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.

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℃.

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).