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H. A. PHILLIPS

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REFRIGERATION CONTROL SYSTEM

Filed April 12, 1937

2 Sheets-Sheet 1

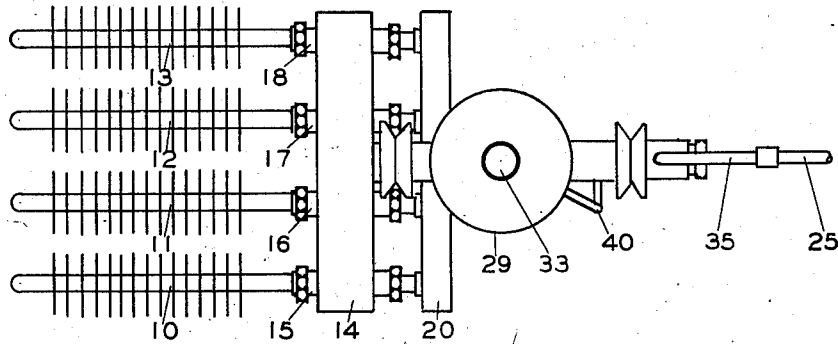


FIG. 1

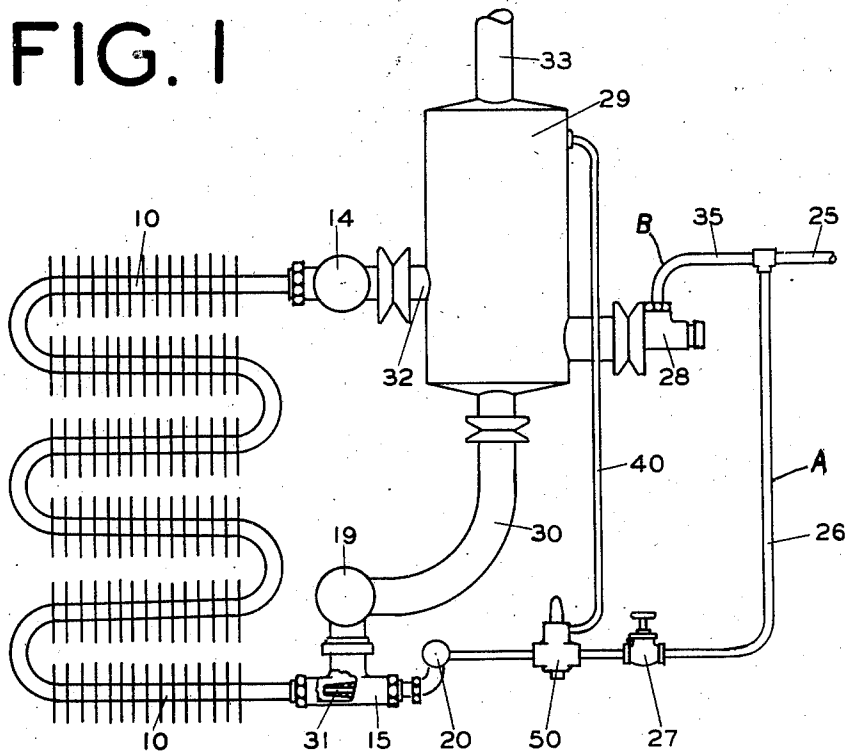


FIG. 2

INVENTOR
HARRY A. PHILLIPS
BY *Maximas R. Kondolf*
ATTORNEY

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2 Sheets-Sheet 2

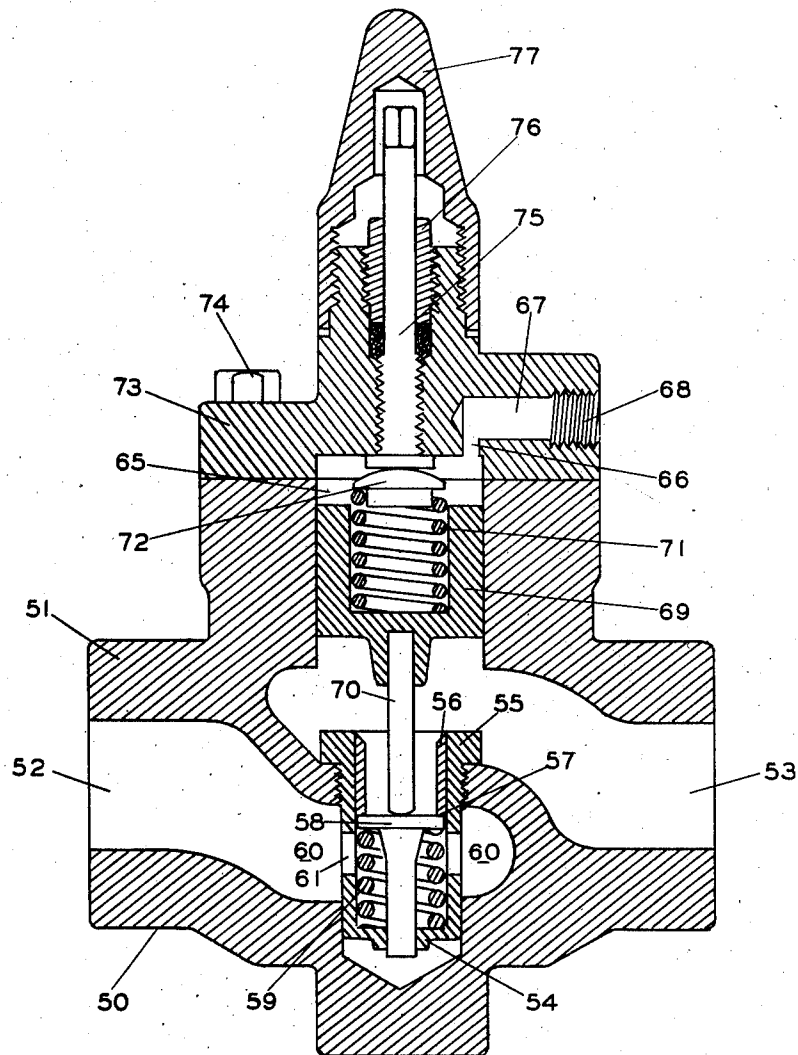


FIG.3

INVENTOR
HARRY A. PHILLIPS
BY *Mathias R. Kondolf*
ATTORNEY

UNITED STATES PATENT OFFICE

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REFRIGERATION CONTROL SYSTEM

Harry A. Phillips, Chicago, Ill.

Application April 12, 1937, Serial No. 137,320

6 Claims. (Cl. 62—2)

This invention relates to a system of refrigeration and more particularly to apparatus and methods of use in connection with the improved operation of the invention disclosed in my co-pending application, Serial No. 55,815, filed December 23, 1935, now matured into Patent No. 2,123,021, dated July 5, 1938.

A principal object of this invention is to utilize the suction pressure existing in the evaporators of a refrigeration system to control means which modulate the continuous feed of liquid refrigerant to the evaporators, as disclosed in my said co-pending application.

A particular object of the invention is to provide valve means and a balance line connected to control said valve in relation to the suction pressure existing in the evaporator.

A further object of the invention is to automatically maintain a pressure, on the continuous feed nozzles which impel circulation in the evaporator, in amount greater than the pressure existing in the evaporator, and to vary this nozzle pressure to correspond with variations in the pressure existing in the evaporator.

The importance of maintaining a rapid circulation of refrigerant in an evaporator, in order to sweep away insulating films, is pointed out.

In order to secure continuous, uniform circulation in the evaporator, it is important that the pressure head of the nozzles be uniformly greater than the evaporator pressure—in some cases, however, it is desirable to vary the pressure head of the nozzle in relation to a uniform evaporator pressure. Means to accomplish this are disclosed hereinafter.

In operating an evaporator with a divided feed, it is desirable to feed a large proportion of refrigerant through the nozzles to secure maximum circulation and its attendant advantage of efficient heat transfer. The necessary additional refrigerant, supplied to the evaporator to meet load conditions not met by the nozzle feed, can be taken care of by a float valve, or other device.

In an evaporator embodying the invention specified herein, a much smaller float valve is required, since a large part of the load is taken care of by the nozzle feeds.

To these and other ends the characteristic features and advantages of my improvement will more fully appear in the following description and the accompanying drawings in illustration thereof.

In the drawings, in which like reference numerals designate like parts,

Fig. 1 is a plan view of an evaporator coil having

an embodiment of my invention in combination therewith.

Fig. 2 is a side elevation of the coil of Fig. 1 and shows the injector means partly in section.

Fig. 3 is a sectional view of one form of a balance apparatus which may be used.

Referring to Fig. 1, reference numerals 10, 11, 12 and 13 designate coils of the evaporator unit. These coils are each connected at the top to the header 14 and at the bottom they are attached to separate injectors. Thus, coil 10 is attached to the injector 15, coil 11 to the injector 16, coil 12 to the injector 17, and coil 13 to the injector 18.

The injectors 15 to 18 inclusive are each connected as shown in Fig. 2 to the headers 19 and 20.

Liquid refrigerant is supplied to the evaporator through the pipe 25 and a portion, herein designated as portion "A", of the total amount of refrigerant supplied to produce the required refrigerating effect in the evaporator is taken from the liquid line 25 through the pipe 26, the valve 27 and the header 20. The other portion, herein designated as portion "B", of the total amount of liquid refrigerant required, passes from the liquid line 25 through the pipe 35, the float valve 28 into the surge drum 29 through the pipe 30 and into the header 19.

In operation the valve 50 is open far enough to permit the entry into the header 20 of the quantity of refrigerant required to produce the minimum refrigerating effect required from the evaporator coils. The refrigerant required to operate each of the injectors 15 to 18 inclusive is supplied from the header 20, and referring to Fig. 2, it will be noted that this portion A of the liquid refrigerant passes from the header 20 through the nozzles of the injectors. Injector 15 being provided with nozzle 31 and similar nozzles being provided for the other injectors. As long as the valve 50 remains open there is a continuous flow of refrigerant through the nozzles of the injectors.

In normal operation in order to obtain the required refrigerating effect from the evaporator coil it is desirable to operate the coil in a flooded condition. As shown in the drawings the float valve 28 in connection with the surge drum 29 provides a means of maintaining the evaporator coil in a flooded condition. The portion B of the total refrigerant which is needed to provide refrigerating effects from the coil, in excess of the minimum or basic load of refrigeration, passes through the valve 28, the surge drum 29 and the pipe 30 into the header 19. From the header 19 the refrigerant surrounds the nozzles of the injectors 15 to 18 inclusive and by reason of in-

jector action the velocity of the refrigerant which comes through the header 19 is greatly accelerated as it enters the evaporator coil.

Part of the liquid refrigerant is converted into gas in the evaporator coils, and the mixture of gas and liquid refrigerant is carried upward through the coils into the header 14 and enters the surge drum 29 through the pipe 32. In the surge drum (or liquid trap) the gaseous part of the refrigerant separates from the liquid portion. The gaseous portion is drawn from the surge drum through the suction pipe 33 and passes over to the other part of the refrigerating system to be condensed into liquid and reused. The liquid portion of the refrigerant which separates from the mixture carried into the drum 29, together with any additional liquid refrigerant which enters the drum 29 through the float valve 28, moves downwardly through the pipe 30 into the header 19 and around the injectors 15 to 18 inclusive and is accelerated in entering the coils by the injector action.

In order to obtain the maximum efficiency from the evaporator coil and break up the films of gas, which resist the transmission of heat into the evaporator as described above, it is desirable to have a re-circulation of liquid refrigerant through the coil, the surge drum and the pipe 30. The maintenance of such a current of liquid refrigerant through the heat absorbing portion of the evaporator circuit is an important feature of my invention. The quantity of refrigerant recirculated through the pipe 30 may be several times as great, during a given period, as the total quantity of refrigerant supplied to the evaporator through the pipe 25 and drawn away through the pipe 33, and which corresponds to the refrigerating effect or load during such period.

The pressures in the several parts of the system will vary with other conditions in the plant but as an illustrative example the pressure of the liquid in the pipe 25 may be taken at 150 pounds per square inch, the pressure in the header 20 about 100 pounds per square inch and the pressure in the evaporator coils and headers 14 and 19, will correspond to the temperature desired, but always much less than that existing in the header 20.

Referring to Fig. 3, the balance valve 50 comprises a casing 51 having a port or opening 52 for the inlet of high pressure refrigerant (taken from the plant liquid receiver or plant condensers). The refrigerant leaves the valve 50 through the port or opening 53 and is fed into the header 20 shown in Fig. 2.

Mounted in the casing 51 intermediate of the ports 52 and 53 is the valve cartridge 54. The cartridge 54 comprises a frame 55, a bushing 56 having a valve seat 57 at its lower end, a valve 58 and a valve spring 59. The valve 58 is adapted to move relative to the valve seat 57 to vary the area of the passage between the valve and the valve seat.

Surrounding the valve cartridge 54 is the passage 60 which connects with the port 52. Openings 61 permit the refrigerant to pass into the valve cartridge 54 and when the valve 58 is away from the valve seat 57 the refrigerant passes through the cartridge 54 and leaves the balance valve 50 through the port 53.

The casing 51 is provided with a chamber 65 which communicates through the passages 66 and 67 with the port 68. The balance feeler line 40 shown in Fig. 2 is connected to this port. This balance line serves to maintain a pressure in the

chamber 65 corresponding to the pressure in the evaporator.

The chamber 65 is cylindrical in shape and is provided with a gas tight piston 69. The rod 70 mounted in the lower end of the piston, extends downwardly into contact with the valve 58, and serves to space the piston 69, from the valve 58. The piston 69 carries the piston spring 71. The spring 71 supports the spring block 72.

The chamber 65 is provided with a cover 73 held to the casing 51 by the bolts 74. The cover 73 carries an adjusting screw 75 which projects through the packing gland 76 so that it may be adjusted from outside the balance valve. A guard cap 77 is threaded to the cover 73 and protects the exposed end of the rod 76.

From the construction described it will be noted that the operating valve 58 is floated or balanced between the springs 59 and 71. The introduction of pressure into the chamber 65 forces the piston 69 and the spacing rod 70 downwardly thereby moving the valve 58 away from its seat 57 and consequently increasing the area of the flow passage for refrigerant through the balance valve.

The strength of the springs 59 and 71 and the area of the piston 69 are calculated to give any desired pressure head on the nozzles 31 in relation to the pressure existing in the evaporator. The condensing pressure in the particular plant must also be taken into consideration because of the counteracting effect of this head pressure against the underside of the valve 58.

In designing the balance apparatus, the piston 69 may be dimensioned to obtain a non-uniform differential of nozzle pressure over the evaporator pressure.

The chamber 65 is preferably of sufficient size to permit the withdrawal, after removing the cover 73, of the cartridge 54 for repair purposes.

The balance line 40, by providing variations in pressure on the piston 69 of the balance apparatus 50 to correspond with pressures existing in the evaporator, secures a larger area of passage for refrigerant through the balance apparatus 50 when the evaporator pressure rises. The increased feed of refrigerant, when the pressure in the evaporator rises, results in a greater discharge from the nozzles 31, and a greater impelling force to the current of refrigerant recirculating through the evaporator circuit.

It will be noted that when the evaporator is started up, or in case of an increased load of substantial amount being placed on the evaporator,—for example in liquid cooling work, where a batch of hot liquid is suddenly flowed over the evaporator coils—the large amount of refrigerant vaporized will raise the pressure in the evaporator and the increased flow of refrigerant through the nozzles 31 will be secured. Thus all or a large proportion of the excess load will be automatically taken care of, by the operation of the balance valve. In the evaporator shown in Fig. 1, the float valve 28, having its individual plant liquid feed 35, will supply refrigerant to the apparatus to meet load conditions not met by the refrigerant fed through the nozzles 31, as more particularly described in my co-pending application above mentioned.

It will be obvious that a diaphragm may be substituted for the piston 69 in the balance apparatus shown in Fig. 3.

This application is a continuation in part of my prior application, above mentioned, Serial 75

No. 55,815, filed December 23, 1935, now matured into Patent No. 2,123,021, dated July 5, 1938.

I claim:

1. In the art of refrigeration, the method of feeding an evaporator circuit, maintained under vaporizing pressure, which comprises the division of the liquefied refrigerant supplied to said evaporator into a feed A and a feed B; continuously jetting said feed A, under greater pressure into said circuit to impel a current of liquefied refrigerant in said circuit; modulating the amount of said feed A in relation to the pressure existing in the evaporator; and supplying liquefied refrigerant to said circuit by said feed B, as required by load conditions and not supplied by feed A.

2. In the art of operating a refrigeration system, the method of feeding an evaporator which comprises the division of the flow of liquid refrigerant supplied to said evaporator from the condensing side of said system into two or more feeds into said evaporator; one or more of said feeds being used to accelerate the circulation of refrigerant through said evaporator and being supplied continuously during the operation of said evaporator; modulating the amount of said accelerating feeds in relation to the pressure existing in the evaporator; and utilizing the rest of said feeds to supply additional refrigerant to the evaporator, as demanded by load conditions and not supplied by the continuous feed connections.

3. In the art of refrigeration, the method of re-circulating liquid refrigerant in a flooded evaporator circuit which comprises the division of the total supply of liquid refrigerant, to be vaporized in said evaporator, into a portion A and a portion B; continuously jetting said portion A into said circuit to impel said recirculation; modulating the amount of said portion A in relation to the pressure existing in said evaporator; and feeding said portion B into said cir-

cuit as required to maintain flooded operation of said evaporator.

4. An evaporator for a refrigeration plant, comprising a heat absorbing element, a plant suction connection to said evaporator; a plant feed of liquid refrigerant to said element connected to impel circulation in said element; a balance apparatus in said plant feed line; a balance feeler line from said balance apparatus to said evaporator; and a separate plant feed of liquid refrigerant to supply additional refrigerant to said evaporator as required by load conditions and not supplied by first mentioned feed connection.

5. An evaporator for a refrigeration plant, comprising a heat absorbing element; a plant suction connection to said evaporator to maintain suction pressure in said element; a plant feed of liquid refrigerant to said element connected to impel circulation in said element; a balance apparatus in said plant feed line; and a balance line from said evaporator to said apparatus whereby variations in the suction pressure in said heat absorbing element will cause corresponding variations in the flow through said plant feed line.

6. An evaporator for a refrigeration plant, comprising a heat absorbing element; a plant suction connection to said evaporator to maintain suction pressure in said element; a plant feed of liquid refrigerant to said element connected to impel circulation in said element; a balance apparatus in said plant feed line; and a balance line from said evaporator to said apparatus whereby variations in the suction pressure in said heat absorbing element will cause corresponding variations in the flow through said plant feed line, and a separate plant feed of liquid refrigerant to supply additional refrigerant as required by load conditions and not supplied by said first mentioned feed connection.

HARRY A. PHILLIPS.