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54 **Refrigerant recovering method.**

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Description

This invention relates to a refrigerant recovering method .

A refrigerant, such as a fluorocarbon refrigerant, is commonly employed in an air conditioner of an automobile or a refrigerator.

A refrigeration system will operate most efficiently when the refrigerant, which has become impure by pollutants in use, is made pure and relatively free of pollutants, for example, oil, air and water.

Therefore, it is necessary to periodically remove and recharge the refrigerant within the refrigerant system.

Various refrigerant processing and charging methods are already known. US-A-4,768,347 discloses such method in which a pressure switch controlling a solenoid valve is arranged between the refrigeration circuit and a suction conduit.

Such a refrigerant recovering system comprises a liquefying unit which sucks the original refrigerant from an external freezing circuit or refrigeration circuit which is employed in, for example, an air conditioning system.

When the original refrigerant is sucked from the external freezing circuit by a suction unit, the amount of the original refrigerant in the external freezing circuit gradually decreases.

According to the decreasing amount of the original refrigerant, the inner temperature of the external freezing circuit will gradually decrease by evaporation of the original refrigerant in the external circuit.

As a result, the inner pressure of the external freezing circuit becomes negative pressure in comparison with atmospheric pressure. This negative pressure causes the external freezing circuit to be invaded by atmosphere, therein.

It is therefore an object of the present invention to provide a refrigerant recovering method for recovering the original refrigerant from an external freezing circuit etc. without invasion of atmosphere into the external freezing circuit.

It is another object of this invention to provide a method of the type described, which will prevent decrease of the inner pressure of the external freezing circuit while charging the original refrigerant.

Other objects of this invention will become clear as the description proceeds.

In accordance with this invention, there is provided a refrigerant recovering method for use in recovering an original refrigerant from a refrigeration circuit as indicated in the claim.

Fig. 1 is a block diagram of a refrigerant recovering method according to an embodiment of this invention.

A refrigerant recovering unit according to an embodiment of this invention is connected to an air conditioning system of an automobile.

The air conditioning system uses a fluorocarbon refrigerant as an original refrigerant in a freezing circuit (not shown).

Referring to Fig. 1, the refrigerant recovering unit comprises an inlet electromagnetic valve 10 on a conducting pipe 12 which is coupled to the external freezing circuit. The original refrigerant flows as a liquid phase flow and gaseous flow through the conducting pipe 12.

For controlling inner pressure of the external freezing circuit, a pressure sensor 11 is connected to the external freezing circuit. The pressure sensor 11 is for judging whether or not the inner pressure is negative in comparison with atmospheric pressure to produce an internal signal when the inner pressure is negative. The internal signal is sent to the electromagnetic valve 10 through a wire 11a. Responsive to the internal signal, the electromagnetic valve 10 is automatically driven to inhibit passage of the original refrigerant in the conducting pipe 12.

When the inlet electromagnetic valve 10 is opened for introducing the original refrigerant from the freezing circuit, the original refrigerant is sucked to a first filter dryer 13 by virtue of a compressor 18 which will later be described. The inlet electromagnetic valve 11 can be disconnected from the freezing circuit. The first filter dryer 13 is for removing an impurity, moisture, and acid content from the original refrigerant in the manner known in the art.

An accumulator 14 is connected to the first filter dryer 13 for accumulating the original refrigerant. The liquid phase flow is accumulated in a bottom part of the accumulator 14, and the gaseous phase flow thereon is supplied to a first oil interceptor 15. The first oil interceptor 15 is to intercept an oil element of the original refrigerant. The intercepted oil element is accumulated in an oil tank 17 through an oil valve 16.

The original refrigerant is supplied to the compressor 18 from the first oil interceptor 15. In this event, the original refrigerant is of gaseous phase.

The gaseous original refrigerant is compressed in the compressor 18 and is supplied as a compressed refrigerant to a condenser 20 through a second oil interceptor 19. The intercepted oil element is accumulated in another oil tank (not shown). In the condenser 20, the compressed refrigerant is cooled to thereby be condensed as a condensed refrigerant. The condensed refrigerant is supplied to a second filter dryer 21 which is for removing an impurity, moisture, and acid content from the condensed refrigerant.

After that, the condensed refrigerant is supplied to a separation vessel 22 and is separated into a gaseous phase refrigerant component and a liquid phase refrigerant component in the separation vessel 22.

The separation vessel 22 comprises an upper part and a bottom part defining an upper space and a bottom space, respectively. The upper space and the bottom space is contiguous each other to form a

hollow space in the separation vessel 22. As well known in the art, the gaseous phase refrigerant component has superior purity in comparison with the liquid phase refrigerant component.

A combination of the compressor 18, the second oil interceptor 19, the condenser 20, the second filter dryer 21 and, the separation vessel 22 is referred to as a separating arrangement. A pipe 12 is for connecting between the inlet electromagnetic valve 11 and the separation vessel 22.

The separation vessel 22 has a first outlet port 22a at an upper portion thereof and a second outlet port 22b at a bottom portion thereof. The first outlet port 22a is connected to a liquefaction vessel 24a through a first supplying pipe 12a to communicate with a thermal space which is defined by the liquefaction vessel 24a. Therefore, the gaseous phase refrigerant component is sent as an object refrigerant from the separation vessel 22 to the liquefaction vessel 24b. On the other hand, the second outlet port 22b is connected to an evaporator 24b through an automatic expansion valve 23 and a second supplying pipe 12b. Therefore, the liquid phase refrigerant component is sent as a liquid refrigerant from the separation vessel 22 to the evaporator 24b and is evaporated in the evaporator 24b to carry out cooling of a surrounding area of the evaporator 24b in the manner known in the art.

The evaporator 24b is thermally coupled to the thermal space of the liquefaction vessel 24a. In this embodiment, the evaporator 24b is contained in the liquefaction vessel 24a. As a result, the gaseous phase refrigerant component is cooled in the liquefaction vessel 24a by evaporation of the liquid refrigerant, namely, the liquid phase refrigerant component in the evaporator 24b. In other words, heat exchange is carried out between the gaseous and the liquid phase refrigerant components. Therefore, the evaporator 24b may be referred to as a liquefying arrangement.

After being evaporated in the evaporator 24b, the liquid refrigerant is returned to the compressor 18 through a returning pipe 12c.

A temperature detecting unit 25 is thermally coupled to the returning pipe 12c. The temperature detecting unit 25 is for detecting temperature of the liquid refrigerant at vicinity of the liquefaction vessel 24a to produce a temperature signal which is representative of the temperature signal which is representative of the temperature. Responsive to the temperature signal, the automatic expansion valve 23 is automatically driven to adjust flow amount of the liquid phase refrigerant component.

The liquefied object refrigerant is collected at a lower portion of the thermal space of the liquefaction vessel 24a. A storage container 26 is placed under the liquefaction vessel 24a and is connected to the thermal space through a sending pipe 27. Therefore, the

liquefied object refrigerant drips from the liquefaction vessel 24a towards the storage container 26 through the sending pipe 27 by gravitational force thereof. As a result, the liquefied object refrigerant is charged in the storage container 26. It is a matter of course that the modified refrigerant has a relatively higher purity in the storage container 26.

When the thermal space is not enough of quantity of the liquefied object refrigerant, the liquefied object refrigerant is prevented from charging thereof towards the storage container 26.

For controlling quantity of liquid of the thermal space, a liquid level sensor 28 is connected to the liquefaction vessel 24a. The liquid level sensor 28 is for detecting a predetermined liquid level to produce a condition signal. The condition signal is sent to an electromagnetic valve 29. The electromagnetic valve 29 is coupled to the sending pipe 27. Responsive to the condition signal, the electromagnetic valve 29 is automatically driven to adjust the movement of the liquefied object refrigerant through the sending pipe 27. A combination of the sending pipe 27, the liquid level sensor 28, and the electromagnetic valve 29 is referred to as a control arrangement. In this event, it is preferable that the condition signal responsive to the predetermined liquid level is produced until the evaporator 24b is made thoroughly wet by the liquefied object refrigerant in the liquefaction vessel 24b because of an effectiveness of the heat exchange. When the detected liquid level is lowered than the predetermined liquid level, the electromagnetic valve 29 is driven in response to the condition signal to stop the dripping of the liquefied object refrigerant to the storage container 26.

When the detected liquid level is higher than the predetermined level, the electromagnetic valve 29 is driven in response to the condition signal to open the sending pipe 27. So that, the liquefied object refrigerant flows into the storage container 26. Preferably, a breathing pipe 30 is disposed between the liquefaction vessel 24a and the storage container 26 for breathing a residual gas of the refrigerant in the storage container 26 because of smooth flow of the liquefied object refrigerant. Therefore, the effectiveness of the heat exchange is increased in the liquefying arrangement.

The object refrigerant can be smoothly charged into the storage container 26 by a repeat of operation which is described before.

Claims

1. Method for recovering refrigerant from a refrigeration circuit under pressure, wherein the following steps are repeatedly carried out:
 - a) measuring the pressure in the refrigeration circuit;

b) sucking the refrigerant from the refrigeration circuit until the pressure in the refrigeration circuit drops below the atmospheric pressure;

c) stopping the suction operation by closing a valve in the suction conduit when atmospheric pressure has been reached in the refrigeration circuit, so as to avoid the invasion of air into the refrigeration conduit.

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Patentansprüche

1. Verfahren zur Wiedergewinnung von Kältemittel aus einem unter Druck stehenden Kältekreislauf, wobei wiederholt die folgenden Schritte durchgeführt werden:

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a) Messen des Drucks im Kältekreislauf;

b) Absaugen des Kältemittels aus dem Kältekreislauf, bis der Druck im Kältekreislauf unter den Atmosphärendruck sinkt;

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c) Stoppen des Ansaugens durch Schließen eines Ventils in der Saugleitung, wenn im Kältekreislauf Atmosphärendruck erreicht wurde, um so ein Eindringen von Luft in den Kältekreislauf zu verhindern.

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Revendications

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1. Procédé de récupérer un agent réfrigérant d'un circuit de refroidissement sous pression, dans lequel on fait les opérations suivantes en répétition:

(a) mesurer la pression dans le circuit de refroidissement;

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(b) aspirer ledit agent réfrigérant dudit circuit de refroidissement jusqu'à ce que la pression dans ledit circuit de refroidissement tombe au dessous de la pression atmosphérique;

(c) arrêter l'opération d'aspiration en fermant une soupape dans le passage d'aspiration dès que le niveau de pression atmosphérique était atteint dans ledit circuit de refroidissement, afin d'empêcher la pénétration de l'air dans ledit circuit de refroidissement.

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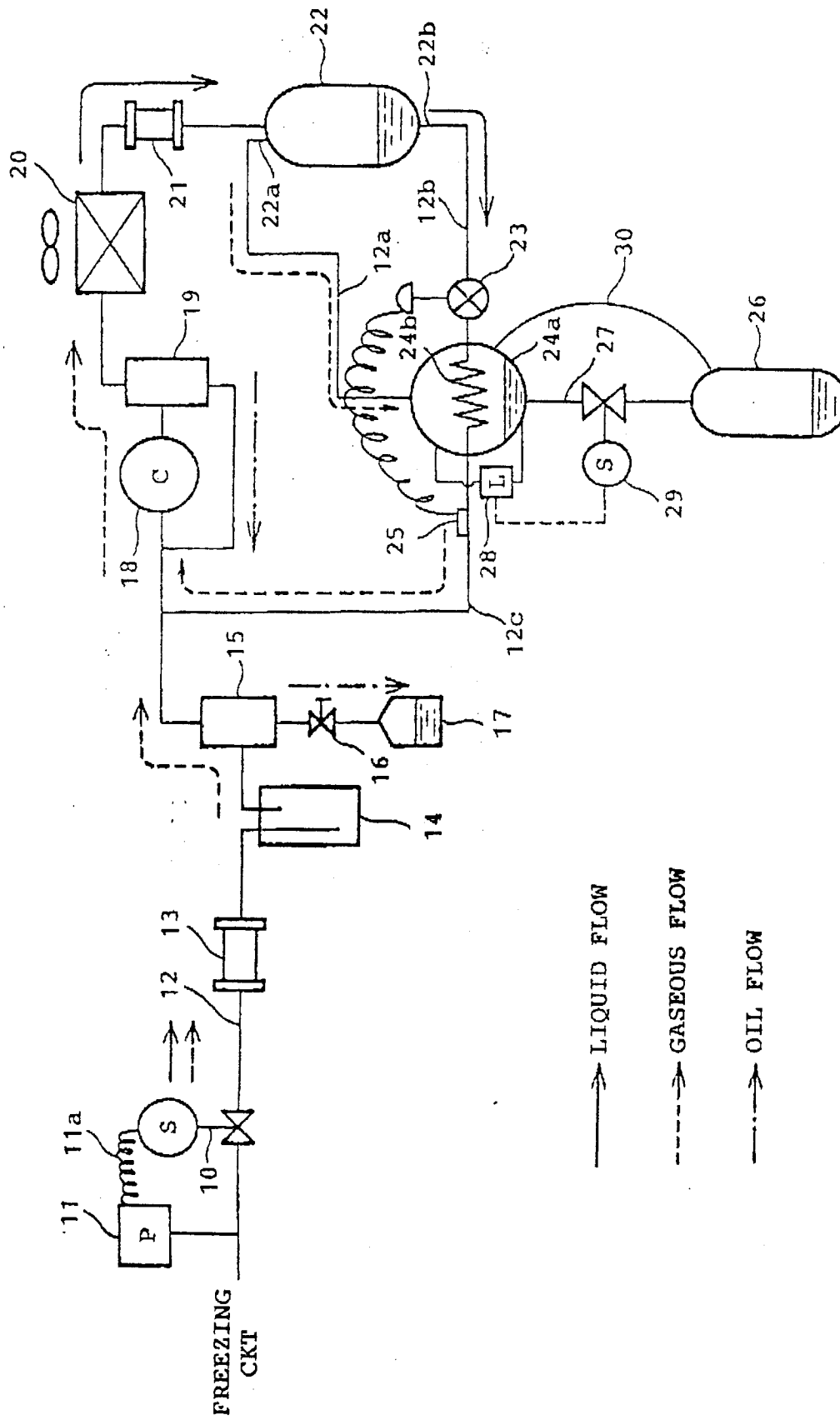


FIG. 1