

DESCRIPTION

Title of Invention

OUTDOOR UNIT AND AIR-CONDITIONING APPARATUS

Technical Field

5 [0001]

The present invention relates to an outdoor unit of an air-conditioning apparatus that employs a compressor-based refrigeration cycle and the air-conditioning apparatus including the outdoor unit, and more particularly to an outdoor unit and an air-conditioning apparatus configured to provide higher safety and reliability during the installation work and maintenance service of the air-conditioning apparatus.

Background Art

[0002]

Conventionally, hydrochlorofluorocarbon (HCFC)-based R22 refrigerant or hydrofluorocarbon (HFC)-based R410A refrigerant is mainly employed in air-conditioning apparatuses. Thus, many of the existing air-conditioning apparatuses and those currently in production employ the R22 refrigerant or the R410A refrigerant.

[0003]

In recent years, however, a HFC-based R32 refrigerant (difluoromethane), a hydrofluoroolefin-based refrigerant (e.g., HFO1234yf, HFO1234ze), mixed refrigerant containing R32 or HFO-based refrigerant, and natural refrigerant such as R290 (propane) and R600a (isobutane), which are all flammable refrigerant, have come to be focused on from the viewpoint of ozone layer protection and global warming prevention. Among those, the HFC-based R32 refrigerant has an advantage of significantly lower global warming potential (hereinafter, GWP) by

atmospheric emission, compared with the R22 refrigerant and the R410A refrigerant.

[0004]

However, since the R32 refrigerant is flammable, the apparatus that employs the R32 refrigerant has to be designed with sufficient consideration of safety. Accordingly, when a flammable refrigerant such as the R32 refrigerant is to be employed, a certain amount of cost has to be invested for improving the safety level.

[0005]

The air-conditioning apparatus includes a compression refrigeration cycle composed of a compressor, an outdoor heat exchanger, an indoor heat exchanger, a four-way valve, and a depressurizer connected to one another via a refrigerant pipe. Therefore, for the air-conditioning apparatus that employs a flammable refrigerant such as the R32 refrigerant in particular, a safety-oriented design has to be adopted for loading work of the refrigerant in the refrigerant circuit performed, for example, during the installation of the air-conditioning apparatus and the maintenance service thereof.

[0006]

An example of the mentioned design can be found in Patent Literature 1, which discloses a "refrigerating apparatus including an inlet through which refrigerant is loaded in a refrigerant circuit, and a display section located in the vicinity of the inlet and indicating a type of the refrigerant employed.

Citation List

Patent Literature

[0007]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 10-311629

Summary of Invention

Technical Problem

[0008]

Patent Literature 1 discloses a technique of indicating the type of the refrigerant at a position close to the inlet (service port) through which the refrigerant is loaded, thereby allowing the operator to recognize the type of the refrigerant being used. However, the installation work of the air-conditioning apparatus may have to be performed under an unfavorable condition (for example, insufficient light and narrow space that forces the operator to take an irregular posture) depending on the location of the installation site. Accordingly, the operator may fail to recognize the displayed content, and therefore simply displaying the type of the refrigerant may be insufficient for perfectly assuring that the displayed content is recognized by the operator.

[0009]

In the case of employing a flammable refrigerant such as the R32 refrigerant, in particular, the risk that the display fails to be recognized has to be completely eliminated no matter how unfavorable the installation work condition is, otherwise sufficient safety is unable to be secured. Accordingly, it is necessary to develop a more reliable method than ever that allows the operator to recognize without fail the type of the refrigerant employed.

[0010]

Further, the ongoing increase in substitution works of the refrigerant leads to an increase in types of the refrigerants to be handled. Accordingly, the contractors providing the service become more likely to charge a wrong refrigerant by mistake. In such a case, the safety and reliability are significantly degraded.

[0011]

For example, existing air-conditioning apparatuses that employ the R22 refrigerant or R410A refrigerant are not designed in consideration of the safety with respect to the flammable refrigerant. On the assumption that the flammable refrigerant is charged by mistake in such an existing air-conditioning apparatus, the refrigerant concentration of ambient air may reach or exceed a flammable limit, if the refrigerant leaks during the installation or maintenance work or if the refrigerant leaks owing to breakdown of the refrigerant circuit during the use of the air-conditioning apparatus.

[0012]

Conversely, in case that the R22 refrigerant or the R410A refrigerant is erroneously charged in an air-conditioning apparatus configured to use the flammable refrigerant, the inside of the compressor may be worn and the cooling and heating performance may be degraded, because, for example, refrigerating machine oil appropriate for the flammable refrigerant is selected and employed, and thus the reliability is significantly degraded.

[0013]

The present invention has been accomplished in view of the foregoing problem, and provides an outdoor unit that allows an operator (e.g., operator engaged in installation work, operator engaged in maintenance service, or operator engaged in recycle work) to recognize the type of the refrigerant without fail, thereby improving the safety and reliability, and an air-conditioning apparatus including such an outdoor unit.

Solution to Problem

[0014]

In an aspect, the present invention provides an outdoor unit including a refrigerant pipe connection valve including a refrigerant charging service port sealed with a sealing hexagon nut to be removed when refrigerant is charged.

The outdoor unit includes an indication cover including a cover portion on which at least one of a type of the refrigerant employed and a caution are marked, the cover portion being disposed so as to cover a hexagonal column-shaped outer circumference of the sealing hexagon nut, a ring portion attached to the refrigerant pipe connection valve, and a joint portion formed so as to be bendable and connecting between the cover portion and the ring portion.

[0015]

In another aspect, the present invention provides an air-conditioning apparatus including the foregoing outdoor unit and an indoor unit connected to the outdoor unit.

Advantageous Effects of Invention

[0016]

The outdoor unit configured as above minimizes the likelihood of erroneous charging of the refrigerant by the operator during the refrigerant loading work, thereby improving safety level.

[0017]

Since the air-conditioning apparatus according to the present invention includes the foregoing outdoor unit, the degradation in performance and quality of the air-conditioning apparatus can be suppressed.

Brief Description of Drawings

[0018]

[Fig. 1] Fig. 1 is a schematic perspective view showing a general configuration of an air-conditioning apparatus including an outdoor unit according to Embodiment of the present invention.

[Fig. 2] Fig. 2 is a perspective view showing an example of a configuration of an indication cover attached to the outdoor unit according to Embodiment of the present invention.

[Fig. 3] Fig. 3 is an enlarged perspective view showing a part of a side face of the outdoor unit according to Embodiment of the present invention, with the indication cover attached thereto.

5 [Fig. 4] Fig. 4 is a perspective view showing another example of the configuration of the indication cover attached to the outdoor unit according to Embodiment of the present invention.

[Fig. 5] Fig. 5 is an enlarged perspective view showing a part of a side face of the outdoor unit according to Embodiment of the present invention, with the indication cover attached thereto.

10 [Fig. 6] Fig. 6 is a perspective view showing still another example of the configuration of the indication cover attached to the outdoor unit according to Embodiment of the present invention.

[Fig. 7] Fig. 7 is an enlarged perspective view showing a part of a side face of the outdoor unit according to Embodiment of the present invention, with the indication cover attached thereto.

[Fig. 8] Fig. 8 is a perspective view showing another example of the configuration of the indication cover attached to the outdoor unit according to Embodiment of the present invention.

20 [Fig. 9] Fig. 9 is an enlarged perspective view showing a part of a side face of the outdoor unit according to Embodiment of the present invention, with the indication cover attached thereto.

Description of Embodiments

[0019]

25 Hereafter, Embodiment of the present invention will be described with reference to the drawings. In the drawings referred to hereafter, including Fig. 1, relations in size among constituents may differ from actual ones. In the drawings referred to hereafter including Fig. 1, in addition, the constituents of the

same reference numeral are identical or corresponding ones, which is to be applied throughout the description. Further, the configurations of the constituents expressed throughout the description are merely exemplary, and not intended to limit the configuration to those expressions.

5 [0020]

Fig. 1 is a schematic perspective view showing a general configuration of an air-conditioning apparatus A including an outdoor unit B according to Embodiment of the present invention. Referring to Fig. 1, the configuration of the air-conditioning apparatus A will be described.

10 [0021]

The air-conditioning apparatus A may be exemplified by a separate type home-use air-conditioner, and includes an indoor unit C and an outdoor unit B.

The outdoor unit B is fixed on pedestals 51 installed in a space separated from a space to be air-conditioned (e.g., outdoor space), and serves to supply cooling energy or heating energy to the indoor unit C. It is preferable to install the outdoor unit B at a position that allows an air passage for the operation to be secured, not excessively distant from the indoor unit C.

The indoor unit C is hooked on and fixed to a mounting plate 21 fixed to a room wall for example with screws 59, and serves to supply conditioned air to the space to be air-conditioned.

20 [0022]

The outdoor unit B according to Embodiment is configured so as to allow an operator (e.g., operator engaged in installation work of the air-conditioning apparatus A, operator engaged in maintenance service of the air-conditioning apparatus A, or operator engaged in recycle work of the air-conditioning apparatus A) to recognize without fail the type of the refrigerant charged in the air-conditioning apparatus A.

[0023]

A liquid-side pipe joint 12 and a gas-side pipe joint 13 are connected to the indoor unit C. A liquid-side valve (refrigerant pipe connection valve) 8 and a gas-side valve (refrigerant pipe connection valve) 9 are connected to the outdoor unit B.

5 The liquid-side pipe joint 12 of the indoor unit C and the liquid-side valve 8 of the outdoor unit B are connected to each other via an extension pipe (in/out connection refrigerant pipe) 7 having flared ends.

Likewise, the gas-side pipe joint 13 of the indoor unit C and the gas-side valve 9 of the outdoor unit B are connected to each other via another extension
10 pipe 7 having flared ends. Accordingly, components of the indoor unit C and those of the outdoor unit B are connected via the pipes, and thus a refrigerant circuit is constituted.

[0024]

Further, for electrical connection between the indoor unit C and the outdoor
15 unit B, a terminal base of the indoor unit C and a terminal base 17 of the outdoor unit B are connected to each other via a cable 22. The liquid-side valve 8, the gas-side valve 9, and the terminal base 17 of the outdoor unit B are located at positions that allow a service cover 10 to be removed from the outdoor unit B. In
other words, the service cover 10 is removably attached to a side face of the
20 outdoor unit B. In addition, the liquid-side valve 8 and the gas-side valve 9 are fixed to a valve fixing plate 14, as shown in Fig. 3.

[0025]

(Indoor Unit C)

The indoor unit C at least includes an indoor heat exchanger and an air-
25 sending fan.

The indoor heat exchanger serves as condenser (radiator) in the heating operation and as evaporator in the cooling operation.

The air-sending fan is located in the vicinity of the indoor heat exchanger, and supplies airflow to the indoor heat exchanger.

[0026]

The indoor unit C includes an air inlet formed on the upper face, for sucking air in the space to be air-conditioned. The indoor unit C also includes an air outlet formed in a lower portion of the front face, for blowing the conditioned air, obtained through heat exchange with the air sucked through the air inlet in the indoor heat exchanger, to the space to be air-conditioned.

[0027]

(Outdoor Unit B)

The outdoor unit B at least includes a compressor that compresses the refrigerant, for example with variable rotation speed, a four-way valve for switching the flow of the refrigerant, an outdoor heat exchanger that serves as evaporator in the heating operation and as condenser (radiator) in the cooling operation, a flow control device (depressurizer) that reduces the pressure of the refrigerant, and an outdoor fan that supplies airflow to the outdoor heat exchanger.

The outdoor unit B also includes a casing (outer shell) composed of a front panel 62 constituting the front face and a part of the side face, a top panel 65 constituting the upper face, and a side panel 66 constituting a part of the side face.

[0028]

The front panel 62 includes an opening 63 through which air passes. A fan guard 64 formed of wires is attached to the opening 63.

The side panel 66 includes an opening 68 through which the cable 22 is drawn out of the outdoor unit B. The cable 22 exposed from the opening 68 of the side panel 66 is covered with the service cover 10. The outdoor unit B further includes a driving unit configured to drive the compressor, the four-way valve, and

the outdoor fan, and the terminal base 17 for electrical connection to the indoor unit C.

[0029]

(Refrigerant Circuit)

5 The indoor heat exchanger of the indoor unit C, the compressor, the four-way valve, the outdoor heat exchanger, and the flow control device of the outdoor unit B are connected to one another via the pipe, so as to constitute the refrigerant circuit. More specifically, the refrigerant circuit is configured such that in the heating operation the refrigerant flows through the compressor, the four-way valve, 10 the indoor heat exchanger, the flow control device, and the outdoor heat exchanger in this sequence, and that in the cooling operation the refrigerant flows through the compressor, the four-way valve, the outdoor heat exchanger, the flow control device, and the indoor heat exchanger in this sequence.

15 Here, the four-way valve may be excluded so as to perform only either of the cooling operation and the heating operation. In addition, for example a plurality of two-way valves or three-way valves may be employed in place of the four-way valve, so as to switch the flow of the refrigerant in the same way.

[0030]

(Refrigerant)

20 Examples of the refrigerant that may be circulated through the refrigerant circuit of the air-conditioning apparatus A include an R32 refrigerant, which is flammable. Naturally, the refrigerant that may be used in the air-conditioning apparatus A is not limited to the R32 refrigerant. For example, other flammable refrigerant such as an R290 refrigerant, natural refrigerant such as carbon dioxide 25 (CO₂), hydrocarbon, and helium, and substitute refrigerant free from chlorine, typically R410A but also including R407C and R404A, may be employed.

[0031]

(Installation Method of Air-Conditioning Apparatus A)

The installation method of the air-conditioning apparatus A will now be described hereunder.

First, the mounting plate 21 for mounting the indoor unit C is fixed to a room wall with screws 59 or the like. The indoor unit C is hooked onto the mounting plate 21, thus to be fixed thereto.

Then the outdoor unit B is installed at a position that allows the air passage for the operation to be secured, not excessively distant from the indoor unit C (e.g., space around the house, veranda, roof top, garage, garden, and so forth).

[0032]

The liquid-side pipe joint 12 of the indoor unit C and the liquid-side valve 8 of the outdoor unit B are then connected to each other via the extension pipe 7 having the flared ends, to form the refrigerant circuit of the air-conditioning apparatus A. Likewise, the gas-side pipe joint 13 of the indoor unit C and the gas-side valve 9 of the outdoor unit B are connected to each other via another extension pipe 7 having the flared ends. Further, for electrical connection between the indoor unit C and the outdoor unit B, the terminal base of the indoor unit C and the terminal base 17 of the outdoor unit B are connected to each other via the cable 22.

[0033]

Then the service cover 10 is attached to the side face of the outdoor unit B, so as to cover the liquid-side valve 8, the gas-side valve 9, and the terminal base 17 of the outdoor unit B.

Here, each of the pair of extension pipes 7 is covered with a heat insulation material. Then the pair of extension pipes 7 each covered with the heat insulation material are wound together with a tape 61 in a bundle.

[0034]

Fig. 2 is a perspective view showing an example of the configuration of an indication cover 70 (hereinafter, indication cover 70A) attached to the outdoor unit B. Fig. 3 is an enlarged perspective view showing a part of the side face of the outdoor unit B with the indication cover 70A attached thereto. Referring to Fig. 2 and Fig. 3, the configuration of the indication cover 70A and recognition of the operator about the type of the refrigerant charged in the air-conditioning apparatus A will be described hereunder.

[0035]

The liquid-side valve 8 and the gas-side valve 9 are provided on the side face of the outdoor unit B. The gas-side valve 9 includes a refrigerant charging service port 23. The operator at the installation site removes a sealing hexagon nut 24 first, and then attaches a refrigerant charging hose to the refrigerant charging service port 23. Through such process, a built-in push-pin valve in the refrigerant charging service port 23 is opened, so as to charge the refrigerant.

[0036]

The sealing hexagon nut 24 used in an air-conditioner that employs an R410A refrigerant, which is primarily used at present, has a size of 1/2 inches, and the distance between flats of the sealing hexagon nut 24 is 17 mm. However, in the case of using the sealing hexagon nut 24 of the mentioned size, the operator may be led to confuse the type of the refrigerant when a refrigerant other than the R410A refrigerant is charged in the installed air-conditioner.

[0037]

Accordingly, as illustrated in Fig. 3, in the outdoor unit B the indication cover 70A on which the refrigerant name is marked is provided at the joint portion of the gas-side valve 9 on the side of the outdoor unit B. Preferably, the indication cover 70A may be formed of an elastic material such as a resin, a metal, rubber, or the

like. The indication cover 70A includes, as illustrated in Fig. 2, a cover portion 71A, a joint portion 72A, and a ring portion 73A.

[0038]

The cover portion 71A is formed so as to cover a hexagonal column-shaped portion of the sealing hexagon nut 24. In other words, the cover portion 71A is configured so as to allow the hexagonal column-shaped portion of the sealing hexagon nut 24 to be inserted therein and thus to cover the outer circumference of the hexagonal column-shaped portion of the sealing hexagon nut 24. In addition, the refrigerant name of "R32" is marked on the cover portion 71A at a plurality of positions, so that the refrigerant name can be distinguished from any angle. Here, not only the type of the refrigerant, but also a symbol or initial indicating that the refrigerant is flammable, or a caution phrase to that effect may be marked on the cover portion 71A.

[0039]

The joint portion 72A, which serves to connect between the cover portion 71A and the ring portion 73A, is formed so as to be bendable. In other words, the joint portion 72A is configured so as to be connected to a part of the cover portion 71A and to a part of the ring portion 73A. The joint portion 72A is, for example, formed in a flat belt shape, and is bendable. It is preferable, as shown in Fig. 2, to form the joint portion 72A such that the upper and lower surfaces of a central portion is recessed, in other words in a reduced thickness, with respect to the adjacent portions on the side of the cover portion 71A and the ring portion 73A. Such a configuration facilitates the joint portion 72A to be bent, thereby improving the work efficiency in fitting the cover portion 71A onto the sealing hexagon nut 24. Here, the thickness and the width of the joint portion 72A may be determined as desired, depending on the material to be employed.

[0040]

The ring portion 73A is formed in a diameter larger than the joint portion of the gas-side valve 9 on the side of the outdoor unit B, so as to be attached to the joint portion of the gas-side valve 9 on the side of the outdoor unit B. As a practical example of the attaching method of the ring portion 73A, the ring portion 73A may be enlarged and hooked around the gas-side valve 9 screw-fixed to the valve fixing plate 14, at a position close to the screw-fixing position, as illustrated in Fig. 3. In this case, the ring portion 73A can be temporarily expanded because of the elasticity of the rubber when being attached, so as to be hooked around the gas-side valve 9. Accordingly, the indication cover 70A can be applied to a plurality of types of sealing hexagon nuts 24 and gas-side valves 9 of different sizes. Then upon fitting the cover portion 71A onto the sealing hexagon nut 24, the attaching work is finished.

[0041]

The presence of the indication cover 70A forces the operator to remove the cover portion 71A of the indication cover 70A first, before removing the sealing hexagon nut 24 of the refrigerant charging service port 23, when the refrigerant is to be charged in the installation work or maintenance service of the outdoor unit B. In other words, the indication cover 70A serves as an attachment that requires a work of the operator when the sealing hexagon nut 24 is to be removed.

[0042]

Fig. 4 is a perspective view showing another example of the configuration of the indication cover 70 (hereinafter, indication cover 70B) attached to the outdoor unit B. Fig. 5 is an enlarged perspective view showing a part of the side face of the outdoor unit B with the indication cover 70B attached thereto.

Referring to Fig. 4 and Fig. 5, the configuration of the indication cover 70B and recognition of the operator about the type of the refrigerant charged in the air-conditioning apparatus A will be described hereunder.

[0043]

The basic configuration of the indication cover 70B is similar to that of the indication cover 70A shown in Fig. 2, however the ring portion (hereinafter, ring portion 73B) to be attached to the gas-side valve 9 is configured differently.

5 [0044]

The indication cover 70B includes a cover portion 71B, a joint portion 72B, and a ring portion 73B as illustrated in Fig. 4.

The cover portion 71B and the joint portion 72B are configured in the same way as the cover portion 71A and the joint portion 72A of the indication cover 70A shown in Fig. 2.

10 [0045]

The ring portion 73B is intended to be attached to a position different from where the ring portion 73A of the indication cover 70A shown in Fig. 2 is attached, and therefore formed in a different shape from the ring portion 73A of the indication cover 70A shown in Fig. 2. More specifically, the ring portion 73B is configured to be fitted around a base portion of the gas-side valve 9 where the sealing hexagon nut 24 is attached, instead of around the joint portion of the gas-side valve 9 on the side of the outdoor unit B.

15 [0046]

20 The ring portion 73B includes a first ring portion 74 and a second ring portion 75.

The first ring portion 74 is formed in a ring shape having a diameter equal to or smaller than the base portion of the gas-side valve 9 where the sealing hexagon nut 24 is attached, so as to be fixed (locked) around the base portion of the gas-side valve 9 where the sealing hexagon nut 24 is attached with the elastic force of the first ring portion 74.

The second ring portion 75 includes a central portion 75A and a U-shaped portion 75B (first U-shaped portion) outwardly protruding with respect to the central portion 75A, and is formed such that the U-shaped portion 75B can be deformed.
[0047]

5 Accordingly, it is preferable to employ an elastically deformable material such as rubber or a resin to form the ring portion 73B. When the ring portion 73B is made of rubber for example, the indication cover 70B can be applied to a plurality of types of sealing hexagon nuts 24 and gas-side valves 9 of different sizes, which leads to further improvement of work efficiency. In addition, the
10 number of pieces of the U-shaped portions 75B is not limited to the number illustrated in Fig. 4.

[0048]

As a practical example of the attaching method of the ring portion 73B, the U-shaped portion 75B may be deformed so as to fit the base portion of the gas-side valve 9 where the sealing hexagon nut 24 is attached in the central portion
15 75A, and then the ring portion 73B may be made to slide so as to move the base portion of the gas-side valve 9 where the sealing hexagon nut 24 is attached, to the first ring portion 74. Thus, the base portion of the gas-side valve 9 where the sealing hexagon nut 24 is attached is locked in the first ring portion 74. Then
20 upon fitting the cover portion 71B onto the sealing hexagon nut 24, the attaching work is finished.

[0049]

The presence of the indication cover 70B forces the operator to remove the cover portion 71B of the indication cover 70B first, before removing the sealing
25 hexagon nut 24 of the refrigerant charging service port 23, when the refrigerant is to be charged in the installation work or maintenance service of the outdoor unit B.

In other words, the indication cover 70B serves as an attachment that requires a work of the operator when the sealing hexagon nut 24 is to be removed.

[0050]

Fig. 6 is a perspective view showing still another example of the configuration of the indication cover 70 (hereinafter, indication cover 70C) attached to the outdoor unit B. Fig. 7 is an enlarged perspective view showing a part of the side face of the outdoor unit B with the indication cover 70C attached thereto. Referring to Fig. 6 and Fig. 7, the configuration of the indication cover 70C and recognition of the operator about the type of the refrigerant charged in the air-conditioning apparatus A will be described hereunder.

[0051]

The basic configuration of the indication cover 70C is similar to that of the indication cover 70A shown in Fig. 2, however the ring portion (hereinafter, ring portion 73C) to be attached to the gas-side valve 9 is configured differently.

[0052]

The indication cover 70C includes a cover portion 71C, a joint portion 72C, and a ring portion 73C as illustrated in Fig. 6.

The cover portion 71C and the joint portion 72C are configured in the same way as the cover portion 71A and the joint portion 72A of the indication cover 70A shown in Fig. 2.

[0053]

The ring portion 73C is intended to be attached to a position different from where the ring portion 73A of the indication cover 70A shown in Fig. 2 is attached, and therefore formed in a different shape from the ring portion 73A of the indication cover 70A shown in Fig. 2. More specifically, the ring portion 73C is configured to be fitted around the base portion of the gas-side valve 9 where the sealing

hexagon nut 24 is attached, instead of around the joint portion of the gas-side valve 9 on the side of the outdoor unit B.

[0054]

5 The ring portion 73C includes a ring central portion 76 and a U-shaped portion 77 (second U-shaped portion) outwardly protruding with respect to the ring central portion 76.

10 The ring central portion 76 is formed in a ring shape having a diameter equal to or smaller than the base portion of the gas-side valve 9 where the sealing hexagon nut 24 is attached, so as to be fixed (locked) around the base portion of the gas-side valve 9 where the sealing hexagon nut 24 is attached.

The U-shaped portion 77 is formed and deformable.

[0055]

15 Accordingly, it is preferable to employ an elastically deformable material such as rubber or a resin to form the ring portion 73C. When the ring portion 73C is made of rubber for example, the indication cover 70C can be applied to a plurality of types of sealing hexagon nuts 24 and gas-side valves 9 of different sizes, which leads to further improvement of work efficiency. In addition, it suffices that at least two pieces of U-shaped portions 77 are provided as illustrated in Fig. 6.

20 [0056]

As a practical example of the attaching method of the ring portion 73C, the U-shaped portion 77 may be deformed so as to fit the base portion of the gas-side valve 9 where the sealing hexagon nut 24 is attached in the ring central portion 76. Thus, the base portion of the gas-side valve 9 where the sealing hexagon nut 24 is attached is locked in the ring central portion 76. Then upon fitting the cover portion 71B onto the sealing hexagon nut 24, the attaching work is finished.

[0057]

The presence of the indication cover 70C forces the operator to remove the cover portion 71C of the indication cover 70C first, before removing the sealing hexagon nut 24 of the refrigerant charging service port 23, when the refrigerant is to be charged in the installation work or maintenance service of the outdoor unit B.

5 In other words, the indication cover 70C serves as an attachment that requires a work of the operator when the sealing hexagon nut 24 is to be removed.

[0058]

Fig. 8 is a perspective view showing still another example of the configuration of the indication cover 70 (hereinafter, indication cover 70D) attached to the outdoor unit B. Fig. 9 is an enlarged perspective view showing a part of the side face of the outdoor unit B with the indication cover 70D attached thereto. Referring to Fig. 8 and Fig. 9, the configuration of the indication cover 70D and recognition of the operator about the type of the refrigerant charged in the air-conditioning apparatus A will be described hereunder.

15 [0059]

The basic configuration of the indication cover 70D is similar to that of the indication cover 70A shown in Fig. 2, however the ring portion (hereinafter, ring portion 73D) to be attached to the gas-side valve 9 is configured differently.

[0060]

20 The indication cover 70D includes a cover portion 71D, a joint portion 72D, and a ring portion 73D as illustrated in Fig. 8.

The cover portion 71D is configured in the same way as the cover portion 71A of the indication cover 70A shown in Fig. 2.

The joint portion 72D illustrated in Fig. 8 is formed in a flat belt shape.

25 [0061]

The ring portion 73D is intended to be attached to a position different from where the ring portion 73A of the indication cover 70A shown in Fig. 2 is attached,

and therefore formed in a different shape from the ring portion 73A of the indication cover 70A shown in Fig. 2. More specifically, the ring portion 73D is configured to be fitted around the base portion of the gas-side valve 9 where the sealing hexagon nut 24 is attached, instead of around the joint portion of the gas-side valve 9 on the side of the outdoor unit B.

[0062]

The ring portion 73D is a disk-shaped portion including an asterisk-shaped opening formed therein, and has a ring shape as a whole.

It is preferable to employ an elastically deformable material such as rubber or a resin to form the ring portion 73D. When the ring portion 73D is made of rubber for example, the indication cover 70D can be applied to a plurality of types of sealing hexagon nuts 24 and gas-side valves 9 of different sizes, which leads to further improvement of work efficiency.

[0063]

As a practical example of the attaching method of the ring portion 73D, the base portion of the gas-side valve 9 where the sealing hexagon nut 24 is attached may be press-inserted through the asterisk-shaped opening. Thus, the base portion of the gas-side valve 9 where the sealing hexagon nut 24 is attached is press-fitted and locked in the asterisk-shaped opening. Then upon fitting the cover portion 71B onto the sealing hexagon nut 24, the attaching work is finished.

[0064]

The presence of the indication cover 70D forces the operator to remove the cover portion 71D of the indication cover 70D first, before removing the sealing hexagon nut 24 of the refrigerant charging service port 23, when the refrigerant is to be charged in the installation work or maintenance service of the outdoor unit B. In other words, the indication cover 70D serves as an attachment that requires a work of the operator when the sealing hexagon nut 24 is to be removed.

[0065]

As described thus far, the outdoor unit B includes the attachment (indication covers 70A to 70D) that requires a work of the operator when the sealing hexagon nut 24 is to be removed, and therefore further assures that the operator recognizes the type of the refrigerant, than the case of simply applying a sticker or the like on which the type of the refrigerant is marked, to a position close to the connection valve. Therefore, the operator is prevented from charging a wrong refrigerant in the refrigerant loading work, which leads to a higher level of safety and minimized likelihood of degradation in performance and quality of the air-conditioning apparatus A. In the case of employing flammable refrigerant such as the R32 refrigerant, in particular, the improvement is prominent from the viewpoint of safety, and significant contribution to global warming prevention can be realized.

[0066]

Here, the shape of the joint portion 72 (joint portions 72A to 72D) is not limited to those illustrated in the drawings, but may be formed as desired. The indication on the cover portion 71 (cover portions 71A to 71D) may also include, as stated above, in addition to or instead of the type of the refrigerant, a symbol or initial indicating to the effect that the refrigerant is flammable, and a caution phrase expressing the same effect. It is preferable that the mark is engraved, rather than printed, because of durability over an extended period of time, which is advantageous, for example, for identifying the type of the refrigerant in the case of collecting the refrigerant in a recycle center. Although printing is more appropriate when detailed cautions are to be marked, symbols or initials are more advantageous when the display space is limited or when the apparatus is intended to be globally distributed.

[0067]

The type of the refrigerant and the related cautions are information to be provided to the operator in the event of installation or maintenance service, and in the case of the outdoor unit B such information is marked on the gas-side valve 9, and can be accessed upon removing the service cover 10 from the outdoor unit B.

5 Such a configuration keeps general users from accessing unnecessary information, thereby minimizing the likelihood of useless confusion. In particular, a low-flammable refrigerant such as R32 is barely likely to burn, though classified as flammable, and barely likely to incur a burning accident provided that the operator refrains from using fire during the installation or maintenance service of
10 the air-conditioning apparatus. Accordingly, making the cautions accessible only by the operator exempts the general users from feeling unnecessary anxiety, and therefore such an arrangement is particularly useful when a low-flammable refrigerant is employed.

[0068]

15 Although prevention of charging a wrong refrigerant during the installation work of the air-conditioning apparatus A has been described above, the same effects can be attained in the maintenance service of the air-conditioning apparatus A. For example, when the refrigerant in the refrigerant circuit is to be collected for repairing the refrigerant circuit in the event of malfunction, a refrigerant collection
20 device is connected to the refrigerant charging service port 23, to collect the refrigerant. When the new refrigerant is charged also, a refrigerant cylinder prepared in advance is connected to the refrigerant charging service port 23, to charge the refrigerant loaded in the refrigerant cylinder, into the apparatus. Thus, in the case of maintenance service also, the operator can recognize that the type of
25 the refrigerant is different from the previous one, at the moment of removing the sealing hexagon nut 24 of the refrigerant charging service port 23.

[0069]

Further, the refrigerant charging service port 23 is designed for a screw of 1/2 inches, which is identical with the port for the R410A refrigerant conventionally employed. Accordingly, the operator can prepare the charging hose, the vacuum pump, and the pressure gauge that are the same as those utilized thus far, and there is no need to prepare (purchase) those devices specifically for the R32 refrigerant. Therefore, the operator can be exempted from expenses and a time period for newly setting up the infrastructure, which facilitates the air-conditioning apparatus A that employs refrigerant having a low global warming potential to be promptly distributed in the market.

[0070]

Although the refrigerant charging service port 23 is designed for a screw of 1/2 inches, which is identical with the port for the R410A refrigerant primarily employed at present, the port may be designed for a screw of 7/16 inches for the R22 refrigerant conventionally employed. Since the operator already possesses the charging hose, the vacuum pump, and the pressure gauge used thus far for the R22 refrigerant and the R410A refrigerant, the same advantageous effects can be attained with those devices for the R22 refrigerant.

[0071]

Although the air-conditioning apparatus A is exemplified by a separate type home-use air-conditioner in Embodiment, the air-conditioning apparatus A is not limited to the separate type home-use air-conditioner, but may be a commercial-use air-conditioner or refrigerator provided that the outdoor unit B includes the refrigerant charging service port 23.

[0072]

In Embodiment, the color of the cover portion 71 (cover portions 71A to 71D) is not specifically described. It is preferable, however, the color of the indicator plate and the indication cover is the same as the color of the refrigerant

cylinder for easy visual recognition, because the color of the refrigerant cylinder is different depending on the type of the refrigerant cylinder. For example, the color mark of the cylinder of the R32 refrigerant is light blue, and hence it is preferable that the indicator plate and the indication cover are painted in light blue.

[0073]

Further, all of the cover portion 71 (cover portions 71A to 71D), the joint portion 72 (joint portions 72A to 72D), and the ring portion 73 (ring portions 73A to 73D) may be integrally formed of the same material, or a part of those portions may be formed of a different material and combined with the remaining part. For example, the ring portion 73 may be formed of a metal, the joint portion 72 may be formed of soft rubber, and the cover portion 71 may be formed of rubber softer than the joint portion 72. Alternatively, all of the cover portion 71, the joint portion 72, and the ring portion 73 may be integrally formed of the same material, for example rubber.

[0074]

Although it is preferable to form the ring portion 73 from rubber as stated above, different materials may be adopted. For example, a part of the ring portion 73 may be formed of a metal and the remaining part may be formed of rubber or a resin. Alternatively, the ring portion 73 may be formed of a metal and an elastic material such as a spring may be associated therewith.

Reference Signs List

[0075]

7: extension pipe, 8: liquid-side valve, 9: gas-side valve, 10: service cover, 12: liquid-side pipe joint, 13: gas-side pipe joint, 14: valve fixing plate, 17: terminal base, 21: mounting plate, 22: cable, 23: refrigerant charging service port, 24: sealing hexagon nut, 51: pedestal, 59: screw, 61: tape, 62: front panel, 63:

opening, 64: fan guard, 65: top panel, 66: side panel, 68: opening, 70: indication
cover, 70A indication cover, 70B: indication cover, 70C: indication cover, 70D:
indication cover, 71: cover portion, 71A: cover portion, 71B: cover portion, 71C:
cover portion, 71D: cover portion, 72: joint portion, 72A: joint portion, 72B: joint
5 portion, 72C: joint portion, 72D: joint portion, 73A: ring portion, 73B: ring portion,
73C: ring portion, 73D: ring portion, 74: first ring portion, 75: second ring portion,
75A: central portion, 75B: U-shaped portion, 76: ring central portion, 77: U-
shaped portion, A: air-conditioning apparatus, B: outdoor unit, C: indoor unit.

CLAIMS

[Claim 1]

- An outdoor unit including a refrigerant pipe connection valve including a refrigerant charging service port sealed with a sealing hexagon nut to be removed
- 5 when refrigerant is charged, the outdoor unit comprising an indication cover including:
- a cover portion on which at least one of a type of the refrigerant employed and a caution are marked, the cover portion being disposed so as to cover a hexagonal column-shaped outer circumference of the sealing hexagon nut;
 - a ring portion attached to the refrigerant pipe connection valve; and
- 10 a joint portion connecting between the cover portion and the ring portion, wherein the joint portion is formed in a flat belt shape, and is bendable, a central portion of the joint portion being formed thinner than adjacent portions on a side of the cover portion and a side of the ring portion.

[Claim 2]

- 15 The outdoor unit of claim 1,
- wherein the cover portion, the ring portion, and the joint portion of the indication cover are integrally formed of elastically deformable rubber.

[Claim 3]

- The outdoor unit of claim 2,
- 20 wherein the ring portion is elastically fixed to the refrigerant pipe connection valve.

[Claim 4]

- An air-conditioning apparatus comprising:
- the outdoor unit of any one of claims 1 to 3; and
- 25 an indoor unit connected to the outdoor unit.