April 13, 1965 I. RASOVICH ETAL 3,177,680

REFRIGERATION SYSTEM WITH OIL RETURN MEANS

Filed Nov. 30, 1962

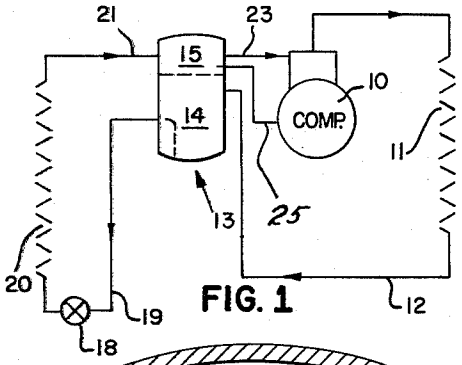


FIG. 1

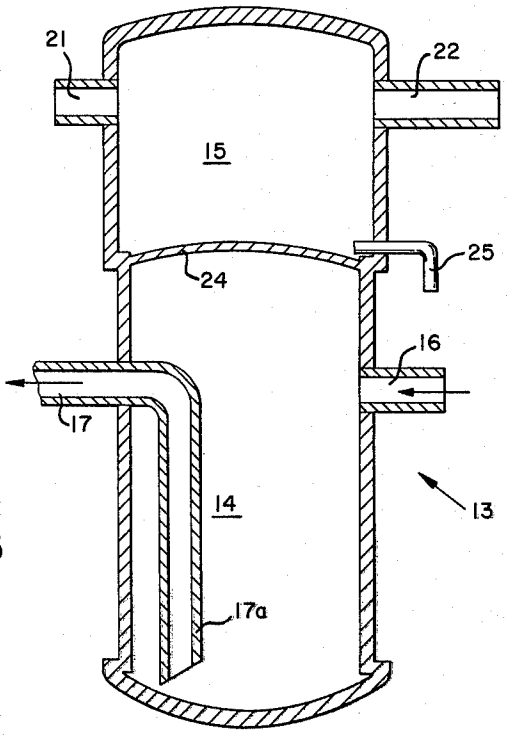


FIG. 2

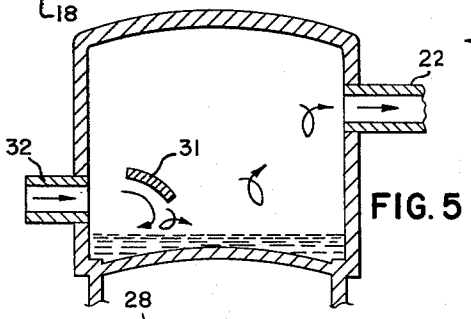


FIG. 5

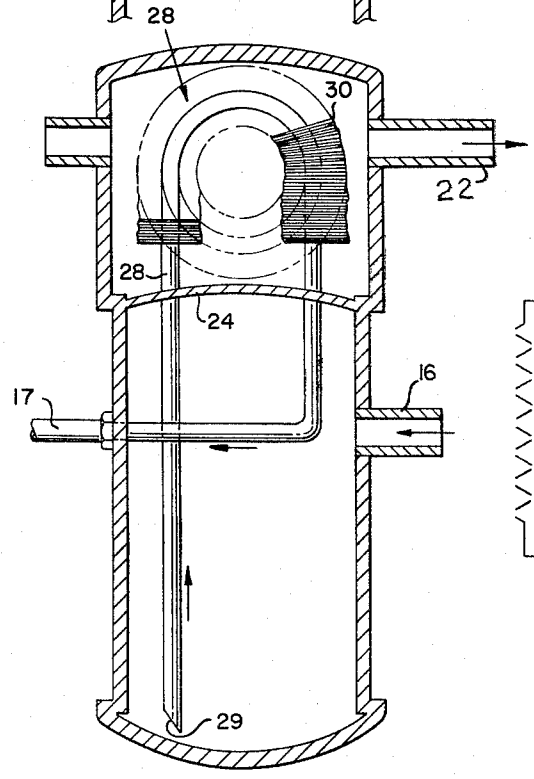


FIG. 4

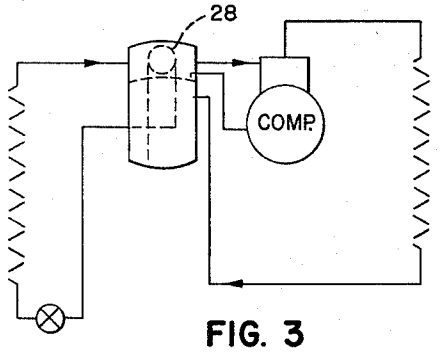


FIG. 3

INVENTOR.
IVAN RASOVICH
ROBERT E. CROWL

BY Flehr and Swain

ATTORNEYS

United States Patent Office 3,177,680 Patented Apr. 13, 1965

1

3,177,680

REFRIGERATION SYSTEM WITH OIL RETURN MEANS

Ivan Rasovich, Los Angeles, and Robert E. Crowl, Whittier, Calif., assignors to Freightlines Corporation, Portland, Oreg., a corporation of Delaware

Filed Nov. 30, 1962, Ser. No. 241,407
1 Claim. (Cl. 62—471)

This invention relates to a refrigeration system including a composite unit incorporating a plurality of components of the system.

Refrigeration systems can be arranged in a closed loop of components comprising a compressor, condenser, receiver, expansion valve, evaporator and accumulator, the last named being connected to the suction side of the compressor.

It is a general object of the present invention to provide a system wherein a plurality of system components are structurally combined to provide improved performance of the system.

Another object of the invention is to combine receiver and accumulator components for improved system performance.

Another object of the invention is to further combine the rceeiver and accumulator components to incorporate a hot gas loop disposed in heat exchange relation therebetween.

These and other objects of the invention will be more clearly apparent from the following description, claims and drawings, in which:

FIGURE 1 schematically shows a refrigeration system according to the invention;

FIGURE 2 is a side elevation partly diagrammatic view in section of a composite unit taken from the system shown in FIGURE 1 according to the invention;

FIGURE 3 schematically shows another system embodying the invention;

FIGURE 4 is a side elevation partly diagrammatic view in section of another embodiment, according to the invention, of a composite unit taken from the system shown in FIGURE 3; and

FIGURE 5 is a side elevation, partly diagrammatic view in section of another embodiment of the invention.

Generally, a refrigeration system is provided including receiver and accumulator components in a composite unit. The composite unit includes a heat conductive partition separating the receiver and accumulator compartments. The combination of the receiver and accumulator provides a number of advantages as will be described below.

The system schematically represented in FIGURE 1 comprises a compressor 10 which discharges to a condenser 11. Condenser 11 is connected by line 12 to a composite unit 13 shown in detail in FIGURE 2.

Unit 13 includes lower and upper compartments 14 and 15, respectively, serving as receiver and accumulator components of the system. Receiver compartment 14 is provided with inlet and outlet connections 16 and 17, respectively. Connection 16 is disposed a predetermined distance above the bottom of compartment 14 to deliver and deposit an accumulation of high pressure, high temperature liquid refrigerant therein coming from the condenser. Outlet 17 is equipped with a dip tube portion 17*a* so as to pass high pressure, high temperature refrigerant liquid from compartment 14 to an expansion valve 18 via line 19. An evaporator component 20 is connected downstream of the expansion valve. Evaporator 20 delivers low temperature, low pressure gas to accumulator compartment 15 via an intake connection 21 disposed in the upper region thereof. From compartment 15 gas refrigerant is passed by way of a discharge connection 22 back to the suction side of compressor 10 via line 23.

2

A partition 24 of heat conductive material separates the two compartments thereby providing heat transfer means to exchange heat between fluid in compartment 14 and fluid (gas and entrained liquids) in compartment 15.

Finally, it is to be noted that an oil drain line 25 has been provided to connect the lower region of compartment 15 to compressor 10. In another embodiment a drain line can be disposed with one end leading from the bottom of the accumulator chamber. The other end leads into the outlet connection 22 so as to apply a suction to the end in the accumulator, the latter acting as a jet pump to remove oil from the bottom of the accumulator. Removal of liquid in this manner precludes liquid refrigerant from draining by gravity alone from the bottom of the accumulator into the suction side of the compressor when the unit is shut off. Drainage into the compressor intake at this time can create a dangerous condition for the subsequent start up of the unit.

Another embodiment for draining entrained liquid from the accumulator consists of mounting a baffle plate 31 (FIGURE 5) to deflect the stream of fluid entering via connection 32. Plate 31 serves to cause vigorous agitation and turbulence which suspends and entrains the liquid. Connection 32 is comparable to connection 21 except that it is disposed lower so as to be closer to the accumulated liquid. In the accumulator as shown in FIGURE 5, no drain line is required.

The operation of the system in FIGURE 1 can best be explained starting with the compressor. Compressor 10 discharges high pressure gas into the condenser. In the condenser, the refrigerant is condensed into a liquid. This high pressure liquid then flows to the receiver which serves to store the liquid refrigerant in order to ensure that the expansion valve is provided with a positive supply of liquid refrigerant. Expansion valve 18 serves to reduce the pressure of the liquid so that low pressure liquid enters the evaporator. In the evaporator, heat is absorbed from the surrounding air by the evaporating low pressure liquid. The low pressure gas or vapor formed is directed into the suction accumulator, compartment 15, to trap any liquid refrigerant (and possible oil) existing in this part of the system. Thus, any liquid refrigerant and oil that may be entrained in the low pressure gas in the accumulator will drop to the bottom. The compressor is accordingly protected against possible damage from liquid refrigerant entering the intake. Any liquid refrigerant entrapped in the accumulator will eventually boil off because of heat from the receiver to form a vapor and any oil will gradually drain to sump in the compressor through drain line 25. In the embodiment of FIGURE 5 the oil is suspended due to turbulence and carried as harmless tiny droplets into the compressor.

By transferring some heat of the liquid in compartment 14 to the fluid in compartment 15, evaporation of liquid in the accumulator occurs more rapidly and without the necessity of applying external heat.

A corresponding reduction in the temperature of the liquid which passes through receiver 14 causes the receiver temperature to remain lower than the temperature of the entering liquid. In this condition, there is less possibility of the receiver temperature going above condenser temperature as might be caused by receiving heat from external sources. For example, such external heat might emanate from surrounding equipment as is not an uncommon problem in the transport refrigeration field. Minimizing the foregoing possibility of receiver temperature going above condenser temperature reduces the likelihood of "gas binding" of the receiver, causing a resultant poor flow of liquid from condenser to receiver. Gas binding, as is known, can result in undesirable excessive high side refrigeration system pressure.

By transferring heat from the hot, high pressure refrigerant liquid in compartment 14 to the cooler, low pressure gas and entrained liquid in compartment 15, the liquid passing from the receiver is cooler than it otherwise would be. Thus, the refrigerant effect per mass quantity of liquid is increased when the refrigerant evaporates in the evaporator. Furthermore, the gas in the accumulator is heated more than it would be otherwise which serves to further ensure that liquid does not return to the compressor suction. Under certain conditions, for example, such as where low temperature return gas is encountered, an increase in compressor volumetric efficiency can be attributed to this aspect.

In addition to the foregoing advantages, it will be readily apparent that the composite unit 13 described above provides the advantage of considerable space saving, reduces the number of components which it is necessary to mount and install, and minimizes the number of refrigeration piping joints required, thereby minimizing the possibility of deleterious leaks.

If it is desired to further enhance the heat transfer between liquid in receiver 14 and fluid in accumulator 15, a hot liquid loop 28 can be disposed with an open end 29 extending into a region of the receiver located below the inlet 16, as shown in FIGURE 4. Loop 28 extends upwardly from the bottom of the receiver, through partition 24, makes one or more convolutions in accumulator 15 and returns to outlet 17. A finned heat exchange means 30 can be attached to loop 28 to increase heat transfer from liquid in line 28 to fluid in the accumulator.

The unit shown in FIGURE 4 is incorporated in a system as shown in FIGURE 3 which operates in substantially the same manner as above described with the exception of the enhancement of the heat transfer mentioned above.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to preferred embodiments, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. For example, hot liquid loop 28 can be arranged to go around partition 24 rather than through it by disposing loop 28 to pass through the respective walls of compartments 14 and 15. It is the intention, therefore, to be limited only as indicated by the scope of the following claim.

We claim:

In a refrigeration system having a compressor including a sump portion, condenser, receiver, fluid expansion means, evaporator and accumulator arranged in a closed loop disposed in the foregoing order, wherein said accumulator is coupled via a discharge line to discharge into the compressor, a composite unit formed to include

two compartments, one of said compartments serving as the receiver and the other serving as the accumulator, said receiver having fluid inlet and outlet connections, said receiver being formed as a chamber for receiving a deposited accumulation of refrigerant therein from said condenser via said inlet connection and for passing same from said chamber to said expansion means via said outlet connection, said accumulator having intake and discharge connections, said discharge connection leading to said discharge line, said accumulator being formed as a chamber including upwardly extending sidewalls, a top wall enclosing the upper end of the last named chamber and a relatively broad bottom wall enclosing the lower end thereof, the area transversely of the fluid flow path via said accumulator intake connection being substantially less than the area transversely of the fluid flow path through said accumulator compartment to reduce the velocity of fluid passing through the accumulator compartment space, said discharge connection of the accumulator being disposed sufficiently above said bottom wall to entrap and accumulate on the bottom wall liquid entrained in the stream of fluid entering said accumulator chamber via said intake connection from said evaporator said bottom wall serving when heated to convert said liquid to a gas and pass said gas from said accumulator chamber to said compressor via said discharge connection, said bottom wall forming the top wall of said receiver compartment to be heated by refrigerant in the latter said bottom wall being readily conductive and disposed to transfer heat out of said receiver chamber upwardly to the bottom of the entrapped volume of liquid in the accumulator to evaporate same and an oil drain line independent of said discharge line and disposed with one end leading from a position immediately adjacent the bottom of said accumulator chamber, and the other end leading into said sump to remove oil from said accumulator chamber and direct same to said sump while bypassing said discharge line.

References Cited by the Examiner

UNITED STATES PATENTS

1,827,480	10/31	Martin	62—513 X
2,068,677	1/37	Higham	62—513 X
2,171,239	8/39	Gygax	62—513 X
2,603,954	7/52	Davis	62—471
3,012,414	12/61	La Porte	62—275

FOREIGN PATENTS

447,661	4/49	Italy.

ROBERT A. O'LEARY, *Primary Examiner.*

MEYER PERLIN, *Examiner.*

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

April 13, 1965

Patent No. 3,177,680

Ivan Rasovich et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, lines 2 and 3 and line 12, and in the heading to the printed specification, line 5, for "Freightlines Corporation", each occurrence, read -- Freightliner Corporation --.

Signed and sealed this 5th day of October 1965.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents