

(54) [Title of the Invention] WORKING MEDIUM MIXTURE

[Claims]

[Claim 1] A working medium mixture, containing: tetrafluoroethane; and halogenated hydrocarbon having a normal boiling point of -50 to -35°C, as essential components.

[Claim 2] The working medium mixture according to claim 1, wherein the halogenated hydrocarbon is a compound containing at least one hydrogen atom.

[Detailed Description of the Invention]

[0001]

[Technical Field of Application] The present invention relates to a novel working medium mixture that can be used in a refrigerator, a heat pump, or the like.

[0002]

[Related Art] Test developments, which have not matured into practical use, have been made in connection with air conditioning, freezing and refrigerating equipment (refrigeration cycle, heat pump cycle), waste heat recovery power generation (Rankine cycle), heat exchange equipment (heat pipe) and the like.

[0003] As working media to be used in such devices, water, hydrocarbons such as propane and butane, chlorofluorocarbons such as trichloromonofluoromethane (R-11) and 1,2-dichlorotetrafluoroethane (R-114), and ammonium

are known.

[0004]

[Object of the Invention] As chlorofluorocarbons are less toxic, non-flammable and chemically stable, and various types of chlorofluorocarbons having different boiling points are readily available, evaluation studies as working media have been actively conducted. The present inventors have found that, as a result of searching for fluorocarbons with high heat recovery efficiency (particularly, for a freezer, a refrigerator, a heating / cooling apparatus, a hot water supply apparatus, or a heat pump for waste heat recovery), a working medium mixture that contains tetrafluoroethane and halogenated hydrocarbon having a standard boiling point of -50 to -35°C , particularly, a halogenated hydrocarbon that contains at least one hydrogen atom was found that the coefficient of performance, the refrigeration capacity, and the like are improved as compared with an individual component before mixing. The present invention proposes a novel such working medium mixture.

[0005]

[Configuration of the Invention] In the present invention, two types of isomers of 1,1,2,2-tetrafluoroethane (R-134) and 1,1,1,2-tetrafluoroethane (R-134a) are known for the tetrafluoroethane, but since the isomers have similar

physical properties, the isomers may be used alone, or a mixture thereof may be used.

[0006] As the halogenated hydrocarbon having a standard boiling point of -50 to -35°C , the following compounds are preferred. In addition, use of a halogenated hydrocarbon having a standard boiling point of -50°C or lower is impractical because the standard boiling point with respect to tetrafluoroethane is very different, and a dew point temperature and a boiling point temperature in a state of a constant pressure is extremely different, even though a temperature gradient in a heat exchanger of a heat source fluid or a load fluid is taken into consideration. Further if a halogenated hydrocarbon having a standard boiling point of -50°C or less is mixed, there is a disadvantage that high pressure becomes extremely high. On the other hand, it is also impractical, if a halogenated hydrocarbon having a standard boiling point of -35°C or higher is mixed, because the refrigeration capacity per unit volume of a compressor is generally lowered and low pressure is extremely low, except for a specific case of forming an azeotropic mixture. Further, it has been found that, among halogenated hydrocarbons, a compound containing one or more hydrogen atoms tends to increase the latent heat of vaporization compared with a compound containing no hydrogen atom at all, and is preferable for improving the refrigeration capacity,

the heating capacity, and the coefficient of performance. As the halogenated hydrocarbon, a single halogenated hydrocarbon or a mixture thereof may be used. In addition, when an isomer is present in the halogenated hydrocarbon, the isomer may be used alone or in combination.

[0007] Examples of the methane derivative are capable of including CHClF_2 (R22).

[0008] Examples of the ethane derivative are capable of including $\text{CClF}_2\text{-CF}_3$ (R115), $\text{CHF}_2\text{-CF}_3$ (R125), $\text{CF}_3\text{-CH}_3$ (R143a), and $\text{CH}_2\text{F-CH}_3$ (R161).

[0009] Examples of an azeotropic medium are capable of including R502 (R22/R115 mixture).

[0010] Hereinafter, the present invention will be described in detail with reference to Fig. 1 illustrating a flow sheet of a refrigeration cycle system using a working medium of the present invention. In Fig. 1, a reference numeral 1 indicates a compressor, a reference numeral 2 indicates a condenser, reference numerals 3 and 3' indicate a load fluid pipe, a reference numeral 4 indicates a pressure reducing device, a reference numeral 5 indicates an evaporator, and reference numerals 6 and 6' indicate a heat source fluid pipe.

[0011] In the refrigeration cycle system illustrated in Fig. 1, the working medium is compressed in a compressor 1, and then guided to an agglomerator 2, cooled by a load fluid

introduced from a pipe 3 in the condenser 2, and condensed. On the other hand, the load fluid is heated reversely in the condenser 2 and subjected to load heating through the pipe 3'. Next, the condensed working medium is depressurized by a vacuum device 4, and then, guided to an evaporator, and heated by a heat source fluid that is introduced from a pipe 6 and discharged from a pipe 6' in the evaporator 5, and then, sucked into a compressor 1 again, and the cycle described above is repeated. On the other hand, the heat source fluid is cooled reversely in the evaporator 5 and subjected to cooling through the pipe 6'.

[0012] Figs. 2 and 3 illustrate the cycle of the working medium in the refrigeration cycle system illustrated in Fig. 1 on a pressure-enthalpy diagram. When the saturated vapor of the working medium is adiabatically compressed, Fig. 2 illustrates a wet state and Fig. 3 illustrates a dry state.

[0013] A change in the working medium by the compressor in Fig. 1 corresponds to a change of 8 to 9 or 13 to 14 in Figs. 2 and 3, a change in the working medium by the condenser corresponds to a change of 9 → 10 → 11 → or 14 → 15 → 16 → 17, a change in the working medium by the pressure reducing device corresponds to a change of 11 to 12 or 17 to 18, and a change in the working medium by the evaporator corresponds to a change of 12 to 8 or 18 to 13, respectively.

[0014] As an operating condition of the refrigeration cycle system in Fig. 1 using the working medium of the present invention, an evaporation end temperature of the working medium in the evaporator (the temperature of the reference numeral 7 or 13, hereinafter, referred to as an evaporation temperature) and a temperature at which the condensation of the working medium in the condenser started (the temperature of the reference numeral 9 or 15, hereinafter, referred to as a condensation temperature) were set. In Tables 1 to 3, the coefficient of performance in the refrigeration cycle system using the working medium of the present invention, and the refrigeration capacity per unit excluded volume of a compressor are shown.

[0015] By mixing [the two components] as shown in the Tables below, the coefficient of performance and the refrigeration capacity are improved compared with a case where a single component is used. When the coefficient of performance is large, power consumption is small, and when the refrigeration capacity is large, the refrigerating device is small, which are preferable. A preferred mixing composition (molar ratio) with emphasis on the coefficient of performance is, for example, 1/99 - 99 - 1 for R22/R134a, 1/99-40/60 for R125/R134a, and 1/99 - 50/50 for R502-R134a. In addition, a preferred mixing composition (molar ratio), which is important to the refrigeration capacity while

maintaining the coefficient of performance, is, for example, 1/99 to 99/1 for R125/R134a and 1/99-99/1 for R502/R134a.

[0016] While the working medium mixture of the present invention is particularly effective when applied to refrigeration cycles for air conditioning, freezing, and refrigeration in the fields of a low temperature to a medium temperature, and a high temperature, the working medium mixture can be used as a working medium for a Rankine cycle or various other heat recovery techniques. The working medium mixture of the present invention is excellent in thermal stability and does not require a stabilizer in a normal use conditions, but when an increase in the thermal stability is required due to a severe use condition, a phosphite-based compound such as dimethyl phosphite, diisopropyl phosphite, and diphenyl phosphite, a thiophosphite-based compound, or a phosphine sulfide-based compound such as triphenoxyphosphine sulfide and trimethyl phosphine sulfide, and the other stabilizers may be added in a small amount of approximately 1 part by weight with respect to 100 parts by weight of the working medium.

Table 1 (Evaporation Temperature: -15°C, Condensation Temperature: 30°C, Degree of Supercooling: 5°C)

Molar Ratio of	100/0	90/10	80/20	50/50	20/80	10/90	0/100
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R-134a/R-22							
Coefficient of Performance (-)	4.80	4.84	4.86	4.88	4.87	4.86	4.85
Refrigeration Capacity (Kcal/m ³)	271	290	310	380	466	494	518

Table 2 (Evaporation Temperature: -15°C, Condensation Temperature: 30°C, Degree of Supercooling: 5°C)

Molar Ratio of R-134a/R-125	100/0	90/10	80/20	70/30	60/40	10/90	0/100
Coefficient of Performance (-)	4.80	4.85	4.85	4.81	4.75	4.45	4.41
Refrigeration Capacity (Kcal/m ³)	271	296	321	347	375	535	554

Table 3 (Evaporation Temperature: -15°C, Condensation Temperature: 30°C, Degree of Supercooling: 5°C)

Molar Ratio of R-134a/R-502	100/0	90/10	80/20	70/30	60/40	10/90	0/100
Coefficient of Performance (-)	4.80	4.82	4.84	4.84	4.80	4.73	4.71
Refrigeration Capacity (Kcal/m ³)	271	288	307	350	401	507	553

[0017]

[Effects of the Invention] The working medium mixture of the present invention is excellent in refrigeration cycle efficiency, that is, refrigeration and heating efficiency, and has significant improvement compared to a single component before mixing.

[0018]

[Brief Description of Drawings]

Fig. 1 is a flow sheet of a refrigeration cycle for illustrating one embodiment of the present invention, and Figs. 2 and 3 are diagrams illustrating a cycle using the working medium mixture of the present invention in a pressure-enthalpy diagram.

Fig.1

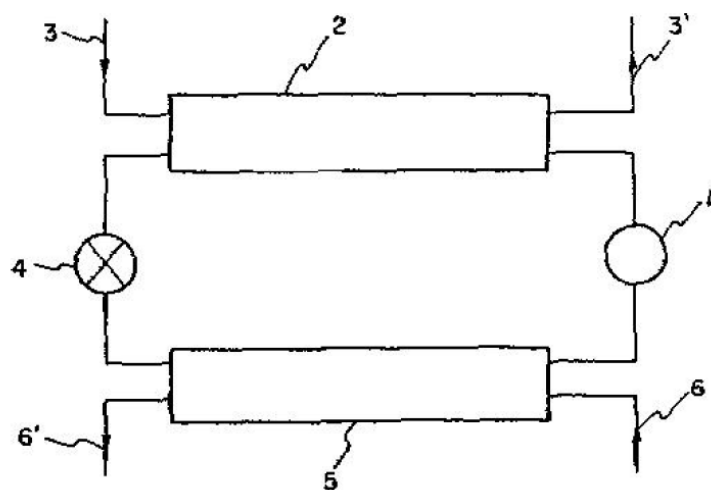


Fig.2

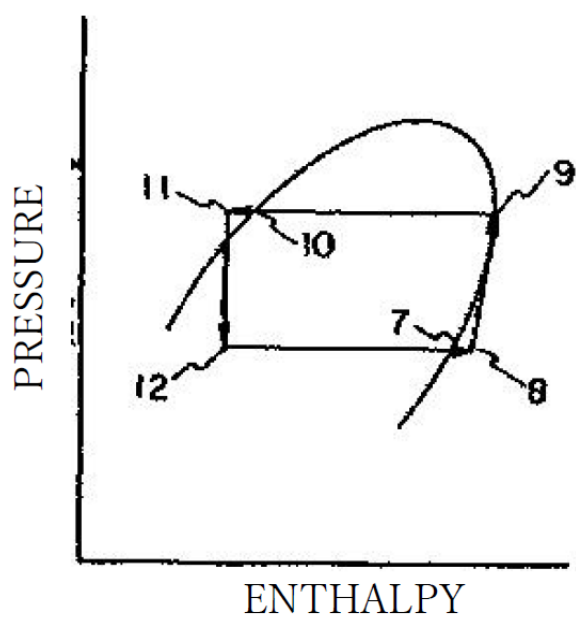


Fig.3

