Sept. 27, 1966 E. J. KOCHER ET AL 3,274,796

REFRIGERATION SYSTEM WITH TUBE OIL SEPARATION MEANS

Filed Sept. 23, 1965

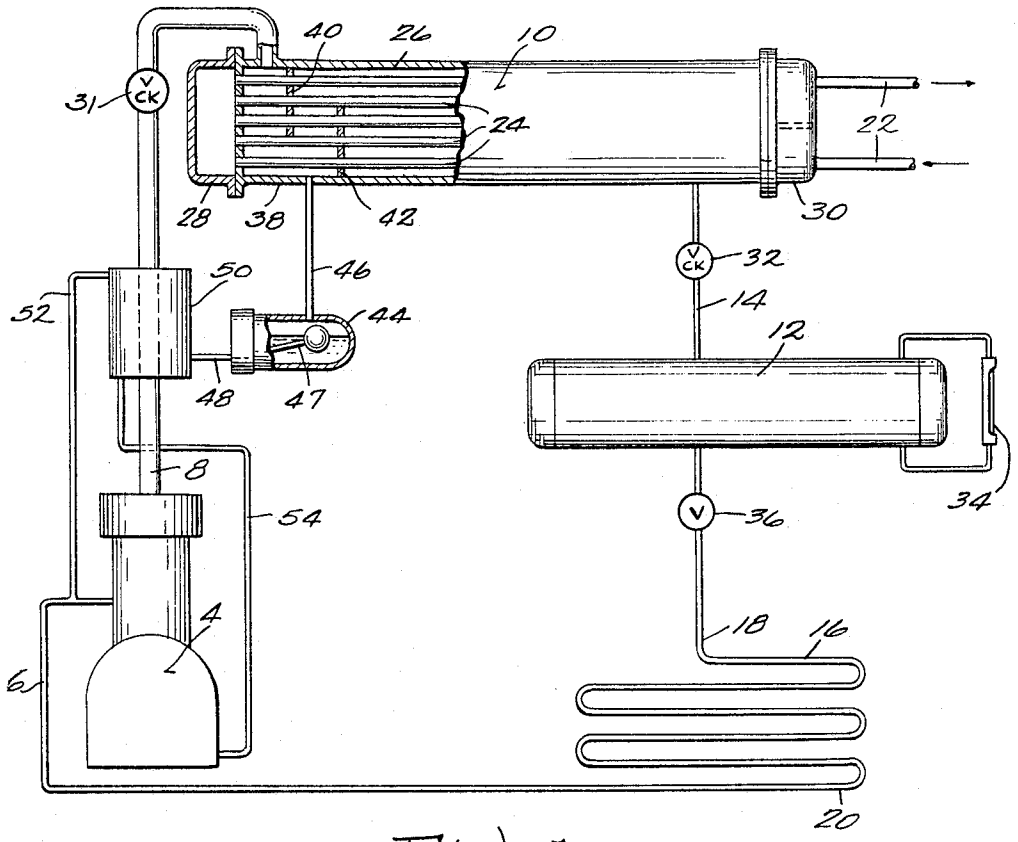


Fig. 1

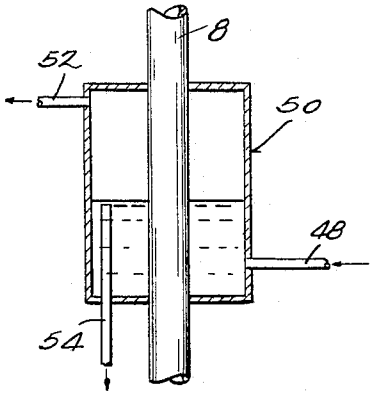


Fig. 2

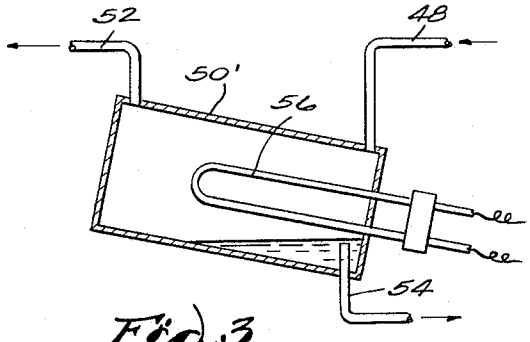


Fig. 3

INVENTORS
ERICH J. KOCHER
JOSEPH N. LONG

BY Lieber & Nilles
ATTORNEYS

United States Patent Office 3,274,796 Patented Sept. 27, 1966

3,274,796

REFRIGERATION SYSTEM WITH LUBE OIL SEPARATION MEANS

Erich J. Kocher and Joseph N. Long, both of Milwaukee, Wis., assignors to Vilter Manufacturing Corporation, Milwaukee, Wis., a corporation of Wisconsin

Filed Sept. 23, 1965, Ser. No. 489,611
4 Claims. (Cl. 62—473)

The present invention relates generally to improvements in the art of refrigeration, and relates more particularly to the provision of a refrigerating system and apparatus employing improved instrumentalities for separating entrained oil from the system refrigerant and for extracting refrigerant remaining in the separated oil.

Refrigerating systems of the type to which this invention relates commonly employ reciprocating compressors to provide high pressure refrigerant to the system in gaseous state. Normally, oil is employed in these compressors for cooling and lubricating purposes, the oil being customarily sprayed or splashed about the working parts. Inevitably, some of the compressor lubricating oil becomes entrained in the refrigerant passing through the compressor. If allowed to circulate, this oil reduces the efficiency of the system by coating the various heat transfer surfaces of the system. The oil also causes maintenance problems by congealing in the low temperature portions of the system and clogging check valves and other components.

It is therefore desirable to extract or separate the entrained oil from the refrigerant as quickly as possible after compression to minimize the effects of the oil on other parts of the system. Furthermore, it is desirable to provide a means in the system to perform as complete a separation process as possible. This is important not only to keep the oil out of the refrigerant for the aforesaid reasons, but also to maintain or preserve the lubricating properties of the oil and to retain the quality and cooling properties of the refrigerant used in the system.

Numerous refrigerant systems have heretofore included oil separating means for separating and removing entrained compressor oil from the refrigerant. Such means have, in most instances, consisted of an oil separator as a separate component in the system as shown, for example, in U.S. Patent No. 3,021,689. In other cases, it has been proposed to incorporate the oil separating means directly in a portion of the condenser as shown and described in U.S. Patent No. 3,201,949. In general, however, the oil separating means have consisted of devices of one type or another employed in conjunction with the condenser of the system to separate the oil from the refrigerant either before or after the refrigerant is condensed.

However, in all known prior systems, varying amounts of refrigerant remains commingled with the oil in either the liquid or gaseous state even after treatment by such oil separating means. To achieve maximum efficiency from the refrigeration system and apparatus, it is therefore desirable to provide a means for extracting this refrigerant fom the separated oil.

The present invention contemplates the provision of an improved refrigerant extraction means and a novel combination of such extraction means with other elements of a refrigerating system.

In addition, the refrigerant extraction means provided by the present invention has no moving parts, and therefore requires no maintenance or adjustment for satisfactory operation even for extended operating periods.

Furthermore, the refrigerant extraction means of this invention utilizes a heat exchanger to treat the separated oil to extract refrigerant commingled therewith. More specifically, the improved refrigerant extraction means

employs, in one embodiment thereof, the hot, high pressure refrigerant discharged from the compressor to supply the necessary heat input to the heat exchanger, thereby resulting in an efficient, simple and economical mode of operation.

The invention may be better understood by reference to the following specification and drawing, forming a part thereof, in which:

FIGURE 1 is a diagrammatic part sectional view illustrating the components of a refrigerating system embodying the concept of the present invention;

FIGURE 2 is a cross-sectional view of the improved refrigerant extraction means; and

FIGURE 3 is an alternate embodiment of the refrigerant extraction means.

Referring now to the drawing, wherein like reference characters designate the same or similar parts, a typical refrigerating system is shown therein as comprising, in general, a compressor **4**, having an inlet or suction conduit **6** leading thereto and an outlet or high pressure discharge line **8** leading therefrom; a condenser **10**, disposed in the high pressure discharge line **8**; a receiver **12** communicating with condenser **10** through conduit **14**; and an evaporator or cooling coil **16** having its inlet end **18** in communication with receiver **12** and its outlet end **20** in communication with compressor **4** by way of suction conduit **6**. As shown, an oil separating means is also provided, and such means is illustrated herein as being embodied directly in the condenser **10** within the entrance section **38** thereof.

Compressor **4** may be of the conventional oil lubricated reciprocating piston type, and the condenser **10** may be of the so-called shell and tube type in which cooling water supplied to conduit connection **22** is circulated through a plurality of tubes **24**, traversing the shell **26** between heads **28** and **30**. The high pressure discharge line **8** has the usual one-way, non-return check valve **31** therein and a similar check valve **32** is interposed in the gravity feedline **14** between condenser **10** and the receiver **12**. The receiver is also provided with the customary liquid level indicating gauge **34**, and the usual expansion valve **36** is provided in the inlet to evaporator **16**.

The oil separating means of the above described system may, of course, be in the nature of a separate structure but, for the purpose of illustration, this separating means has been shown and described herein as forming an integral part of the condenser **10**. Thus, while a specific construction has been shown in the drawing accompanying and forming a part of this specification, it should be understood that no limitation relative to the scope of the invention is to be thereby implied.

As illusrated, the condenser **10** includes an oil separating section **38** at its inlet end, such oil separating section being formed by a plurality of spaced baffles **40** and **42**, providing a circuitous path of travel for the gaseous refregerant and entrained oil discharged by compressor **4** through discharge line **8**. As the gaseous refrigerant and the entrained oil enter the condenser **10**, they impinge upon the depending baffle **40** and are directed downwardly about cooling tubes **24**. The gaseous refrigerant and entrained oil next impinge upon the downwardly projecting baffle **42** and are caused to flow in an upward direction about cooling tubes **24** before leaving section **38** and entering the main body of shell **26**. By reason of the impingement of the refrigerant vapor and entrained oil upon the baffles and the prolonged period of cooling afforded during the travel of the vapor and oil in its circuitous path about the tube **24** within section **38**, the oil and the gaseous refrigerant are caused to separate, and the separated oil is confined to section **38** by the baffle **42**.

While the oil separating section **38** separates the major portion of the oil from the refrigerant, a certain portion

of the refrigerant has been found to remain commingled in the oil, either in gaseous or liquid state, in the sump of the oill separating section 38. Therefore, in order to more completely separate the oil and the refrigerant in accordance with this invention, the oil from the oil separating section 38 of the condenser 10 is passed through a refrigerant extraction means 21, which extracts the commingled refrigerant, returns it to the refrigerating system, and returns the oil to the compressor 4.

Specifically, the sump of the oil separating section 38 is connected to a float valve chamber 44 by means of a conduit 46. In turn, a float valve 47 in the chamber supplies the separated oil to the refrigerant extraction means 21 through conduit 48. Refrigerant extraction means 21 comprises a chamber 50 having an inlet from conduit 48, a gas outlet 52, and an oil outlet 54. Oil outlet 54 may extend upward into the chamber 50, as shown in FIGURE 2, to permit a pool of the separated oil to form in the chamber. Chamber 50 also contains a source of heat. This may, for example, be an electric heating element 56 (see FIGURE 3), but in the preferred embodiment, the source of heat may be the discharge line 8, containing hot high pressure gas from the compressor 4. Thus, in FIGURES 1 and 2, the chamber 50 has been shown as surrounding or embracing the discharge line 8 in the nature of a jacket. It will be appreciated that the chamber 50, surrounding the discharge line 8, forms, in effect, a heat exchanger in which heat from line 8 is transferred to the contents of chamber 50, and the exterior of the conduit 8 at this location may be provided with fins if desired.

In operation, the compressor 4 provides high pressure, gaseous refrigerant to discharge line 8. This will be of increased temperature due to its compression. Additionally, the gas will have oil from the compressor 4 entrained therein. The gas is forced from compressor 4 through the discharge line 8 to the inlet end of the condenser 10. As previously described, the inlet of condenser 10 includes separating section 38, which removes the major portion of the entrained oil from the gaseous refrigerant prior to condensing the refrigerant to a liquid. This separated oil, along with whatever refrigerant is commingled therewith, collects in the bottom of oil separating section 38, and the refrigerant continues its passage through condenser 10 and past check valve 32 and then through the refrigeration system in the normal manner.

The oil in the bottom of the oil separating section 38 passes through conduit 46 to the float valve chamber 44. This oil, which is collected in the float valve body 44, is then conducted by the float valve 47 to the refrigerant extraction chamber 50 via conduit 48 and forms a pool in the bottom of chamber 50, which surrounds the discharge line 8. The elevated temperature of the discharge line 8, due to the hot compressed gases passing therethrough, heats the separated oil and boils out any remaining refrigerant therefrom. The refrigerant then passes, in the form of vapor, through conduit 52 to the suction line 6 and hence to the inlet of compressor 4. The oil remains in the jacket 50 until a sufficient quantity has accumulated to overflow through the conduit 52 to the oil sump of the compressor 4. The continued heating of the oil during the period of accumulation in chamber 50 aids in the extraction process. It is also to be noted that the oil supplied through conduit 48 enters near the bottom of chamber 50, thereby coming into initial contact with that portion of discharge line 8 closest to compressor 4. Since this is the hottest portion of the line 8, more efficient and complete extraction of the commingled refrigerant from the separated oil results.

A similar operation occurs with the embodiment of the invention shown in FIGURE 3, which may be used to advantage in instances where it is desired to closely control the amount of heat applied to the separated oil. The separated oil and entrained refrigerant from the oil separating section 38 of the condenser 10 is supplied through conduit 48 to chamber 50. The oil then passes over the

electric element 56 to extract the commingled refrigerant from the oil.

It will be appreciated from the foregoing that the present invetion provides for the effective removal of compressor oil from the system refrigerant by initially providing a means to separate entrained oil from the refrigerant employed in the system and thereafter providing a means to treat the oil to extract remaining commingled refrigerant from the oil. Further, the present invention provides an extremely simple regrigerant extraction means employing, in one embodiment thereof, heat from the compressor discharge line. Such use therefore adds to the efficiency and economy of the operation of the refrigeration system. However, if accurate control of temperature is desired, a separate heating element such as that incorporated in the alternate embodiment of the invention may be utilized.

Additional embodiments, modifications, and alterations may, of course, be made to the present invention, and it is intended to cover in the appended claims all such variations and modifications as fall within the true scope and spirit of the invention.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention:

We claim:

1. In a refrigeration system including an oil lubricated compressor having a hot gas discharge conduit communicating with a condenser, means associated with the inlet to the condenser in communication with the hot gas discharge conduit for initially separating oil from the refrigerant employed in the system, an extraction chamber surrounding a closed portion of said hot gas discharge conduit between the compressor and said initial oil separating means, whereby said discharge conduit provides a heating element for said extraction chamber, and a conduit communicating between said initial oil separating means and said chamber for conducting the initially separated oil having residue refrigerant therein to said chamber, whereby said heating element provides heat for extracting residue refrigerant from the oil, said chamber also having a conduit communicating therewith for discharging refrigerant therefrom and a separate conduit communicating therewith for discharging oil therefrom.

2. A refrigeration system according to claim 1, wherein the initial oil separating means is formed in the inlet end of the condenser and the conduit for discharging refrigerant from the extraction chamber communicates with the upper portion of said chamber, while the conduit for discharging oil from said chamber extends upwardly from the bottom and into communication with an intermediate portion of the interior of said chamber.

3. A refrigerating system according to claim 1, wherein the conduit for discharging refrigerant from the extraction chamber communicates with the low pressure inlet side of the compressor while the conduit for discharging oil from the extraction chamber communicates with the compressor crankcase.

4. In a refrigerating system including an oil lubricated compressor having a hot gas discharge conduit communicating with a condenser, means associated with the inlet to the condenser in communication with the hot gas discharge conduit for initially separating oil from the refrigerant employed in the system, a tilted extraction chamber having a thermostatically controlled heating element projecting therein from one end thereof, a conduit communicating between said initial oil separating means and said extraction chamber above said heating element for conducting the initially separated oil having residue refrigerant therein to said chamber, a conduit communicating between said chamber and the low pressure inlet side of said compressor for discharging refrigerant from said chamber and conducting the same to said low pressure inlet, and another conduit communicating between said extraction chamber and the compressor crankcase

for conducting refrigerant-free oil from said chamber to the compressor crankcase.

References Cited by the Examiner

UNITED STATES PATENTS

2,175,913	10/1939	Philipp	62—472 X
2,461,342	2/1949	Obreiter	62—83
2,900,801	8/1959	Honegger	62—473 X

FOREIGN PATENTS

622,043 4/1949 Great Britain.

ROBERT A. O'LEARY, *Primary Examiner.*
W. E. WAYNER, *Assistant Examiner.*