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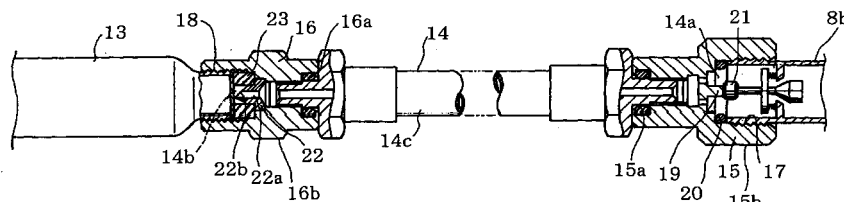
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(54) **Replacing gas collecting trap for an air conditioner**

(57) This invention relates to a replacing gas collecting trap apparatus used for installing an air conditioner, an outdoor unit includes a compressor and an outdoor unit heat exchanger and refrigerant gas is charged into both of the compressor and the outdoor unit heat exchanger, an indoor unit includes an indoor unit heat exchanger which is opened into atmosphere, and a connecting pipe connecting the outdoor unit and the indoor unit, that is comprised of: a trap container body; a gas trap agent charged in said trap container for absorbing and collecting a replacing gas which has replaced air in said indoor unit heat exchanger and said connecting pipe

through a connecting apparatus, wherein a volume of space inside said trap container is larger than the volume of inner space of said connecting apparatus. By this configuration, when the collecting trap apparatus is connected to the refrigeration cycle, by the volume of the space of negative pressure inside the apparatus, the air inside the connecting apparatus and the replacing gas contained in the connecting pipes are inhaled at one go to the collecting trap apparatus, then collected to the gas trap agent by physical absorption or chemical reaction.

FIG.3



EP 1 067 340 A2

Description

Background of the Invention

5 (1) Field of the Invention

[0001] The present invention relates to a method for installing an air conditioner, connecting an indoor unit and an outdoor unit using connecting pipes, and to a collecting trap apparatus of replacing gas used for this method.

10 (2) Description of the Prior Art

[0002] A refrigeration cycle used for an air conditioner comprises a mechanical portion in which a compressor, a heat exchanger and a refrigerant flow rate controller having an expanding mechanism such as a capillary tube or an expanding valve, are connected by pipes such as copper pipes, and fluid charged in the refrigeration cycle such as refrigerant and lubricant oil composition.

[0003] A separate-type air conditioner comprises an outdoor unit having a compressor and a heat exchanger, and an indoor unit having another heat exchanger installed at a place where refrigeration air conditioning is performed. The outdoor unit and the indoor unit are connected through connection pipes such as copper pipes. In this type of refrigeration cycle, it is common to establish the refrigeration cycle in the following way: first, a part or all of the refrigerant and lubricant oil composition is previously charged into the outdoor unit and the valves of the outdoor unit are closed; and then the outdoor unit is connected to the indoor unit by the connection pipes at the time of installing.

[0004] However, if the pipes are merely connected in this way, air remains in the indoor unit and the connection pipes. In order to remove the air, a conventional method employs a vacuum pump connected to a refrigerant charge port provided at the valve of the outdoor unit. And, after the air is removed by the vacuum pump, the valve is opened to connect the indoor unit and the outdoor unit, thereby forming the refrigeration cycle.

[0005] There is another simple installing method in which a valve of the outdoor unit is opened at the time of the installing so that the refrigerant in the outdoor unit is allowed to flow into the one of connection pipes, the indoor unit and then the other connection pipe and is released together with the air remained in the system from a gap created by moderating the connection of a connection port or a refrigerant charge port provided at the other valve of the outdoor unit; thereby replacing the gas in the indoor unit and the connection pipes.

[0006] In view of these conventional methods, Japanese Patent Application Laid-open No.H3-70953 discloses a method to establish a refrigeration cycle without using a vacuum pump in which, after replacing the gas in the refrigeration cycle by oxygen, the refrigerant is charged and the oxygen is solidified by oxygen fixing agent disposed in the refrigeration cycle.

[0007] Further, Japanese Patent Application Laid-open No.H7-159004 discloses a method for charging, into a portion of a refrigeration cycle, material capable of absorbing two or more of water, oxygen, nitrogen, carbon dioxide and the like in the air in such a separate type air conditioner in which among a freezing compressor, a condenser, an expanding mechanism such as a capillary tube and an expanding valve, and an evaporator, one of the condenser and the evaporator, or one of the condenser and the evaporator is separated from the expanding mechanism and connected by the pipes.

[0008] Further, Japanese Patent Application Laid-open No.H7-269994 discloses a refrigeration cycle in which oxygen absorbing agent is disposed in a refrigerant circulating system.

[0009] Further, Japanese Patent Application Laid-open No.H9-292168 discloses a method in which air absorbing agent is disposed for removing air in a pipe and an indoor unit, and a method in which after carbon dioxide is charged in the pipe and the indoor unit, the carbon dioxide in the pipe and the indoor unit is absorbed by carbon dioxide absorbing agent to establish vacuum.

[0010] Since air remaining in the refrigeration cycle deteriorates freezing ability as non-condensation gas, and oxygen and water facilitate degradation of freezer oil, iron and the like in the refrigeration cycle, it is inevitably necessary to remove the air.

[0011] Among the above-described conventional techniques, the method for removing the air using the vacuum pump is common. However, in order to operate the vacuum pump in the installing site, it is necessary that an electric power supply is available; further, it is difficult to use the pump on a roof and the like, and therefore, this method cannot be called a simple method.

[0012] Further, in the case of the replacing method of air using refrigerant, it is not possible to avoid emissions of chlorofluorocarbon, which is the refrigerant, into the atmosphere, and this is not preferable because of global-warming problem in view of global environment concerns.

[0013] Further, concerning a method for collecting a replacing gas after the air in the indoor heat exchanger and the connection pipes is once replaced by the replacing gas, no simple apparatus for collecting the replacing gas has not

been proposed.

[0014] Thereupon, it is an object of the present invention to provide a method for installing an air conditioner capable of easily and reliably collecting a replacing gas after the air in an indoor heat exchanger and a connection pipe is once replaced by the replacing gas, and to provide a collecting trap apparatus of replacing gas used for this method.

Disclosure of the Invention

[0015] To achieve the above object and other objects, according to the present invention, as the first mode of the invention, there is provided a replacing gas collecting trap apparatus used for installing an air conditioner which is comprised of an outdoor unit including a compressor and an outdoor unit heat exchanger and refrigerant gas is charged into both of the compressor and the outdoor unit exchanger; an indoor unit including an indoor unit heat exchanger which is opened into atmosphere; and a connecting pipe connecting the outdoor unit and the indoor unit, that is comprised of: a trap container body; a gas trap agent charged in said trap container for absorbing and collecting a replacing gas which has replaced air in said indoor unit heat exchanger and said connecting pipe through a connecting apparatus, wherein a volume of space inside said trap container is larger than the volume of inner space of said connecting apparatus. By this mode of the invention, when the collecting trap apparatus is connected, by the volume of the space of negative pressure inside the apparatus, the air inside the connecting apparatus and the replacing gas contained in the connecting pipes are inhaled at one go to the collecting trap apparatus, then collected to the gas trap agent by physical absorption or chemical reaction. In other words, since the volume of the space inside the collecting trap apparatus which is brought to a sufficient negative pressure is larger than the volume of the inner space of the connecting apparatus, the air contained in the inner pass way of the connecting apparatus and the replacing gas contained in the connecting pipes are together brought into the collecting trap apparatus and mixed and diffused so that the replacing gas is in speedy fashion absorbed physically or reacted chemically; thereby the volume of the space inside the collecting trap apparatus of sufficient negative pressure acts as a trigger.

[0016] Further, according to the present invention, there is provided a replacing gas collecting trap apparatus as the second mode that meets the following formula:

$$\text{Volume of inside space of a connecting apparatus} \leq (\text{Volume of spaces of a container}) \times (760 - 5A)/760$$

Where A is the pressure inside the container.

[0017] By this mode of the invention, the relation between the volume of the space of collecting trap apparatus and the volume of the space of the connecting apparatus is optimized according to the negative pressure level of the inside of the collecting trap apparatus. As a result, even in the cases where the level of negative pressure is not high, by either setting the volume of space inside the collecting trap apparatus larger or setting the volume of space inside the connecting apparatus smaller, it is made possible to collect the replacing gas in speedy fashion by the replacing gas trap agent.

[0018] Further, according to the present invention, there is provided a replacing gas collecting trap apparatus, as the third mode, used for installing an air conditioner which is comprised of an outdoor unit including a compressor and an outdoor unit heat exchanger and refrigerant gas is charged into both of the compressor and the outdoor unit exchanger; an indoor unit including an indoor unit heat exchanger which is opened into atmosphere; and a connecting pipe connecting the outdoor unit and the indoor unit, that is comprised of: a trap container body; an trap agent charged in the trap container for absorbing and collecting a replacing gas which has replaced air in the indoor unit heat exchanger and the connecting pipe, wherein, a sliding prevention means is provided on the outside surface of the trap container. By this mode of the invention, by providing the sliding prevention means onto the outer surface of the trap container, it makes unnecessary to use a hexangular wrench or spanner, the use of which takes time and is inconvenient and it makes possible to install by bear hand so that speedy installation is achieved.

[0019] Further, according to the present invention, as the forth mode, there is provided a connecting apparatus for installing an air conditioner which is comprised of an outdoor unit including a compressor and an outdoor unit heat exchanger and refrigerant gas is charged into both of the compressor and the outdoor unit exchanger; an indoor unit including an indoor unit heat exchanger which is opened into atmosphere; a connecting pipe connecting the outdoor unit and the indoor unit; wherein, air in the indoor unit heat exchanger is replaced by a replacing gas through one of the connecting apparatus (A), then, the replacing gas is collected trough one of the connecting apparatus (B), the connecting apparatus is comprised of: a sliding prevention means provided on the outside surface of the connecting apparatus (A) and (B). By this mode of the invention, by providing the sliding prevention means onto the outer surface of the connecting apparatus, it makes unnecessary to use a hexangular wrench or spanner, the use of which takes time and is inconvenient and it makes possible to install by bear hand so that speedy installation is achieved.

[0020] Further, according to the present invention, there is provided a replacing gas collecting trap apparatus, as

the fifth mode, used for installing an air conditioner which is comprised of an outdoor unit including a compressor and an outdoor unit heat exchanger and refrigerant gas is charged into both of said compressor and the outdoor unit exchanger; an indoor unit including an indoor unit heat exchanger which is opened into atmosphere; and a connecting pipe connecting the outdoor unit and the indoor unit, that is comprised of: a trap container body; an trap agent charged in the trap container for absorbing and collecting a replacing gas which has replaced air in said indoor unit heat exchanger and the connecting pipe, wherein, a water retention member is provided on the outside surface of the trap container. By this mode of the invention, even in a summer time, if a replacing gas collecting trap apparatus is left inside of a car or under the burning sun, by conducting installation while providing the water to the water retention member and continuously cooling off, it is possible to improve the absorption characteristics of the gas trap agent and thereby, it is possible to achieve a sufficient negative pressure inside of connecting pipes and indoor unit.

[0021] Further, according to the present invention, there is provided a method, as the sixth mode, for installing an air conditioner for connecting an indoor unit and an outdoor unit by a connecting pipe, wherein replacing gas is introduced into the indoor unit and the connecting pipe at the time of installing operation so that air in the indoor unit and the connecting pipe is replaced by the replacing gas and then, a collecting trap apparatus is connected to a portion of the air conditioner through a connecting apparatus whose volume of inner space is smaller than the volume of inner space of the collecting trap apparatus, thereby, the replacing gas is collected by a replacing gas trap agent contained in the collecting trap apparatus. By this mode of the invention, it is possible to complete the installation in a short time since the gas trap agent in the collecting trap apparatus absorbs the replacing gas at one go by a physical absorption or chemical reaction. Further, when the collecting trap apparatus is connected, by the volume of the space of negative pressure inside the apparatus, the air inside the connecting apparatus and the replacing gas contained in the connecting pipes are inhaled at one go to the collecting trap apparatus, then collected to the gas trap agent by physical absorption or chemical reaction. In other words, since the volume of the space inside the collecting trap apparatus which is brought to a sufficient negative pressure is larger than the volume of the inner space of the connecting apparatus, the air contained in the inner pass way of the connecting apparatus and the replacing gas contained in the connecting pipes are together brought into the collecting trap apparatus and mixed and diffused so that the replacing gas is in speedy fashion absorbed physically or reacted chemically; thereby the volume of the space inside the collecting trap apparatus of sufficient negative pressure acts as a trigger.

[0022] Further, according to the present invention, there is provided, as the seventh mode, a method for installing an air conditioner for connecting an indoor unit and an outdoor unit by a connecting pipe, wherein replacing gas is introduced into the indoor unit and the connecting pipe at the time of installing operation through a connecting apparatus A whose outside surface of a connecting means is provided with a sliding prevention measure so that air in the indoor unit and the connecting pipe is replaced by the replacing gas and then, a collecting trap apparatus whose outside surface is provided with a sliding prevention measure is connected to a portion of the air conditioner through a connecting apparatus B whose outside surface of a connecting means is provided with a sliding prevention measure thereby, the replacing gas is collected by a replacing gas trap agent contained in the collecting trap apparatus. By this mode of the invention, no electric power supply is necessary and it is possible to complete the installation in a short time since the gas trap agent in the collecting trap apparatus absorbs the replacing gas at one go by a physical absorption or chemical reaction. At that time, since the sliding prevention means is provided on the outside surface of the collecting trap apparatus and the connecting apparatus, it makes unnecessary to use a hexangular wrench or spanner, the use of which takes time and is inconvenient and it makes possible to install by bear hands so that speedy installation is achieved.

[0023] Further, according to the present invention, there is provided a method, as the eighth mode, for installing an air conditioner for connecting an indoor unit and an outdoor unit by a connecting pipe, wherein replacing gas is introduced into the indoor unit and the connecting pipe at the time of installing operation so that air in the indoor unit and the connecting pipe is replaced by the replacing gas and then, a collecting trap apparatus whose outer surface is provided with a water retention member and to which water is supplied is connected to a portion of the air conditioner, thereby, the replacing gas is collected by a replacing gas trap agent contained in the collecting trap apparatus. By this mode of the invention, no electric power supply is necessary and it is possible to complete the installation in a short time since the gas trap agent in the collecting trap apparatus absorbs the replacing gas at one go by a physical absorption or chemical reaction. Further, even in a summer time, if a replacing gas collecting trap apparatus is left inside of a car or under the burning sun, by conducting installation while providing the water to the water retention member and continuously cooling off, it is possible to improve the absorption characteristics of the gas trap agent and thereby, it is possible to achieve a sufficient negative pressure inside of connecting pipes and indoor unit.

Brief Description of the Drawings

[0024]

Fig.1 is a block diagram of a refrigeration cycle for an air conditioner used for an embodiment of the present inven-

tion to which a carbon dioxide gas cylinder is connected;

Fig.2 is a block diagram of a refrigeration cycle for an air conditioner used for an embodiment of the present invention to which a replacing gas collecting trap apparatus is connected;

Fig. 3 is a schematic diagram of a connecting apparatus used for connecting a service port and a replacing gas collecting trap apparatus of an embodiment of the present invention;

Fig.4 is a sectional view of an replacing gas collecting trap apparatus according to the first embodiment;

Fig.5 is an outside appearance view of Fig. 4;

Fig.6 is a schematic sectional view of a replacing gas collecting trap apparatus taken along the A-A line of Fig. 5;

Fig.7 is a schematic sectional view of a replacing gas collecting trap apparatus according to the third embodiment;

Fig.8 is a schematic sectional view of a replacing gas collecting trap apparatus according to the fifth embodiment;

Fig.9 is a schematic sectional view of a replacing gas collecting trap apparatus taken along the B-B line of Fig.8;

Fig.10 is a schematic sectional view of an essential portion A in the Fig. 9; and

Fig.11 is an outside appearance view of a replacing gas collecting trap apparatus according to the thirteenth embodiment.

Detailed Description of the Preferred Embodiments

[0025] Embodiments of the present invention will be explained with reference to the drawings below.

[0026] Figs.1 and 2 are block diagrams of refrigeration cycles used in this embodiment. Fig.1 shows the refrigeration cycle to which a carbon dioxide gas cylinder is connected, and Fig.2 shows the refrigeration cycle to which a replacing gas collecting trap apparatus is connected.

[0027] First, the entire structure of the refrigeration cycle constituting the air conditioner will be explained using Figs.1 and 2.

[0028] The refrigeration cycle comprises a compressor 1, a four-way valve 2, an outdoor unit heat exchanger 3, an expansion device 4, a dryer 5 and an indoor unit heat exchanger 6. The compressor 1, the four-way valve 2, the outdoor unit heat exchanger 3, the expansion device 4 and the dryer 5 are disposed in an outdoor unit A, and the indoor unit heat exchanger 6 is disposed in an indoor unit B.

[0029] The outdoor unit A is provided with a liquid-side two-way valve 7 and a gas-side three-way valve 8. The outdoor unit A and the indoor unit B are connected to each other through connection pipes 9 and 10 using the liquid-side two-way valve 7 and the gas-side three-way valve 8. The liquid-side two-way valve 7 is provided with a screw portion 7a, and a pipe on the side of the outdoor unit A and a connecting pipe 9 are brought into communication with each other by opening the screw portion 7a. The gas-side three-way valve 8 is provided with a screw portion 8a and a service port 8b, and a pipe on the side of the outdoor unit A and a connecting pipe 10 are brought into communication with each other by opening this screw portion 8a.

[0030] As shown in Fig.1, a carbon dioxide gas cylinder 11 can be connected to the service port 8b using a connecting apparatus 12, and as shown in Fig.2, a replacing gas collecting trap apparatus 13 can be connected to the service port 8b using a connecting apparatus 14.

[0031] These carbon dioxide gas cylinder 11 and the replacing gas collecting trap apparatus 13 can be brought into communication with the connecting pipe 10 by connecting with the connecting apparatus 12 and 14, respectively.

[0032] Fig.3 is a schematic view of the connecting apparatus 14 for connecting the replacing gas collecting trap apparatus to a service port 8b according to one embodiment of the invention.

[0033] The connecting apparatus 14 is provided at its one end with the first connecting portion 14a which will be connected to the service port 8b, and at the other end with the second connecting portion 14a which will be connected to the replacing gas collecting trap apparatus 13. At the connecting portion 14a, there is provided with a connecting means 15 which will be connected to the service port 8b. Further, at the connecting portion 14b, there is provided with a connecting means 16 which will be connected to the replacing gas collecting trap apparatus 13. Further, these connecting means 15 and connecting means 16 are, respectively, being rotatably connected to the connecting pipe 14C through ring shaped seal members 15a and 16a. Further, the outer peripheral surface of the connecting means 15 and the connecting means 16 are provided with roulette finish portions 15b and 16b. In this way, by rotatably providing the connecting means 15, 16 to the connecting pipe 14C, it will not be necessary to rotate the connecting means 15, 16 and the body of connecting apparatus 14, all together; thereby, a good installability is achieved. Here; the connecting pipe 14C is comprised of a material, such as rubber hose, so that it will be flexibly adaptable; therefore, an installation at places where the work space is limited will be made easier.

[0034] A female screw 17 is formed on an inner peripheral surface of the connecting means 15, which is threadedly engaged with a male screw of the service port 8b. And a female screw 18 is formed on an inner peripheral surface of the connecting means 16, which is threadedly engaged with a male screw formed on an opening of the replacing gas collecting trap apparatus. A valve rod 19 and a seal member 20, which is comprised of, for example, O-ring etc. are provided in the connecting means 15. Here, the valve rod 19 abuts against a valve core 21 in the service port 8b, and is

able to push the valve core 21. On the other hand, an opening means 22 is formed in the connecting means 16 such that a hole can be formed on the plate shape cap provided at the opening of the replacing gas collecting trap apparatus 13. The opening means is comprised of a needle shape member having a through hole 22a at the center portion and an inclined surface 22b. At the outer peripheral surface of the opening means 22, a ring shape seal member 23 is provided. Here, there is provided a space where the tip portion of the opening of the replacing gas collecting trap apparatus 13 between the opening means and the seal member 23. The seal member 23 is comprised of a material which has elasticity, such as a rubber. Incidentally, the seal member 23 will be elastically transformed to the predetermined extent in the direction of the stroke. Although it is structured such that the service port 8b will be opened by pushing the valve core 21, the valve core 21 is conditioned so as to be pushed against a seat by the elastic body.

(The First Embodiment)

[0035] Figs.4 to 6 show the trap apparatus according to the first embodiment, wherein Fig. 4 is a schematic sectional side view of a replacing gas collecting trap apparatus of the embodiment, Fig.17 is a view of an outward appearance of the replacing gas collecting trap apparatus, and Fig.18 is a sectional view taken along the A - A line as shown in Fig. 5.

[0036] In the trap apparatus 13-A, spherical zeolite 24 is charged into an aluminum container body. The zeolite 24 has 6 to 8 mesh diameter. The trap apparatus 13-A is provided therein with a baffle 25 for separating an inlet C and the zeolite 24, and the zeolite 24 is securely held thereby. The baffle 25 is provided with holes of such a size that the zeolite 24 cannot pass through. In the present embodiment, the opening rate of the baffle 25 was set to 60%, and 100g of zeolite was charged in total. There is provided with a space D at the vicinity of the inlet C and between baffle 25 and the inlet C of the container body. Further, there are spaces between the charged spherical zeolite particles 24 which are contacted each other. The accumulated volume of such spaces is set to 20 cc. The container body whose inlet is kept open is transferred to an atmospheric furnace and it is gradually heated up to 350 °C and kept it for 2 hours while the pressure is being reduced, by a vacuum pump. Then, after it is cooled down to 200 °C, the atmosphere is replaced by carbon dioxide, and immediately thereafter, it is sealed up by coating a plate shape cap with resin of epoxy system. As a result, under the condition of 25 °C and one atmospheric pressure, the inside pressure of the trap container was able to be about 15 mm Hg. Finally, as exterior members, fins 26 are pressed into and adhered to the container body for the purpose of sliding prevention during installation procedures.

[0037] Next, a method for installing the air conditioner will be explained.

[0038] Before the air conditioner is installed, refrigerant gas is charged into the pipes on the side of the outdoor A such as the compressor 1 and the outdoor unit heat exchanger 3. At that time, refrigerant gas which is necessary for driving as well as is used for the purging operation is charged into the outdoor unit A. On the other hand, the pipes on the side of the indoor unit B such as the indoor unit heat exchanger 6, as well as the connecting pipes 9 and 10 are not sealed and are opened into the atmosphere.

[0039] First, the outdoor unit A and the indoor unit B are connected through the connecting pipes 9 and 10. At that time, the screw 7a of the liquid-side two-way valve 7 and the screw 8a of the gas-side three-way valve 8 are closed. A carbon dioxide cylinder 11 is mounted to the service port 8b of the gas-side three-way valve 8 of the outdoor unit A by the bear hands through a connecting apparatus 12 whose outer side surface is of roulette finish.

[0040] After the carbon dioxide cylinder 11 is mounted to the service port 8b, the flare portion of the liquid-side two-way valve 7 is slightly loosened. By pushing the carbon dioxide cylinder 11 against the connecting apparatus 12 while the carbon dioxide cylinder 11 being rotated, the carbon dioxide in the carbon dioxide cylinder 11 is introduced into the connecting pipes 9 and 10 and the indoor unit B. Air in the connecting pipe 9 and 10 and the indoor unit B is discharged out into the atmosphere from the loosened portion of the flare portion of the liquid-side two-way valve 7.

[0041] At that time, the flare portion of the liquid-side two-way valve 7 is tightly closed in a state where the pressure in the connecting pipes 9 and 10 and the indoor unit B at approximately ordinary pressure.

[0042] Next, the connecting apparatus 12, whose outer side surface is of roulette finish, is, by bear hands, removed from the service port 8b together with the carbon dioxide cylinder 11. Then, as shown in Fig.2, the gas collecting trap apparatus 13-A is, by bear hands, mounted to the service port 8b by the connecting apparatus 14-A whose outer side surface is of roulette finish. At that time, the volume of inner space of the connecting apparatus 14-A is 5 cc and is opened to the atmosphere until it is brought into communication with the inside of the trap apparatus 13-A. The mounting is carried out in such a way that the trap apparatus 13-A is pushed against the connecting apparatus 14 while rotating the trap apparatus 13-A. At this time, since the outer side surface of the trap apparatus is provided with uneven fins, it effectively prevents sliding. By mounting in this way, and thereby bringing the replacing gas collecting trap apparatus 13-A and the connecting pipe 10 into communication with each other, carbon dioxide in the connecting pipe 10 is introduced through the inner passage of connecting apparatus 14-A from the service port 8b into the trap apparatus 13-A. Namely, because of the establishment of the communication, the inside of the trap apparatus 13-A tends to return to the ordinary pressure, and because of the inhaling effect caused due to the fact that the inside of the trap apparatus 13-

A is of sufficiently reduced pressure condition, air which has occupied the inner space of the connecting apparatus 14-A is brought into the inside of the trap apparatus by being mixed and diffused with carbon dioxide gas which is located inside the connecting pipe 10 (therefore, the air in the connecting apparatus is located between the trap apparatus and the carbon dioxide gas in the connecting pipe 10). Therefore, the accumulated volume of space in the trap apparatus 13-A, which is of sufficiently reduced pressure state function as a trigger of the inhaling effect. The carbon dioxide which has been brought into the inside of the trap apparatus is collected by physical absorption by contacting the zeolite, and eventually, the inside of connecting pipes 9 and 10 as well as the indoor unit B is brought to a sufficient negative pressure state.

[0043] After the above condition is established, the screw portion 7a of the liquid-side two-way valve 7 is slightly loosened, the refrigerant gas in the outdoor unit A is introduced, thereby bringing the pressure in the connecting pipes 9 and 10 and the pipe of the indoor unit B into positive pressure (about 0.2 kgf/cm²). Thereafter, the connecting apparatus 14-A is removed by bear hands from the service port 8b together with the trap apparatus 13-A, and the screw portion 7a of the liquid-side two-way valve 7 is again completely opened. Lastly, the screw portion 8a of the gas-side three-way valve 8 is also completely opened, and the installing operation of the air conditioner is completed.

[0044] In the above installing operation, the connecting apparatus 12 used for connecting with a carbon dioxide gas cylinder and the connecting apparatus 14 used for connecting with a trap apparatus are different apparatus; however, those may be made as a common apparatus. Further, the refrigerant charged into the outdoor unit A is introduced into the connecting pipes 9 and 10 and the indoor unit B before the connecting apparatus 14-A is detached from the service port 8b together with the trap apparatus 13-A. This is for preventing the air from entering into inside of the connecting pipe 10 from outside during the final operation of detaching the connecting apparatus even though the negative pressure state is established. If the connecting apparatus 14-A is designed such that it can be detached from the service port 8b instantaneously, it is unnecessary to introduce the refrigerant into the connecting pipe 9 and 10 and the indoor unit B.

[0045] Using the trap apparatus 13-A of the first embodiment shown in Figs. 4 to 6, the above installation was carried out under the operational environment of 25°C. Here, in the above embodiment, the volume of the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 was 1.5 liters.

[0046] As a result, in the 25 °C environment, the indoor trap apparatus 13-A made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in four minutes.

(The Second Embodiment)

[0047] In this embodiment, the trap apparatus was completed in the same way as the First Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 20 cc, and the inside space volume of the connecting apparatus 14-B was set to 10 cc. As a result, in the 25 °C environment, the indoor trap apparatus 13-A made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in eight minutes.

(The Comparison Example 1)

[0048] In this comparison example, the trap apparatus was completed in the same way as the First Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 20 cc, and the inside space volume of the connecting apparatus 14-C was set to 20 cc. As a result, in the 25 °C environment, the indoor trap apparatus 13-A made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in fifteen minutes.

(The Third Embodiment)

[0049] In this embodiment, as shown in Fig. 7, zeolite 27 of hollow cylindrical shape is used and the zeolite 27 is securely held by baffle 28. The zeolite 27 is of 5 φ X 7 mm and thickness of 2mm, and 100g of zeolite in total is charged. The opening rate of the baffle 25 was set to 60%. There is provided with a space F at the vicinity of the inlet E and between baffle 28 and the inlet E of the container body. Further, there are spaces between the charged hollow cylindrical zeolite particles 27 which are contacted each other. The accumulated volume of such spaces is set to 50 cc. The container body whose inlet is kept open is transferred to an atmospheric furnace and it is gradually heated up to 350 °C and kept it for 2 hours while the pressure is being reduced by a vacuum pump. Then, after it is cooled down to 200 °C, the atmosphere is replaced by carbon dioxide, and immediately thereafter, it is sealed up by coating a plate shape cap with resin of epoxy system. As a result, under the condition of 25 °C and one atmospheric pressure, the inside pressure of the trap container 13-B was able to be about 12 mm Hg. Finally, as exterior members, fins 29 are pressed into and

adhered to the container body. As a result, in the 25 °C environment, the indoor trap apparatus 13-B made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in three minutes in the case of the inner space of the connecting apparatus 14-A being 5cc.

(The Fourth Embodiment)

[0050] In this embodiment, the trap apparatus was completed in the same way as the Third Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 50 cc, and the inside space volume of the connecting apparatus 14-C was set to 20 cc. As a result, in the 25 °C environment, the indoor trap apparatus 13-B made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in seven minutes.

(The Comparison Example 2)

[0051] In this comparison example, the trap apparatus was completed in the same way as the Third Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 50 cc, and the inside space volume of the connecting apparatus 14-C was set to 50 cc. As a result, in the 25 °C environment, the indoor trap apparatus 13-B made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in sixteen minutes.

(The Fifth Embodiment)

[0052] In this embodiment, inside of a container body made of aluminum, to one side of which an opening portion is provided, there is provided with a ceramic honeycomb structure body 30. The honeycomb structure body 30 has 400 cells/inch², and volume of 70Φ×50mm, and is provided on its surface with a coating layer 31 mainly made of zeolite in the amount of 80g in total. Inside of the trap apparatus 13-C and at the outer wall of opening portion of container, there are provided with three dimples and thereby, the ceramic honeycomb structure body 30 is securely held. Thereafter, the opening portion of the container is made to an inlet G by drawing. Thereafter, the container body is transferred to an atmospheric furnace and it is gradually heated up to 350 °C and kept it for 2 hours while the pressure is being reduced by a vacuum pump. Then, after it is cooled down to 200 °C, the atmosphere is replaced by carbon dioxide, and immediately thereafter, it is scaled up by coating a plate shape cap with resin of epoxy system. As a result, under the condition of 25 °C and one atmospheric pressure, the inside pressure of the trap container was able to be about 8 mm Hg. Finally, as exterior members, fins 32 are pressed into and adhered to the container body for the purpose of sliding prevention. At the vicinity of the inlet G of the container body, there is provided with an space H between the inlet G and the ceramic honeycomb structure body 30; further, the passage holes within the ceramic honeycomb structure body 30 is additional spaces; and it is designed to make the accumulated spaces inside the container is 120 cc.

[0053] As a result, in the 25 °C environment, the indoor trap apparatus 13-C made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in two minutes in the case of the inner space of the connecting apparatus 14-A being 5cc.

(The Sixth Embodiment)

[0054] In this embodiment, the trap apparatus was completed in the same way as the Fifth Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 120 cc, and the inside space volume of the connecting apparatus 14-C was set to 20 cc. As a result, in the 25 °C environment, the indoor trap apparatus 13-C made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in four minutes.

(The Seventh Embodiment)

[0055] In this embodiment, the trap apparatus was completed in the same way as the Fifth Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 120 cc, and the inside space volume of the connecting apparatus 14-D was set to 50 cc. As a result, in the 25 °C environment, the indoor trap apparatus 13-C made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in seven minutes.

(The Comparison Example 3)

[0056] In this comparison example, the trap apparatus was completed in the same way as the Fifth Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 120 cc, and the inside space volume of the connecting apparatus 14-E was set to 120 cc. As a result, in the 25 °C environment, the indoor trap apparatus 13-C made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in seventeen minutes.

(The Eighth Embodiment)

[0057] In this embodiment, the trap apparatus was completed in the similar way to the Fifth Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 120 cc, and the inside of the trap apparatus was intentionally set to 20 mmHg. Further, the inside space volume of the connecting apparatus 14-B was set to 10 cc. As a result, in the 25 °C environment, the indoor trap apparatus 13-D made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in tree minutes.

(The Ninth Embodiment)

[0058] In this embodiment, the trap apparatus was completed in the similar way to the Fifth Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 120 cc, and the inside of the trap apparatus was intentionally set to 50 mmHg. Further, the inside space volume of the connecting apparatus 14-B was set to 10 cc. As a result, in the 25 °C environment, the indoor trap apparatus 13-E made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in four minutes.

(The Tenth Embodiment)

[0059] In this embodiment, the trap apparatus was completed in the similar way to the Fifth Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 120 cc, and the inside of the trap apparatus was intentionally set to 50 mmHg. Further, the inside space volume of the connecting apparatus 14-C was set to 20 cc. As a result, in the 25 °C environment, the indoor trap apparatus 13-E made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in five minutes.

(The Eleventh Embodiment)

[0060] In this embodiment, the trap apparatus was completed in the similar way to the Fifth Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 120 cc, and the inside of the trap apparatus was intentionally set to 120 mmHg. Further, the inside space volume of the connecting apparatus 14-C was set to 20 cc. As a result, in the 25 °C environment, the indoor trap apparatus 13-F made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in seven minutes.

(The Twelfth Embodiment)

[0061] In this embodiment, the trap apparatus was completed in the similar way to the Fifth Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 120 cc, and the inside of the trap apparatus was intentionally set to 50 mmHg. Further, the inside space volume of the connecting apparatus 14-D was set to 50 cc. As a result, in the 25 °C environment, the indoor trap apparatus 13-E made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in ten minutes.

(The Comparison Example 4)

[0062] In this comparison example, the trap apparatus was completed in the similar way to the Fifth Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 120 cc, and the inside of the trap apparatus was intentionally set to 100 mmHg. Further, the inside space volume of the connecting apparatus 14-D was

set to 50 cc. As a result, in the 25 °C environment, the indoor trap apparatus 13-F made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in twenty minutes.

5 (The Comparison Example 5)

[0063] In this comparison example, the trap apparatus was completed in the similar way to the First Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 20 cc, and the inside pressure of the trap apparatus was designed to set to about 15 mmHg at one atmospheric pressure and at 25 °C. Further, the inside
10 space volume of the connecting apparatus 14-A was set to 5 cc. As a result, the indoor trap apparatus 13-A which was left in the 60 °C environment for one hour could only made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached to 70 mmHg after ten minutes.

(The Thirteenth Embodiment)

15 [0064] In this embodiment, the trap apparatus was completed in the similar way to the First Embodiment, and the volume of the space in the trap apparatus was set to the same volume, i.e., 20 cc, and the inside pressure of the trap apparatus was designed to set to about 15 mmHg at one atmospheric pressure and at 25 °C. In the Fig. 11, the outer appearance of the trap apparatus is shown and on its outer side surface, the water retention member 33 of 3mm thick-
20 ness made of polyester fiber is provided. The water retention member 33 is over-coated with the nylon mesh material which would prevent slipping even in a case that the installation operation is conducted bear hands. Further, the inside space volume of the connecting apparatus 14-A was set to 5 cc. Here, the main body of indoor trap apparatus 13-A which was left in the 60 °C environment for one hour was soaked into the water and the water is permeated into the water retention member 33. After that, since the apparatus was sufficiently cooled off due to the direct cooling by the
25 water and the latent heat of evaporation, it made the pressure in the pipe of the indoor unit B including the indoor unit heat exchanger 6 and the connecting pipes 9 and 10 to have reached the sufficient negative atmosphere (10 mmHg or less) in four minutes.

[0065] As understood from the Comparison Example 4 and the thirteenth Embodiment, in cases where carbon dioxide gas is physically absorbed to the zeolite, the temperature of the environment, will influence and if the temperature of the operational environment exceeded 40 °C, it was difficult to achieve an eventual sufficient negative pressure state. Conversely, if the container body is cooled as in the Fourteenth Embodiment, the performance of the gas trapping material is improved. Therefore, in case that a sufficient negative pressure state is not achieved, the level of negative pressure state will be improved if the trap container is cooled down by ice water.

[0066] In the embodiments, as means for preventing sliding, uneven shaped fins are provided onto the outside of container body, however, the means for preventing sliding applicable to the present invention is not limited to this particular means. As another means, uneven condition like that of roulette may be provided to the container body; other conventional sliding prevention measures such as sandpaper, rubber bands, etc. are also applicable.

[0067] In the embodiments, after the inner air was replaced by carbon dioxide gas by purging, the inside of the connecting pipes and the indoor unit was returned to the normal pressure and the next operation was carried out. However,
40 it is possible to do it keeping the positive pressure state. In that case, necessary level of positive pressure may be slightly higher than that of the atmospheric pressure, and it is believed to be preferable if it is equal to or less than 0.3 kgf/cm². By this, when the carbon dioxide trap apparatus is brought into communication with the inside thereof, by means of affirmative gas convection effect, the carbon dioxide gas trapping is carried out efficiently. Further, as means which affords the similar effect, the inside of carbon dioxide trap apparatus may be made a sufficient negative pressure state, thereby, the gas convection effect from the inside of connecting pipes and the indoor unit to the carbon dioxide gas trap apparatus may be realized. Specifically, as understood from the embodiments, it is believed to be preferable if it is equal to or less than 20 mmHg.

[0068] Even in a case where the level of the negative pressure inside the collecting trap apparatus is not good, by optimizing the volume of space of the container as well as that of the connecting apparatus, to some extent, it is possible to inhale the replacing gas to the collecting trap apparatus. However, it took a long time to achieve sufficient negative pressure state since the gas remained in the collecting trap apparatus of the replacing gas disturbs the reaction between the trapping material and the replacing gas.

[0069] In the embodiments, the inner volume of the indoor unit and the connecting pipes was 1.5 liter and the zeolite used was 100g; however, the effect of the invention may be expected if 60g or greater weight of zeolite per 1 liter of the inner volume of the indoor unit and the connecting pipes is used. By this amount, the carbon dioxide gas is collected in a short time and the 10-30mmHg level negative pressure state is achieved. If there is too much zeolite, it means that the container the trap material becomes bulky so that it cannot be said preferable. Further, if the amount is less than 60g, the level of achievable negative pressure is decreased and the speed is slow, so that the objective of the present

invention may not be achieved. Furthermore, if the water is absorbed as a contamination, it disturbs the collection of the carbon dioxide gas. Therefore, it is believed to be preferable if the 60 - 100g is used for practical use.

[0070] In the embodiments, the cases in which carbon dioxide gas is used as a replacing gas and zeolite is used as a gas trapping agent are explained. However, the applicable scope of the invention is not limited to these examples. Other combinations, as long as a gas trapping agent functions for a replacing gas and which results in a sufficient negative pressure state in collecting the gas, are applicable.

[0071] In the embodiments, as a water retention member, a member which is comprised of polyester fibers is used. However, other water retention member may be used in this invention, such as natural fibers, inorganic fibers, etc.

[0072] In the embodiments, an installation method of an outdoor unit which is provided with a conventional 2 way valve and tree way valve is explained. However, an outdoor unit that is provided with a tree way valve and another three way valve can be utilized. Further, in the embodiments, installation is carried out using two types of connecting apparatus for a two way valve. However, in this invention, an installation may be carried out using a connecting apparatus of T-shape, thereby, the carbon dioxide gas supply part and carbon dioxide gas inhaling part may be separately provided from one connecting point.

[0073] In the embodiments, an example where a dryer is provided inside of an outdoor unit is shown. In air purge of the indoor unit and the connecting pipes, the vacuum pump method may eliminate water existing inside by adopting sufficient vacuum pump operation time. However, water may not be eliminated by the purge method using a replacing gas as this invention. Therefore, a long term reliability may be assured if an air conditioner contains a dryer in a refrigerant cycle.

Claims

1. A replacing gas collecting trap apparatus used for installing an air conditioner which is comprised of an outdoor unit including a compressor and an outdoor unit heat exchanger and refrigerant gas is charged into both of said compressor and said outdoor unit exchanger; an indoor unit including an indoor unit heat exchanger which is opened into atmosphere; and a connecting pipe connecting said outdoor unit and said indoor unit, comprising: a trap container body; a gas trap agent charged in said trap container for absorbing and collecting a replacing gas which has replaced air in said indoor unit heat exchanger and said connecting pipe through a connecting apparatus, wherein a volume of space inside said trap container is larger than the volume of inner space of said connecting apparatus.

2. A replacing gas collecting trap apparatus that meets the following formula:

$$\text{Volume of inside space of a connecting apparatus} \leq (\text{Volume of spaces of a container}) \times (760 - A)/760$$

Where A is the pressure inside the container.

3. A replacing gas collecting trap apparatus used for installing an air conditioner which is comprised of an outdoor unit including a compressor and an outdoor unit heat exchanger and refrigerant gas is charged into both of said compressor and said outdoor unit exchanger; an indoor unit including an indoor unit heat exchanger which is opened into atmosphere; and a connecting pipe connecting said outdoor unit and said indoor unit, comprising: a trap container body; an trap agent charged in said trap container for absorbing and collecting a replacing gas which has replaced air in said indoor unit heat exchanger and said connecting pipe, wherein, a sliding prevention means is provided on the outside surface of said trap container.

4. A connecting apparatus for installing an air conditioner which is comprised of an outdoor unit including a compressor and an outdoor unit heat exchanger and refrigerant gas is charged into both of said compressor and said outdoor unit exchanger; an indoor unit including an indoor unit heat exchanger which is opened into atmosphere; a connecting pipe connecting said outdoor unit and said indoor unit; wherein, air in said indoor unit heat exchanger is replaced by a replacing gas through one of said connecting apparatus (A), then, said replacing gas is collected through one of said connecting apparatus (B), said connecting apparatus comprising: a sliding prevention means provided on the outside surface of said connecting apparatus (A) and (B).

5. A replacing gas collecting trap apparatus used for installing an air conditioner which is comprised of an outdoor unit including a compressor and an outdoor unit heat exchanger and refrigerant gas is charged into both of said compressor and said outdoor unit exchanger; an indoor unit including an indoor unit heat exchanger which is opened into atmosphere; and a connecting pipe connecting said outdoor unit and said indoor unit, comprising: a trap container body; an trap agent charged in said trap container for absorbing and collecting a replacing gas which has replaced air in said indoor unit heat exchanger and said connecting pipe, wherein, a water retention member is pro-

vided on the outside surface of said trap container.

- 5 6. A method for installing an air conditioner for connecting an indoor unit and an outdoor unit by a connecting pipe, wherein replacing gas is introduced into said indoor unit and said connecting pipe at the time of installing operation so that air in said indoor unit and said connecting pipe is replaced by said replacing gas and then, a collecting trap apparatus is connected to a portion of said air conditioner through a connecting apparatus whose volume of inner space is smaller than the volume of inner space of said collecting trap apparatus, thereby, said replacing gas is collected by a replacing gas trap agent contained in said collecting trap apparatus.
- 10 7. A method for installing an air conditioner for connecting an indoor unit and an outdoor unit by a connecting pipe, wherein replacing gas is introduced into said indoor unit and said connecting pipe at the time of installing operation through a connecting apparatus A whose outside surface of a connecting means is provided with a sliding prevention measure so that air in said indoor unit and said connecting pipe is replaced by said replacing gas and then, a collecting trap apparatus whose outside surface is provided with a sliding prevention measure is connected to a portion of said air conditioner through a connecting apparatus B whose outside surface of a connecting means is provided with a sliding prevention measure thereby, said replacing gas is collected by a replacing gas trap agent contained in said collecting trap apparatus.
- 15 8. A method for installing an air conditioner for connecting an indoor unit and an outdoor unit by a connecting pipe, wherein replacing gas is introduced into said indoor unit and said connecting pipe at the time of installing operation so that air in said indoor unit and said connecting pipe is replaced by said replacing gas and then, a collecting trap apparatus whose outer surface is provided with a water retention member and to which water is supplied is connected to a portion of said air conditioner, thereby, said replacing gas is collected by a replacing gas trap agent contained in said collecting trap apparatus.
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- 25
- 30
- 35
- 40
- 45
- 50
- 55

FIG. 1

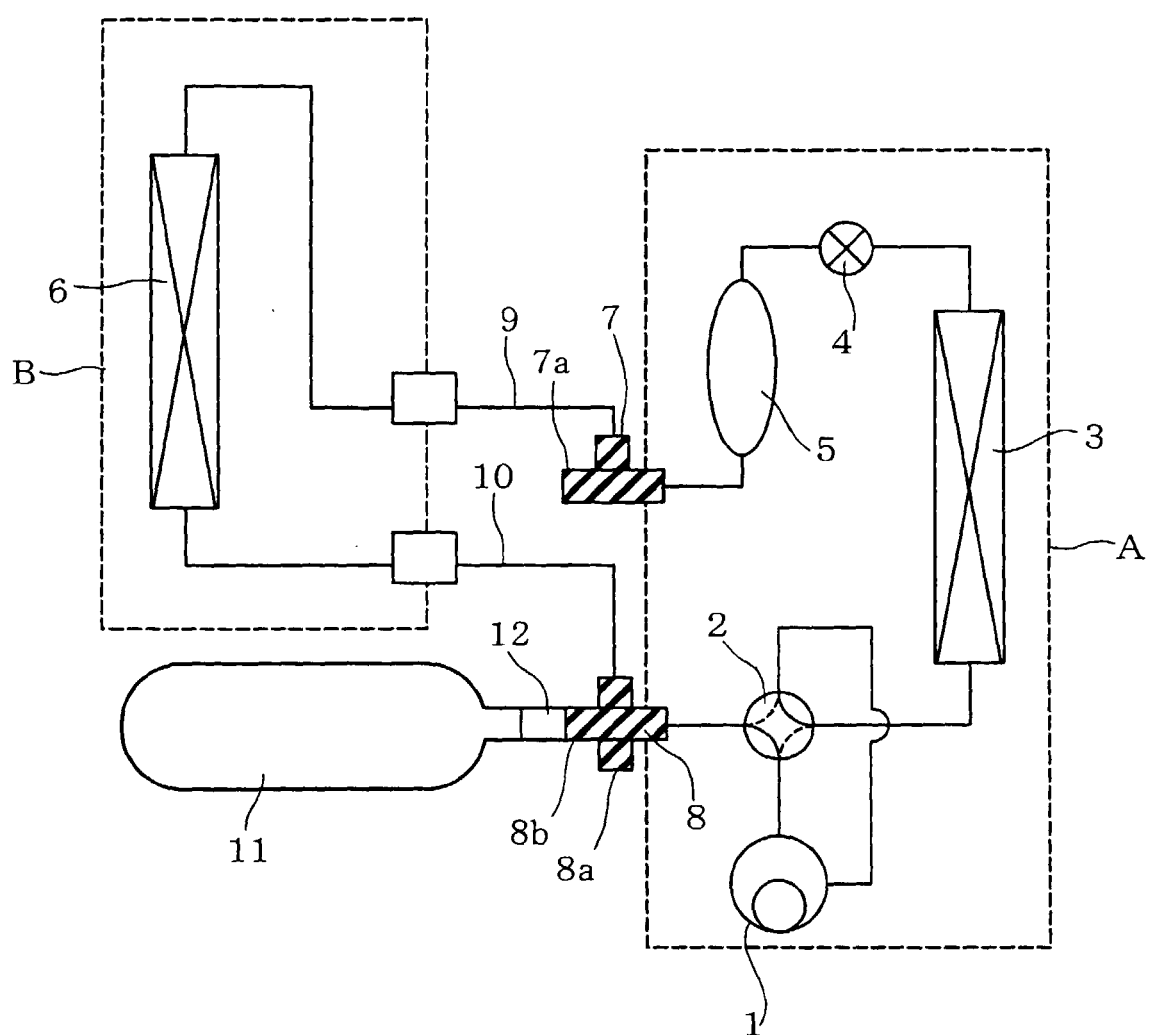


FIG.2

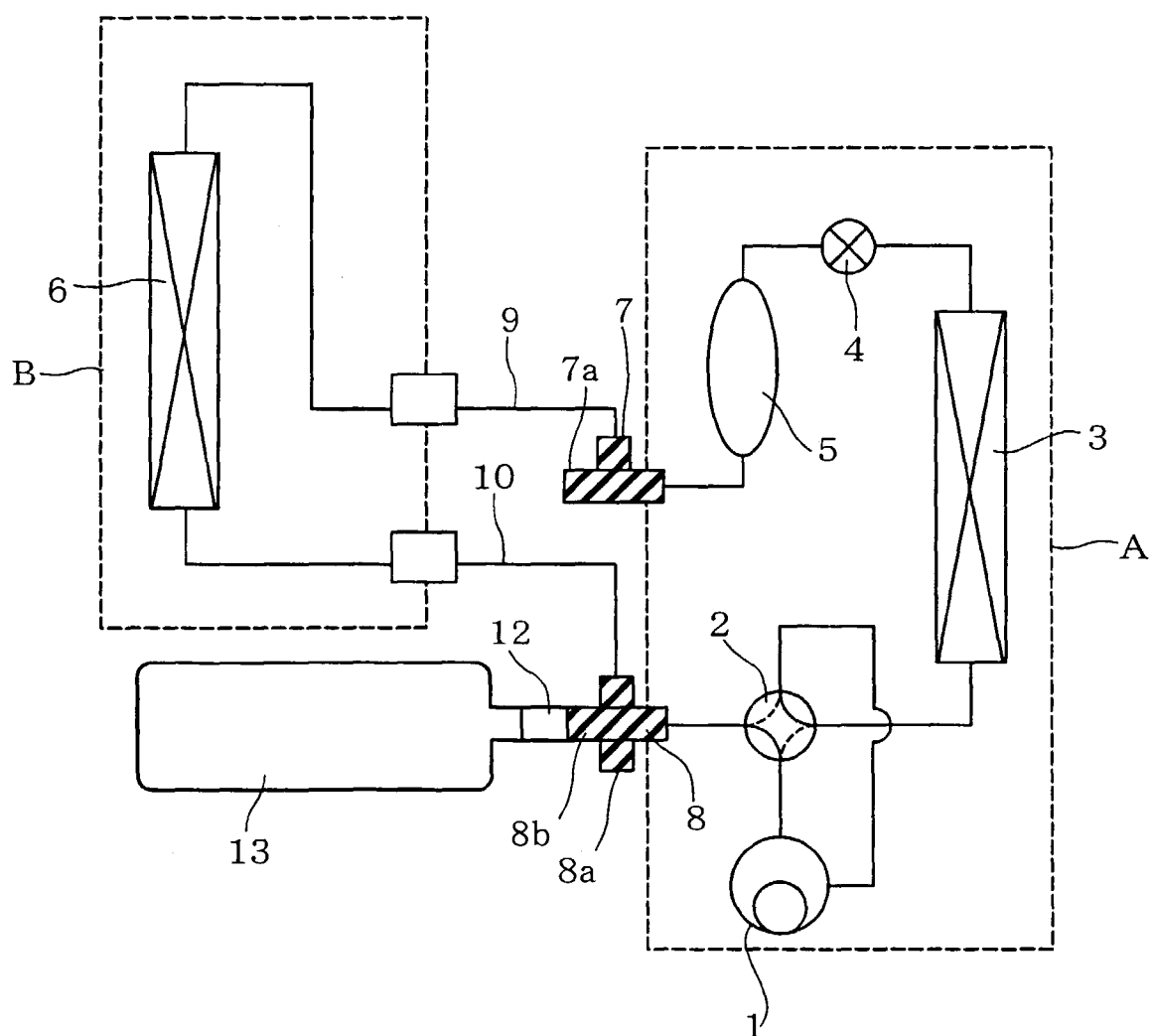


FIG. 3

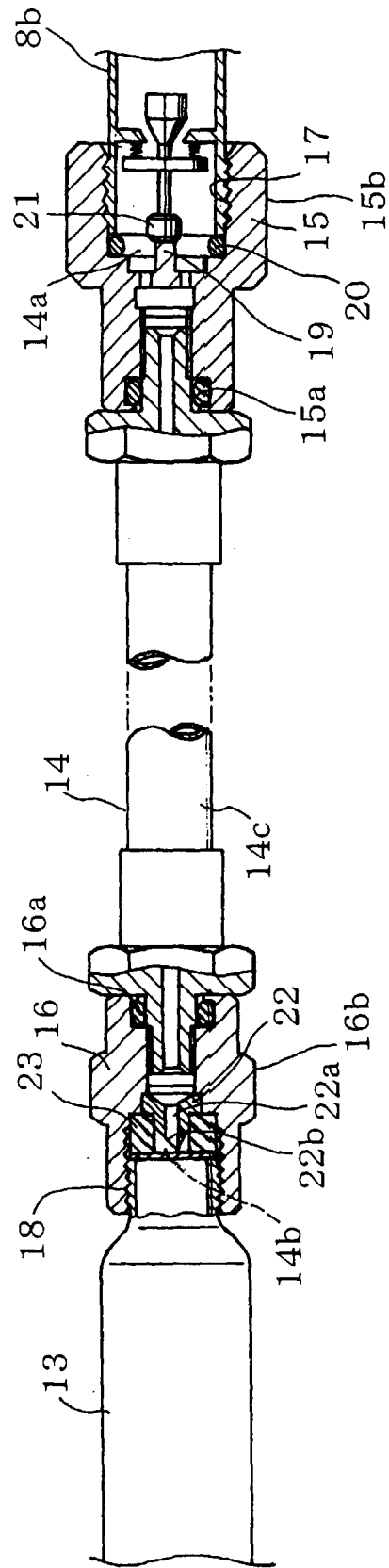


FIG. 4

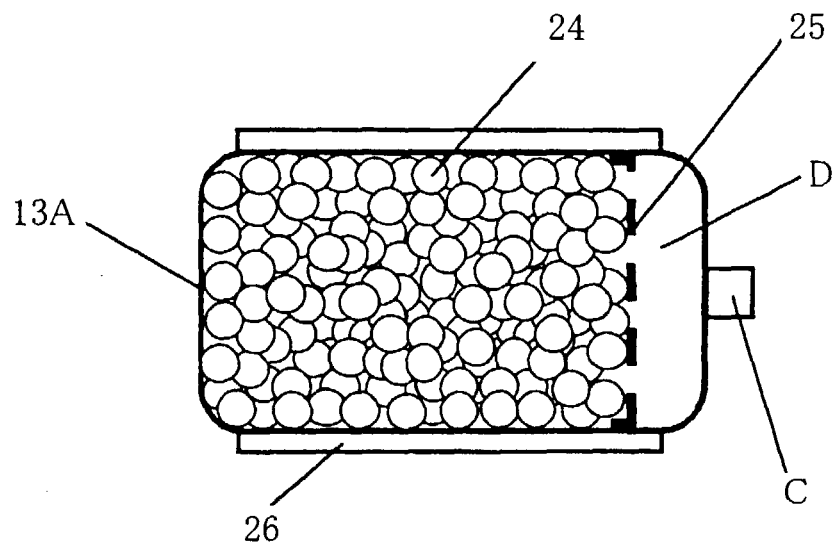


FIG. 5

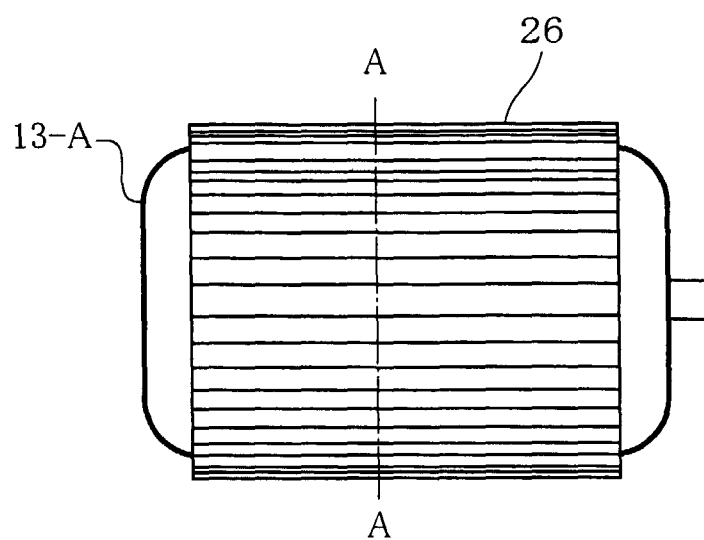


FIG. 6

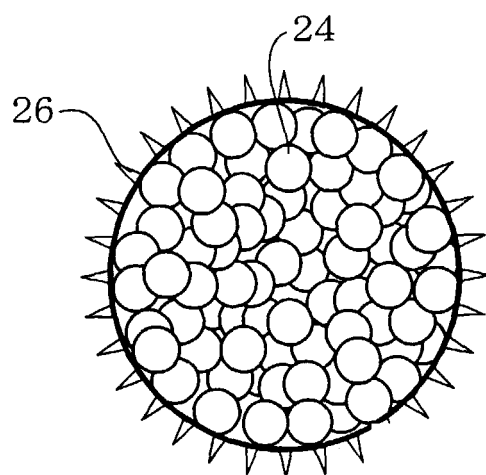


FIG. 7

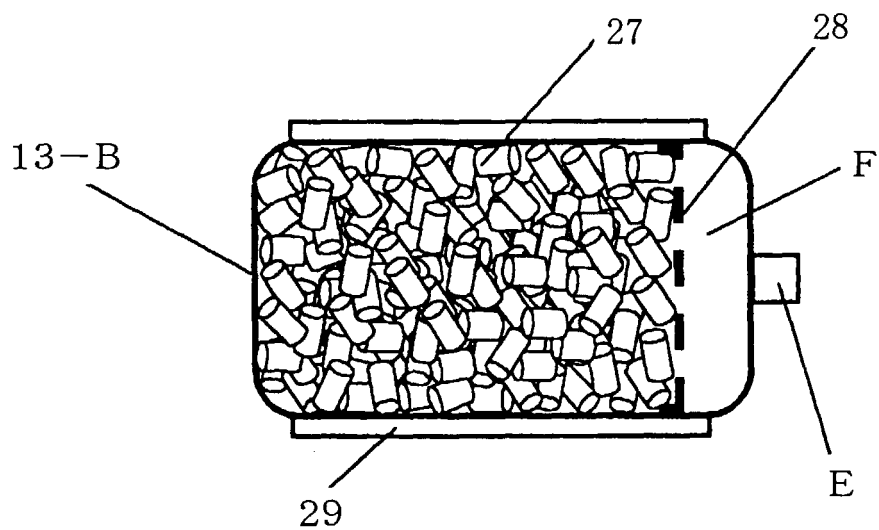


FIG. 8

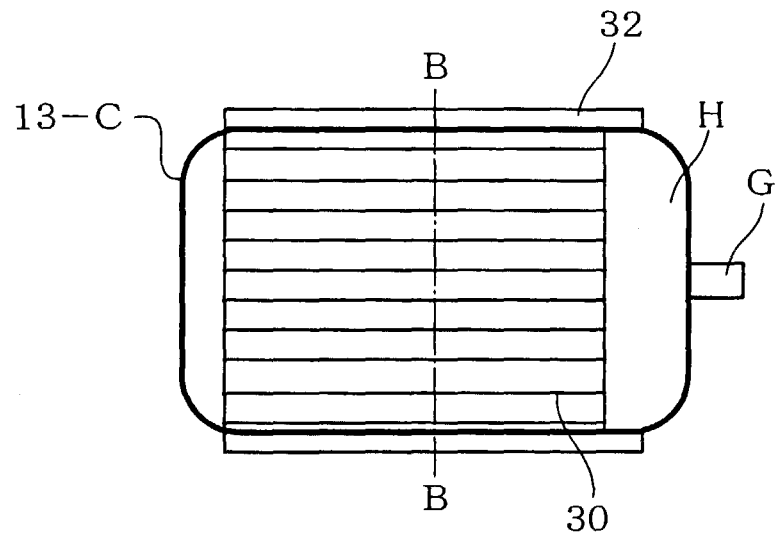


FIG. 9

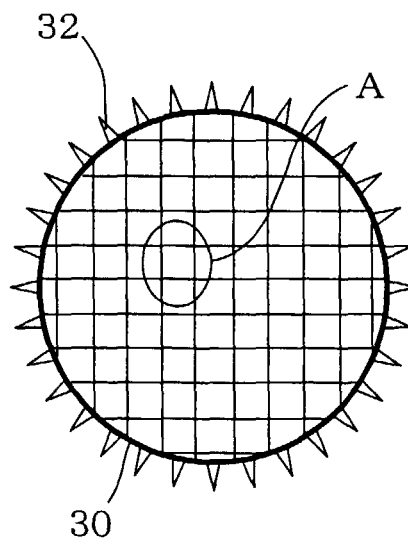


FIG. 10

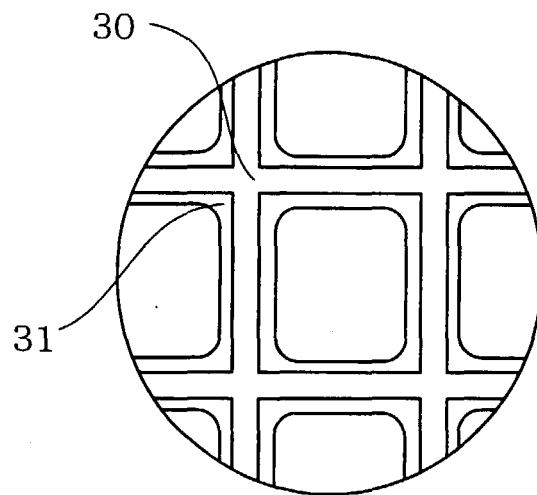


FIG. 11

