Dec. 11, 1951 E. A. WENK 2,577,834

APPARATUS FOR DEWAXING AND DEHYDRATING REFRIGERANTS

Filed March 19, 1948

Fig. 1.

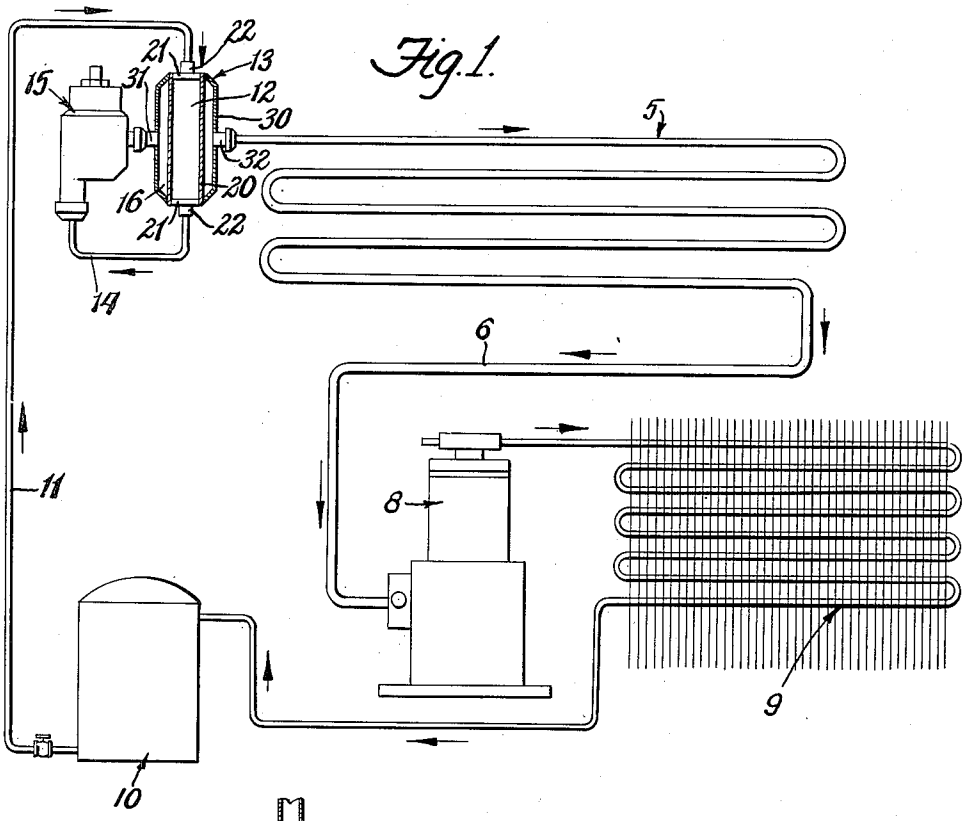


Fig. 2.

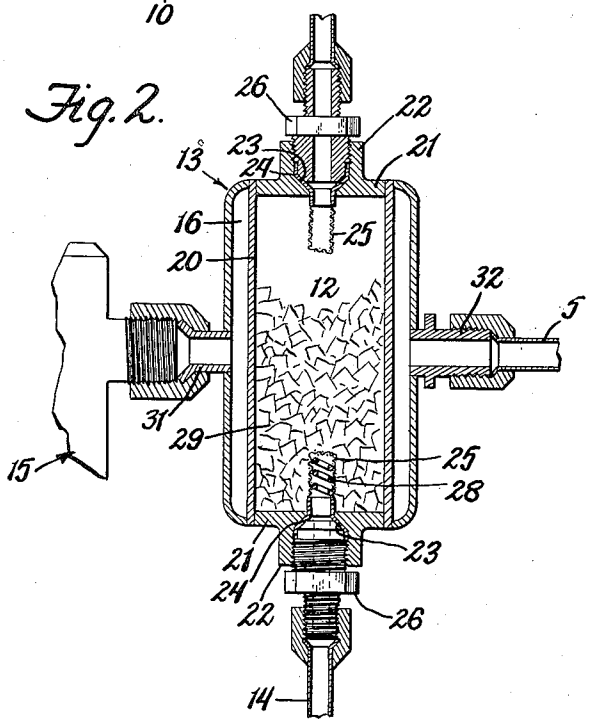
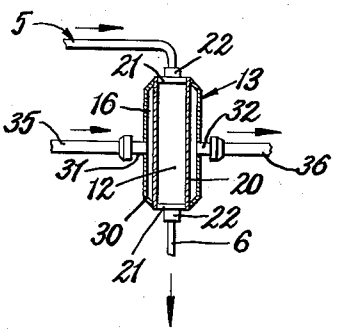


Fig 3.



INVENTOR.

Edward A. Wenk

BY

Popp and Popp

Attorneys

Patented Dec. 11, 1951 2,577,834

UNITED STATES PATENT OFFICE

2,577,834

APPARATUS FOR DEWAXING AND DEHYDRATING REFRIGERANTS

Edward A. Wenk, New York, N. Y.

Application March 19, 1948, Serial No. 15,756

7 Claims. (Cl. 62—115)

1

This invention relates to apparatus for dewaxing and dehydrating refrigerants such as are used in compressor-condensor evaporator refrigeration systems.

The most common of such refrigerants used commercially are of the group known as halide refrigerants or substituted hydrocarbon refrigerants, such as Freon 12 (CCl_2F_2) and methyl chloride (CH_3Cl). For many year irregularities in the operation of liquid control valves handling such refrigerants were blamed primarily on moisture and to remove this moisture, which was believed to freeze and interfere with the operation of the expansion valve, a dehydrator was installed in the liquid refrigerant line feeding the expansion valve, usually near the liquid receiver. Such a dehydrator was usually a capped section of tubing provided with suitable connections on both ends to attach it to the line and containing an adsorbent such as calcium oxide, silica gel, activated alumina or calcium chloride. The adsorbent was confined within the dehydrator by suitable filter pads or screens.

My investigation of the problem of such irregularities of the action of expansion valves in refrigeration systems indicated little evidence that moisture had been present or that it was a primary cause of such irregularities. This investigation further led to the conclusion that such irregularities were due primarily to a wax which forms in the oil in the compressor. This waxy substance was found in the compressors and expansion valves and is characterized by being soluble only in toluol and as having a very low melting point, in the order of 60° to 70° F. This wax also seems to adversely affect the lubricating qualities of the refrigeration oil at temperatures of from 70° to 110° F., this being the usual temperature range of the lubricant in a refrigeration compressor.

The above practice of installing a dehydrator in the liquid refrigerant feed line between the liquid receiver and the expansion valve, but usually right next to the condenser, has not proved satisfactory because of the wide temperature range of the liquid refrigerant at this point and the high temperature of the surrounding air as well as the heat derived by conduction from the condenser. Because of the high temperature of the dehydrator at this location it is not possible to remove any wax from the refrigerant passing through it and it is also possible to remove but little of the moisture.

The principal object of the present invention is to provide a simple and efficient apparatus for dewaxing the refrigerant in a refrigeration system

2

thereby to improve the performance of the expansion valve as well as to improve the lubricating effect of the oil in the compressor.

Another object is to provide such apparatus which dehydrates the lubricant in addition to dewaxing the same.

Another object is to provide such apparatus in which the rate of adsorption of the moisture is substantially increased.

Another object is to provide such apparatus in which the capacity of the moisture adsorbent or desiccant is substantially increased.

Another aim is to provide such apparatus in which all wax present in the refrigerant is precipitated and readily removable.

Another object is to provide such apparatus in which a substantial overall increase in the capacity of the condenser and evaporator can be obtained.

Another aim is to provide such apparatus which serves to entrain and remove from the refrigerant all dirt, scale or other foreign matter.

Another object is to provide such apparatus which is low in cost and trouble-free in operation and which will stand up under conditions of severe and constant use without requiring repair.

Other objects and advantages of the invention will appear from the following description and drawings in which:

Fig. 1 is a diagrammatic representation of compressor-condenser-evaporator refrigeration apparatus embodying the present invention.

Fig. 2 is an enlarged vertical section through a dewaxing and dehydrating unit used in the apparatus shown in Fig. 1.

Fig. 3 is a fragmentary view similar to Fig. 1 and showing a modified form of the invention.

Referring to Fig. 1, the numeral 5 represents an evaporator connected by a suction line 6 with a compressor 8 the outlet of which is connected to a condenser 9. The discharge line from the condenser 9 connects with a receiver 10 the liquid line 11 from which connects with the central chamber 12 of a dewaxing and dehydrating unit 13 forming a part of the present invention. From the chamber 12 of the dewaxing and dehydrating unit 13, the liquid refrigerant flows through a line 14 to an expansion valve 15. The expansion valve 15 discharges into the jacket space 16 of the dewaxing and dehydrating unit 13 which also communicates with the inlet to the evaporator coil 5. It will be seen that except for the dewaxing and dehydrating unit 13, Fig. 1 shows a conventional compressor-condenser-evaporator refrigeration system.

This dewaxing and dehydrating unit 13 is

shown in detail in Fig. 2 and as there shown includes an inner tubular shell 20 enclosed by upper and lower end heads 21 to provide the central chamber 12 through which the liquid refrigerant passes to the expansion valve 15 as previously described. Each of the end heads 21 is formed to provide an outwardly projecting, internally threaded flare fitting socket 22 having an outwardly facing conical seat 23 at its inner end surrounding an opening communicating with the interior central chamber 12. In each of these sockets 22 is arranged the enlarged outwardly flaring concavo-convex end flange 24 of a tubular screen 25, the flange of this screen fitting against the seat 23 of the corresponding socket 22 and the screen 25 projecting into the central chamber 12 and being closed at its inner end. Each screen is retained in place by a reducing flare union 26, the enlarged externally threaded end of which screws into the corresponding socket 22 against the enlarged outwardly flaring concavo-convex flange 24 of the screen therein and the reduced externally threaded end of which is connected by the usual flare fitting to the flared end of the corresponding liquid refrigerant line. The reducing flare union 26 at the upper end of the dewaxing and dehydrating unit connects with the liquid line 11 from the receiver 10 and the reducing flare union at the lower end of the unit connects with the liquid line 14 leading to the expansion valve 15. At the suction or outlet end of the unit the tubular screen 25 can be internally supported against collapse by a helical spring 28.

The chamber 12 so provided with the tubular screens 25 at its inlet and outlet is filled with a suitable solid desiccant or adsorbent 29 in granular or lump form to remove the moisture from the liquid refrigerant passing therethrough. This can be in the form of silica gel, activated alumina, calcium oxide, calcium chloride or the like. However, the use of such desiccant or moisture adsorbent is only necessary where removal of the moisture from the refrigerant is desired and if only wax removal is required the filler 29 in the inner chamber 12 can be in the form of metal wool, felt, porous stone or suitable baffles to effect the desired heat transfer.

The tubular shell 20 is enclosed by a jacket 30 which is shown as having an inlet 31 at one side connected in any suitable manner with the outlet of the expansion valve 15 and as having an outlet 32 at its other side connected in any suitable manner with the inlet of the evaporator coil 5.

In the operation of the apparatus as above described, the refrigerant is compressed in the compressor 8, is liquefied in the condenser 9 and passes through the receiver 10, liquid line 11, upper union 26, and upper tubular screen 25 into the inner chamber 12 of the dewaxing and dehydrating unit 13 and into contact with the adsorbent 29 therein. This adsorbent is maintained at a low temperature, in the order of 35° F., by the low temperature refrigerant expanding in the jacket space 16 and at this low temperature all of the wax within the passing refrigerant congeals upon the adsorbent 29. This adsorbent further acts as a desiccant to abstract the moisture present in the passing refrigerant. At this low temperature of the assumed 35° F. the rate of adsorption of this moisture is high as compared with the high temperatures present in conventional dehydrators arranged in advance of the expansion valve 15. Further, at this low temperature the capacity of the adsorbent 29 as a drying agent is increased by 16% or more as compared with conventional dehydrators conventionally located and operating at a higher temperature. The important feature of the low temperature at which the adsorbent is maintained, however, resides in its capacity to completely remove the wax from the refrigerant.

From the inner chamber 12 containing the adsorbent 29 the liquid refrigerant passes through the lower tubular screen 25, lower union 26 and line 14 into the reducing valve 15 which discharges the refrigerant as a high pressure gas through the inlet 31 into the jacket space 16 of the dewaxing and dehydrating unit 13 thereby to maintain the low temperature of the adsorbent 29 therein as previously described. The gas then passes from the outlet 32 to the expansion coil 5 from which the gaseous refrigerant returns through the suction line 6 to the compressor.

The above arrangement provides the maximum effect in dewaxing and dehydrating the refrigerant. At a slight sacrifice in this regard the dewaxing and dehumidifying unit 13 can, however, be additionally employed as a heat exchanger by arranging it at the outlet of the evaporator 5 as shown in Fig. 3 instead of at its inlet as shown in Figs. 1 and 2. With the dewaxing and dehydrating unit located as shown in Fig. 3, the low pressure gas from the evaporator 5 passes through the adsorbent contained within the central chamber 12 and which is maintained at the assumed low temperature of 35° F. by liquid refrigerant from the expansion valve 15 entering the jacket space 16 from a line 35 and leaving this jacket space through a line 36 connected with the inlet of the evaporator 5. By so utilizing the dewaxer and dehydrator 13 as a heat exchanger at the outlet end of the evaporator as shown in Fig. 3 an increase in the capacity of the condenser 9 of from 5 to 10% is achieved.

It will be apparent that many changes in the construction of the dewaxing and dehydrating unit 13 can be made without departing from the invention. In particular any form of heat exchange devices can be employed as by fastening the inner shell 20 directly to the high pressure line from the expansion valve 15 to the evaporator 5 instead of jacketing this shell as shown. The invention is therefore not to be regarded as limited to the specific features shown but is to be accorded the full range of equivalents comprehended by the following claims.

I claim:

1. In refrigerating apparatus having a compressor, condenser, expansion valve and evaporator through which an expansible refrigerant is recirculated in series, the combination therewith of means for dewaxing the refrigerant so recirculated comprising a body forming a first chamber connected with one end of said evaporator and containing a desiccant and through which said refrigerant passes and formed to provide a second chamber in heat exchange relation with said first chamber, and means arranged to pass the expanding refrigerant from said expansion valve to said evaporator through said second chamber in heat exchange relation with said first chamber to cool the refrigerant passing therethrough to a temperature at which the wax contained within the refrigerant congeals therein.

2. In refrigerating apparatus having a compressor, condenser, expansion valve and evapo-

rator through which an expansible refrigerant is recirculated in series, the combination therewith of means for dewaxing the refrigerant so recirculated comprising a body forming a first chamber connected with the inlet end of said expansion valve and through which said refrigerant passes and formed to provide a second chamber in heat exchange relation with said first chamber, and means arranged to pass the expanding refrigerant from said expansion valve to said evaporator through said second chamber in heat exchange relation with said first chamber to cool the refrigerant passing therethrough to a temperature at which the wax contained within the refrigerant congeals therein.

3. In refrigerating apparatus having a compressor, condenser, expansion valve and evaporator through which an expansible refrigerant is recirculated in series, the combination therewith of means for dewaxing the refrigerant so recirculated comprising a body forming a first chamber connected with the outlet end of said evaporator and containing a desiccant and through which said refrigerant passes and formed to provide a second chamber in heat exchange relation with said first chamber, and means arranged to pass the expanding refrigerant from said expansion valve to said evaporator through said second chamber in heat exchange relation with said first chamber to cool the refrigerant passing therethrough to a temperature at which the wax contained within the refrigerant congeals therein.

4. In refrigerating apparatus having a compressor, condenser, expansion valve and evaporator through which an expansible refrigerant is recirculated in series, the combination therewith of means for dewaxing and dehydrating the refrigerant so recirculated, comprising a body forming a first chamber connected at one end with said evaporator and through which said refrigerant passes and formed to provide a second chamber in heat exchange relation with said first chamber, a desiccant confined within said first chamber and contacted by said refrigerant, and means arranged to pass the expanding refrigerant from said expansion valve to said evaporator through said second chamber in heat exchange relation with said first chamber to cool said desiccant and the refrigerant passing in contact therewith to a temperature at which the wax contained within the refrigerant congeals on said desiccant.

5. In refrigerating apparatus having a compressor, condenser, expansion valve and evaporator through which an expansible refrigerant is recirculated in series, the combination therewith of means for dewaxing and dehydrating the refrigerant so recirculated, comprising a body forming a first chamber connected with the inlet of said expansion valve and through which said refrigerant passes and formed to provide a second

chamber in heat exchange relation with said first chamber, a desiccant confined within said first chamber and contacted by said refrigerant, and means arranged to pass the expanding refrigerant from said expansion valve to said evaporator through said second chamber in heat exchange relation with said first chamber to cool said desiccant and the refrigerant passing in contact therewith to a temperature at which the wax congeals on said desiccant.

6. In refrigerating apparatus having a compressor, condenser, expansion valve and evaporator through which an expansible refrigerant is recirculated in series, the combination therewith of means for dewaxing and dehydrating the refrigerant so recirculated, comprising a body forming a first chamber connected with the outlet of said evaporator and through which said refrigerant passes and formed to provide a second chamber in heat exchange relation with said first chamber, a desiccant confined within said first chamber and contacted by said refrigerant, and means arranged to pass the expanding refrigerant from said expansion valve to said evaporator through said second chamber in heat exchange relation with said first chamber to cool said desiccant and the refrigerant passing in contact therewith to a temperature at which the wax congeals on said desiccant.

7. In combination with a refrigeration apparatus, an expansion valve, a casing into which refrigerant on its way to the evaporator is expanded from said valve, a conduit traversing said casing and being in heat exchange relation therewith, means for supplying liquid refrigerant to said conduit, means for conducting said liquid refrigerant from said conduit to the inlet of said valve, and refrigerant filter means in said conduit.

EDWARD A. WENK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,073,863	Bird	Mar. 16, 1937
2,199,258	Gray	Apr. 30, 1940
2,230,892	Miller	Feb. 4, 1941
2,243,949	Fox	June 3, 1941
2,279,928	Shoemaker	Apr. 14, 1942
2,285,123	Phillips	June 2, 1942
2,341,430	Elsey	Feb. 8, 1944
2,430,692	Touborg	Nov. 11, 1947

OTHER REFERENCES

Article in the "Ice and Refrigeration" magazine entitled "Expansion Valves," July 1946 issue; pages 33 through 36.