A device for drawing off cooling agents from refrigeration and heating plant such as heat pumps and large cooling installations, for instance. The present invention consists of a connecting pipe (14) intended to be connected to the system which is to be drained, said connecting pipe (14) discharging into a sealed tank (5), with a compressor (1) connected to its suction side to said tank (5) and on its delivery side connected in series with a condenser (4), a heat exchanger (17) located either inside or adjacent to said tank (5) and a filling cylinder (13) or similar, in that order. The operation of the compressor (1) will thus cause the cooling agent to flow down into the tank (5), to be compressed by the compressor (1), to be condensed and to give off heat as it passes through the heat exchanger (17), causing the cylinder (13) to be filled via a pipe (21).
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Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

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A device for drawing off cooling agents from refrigeration and heating plant.

The present invention relates to a device for drawing off cooling agents from refrigeration and heating plant such as heat pumps and large cooling installations, for instance.

In the event of a fault arising in equipment of this kind, it will as a rule be necessary to drain the system within the equipment which contains a cooling agent, usually freon. The draining of existing systems is done by opening a valve and allowing the cooling agent to escape into the atmosphere.

This involves high costs on the one hand, since the price of cooling agents is high, and negative environmental effects on the other hand, since freon gas causes the ozone layer in the atmosphere to break down.

It is therefore desirable to collect cooling agents which must be removed from the system during repairs to a piece of equipment, and subsequently to refill the system with the same cooling agent.

The present invention proposes a device by means of which a cooling agent may be drained from a system and subsequently re-used.

Thus the invention relates to a device for draining
cooling agents from refrigeration and heating plant such as heat pumps and large cooling installations, for instance, and is characterized in that a connecting pipe is provided which is intended to be connected to the system which is to be drained, said connecting pipe discharging into a sealed tank, and in that a compressor is provided which is connected on its suction side to said tank and on its delivery side is connected in series with a condenser, a heat exchanger located either inside or adjacent to said tank and a filling cylinder or similar, in that order, whereby the operation of the compressor will cause the cooling agent to flow down into the tank from the connecting pipe, to evaporate in the tank, to be compressed by the compressor, to be condensed and to give off heat as it passes through the heat exchanger, causing the cylinder to be filled via a pipe.

The invention is described below in greater detail with reference to the attached drawing, in which Fig. 1 is an outline diagram of a device in accordance with the invention.

The device illustrated in Fig. 1 consists of a compressor 1 with a driving motor 2. The driving motor 2 is also arranged so as to drive a fan 3 for causing air to pass through a condenser 4. The device also incorporates a heat exchanger and a tank 5. The compressor 1 is connected on its suction side to the tank 5 and on its delivery side in series with the condenser 4, the heat exchanger, a filter 9 and a filling cylinder 13, in conjunction with which the device is designed to operate. The inlet side of the condenser 4 is also connected to a connecting pipe 14 which is intended to be connected to the equipment from which the cooling agent is to be removed. A check valve 8 is arranged between the connecting pipe 14 and the condenser 4 in such a way that it will permit the cooling agent to flow only in the direction of the condenser 4.
The connecting pipe 14 is also connected via a solenoid valve 6 and a throttle valve or expansion valve 7 to the inside of the tank 5. Inside the tank 5 is located the heat exchanger in the form of a coiled tube 17, for instance.

Also included are a pressure control device 10, a pressure-operated safety valve 11 and a pressure-operated valve 12.

The operating function of the device is described below, together with an account of the pipework and its connections used in the device.

When plant containing a cooling agent is to be drained, the connecting pipe 14 is connected to the plant in question. This involves keeping the solenoid valve 6 closed and the compressor 1 not in operation. This will cause the cooling agent to flow through a pipe 15, through another pipe 16 via the check valve 8 and on through the condenser 4, through the heat exchanger 17 and the filter 9 to the cylinder 13. The cooling agent will also flow down to the compressor via a pipe 18. The safety valve 11 and the pressure-operated valve 12 are both closed.

The safety valve 11 is connected parallel to and above the check valve 8. The pressure-operated valve 12 is located in another pipe 20 to the cylinder between an upper pipe 25 which discharges into the cylinder 13 and the connecting pipe 14.

Once the pressure inside the device has equalized with the pressure inside the system which is to be drained, the solenoid valve 6 is opened and the compressor 1 is started up. The cooling agent will then flow directly from the pipe 14 via the pipe 15, the solenoid valve 6 and the throttle valve 7 down into the tank 5. The compressor 1 is so arranged as to suck the cooling agent, which in its normal condition is in the form of a gas, from the upper part of the
tank 5 through a pipe 19 and to compress the cooling agent, thereby forcing it via the pipe 18 and through the condenser 4 which is known to be so arranged as to transform the gaseous cooling agent into the form of a liquid. This will lower the temperature of the cooling agent, which will then flow through the heat exchanger 17 and the filter 9 to a pipe 26 which discharges into the lower part of the cylinder 13.

The effect of the compressor is to build up a level of pressure at its delivery side considerably in excess of the pressure in the pipes 14, 15, thus preventing the cooling agent from passing through the check valve 8 to the condenser 4.

The cooling agent which now under compression will give off heat in the heat exchanger 17 to the cooling agent surrounding the heat exchanger coil 17 in the tank, with the result that the cooling agent in the tank 5 will gradually be evaporated.

When the pressure inside the cylinder 13 has risen to a pre-determined level the pressure-operated valve 12 will open, whereupon the gaseous cooling agent in the cylinder will be sucked via the pipe 15, the valve 6 and the throttle valve 7 down into the tank 5. This will result in the gaseous cooling agent in the cylinder 13 being transformed into a liquid in the condenser 4, whereby the cylinder 13 will finally be filled completely with liquid cooling agent.

The pre-determined pressure level will depend on the level to which it is wished to fill the cylinder 13.

The cooling agent in the cylinder 13 will be cooled by the circulation of gas in the cylinder 13 in the compressor 1, the condenser 4 and the heat exchanger 17.

The aforementioned circulation may be produced by connecting the pipe 14 to the system which is to be drained, but may also be produced by means of a tap 22 after the pipe 14 has been closed off.
Once the cylinder 13 has been completely filled with liquid cooling agent the pipes 20, 21 to the cylinder are closed off by means of taps 23, 24.

When a system which has been drained is to be refilled, the cylinder is connected to the system in the usual manner, but which does not, however, fall within the scope of the present invention.

The pressure control device 10, which is so arranged as to sense the pressure at the delivery side of the compressor, and the safety valve 11 may be omitted or replaced by other, equivalent components.

The safety valve 11 is so arranged as to release cooling agent via the pipe 14 in the event of excessive pressure occurring on the delivery side of the compressor.

The pressure control device 10 is so arranged that it will shut down the compressor 1 by means of electrical circuits and devices which are not illustrated here in the event of excessive pressure occurring on the delivery side of the compressor.

The filter 9 is not essential, but it is recommended that it be fitted. The filter is of a conventional and familiar type and may be so arranged as to remove dirt, acids and water or other contaminants from the cooling agent.

The expansion valve or throttle valve 7, of a familiar type, is intended to reduce the rate at which the cooling agent flows down into the tank 5 from the system which is to be drained.

The operating range of the safety valve 11, the pressure control device 10 and the pressure-operated valve 12 must, of course, be selected with regard to the area of application for which the device in accordance with the present invention is being designed, i.e. with regard to the type of cooling agent, the capacity of the device and the type of cylinder 13.
It may be stated by way of an example that when draining the cooling agent in the form of freon at room temperature, the pressure at the suction side of the compressor once it has been started up will be between approximately 0.5 and 5 atm., and about 12 - 15 atm. at the delivery side. The temperature of the cooling agent before it enters the condenser will be approximately +60 - 80°C and after it has left the condenser approximately +20 - 30°C. The temperature of the cooling agent after it has left the heat exchanger will be approximately +10 - 15°C.

Under the conditions indicated above by way of an example, the safety valve 11 will be set at 30 atm. and the pressure control device at 20 - 25 atm. The pressure-operated valve 12 is set in accordance with the type of cylinder 13, but may, for example, be so arranged as to open when the pressure inside the cylinder reaches 10 atm.

It may be stated by way of an example that the cylinder 13 used in refrigeration plant of normal size will be the so-called 60 kg cylinder. It is, of course, possible to make use of both larger and smaller cylinders, and also of a number of cylinders connected together in parallel or in series.

Thus the present invention proposes a device by means of which the cooling agent contained in a system may be drained completely and stored in a filling cylinder, which may as a rule be filled completely, so that it may subsequently be used to refill the system. The invention thus effectively overcomes the disadvantages mentioned in the introduction which are encountered when draining a system in the conventional manner.

A typical embodiment of the present invention has been described above with reference to Fig. 1. All the components referred to and illustrated in conjunction
with the description and Fig. 1 are of a suitable and familiar type and are commercially available.

The typical embodiment of the device in accordance with the present invention may, of course, be modified on condition that it is not caused to deviate in so doing from the idea of invention.

The present invention shall not, therefore, be regarded as being restricted to the embodiment described above, but may be modified within the scope of the attached Patent Claims.
Patent Claims

1. A device for drawing off cooling agents from refrigeration and heating plant such as heat pumps and large cooling installations, for instance, characterized in that a connecting pipe (14) is intended to be connected to the system which is to be drained, said connecting pipe (14) discharging into a sealed tank (5), and in that a compressor (1) is connected on its suction side to said tank (5) and on its delivery side is connected in series with a condenser (4), a heat exchanger (17) located either inside or adjacent to said tank (5) and a filling cylinder (13) or similar, in that order, whereby the operation of the compressor (1) will cause the cooling agent to flow down into the tank (5) from the connecting pipe (14), to evaporate in the tank (5), to be compressed by the compressor (4), to be condensed and to give off heat as it passes through the heat exchanger (17), causing the cylinder (13) to be filled via a pipe (21).

2. A device in accordance with Patent Claim 1, characterized in that a valve (6) is so arranged in said connecting pipe (14, 15) as to cause the pipe to be open or closed, and in that said pipe (14, 15) at a point between its end which faces away from said tank and said valve (6) is directly connected to the condenser (4) via a pipe (16) and a check valve (8), said check valve (8) being so arranged as to permit the cooling agent to flow from the connecting pipe (14) only in the direction of the condenser (4), so that in an initial stage of drawing off the cooling agent when said valve (6) is closed and the compressor (1) is not in operation, the cooling medium will be able to flow from the connecting pipe (14) via the condenser (4) and the heat exchanger (17) to the filling cylinder (13).
3. A device in accordance with Patent Claims 1 or 2, characterized in that the connecting pipe (14) is connected to the cylinder (13) by means of another pipe (20) leading to said cylinder (13) which discharges into the upper end of the cylinder (13), and in that a pressure-controlled valve (12) is so arranged in said pipe (20) as to permit the cooling agent to flow through the pipe (20) when the pressure inside the cylinder (13) exceeds a pre-determined level.
# INTERNATIONAL SEARCH REPORT

## I. CLASSIFICATION OF SUBJECT MATTER

According to International Patent Classification (IPC) or to both National Classification and IPC:

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## II. FIELDS SEARCHED

Minimum Documentation Searched:

SE, NO, DK, FI classes as above

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<td>US, A, 2 715 317 published 1955, August 16, R L Rhodes</td>
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<td>A</td>
<td>US, A, 3 232 070 published 1966, February 1, J J Sparano</td>
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### IV. CERTIFICATION

- **Date of the Actual Completion of the International Search**: 1980-12-11
- **Date of Mailing of this International Search Report**: 1980-12-17

**International Searching Authority**: Swedish Patent Office

**Signature of Authorized Officer**: Bengt Johansson
### INTERNATIONAL SEARCH REPORT

#### I. CLASSIFICATION OF SUBJECT MATTER
According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl 3/F24J 3/02

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Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched

AU: IPC as above

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<td>US,A,3990430, published November 9, 1976, Robertson.</td>
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### IV. CERTIFICATION

Date of the Actual Completion of the International Search

18th November 1980 (18.11.80)

International Searching Authority

Australian Patent Office

Signature of Authorized Officer

A.S. Moore

Form PCT/ISA/210 (second sheet) (October 1977)
FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSearchABLE

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. Claim numbers ________, because they relate to subject matter not required to be searched by this Authority, namely:

2. Claim numbers ________, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

VI. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

This International Searching Authority found multiple inventions in this international application as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

Remark on Protest:

☐ The additional search fees were accompanied by applicant's protest.
☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (supplemental sheet (2)) (October 1977)