

March 24, 1942.

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2,277,647

REFRIGERATION

Filed Aug. 1, 1940

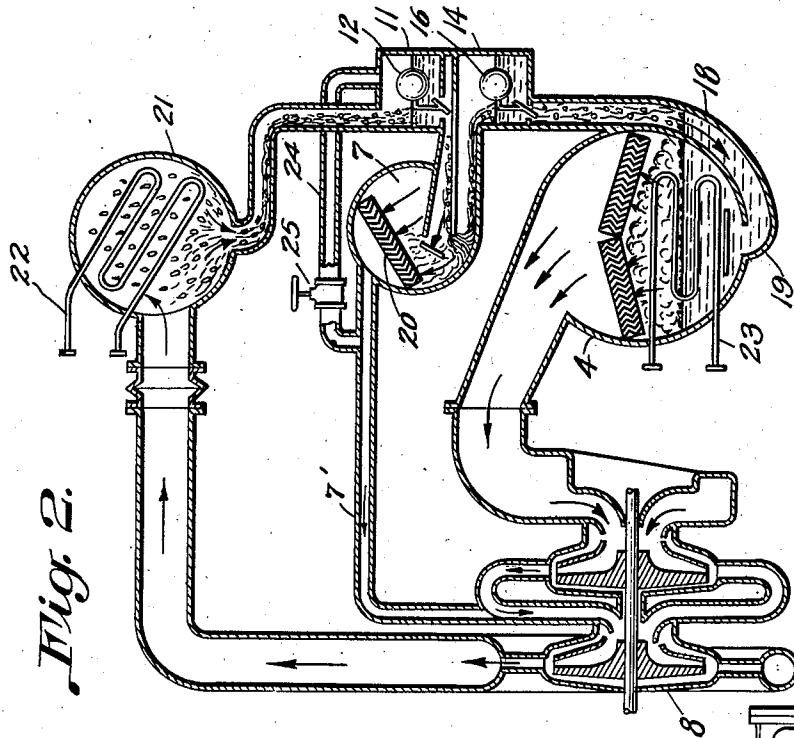


Fig. 2.

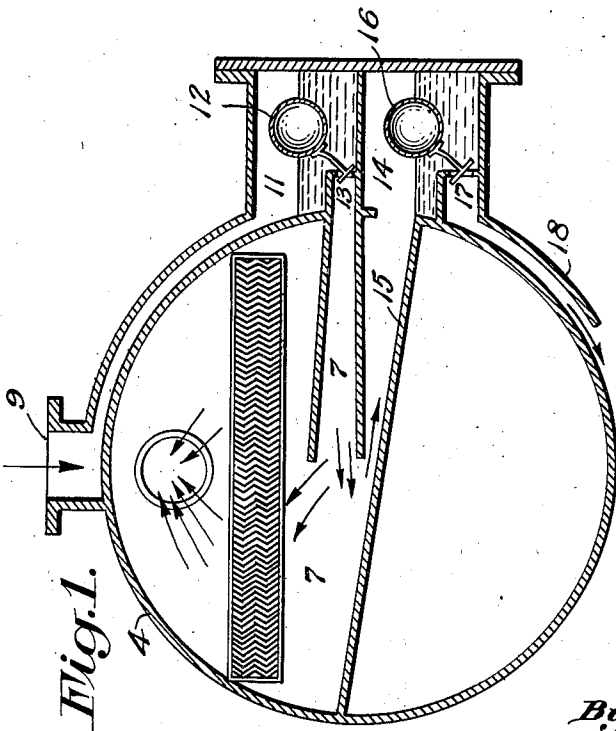


Fig. 1.

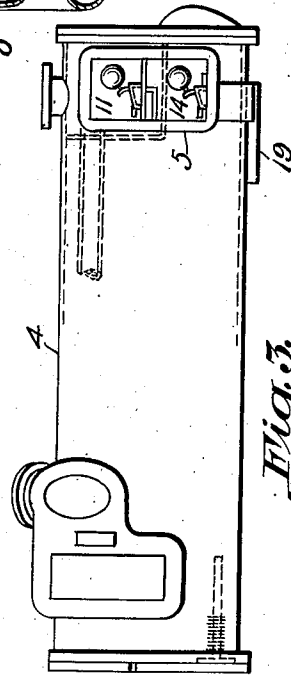


Fig. 3.

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2,277,647

REFRIGERATION

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Application August 1, 1940, Serial No. 349,156

8 Claims. (Cl. 62-115)

This invention relates to refrigeration, and more particularly to features of construction and methods of operation employed in connection with a centrifugal refrigeration compressor having a plurality of stages of compression, assembled in combination with a brine or water cooler, a condenser and related auxiliary elements.

Important features of the invention reside in the arrangement of an economizer structure located within the cooler at one end thereof, preferably the end opposite the suction connection, and forming an integral part of the cooler structure; and in the provision of two float chambers superposed one above the other for allowing refrigerant gas admitted from the condenser into the upper or condenser float chamber to "flash" into an economizer chamber, the flash gas being routed directly to an advanced stage of compression, thereby effecting economy in power consumption, and increasing the capacity of the initial stages of compression of the compressor.

These and other features will be apparent from the following detailed description of a typical form of the invention to be read in connection with the accompanying drawing in which:

Fig. 1 is a diagrammatic view of a cooler or evaporator shell structure within which applicant's economizer is located.

Fig. 2 shows a refrigerant cycle in which the function of applicant's economizer is illustrated, and

Fig. 3 is an elevational view of the cooler, broken away in part to illustrate the economizer assembly.

Considering the drawing, similar designations refer to similar parts, numeral 4 represents a shell and tube cooler of the type illustrated in my co-pending application Serial No. 349,155, filed concurrently herewith. The refrigerant cycle and combination of apparatus in which cooler 4 is employed is preferably that described in my said copending application. The economizer structure generally designated by the numeral 5 is located in the cooler shell preferably at the end opposite suction connection 6.

The cooler shell contains a tube bundle as illustrated in my said copending application, the tubes preferably being finned. The economizer chamber is positioned above the tube bundle in the cooler shell and is entirely separate from the cooler gas space.

In effect, the economizer is a chamber connected by an internal conduit 7 passing longitudinally through the cooler gas space to an advanced stage of compression of compressor 8. 55

The pressure in chamber and intermediate conduit 7 is lower than the condenser pressure and higher than the pressure in the cooler, being in between the two. The conduit carries away the refrigerant vapors generated in the chamber, delivering said "flash" gas to the second stage of compression illustrated, for example, in Fig. 2.

Liquid refrigerant from the condenser flows downwardly entering the cooler shell at point 9. It follows a course in a channel 10 which may be concentric with shell 4, and drains into an upper chamber 11 called a condensate float chamber. Float valve 12 in chamber 11 keeps the condenser drained of refrigerant and through orifice 13 admits the refrigerant from the condenser into the economizer chamber. The economizer chamber is at lower pressure than that of the condenser since the conduit connecting the chamber to the compressor goes directly to the intake of the second stage of compression. As a result, there will be flashing of refrigerant in the economizer chamber, the flash gas going to the second stage of compression, thereby saving the power otherwise expended in compressing this gas in the first stage of compression. The refrigerant less the "flash" gas, still in liquid form, drains into economizer float chamber 14 through passage 15. Float valve 16 controls orifice 17 to admit refrigerant to passage 18 which may be concentric with shell 4. The refrigerant enters the cooler through a bottom intake 19 shown in Fig. 2 and floods upwardly through the tube bundle of the cooler. The float valves may be suitably screened to prevent sticking due to foreign matter getting into the valve mechanism.

As shown in Fig. 1, the "flash" gas before entering the conduit 7' leading from chamber 7 passes through eliminator 20 which extracts entrained liquid refrigerant and drains it back into chamber 7.

The operation of the economizer may be noted from the refrigerant flow diagram shown in Fig. 2 which illustrates the refrigeration cycle and the function of the economizer. Starting from condenser 21 which contains a tube bundle as described in applicant's copending application and illustrated in Fig. 2 by a water course 22, the condensed refrigerant first flows into condensate chamber 11. Float valve 12 regulates the flow of refrigerant into chamber 7 connected by conduit 7' to the second stage of two-stage compressor 8. Chamber 7 and its connected conduit 7' actually comprise an uninterrupted passage throughout which the pressure is the

same, intermediate between the condenser and cooler pressures. Reduced pressure in chamber 7 forces a flashing of gas which passes from chamber 7 through conduit 7' into the second stage of compression. The remaining liquid refrigerant enters chamber 14 and flows therefrom under control of valve 16 through passage 18 into cooler 4 which is equipped with a tube-bundle diagrammatically illustrated by the water course 23.

By eliminating the flash gas which is routed from the economizer directly to the second stage of compression, the capacity of the first stage to admit working gas is increased by an amount corresponding to that drawn off in the economizer. The second stage is designed to admit the gas compressed in the first stage plus the flash gas from the economizer. The capacity of the compressor is increased because in general the capacity limit of a compressor is to a great extent dependent on the amount of gas which can be admitted into the inlet of the first stage.

Since the economizer, in structure, is part of the cooler and within the cooler shell, a great saving is effected in space as well as in cost of piping and insulation.

In effect, applicant provides in his economizer a structure which progressively reduces refrigerant pressure in its course from condenser to cooler, at the same time effecting a separation of gas from liquid to increase the refrigeration capacity of the system.

As a further aid to efficiency, applicant provides bypass connection 24 which, in effect, is a bypass from the condenser to the economizer since it connects an area under condenser pressure to an area under economizer pressure which is a lesser pressure intermediate condenser and cooler pressures. Bypass 24 is controlled by valve 25 and with the bypass open flashing may directly take place with a routing of flash gas to the second stage of the compressor. Applicant's arrangement may be utilized instead of and is preferable to that of a bypass from condenser to evaporator since the capacity of the first stage is increased by that of the flash gas which passes through the bypass to the second stage.

Since many changes may be made in the invention without departing from the scope thereof, it is intended that all matter set forth in the above description, or shown in the accompanying drawing, be regarded as illustrative only and not in a limiting sense.

I claim:

1. An economizer arrangement of the character described comprising a first chamber, a second chamber at a level below the first chamber, means for automatically feeding refrigerant from a condenser to the first chamber, an orifice in each chamber, and means for regulating the opening of said orifice whereby refrigerant in desired volume will first be admitted from the first chamber to a third chamber to effect separation of vapor therefrom, then be admitted to the second chamber, and finally be admitted from the second chamber to a cooler.

2. In a refrigeration system of the character described, a cooler of the shell and tube type, a condenser, a multi-stage refrigerant compressor operatively associated with said cooler and condenser, an economizer comprising a plurality of refrigerant compartments, said economizer being positioned within said cooler, and means for routing liquid refrigerant from the condenser to one portion of the economizer maintained at a

pressure less than that of the condenser and greater than that of the cooler so that a portion of the refrigerant is vaporized, means for routing the vaporized refrigerant to an advanced stage of compression of the compressor, and means for routing the remainder of the liquid refrigerant to the cooler.

3. In a refrigeration system of the character described, a cooler, a condenser, a multi-stage refrigerant compressor operatively associated with said cooler and condenser, an economizer, and means for routing liquid refrigerant from the condenser to one portion of the economizer maintained at a pressure less than that of the condenser and greater than that of the cooler so that a portion of the refrigerant is vaporized, means for routing the vaporized refrigerant to an advanced stage of compression of the compressor, and means for routing the remainder of the liquid refrigerant to the cooler, said economizer having parts thereof connected to the condenser, the cooler, and an advanced stage of compression of the compressor, said economizer being located within the cooler at one end thereof, the other end being connected to the suction side of the compressor.

4. In a refrigeration system of the character described, the combination of a compressor, a cooler and a condenser operatively associated with the compressor, means associated with said cooler for progressively reducing the pressure of refrigerant routed from the condenser to the cooler, said means effecting a separation of refrigerant vapor from refrigerant liquid, and comprising a first float chamber connected to the condenser and to an advanced stage of compression of said compressor, a second float chamber communicative with said first chamber, and means for delivering refrigerant liquid from said second float chamber to a bottom portion of the cooler.

5. In a refrigeration system of the character described, the combination of a compressor, a cooler and a condenser operatively associated with the compressor, means associated with said cooler for progressively reducing the pressure of refrigerant routed from the condenser to the cooler, said means effecting a separation of refrigerant vapor from refrigerant liquid, means for delivering such refrigerant liquid to the cooler, and means for delivering the separated refrigerant vapor to the compressor, said last-mentioned means comprising a chamber, an internal conduit within the cooler running longitudinally thereof connecting said chamber to an advanced stage of compression of said compressor, and an eliminator at the entrance to said conduit.

6. In a refrigeration system of the character described, a compressor, a cooler and a condenser operatively associated with the compressor, means associated with said cooler for progressively reducing the pressure of refrigerant routed from the condenser to the cooler, said means effecting a separation of refrigerant vapor from refrigerant liquid, means for delivering the refrigerant liquid to the cooler, said means associated with said compressor comprising an economizer forming part of and located within the cooler, said economizer including a condensate trap, a passage concentric with the cooler shell connecting said trap to the condenser, a second trap, and a second passage concentric with the cooler shell connecting said second trap to the cooler.

7. An economizer apparatus of the character described comprising a first chamber, means for

supplying liquid refrigerant to said first chamber, means for delivering refrigerant from said chamber to an area of lower pressure than that obtaining in said first chamber, means responsive to variations in liquid level in said first chamber for regulating such delivery, means for withdrawing from said area flash vapor formed as an incident to the delivery of refrigerant to such area, a second chamber, means for delivering refrigerant liquid from said area to said second chamber, means for delivering refrigerant liquid

from said second chamber for evaporation, and means responsive to variations in liquid level in said second chamber for regulating the delivery of refrigerant from said second chamber.

8. An apparatus as described in claim 7 including means forming a downwardly extending passageway between said first and second chambers permitting gravitational flow of refrigerant liquid from the first to the second chamber.

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