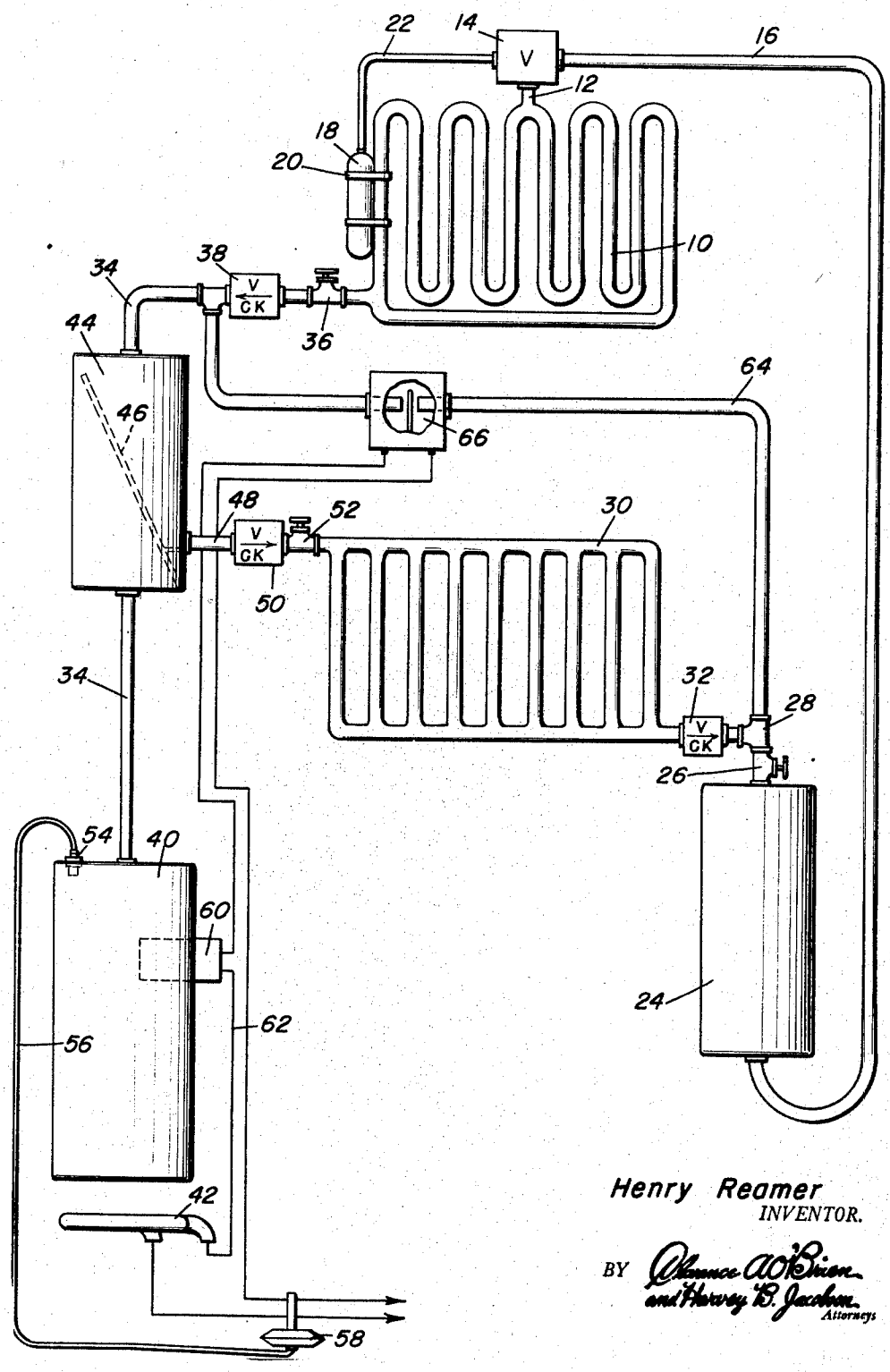
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CYCLIC REFRIGERATION SYSTEM

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CYCLIC REFRIGERATION SYSTEM

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This invention generally relates to a heat exchanging system, and more specifically provides a system employing a heat exchanging fluid for absorbing heat in one place and emitting heat at another place wherein the device may be utilized in conjunction with refrigeration, air conditioning or the like.

Another object of the present invention is to provide a heat exchanging system in accordance with the preceding object which employs a boiler for pressurizing the gaseous refrigerant discharged from the evaporator wherein the compressed gaseous refrigerant is forced into a condenser for cooling with liquified refrigerant subsequently deposited in a receiver tank for supplying the evaporator whereby a pilot line interconnects the receiver tank and the discharge of the evaporator and is equipped with a diaphragm switch to actuate the boiler when the pressure differential between the liquid receiver tank and the discharge of the evaporator is equalized for actuating the refrigerating system through another cycle.

Another important object of the present invention is to provide a heat exchanging system in accordance with the preceding objects which includes a control circuit for the boiler heating device wherein the boiler control circuit is controlled by the diaphragm switch and also by a thermal switch disposed within the boiler whereby the system is actuated in response to temperature in the boiler and a differential in pressure between the two sides of the evaporator.

A still further object of the present invention is to provide a heat exchanging system including a safety device in the boiler for preventing overheating thereof.

Yet another important feature of the present invention is to provide a refrigeration and/or air conditioning system including in its construction the arrangement set forth above together with an accumulator with a baffle therein at the discharge end of the boiler to assure proper passage of the refrigerant gas through the system and from the boiler into the condenser.

Other important objects of the present invention will reside in its simplicity of construction, efficiency of operation, effectiveness, adaptation for its particular purposes and its relatively inexpensive manufacturing costs.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

The figure is a schematic layout of the heat exchange system of the present invention with various portions thereof being labeled.

Referring now specifically to the figure of the drawings, it will be seen that the refrigeration or heat exchanging system of the present invention includes an evaporator 10 which may be of any suitable construction but which is preferably of some coiled arrangement. The evaporator 10 is provided with an inlet pipe 12 to which is connected a control expansion valve 14 with a connecting

line 16 attached thereto. The control expansion valve 14 is provided with a thermal expansion bulb 18 attached to the evaporator 10 by supporting members 20 and connected to the expansion valve 14 by a tube 22 wherein temperature of the evaporator 10 will control the expansion valve 14 in the usual manner. The cooling of the evaporator 10 to a predetermined point will close the expansion valve 14 to prevent entrance of liquid and expanding refrigerant into the evaporator 10. When the temperature of the evaporator 10 reaches a predetermined point, the expansion valve 14 will be opened for admitting liquid refrigerant into the evaporator 10 to permit the expansion thereof and absorption of heat from the evaporator 10 and from articles positioned adjacent the evaporator 10 in the usual manner.

The other end of the connecting line 16 is in communication with a liquid receiver tank 24 which may be of any configuration but is illustrated as being generally cylindrical. The upper end of the receiver tank 24 is provided with a hand valve 26 and a T-fitting 28 with a condenser 30 being connected to one portion of the T-connection 28 with a check valve 32 disposed therebetween wherein the check valve 32 will permit flow of refrigerant from the condenser 30 into the receiver tank 24 but will prevent flow of refrigerant from the receiver tank 24 back into the condenser 30.

Extending from the discharge of the evaporator 10 is a discharge line 34 in which is disposed a hand valve 36 and a check valve 38 wherein the check valve 38 will permit flow of gaseous refrigerant from the evaporator 10 but will prevent flow of the refrigerant from the discharge line 34 back into the evaporator 10. The discharge line 34 is connected at one end to a boiler 40 which is provided with a heat source 42. The discharge line 34 is also provided with an accumulator 44 having an inclined baffle 46 therein wherein the two portions of the discharge line 34 are disposed on opposite sides of the baffle 46. Extending from the accumulator 44 adjacent the bottom thereof is a supply line 48 interconnecting the accumulator 44 and the condenser 30. A check valve 50 and a hand valve 52 are provided in the supply line 48 and the check valve 50 permits flow of refrigerant from the accumulator 44 into the condenser 30 and prevents reverse flow thereof.

A fusible plug 54 is provided in the boiler 40 together with a connecting tube 56 with a control bellows 58 wherein the control bellows 58 controls the heat source 42 for preventing overheating of the boiler 40 in the event automatic operation of the system fails. The boiler 40 is also provided with a thermal switch 60 disposed in a control circuit 62 for the heat source 42 wherein the heat source 42 will be actuated partially in response to the thermal switch 60.

Interconnecting the receiver tank 24 and the discharge line 34 is a pilot line 64 having a diaphragm switch 66 disposed therein wherein the diaphragm switch will be closed when pressure on both portions of the pilot line 64 is equal. When the pressure in the portion of the pilot line 64 adjacent the receiver tank 24 is higher than the pressure in the pilot line 64 connected to the discharge line 34, the pressure switch will be open, thereby de-energizing or disconnecting the circuit 62. Also, when the temperature within the boiler reaches a predetermined point, the thermal switch 60 will open, thereby disconnecting or de-energizing the circuit 62, thereby stopping the action of the heat source.

In operation, thermal switch 60 is closed when a predetermined low temperature has been reached in the boiler 40. As the liquid refrigerant in the receiver tank 24 is expanded through the expansion valve 14 into the evaporator 10, the pressure in the discharge line 34 will gradually rise and become equal to the pressure in the

receiver tank 24, wherein the pressure responsive diaphragm switch 66 in the pilot line 64 will be closed, thereby energizing the circuit 62 for energizing the heat source, thereby applying heat to the boiler 40.

The gaseous refrigerant in the boiler 40 is heated, and expanded and due to the closed nature of the system, the expanding gas will provide a pressurized system since the check valve 38 prevents reverse flow of the heated gas back into the evaporator 10. The pressure of the gaseous refrigerant overcomes the spring tension on the check valve 50 and passes through the condenser 30 where the gas is cooled by natural air circulation and condensed into a liquid, and thus is discharged into the receiver tank 24. When the thermal switch 60 reaches a predetermined temperature, the circuit 62 is de-energized, thereby interrupting the heat source, thereby stopping the flow of heat to the boiler 40. The remaining refrigerant gases in the boiler as well as the accumulator are cooled by natural circulation of air thereby causing a lower pressure in the boiler, accumulator and the discharge line 34 as well as that portion of the pilot line 64 between the switch 66 and the discharge line 34 than the pressure in the remainder of the system. As the pressure differential between the two sides of the diaphragm switch 66 increases during cooling of the boiler, line 34, accumulator and part of line 64, the diaphragm switch 66 will open thereby retaining the circuit 62 de-energized even though the thermal switch 60 may be again closed as the boiler 40 reaches a predetermined low temperature. As the expansion valve 14 admits liquid refrigerant into the evaporator 10, the differential in pressure between the boiler side of the system and the discharge side of the check valve 50 causes flow of refrigerant through the evaporator and out through the check valve 38 which will gradually reduce the differential in pressure until pressure in the entire system is substantially equalized wherein the pressure responsive switch 66 will close and energize the circuit 62 for beginning another cycle of operation. Any type of heating medium may be employed in the present invention and the device may be utilized in various heat exchanging systems.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is follows:

1. A cyclic refrigeration system comprising a liquid refrigerant receiver tank, an evaporator, a connecting line between the tank and evaporator, an expansion valve in said connecting line, means for expanding and heating the gaseous refrigerant discharged from the evaporator, a discharge line extending between the evaporator and the expanding and heating means, a check valve in said discharge line permitting flow from the evaporator to the expanding and heating means, a condenser, a line connecting the condenser to the receiver tank, a supply line between the discharge line and the condenser, said supply line being connected to the discharge line between the expanding and heating means and the check valve in the discharge line, a check valve in the supply line permitting flow of high pressure gaseous refrigerant into the condenser, and means responsive to the differential in pressure in the receiver tank and discharge line for automatically actuating and stopping said expanding and heating means.

2. A cyclic refrigeration system comprising a liquid refrigerant receiver tank, an evaporator, a connecting line between the tank and evaporator, an expansion valve in said connecting line, means for heating the gaseous refrigerant discharged from the evaporator and raising the pressure thereof, a discharge line extending between the evaporator and the heating means, a check valve in said discharge line permitting flow from the evaporator to the heating means, a condenser, a line connecting the condenser to the receiver tank, a supply line between the discharge line and the condenser, said supply line being connected to the discharge line between the heating means and the check valve in the discharge line, a check valve in the supply line permitting flow of high pressure heated gaseous refrigerant into the condenser, and means responsive to the differential in pressure in the receiver tank and discharge line for automatically actuating said heating means when pressures in the system are equal and stopping the heating means when the pressures in the system are unequal, said heating means including a boiler, and a heat source for said boiler.

3. A cyclic refrigeration system comprising a liquid refrigerant receiver tank, an evaporator, a connecting line between the tank and evaporator, an expansion valve in said connecting line, boiler heating means for expanding and heating the gaseous refrigerant discharged from the evaporator, a discharge line extending between the evaporator and the boiler means, a check valve in said discharge line permitting flow from the evaporator to the boiler means, a condenser, a line connecting the condenser to the receiver tank, a supply line between the discharge line and the condenser, said supply line being connected to the discharge line between the boiler means and the check valve in the discharge line, a check valve in the supply line permitting flow of high pressure heated refrigerant into the condenser, and means responsive to the differential in pressure in the receiver tank and discharge line for automatically actuating said boiler means, said boiler means including a boiler, and a heat source for said boiler, said pressure responsive means including a pilot line interconnecting the receiver tank and the discharge line, with the pilot line connecting with the discharge line between the condenser supply line and the check valve in the discharge line and connecting with the line connecting the condenser with the receiver tank, a diaphragm switch in said pilot line, a control circuit for said heating means, said diaphragm switch energizing the control circuit, a thermal switch in said boiler means, said thermal switch connecting the diaphragm switch to the control circuit, said diaphragm switch being closed when the pressure in the tank and discharge line are equal, said thermal switch being closed when the temperature in the heating means drops to a predetermined point thereby actuating the heat source and expanding gaseous refrigerant in the boiler and forcing the same through the condenser until the thermal switch is opened by the temperature of the boiler, the cooling of the boiler and the gaseous refrigerant therein creating a partial vacuum in the discharge line for opening the diaphragm switch and permitting evaporation of liquid refrigerant in the evaporator.

4. The combination of claim 3 wherein an accumulator is disposed in the discharge line with the supply line connected thereto, a baffle in said accumulator providing a guide for flow of gaseous refrigerant into the condenser.

5. A cyclic refrigeration system comprising a liquid refrigerant receiver tank, an evaporator communicated with the tank for receiving liquid refrigerant therefrom, an expansion valve on the inlet side of said evaporator, a condenser communicated with said receiver tank for discharging cooled liquid refrigerant under pressure to the tank, boiler means communicated with the evaporator for receiving gaseous refrigerant therefrom, said condenser having an inlet communicating with the boiler means, a pilot line interconnecting the receiver tank and the outlet side of the evaporator, a check valve permitting flow of gaseous refrigerant from the evaporator, a check valve permitting flow of high pressure gaseous refrigerant into the condenser, a thermal switch disposed in said boiler means for rendering the boiler means inoperative when the gaseous refrigerant reaches a predetermined

temperature, a pressure responsive switch disposed in the pilot line for actuating said boiler means when closed and maintaining the boiler means inoperative when open, said pressure responsive switch being open when the pressure of the gaseous refrigerant in the boiler means and inlet of the condenser is less than the pressure in the condenser and receiver tank thus permitting expansion and evaporation of liquid refrigerant in the evaporator for equalizing pressures in the pilot line thus closing said pressure responsive switch for operating the boiler means for raising the temperature and pressure of the gaseous refrigerant in the boiler for forcing the high pressure heated gaseous refrigerant into the condenser until the temperature in the boiler means opens the thermal switch

for rendering the boiler means inoperative, the cooling of the boiler means causing a pressure reduction of the gaseous refrigerant for opening the pressure responsive switch before the thermal switch is closed thus providing cyclic operation of the system.

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