

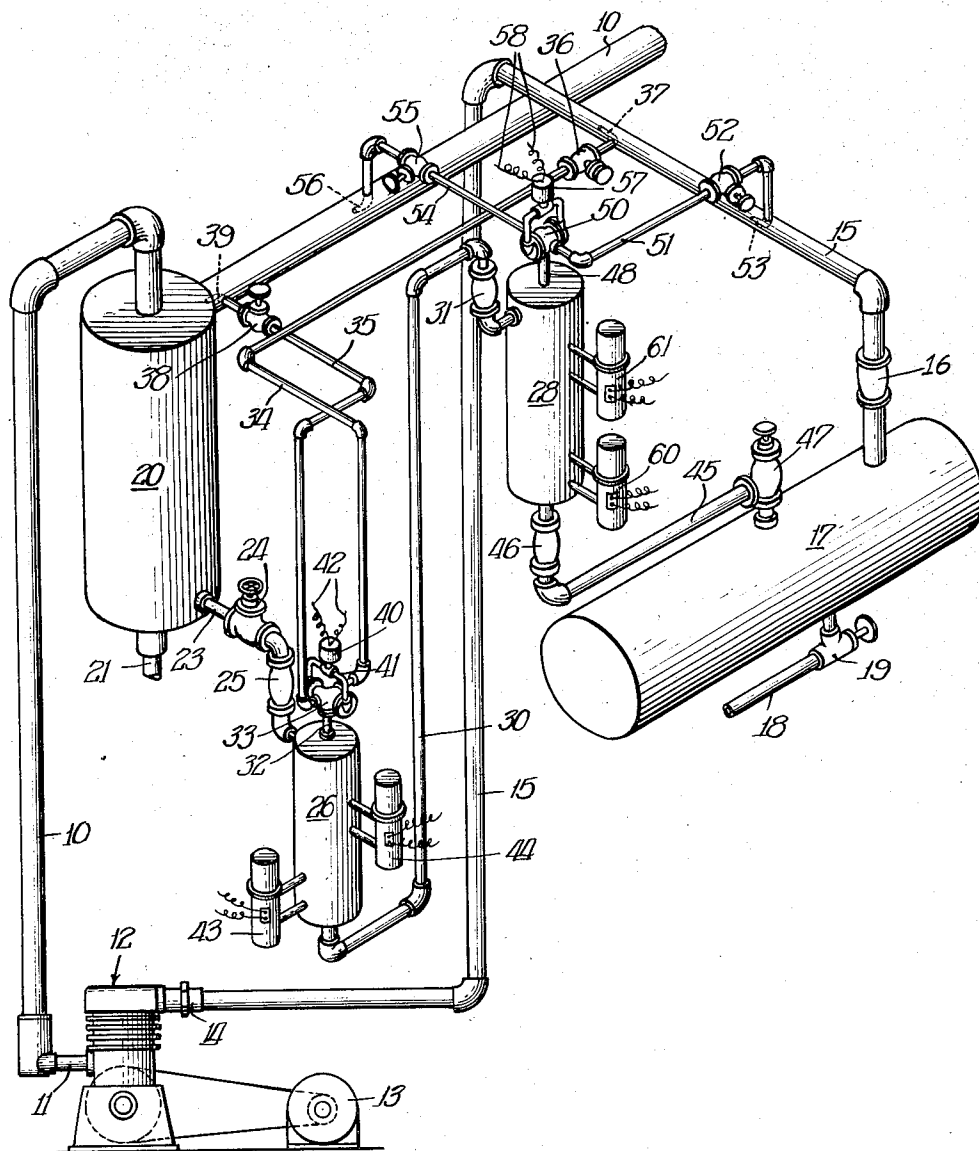
Oct. 9, 1951

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2,570,979

COMPOUND SYSTEM FOR LIQUID REFRIGERANT RETURN

Filed June 23, 1949



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UNITED STATES PATENT OFFICE

2,570,979

COMPOUND SYSTEM FOR LIQUID
REFRIGERANT RETURN

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Application June 23, 1949, Serial No. 100,875

6 Claims. (Cl. 62-115)

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The invention relates to refrigerating apparatus and has reference more particularly to a liquid refrigerant return system which will utilize the high pressure refrigerant gas in two or more stages for returning any liquid refrigerant accumulating in the suction line to the high pressure side of the system so as to by-pass the compressor.

In the copending application entitled Suction Line Liquid Return Trap, Serial No. 59,693, filed November 12, 1948, novel apparatus is disclosed for returning liquid refrigerant accumulating in the suction line and which embodies an accumulator, a liquid trap, and valve structure whereby the high pressure gas from the discharge side of the compressor is utilized to pump the liquid refrigerant collected from the suction line and deliver the same to the high side of the system. The same basic principle is employed in the present invention which, however, constitutes an improvement since a compound system is provided for pumping the liquid refrigerant from its point of accumulation to the high side of the system in two or more stages and which will be automatic in operation and economical in the refrigerant gas used.

Another object of the invention is to provide liquid refrigerant return apparatus embodying two substantially identical units which operate in sequence to elevate the liquid refrigerant from a first liquid trap to a second trap and then from the second trap to the liquid receiver, whereby the returning liquid refrigerant is supplied to the high pressure side of the system in a manner to by-pass the compressor.

Another object is to provide apparatus of the type described which will pump the liquid refrigerant accumulating in the suction return line to a level above the receiver, and which apparatus will utilize the pressure of the refrigerant gas for this purpose. The apparatus of the invention has intermittent operation, which is automatic, however, since float valves are provided for initiating the operation when the level of the liquid reaches a maximum and for terminating the operation when the liquid level reaches a minimum.

With these and various other objects in view, the invention may consist of certain novel features of construction and operation, as will be more fully described and particularly pointed out in the specification, drawings and claims appended hereto.

In the drawing which illustrates an embodiment of the device and wherein like reference characters are used to designate like parts the

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figure is a perspective view of apparatus illustrating a refrigerating system embodying the multi-stage device of the invention for returning liquid refrigerant so as to by-pass the compressor.

Referring to the drawing, it will be seen that the suction line 10 for returning the evaporated refrigerant from the evaporators, not shown, has connection at 11 with the compressor 12. The said compressor is conventional in construction and in operation, being driven by the electric motor 13 by means of an endless belt as shown. The compressor at its inlet end 11 receives the low pressure gaseous refrigerant which has been evaporated in the evaporators and by operation of the compressor the pressure of this gaseous refrigerant is increased with a corresponding increase in temperature. The high pressure discharge side of the compressor has connection at 14 with the high pressure gaseous refrigerant line 15, said line having interposed therein the check valve 16 and which connects with the receiver 17 for delivering the high pressure refrigerant gas thereto.

The cylinder 17 forms a combination receiver and condenser so that the high pressure gaseous refrigerant from the discharge line 15 is condensed to a liquid form and stored in the receiver until ready for use, for which purpose the receiver is provided with the liquid refrigerant line 18 connecting with the receiver at the bottom thereof and which is provided with the hand valve 19. The line 18 conducts the liquid refrigerant to the evaporators of the refrigerating system and following evaporation of the refrigerant, to produce the desired cooling effect, the same is returned to the compressor through the suction line 10, thereby completing the cycle.

The invention provides an improved compound system for returning liquid refrigerant from its point of accumulation in the suction line to the high pressure side of the system, that is, to the receiver, so as to by-pass and protect the compressor which is not adapted to handle slugs of liquid refrigerant with any degree of success. More particularly, the present apparatus utilizes the high pressure refrigerant gas in two or more stages as a pumping medium to convey the liquid refrigerant from the suction line to the receiver. As shown in the drawing, an accumulator drum designated by numeral 20 is interposed in the suction line 10 at a point conveniently in advance of the compressor so that the returning liquid refrigerant in the suction line is collected by the accumulator drum in a manner which, however, permits the refrigerant gas to continue

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its flow through the suction line to the compressor. The accumulator is provided with a conventional drain 21, the same including a hand operated valve, not shown, by means of which oil may be drained from the drum. The liquid refrigerant drain pipe 23 has connection with the accumulator drum at a point adjacent the bottom, the pipe including the hand valve 24 and a check valve 25. The depending end of pipe 23 connects with the top of a container or trap 26 which initially receives the liquid refrigerant from the accumulator drum 20. The present invention provides a second container or liquid trap designated in its entirety by numeral 28 and the structure for pumping the liquid refrigerant from the trap 26 to the elevated trap 28 will now be described.

The liquid refrigerant from the drum 20 naturally drains to the trap 26, it being understood that hand valve 24 is open to permit such drainage. Also the check valve 25 is constructed to allow the liquid refrigerant to drain downwardly into the trap 26, the check valve closing only upon pressure developing in the trap so that the pressure can be maintained in the trap and leakage to the drum 20 prevented. The traps 26 and 28 are connected by conduit means in the form of the pipe 30, the same having connection with the bottom of trap 26 and with the top of trap 28, there being interposed in said pipe a check valve 31. High pressure gaseous refrigerant is admitted to the top of trap 26 by means of the inlet pipe 32 which has connection with the three-way valve 33. The three-way valve employed for the trap 26 and likewise for trap 28 is disclosed and claimed in the co-pending application Serial No. 59,694, filed November 12, 1948, and which is characterized by an inlet for high pressure gaseous refrigerant comprising the pipe 34 and an outlet for venting the trap 26 comprising pipe 35. Referring again to pipe 34, it will be seen that the same is provided with a hand valve 36 and that the pipe enters the high pressure gaseous refrigerant line 15 having its terminal end bent at 37 in a direction toward the flow of the gaseous refrigerant in said line 15. In a similar manner the vent pipe 35 is provided with a hand operated valve 38 and the terminal end of the same enters the suction line 10 as at 39, the said end being bent in a direction downstream with respect to the flow of the gaseous refrigerant in the suction line.

The three-way valve 33 is accordingly provided with an inlet for high pressure fluid, a vent leading to the low pressure suction line, and a third connection, namely, 32, which in certain positions of the valve will deliver the high pressure fluid to the trap 26, and in other positions will connect the trap to the vent pipe 35. Control of the three-way valve is effected by means of a solenoid valve 40 having location in the by-pass conduit 41 connecting with the respective ends of the three-way valve. By means of the electric terminals 42 the solenoid valve 40 is connected to a source of electric current and to the float switches 43 and 44 associated with the trap 26, the float switch 43 controlling the solenoid in accordance with the low level of the liquid within the trap and the float switch 44 controlling the solenoid in accordance with the high level of the liquid in said trap.

With the solenoid valve 40 open it will be seen that the high pressure gaseous refrigerant from line 15 will be permitted to flow through the inlet pipe 34 and upon reaching the valve

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the action of the gaseous refrigerant is such as to close off the vent pipe 35 so that the high pressure gas flows through line 32 to the top of the trap 26. The action of the high pressure gas on check valve 25 is such as to close the valve, with the result that pressure is applied to the liquid refrigerant in the trap causing the same to flow through the conduit means 30 into the second trap 28, which is located above trap 26. When the level of the liquid refrigerant in trap 26 reaches the low limit controlled by the switch 43 the said switch is actuated to cause de-energization of the solenoid valve 40 with the result that the valve is caused to close. As a result the action of the three-way valve is such as to close the inlet pipe 34 and to open the vent pipe 35, thus permitting the gas in trap 26 to escape to the low pressure suction line 10. The bent terminal end 39 as a result of its downstream direction within suction line 10 produces a siphoning effect, drawing off the gas from the trap. As pressure within trap 26 is reduced check valve 25 automatically opens to allow liquid refrigerant from the accumulator 20 to drain by gravity into said trap 26 and when the level of the liquid within the trap reaches the maximum position controlled by float switch 44 the same is actuated to energize solenoid 40 and the cycle is repeated.

The liquid trap 28 is substantially the same as 26 in construction and in operation, the same having intermittent operation and which alternates with 26 for discharging under pressure the liquid refrigerant to the receiver 17 located in the high side of the refrigerating system. The trap 28 is connected by the drain 45 with the receiver 17, the said drain including the check valve 46 and the hand operated valve 47. The pipe 48 connects the top of trap 28 with the three-way valve 50 which is similar in all respects to valve 33. One side of the valve connects with the inlet pipe 51 having the hand operated valve 52 and which enters the high pressure gaseous refrigerant line 15, the said terminal end 53 of the pipe being bent up-stream against the direction of flow of the gaseous refrigerant within pipe 15. The other side of the three-way valve connects with the vent pipe 54 having the hand operated valve 55 and which enters the suction line 10, the terminal end 56 of which is bent downstream as regards the flow of the gaseous refrigerant in said line 10. The solenoid valve 57 is located in the by-pass conduit connecting the respective ends of the three-way valve 50. By means of the electric terminals 58 the solenoid valve 57 is connected with a source of current and with the float switches 60 and 61 associated with the trap 28. Float switch 60 controls solenoid valve 57 in accordance with the low level of the liquid in the trap, whereas, the float switch 61 controls the solenoid valve in accordance with the high level of the liquid.

Following operation of the three-way valve 33, which effects flow of the liquid refrigerant from trap 26 to trap 28 it will be seen that the high level of the liquid in the latter trap will influence float switch 61 which will energize the solenoid valve 57, opening the valve and thus effecting actuation of the three-way valve 50 in such a manner as to allow flow of high pressure gaseous refrigerant from line 51 to the trap 28. Automatically with this operation the vent 54 is closed and the check valve 31 also closes. The pressure built up within trap 28

forces the liquid refrigerant within the trap to flow through drain 45 into receiver 17. When the liquid reaches a predetermined low level the float switch 60 is influenced to cause de-energization of solenoid 57 and the pumping operation is terminated. The three-way valve 50 reverts to its normal position with the vent pipe 51 closed and trap 28 connected to the vent 54. As a result of the bent end 56 a suction is produced which facilitates the drawing of the gas from the trap and its discharge into the low pressure suction line 10.

In the apparatus of the invention for returning liquid refrigerant so as to by-pass the compressor, the refrigerant is subjected to two or more pumping operations, the first one elevating the refrigerant to a trap above the receiver and the second pumping operation discharging the refrigerant to the receiver. Substantially equivalent structure including the liquid traps 26 and 23 and associated valves is provided for the respective pumping operations which take place in an alternate manner as regards the traps and wherein each trap has operation intermittently. Also both pumping operations employ the high pressure gaseous refrigerant and which is admitted to the top of the liquid trap to effect discharge of the liquid refrigerant from the bottom thereof, with the start and termination of each pumping operation being automatic as the same is controlled by the maximum and minimum level float switches.

The invention is not to be limited to or by details of construction of the particular embodiment thereof illustrated by the drawings as various other forms of the device will of course be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

What is claimed is:

1. In a refrigerating system including the conventional compressor having a suction line for returning evaporated refrigerant to the compressor and having a high pressure refrigerant line, an accumulator drum interposed in the suction line for collecting liquid refrigerant to prevent delivery of the same to the compressor, a liquid trap located below the accumulator drum and having connection with the drum for receiving liquid refrigerant therefrom by gravity flow, a second liquid trap having an elevated position with respect to the first mentioned trap, conduit means joining said traps, means supplying high pressure gaseous refrigerant from said high pressure refrigerant line to the first mentioned trap to effect a flow of the liquid refrigerant therein through said conduit means to the second trap, a connection from the second trap to the high pressure refrigerant line, and other means supplying high pressure gaseous refrigerant from said line to the second trap to effect flow of the liquid refrigerant in the suction trap through said connection to the high pressure side of the system.

2. In a refrigerating system, in combination, a suction line for delivering evaporated refrigerant to the compressor of the system, a high pressure refrigerant line connecting with the discharge side of the compressor, a container adapted to receive liquid refrigerant from the suction line, a second container having an elevated position with respect to the first mentioned container, conduit means joining said containers, means supplying high pressure gaseous refriger-

ant from said high pressure refrigerant line to the first mentioned container to effect a flow of the liquid refrigerant through said conduit means to the second container, said means having operation to vent the said first mentioned container to the suction line during the period when the supply of said gaseous refrigerant is stopped, a connection from the second container to the high pressure refrigerant line, other means supplying high pressure gaseous refrigerant from said line to the second container to effect flow of the liquid refrigerant through said connection to the high pressure side of the system, and said other means having operation to vent the second container to the suction line during the period when the supply of gaseous refrigerant is stopped.

3. In a refrigerating system including the conventional compressor having a suction line for returning evaporated refrigerant to the compressor and having a high pressure refrigerant line, an accumulator in the suction line for collecting liquid refrigerant to prevent delivery of the same to the compressor, conduit means providing a passageway connecting the accumulator with a receiver in the high pressure refrigerant line, said conduit means including first and second valved containers with the second container having a position above the first container, and means supplying high pressure gaseous refrigerant from said high pressure refrigerant line to the containers in an intermittent and alternate manner, whereby to pump the liquid refrigerant in the first container to the second container and then from the second container to the receiver.

4. In a refrigerating system including the conventional compressor having a suction line for returning evaporated refrigerant to the compressor and having a high pressure refrigerant line, an accumulator in the suction line for collecting liquid refrigerant to prevent delivery of the same to the compressor, means connecting the accumulator with the high pressure refrigerant line including a first and a second container with the second container having a position above the first container, means supplying high pressure gaseous refrigerant from said high pressure refrigerant line to the first container for discharging liquid refrigerant from the first container to the second container, other means supplying high pressure gaseous refrigerant from said line to the second container for discharging liquid refrigerant from said second container to the high pressure refrigerant line, said means and said other means each including a three-way valve having two operative positions, in one position each valve being operative to connect the high pressure refrigerant line to its respective container and in the second position each valve being operative to connect its respective container to the suction line.

5. In a refrigerating system, in combination, a suction line for delivering evaporated refrigerant to a compressor of the system, a high pressure refrigerant line connecting with the discharge side of the compressor, a container adapted to receive liquid refrigerant from the suction line, a second container having an elevated position with respect to the first mentioned container, conduit means joining said containers, means supplying high pressure gaseous refrigerant from said high pressure line to the first mentioned container to effect a flow of the liquid refrigerant therein through said conduit means

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to the second container, said means having operation to vent the said first mentioned container to the suction line during the period when the supply of said gaseous refrigerant is stopped, a connection from the second container to the high pressure refrigerant line, other means supplying high pressure gaseous refrigerant to the second container to effect flow of the liquid refrigerant through said connection to the system, said other means having operation to vent the second container to the suction line during the period when the supply of gaseous refrigerant is stopped, the means supplying high pressure gaseous refrigerant to the first mentioned container and the other means supplying high pressure gaseous refrigerant to the second container each including a three-way valve, and electric means associated with each valve for controlling the operation thereof in accordance with the level of the liquid in its respective container.

6. In a refrigerating system including the conventional compressor and having a high pressure refrigerant line, the combination of an accumulator drum interposed in the suction line for collecting liquid refrigerant to prevent delivery of the same to the compressor, conduit means providing a passageway connecting the drum with the high pressure refrigerant line, said conduit means including a first container and a second container and check valves on the inlet side of each container and on the outlet side of the second container, the first container having a location below the drum and the second container being located above both the drum

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and the first container, said check valves permitting flow of the liquid refrigerant in one direction only from the drum to the line, means tapping the high pressure refrigerant line and connecting with the containers respectively adjacent the top thereof for supplying high pressure gaseous refrigerant thereto, whereby to effect flow under pressure of the liquid refrigerant in a two-stage operation from the first to the second container and then from the second container to the line, valve members associated with said high pressure refrigerant supplying means for controlling respectively the supply of said gaseous refrigerant to the containers, and said valve members each operating to vent its respective container to the suction line during the time gaseous refrigerant is not supplied to the container.

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