

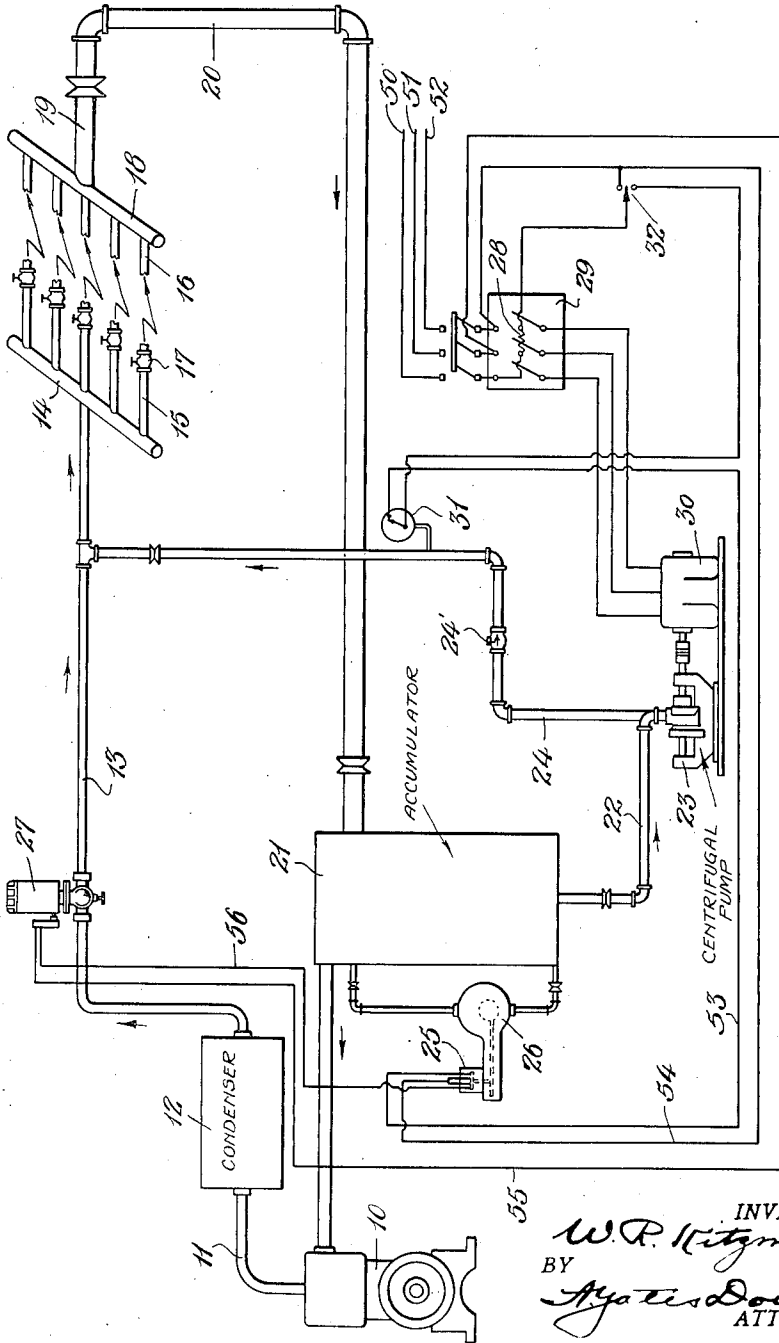
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REFRIGERANT LIQUID RETURN SYSTEM

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REFRIGERANT LIQUID RETURN SYSTEM

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This invention relates to a refrigerating system and more particularly to means for handling liquid refrigerant carried with refrigerant vapor into the suction line from the evaporator or cooling coils and collected in an accumulator.

Heretofore somewhat similar systems have been employed; however, in these systems refrigerant from the accumulator has usually been returned to the condenser or the receiver instead of into the line supplying liquid to the evaporator.

This practice is objectionable because the refrigerant must be pumped against the refrigerant discharge pressure. This requires a reciprocating pump, with its attendant packing difficulties and possibility of leakage, centrifugal pumps not being suitable for this service with ammonia systems since sufficient head pressure cannot be developed to overcome satisfactorily the condenser pressure.

In a system embodying the invention, the operating pressure differential is such that a centrifugal pump may be employed and thus the pumping difficulty is overcome.

It is an object of the invention to provide a refrigerating system with means for withdrawing refrigerant from an accumulator in the suction line and returning this withdrawn refrigerant to the liquid line, the supply of refrigerant from the compressor being controlled in accordance with the quantity of liquid in the accumulator.

A further object of the invention is to provide means whereby the refrigerant pump may be operated with a comparatively small pressure differential and further controlling the operation of the pump for transferring liquid refrigerant from the accumulator to the liquid line subject to the pressure in such liquid line.

Other objects and advantages will be apparent from the following description of the embodiment of the invention shown on the accompanying drawing, wherein

The single figure is a diagrammatic view of a refrigerating system and electrical control circuits illustrating one application of the invention.

Referring to the drawing, a compressor 10 forces compressed refrigerant vapor through a pipe 11 into a condenser 12 where the liquefaction occurs. The liquid refrigerant then passes through a pipe 13 into a header 14 having connections or feed lines 15 supplying refrigerant to expansion or cooling coils 16 controlled by expansion valves 17. The expansion coils 16 may be

of any desired construction. The evaporators or coils 16 are connected by means of a header 18 and pipe 19 with suction line 20, by means of which the vaporized refrigerant is returned for recompression to the compressor 10.

Interposed in the suction line is an accumulator or liquid trap 21 which may be of any desired construction designed to separate liquid refrigerant from gaseous refrigerant.

Liquid refrigerant in the accumulator 21 drains through pipe 22 to a pump 23 which forces such liquid through a line 24 into the liquid line 13 which supplies refrigerant to the cooling coils 16. A check valve 24' in the line 24 prevents the flow of refrigerant from the pressure line 13 to the pump 23 or permits the flow of refrigerant from the pump in the reverse direction. Instead of using an automatic check valve, an electrically operated valve electrically connected in parallel with the motor 30 may be employed.

An electric switch 25 is actuated by a float 26 subject to the liquid level of the refrigerant in the accumulator 21 for controlling the supply of refrigerant from the condenser to the cooling coils by means of an electrically operated valve 27. When the amount of liquid in the accumulator is below a predetermined amount, the float 26 and switch 25 maintain the circuit through the coil of valve 27 closed and the valve 27 open, permitting the flow of refrigerant from the condenser to the cooling coils 16. When there is more than a predetermined quantity of refrigerant in the accumulator 21, the valve 27 will be closed so that the circulation is between the accumulator and the cooling coils without being replenished from the condenser 12.

In other words when the quality of the refrigerant leaving the evaporator is of such a character that it contains liquid below a predetermined value the valve 27 will be operated to permit refrigerant supply to be increased.

The switch 25 is also connected with the energizing coil 28 of an automatic starter 29 in a manner to energize a motor 30 which drives the pump 23. A switch 31 connected to the line 24 is controlled by pressure within the line 24 and is arranged to hold the circuit of the starter coil 28 open until the pressure in the line 24, which is the pressure in the liquid line, drops below a predetermined point.

With this arrangement the pump 23 will not be operated until the pressure in the line 24 is below a certain value and the valve 27 will be opened permitting refrigerant to pass to the coils only when the liquid in the accumulator is below

a certain level. When the switch 25 opens the valve 27 it also interrupts the circuit to the motor starter 29 stopping the motor 30.

If desired a manual switch 32 may be provided to remove the control of the valve 27 and the pump 30 from the action of the float switch 25 and thereby permit manual control of the plant.

From the foregoing description the operation of this system will be apparent. The expansion valves 17 which control the flow of refrigerant to the several coils are adjusted to provide the rate of flow desired or required for each coil. Some liquid refrigerant will pass the expansion coils 16 as a result of improper setting, change in load conditions or intentional heavy flooding of the coils. This liquid refrigerant is carried through the suction line and is trapped out or separated from the suction gas in the accumulator 21, the gaseous refrigerant passing on directly to the compressor 10. When a sufficient quantity of liquid refrigerant has been collected in the accumulator 21, the float 26 will operate the switch 25 and break the circuit to the valve 27 allowing it to close and shut off the supply of liquid refrigerant from the condenser to the expansion coils. The switch 25 has then partially completed the circuit for starting the motor 30 which operates the pump 23 and due to the supply of liquid refrigerant being cut off by the valve 27, the action of the compressor 10 operating through the suction line will reduce the pressure in the pipe 24 until switch 31 closes. This completes the circuit of the starter coil 28 which includes a source of power connected to line 50, coil 28 of an automatic starter 29, through switches 32 and 31, and line 53, through switch 25, through return line 54 to the other line 52 from the source of power. The coil 28 in the automatic starter 29 operates the automatic starting switch to connect the electric supply lines 50, 51 and 52 to the motor 30, thus driving the pump 23 and pumping liquid through the line 24 into the liquid line 13 from whence it flows to the cooling coils.

When the level of the liquid refrigerant in the accumulator 31 has been reduced sufficiently the float 26 will lower and cause switch 25 to break the circuit through the energizing or holding coil 28 of the starter 29 and thus the starting switch breaks the circuit from the supply lines 50, 51 and 52 to the motor 30 stopping the operation of the pump. Simultaneously the switch 25 completes the circuit from the source of electrical supply 28 through line 55, the electrically operated valve 27, the line 56, switch 25 and line 54, to the supply line 52, thus opening the valve 27 and allowing liquid refrigerant from the condenser to flow again to the evaporators through the expansion valve 17. After the valve 27 opens the pressure in liquid line 13 increases, opening the pressure switch 31. This returns the system to the condition originally described ready for another cycle of operation.

High pressure in the liquid line 13 is prevented from blowing back through the pump and the accumulator to the compressor by the check valve 24' when the pump is not operated.

With the construction just described if the expansion valves are opened too wide and liquid is carried over into the suction line, no harm can result since this liquid will be separated in the accumulator as just described and not allowed to pass to the compressor. The invention further eliminates the necessity of close adjustment of

expansion valves and permits maximum flooding of evaporator coils.

If desired the automatic switches and valves may be replaced by hand-operated devices, as for example valve 27, check valve 24' and switches 25 and 31.

It will be obvious to those skilled in the art that various changes may be made in my device without departing from the spirit of the invention and therefore I do not limit myself to what is shown in the drawing and described in the specification, but only as indicated by the appended claims.

I claim:—

1. In a refrigerating system including an evaporator and a high pressure liquid line for supplying liquid refrigerant to said evaporator, means for separating entrained liquid refrigerant from the suction gas, means in the high pressure line for cutting off the supply of liquid refrigerant to the evaporator, means for returning the accumulated liquid refrigerant to said evaporator, and means subject to the liquid in the accumulator for controlling the supply of liquid refrigerant to the evaporator.

2. A refrigerating system comprising compressing, condensing and evaporating means, a liquid line from the condensing to the evaporating means, and a suction line from the evaporating to the compressing means, an accumulator in the suction line, means for shutting off the supply of refrigerant to the evaporating means when the quantity of liquid refrigerant in the accumulator rises a predetermined value, means for pumping liquid in the accumulator back into the liquid line, means operating in accordance with the amount of liquid in the accumulator for interrupting the flow of refrigerant through the liquid line and means for controlling the return of refrigerant into the liquid line in accordance with the amount of liquid in the accumulator.

3. A refrigerating system comprising compressing, condensing and evaporating means, a liquid line from the condensing to the evaporating means, and a suction line from the evaporating to the compressing means, an accumulator in the suction line, means for shutting off the supply of refrigerant to the evaporating means when the quantity of liquid refrigerant in the accumulator rises a predetermined value, means for pumping liquid in the accumulator back into the liquid line, means operating in accordance with the amount of liquid in the accumulator for interrupting the flow of refrigerant into the liquid line in accordance with the amount of liquid in the accumulator and also in accordance with the pressure in the liquid line.

4. In a refrigerating system comprising condensing, evaporating and accumulating means, means for shutting off the supply of refrigerant from the condensing to the evaporating means, means for circulating refrigerant between the accumulating and the evaporating means and means for controlling the circulation in accordance with liquid level in the accumulating means and pressure in the supply line from the condensing to the evaporating means.

5. A refrigerating system comprising condensing, evaporating and accumulating means, and automatic means for controlling the supply of refrigerant from the condensing to the evaporating means and for pumping liquid refrigerant from the accumulating to the condensing means and for controlling the pumping action in response to the liquid level in the accumulating means and

pressure in the feed line from the condensing to the evaporating means.

6. A refrigerating system comprising condensing, evaporating and accumulating means, a liquid refrigerant supply line connecting the condensing and evaporating means, an electrically operated valve in said supply line, a line leading from the evaporating means to the accumulating means, a liquid-level operated switch for controlling the valve in the supply line in response to the accumulation of liquid refrigerant in the accumulator, means for pumping accumulated refrigerant from the accumulating means to the evaporating means, a pressure-operated switch for controlling the pumping means, said switch being operable

in accordance with the pressure within the evaporating means, and means for controlling said pumping means by the fluid operated switch in accordance with the liquid level.

7. In a refrigerating system, interconnected condensing and evaporating means, a refrigerant circuit including the evaporating means but excluding the condensing means, means for producing forced circulation in said circuit, means between said condensing and evaporating means for controlling the supply from the condensing to the evaporating means, and actuating means for said control means responsive to the quality of the refrigerant leaving the evaporator.

WILLIAM R. KITZMILLER. 16