Summary of Invention

Technical Problem

So far, no studies have been made regarding what kinds of refrigerants should be used among refrigerants having a low GWP in an inside air-conditioning device.

Solution to Problem.

An inside air-conditioning device according to an aspect includes a refrigerant circuit and a refrigerant that is sealed in the refrigerant circuit. The refrigerant circuit includes a compressor, a condenser, a decompressor, and an evaporator. The refrigerant ~~contains at least 1,2-difluoroethylene~~ includes trans-1,2-difluoroethylene (HFO-1132(E)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf) in such amounts that the sum of HFO-1132(E) and HFO-1234yf is 99.7 mass% or more, and a content rate of HFO-1132(E) is 12.1 to 45.0 mass% and a content rate of HFO-1234yf is 87.9 to 55.0 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant contains cis-1,2-difluoroethylene (HFO-1132(Z)).

In an embodiment of the above inside air-conditioning device, the refrigerant contains cis-1,2-difluoroethylene (HFO-1132(Z)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf). A content of HFO-

1132(Z) is 53.0 to 59.5% by mass and a content of HFO-1234yf is 47.0 to 40.5% by mass, based on a total mass of HFO-1132(Z) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant is used for operating a refrigeration cycle in which an evaporating temperature is -60 to 20℃.

In an embodiment of the above inside air-conditioning device, the refrigerant consists only of HFO-1132(Z) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant contains cis-1,2-difluoroethylene (HFO-1132(Z)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf). A content of HFO-1132(Z) is 41.0 to 49.2% by mass and a content of HFO-1234yf is 59.0 to 50.8% by mass, based on a total mass of HFO-1132(Z) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant is used for operating a refrigeration cycle in which an evaporating temperature is -60 to 20℃.

In an embodiment of the above inside air-conditioning device, the refrigerant consists only of HFO-1132(Z) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant is used as an alternative refrigerant to R134a, R22, R12, R404A, R407A, R407C, R407F, R407H, R410A, R413A, R417A, R422A, R422B, R422C, R422D, R423A, R424A, R426A, R427A,

R428A, R430A, R434A, R437A, R438A, R448A, R449A, R449B, R449C, R450A, R452A, R452B, R454A, R452B, R454C, R455A, R465A, R502, R507, R513A, R513B, R515A, or R515B.

In an embodiment of the above inside air-conditioning device, the refrigerant contains at least one substance selected from the group consisting of water, a tracer, an ultraviolet fluorescent dye, a stabilizer, and a polymerization inhibitor.

In an embodiment of the above inside air-conditioning device, the refrigerant further contains a refrigerator oil and used as a working fluid for a refrigeration apparatus.

In an embodiment of the above inside air-conditioning device, the refrigerator oil contains at least one polymer selected from the group consisting of a polyalkylene glycol (PAG), a polyol ester (POE), and a polyvinyl ether (PVE).

In an embodiment of the above inside air-conditioning device, the refrigerant contains trans-1,2-difluoroethylene (HFO-1132(E)).

In an embodiment of the above inside air-conditioning device, the refrigerant contains trans-1,2-difluoroethylene (HFO-1132(E)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf). A content rate of HFO-1132(E) is 35.0 to 65.0 mass% and a content rate of HFO-1234yf is 65.0 to 35.0 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf. The refrigerant is used for operating a refrigeration cycle in which an evaporating temperature is -75 to -5°C.

In an embodiment of the above inside air-conditioning

device, wherein a content rate of HFO-1132(E) is 41.3 to 53.5 mass% and a content rate of HFO-1234yf is 58.7 to 46.5 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant consists only of HFO-1132(E) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant contains trans-1,2-difluoroethylene (HFO-1132(E)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf). A content rate of HFO-1132(E) is 40.5 to 49.2 mass% and a content rate of HFO-1234yf is 59.5 to 50.8 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant consists only of HFO-1132(E) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant is used for operating a refrigeration cycle in which an evaporating temperature is -75 to 15℃.

In an embodiment of the above inside air-conditioning device, the refrigerant is used as an alternative refrigerant to R12, R22, R134a, R404A, R407A, R407C, R407F, R407H, R410A, R413A, R417A, R422A, R422B, R422C, R422D, R423A, R424A, R426A, R427A, R430A, R434A, R437A, R438A, R448A, R449A, R449B, R449C, R452A, R452B, R454A, R454B, R454C, R455A, R465A, R502, R507 or R513A.

In an embodiment of the above inside air-conditioning device, the refrigerant contains trans-1,2-difluoroethylene (HFO-1132(E)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf). A content rate of HFO-

1132(E) is 31.1 to 39.8 mass% and a content rate of HFO-1234yf is 68.9 to 60.2 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, a content rate of HFO-1132(E) is 31.1 to 37.9 mass% and a content rate of HFO-1234yf is 68.9 to 62.1 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant consists only of HFO-1132(E) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant is used for operating a refrigeration cycle in which an evaporating temperature is -75 to 15°C.

In an embodiment of the above inside air-conditioning device, the refrigerant is used as an alternative refrigerant to R134a, R1234yf or CO_2.

In an embodiment of the above inside air-conditioning device, the refrigerant contains trans-1,2-difluoroethylene (HFO-1132(E)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf). A content rate of HFO-1132(E) is 21.0 to 28.4 mass% and a content rate of HFO-1234yf is 79.0 to 71.6 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant consists only of HFO-1132(E) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant is used as an alternative refrigerant to R12, R22, R134a, R404A, R407A, R407C, R407F, R407H, R410A, R413A, R417A, R422A, R422B, R422C, R422D, R423A, R424A, R426A, R427A, R430A, R434A, R437A, R438A, R448A, R449A, R449B, R449C, R452A, R452B, R454A, R454B, R454C, R455A, R465A, R502, R507, R513A, R1234yf or R1234ze.

In an embodiment of the above inside air-conditioning device, the refrigerant contains trans-1,2-difluoroethylene (HFO-1132(E)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf). A content rate of HFO-1132(E) is 12.1 to 72.0 mass% and a content rate of HFO-1234yf is 87.9 to 28.0 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant consists only of HFO-1132(E) and HFO-1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant is used as an alternative refrigerant to R12, R134a or R1234yf.

In an embodiment of the above inside air-conditioning device, the refrigerant contains at least one substance selected from the group consisting of water, a tracer, an ultraviolet fluorescent dye, a stabilizer, and a polymerization inhibitor.

In an embodiment of the above inside air-conditioning device, the refrigerant contains a refrigerator oil and used as a working

fluid for a refrigeration apparatus.

In an embodiment of the above inside air-conditioning device, the refrigerator oil contains at least one polymer selected from the group consisting of a polyalkylene glycol (PAG), a polyol ester (POE), and a polyvinyl ether (PVE).

Advantageous Effects of Invention

A composition that contains a refrigerant that is used in embodiments of the inside air-conditioning device has the characteristic of having a coefficient of performance (COP) and a refrigerating capacity that are greater than or equal to those of R134a and having a GWP that is sufficiently small, or has the characteristic of having a coefficient of performance (COP) and a refrigerating capacity that are greater than or equal to those of R404A and having a GWP that is sufficiently small.

Brief Description of Drawings

[Fig. 1] Fig. 1 is a schematic view of an experimental device for determining combustibility (flammability or nonflammability).

CLAIMS

~~[Claim 1]~~

1. An inside air-conditioning device comprising:

a refrigerant circuit (50) that includes a compressor (10), a condenser (25), a decompressor (13), and an evaporator (17); and

a refrigerant that is sealed in the refrigerant circuit (50), ~~and that contains at least 1,2 difluoroethylene~~ characterized in that

the refrigerant comprises trans-1,2-difluoroethylene (HFO-1132 (E)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf) in such amounts that the sum of HFO-1132(E) and HFO-1234yf is 99.7 mass% or more, and

a content rate of HFO-1132(E) is 12.1 to 45.0 mass% and a content rate of HFO-1234yf is 87.9 to 55.0 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf.

~~[Claim 2]~~

~~The inside air-conditioning device according to claim 1, wherein the refrigerant contains cis-1,2-difluoroethylene (HFO-1132(Z)).~~

~~[Claim 3]~~

~~The inside air-conditioning device according to claim 2,~~

~~wherein~~

~~the refrigerant contains cis-1,2-difluoroethylene (HFO-1132(Z)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf), and~~

~~a content of HFO-1132(Z) is 53.0 to 59.5% by mass and a content of HFO-1234yf is 47.0 to 40.5% by mass, based on a total mass of HFO-1132(Z) and HFO-1234yf.~~

~~[Claim 4]~~

~~The inside air-conditioning device according to claim 3, wherein the refrigerant is used for operating a refrigeration cycle in which an evaporating temperature is -60 to 20°C.~~

~~[Claim 5]~~

~~The inside air-conditioning device according to claim 3 or claim 4, wherein the refrigerant consists only of HFO-1132(Z) and HFO-1234yf.~~

~~[Claim 6]~~

~~The inside air-conditioning device according to claim 2, wherein~~

~~the refrigerant contains cis-1,2-difluoroethylene (HFO-1132(Z)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf), and~~

~~a content of HFO-1132(Z) is 41.0 to 49.2% by mass and a content of HFO-1234yf is 59.0 to 50.8% by mass, based on a total mass of HFO-1132(Z) and HFO-1234yf.~~

~~[Claim 7]~~

~~The inside air-conditioning device according to claim 6, wherein the refrigerant is used for operating a refrigeration cycle in which an evaporating temperature is -60 to 20°C.~~

~~[Claim 8]~~

~~The inside air-conditioning device according to claim 6 or claim 7, wherein the refrigerant consists only of HFO-1132(Z) and HFO-1234yf.~~

~~[Claim 9]~~

~~The inside air-conditioning device according to any one of claims 3-8,~~

~~wherein the refrigerant is used as an alternative refrigerant to R134a, R22, R12, R404A, R407A, R407C, R407F, R407H, R410A, R413A, R417A, R422A, R422B, R422C, R422D, R423A, R424A, R426A, R427A, R428A, R430A, R434A, R437A, R438A, R448A, R449A, R449B, R449C, R450A, R452A, R452B, R454A, R452B, R454C, R455A, R465A, R502, R507, R513A, R513B, R515A, or R515B.~~

~~[Claim 10]~~

~~The inside air-conditioning device according to any one of claims 3-9,~~

~~wherein the refrigerant contains at least one substance selected from the group consisting of water, a tracer, an ultraviolet fluorescent dye, a stabilizer, and a polymerization inhibitor.~~

~~[Claim 11]~~

~~The inside air-conditioning device according to any one of claims 3-10,~~
~~wherein the refrigerant further contains a refrigerator oil and used as a working fluid for a refrigeration apparatus.~~

~~[Claim 12]~~

~~The inside air-conditioning device according to claim 11,~~
~~wherein the refrigerator oil contains at least one polymer selected from the group consisting of a polyalkylene glycol (PAG), a polyol ester (POE), and a polyvinyl ether (PVE).~~

~~[Claim 13]~~

~~The inside air-conditioning device according to claim 1, wherein the refrigerant contains trans-1,2-difluoroethylene (HFO-1132(E)).~~

~~[Claim 14]~~

~~The inside air-conditioning device according to claim 13,~~

~~wherein~~

~~the refrigerant contains trans-1,2-difluoroethylene (HFO-1132(E)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf),~~

~~a content rate of HFO-1132(E) is 35.0 to 65.0 mass% and a content rate of HFO-1234yf is 65.0 to 35.0 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf, and~~

~~the refrigerant is used for operating a refrigeration cycle in which an evaporating temperature is -75 to -5°C.~~

~~[Claim 15]~~

~~The inside air-conditioning device according to claim 14, wherein a content rate of HFO-1132(E) is 41.3 to 53.5 mass% and a content rate of HFO-1234yf is 58.7 to 46.5 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf.~~

~~[Claim 16]~~

~~The inside air-conditioning device according to claim 14 or claim 15, wherein the refrigerant consists only of HFO-1132(E) and HFO-1234yf.~~

~~[Claim 17]~~

~~The inside air-conditioning device according to claim 13, wherein~~

~~the refrigerant contains trans-1,2-difluoroethylene (HFO-1132(E)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf),~~

~~and~~

~~a content rate of HFO-1132(E) is 40.5 to 49.2 mass% and a content rate of HFO-1234yf is 59.5 to 50.8 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf.~~

~~[Claim 18]~~

~~The inside air-conditioning device according to claim 17, wherein the refrigerant consists only of HFO-1132(E) and HFO-1234yf.~~

~~[Claim 19]~~

~~The inside air-conditioning device according to claim 17 or claim 18, wherein the refrigerant is used for operating a refrigeration cycle in which an evaporating temperature is -75 to 15°C.~~

~~[Claim 20]~~

~~The inside air-conditioning device according to any one of claims 14-19,~~
~~wherein the refrigerant is used as an alternative refrigerant to R12, R22, R134a, R404A, R407A, R407C, R407F, R407H, R410A, R413A, R417A, R422A, R422B, R422C, R422D, R423A, R424A, R426A, R427A, R430A, R434A, R437A, R438A, R448A, R449A, R449B, R449C, R452A, R452B, R454A, R454B, R454C, R455A, R465A, R502, R507 or R513A.~~

~~[Claim 21]~~

~~The inside air-conditioning device according to claim 13, wherein~~

~~the refrigerant contains trans-1,2-difluoroethylene (HFO-1132(E)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf),~~

~~a content rate of HFO-1132(E) is 31.1 to 39.8 mass% and a content rate of HFO-1234yf is 68.9 to 60.2 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf.~~

~~[Claim 22]~~

~~The inside air-conditioning device according to claim 21, wherein a content rate of HFO-1132(E) is 31.1 to 37.9 mass% and a content rate of HFO-1234yf is 68.9 to 62.1 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf.~~

~~[Claim 23]~~

~~The inside air-conditioning device according to claim 21 or claim 22, wherein the refrigerant consists only of HFO-1132(E) and HFO-1234yf.~~

~~[Claim 24]~~

~~The inside air-conditioning device according to any one of claims 21-23, wherein the refrigerant is used for operating a refrigeration cycle in which an evaporating temperature is~~

~~-75 to 15°C.~~

~~[Claim 25]~~

~~The inside air-conditioning device according to any one of claims 21-24,~~

~~wherein the refrigerant is used as an alternative refrigerant to R134a, R1234yf or CO_2.~~

~~[Claim 26]~~

~~The inside air-conditioning device according to claim 13, wherein~~

~~the refrigerant contains trans-1,2-difluoroethylene (HFO-1132(E)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf),~~

~~a content rate of HFO-1132(E) is 21.0 to 28.4 mass% and a content rate of HFO-1234yf is 79.0 to 71.6 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf.~~

~~[Claim 27]~~

~~The inside air-conditioning device according to claim 26, wherein the refrigerant consists only of HFO-1132(E) and HFO-1234yf.~~

~~[Claim 28]~~

~~The inside air-conditioning device according to claim 26 or claim 27,~~

~~wherein the refrigerant is used as an alternative refrigerant to R12, R22, R134a, R404A, R407A, R407C, R407F, R407H, R410A, R413A, R417A, R422A, R422B, R422C, R422D, R423A, R424A, R426A, R427A, R430A, R434A, R437A, R438A, R448A, R449A, R449B, R449C, R452A, R452B, R454A, R454B, R454C, R455A, R465A, R502, R507, R513A, R1234yf or R1234ze.~~

~~[Claim 29]~~

~~The inside air-conditioning device according to claim 13, wherein~~

~~the refrigerant contains trans-1,2-difluoroethylene (HFO-1132(E)) and 2,3,3,3-tetrafluoropropene (HFO-1234yf),~~

~~a content rate of HFO-1132(E) is 12.1 to 72.0 mass% and a content rate of HFO-1234yf is 87.9 to 28.0 mass%, based on a total mass of HFO-1132(E) and HFO-1234yf.~~

~~[Claim 30]~~

~~The inside air-conditioning device according to claim 29, wherein the refrigerant consists only of HFO-1132(E) and HFO-1234yf.~~

~~[Claim 31]~~

2. The inside air-conditioning device according to claim ~~29~~1 ~~or claim 30~~, wherein the refrigerant is used as an alternative refrigerant to R12, R134a or R1234yf.

~~[Claim 32]~~

3. The inside air-conditioning device according to any one of claims ~~14-31~~1-2, wherein the refrigerant contains at least one substance selected from the group consisting of water, a tracer, an ultraviolet fluorescent dye, a stabilizer, and a polymerization inhibitor.

~~[Claim 33]~~

4. The inside air-conditioning device according to any one of claims ~~14-32~~1-3, wherein the refrigerant contains a refrigerator oil and used as a working fluid for a refrigeration apparatus.

~~[Claim 34]~~

5. The inside air-conditioning device according to claim ~~33~~4, wherein the refrigerator oil contains at least one polymer selected from the group consisting of a polyalkylene glycol (PAG), a polyol ester (POE), and a polyvinyl ether (PVE).