Oct. 11, 1932. G. HILGER 1,882,597

REFRIGERATING SYSTEM

Filed Jan. 21, 1928

Fig. 1.

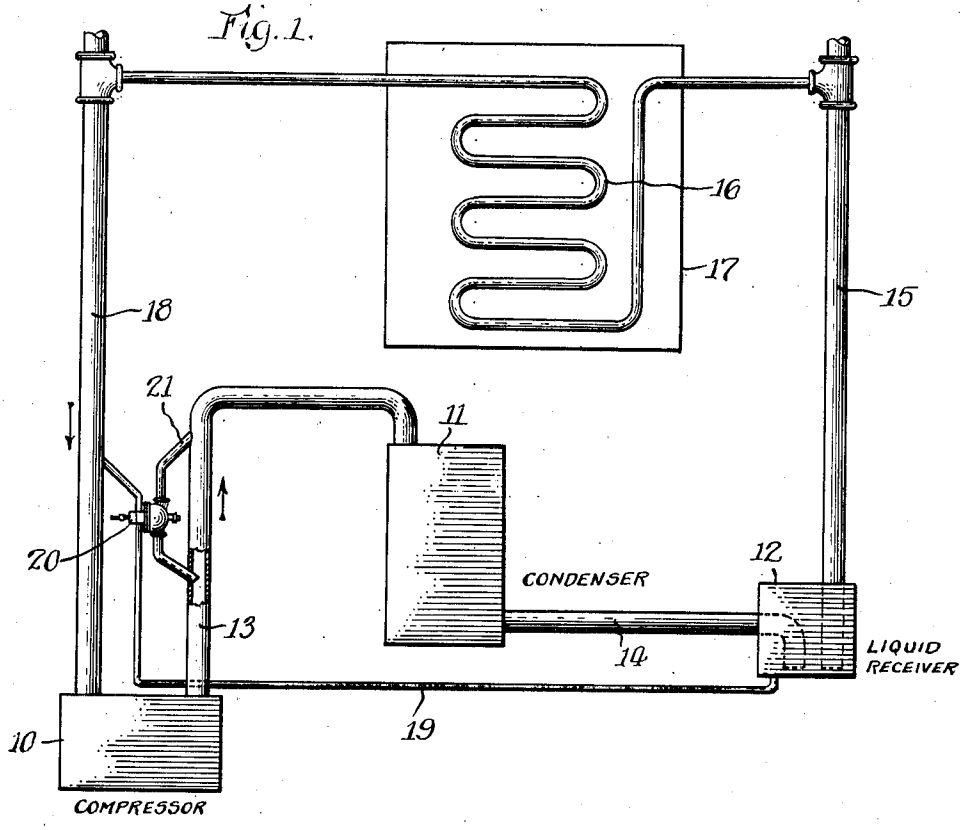
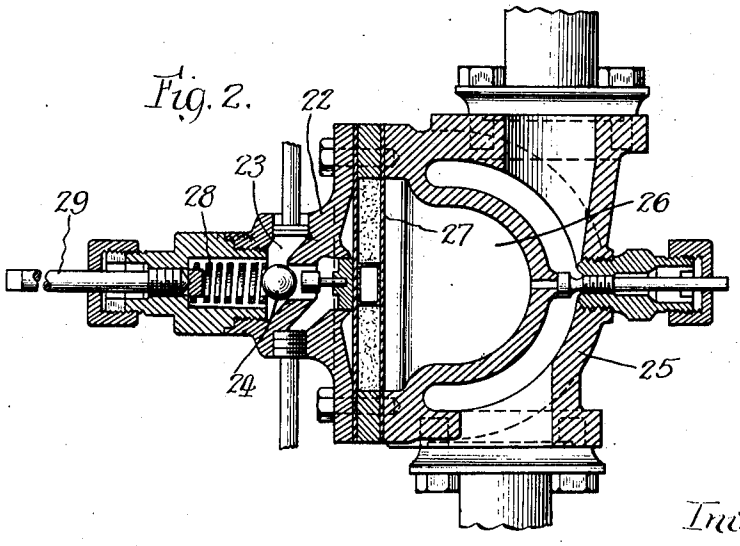


Fig. 2.



Inventor:
George Hilger,
By Chisholm, Parker & Carlson
Attys.

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GEORGE HILGER, OF CHICAGO, ILLINOIS

REFRIGERATING SYSTEM

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The present invention relates to improvements in refrigerating systems, and has particular reference to improvements in refrigerating systems of the expansion type.

In systems of this type, the refrigerant is commonly circulated through a closed cycle comprising a compressor, a condenser connected to the discharge of the compressor, and a refrigerating element receiving liquid from the condenser and returning spent gas to the compressor.

The gas returning to the compressor is frequently highly superheated, and the supply of the gas in this state to the compressor is undesirable in that it results in lowering the capacity of the compressor and hence its efficiency, in undue wear, and frequently in the decomposition of oil and ammonia in the compressor. Thus, when the highly superheated gas contacts with the hot walls of the compressor, it is superheated still more, and consequently expands. As a result, the amount of gas by weight which the compressor can handle is materially reduced. In view of the high initial temperature, the final temperature of compression will be very high, and in fact may be so high as to cause decomposition of the lubricating oil and the gaseous refrigerant. Excessive temperatures and decomposition of the oil and gas in the compressor result in excessive wear.

The primary object of the present invention therefore resides in automatically conditioning the gaseous refrigerant so that when it enters the compressor it will have a relatively low temperature, and but a slight amount of superheat.

A further object resides in the provision of novel means for conditioning the gaseous refrigerant entering the compressor by the addition of liquid refrigerant.

Another object resides in the provision of means for conditioning the gaseous refrigerant entering the compressor by the addition of a small amount of liquid refrigerant for taking up most of the superheat in the gas, which means is automatically controlled in accordance with temperature changes affecting the compression of the gas.

Still another object is to provide novel means of the above character which is readily adjustable.

A general object of the invention resides in the provision of a novel refrigerating system which has a high efficiency and a high capacity, in which the temperatures attained in the compressor are kept below a predetermined maximum so as to obtain a high compressor capacity, and to prevent decomposition of the oil and the refrigerant, and in which the compressor is not subject to excessive and objectionable wear.

Further objects and advantages will become apparent as the description proceeds.

In the accompanying drawing, Fig. 1 is a diagrammatic representation, partially in section, of a refrigerating system embodying the features of my invention.

Fig. 2 is a sectional view of the temperature responsive device for controlling the supply of liquid to the gas entering the compressor.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawing and will herein describe in detail the preferred embodiment, but it is to be understood that I do not thereby intend to limit the invention to the specific form disclosed but intend to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

Referring to the exemplary embodiment of the invention illustrated in the drawings, I have shown a system using ammonia as the refrigerant, but it will be understood that any suitable refrigerant may be used. The system comprises a compressor 10, a condenser 11 and a liquid receiver 12, these units being represented diagrammatically and being designated by suitable legends. The compressor 10 has a discharge pipe 13 leading to the condenser 11, and the latter in turn is connected by a pipe 14 with the liquid receiver 12, the pipe 14 preferably discharging near the bottom of the receiver.

The liquid receiver 12 is connected by a pipe 15, constituting a charging header, to the inlet of a suitable refrigerating element

16. Preferably, the element 16 comprises a suitable coil which is disposed in a chamber 17 to cool the latter, and in which the refrigerant travels upwardly. The discharge end of the refrigerating element is connected through a suitable pipe 18, constituting a discharge or suction header, to the suction side of the compressor 10.

It will be understood that the ammonia gas discharged from the compressor 10 is condensed in the condenser 11, that the condensate is stored in the liquid receiver 12, that liquid from the receiver is supplied to the refrigerating element 16 wherein it is expanded and vaporized, and that the expanded gas from the refrigerating element 16, which frequently is highly superheated, is returned through the pipe 18 to the compressor 10. While I have herein shown one simplified form of refrigerating system, it will be understood that the invention is applicable to a large number of different forms of apparatus.

The present invention resides in the provision of means for conditioning the gas before compression by admitting thereto regulated quantities of liquid ammonia to absorb the excessive superheat. It will be understood that preferably the gas entering the compressor 10 is slightly superheated, so as to prevent any condensate from entering the compressor. While the desuperheating liquid may be added at any suitable point at the suction side of the compressor, in the present instance means is provided for supplying the liquid to the pipe 18. This means comprises a small pipe 19 adapted to receive liquid ammonia from any suitable source such as the liquid receiver 12.

Means is provided for automatically controlling the supply of liquid ammonia through the pipe 19 to the gas in the main 18 in accordance with predetermined temperature conditions affecting the compression. Obviously, if the superheat in the incoming gas increases, more liquid ammonia should be added; if the maximum temperature of compression or the temperature of the compressed gases leaving increases, the gas entering the compressor must have a higher superheat and more liquid ammonia should be added. In the present instance, I prefer to control the supply of liquid ammonia in accordance with the temperature of the gas leaving the compressor. To this end, the temperature responsive control means comprises a suitable valve 20 interposed in the line 19 and in a shunt line 21 branching from the pipe 13.

While any suitable form of valve 20 may be provided, in the present instance, I have provided a valve (see Fig. 2) comprising a casing 22 having a through passageway 23 interposed in the line 19 and controlled by a ball valve 24. One side of the casing is constructed to provide a jacket 25 interposed in the shunt line 21. The jacket 25 partially surrounds a chamber 26 in the casing, one wall of the chamber being formed with an insulating diaphragm 27 operatively associated with the valve 24. In the chamber 26 is contained a quantity of ammonia or the like, which being subjected to the temperature of the refrigerant, i. e., compressed gas, leaving the compressor 10, exerts a greater or less pressure on the diaphragm 27 tending to open the valve 24 against the pressure of the refrigerant in the pipe 19 plus the action of a spring tensioning means, generally designated as 28. The spring 28 is adjustable by means of an adjusting screw 29. Obviously, adjusting of the spring tension will adjust the amount of liquid which will be supplied to the pipe 18 for a predetermined temperature of the gas in the pipe 13.

In operation, when the temperature of the gas in the pipe 13 rises to a predetermined point, the temperature of the liquid in the chamber 26 will increase accordingly, thereby opening the valve 24 so as to supply ammonia liquid to the highly superheated gases entering the compressor through the pipe 18. As the temperature of the gas increases still more, the valve 24 will be opened farther to increase the amount of liquid ammonia passing therethrough. The liquid entering the pipe 18 immediately vaporizes, and in so doing absorbs the excess superheat in the gas. Preferably, enough liquid is added so that the gas as it enters the compressor is just slightly superheated. With the gas under these conditions, no slugs or condensate will enter the compressor, and the latter will fill with the maximum amount of gas by weight, thereby increasing the capacity and efficiency of the compressor. Since the initial temperature of the incoming gas is relatively low, the maximum temperature of compression will not be excessive so as to decompose the oil and ammonia. As a result the compressor is not subject to objectionable wear.

I claim as my invention:

1. A refrigerating system having, in combination, a circulatory system including a compressor, a condenser, and a refrigerating element connected in series, the outlet of said element being connected to the suction side of said compressor, and temperature responsive means for supplying liquid refrigerant to the gas in the system at the suction side of said compressor.

2. A refrigerating system having, in combination, a circulatory system including a compressor, a condenser, and a refrigerating element connected in series, the outlet of said element being connected to the suction side of said compressor, and means for supplying liquid refrigerant to the gas entering said compressor so as to remove excess superheat,

said means being responsive to temperature conditions related to the temperature of the entering gas.

3. A refrigerating system having, in combination, a circulatory system including a compressor, a condenser, and a refrigerating element connected in closed series in the order named, and means for automatically supplying liquid refrigerant to the gas in the system at the suction side of said compressor in accordance with the temperature of the gas leaving the compressor.

4. A refrigerating system comprising, in combination, a circulatory system including a compressor, a condenser for the gas leaving the compressor, a receiver for the condensate from the condenser and a refrigerating element connected to said liquid receiver and discharging to the suction side of said compressor, means for supplying liquid ammonia from said receiver to the inlet to said compressor, valve means interposed in said means, and means responsive to the temperature of the gas leaving the compressor for controlling said valve means.

5. A refrigerating system comprising, in combination, a circulatory system including a compressor, a condenser, a compressor discharge line opening to said condenser, a liquid receiver, a condenser discharge line opening into said receiver, a refrigerating element, a liquid supply line connecting said receiver and said element, a suction line connecting said element and the suction side of said compressor, a liquid supply line connecting said receiver to said suction line, adjustable valve means interposed in said last mentioned line, a shunt line branching from said compressor discharge line and temperature responsive means interposed in said shunt line for controlling said valve means to vary the amount of liquid passing therethrough in accordance with temperature changes in the gas leaving said compressor.

6. A refrigerating system comprising, in combination, a circulatory system including a compressor, a condenser for the gas leaving the compressor and a refrigerating element connected to said condenser and discharging to the suction side of said compressor, means for supplying liquid refrigerant to the inlet to said compressor, valve means interposed in said means, and means responsive to the temperature of the gases leaving the compressor for controlling said valve means.

7. A refrigerating system comprising, in combination, a circulatory system including a compressor, a condenser, a compressor discharge line opening to said condenser, a refrigerating element, a liquid supply line connecting said condenser and said element, a suction line connecting said element and the suction side of said compressor, a liquid supply line connected to said suction line, valve means interposed in said last mentioned line, a shunt line branching from said compressor discharge line and temperature responsive means interposed in said shunt line for controlling said valve means to vary the amount of liquid passing therethrough in accordance with temperature changes in the gas leaving said compressor.

8. A refrigerating system comprising, in combination, a compressor, a condenser, a line for discharging compressed gas to said condenser, a refrigerating element adapted to receive liquid refrigerant from said condenser, and a suction line for returning spent refrigerant from said element to said compressor, means for supplying liquid refrigerant to said suction line, and means responsive to the temperature of the refrigerant in one of said lines for automatically controlling the supply of liquid to said suction line.

9. A refrigerating system comprising, in combination, a compressor, a condenser, a line for discharging compressed gas to said condenser, a refrigerating element adapted to receive liquid refrigerant from said condenser, and a suction line for returning spent refrigerant from said element to said compressor, means for supplying liquid refrigerant to said suction line to absorb superheat in the spent refrigerant returning to said compressor, and means responsive to the temperature of the gas in one of said lines for automatically controlling the supply of liquid refrigerant to said suction line, said first mentioned means opening to said suction line at a point a substantial distance from said compressor so as to insure absorption of superheat and vaporization of the conditioning liquid before the gas enters said compressor.

10. A refrigerating system comprising, in combination, a circulatory system including a compressor adapted to compress a refrigerant, a condenser for the gas leaving the compressor and a refrigerating element connected to the condenser and discharging to the suction side of said compressor, and automatic temperature responsive means for supplying a liquid refrigerant to the system at the suction side of the compressor to condition the incoming gaseous refrigerant from said refrigerating element.

In testimony whereof, I have hereunto affixed my signature.

GEORGE HILGER.