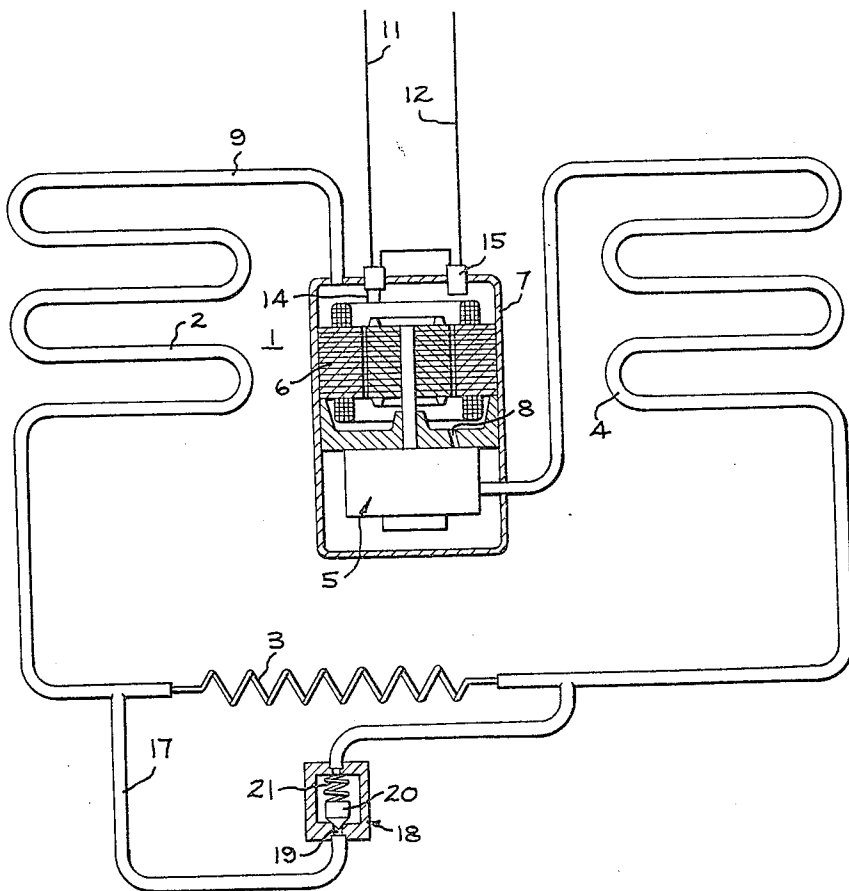


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REFRIGERATION SYSTEM INCLUDING HIGH
PRESSURE LIMIT CONTROL MEANS
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REFRIGERATION SYSTEM INCLUDING HIGH
PRESSURE LIMIT CONTROL MEANS

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The present invention relates to refrigeration systems and is more particularly concerned with a refrigeration system including improved control means for limiting abnormally high side pressure conditions.

Refrigeration systems, such as those employed for air conditioning, comprise in closed, series-flow connection a compressor, a condenser, normal flow control means and an evaporator. The normal flow control means between the condenser and the evaporator may be either a fixed flow restrictor, such as capillary tube, or an expansion valve responsive for example to changes in evaporator temperature. Fan means are normally also provided for circulating outdoor air over the condenser and indoor air over the evaporator. The compressor is driven by a driving motor and the power supply circuit for the motor normally includes a motor overload protector adapted to open the circuit upon an abnormal increase in the current flowing to the motor, an abnormal increase in the motor temperature or both. Many air conditioning refrigeration systems also include pressure limiting controls such as a high pressure cut out switch in the high or condenser side of the system to limit the maximum pressures that may be attained under abnormal or poor condenser cooling conditions such as those resulting from condenser fan motor failure or other interruption of the air flow over the condenser.

It is an object of the present invention to provide improved means for limiting the pressures in the high side of a refrigeration system which does not require the use of a high pressure cut out switch.

Another object of the invention is to provide a refrigeration system including means responsive to an abnormal differential in the high and low side pressures for increasing the flow of refrigerant to the compressor and thereby load the compressor so that the normal motor overload protector will operate to denenergize the motor.

Further objects and advantages of the invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming part of the specification.

In accordance with one embodiment of the present invention, there is provided a refrigeration system comprising a compressor, a condenser, a normal flow control means and an evaporator connected in a closed refrigerant circuit and an electric motor for driving the compressor. The power supply circuit for energizing the motor includes a motor overload protector for opening the circuit upon a substantial increase in the load on the motor. In order to limit the maximum pressures which may be attained in the high side or condenser portion of the system, the system includes a bypass including a normally closed pressure operated valve bypassing the normal flow control means. This valve is adapted to be opened by an abnormal differential between the refrigerant pressures in the condenser and the evaporator and to provide a flow of refrigerant to the compressor such that the motor overload protector will open the motor supply circuit.

For a better understanding of the invention reference may be had to the accompanying drawing in which the single figure represents diagrammatically a refrigeration system embodying the present invention.

The embodiment of the invention illustrated in the

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drawing comprises a hermetic motor compressor unit 1, a condenser 2, normal flow control means 3 and an evaporator 4 connected in closed series-flow relationship. The hermetic compressor unit 1 includes a compressor 5 driven by a motor 6, both of which are contained in a hermetic casing 7. Upon energization of the motor 6, the compressor 5 withdraws low pressure refrigerant from the evaporator 4 and discharges high pressure refrigerant through the casing into the condenser 2. The flow restricting means 3 illustrated as being in the form of a capillary tube maintains a pressure differential between the high or condenser side of the system and the low or evaporator side of the system. It will be understood that the present invention is not limited to the use of a fixed flow restricting means such as a capillary tube for maintaining this pressure differential and that any conventional expansion valve may be used to provide the normal pressure differential. Also while in the illustrated embodiment of the invention, the hermetic compressor unit is illustrated as including means in the form of a passage 8 for conducting compressed refrigerant in heat exchange relationship with the motor 6 before it is discharged through the discharge line 9 into the condenser 2, the invention broadly contemplates the use of non-hermetic motor-compressor units or hermetic compressors in which the motor is cooled by low pressure rather than compressed refrigerant.

Power is supplied to the motor 6 from a power supply circuit including power supply lines 11 and 12 and the motor leads 14 within the hermetic casing. For a normal overload protection of the motor there is provided a motor overload protector 15 in one of the supply lines 11 and 12, the protector being connected in series with the motor 6. This motor overload protector, which may be of the bimetallic switch type may also be so mounted in the casing 7 so as to be responsive to motor temperature whereby that it will open the motor circuit upon either an increase in the flow of current through the supply lines 11 and 12 or an increase in the motor temperature or both. Such devices are well known in the art and do not require further description insofar as the present invention is concerned.

During normal operation of the refrigerant system, the condenser 2 is cooled by means of an air stream passed thereover usually by means of a fan (not shown). Under normal operating conditions, the condenser 2 operates within a predetermined range of high pressure conditions while the evaporator 4 operates at lower pressure conditions. The motor overload protector 15 functions to de-energize the motor whenever the temperature conditions within the motor become abnormally high or the current drawn by the motor is abnormally high due to various overload conditions including "locked rotor" conditions or any condition in which the pressures within the evaporator become abnormal.

Prior air conditioning refrigeration systems of this type have frequently included pressure limiting controls in the high side or condenser side of the system to limit the maximum pressures which may be attained therein under conditions such as condenser fan failure or abnormal decrease in air flow over the condenser. Frequently this type of protection has been accomplished by means of a pressure operated switch responsive to pressure conditions within the high side or condenser side of the system and adapted to interrupt the compressor motor circuit at some predetermined abnormal pressure.

In accordance with the present invention, a high pressure switch of this type is eliminated by providing in the refrigerant circuit means responsive to an abnormal pressure differential between the two sides of the system and adapted upon operation to substantially increase the flow

of refrigerant to the compressor and thereby load the motor 6 to the point such that the motor overload protector 15 will operate to deenergize the motor.

In order to better understand the operation of the present invention it may be noted that upon condenser fan or air flow failure, there is little or no condensation taking place in the condenser due to the fact that the condenser is operating at abnormally high temperatures. As a result there is primarily gaseous rather than liquid refrigerant present at the inlet end of the normal flow control means and the mass flow capacity thereof is very limited under these conditions. As a result of the decreased flow of refrigerant through the normal flow control means, the compressor operates at relatively low suction pressures even though the head pressure is excessive. As such a condition actually decreases the power required to drive the compressor motor, the motor overload protector such as the protector 15 will not operate to correct the malfunction of the system.

In order to render the motor overload protector 15 operative to de-energize the motor 6 upon a condenser fan or air flow failure, there is provided means responsive to an abnormal increase in the condenser or high side pressure or more specifically to an abnormal differential between the high and low system pressures for bypassing refrigerant flow around the normal flow control means 3 in an amount such as to abnormally increase the low side or suction pressures in the system to a point such that the motor will become sufficiently loaded so that the overload protector 15 will open to stop the operation of the system. More specifically there is provided a bypass line 17 bypassing the normal flow control means 3 and including a pressure operated valve 18 comprising an inlet port 19 and a valve member 20 which is normally spring biased to close the port 19 by means of a spring 21. The spring 21 is designed to maintain the valve 18 closed under all normal pressure differential conditions existing in the system and to open under abnormal pressure conditions. When opened, the valve 18 permits the flow of substantial quantities of refrigerant around the normal flow control means 3 and into the evaporator 4 to thereby substantially increase the low side pressures in the system. This increase in the suction pressure for the compressor 5 correspondingly increases the motor load so that the normal motor overload protector 15 opens to de-energize the motor and prevent further increase in the high side pressure.

While there has been shown and described a particular embodiment of the present invention it is to be understood that it is not limited thereto and is intended by the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A refrigeration system comprising a compressor, a condenser, a normal flow control means and an evaporator connected in closed refrigerant circuit,
 - an electric motor for driving said compressor,
 - a supply circuit for energizing said motor including a

motor overload protector for opening said supply circuit upon a substantial increase in the load on said motor,

a bypass including a normally closed valve means bypassing said flow control means,

said valve means opening upon an abnormal increase in the differential between the refrigerant pressures in said condenser and said evaporator to increase substantially the flow of refrigerant to said compressor and thereby load said motor and cause said overload protector to open said supply circuit,

said valve means constituting the sole means for limiting abnormal pressure conditions in said condenser.

2. A refrigeration system comprising a compressor, a condenser, a fixed flow control means and an evaporator connected in a closed refrigerant circuit,

an electric motor for driving said compressor,

a supply circuit for energizing said motor including a motor overload protector for opening said supply circuit upon a substantial increase in the load on said motor,

a bypass including a normally closed valve means bypassing said flow control means,

said valve means opening upon an abnormal increase in the refrigerant pressure in said condenser to increase substantially the flow of refrigerant to said compressor sufficiently to load said motor and cause said over-load protector to open said supply circuit,

said valve means constituting the sole means for limiting abnormal pressure conditions in said condenser.

3. A refrigeration system comprising a compressor, a condenser, a fixed flow restrictor and an evaporator connected in a closed refrigerant circuit,

an electric motor for driving said compressor, said motor and compressor being sealed in a hermetic casing and said motor being cooled by refrigerant circulating through said casing,

a supply circuit for energizing said motor including a motor overload protector mounted on said casing and responsive to the temperature of the refrigerant circulating over said motor for opening said supply circuit upon a substantial increase in the load on said motor,

a bypass including a normally closed valve means bypassing said flow restrictor,

said valve means opening upon an abnormal increase in the differential between the refrigerant pressures in said condenser and said evaporator to increase substantially the flow of refrigerant to said compressor and thereby load said compressor and cause said overload protector to open said supply circuit,

said valve means constituting the sole means for limiting abnormal pressure conditions in said condenser.

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MEYER PERLIN, *Primary Examiner.*