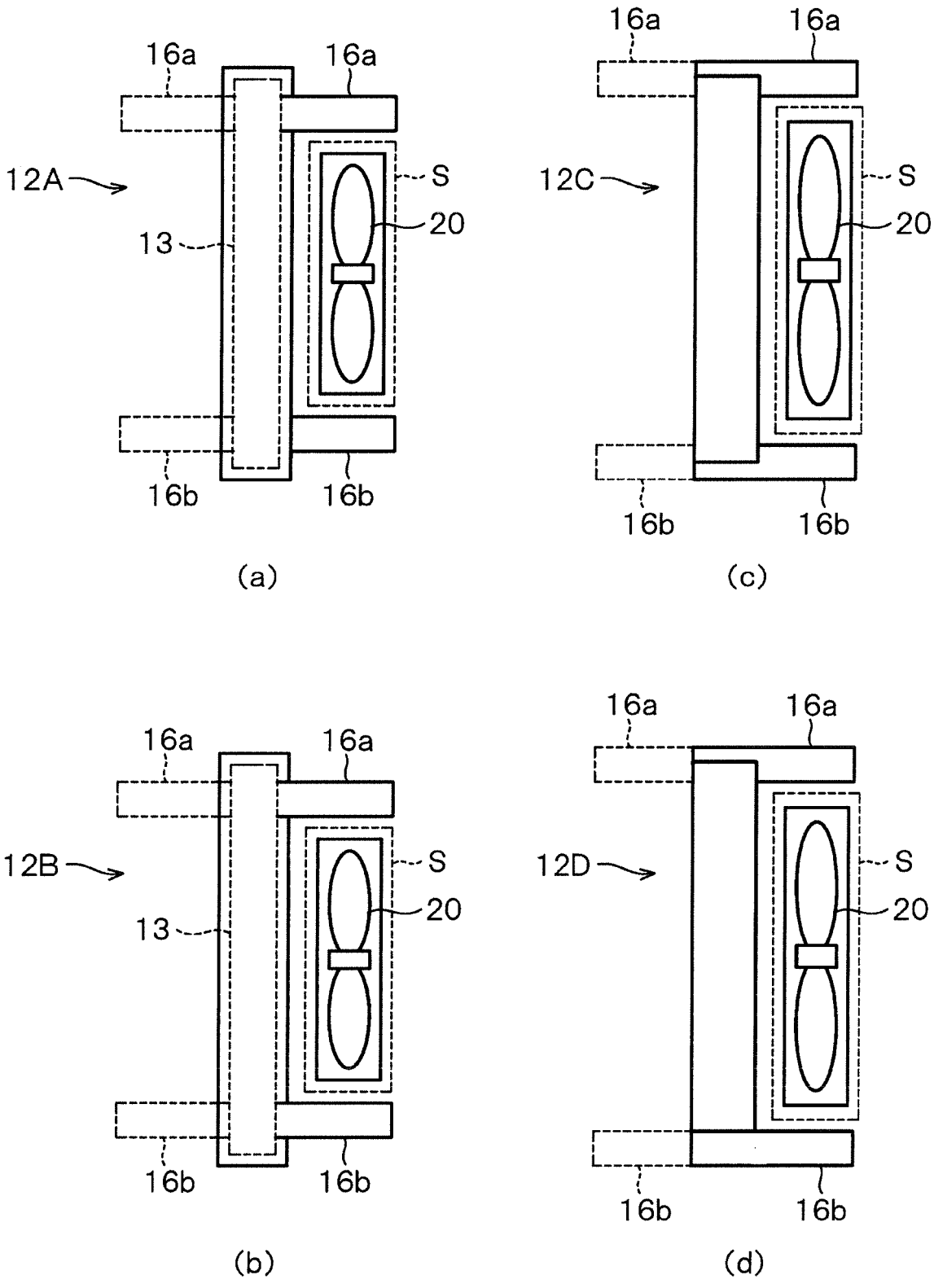

16a
16a
12A
S
20
13
16b
16b
(a)
16a
16a
12C
S
20
16b
16b
(c)
16a
16a
12B
S
20
13
16b
16b
(b)
16a
16a
12D
S
20
16b
16b
(d)

FIG. 17

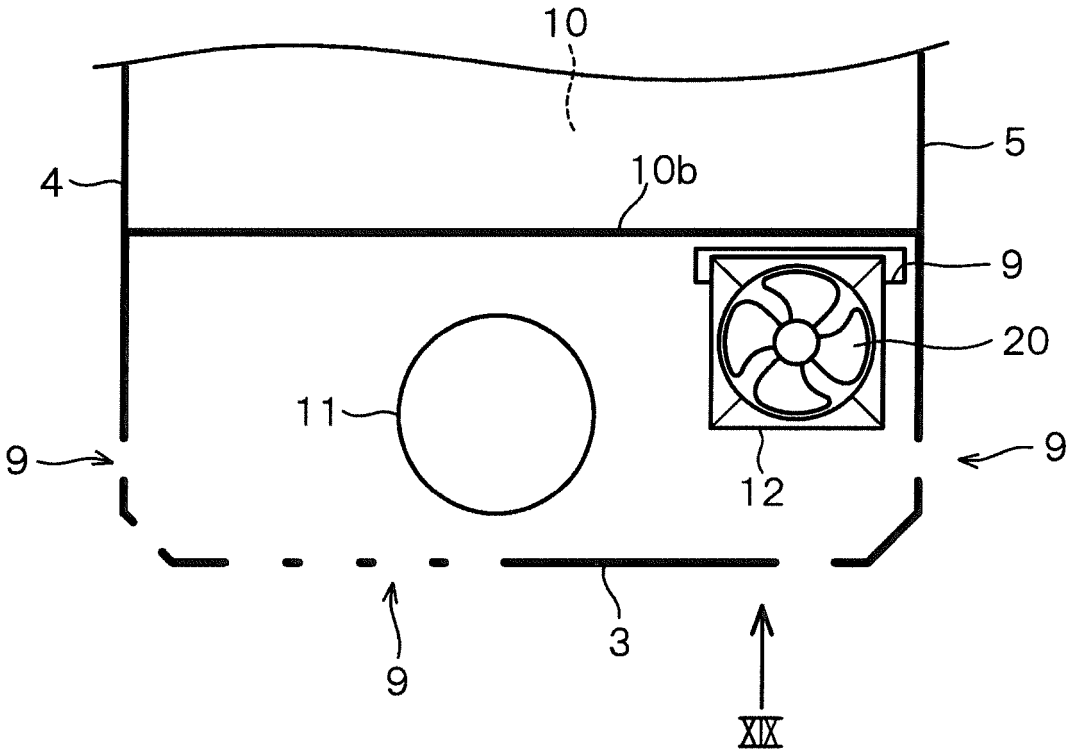


FIG.18

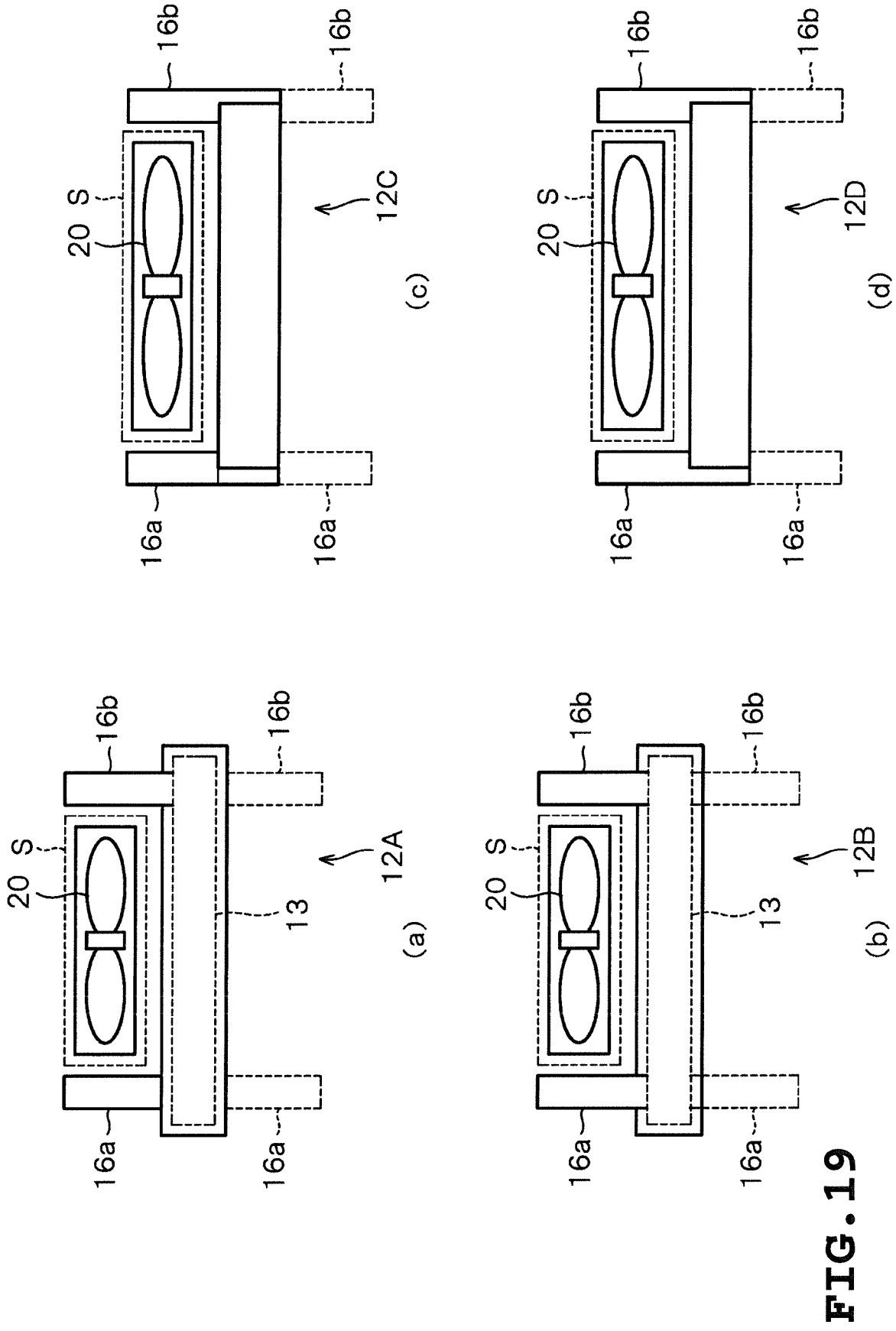

16b
16b
20
S
12C
(c)
16a
16a
16b
16b
20
S
12D
(d)
16a
16a
16b
16b
20
S
13
12A
(a)
16a
16a
16b
16b
20
S
13
12B
(b)
16a
16a

FIG.19

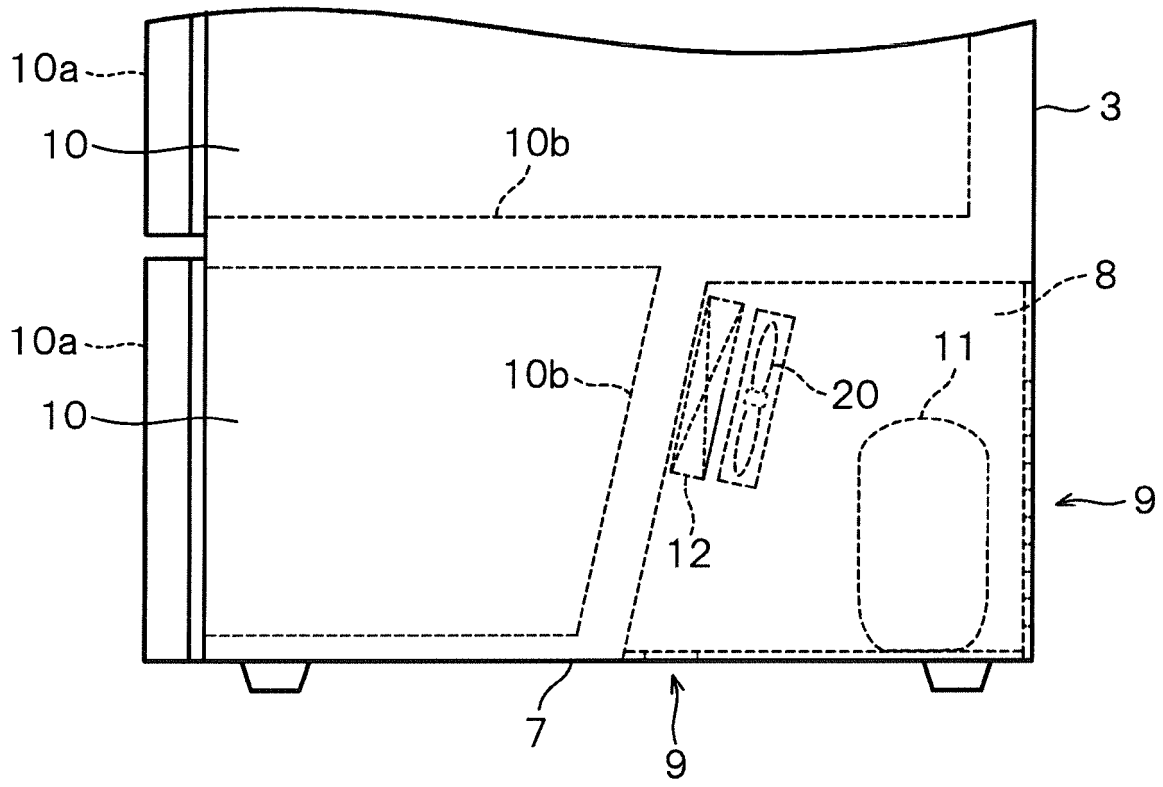
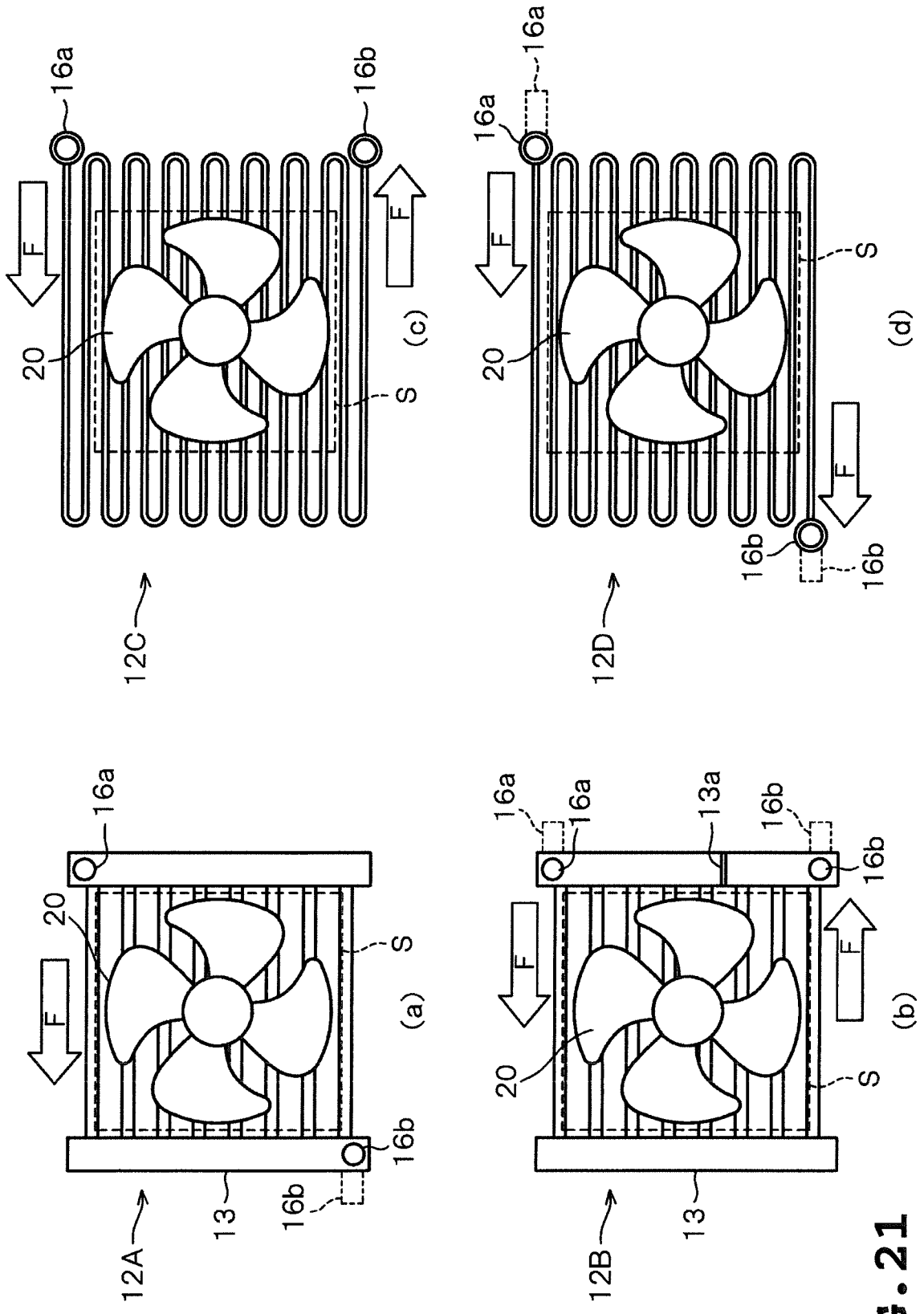


FIG.20


16a
16b
F
F
20
S
(c)
12C
16a
16a
F
S
20
(d)
F
16b
16b
12D
16a
16a
13a
16b
16b
F
F
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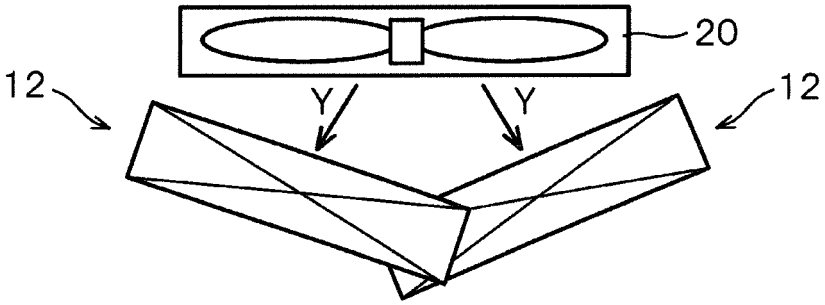
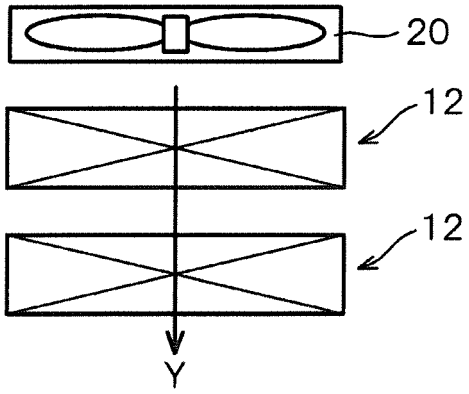
(b)
12B
13
16a
20
S
(a)
F
16b
12A
13
16b

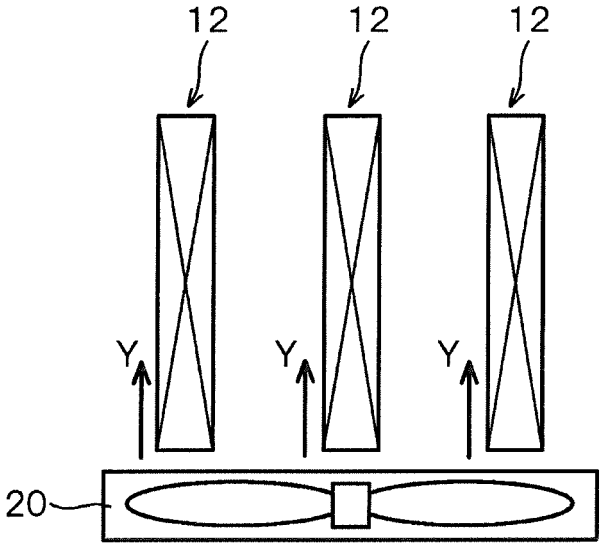
FIG. 21



(a)

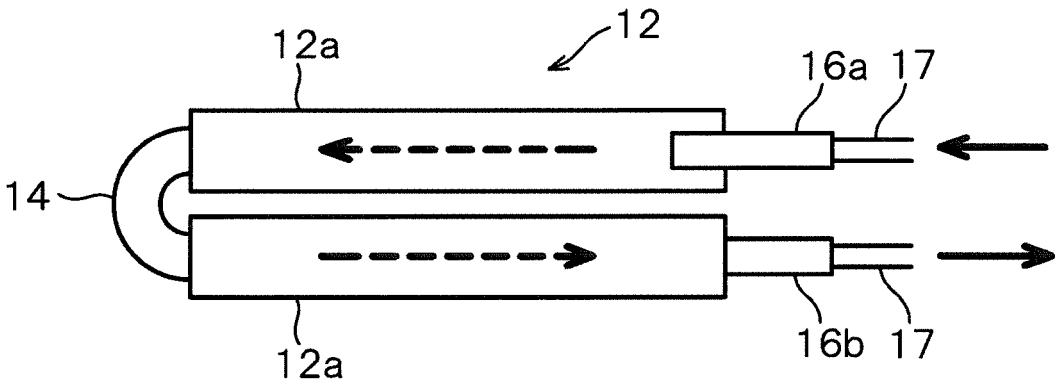


(b)

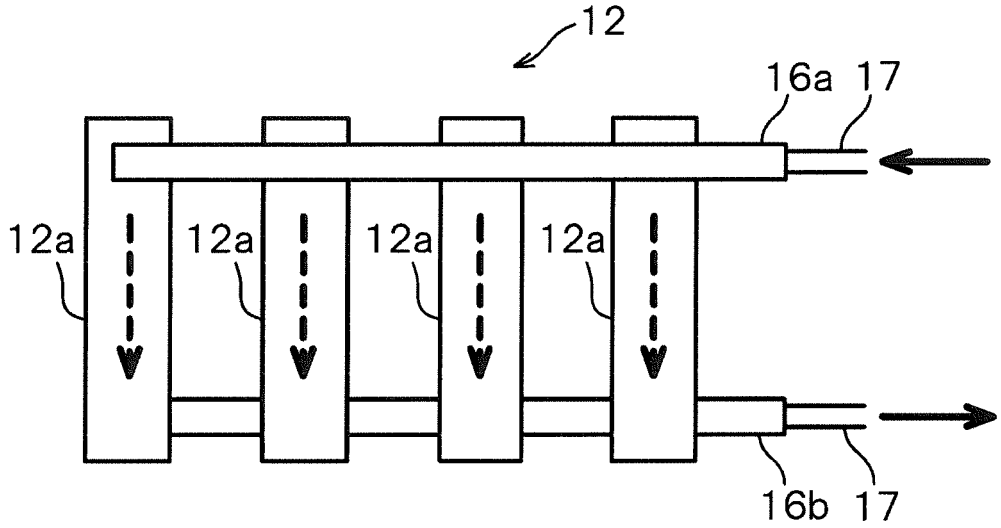


(c)

FIG.22

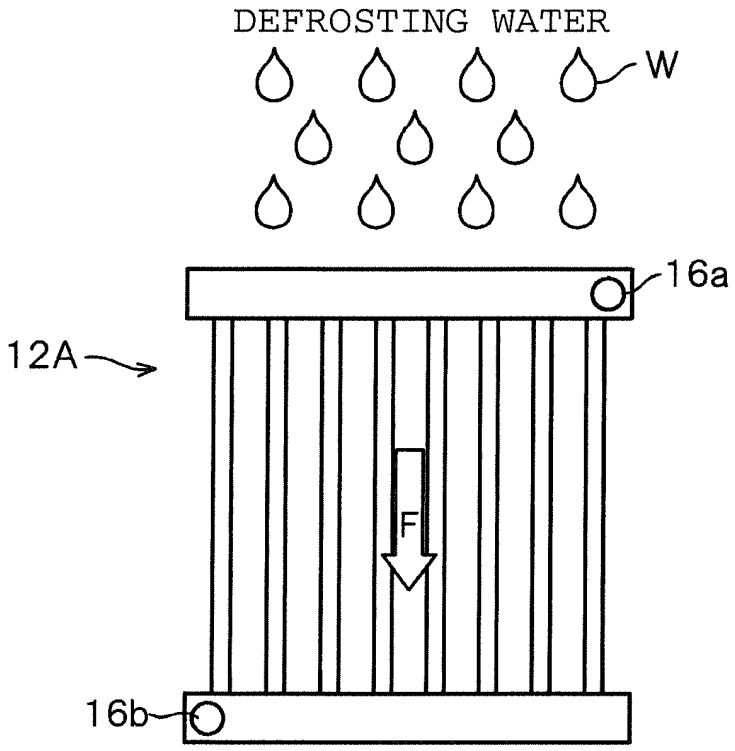


(a)

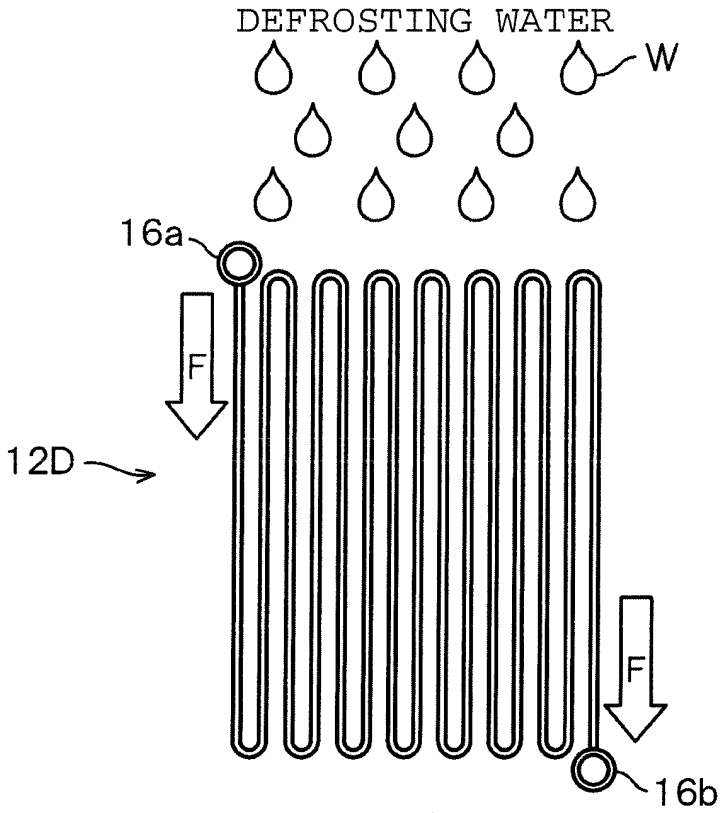


(b)

FIG.23


DEFROSTING WATER
W
16a
12A
F
16b

(a)


DEFROSTING WATER
W
16a
F
12D
F
16b

(b)

FIG. 24

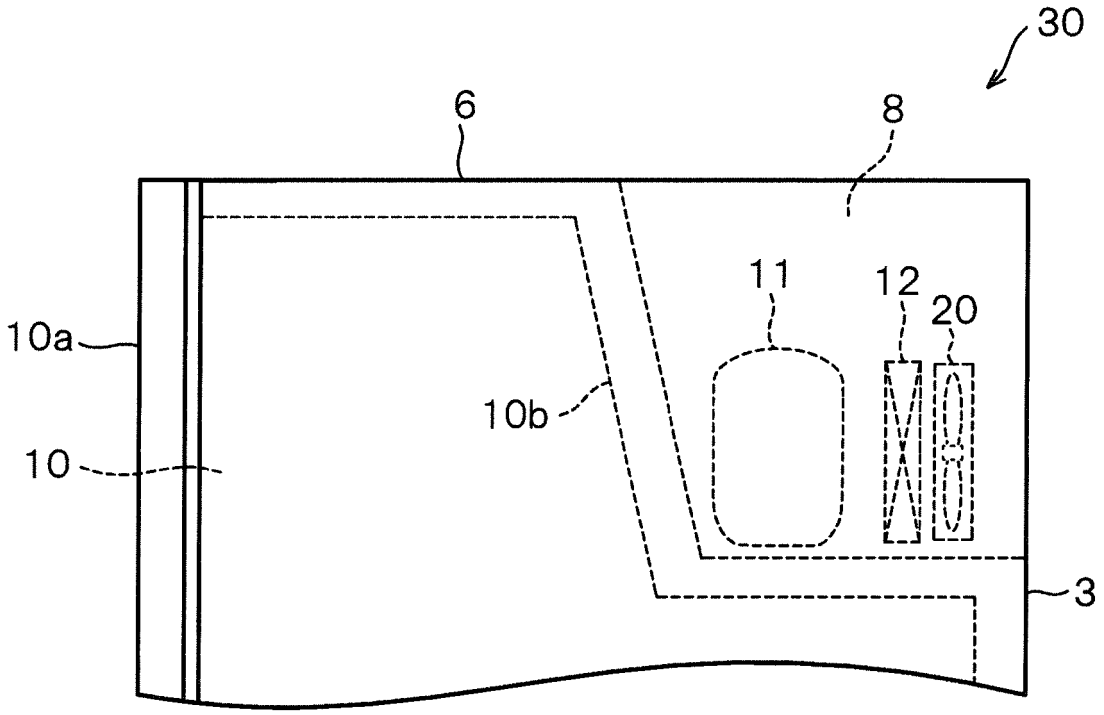


FIG.25

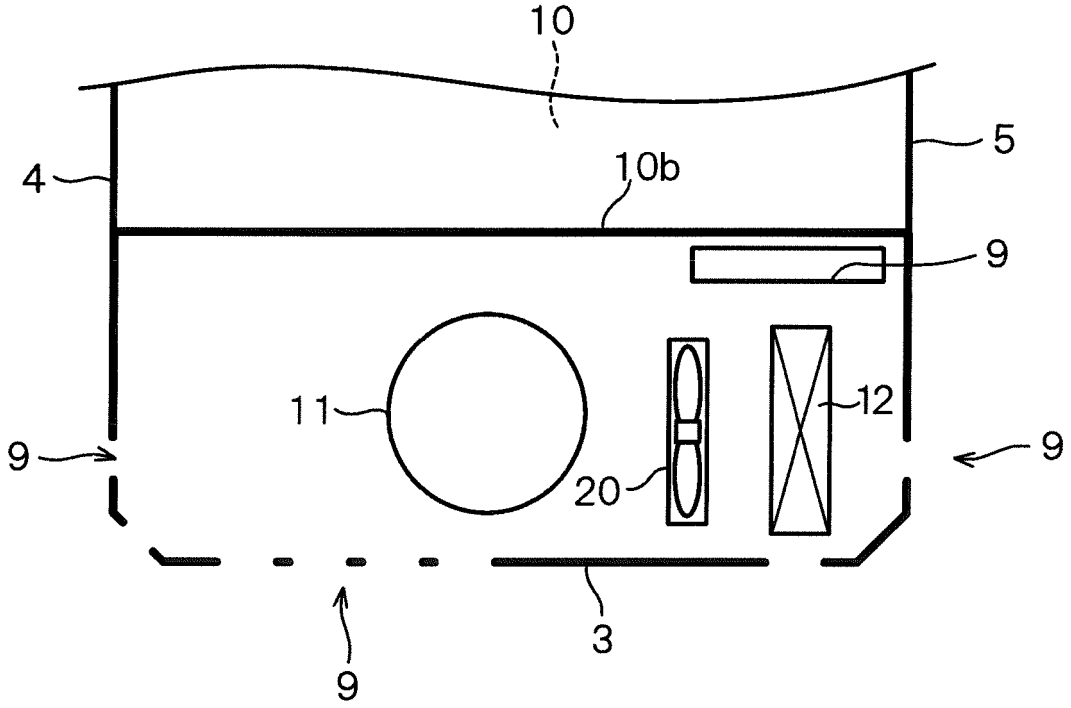


FIG.26

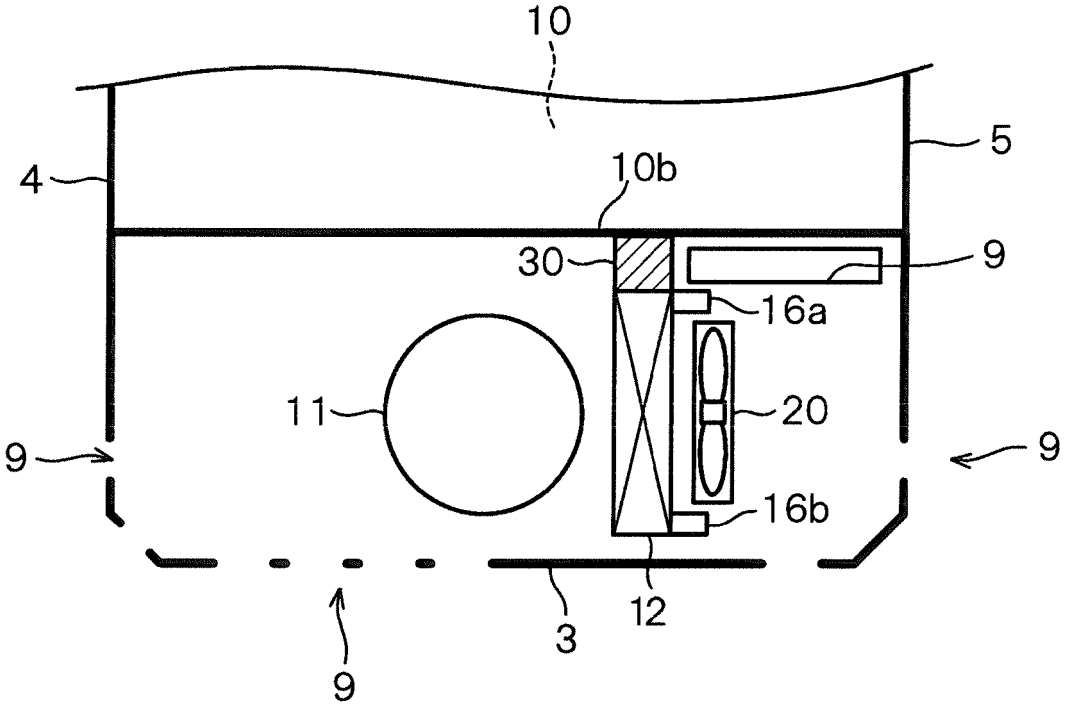


FIG.27

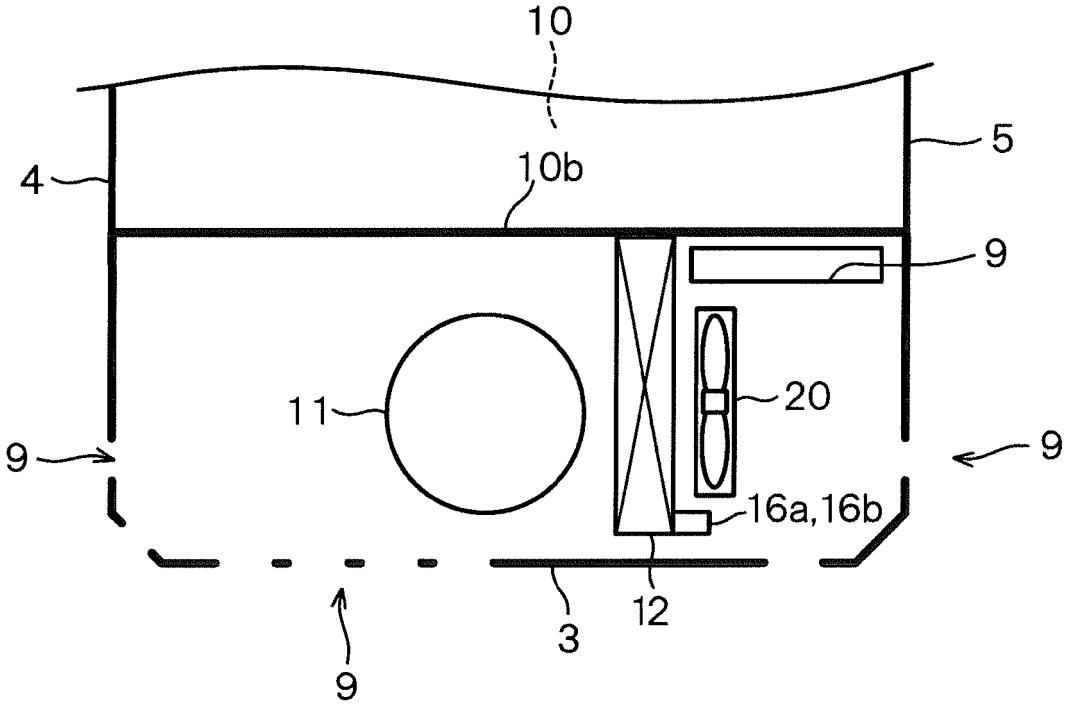

10
5
4
10b
9
11
20
9
9
16a,16b
12
3
9

FIG.28

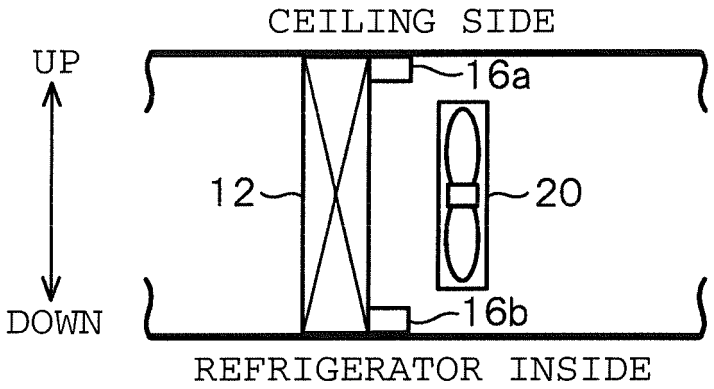

CEILING SIDE
UP
16a
12
20
DOWN
16b
REFRIGERATOR INSIDE

FIG.29

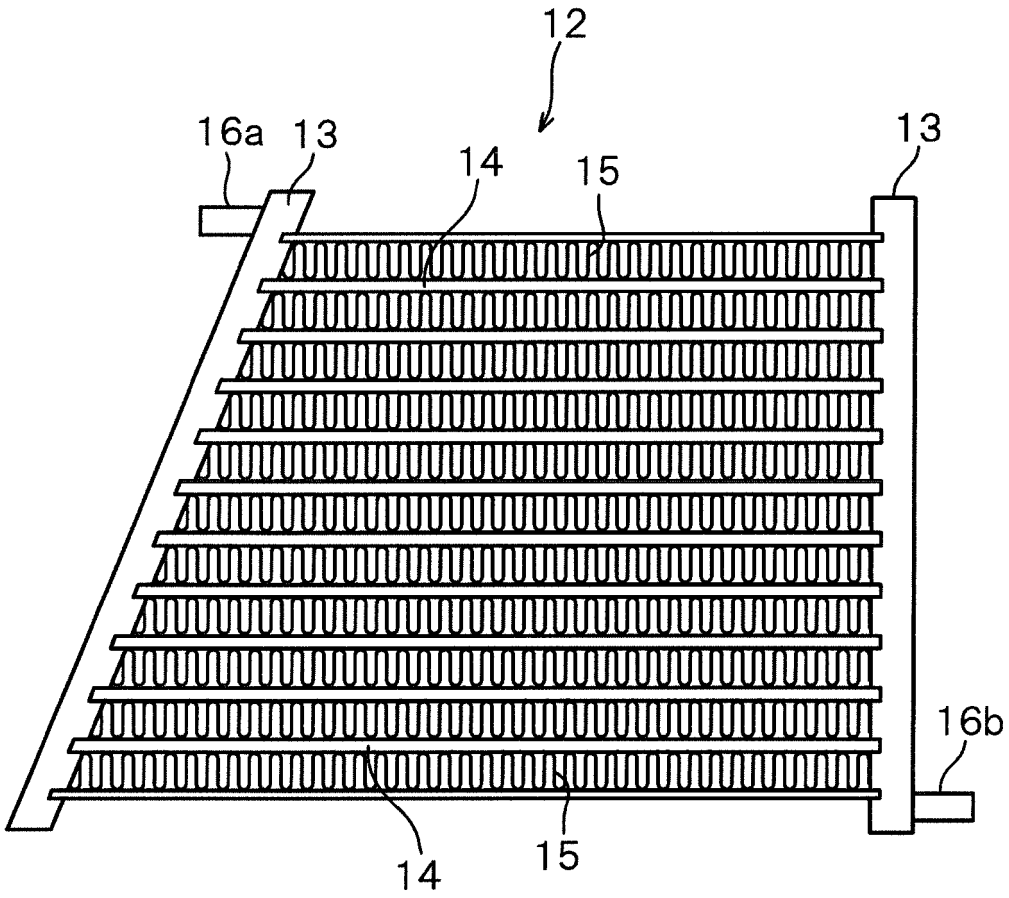


FIG.30

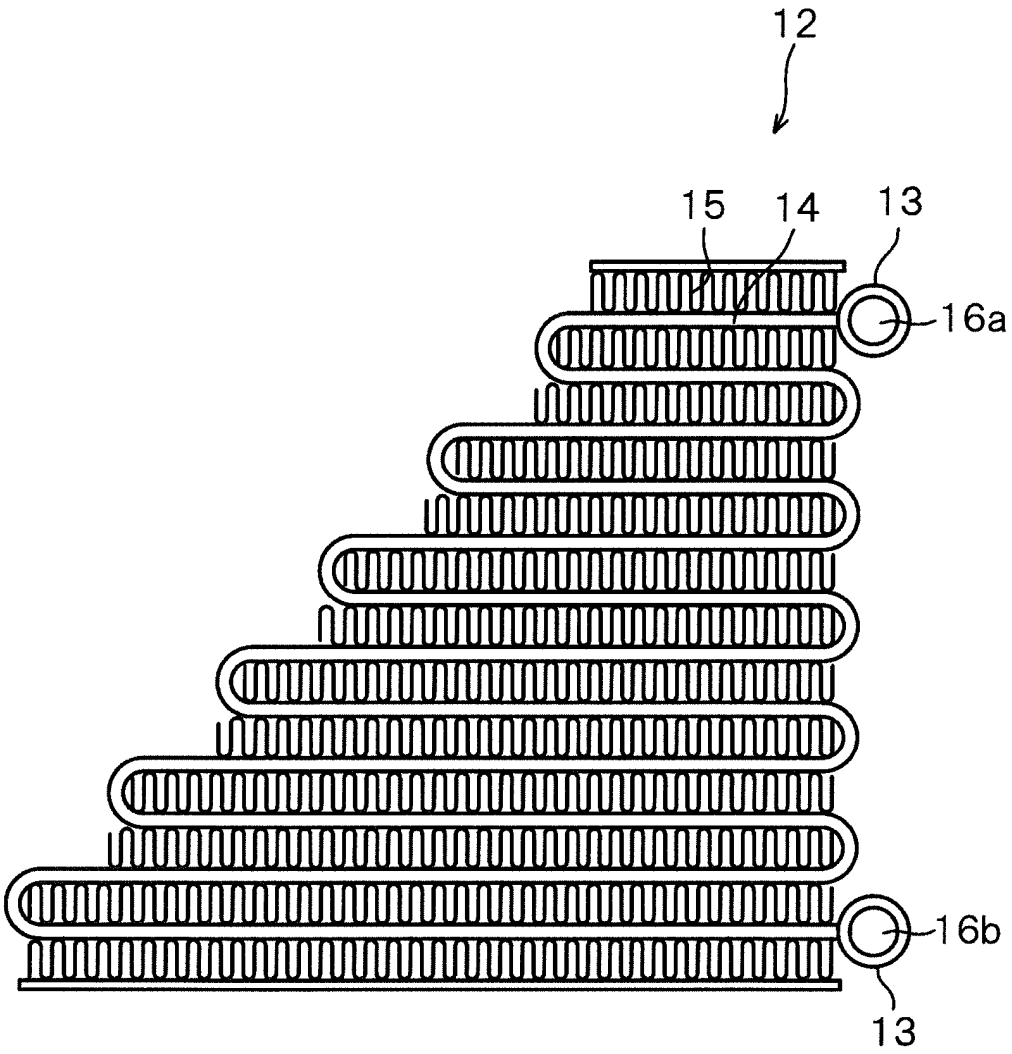


FIG.31

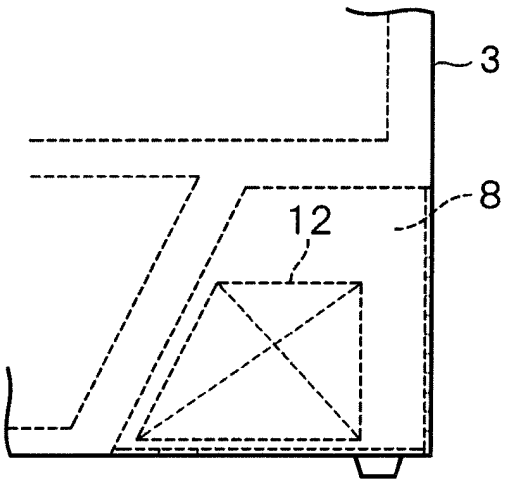


FIG.32

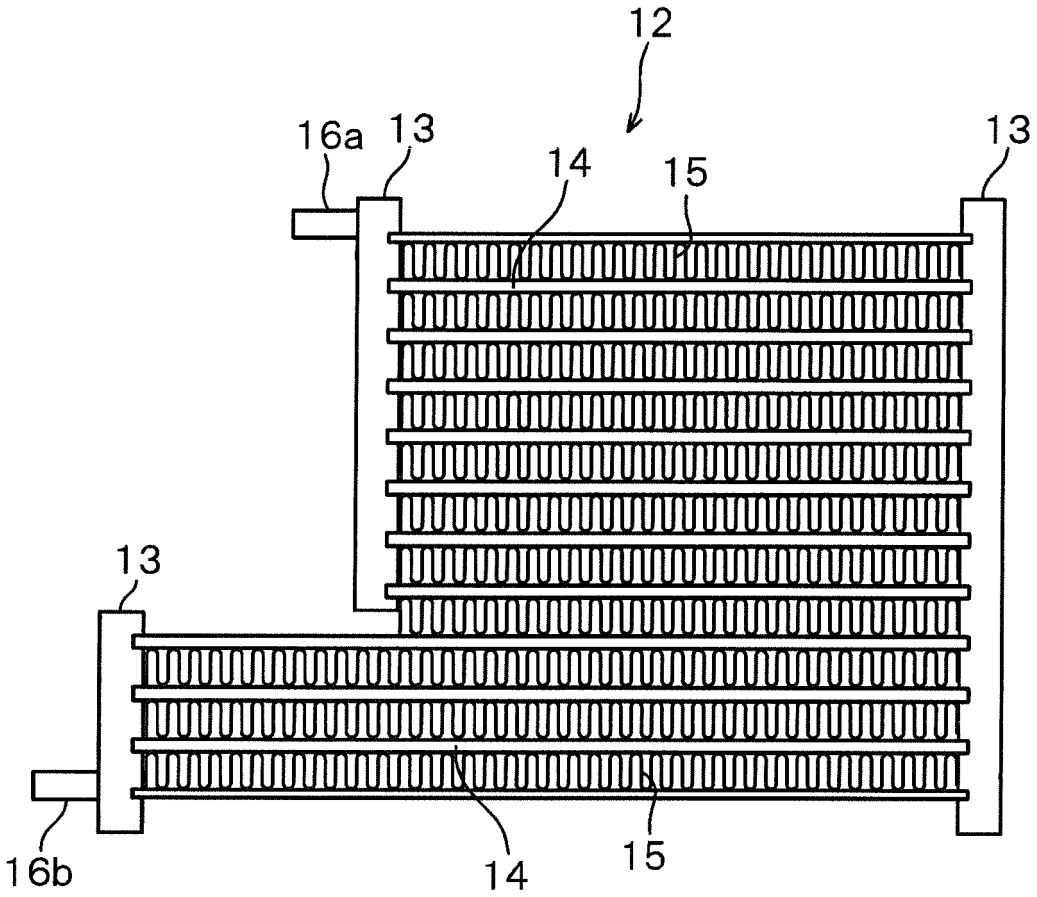


FIG.33

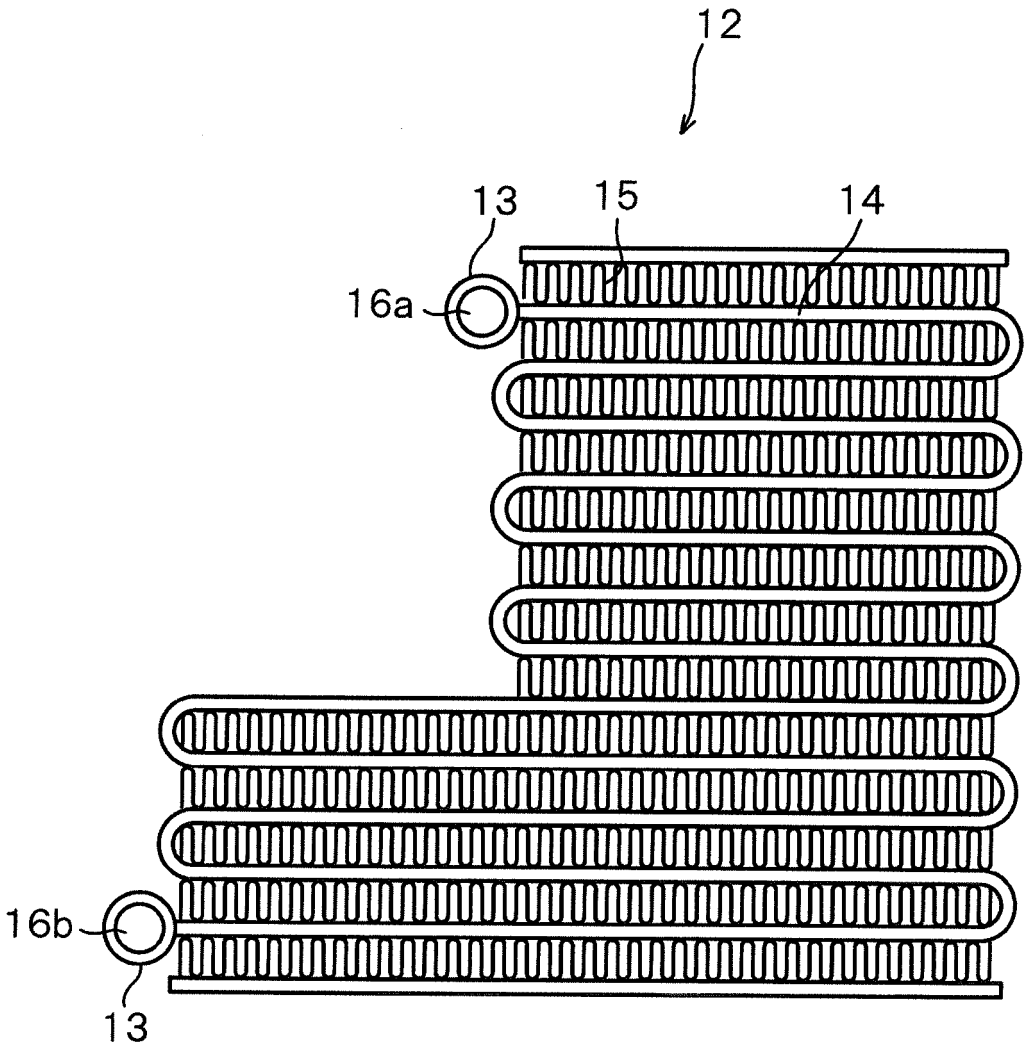


FIG.34

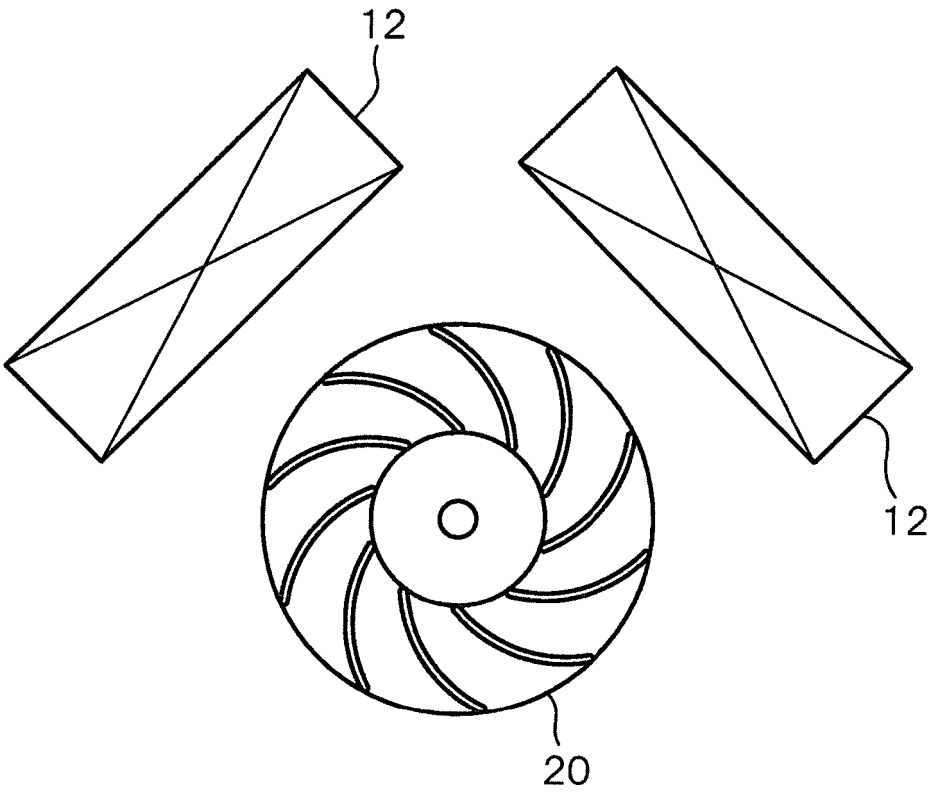


FIG.35

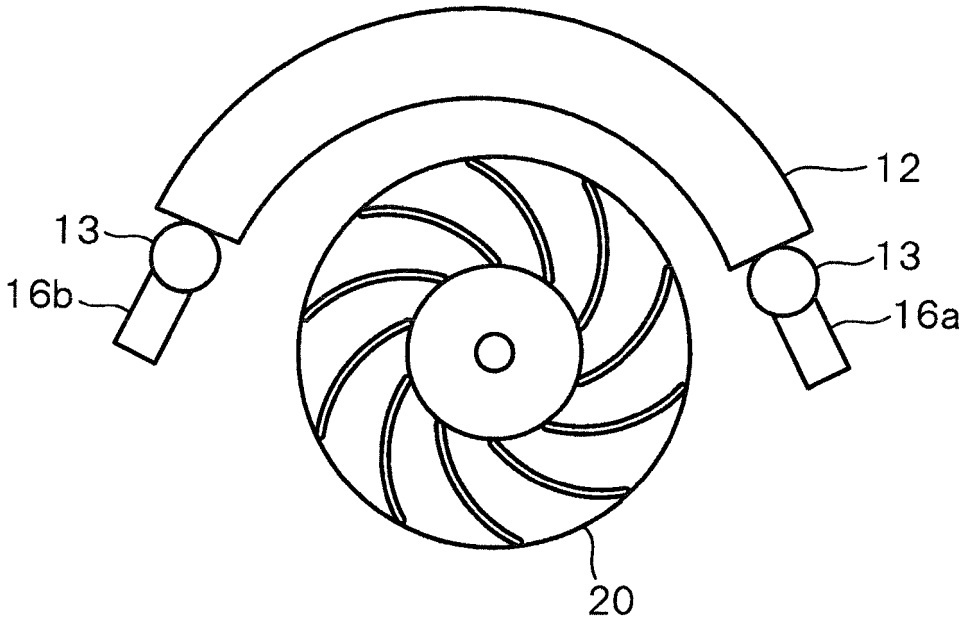


FIG.36

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/016031

A. CLASSIFICATION OF SUBJECT MATTER
F25D19/00(2006.01)i, *F25B39/04*(2006.01)i, *F25D11/00*(2006.01)i, *F25D21/14*(2006.01)i, *F28D1/047*(2006.01)i, *F28D1/053*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F25D19/00, F25B39/04, F25D11/00, F25D21/14, F28D1/047, F28D1/053

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2017
Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	CN 101769656 A (ZHEJIANG KANGSHENG CO., LTD.), 07 July 2010 (07.07.2010), claims; fig. 1 to 4 (Family: none)	1,17 2-10,12-13, 15-16,24 11,14,18-23, 25-26
X Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 023229/1989(Laid-open No. 115668/1990) (Showa Aluminum Corp.), 17 September 1990 (17.09.1990), claims; fig. 1 to 3 (Family: none)	1,18 2-13,15-16, 21,24 14,17,19-20, 22-23,25-26

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 July 2017 (11.07.17)	25 July 2017 (25.07.17)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/016031

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	CN 104390395 A (HEFEI HUALING CO., LTD.), 04 March 2015 (04.03.2015), claims; fig. 2 to 4 (Family: none)	1,19-20 2-10,12-13, 15-16,23 11,14,17-18, 21-22,24-26
X Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 152900/1989(Laid-open No. 096574/1991) (Showa Aluminum Corp.), 02 October 1991 (02.10.1991), claims; fig. 1 to 5 (Family: none)	1,19-20 2-10,12-13, 15-16,23 11,14,17-18, 21-22,24-26
Y	JP 2011-231948 A (Toshiba Corp.), 17 November 2011 (17.11.2011), claims; fig. 1 to 2 & CN 202158706 U	2,4-5,11-12, 21
Y	JP 2014-020680 A (Toshiba Corp.), 03 February 2014 (03.02.2014), claims; paragraph [0018]; fig. 1 to 6 & WO 2014/013636 A1 & CN 104380015 A & RU 2015105587 A	2,5,10-12,21
Y	US 6519970 B1 (GENERAL ELECTRIC CO.), 18 February 2003 (18.02.2003), fig. 1 to 4 (Family: none)	2,6,8,12,21
Y	JP 2016-044824 A (Hitachi Appliances, Inc.), 04 April 2016 (04.04.2016), fig. 3 (Family: none)	2,6,12,21
Y	JP 2014-059073 A (Sharp Corp.), 03 April 2014 (03.04.2014), paragraph [0035]; fig. 2 to 3, 5 (Family: none)	3,6,8,12, 15-16,21
Y	JP 08-296945 A (Matsushita Refrigeration Co.), 12 November 1996 (12.11.1996), paragraphs [0028] to [0032]; fig. 8 to 9 (Family: none)	7,21
Y	JP 2003-004359 A (Hitachi, Ltd.), 08 January 2003 (08.01.2003), claims; fig. 1, 4 (Family: none)	9,21

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/016031

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2011-208909 A (Sanyo Electric Co., Ltd.), 20 October 2011 (20.10.2011), fig. 1 to 4 (Family: none)	13,21
Y	JP 04-036574 A (Sanyo Electric Co., Ltd.), 06 February 1992 (06.02.1992), fig. 1 to 3 (Family: none)	13,21
Y	JP 04-340070 A (Showa Aluminum Corp.), 26 November 1992 (26.11.1992), fig. 1 to 2, 4 (Family: none)	23
Y	CN 104493449 A (ZHEJIANG KANGSHENG HEAT EXCHANGER CO., LTD.), 08 April 2015 (08.04.2015), figures (Family: none)	24
X	JP 09-026252 A (Sharp Corp.), 28 January 1997 (28.01.1997), claims; fig. 1 to 4 (Family: none)	25-26

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2014238219 A **[0003]**