

Nov. 19, 1957

S. R. HIRSCH
REFRIGERATION SYSTEM

2,813,404

Filed Aug. 26, 1955

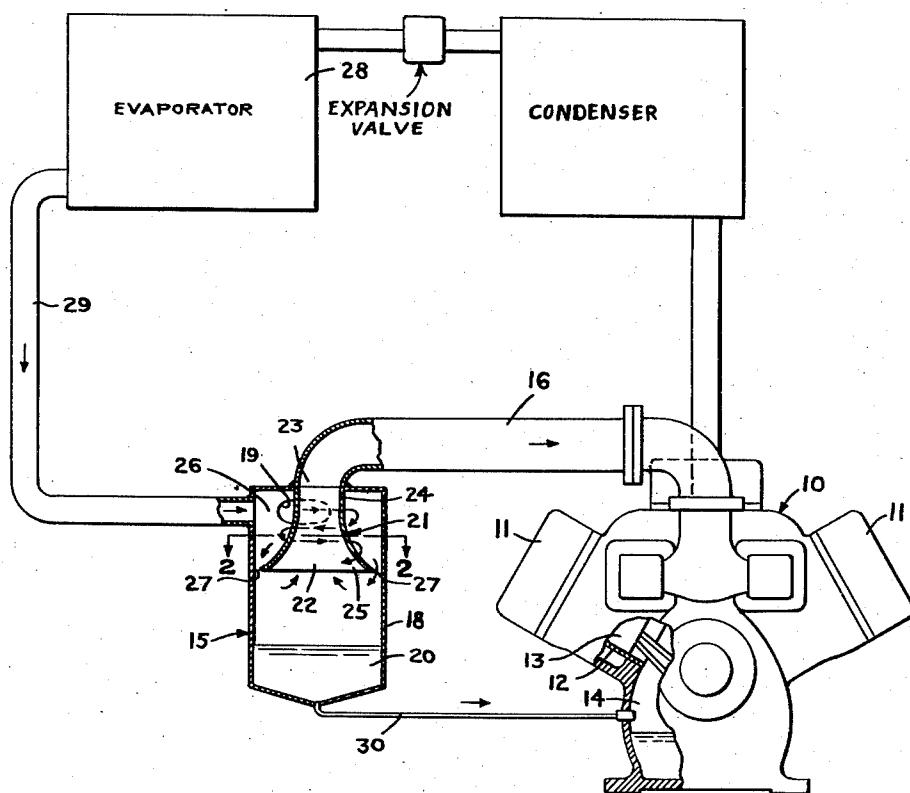


FIG. 1

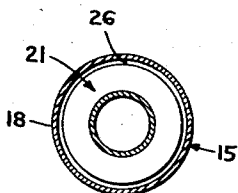


FIG. 2

SYLVAN R. HIRSCH
INVENTOR.

BY *Daniel H. Bohi*
Atty

1

2,813,404

REFRIGERATION SYSTEM

Sylvan R. Hirsch, Longmeadow, Mass., assignor to Worthington Corporation, Harrison, N. J., a corporation of Delaware

Application August 26, 1955, Serial No. 530,730

2 Claims. (Cl. 62—115)

The present invention relates to a refrigeration system and more particularly to a compression refrigeration system using a liquefiable fluid.

In a compression refrigeration system, liquid refrigerant is expanded from the high side of the system through an expansion valve into an evaporator where a portion of the liquid is gasified just by the expansion, and the remaining portion of the liquid is evaporated by heat being applied by the load imposed on the evaporator. This gas is then conducted to the compressor and the usual cycle of refrigeration results.

In the evaporator, however, because of fluctuating loads, there are times when all the refrigerant is not converted from liquid into a gas and often the controls in the system are not sensitive enough to reduce the entrained liquid portion of the gas-liquid mixture discharged from the evaporator rapidly enough so that some of the entrained liquid in the mixture is carried over into the suction line of the compressor and thereby causes damage to the compressor.

A common method to prevent the carry-over of entrained liquid into the compressor is to provide a large suction trap or accumulator where the velocity of the refrigerant vapor with the entrained liquid particles is dropped down to a low value so that the liquid cannot be picked up by the vapor portion of the mixture and carried into the compressor cylinder. The difficulty with this solution of the problem is that the accumulator must be of very large size in order to get the velocity sufficiently low to be of any practical value.

In accordance with the present invention, means are provided to maintain the refrigerant vapor-liquid mixture velocity sufficiently high so that when the load in the evaporator varies and a large portion of liquid is entrained in a mixture it will cause a slight restriction in the suction line to the compressor. This will develop a pressure differential in the line so that the difference in pressure is sufficient to volatize a considerable amount of the entrained liquid to prevent carry-over to the compressor cylinder and thus avoid damage to the compressor.

The present invention provides a restricted area in communication with the suction line of the compressor which causes a pressure drop therethrough to produce a flashing of the entrained liquid in the vapor-liquid mixture which is drawn into the compressor suction line and can be handled thereby without any damage to the compressor.

The present invention together with its various features and objects will be better understood by reference to the accompanying drawing in which—

Figure 1 is a diagrammatic view of a refrigeration apparatus embodying the present invention, and

Figure 2 is a section taken on line 2—2 of Figure 1.

Referring to the drawings, the reference numeral 10 designates a reciprocating compressor having cylinder heads 11 enclosing cylinders, only one cylinder 12 of

2

which is shown. A piston 13 is disposed in each cylinder for reciprocating movement therein. A fluid-tight crankcase 14 is provided in the lower portion of the compressor housing. A separator 15 is in communication with the compressor through a compressor suction line 16 connected therebetween.

Separator 15 comprises a cylindrical vessel 18 with an axial opening in the top thereof and a tangential opening 19 in the upper side wall thereof. The lower portion of vessel 18 forms a liquid compartment 20 for holding refrigerant liquid which has been separated from refrigerant gas, as hereinafter described. A hollow casing 21 is disposed in the upper portion of vessel 18 having inlet and outlet openings 22 and 23 respectively therein.

Casing 21 is secured to vessel 18 in a fluid-tight relationship therewith adjacent the axial opening therein while suction line 16 is connected in a fluid-tight relationship to the casing 21 adjacent outlet opening 23.

The upper portion 24 of casing 21 is substantially cylindrical-shaped while the lower portion 25 of the casing is substantially bell-shaped. Casing portions 24 and 25 are in spaced relationship with the inner surface of vessel 18 to form an annular chamber 26 therebetween in which refrigerant gas and liquid are separated from one another. The lower edge of bell-shaped portion 25 extends to a point adjacent the inner surface of the vessel to provide a restricted annular opening or passageway 27 therebetween.

An evaporator 28 is in communication with separator 15 through a discharge line 29 connected at one end to the evaporator and at the other end thereof to tangential opening 19.

In operation, refrigerant gas which has been compressed in the compressor 10 is passed through a condenser not shown and is condensed to a liquid. Thereafter the refrigerant liquid passes through an expansion valve not shown where a small portion of the liquid is gasified just by the expansion. The liquid-gas mixture then passes into the evaporator and the remaining portion of the liquid is evaporated by heat being applied by the load imposed on the evaporator. The evaporated or gasified refrigerant is thereafter discharged from the evaporator through discharge conduit 29. When all of the refrigerant liquid is not converted from a liquid into a gas, the entrained liquid is carried with the gas through line 29 and enters separator 15 through tangential opening 19. The gas-liquid mixture upon entering vessel 18 has imparted thereto a rotary movement and travels around the inner surface of the casing. The heavier liquid particles in the mixture are thrown to the outside of chamber 26 against the inner surface of the vessel while the lighter gaseous portions of the mixture are whirled in the chamber centrally of the liquid due to centrifugal force, and thus the liquid portion is separated from the gas portion of the mixture. Thereafter, the separated liquid flows down the inner surface of the vessel through opening 27 into compartment 20. The separated gas passes through opening 22, inwardly of the liquid, and is drawn through casing 21 into suction line 16 to be recompressed in compressor 10.

Should the load on the evaporator be sufficiently low so that there is a large portion of entrained liquid in the mixture, the liquid reduces the cross-sectional area of the passageway 27, or closes it off. This causes a momentary drop in pressure thereacross and there is a flashing of the liquid into a gas because of the pressure drop. The gas thereafter passes through inlet opening 22 in the casing 21 and is discharged through outlet 23 into suction line 16 from whence it is drawn into the compressor for recompression therein. Thus, the present invention provides apparatus which produces a centrifugal

action and a restrictor action or slight restriction which develops a pressure differential and causes a volatilization of a considerable amount of the liquid to prevent carry-over thereof into the compressor.

The solid liquid, and any oil from the lubrication system of the compressor, which falls out of the gas stream and is collected in the separator compartment 20 is drained to crankcase 14 of the compressor through drain line 30.

Inasmuch as various changes may be made in the particular form, location and arrangement of the parts of the apparatus disclosed without departing from the principles of the invention, it will be understood that the invention is not to be limited except by the scope of the appended claims.

What is claimed is:

1. In a refrigeration system, a compressor, a suction line connected to said compressor for flowing refrigerant gas therethrough to be compressed, a centrifugal separator to separate entrained liquid from refrigerant gas, said separator comprising a cylindrical vessel having a liquid compartment in the bottom thereof, a casing disposed in the upper portion of said vessel having a cylindrical upper portion and a bell-shaped lower portion in spaced relationship with the inner surface of said vessel to form a gas-liquid chamber therebetween, said vessel having a tangential inlet opening in the upper portion thereof to receive refrigerant gas and entrained liquid therethrough for centrifuging in said gas-liquid chamber, the lower edge of said bell-shaped portion extending to a point adjacent the inner surface of said vessel to form a restricted annular opening therebetween to provide a pressure drop thereacross when the quantity of liquid entrained in the gas reduces the size of said opening to vaporize the liquid, said casing having an inlet in communication with said annular opening and an outlet in communication with said suction line for passing separated gas therethrough from the annular opening to said suction line.

rated gas therethrough from the annular opening to said suction line.

2. In a refrigeration system, a compressor, a suction line connected to said compressor for flowing refrigerant gas therethrough to be compressed, an evaporator, a discharge line connected to said evaporator to receive refrigerant gas therefrom, a centrifugal separator to separate entrained liquid from refrigerant gas, said separator comprising a cylindrical vessel having a liquid compartment in the bottom thereof, a casing disposed in the upper portion of said vessel having a cylindrical upper portion and a bell-shaped lower portion in spaced relationship with the inner surface of said vessel to form a gas-liquid chamber therebetween, said vessel having a tangential inlet opening in the upper portion thereof in communication with said discharge line to receive refrigerant gas and entrained liquid therethrough for centrifuging in said gas-liquid chamber, the lower edge of said bell-shaped portion extending to a point adjacent the inner surface of said vessel to form a restricted annular opening therebetween to provide a pressure drop thereacross when the quantity of liquid entrained in the gas reduces the size of said opening to vaporize the liquid, said casing having an inlet in communication with said annular opening and an outlet in communication with said suction line for passing separated gas therethrough from the annular opening to said suction line.

References Cited in the file of this patent

UNITED STATES PATENTS

2,015,464	Saint-Jacques	Sept. 24, 1935
2,187,646	Darrieus	Jan. 16, 1940
2,343,514	McCormack	Mar. 7, 1944
2,466,863	Phillips	Apr. 12, 1949
2,474,892	Ecabert	July 5, 1949
2,512,758	Winkler	June 27, 1950
2,645,884	Kellie	July 21, 1953