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(54) REFRIGERATION CYCLE DEVICE

(57) In an outdoor unit (102) of a refrigeration cycle apparatus (100), extension pipe connection valves (13a, 13b) are set on a valve base (54) fixed to a partition plate (50) and a machine chamber side panel (53), and an indication section (61) is arranged on a surface of the valve base (54) on a machine chamber front panel (52) side. The indication section (61) indicates, in addition to a name of refrigerant to be used, a refrigerant class, refrigerant properties, work environment guidelines, and information for access to the work environment guidelines.

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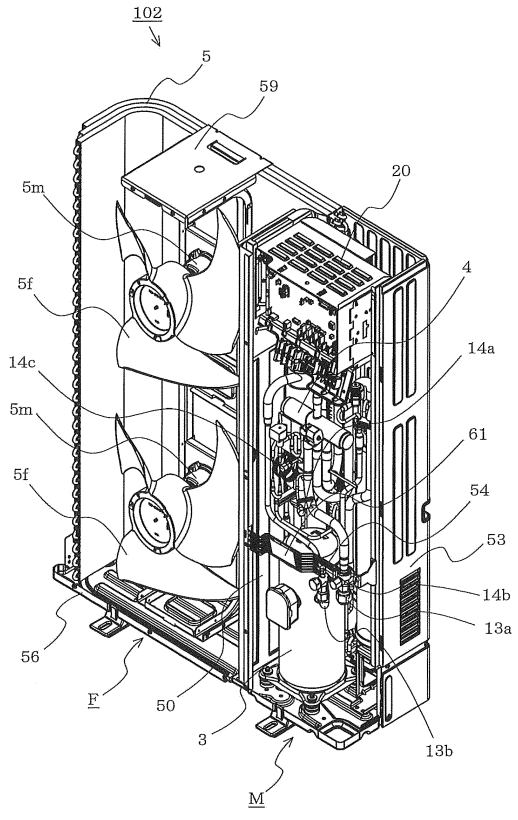

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Description

Technical Field

[0001] The present invention relates to a refrigeration cycle apparatus, and more particularly, to a refrigeration cycle apparatus to be mounted on an air-conditioning apparatus, a hot water supply unit, a refrigerating machine, a vending machine, or the like.

Background Art

[0002] Hitherto, in an apparatus including a device for executing a refrigeration cycle (referred to as "refrigeration cycle apparatus" in the present invention) as represented by an air-conditioning apparatus, "HFC refrigerant" such as R410A having no flame propagation is used as refrigerant. Unlike related-art "HCFC refrigerant" such as R22, R410A has an ozone depletion potential (hereinafter referred to as "ODP") of zero and hence does not deplete an ozone layer. However, R41 0A has a property of high global warming potential (hereinafter referred to as "GWP").

[0003] Therefore, as a part of prevention of global warming, consideration has been made to replace the HFC refrigerant having high GWP, such as R410A, with refrigerant having low GWP.

[0004] As candidate refrigerant having low GWP, there is given HC refrigerant such as R290 (C_3H_8; propane) and R1270 (C_3H_6; propylene), which are natural refrigerants. However, unlike R410A having no flame propagation, the HC refrigerant has flammability at a high flammable level, and hence caution is required for refrigerant leakage.

[0005] Further, as another candidate refrigerant having low GWP, there is given HFC refrigerant having no carbon-carbon double bond in a composition thereof, such as R32 (CH_2F_2; difluoromethane) having GWP lower than R410A.

[0006] Further, as similar refrigerant candidate, there is given a halogenated hydrocarbon having a carbon-carbon double bond in a composition thereof, which is a kind of the HFC refrigerant similarly to R32. As such halogenated hydrocarbon, there are given, for example, HFO-1234yf ($CF_3CF=CH_2$; tetrafluoropropene) and HFO-1234ze (CF_3-CH=CHF). Note that, in order to distinguish the HFC refrigerant having a carbon-carbon double bond in a composition thereof from the HFC refrigerant having no carbon-carbon double bond in a composition thereof, such as R32, the HFC refrigerant having a carbon-carbon double bond in a composition thereof is expressed as "HFO" through use of "O" of an olefin (unsaturated hydrocarbon having a carbon-carbon double bond is called an olefin) in most cases.

[0007] The above-mentioned HFC refrigerant (including the HFO refrigerant) having low GWP is not as high flammable as the HC refrigerant such as R290 (C_3H_8; propane), which is natural refrigerant, but the HFC refrigerant (including the HFO refrigerant) having low GWP has flammability at a slightly flammable level unlike R410A having no flame propagation. Therefore, similarly to R290, caution is required for refrigerant leakage. Refrigerant having flammability is hereinafter referred to as "flammable refrigerant" even when the flammability is at a slightly flammable level.

[0008] Further, as still another candidate refrigerant having low GWP, R717 (NH_3; ammonia) is given. However, R717 has flammability at a slightly flammable level similarly to R32 (CH_2F_2; difluoromethane) and also has toxicity. Therefore, similarly to R290, caution is required for refrigerant leakage. Refrigerant having toxicity is hereinafter referred to as "toxic refrigerant".

[0009] As described above, caution is required for refrigerant leakage of the flammable refrigerant or the toxic refrigerant. Therefore, there is disclosed such a cooling device that a refrigerant name indication label indicating a name of refrigerant to be used in the cooling device is attached to the vicinity of a service port for connection to a charging hose so that a service engineer (hereinafter referred to as "on-site worker") can reconfirm the refrigerant to be used particularly when filling the refrigerant to be used into the cooling device (see, for example, Patent Literature 1).

[0010] Further, there is disclosed such a vending machine that a tape is attached to an outer wall of a compressor to provide refrigerant indication such as "refrigerant name, refrigerant No., chemical name, chemical formula, and refrigerant features", and warning indication such as "exclamation mark, flammability mark, danger/warning indication, caution for high voltage, and handle with care" (see, for example, Patent Literature 2).

Citation List

Patent Literature

[0011]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 10-311629 (Page 3, Fig. 2)
Patent Literature 2: Japanese Unexamined Patent Application Publication No. 2008-40652 (Page 6, Fig. 2)

Summary of Invention

Technical Problem

[0012] However, in the cooling device disclosed in Patent Literature 1, the refrigerant name indication label indicates the name of refrigerant to be used (refrigerant name), but the label does not indicate properties of refrigerant such as flammability and toxicity.

[0013] Further, in the vending machine disclosed in Patent Literature 2, the refrigerant features and the flammability mark are indicated in addition to the refrigerant name, but for example, the degree of flammability is not indicated in spite of the indication of the distinction between no flame propagation and flammability. That is, the degree of properties of refrigerant for indicating whether the refrigerant is high flammable or slightly flammable is not indicated.

[0014] Therefore, during on-site work such as installation, repair, or dismantlement, the on-site worker cannot necessarily understand specific work environment guidelines on what construction method and tool, protective tool, work environment, and the like need to be prepared depending on the degree of properties of refrigerant to be used.

[0015] Thus, there is a problem in that, if the refrigerant leaks during the on-site work, measures appropriate for the on-site worker and people around the site cannot be taken. For example, the following problem may arise. The levels of the work environment guidelines such as the constraint on fire use, the specification constraint on an electric tool, and the work environment of ventilation and air circulation vary depending on the degree of flammability of refrigerant to be used. Therefore, when the on-site worker starts on-site work without correctly understanding the work environment guidelines, the on-site work preparation in accordance with the work environment guidelines that vary in request level depending on the degree of flammability of refrigerant may be insufficient. If the refrigerant leaks in this case, appropriate measures cannot be taken sufficiently.

[0016] The present invention has been made to solve the above-mentioned problem, and it is an object of the present invention to provide a refrigeration cycle apparatus that enables an on-site worker to understand work environment guidelines in accordance with the degree of properties of refrigerant in a stage in which the on-site worker starts on-site work such as installation, repair, or dismantlement of the refrigeration cycle apparatus using refrigerant having flammability and toxicity, thereby allowing appropriate measures to be taken sufficiently even in the case where the refrigerant leaks during the on-site work.

Solution to Problem

[0017] According to one embodiment of the present invention, there is provided a refrigeration cycle apparatus for executing a refrigeration cycle, including: a compressor; a heat source-side heat exchanger; expansion means; a load-side heat exchanger; a refrigerant pipe for circulating refrigerant having at least one characteristic of flammability or toxicity by coupling the compressor, the heat source-side heat exchanger, the expansion means, and the load-side heat exchanger to each other; and an indication section arranged on at least one of a part of the refrigerant pipe, a part of a pipe support member for supporting the refrigerant pipe, a periphery of the part of the refrigerant pipe, and a periphery of the part of the pipe support member, the indication section being configured to indicate work environment guidelines in accordance with the at least one characteristic of the refrigerant.

Advantageous Effects of Invention

[0018] According to the one embodiment of the present invention, in the refrigeration cycle apparatus using the refrigerant having the at least one characteristic of flammability or toxicity, the indication section for indicating the work environment guidelines in accordance with the refrigerant characteristic is arranged on the at least one of the part of the refrigerant pipe, the part of the pipe support member for supporting the refrigerant pipe, the periphery of the part of the refrigerant pipe, or the periphery of the part of the pipe support member.

[0019] Therefore, the indication section attracts the attention of the on-site worker without fail during any on-site work having a risk of refrigerant leakage, such as the time when the refrigeration cycle apparatus is installed, when a valve is opened for extension pipe connection or a test operation, when the valve is closed for collecting the refrigerant during repair, when a refrigerant cylinder is connected for filling the refrigerant, or when the valve is closed for collecting the refrigerant during dismantlement.

[0020] With this, attention required for the on-site work is aroused, and the on-site worker can understand the work environment guidelines indicated on the indication section readily and exactly. Thus, even in the case where the refrigerant having flammability and toxicity leaks during the on-site work such as installation, repair, or dismantlement, measures appropriate for the on-site worker and people around the site can be taken, with the result that the refrigeration cycle apparatus enhanced in reliability for unexpected refrigerant leakage can be obtained.

Brief Description of Drawings

[0021]

[Fig. 1] Fig. 1 is a refrigerant circuit diagram schematically illustrating a configuration of a refrigerant circuit, for illustrating an air-conditioning apparatus serving as a refrigeration cycle apparatus according to Embodiment 1 of the present invention.
[Fig. 2] Fig. 2 is a perspective view illustrating an outer appearance of an outdoor unit of the air-conditioning apparatus serving as the refrigeration cycle apparatus according to Embodiment 1 of the present invention.
[Fig. 3] Fig. 3 is a perspective view illustrating an outer appearance of the outdoor unit of the air-conditioning apparatus serving as the refrigeration cycle apparatus according to Embodiment 1 of the present invention in a state in which a front panel and a top panel are removed.
[Fig. 4] Fig. 4 is a front view illustrating an indication section arranged in the air-conditioning apparatus illustrated in Fig. 1 to Fig. 3 in the case where refrigerant is R32.
[Fig. 5] Fig. 5 is a front view illustrating the indication section arranged in the air-conditioning apparatus illustrated in Fig. 1 to Fig. 3 in the case where refrigerant is R290 (propane).
[Fig. 6] Fig. 6 is a front view illustrating the indication section arranged in the air-conditioning apparatus illustrated in Fig. 1 to Fig. 3 in the case where refrigerant is R717 (ammonia).
[Fig. 7] Fig. 7 is a front view of the indication section arranged in the air-conditioning apparatus illustrated in Fig. 1 to Fig. 3 in the case where indication items are modified.
[Fig. 8] Fig. 8 is a front view of the indication section arranged in the air-conditioning apparatus illustrated in Fig. 1 to Fig. 3 in the case where indication items are modified.
[Fig. 9] Fig. 9 is a perspective view illustrating a modified example of an indoor unit forming the air-conditioning apparatus illustrated in Fig. 1 to Fig. 3.

Description of Embodiments

[Embodiment 1]

[0022] Fig. 1 to Fig. 3 illustrate an air-conditioning apparatus serving as a refrigeration cycle apparatus according to Embodiment 1 of the present invention. Fig. 1 is a refrigerant circuit diagram schematically illustrating a configuration of a refrigerant circuit. Fig. 2 is a perspective view illustrating an outer appearance of an outdoor unit. Fig. 3 is a perspective view illustrating an outer appearance of the outdoor unit in a state in which a front panel and a top panel are removed. Note that, each figure is a schematic illustration, and the present invention is not limited to the embodiment illustrated in each figure.

[0023] Now, Embodiment 1 of the present invention is described with reference to Fig. 1 to Fig. 3. In this case, Embodiment 1 is described through use of an air-conditioning apparatus for cooling and heating indoors as a refrigeration cycle apparatus using a refrigeration cycle in which refrigerant compressed with a compressor is circulated so as to receive heat from a low-temperature heat source and to exhaust the heat to a high-temperature heat source. Note that, the present invention is not limited to the air-conditioning apparatus, and may be applied to, for example, a heating/cooling system, a hot water supply unit, a refrigerating machine, a vending machine, or the like as long as the refrigeration cycle is executed.

(Air-Conditioning Apparatus)

[0024] In Fig. 1, an air-conditioning apparatus 100 serving as the refrigeration cycle apparatus according to Embodiment 1 is a separate type including an indoor unit (same as a load-side unit) 101 to be installed indoors, an outdoor unit (same as a heat source-side unit) 102 to be installed outdoors, and extension pipes 10a and 10b for coupling the indoor unit 101 and the outdoor unit 102 to each other.

(Refrigerant Circuit of Outdoor Unit)

[0025] The outdoor unit 102 includes a compressor 3 for compressing and discharging refrigerant, a refrigerant flow switching valve (hereinafter referred to as "four-way valve") 4 for switching a flow direction of refrigerant in the refrigerant circuit between a cooling operation and a heating operation, an outdoor heat exchanger 5 serving as a heat source-side heat exchanger for exchanging heat between outdoor air and refrigerant, and a pressure reducing device (hereinafter referred to as "expansion valve") 6 serving as expansion means such as an electronically controlled expansion valve for reducing a pressure of refrigerant from a high pressure to a low pressure with a changeable opening degree. Those

components are coupled to each other through an outdoor refrigerant pipe (same as a heat source-side refrigerant pipe) 8.

[0026] Further, an outdoor air-sending fan 5f for supplying (blowing) outdoor air to the outdoor heat exchanger 5 is set so as to be opposed to the outdoor heat exchanger 5. An air flow passing through the outdoor heat exchanger 5 is generated by rotating the outdoor air-sending fan 5f. The outdoor unit 102 uses a propeller fan as the outdoor air-sending fan 5f, and the propeller fan is arranged on a downstream side of the outdoor heat exchanger 5 (downstream side of the air flow generated by the outdoor air-sending fan 5f) in a mode of sucking outdoor air passing through the outdoor heat exchanger 5.

(Outdoor Refrigerant Pipe)

[0027] The outdoor refrigerant pipe 8 refers to a refrigerant pipe for coupling an extension pipe connection valve 13a on a gas side (during the cooling operation) and the four-way valve 4 to each other, a suction pipe 11, a discharge pipe 12, a refrigerant pipe for coupling the four-way valve 4 and the outdoor heat exchanger 5 to each other, a refrigerant pipe for coupling the outdoor heat exchanger 5 and the expansion valve 6 to each other, and a refrigerant pipe for coupling the expansion valve 6 and an extension pipe connection valve 13b on a liquid side (during the cooling operation) to each other. Those pipes are collectively referred to as "outdoor refrigerant pipe 8".

(Extension Pipe Connection Valve)

[0028] The extension pipe connection valve 13a on the gas side is arranged in a connection portion of the outdoor refrigerant pipe 8 to the extension pipe 10a on the gas side, whereas the extension pipe connection valve 13b on the liquid side is arranged in a connection portion of the outdoor refrigerant pipe 8 to the extension pipe 10b on the liquid side.

[0029] The extension pipe connection valve 13a on the gas side is a two-way valve switchable to be opened or closed, and a flare joint 16a is mounted on one end of the extension pipe connection valve 13a on the gas side.

[0030] Further, the extension pipe connection valve 13b on the liquid side is a three-way valve switchable to be opened or closed, and a service port 14b to be used for evacuation (during work before supply of refrigerant to the air-conditioning apparatus 100) and a flare joint 16b are mounted on the extension pipe connection valve 13b on the liquid side.

[0031] Then, a male screw is formed on each outdoor refrigerant pipe 8 side of the flare joints 16a and 16b mounted on the extension pipe connection valves 13a and 13b (also including the service port 14b). At a time of shipping of the outdoor unit 102 (including the shipping of the air-conditioning apparatus 100), a flare nut (not shown) having a female screw to be threadingly engaged with the male screw is mounted on the male screw.

(Service Port)

[0032] Note that, for convenience of the description below, in the outdoor refrigerant pipe 8, a range connecting the compressor 3 to an inlet of the four-way valve 4 on a discharge side of the compressor 3 is referred to as the discharge pipe 12, and a range connecting the four-way valve 4 to the compressor 3 on a suction side of the compressor 3 is referred to as the suction pipe 11.

[0033] Thus, in any of the cooling operation (operation for supplying low-temperature and low-pressure refrigerant to an indoor heat exchanger 7) or the heating operation (operation for supplying high-temperature and high-pressure refrigerant to the indoor heat exchanger 7), the high-temperature and high-pressure gas refrigerant compressed with the compressor 3 constantly flows into the discharge pipe 12, and the low-temperature and low-pressure refrigerant subjected to an evaporation function flows into the suction pipe 11.

[0034] The low-temperature and low-pressure refrigerant flowing through the suction pipe 11 is sometimes in the form of gas refrigerant and sometimes in a two phase state. A service port 14a with a flare joint on a low-pressure side is formed in the suction pipe 11, and a service port 14c with a flare joint on a high-pressure side is formed in the discharge pipe 12. The service ports 14a and 14c are used for connecting pressure gauges thereto during a test operation at a time of installation or repair so that an operation pressure is measured.

[0035] Note that, a male screw is formed on each flare joint (not shown) of the service ports 14a and 14c, and a flare nut (not shown) is mounted on the male screw at a time of shipping of the outdoor unit 102 (including the shipping of the air-conditioning apparatus 100).

(Refrigerant Circuit of Indoor Unit)

[0036] The indoor unit 101 includes the indoor heat exchanger 7 serving as a use-side heat exchanger for exchanging heat between indoor air and refrigerant. An indoor refrigerant pipe (same as a use-side refrigerant pipe) 9 is connected to the indoor heat exchanger 7.

[0037] A flare joint 15a for connecting the extension pipe 10a on the gas side is arranged in a connection portion of

the indoor refrigerant pipe 9 to the extension pipe 10a on the gas side, whereas a flare joint 15b for connecting the extension pipe 10b on the liquid side is arranged in a connection portion of the indoor refrigerant pipe 9 to the extension pipe 10b on the liquid side.

[0038] The flare joints 15a and 15b respectively have a male screw formed thereon, and a flare nut (not shown) having a female screw to be threadingly engaged with the male screw is mounted on the male screw at a time of the shipping of the indoor unit 101 (including the shipping of the air-conditioning apparatus 100).

[0039] Further, an indoor air-sending fan 7f is set so as to be opposed to the indoor heat exchanger 7, and an air flow passing through the indoor heat exchanger 7 is generated by rotating the indoor air-sending fan 7f. Note that, as the indoor air-sending fan 7f, various fans such as a cross flow fan and a turbo fan are adopted depending on the form of the indoor unit 101. Further, the indoor air-sending fan 7f may be positioned on a downstream side or an upstream side of the indoor heat exchanger 7 in the air flow generated by the indoor air-sending fan 7f.

(Refrigerant Circuit of Air-Conditioning Apparatus)

[0040] Both ends of the extension pipe 10a on the gas side are respectively connected removably to the flare joint 16a mounted on the extension pipe connection valve 13a on the gas side of the outdoor unit 102 and the flare joint 15a mounted on the indoor refrigerant pipe 9 of the indoor unit 101, whereas both ends of the extension pipe 10b on the liquid side are respectively connected removably to the flare joint 16b mounted on the extension pipe connection valve 13b on the liquid side of the outdoor unit 102 and the flare joint 15b mounted on the indoor refrigerant pipe 9 of the indoor unit 101.

[0041] That is, the outdoor refrigerant pipe 8 and the indoor refrigerant pipe 9 are connected through the extension pipes 10a and 10b to form the refrigerant circuit, thereby constructing a compression type heat pump cycle for circulating the refrigerant compressed with the compressor 3.

(Refrigerant Flow during Cooling Operation)

[0042] In Fig. 1, the solid arrows denote a flow direction of the refrigerant during the cooling operation. In the cooling operation, the four-way valve 4 is switched to the refrigerant circuit denoted by the solid line, and the high-temperature and high-pressure gas refrigerant discharged from the compressor 3 passes through the four-way valve 4 to first flow into the outdoor heat exchanger 5.

[0043] The outdoor heat exchanger 5 serves as a condenser. That is, when the air flow generated by the rotation of the outdoor air-sending fan 5f passes through the outdoor heat exchanger 5, the outdoor air passing through the outdoor heat exchanger 5 and the refrigerant flowing through the outdoor heat exchanger 5 exchange heat, and condensation heat of the refrigerant is supplied to the outdoor air. Thus, the refrigerant is condensed in the outdoor heat exchanger 5 to turn into high-pressure and intermediate-temperature liquid refrigerant.

[0044] Next, the high-pressure and intermediate-temperature liquid refrigerant flows into the expansion valve 6 and is subjected to adiabatic expansion in the expansion valve 6 to turn into low-pressure and low-temperature two-phase refrigerant.

[0045] Subsequently, the low-pressure and low-temperature two-phase refrigerant is supplied to the indoor unit 101 through the extension pipe 10b on the liquid side and flows into the indoor heat exchanger 7. The indoor heat exchanger 7 serves as an evaporator. That is, when the indoor air flow generated by the rotation of the indoor air-sending fan 7f passes through the indoor heat exchanger 7, the indoor air passing through the indoor heat exchanger 7 and the refrigerant flowing through the indoor heat exchanger 7 exchange heat, and the refrigerant is evaporated by taking away evaporation heat (heating energy) from the indoor air to turn into low-temperature and low-pressure gas refrigerant or two-phase refrigerant. On the other hand, the indoor air passing through the indoor heat exchanger 7 is cooled by taking away cooling energy from the refrigerant, to thereby cool indoors.

[0046] Further, the refrigerant, which is turned into the low-temperature and low-pressure gas refrigerant or the two-phase refrigerant through evaporation in the indoor heat exchanger 7, is supplied to the outdoor unit 102 through the extension pipe 10a on the gas side and sucked into the compressor 3 through the four-way valve 4. Then, the low-temperature and low-pressure gas refrigerant or the two-phase refrigerant is compressed into high-temperature and high-pressure gas refrigerant again with the compressor 3. In the cooling operation, this cycle is repeated.

(Refrigerant Flow during Heating Operation)

[0047] In Fig. 1, the dotted arrows denote a flow direction of the refrigerant during the heating operation. When the four-way valve 4 is switched to the refrigerant circuit denoted by the dotted line, the refrigerant flows in a direction opposite to that during the cooling operation and first flows into the indoor heat exchanger 7. By operating the indoor heat exchanger 7 as a condenser and operating the outdoor heat exchanger 5 as an evaporator, condensation heat

(heating energy) is supplied to the indoor air passing through the indoor heat exchanger 7 to heat the indoor air, thereby performing the heating operation.

(Refrigerant)

[0048] In the air-conditioning apparatus 100, as the refrigerant flowing through the refrigerant circuit, R32 (CH_2F_2; difluoromethane) is used. R32 is HFC refrigerant that has slight flammability although relatively less influencing global warming due to GWP lower than that of HFC refrigerant R410A, which is currently used widely in air-conditioning apparatus. A predetermined amount of the refrigerant is shipped in a state of being sealed in the outdoor unit 102 in advance, and in the case where the amount of the refrigerant is insufficient depending on the length of the extension pipes 10a and 10b when the air-conditioning apparatus 100 is installed, the refrigerant is additionally filled into the air-conditioning apparatus 100 during on-site work.

[0049] Note that, the refrigerant is not limited to R32 and may be, for example, HFO refrigerant, such as HFO-1234yf ($CF_3CF=CH_2$; tetrafluoropropene) or HFO-1234ze (CF_3-CH=CHF), which is a halogenated hydrocarbon having a carbon-carbon double bond in a composition thereof as a kind of the above-mentioned HFC refrigerant having slight flammability similarly to R32, and has GWP further lower than the R32 refrigerant.

[0050] Further, the refrigerant may be HC refrigerant having higher flammability, such as R290 (C_3H_8; propane) or R1270 (C_3H_6; propylene), or slightly flammable and highly toxic R717 (NH_3: ammonia). Further, the refrigerant may be a mixed refrigerant containing two or more kinds of those refrigerants.

(Structure of Outdoor Unit)

[0051] In Fig. 2 and Fig. 3, a housing 2 forming an outer wall of the outdoor unit 102 of the air-conditioning apparatus 100 is formed of a combination of a plurality of plate-shaped sheet-metal parts, and a partition plate 50 for partitioning an inside of the outdoor unit 102 (inside of the housing 2) into right and left regions is set in an upright posture on a bottom plate 56 serving as a bottom portion of the housing 2. The housing 2 is partitioned by the partition plate 50 into a fan chamber F including the outdoor air-sending fans 5f and the outdoor heat exchanger 5 and a machine chamber M including the compressor 3, the outdoor refrigerant pipe 8, and an electrical component unit 20.

(Housing)

[0052] The housing 2 forming the outer wall of the outdoor unit 102 is formed of, in addition to the bottom plate 56, a fan chamber front panel 51 covering a front surface of the fan chamber F, an L-shaped machine chamber front panel 52 covering a front surface of the machine chamber M and a front portion of a side surface of the machine chamber M on an opposite side of the partition plate 50, an L-shaped machine chamber side panel 53 covering a back portion of the side surface and a back surface of the machine chamber M, and a top panel 55 covering a top surface of the outdoor unit 102 across the fan chamber F and the machine chamber M. Those panels are all made of sheet-metal parts. Note that, the panels forming the housing 2 may be formed of smaller parts or some of the panels may be molded integrally.

[0053] A product name plate 60 is attached to an outer front surface of the machine chamber front panel 52, and one of items described in the product name plate 60 is a name of refrigerant to be used. Fig. 3 illustrates the housing in a state in which the top panel 55, the fan chamber front panel 51, and the machine chamber front panel 52 are removed, and the on-site work such as installation, repair, or dismantlement is performed in a state in which at least the machine chamber front panel 52 is removed. Note that, in Fig. 3, electric wiring and the like are not shown.

(Outdoor Air-Sending Fan)

[0054] In the fan chamber front panel 51, substantially circular air outlets 57 are formed so as to be opposed to the outdoor air-sending fans 5f. In order to prevent an object from being brought into contact with the outdoor air-sending fans 5f through the air outlets 57, fan guards 58 ensured in an air flow area are mounted on the air outlets 57.

[0055] The outdoor heat exchanger 5 has a substantially L-shape in transverse cross section and is fixed onto the bottom plate 56 so that a long side portion of the outdoor heat exchanger 5 is positioned in a back surface region of the fan chamber F. A short side portion of the outdoor heat exchanger 5 is positioned in a side surface region of the fan chamber F on an opposite side from the partition plate 50. Each outdoor air-sending fan 5f is positioned in front of the long side portion of the outdoor heat exchanger 5 in the fan chamber F. The outdoor heat exchanger 5 is positioned on an upstream side of the air flow generated by the rotation of the outdoor air-sending fan 5f, and the outdoor air-sending fan 5f is positioned on a downstream side of the air flow generated by the rotation of the outdoor air-sending fan 5f.

[0056] At the back of the outdoor air-sending fan 5f, a fan motor 5m for rotationally driving the outdoor air-sending fan 5f is arranged so as to be coupled to the outdoor air-sending fan 5f through intermediation of a rotation shaft. The fan

motor 5m is fixed onto a fan motor support plate 59 that is fixed onto the bottom plate 56 in an upright posture. The fan motor support plate 59 is positioned between the outdoor air-sending fan 5f and the long side portion of the outdoor heat exchanger 5 in a fore- and-aft direction.

(Compressor)

[0057] On the other hand, in a lower portion of the machine chamber M, the compressor 3 having a mass larger than the other components is set on the bottom plate 56 through intermediation of a vibration isolation rubber. The compressor 3 includes, in a sealed container, a compression mechanism for compressing refrigerant by the rotation of compression elements and an electric motor for rotationally driving the compression elements of the compression mechanism. The compressor 3 sucks the refrigerant from the suction pipe 11 and causes the refrigerant gas compressed in the compression mechanism to flow out to the discharge pipe 12.

[0058] In an upper portion of the machine chamber M, which is positioned at least above the compressor 3, the electrical component unit 20 is set. The electrical component unit 20 accommodates an electronic circuit board having mounted thereon electric and electronic components and the like forming a controller for controlling the operation of the air-conditioning apparatus 100 in conjunction with a controller of the indoor unit 101.

(Outdoor Refrigerant Pipe)

[0059] The outdoor refrigerant pipe 8 is arranged so as to be routed in a space of the machine chamber M excluding the compressor 3 positioned in the lower portion and the electrical component unit 20 positioned in the upper portion.

[0060] In the outdoor refrigerant pipe 8, the extension pipe connection valves 13a and 13b are fixed onto a valve base (same as a pipe support member) 54 arranged closely to the machine chamber front panel 52 side in the machine chamber M in the form of being fixed onto the partition plate 50 and the machine chamber side panel 53. Similarly, the service port 14a on the low-pressure side and the service port 14c on the high-pressure side are also arranged in the vicinity of the valve base 54 arranged closely to the machine chamber front panel 52 side so as to be routed from the outdoor refrigerant pipe 8.

[0061] Due to the above-mentioned arrangement state, during the on-site work such as installation, repair, or dismantlement, the extension pipe connection valves 13a and 13b and the service ports 14a, 14b, and 14c, with which the hand may be brought into contact, are positioned foremost in a state in which the machine chamber front panel 52 is removed. That is, the on-site work can be performed without being interfered with by the compressor 3 and the outdoor refrigerant pipe 8 accommodated in the machine chamber M.

[0062] An indication section 61 is arranged on a surface of the valve base 54 on the machine chamber front panel 52 side to indicate, in addition to the name of refrigerant to be used, a refrigerant class, refrigerant properties, work environment guidelines, and information for access to the work environment guidelines (described separately in detail).

[0063] Note that, in the foregoing, the indication section 61 is arranged in a part of the valve base (pipe support member) 54, but the present invention is not limited thereto. The indication section 61 may be arranged directly in a part of the outdoor refrigerant pipe 8 or may be arranged in the vicinity of the part of the valve base 54 or in the vicinity (referred to as "periphery" in the present invention) of the part (close to the valve base 54) of the outdoor refrigerant pipe 8. That is, in the case where the valve base 54 is formed of (divided into) a plurality of members and each member is small, the indication section 61 may be arranged on the periphery of the members or across the members and the periphery thereof.

(On-Site Work)

[0064] Subsequently, an example of the on-site work is described by exemplifying installation. First, at least the machine chamber front panel 52 is removed from the housing 2 forming the outer wall of the outdoor unit 102.

[0065] Next, one end of the extension pipe 10a and one end of the extension pipe 10b are respectively connected to the flare joints 16a and 16b mounted on the extension pipe connection valves 13a and 13b of the outdoor unit 102 through flare pipes, and the other end of the extension pipe 10a and the other end of the extension pipe 10b are respectively connected to the flare joints 15a and 15b of the indoor unit 101 through flare pipes, to thereby form the refrigerant circuit of the air-conditioning apparatus 100 (which enables the circulation of refrigerant).

[0066] Further, in addition to the connection of a power source and a ground, electric wiring work of the indoor unit 101, the outdoor unit 102, and a remote controller (not shown) is also performed so that the air-conditioning apparatus 100 can be operated.

(Replenishment of Refrigerant)

[0067] Next, the flare nut (not shown) of the service port 14b of the extension pipe connection valve 13b on the liquid side is removed. A vacuum pump, which is prepared in advance, is connected to the service port 14b through use of a charging hose, and the extension pipes 10a and 10b, the indoor refrigerant pipe 9, and the indoor heat exchanger 7 in the indoor unit 101 are evacuated so that air and moisture in the refrigerant circuit are removed.

[0068] The vacuum pump is connected to the service port 14b through intermediation of a pressure gauge (vacuum degree meter), and the evacuation is ended after confirming through the pressure gauge (vacuum degree meter) that a predetermined vacuum degree is reached. Then, the vacuum pump is removed, and the flare nut (not shown) for the service port 14b is mounted again.

[0069] Next, the extension pipe connection valves 13a and 13b are operated to be opened so that the refrigerant sealed in the outdoor unit 102 at a time of shipping is released to the indoor unit 101 and the extension pipes 10a and 10b.

[0070] Then, a test operation is performed by operating the remote controller and a switch and the like on the electronic circuit board of the electrical component unit 20. In this case, when the amount of the refrigerant is insufficient depending on the length of the extension pipes 10a and 10b, the flare nut (not shown) of the service port 14b of the extension pipe connection valve 13b is removed, and a refrigerant cylinder is connected to the service port 14b through use of a charging hose so that a predetermined amount of refrigerant is additionally filled into the air-conditioning apparatus 100.

[0071] Further, pressure gauges are connected respectively to the service port 14a on the low-pressure side and the service port 14c on the high-pressure side to monitor the operation state of the air-conditioning apparatus 100. When there is no problem in the operation state, the test operation is ended. Then, the pressure gauges are removed, and the flare nuts (not shown) of the service ports 14a and 14c are mounted again.

[0072] As described above, during the on-site work, the on-site worker touches the extension pipe connection valves 13a and 13b and the service ports 14a, 14b, and 14c and turns his/her eyes on the vicinity of the extension pipe connection valves 13a and 13b and the service ports 14a, 14b, and 14c without fail, with the result that the on-site worker also turns his/her eyes on the valve base 54 serving as a fixing base of the extension pipe connection valves 13a and 13b. Accordingly, the on-site worker also turns his/her eyes on the indication section 61 arranged on the surface of the valve base 54 on the machine chamber front panel 52 side without fail.

(Indication Section)

[0073] Fig. 4 to Fig. 8 are front views illustrating the indication section arranged in the air-conditioning apparatus illustrated in Fig. 1 to Fig. 3. Fig. 4 illustrates the case where the refrigerant is R32. Fig. 5 illustrates the case where the refrigerant is R290 (propane). Fig. 6 illustrates the case where the refrigerant is R717 (ammonia). Fig. 7 and Fig. 8 illustrate the case where indication items in the indication section are modified.

[0074] As described above, the outdoor unit 102 has the above-mentioned basic configuration and executes a procedure of the above-mentioned on-site work. The air-conditioning apparatus 100 uses, as the refrigerant flowing through the refrigerant circuit, HFC refrigerant (R32 in this case) having low GWP effective for preventing global warming.

[0075] The above-mentioned HFC refrigerant is slightly flammable. Therefore, it is necessary to prepare the work environment that ensures the high safety to the on-site worker and people around the site, that is, the required safety realized by understanding the work environment guidelines in accordance with the degree of flammability even in the case where refrigerant having flammability leaks during the on-site work of the air-conditioning apparatus 100.

[0076] Thus, in the outdoor unit 102, the indication section 61 is arranged on the valve base 54 on which the on-site worker turns his/her eyes without fail even after removing the machine chamber front panel 52 during the on-site work.

[0077] In Fig. 4 to Fig. 6, the indication section 61 indicates (i) a name of refrigerant to be used, (ii) a refrigerant class, (iii) refrigerant properties, (iv) work environment guidelines, and (v) information for access to the work environment guidelines.

(Refrigerant Class)

[0078] In Table 1, the refrigerant class of refrigerant is defined by a combination of a mark indicating the degree of toxicity and a mark indicating the degree of flammability. That is, according to "ASHRAE 34", the toxicity is classified into lower toxicity (A) and higher toxicity (B), and the flammability is classified into no flame propagation (1), slight flammability (2L), lower flammability (2), and higher flammability (3). Thus, the refrigerant class is classified into eight levels from "A1" indicating lower toxicity and no flame propagation to "B3" indicating higher toxicity and higher flammability, and for example, R32 having lower toxicity and slight flammability is classified as "A2L".

[0079] Note that, "ISO 817" as well as "ASHRAE 34" determines the international standard, and the refrigerant class in the present invention is not limited to the class shown in Table 1 ("ASHRAE 34" and "ISO 817").

[Table 1]

Refrigerant type	Refrigerant class	Refrigerant properties	
		Toxicity	Flammability
R410A	A1	Lower toxicity	No flame propagation
R32	A2L	Lower toxicity	Slight flammability
HFO-1234yf	A2L	Lower toxicity	Slight flammability
HFO-1234ze	A2L	Lower toxicity	Slight flammability
R290 (Propane)	A3	Lower toxicity	Higher flammability
R1270 (Propylene)	A3	Lower toxicity	Higher flammability
R717 (Ammonia)	BL2	Higher toxicity	Slight flammability

(Refrigerant Properties)

[0080] In Fig. 4 to Fig. 6, the refrigerant properties indicated on the indication section 61 correspond to the above-mentioned refrigerant class and are represented by terms indicating the degree of toxicity and terms indicating the degree of flammability. Thus, for example, in R32, the refrigerant class is indicated as "A2L" and the refrigerant properties are indicated as "lower toxicity and slight flammability".

[0081] Accordingly, the refrigerant properties are indicated variously to correspond to the refrigerant class, and hence the levels of the work environment guidelines during the on-site work vary. Specifically, the indication section 61 indicates the need to ensure a work environment at each level for the constraint on fire use, the specification constraint on an electric tool, the need for ventilation or air circulation, and the like.

(Work Environment Guidelines)

[0082] In Fig. 4 to Fig. 6, as international specification standard names defining the work environment guidelines, "IEC 60335-2-40" and "ISO 5149" are indicated. That is, the work environment guidelines in accordance with the refrigerant class are internationally defined by "ISO 5149" and "IEC 60335-2-40" and disclosed, in each country, as guidelines by an authority concerned, an academic society, an industrial association organized by manufacturers of a refrigeration cycle apparatus, or the like. Further, the work environment guidelines may be disclosed also to the manufacturers of a refrigeration cycle apparatus in the form of instructions for installation, a service manual, or the like.

[0083] Thus, the work environment guidelines to be indicated on the indication section 61 are not limited to the above-mentioned international specification names and may be the name of the authority concerned, the academic society, the industrial association, or the like.

(Information for Access to Work Environment Guidelines)

[0084] In Fig. 4 to Fig. 6, the indication section 61 indicates, in addition to the international specification numbers ("ISO 5149" and "IEC 60335-2-40"), a QR code (trademark) of a matrix type indicating a site that manages the international specifications as information for access to the contents (details of the work environment guidelines) corresponding to the international specification numbers.

[0085] Thus, even in the case where the on-site worker does not carry documents describing the contents (details of the work environment guidelines) during the on-site work, the on-site worker can understand and confirm the contents (details of the work environment guidelines) easily through use of a mobile phone or a smart phone even at the site of the on-site work.

[0086] Note that, the information for access to the work environment guidelines is not limited to the QR code (trademark) of a matrix type indicating a site that manages the international specifications, and as described above, the work environment guidelines may be defined by the authority concerned, the academic society, the industrial association, or the manufacturers of each country, instead of being defined by the above mentioned international standards. Thus, the information for access to the work environment guidelines may be a URL or a two-dimensional code (PDF417 of a stacked bar code type, a QR code (trademark) of a matrix type, Data Matrix, Mix Code, etc.) of a website corresponding to the name of the authority concerned, the academic society, the industrial association, or the like, instead of the site

that manages the international standards.

(Functions and Effects)

[0087] Focusing on the fact that the on-site worker touches the extension pipe connection valves 13a and 13b of the outdoor unit 102 and the vicinity thereof and turns his/her eyes on the vicinity without fail during the on-site work, in the outdoor unit 102 of the air-conditioning apparatus 100, the indication section 61 is arranged on the valve base 54 serving as a fixing base of the extension pipe connection valves 13a and 13b. The indication section 61 indicates, in addition to (i) a name of refrigerant to be used, (ii) a refrigerant class, (iii) refrigerant properties, (iv) work environment guidelines, and (v) information for access to the work environment guidelines.

[0088] Thus, although R32, which is HFC refrigerant having slight flammability in spite of low GWP, is used as the refrigerant, measures appropriate for the on-site worker and people around the site can be taken sufficiently even in the case where the refrigerant leaks during the on-site work.

[0089] Further, as the information for access to the work environment guidelines in accordance with the refrigerant class, a URL or a two-dimensional code of a website of the international specifications, the authority concerned, the academic society, the industrial association, or the manufacturers, capable of accessing the international specifications, guidelines, and manuals, are indicated. Therefore, the on-site worker can understand and confirm the details of the work environment guidelines easily through use of a mobile phone or a smart phone even at the site of the on-site work. That is, the work environment for the unexpected refrigerant leakage can be ensured in advance more reliably. Accordingly, the reliability for the unexpected refrigerant leakage is enhanced.

[0090] Note that, the indication section 61 is arranged on the valve base 54 in the foregoing, but the present invention is not limited thereto, and the indication section 61 may be arranged at a position close to the extension pipe connection valves 13a and 13b of the outdoor refrigerant pipe 8.

(Modified Example 1 of Indication)

[0091] In Fig. 7, the indication section 61 indicates, as the work environment guidelines, main points of the guidelines instead of the names of the international specifications. That is, specific contents (for fire use, an electric tool, and ventilation and air circulation) required for ensuring the work environment are indicated. Thus, the on-site worker can directly understand cautions in the on-site work in detail at the site of the on-site work.

[0092] Note that, in addition to the above-mentioned indication, the work environment guidelines (names of the international specifications) and a QR code (trademark) may be indicated.

(Modified Example 2 of Indication)

[0093] In Fig. 8, the indication section 61 indicates the refrigerant properties by terms in parentheses after the mark indicating the refrigerant class and indicates "work environment cautions" instead of the work environment guidelines.

[0094] Thus, the on-site worker can understand the cautions in the on-site work readily and exactly at the site of the on-site work.

[0095] Note that, in addition to the above-mentioned indication, the above-mentioned work environment guidelines (names of the international specifications) and a QR code (trademark) may be indicated.

(Modified Example of Indoor Unit)

[0096] Fig. 9 is a perspective view illustrating a modified example of the indoor unit forming the air-conditioning apparatus illustrated in Fig. 1 to Fig. 3 in a state in which a part of components (indoor fan, decorative panel, etc.) is seen through.

[0097] In Fig. 9, the indoor unit 101 of the air-conditioning apparatus 100 is constructed such that a housing 1 of the indoor unit 101 is concealed in an indoor ceiling (not shown), and a substantially rectangular decorative panel (not shown) is removably set in a lower portion of the indoor unit 101.

[0098] The indoor air-sending fan 7f (not shown) having an air inlet on a lower side and a bellmouth (not shown) for introducing air into the indoor air-sending fan 7f are arranged in a substantially central portion inside the housing 1.

(Indoor Heat Exchanger)

[0099] The indoor heat exchanger 7 having a substantially annular shape, which includes indoor heat exchanger portions 7a, 7b, 7c, and 7d arranged respectively in parallel to side surfaces 1a, 1b, 1c, and 1d of the housing 1, is arranged so as to surround the indoor air-sending fan 7f (not shown), and a drain pan (removed) is set in a lower portion

of the indoor heat exchanger 7.

[0100] The indoor refrigerant pipe 9 is connected to the indoor heat exchanger portion 7a, and refrigerant supplied from the outdoor unit 102 passes through the indoor heat exchanger portions 7b, 7c, and 7d through the indoor heat exchanger portion 7a and is returned to the outdoor unit 102 through the indoor heat exchanger portion 7a. A refrigeration cycle is executed in this manner.

[0101] Thus, the indoor air sent from the indoor air-sending fan 7f and the refrigerant for executing the refrigeration cycle exchange heat so that the indoor air is conditioned (cooled or heated, or dehumidified or humidified). Further, air outlets 31 a, 31 b, 31 c, and 31 d are respectively formed between outer peripheral sides of the indoor heat exchanger portions 7a, 7b, 7c, and 7d and the side surfaces 1 a, 1 b, 1 c, and 1 d of the housing 1, and the conditioned indoor air is blown out indoors through the air outlets 31 a, 31 b, 31 c, and 31 d.

(Indication Section)

[0102] Further, an indoor valve base (same as a pipe support member) 32 having set thereon the flare joint 15a for connecting the extension pipe 10a on the gas side and the flare joint 15b for connecting the extension pipe 10b on the liquid side is fixed onto the housing 1 at a position between an end surface of the air outlet 31 a and an end surface of the air outlet 31 d so as to be opposed to an end surface of the indoor heat exchange portion 7a.

[0103] Then, the indication section 61 is arranged on the indoor valve base 32.

[0104] With this, the on-site worker touches the flare joints 15a and 15b of the indoor unit 101 and the vicinity thereof and turns his/her eyes on the vicinity of the flare joints 15a and 15b without fail during the on-site work, and hence the indication section 61 arranged on the indoor valve base 32 attracts the attention of the on-site worker without fail in the same way as in the case of the indication section 61 arranged on the valve base 54 having set thereon the extension pipe connection valves 13a and 13b of the outdoor unit 102.

[0105] Thus, in the same way as in the case of the on-site work in the outdoor unit 102, even in the case where the refrigerant leaks during the on-site work in the indoor unit 101, measures appropriate for the on-site worker and people around the site can be taken sufficiently, and the work environment for the unexpected refrigerant leakage can be ensured in advance more reliably, with the result that the reliability for the unexpected refrigerant leakage is enhanced.

[0106] Note that, the indication section 61 is arranged on the indoor valve base 32 in the foregoing, but the present invention is not limited thereto, and the indication section 61 may be arranged on the periphery of (closely to) the flare joints 15a and 15b of the refrigerant pipe. That is, in the case where the indoor valve base 32 is formed of (divided into) a plurality of members and each member is small, the indication section 61 may be arranged on the periphery of the members or across the members and the periphery thereof.

[0107] Further, the indication section 61 may be arranged on both the outdoor unit 102 and the indoor unit 101 or may be arranged on only the outdoor unit 102.

[0108] In the foregoing, the outdoor unit 102 and the indoor unit 101 are described by exemplifying the air-conditioning apparatus 100 as the refrigeration cycle apparatus of the present invention, but the present invention is not limited to the air-conditioning apparatus 100. That is, the present invention may be applied to any refrigeration cycle apparatus as long as the refrigeration cycle apparatus includes units (heat source-side unit, load-side unit, etc.) requiring work of connecting the refrigerant pipe and work of filling refrigerant through the service port during the on-site work such as installation, repair, or dismantlement, and as the refrigerant that circulates the refrigerant circuit, the refrigerant having flammability and toxicity is used. For example, the present invention may also be applied to other refrigeration cycle apparatus such as a heat pump hot water supply unit, a refrigerating machine, and a chiller, and the similar functions and effects are obtained. Therefore, measures can be taken appropriately for the unexpected refrigerant leakage.

Reference Signs List

[0109] 1 housing 1a side surface 1b side surface 1c side surface 1d side surface 2 housing 3 compressor 4 four-way valve (refrigerant flow switching valve) 5 outdoor heat exchanger 5f outdoor air-sending fan 5m fan motor 6 expansion valve (pressure reducing device) 7 indoor heat exchanger 7a indoor heat exchanger portion 7b indoor heat exchanger portion 7c indoor heat exchanger portion 7d indoor heat exchanger portion 7f indoor air-sending fan 8 outdoor refrigerant pipe 9 indoor refrigerant pipe 10a extension pipe 10b extension pipe 11 suction pipe 12 discharge pipe 13a extension pipe connection valve 13b extension pipe connection valve 14a service port 14b service port 14c service port 15a flare joint 15b flare joint 16a flare joint 16b flare joint 20 electrical component unit 31 a air outlet 31 b air outlet 31 c air outlet 31 d air outlet 32 indoor valve base 50 partition plate 51 fan chamber front panel 52 machine chamber front panel 53 machine chamber side panel 54 valve base 55 top panel 56 bottom plate 57 air outlet 58 fan guard 59 fan motor support plate 60 product name plate 61 indication section 100 air-conditioning apparatus (refrigeration cycle apparatus) 101 indoor unit 102 outdoor unit

Claims

1. A refrigeration cycle apparatus for executing a refrigeration cycle, comprising:

   a compressor;
   a heat source-side heat exchanger;
   expansion means;
   a load-side heat exchanger;
   a refrigerant pipe for circulating refrigerant having at least one of a characteristic of flammability and a characteristic of toxicity by coupling the compressor, the heat source-side heat exchanger, the expansion means, and the load-side heat exchanger to each other; and
   an indication section arranged on at least one of a part of the refrigerant pipe, a part of a pipe support member for supporting the refrigerant pipe, a periphery of the part of the refrigerant pipe, and a periphery of the part of the pipe support member,
   the indication section being configured to indicate work environment guidelines in accordance with the at least one characteristic of the refrigerant.

2. The refrigeration cycle apparatus of claim 1,
   wherein the refrigerant pipe includes a service port for supplying the refrigerant, and
   wherein the indication section is arranged at a position of the service port.

3. The refrigeration cycle apparatus of claim 1 or 2, further comprising:

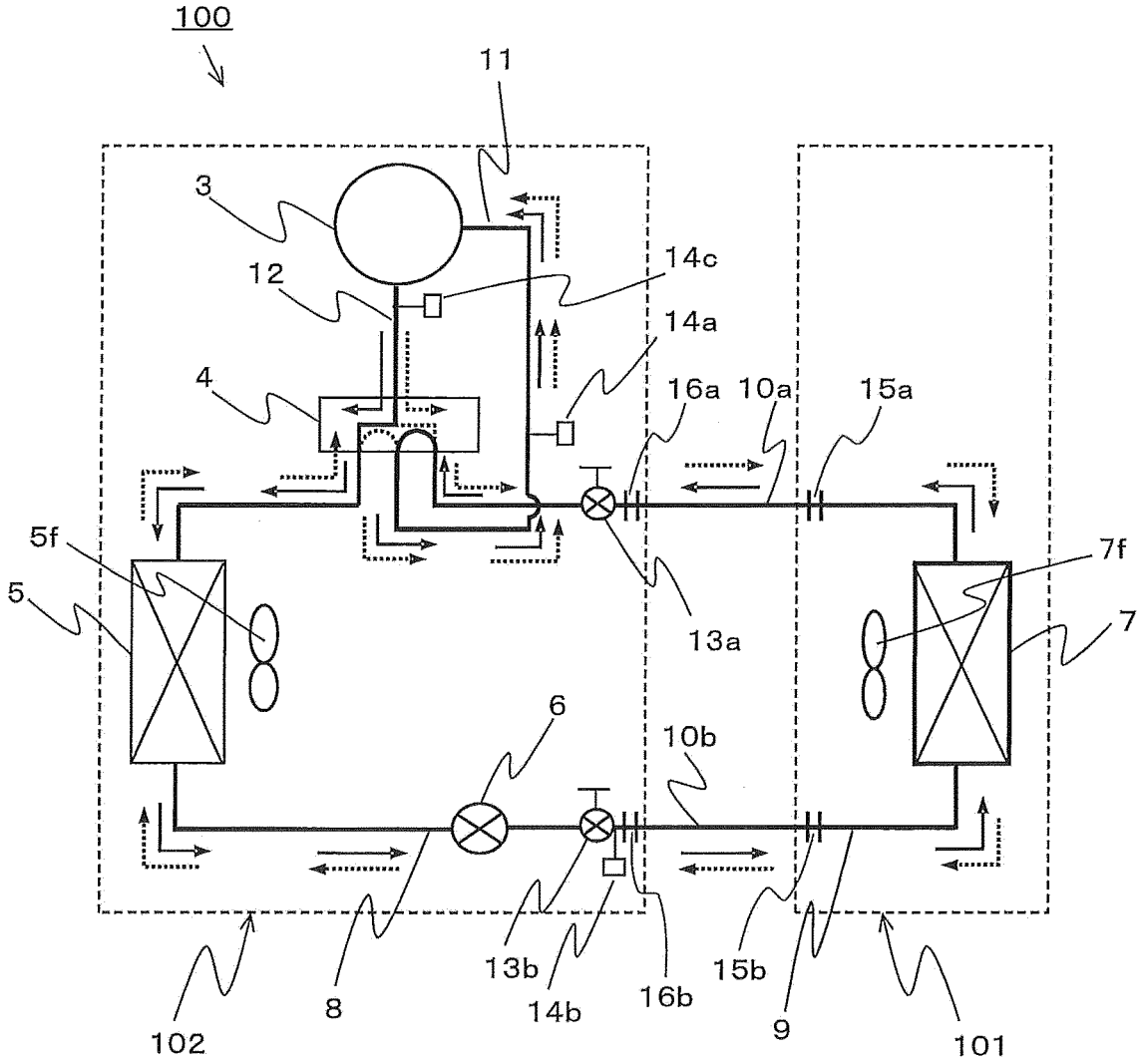
   a heat source-side unit including the compressor and the heat source-side heat exchanger; and
   a load-side unit including the load-side heat exchanger,
   wherein one of both ends of an extension pipe as the part of the refrigerant pipe is connected to a heat source-side connection valve arranged at a heat source-side refrigerant pipe as the part of the refrigerant pipe arranged in the heat source-side unit and an other one of both ends of the extension pipe as the part of the refrigerant pipe is connected to a load-side connection valve arranged at a load-side refrigerant pipe as the part of the refrigerant pipe arranged in the load-side unit, and
   wherein the indication section is arranged on at least one of a position of the heat source-side connection valve, a position of a heat source-side valve support member at which the heat source-side connection valve is set, a periphery of the position of the heat source-side connection valve, and a periphery of the position of the heat source-side valve support member.

4. The refrigeration cycle apparatus of claim 3, wherein the indication section is arranged on at least one of a position of the load-side connection valve, a position of a load-side valve support member at which the load-side connection valve is set, a periphery of the position of the load-side connection valve, or a periphery of the position of the load-side valve support member.

5. The refrigeration cycle apparatus of any one of claims 1 to 4, wherein the indication section indicates a refrigerant name, a refrigerant class, and refrigerant properties in addition to the work environment guidelines.

6. The refrigeration cycle apparatus of claim 5, wherein the indication section indicates information for access to the work environment guidelines.

FIG. 1


100
11
3
12
14c
14a
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16a
10a
15a
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7
13a
6
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102
8
9
101

FIG. 2

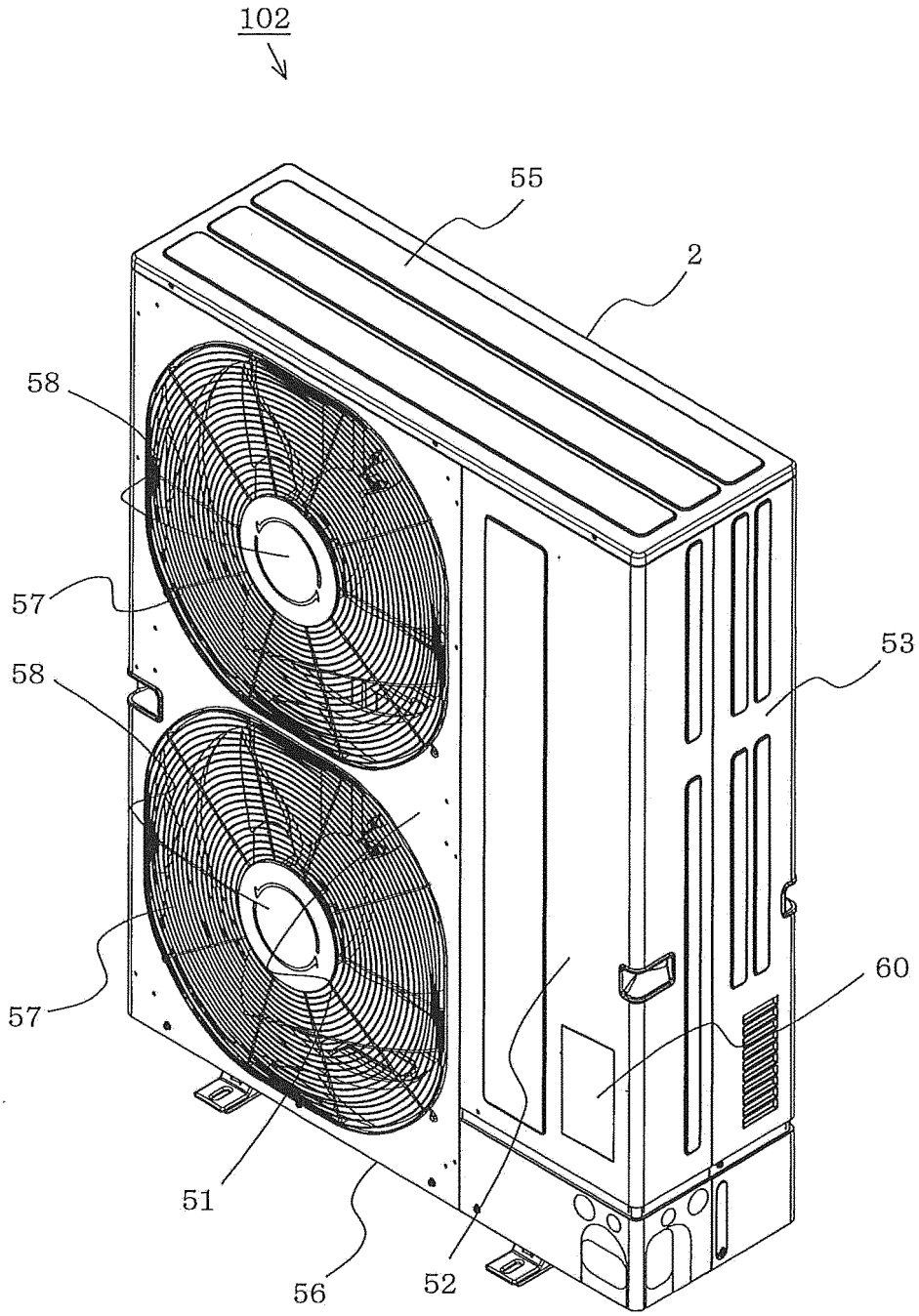


FIG. 3

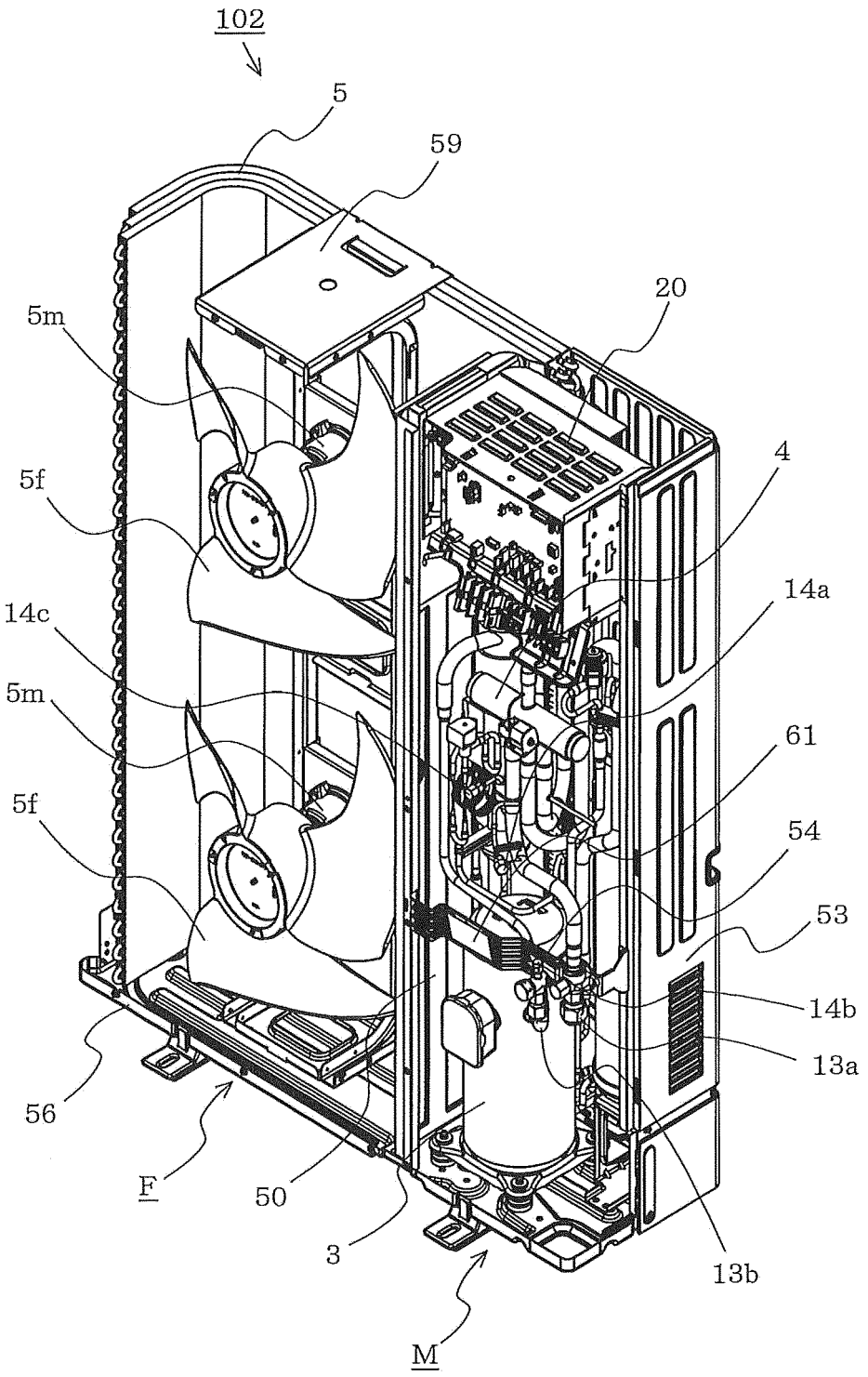


FIG. 4

CASE OF R32

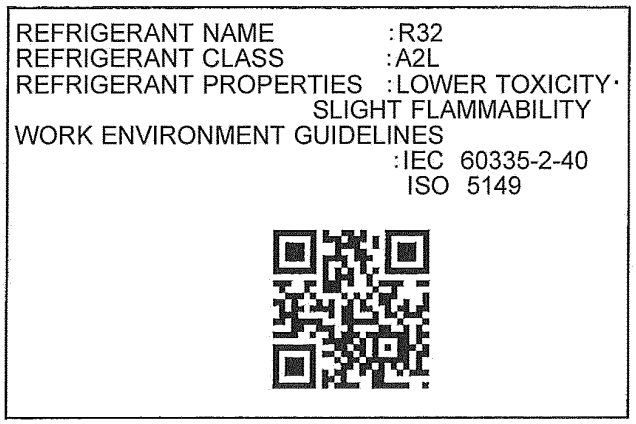


FIG. 5

CASE OF R290 (PROPANE)

FIG. 6

CASE OF R717 (AMMONIA)

FIG. 7

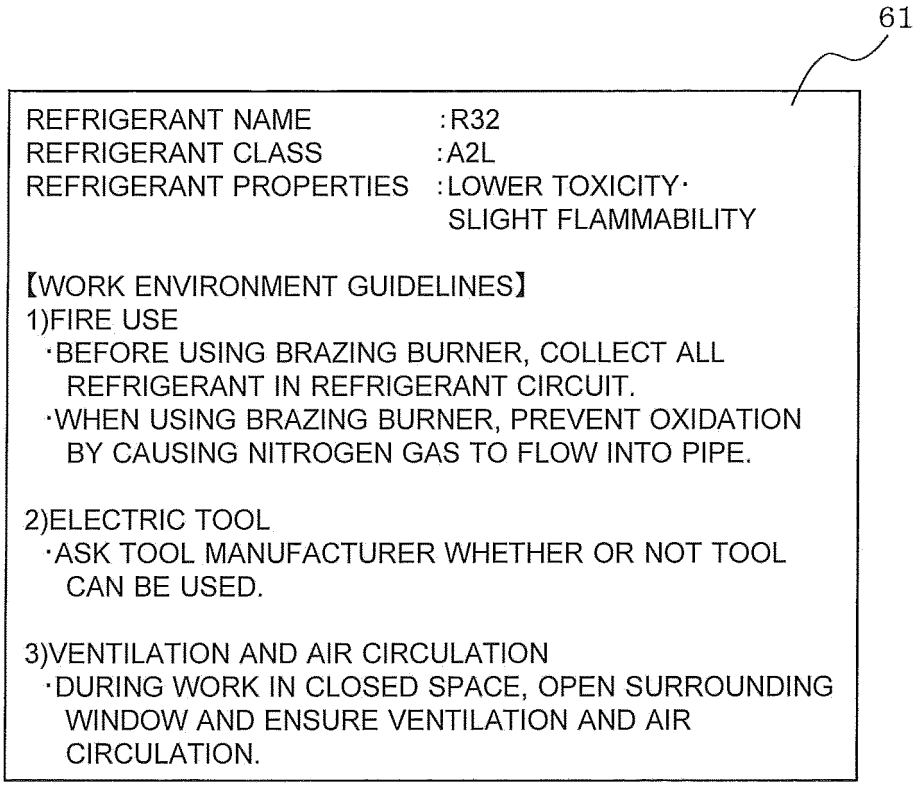

61
REFRIGERANT NAME :R32
REFRIGERANT CLASS :A2L
REFRIGERANT PROPERTIES :LOWER TOXICITY・
SLIGHT FLAMMABILITY
【WORK ENVIRONMENT GUIDELINES】
1)FIRE USE
・BEFORE USING BRAZING BURNER, COLLECT ALL REFRIGERANT IN REFRIGERANT CIRCUIT.
・WHEN USING BRAZING BURNER, PREVENT OXIDATION BY CAUSING NITROGEN GAS TO FLOW INTO PIPE.
2)ELECTRIC TOOL
・ASK TOOL MANUFACTURER WHETHER OR NOT TOOL CAN BE USED.
3)VENTILATION AND AIR CIRCULATION
・DURING WORK IN CLOSED SPACE, OPEN SURROUNDING WINDOW AND ENSURE VENTILATION AND AIR CIRCULATION.

FIG. 8

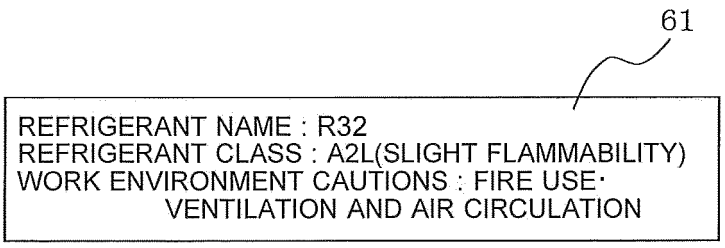
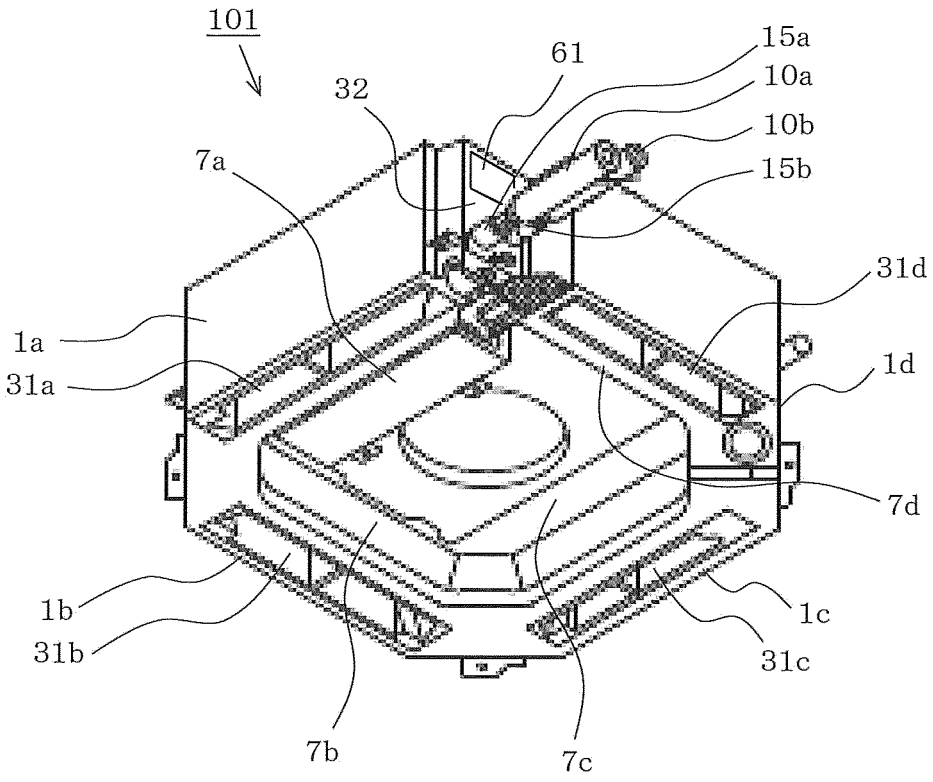

61
REFRIGERANT NAME : R32
REFRIGERANT CLASS : A2L(SLIGHT FLAMMABILITY)
WORK ENVIRONMENT CAUTIONS : FIRE USE・
VENTILATION AND AIR CIRCULATION

FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/052512

A. CLASSIFICATION OF SUBJECT MATTER
F25B49/02(2006.01)i, *F24F1/32*(2011.01)i, *F24F11/02*(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)
F25B49/02, F24F1/32, F24F11/02

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 1996-2014
Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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.
Y	JP 2008-40652 A (Matsushita Electric Industrial Co., Ltd.), 21 February 2008 (21.02.2008), paragraphs [0013], [0024], [0036] to [0039]; fig. 2 (Family: none)	1-3,5-6
Y	Heisei 18 Nendo Hyojun Gijutsushu Kucho Setsubi no Seko Gijutsu, Japan Patent Office, 14 March 2007 (14.03.2007), pages 305 to 307 <URL:http://www.jpo.go.jp/shiryou/s_sonota/hyoujun_gijutsu/kutyou/2-2-3.pdf>	1-3,5-6
Y	JP 2012-193866 A (Mitsubishi Electric Corp.), 11 October 2012 (11.10.2012), claim 8; paragraphs [0026], [0033]; fig. 1 (Family: none)	2-3

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 May, 2014 (01.05.14)	13 May, 2014 (13.05.14)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/052512

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 5168435 B2 (Panasonic Corp.), 21 March 2013 (21.03.2013), paragraphs [0111] to [0113] & JP 5131414 B & WO 2012/157253 A & WO 2012/157252 A1	6
A	JP 2006-258385 A (Fujitsu General Ltd.), 28 September 2006 (28.09.2006), paragraph [0020]; fig. 2 (Family: none)	4
A	JP 10-300249 A (Hitachi, Ltd.), 13 November 1998 (13.11.1998), paragraph [0015] (Family: none)	1
A	JP 6-273007 A (Hitachi, Ltd.), 30 September 1994 (30.09.1994), paragraphs [0010], [0014]; fig. 9 (Family: none)	2-3
A	JP 2003-233319 A (Mitsubishi Electric Corp.), 22 August 2003 (22.08.2003), fig. 1 (Family: none)	5

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 10311629 A **[0011]**
- JP 2008040652 A **[0011]**