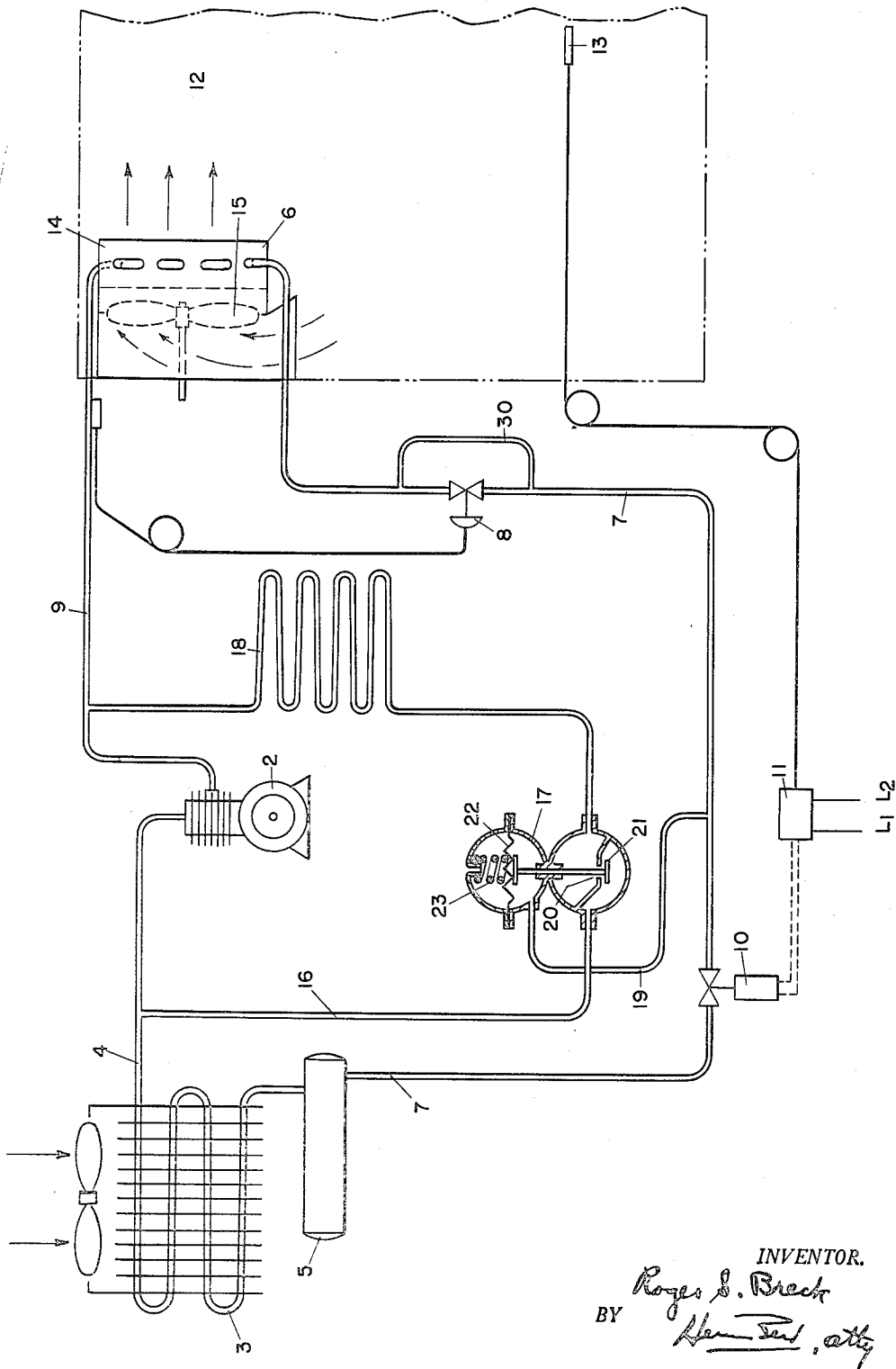


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REFRIGERATION SYSTEM PROVIDED WITH
COMPRESSOR UNLOADING MECHANISM
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REFRIGERATION SYSTEM PROVIDED WITH COMPRESSOR UNLOADING MECHANISM

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This invention relates to a refrigeration system and more particularly to a refrigeration system provided with mechanism for automatically pumping down the evaporator and for by-passing gaseous refrigerant about the compressor.

The chief object of the present invention is to provide a refrigeration system including automatically operable mechanism which permits the compressor to remain in continuous operation while by-passing compressed gas to the suction side of the compressor when refrigeration is not desired.

An object of the invention is to provide mechanism for a reciprocating compressor driven by an internal combustion engine which by-passes compressed gas to the suction side of the compressor while the compressor remains in continuous operation driven by the engine thus rendering a refrigeration system in which the compressor is employed of particular advantage when applied to cool storage compartment of vehicles such as trucks and trailers.

A further object is to provide by-passing mechanism for the reciprocating compressor of a refrigeration system, the by-passing mechanism being responsive to pressure in the liquid line of the system to by-pass gaseous refrigerant to the suction side of the compressor. Other objects of my invention will be readily perceived from the following description.

This invention relates to a refrigeration system which includes a compressor, a condenser, an evaporator placed in a compartment to be cooled and expansion means in the liquid line. Mechanism is provided for by-passing compressed gas from the discharge line to the suction line of the refrigeration system. A control member is placed in the by-pass line and is automatically responsive to pressure in the liquid line to open or to close the by-pass line.

This invention further relates to a method of operation of a refrigeration system in which the steps consist in compressing gaseous refrigerant, condensing the compressed refrigerant, evaporating the condensed refrigerant, returning the evaporated refrigerant to the compressor, and, under conditions when it is desired to operate the compressor continuously but not to provide cooling, by-passing compressed refrigerant from the discharge line to the suction line, and regulating the refrigerant by-passed about the compressor in response to a predetermined change in pressure in the liquid line.

The attached drawing is a diagrammatic view of a refrigeration system embodying the present invention.

Referring to the drawing, there is shown a compressor 2 connected to a condenser 3 by discharge line 4. The condenser is connected to a receiver 5. Receiver 5 is connected to an evaporator 6 by liquid line 7. Expansion means 8 such as an expansion valve is placed in line 7 between receiver 5 and evaporator 6. Evaporator 6 is connected to compressor 2 by suction line 9. A solenoid valve 10 is placed in liquid line 7 between receiver 5 and the expansion valve 8. Solenoid valve 10 is actuated by

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a thermostat 11 operable in response to the temperature of a compartment 12 being cooled as reflected by bulb 13. Compartment 12, preferably, is the storage compartment of a vehicle such as a truck or trailer. In response to a predetermined decrease in temperature in compartment 12 reflected by bulb 13 a switch (not shown) of thermostat 11 is opened, de-energizing an electrical circuit to solenoid valve 10 thereby de-energizing the same to move to a closed position.

Evaporator 6 preferably is placed in a casing 14, a fan 15 being provided to draw air from compartment 12 within casing 14 and to pass such air through evaporator 6 in heat exchange relation with refrigerant therein to cool the compartment.

A by-pass line 16 connects discharge line 4 and suction line 9. A control valve 17 is placed in by-pass 16. A heat exchange member 18 is also placed in line 16 preferably between valve 17 and the suction line. Member 18 serves to remove the heat of compression from gaseous refrigerant passing therethrough by placing it in heat exchange relation with ambient air.

Control valve 17 is connected to liquid line 7 by a line 19 at a place between valve 10 and expansion valve 8. Control valve 17 includes a housing having a port 20 therethrough. A valve member 21 closes port 20. Diaphragm 22 in the housing actuates valve member 21 to move toward or from port 20. A spring 23 and atmospheric pressure flex diaphragm 22 in one direction. Pressure in liquid line 7 is applied through line 19 to the opposite side of the diaphragm to flex the diaphragm in the opposite direction thereby moving the valve member 21 to close port 20. It will be appreciated valve 17 is held in closed position when the pressure in line 7 is equivalent to condenser pressure. However, when solenoid valve 10 is closed, pressure in line 7 between the solenoid valve 10 and the expansion valve 8 quickly falls to a pressure equivalent to evaporator pressure. Ordinarily, valve 17 is so adjusted as to operate at a pressure above atmospheric pressure and below the pressure corresponding to the minimum anticipated evaporator temperature. Generally, a setting of 5 to 10 p. s. i. g. is satisfactory in most applications. Thus, when valve 10 is in a closed position, pressure applied through line 19 against the diaphragm of valve 17 decreases to evaporator pressure which in turn further decreases as the evaporator is pumped down by the compressor. When this pressure falls to the predetermined setting of valve 17, the valve opens and thereafter maintains a constant suction pressure.

It will be understood that a small hole may be drilled across the seat of expansion valve 8 to communicate with the pressure in line 7 to permit the line to be pumped out when refrigeration is not desired. If desired, a capillary by-pass as shown at 30 may be provided to accomplish the same result. Such means are provided due to the characteristic operation of an expansion valve.

Considering the operation of the refrigeration system of the present invention when it is desired to cool the storage compartment, compressor 2 compresses refrigerant, the hot gaseous refrigerant being discharged through line 4 to the condenser 3. The gaseous refrigerant is condensed in condenser 3, the liquid refrigerant passing to receiver 5. Assuming solenoid valve 10 is in an open position as regulated by thermostat 11 responsive to the temperature in compartment 12 as reflected by bulb 13 liquid refrigerant passes through line 7 to the expansion valve 8 which regulates flow of refrigerant into the evaporator. In the evaporator, the refrigerant is placed in heat exchange relation with air to be cooled thereby evaporating refrigerant, the evaporated refrigerant returning to the compressor through suction line 9.

When the temperature in compartment 12 decreases to

a predetermined point, thermostat 11 actuates solenoid valve 10 to move to a closed position thus preventing passage of refrigerant from receiver 5 to evaporator 6. Since the compressor remains in operation the pressure in line 7 between valve 10 and the evaporator immediately falls to evaporator pressure. Since the compressor continues to operate to pump down the evaporator such pressure continues to fall. When pressure in line 7 and line 19 has fallen to the predetermined setting of control valve 17, valve 17 opens, thereby opening by-pass line 16 and permitting compressed refrigerant to pass from discharge line 4 to suction line 7. Preferably, the by-passed gaseous refrigerant passes through heat exchange member 18 to remove the heat of compression. Since the gaseous refrigerant passes through the by-pass line 16, it will be appreciated that it is not passed to the evaporator so that no refrigeration is obtained even though the compressor remains in continuous operation.

The present invention is of particular advantage when it is desired to operate the compressor continuously as by an internal combustion engine since by-passing of refrigerant from the compressor discharge to the compressor suction is permitted when refrigeration is not desired.

The present invention provides automatic evaporator pump down and permits by-passing of refrigerant about the compressor while the compressor is maintained in continuous operation when refrigeration is not desired. The invention may be readily applied to existing refrigeration systems and is inexpensive in initial costs as well as costs of operation.

While I have described a preferred embodiment of the invention, it will be understood the invention is not limited thereto since it may be otherwise embodied within the scope of the following claims.

I claim:

1. In a refrigeration system, the combination of a compressor, a condenser connected to the compressor, an evaporator placed in a compartment to be cooled, a liquid line connecting the condenser with the evaporator, a discharge line connecting the compressor and the condenser, a suction line connecting the evaporator and the compressor, expansion means in the liquid line, means for by-passing gaseous refrigerant about the compressor while continuing operation of the compressor, said means being responsive to pressure in said liquid line, a control member placed in the liquid line and means for actuating the control member in response to the temperature of the compartment being cooled.

2. In a refrigeration system, the combination of a compressor, a condenser, a discharge line connecting the compressor and the condenser, an evaporator, a liquid line connecting the condenser with the evaporator, a suction line connecting the evaporator and the compressor, expansion means in the liquid line for regulating flow

of refrigerant to the evaporator, a by-pass line connecting the discharge line with the suction line, a heat exchange member in the by-pass line to remove heat from refrigerant passing therethrough and a control valve in said by-pass line, said control valve being in communication with the liquid line and responsive to pressure in the liquid line to control passage of refrigerant through said by-pass line.

3. In a refrigeration system, the combination of a compressor, a condenser, a discharge line connecting the compressor and condenser, an evaporator, a liquid line connecting the condenser with the evaporator, a suction line connecting the evaporator and the compressor, expansion means in the liquid line for regulating flow of refrigerant to the evaporator, a by-pass line connecting the discharge line with the suction line, a control valve in said by-pass line, said control valve being in communication with the liquid line and responsive to pressure in the liquid line to control passage of gaseous refrigerant through said by-pass line, a control valve placed in the liquid line between the condenser and the evaporator, and a regulating member for said control valve responsive to temperature of the compartment being cooled.

4. In a refrigeration system, the combination of a compressor, a condenser, a discharge line connecting the compressor and condenser, an evaporator, a liquid line connecting the condenser with the evaporator, a suction line connecting the evaporator and the compressor, expansion means in the liquid line for regulating flow of refrigerant to the evaporator, a by-pass line connecting the discharge line with the suction line, a control valve in said by-pass line, said control valve being in communication with the liquid line and responsive to pressure in the liquid line to control passage of refrigerant through said by-pass line, a control valve placed in the liquid line between the condenser and the evaporator, a regulating member for said control valve responsive to temperature of the compartment being cooled, and a heat exchange member in the by-pass line to remove heat from refrigerant passing therethrough.

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