

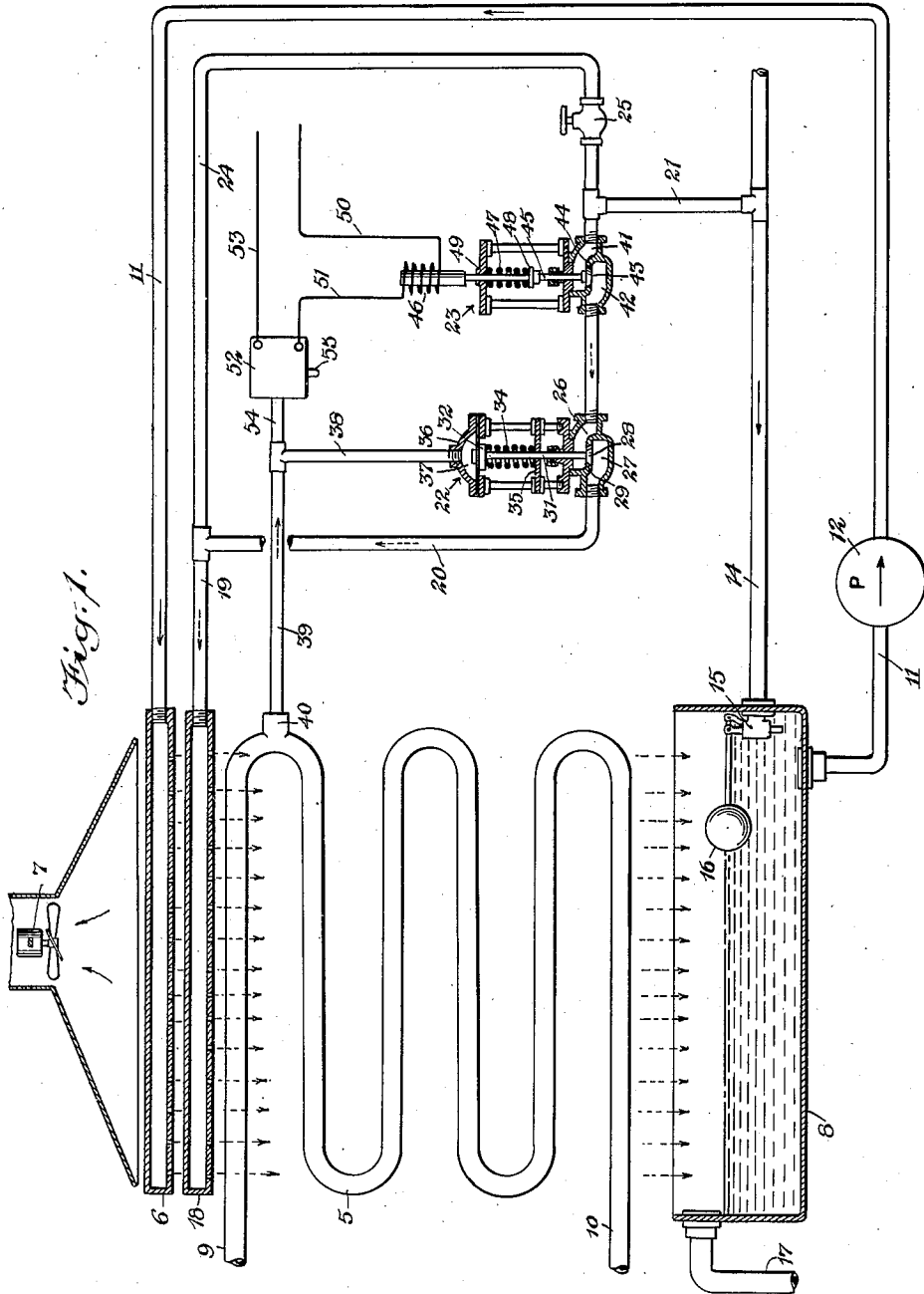
Feb. 11, 1941.

T. S. WETTER
REFRIGERATING APPARATUS

2,231,856

Filed Aug. 13, 1938

2 Sheets-Sheet 1



WITNESSES
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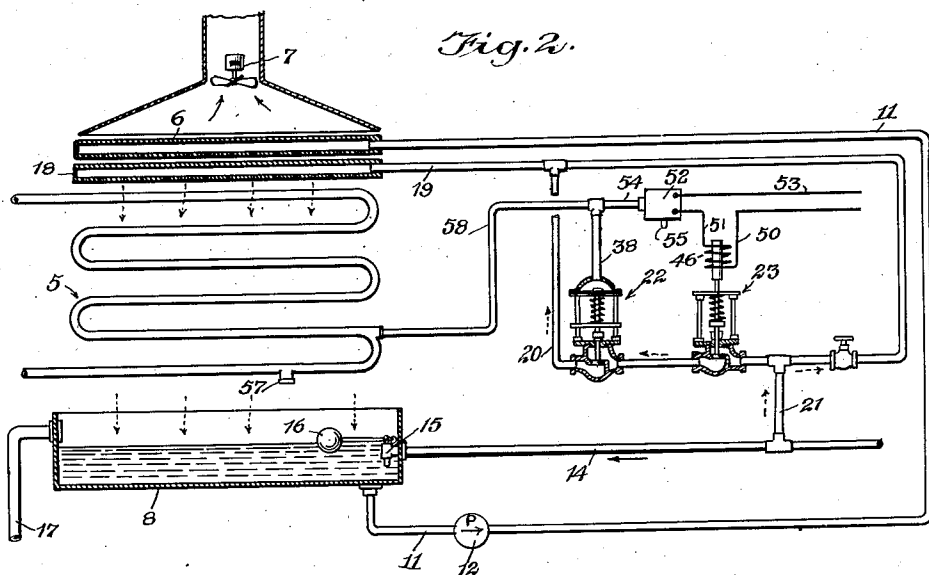
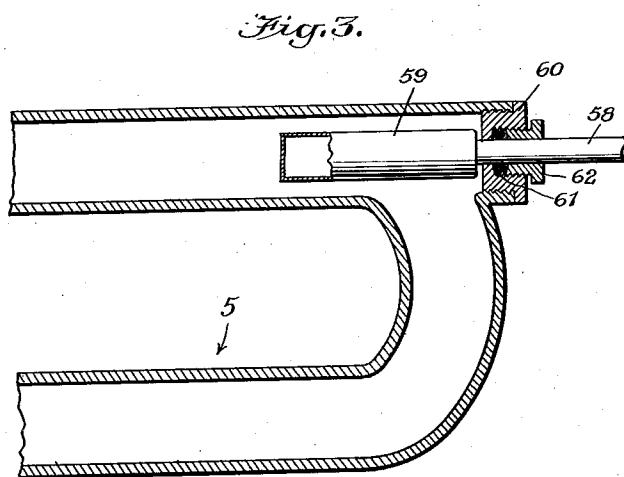
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2,231,856

REFRIGERATING APPARATUS

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3 Claims. (Cl. 257—2)

This invention relates to refrigerating apparatus and particularly to an improved refrigerating condenser of the evaporator, shower or economizer type.

The increasing use of large size refrigeration machines has caused a problem for various municipalities due to the large quantities of condensing water used. The problem is rapidly approaching an acute stage and is overloading both water supply and sewage systems.

To meet this situation there has been an increasing use of refrigeration condensers of the type variously known as evaporator, shower, or economizer condensers which are combinations of a forced draft water cooling tower and an atmospheric condenser. In this type of condenser the coil is usually disposed in a housing that has a drip or catch pan at the bottom thereof. The water is either sprayed or trickled over the coil and a fan blows a continuous stream of air through or over the water and coil. This induces a rapid evaporation of part of the water, cooling the remainder to within several degrees of the wet bulb temperature of the air. The unevaporated water falls into the drip pan and is recirculated by means of a pump. A certain quantity of water in the system is lost by evaporation and this is compensated for by a supply pipe controlled by a float valve.

The quantities of air and water circulated by the fan and pump may vary widely but it is essential that both fan and motor be in operation in order for this type of condenser to function. Upon the failure of either the fan or pump the condenser pressure and temperature will mount rapidly reaching the pressure at which the high pressure cutout shuts down the compressor, or where a fusible plug is employed, reaching the temperature at which the plug fuses.

It will be appreciated that this interruption of operation caused by the failure of either or both the pump and condenser is highly undesirable and it is a prime object of this invention to overcome the difficulties heretofore encountered in this respect and to provide an improved condenser which automatically is caused to function as an atmospheric condenser in case of fan or pump failure.

A further object of the invention is the provision of an improved condenser of the economizer, shower or evaporator type which is provided with an auxiliary water supply which converts the condenser into an atmospheric condenser when the pressure or temperature of the fluid

in the condenser reaches a predetermined level due to failure of the pump or fan.

Another object is the provision in a condenser of the above character of manually operated means in addition to automatically operated means whereby the condenser may be caused to function as an atmospheric condenser.

For a fuller understanding of the invention reference should be had to accompanying drawings in which

Fig. 1 is a diagram of a refrigerating condenser embodying my invention;

Fig. 2 is a similar view of a modified type of apparatus embodying my invention which is thermostatically controlled; and

Fig. 3 is an enlarged sectional view of the condensing zone of the condenser illustrated in Fig. 2, showing one manner in which the thermostatic bulb may be connected to the condensing coil.

In the accompanying drawings I have illustrated diagrammatically one form of shower, economizer, or evaporator condenser to which my invention may be applied and the apparatus consists generally of a condenser coil 5 having a spray pipe 6 disposed over the top thereof for spraying water on the coil; a suction fan or a blower 7 for drawing a current of air over the coil and over and through the water; and a drip pan 8 disposed beneath the coil for receiving the unevaporated water.

The refrigerant enters the coil 5 at the upper end thereof indicated at 9 and circulates through the return bends of the coil where it is condensed and is then discharged through the outlet 10. As the water drips downwardly from the spray pipe 6 the current of air induced by the fan 7 causes rapid evaporation of a certain amount of the water cooling the remainder of the water and the coil. The unevaporated water which drips into the pan 8 is recirculated through pipe 11 by means of pump 12 so as to return to the spray pipe 6 where it is again sprayed downwardly on the coil 5.

In order to compensate for the water lost by evaporation a supply pipe 14 leading from a suitable source of water supply (not shown) is connected to the drip pan 8 and the outlet of the supply pipe is controlled by means of float valve 15 which is of conventional construction. When the water in the drip pan 8 drops below the level shown in the drawings the float 16 moves downwardly causing the valve 15 to open so as to permit more water to enter the drip pan through pipe 14. In this way a substantially uniform

quantity of water is maintained in the system at all times.

The mechanism heretofore described forms one standard type of economizer, shower, or evaporator condenser and its construction and operation will be readily understood by those skilled in the art. When the fan 7 and pump 12 operate in the proper manner condensers of this type produce very satisfactory results. However, when either or both the fan or pump cease to function the condenser will no longer operate in a satisfactory manner and the pressure and temperature in the condenser will rise. In order to cause the continued satisfactory operation of the condenser upon the failure of either the pump or fan I have provided certain auxiliary mechanisms whereby the condenser will then be caused to operate as an atmospheric condenser.

In Fig. 1 I have illustrated the preferred form of mechanism for accomplishing this result. This mechanism takes the form of an overflow pipe 17 connected to the drip pan 8 above the water level at which the float 16 causes the valve 15 to function and also an auxiliary water supply system for supplying additional water to the condenser coil so that it may thereafter operate as an atmospheric condenser. The auxiliary supply preferably takes the form of an additional spray pipe 18 connected by conduit or pipe 19 to pipe 20 which in turn is connected by conduit or pipe 21 to the water supply pipe 14. The flow of water through the pipe 20 is controlled by pressure operated valve 22 and electrically operated valve 23.

The pipe 19 is also connected by means of a by-pass pipe 24 having a manually controlled valve 25 to the pipe 21. It will be seen that by opening manually controlled valve 25 water from supply pipe 14 can pass through pipe 21, pipe 24 and pipe 19 into the spray pipe 18. The pressure of the water supply and the size of the pipes is such that the water spray coming from spray pipe 18 is sufficient to cause the condenser coil 5 to function as an atmospheric condenser.

The pressure operated valve 22 and the electrically operated valve 23 are caused to operate by an increase in pressure in the condenser coil above a predetermined level and preferably the pressure operated valve should be set so as to open at the desired operating pressure of the condenser while the electrically operated valve is set so as to open when the pressure approaches the pressure at which the high pressure cutout (not shown) of the refrigerating system shuts down the compressor. Thus as a specific example where my invention is used in connection with a refrigerating system employing ammonia as the refrigerant the pressure operated valve starts to open when the pressure of the refrigerant reaches 185 pounds and the electrically operated valve opens when the pressure reaches 225 pounds.

The pressure operated valve is provided with inlet and outlet chambers 26 and 27 respectively between which is disposed the valve 28 which seats against the valve seat 29. A valve stem 31 extends upwardly from the valve 28 and is connected at its upper end to a diaphragm 32. To normally hold the valve in closed position a spring 34 is disposed around the stem between the diaphragm 32 and the transverse member 35. A cap 36 is connected over the top of the diaphragm 32 so as to provide a pressure chamber 37 connected by conduits 38 and 39 to a stem 40

communicating with the interior of the condenser coil at the first return bend. In this way the pressure in chamber 37 varies with the pressure of the refrigerant. As stated above when ammonia is used as the refrigerant, the tension of the spring 34 is such as to cause valve 28 to open when the pressure of the refrigerant rises above approximately 185 pounds. It will be appreciated that the amount that the valve opens is proportional to the pressure of the refrigerant, thus the higher the pressure the greater the valve opening and correspondingly the lower the pressure the smaller the valve opening.

The electrically operated valve 23 consists of inlet and outlet chambers 41 and 42 respectively between which is disposed the valve 43 seating against valve seat 44. It will be seen that the valve 43 seats oppositely to valve 28, thus valve 28 is closed when in its uppermost position and valve 43 is closed when in its lowermost position. Extending upwardly from valve 43 is valve stem 45, the upper end of which forms an armature for solenoid 46. The valve is normally held in closed position by means of a coil spring 47 disposed around the valve stem between collar 48 and supporting bracket 49. When the solenoid 46 is energized it raises the valve stem and valve 43 upwardly to open position. One end of the solenoid winding is connected by lead 50 to one side of the source of current supply and the other end of the winding is connected by lead 51 to pressure actuated switch 52 which is also connected by lead 53 to the other side of the source of current supply. The pressure actuated switch 52 is of conventional construction and is connected by means of conduit 54 to conduit 39.

The pressure actuated switch 52 is normally open but when the pressure of the refrigerant approaches the critical pressure at which the high pressure cutout shuts down the compression the switch is operated so as to close the circuit of solenoid 46 with the result that valve 23 is caused to open. When switch 52 is operated to close the circuit the circuit remains closed regardless of any drop in pressure of the refrigerant until it has been manually opened by means of the manual reset button 55.

In the normal operation of a refrigerating condenser embodying my invention in which ammonia is used as the refrigerant valve 22 is preferably adjusted to open at 185 pounds pressure and pressure operated switch 52 is adjusted to operate at 225 pounds pressure so as to cause valve 23 to open. When the pump 12 and fan 7 are functioning properly the condenser will operate as a shower, evaporator, or economizer condenser and both of the valves 22 and 23 will normally be closed. When the system is operating in this manner manually by-pass valve 25 should likewise be closed. In the event that either the pump or fan cease to function properly the pressure in the condenser will commence to rise. As it rises above 185 degrees valve 22 will be caused to open, the opening in the valve being proportional to the pressure. However, the auxiliary spray pipe 18 will not operate as yet due to the fact that electrically operated valve 23 does not open until the pressure of the refrigerant reaches 225 pounds. When the pressure of the refrigerant does reach 225 pounds, pressure actuated switch 52 closes the circuit of solenoid 46 causing valve 23 to open. Water will then flow through supply pipe 14 and pipe 21, 20 and 19 into spray pipe 18 and sufficient water will be sprayed by

the spray pipe 18 on the condenser coil 5 to cause the system to operate as an atmospheric condenser.

Due to the large quantity of water sprayed by spray pipe 18 downwardly over the coil 5 into drip pan 8, all of the water cannot be recirculated by pump 12 and this will pass through overflow or drainpipe 17. When the defect in the pump or fan has been corrected electrically operated valve 23 can be shut off by means of the manual reset button 55 on the switch 52 and the system can once again function as a shower, evaporator, or economizer condenser.

It will be appreciated that even where pump 15 or fan failure has not caused the pressure to rise sufficiently to operate the valves 22 and 23 I can cause the system to operate as an atmospheric condenser by opening manually controlled valve 25.

In certain types of systems as where a fusible plug is employed in the condenser coil I prefer to operate the auxiliary spray system by means of variations in the temperature of the refrigerant, preferably in the condensing zone of the condenser coil. An apparatus of this character is illustrated in Figs. 2 and 3 of the drawings which is similar in all respects to the first form of my invention with the exception that a fusible plug 57 is disposed in the condensing zone of the condenser coil 5 and the pressure actuated switch and pressure operated valve are connected to a thermostatic bulb rather than communicating directly with the refrigerant. Fusible plug 57 is of conventional construction and is adapted to fuse and release the refrigerant when the temperature in the condensing zone passes above a critical point. Refrigerating systems employ sulphur dioxide, freon, and similar refrigerants sometimes employ fusible plugs of this character as safety devices.

In this form of my invention the pressure operated valve 22 and the pressure operated switch 52 are connected by the pipes or conduits 38 and 54 respectively to a conduit 58 which in turn is connected to a thermostatic bulb 59 of conventional construction positioned in the condensing zone of the condenser coil as shown most clearly in Fig. 3. A preferred type of structure is shown in the drawings and comprises a fitting 60 threaded in the lowest return bend of the condenser coil 5 and through which the conduit 58 projects. The fitting is provided with an enlarged socket in which packing 61 is disposed, the packing being held in position by means of the threaded plug 62.

The thermostatic bulb 59 is a gas-filled bulb and upon an increase in the temperature of the refrigerant in the condensing zone there is a corresponding increase in the temperature and pressure of the gas in the thermostatic bulb. The increase in pressure is transmitted through the conduits 58 and 38 to pressure operated valve 22 and through the conduits 58 and 54 to the pressure operated switch 52. The parts are so adjusted so as to cause the operation of the switch 52 when the temperature in the condensing zone rises to a point within 25 degrees Fahrenheit of the temperature at which the fusible plug 57 fuses while the pressure actuated valve is adjusted so as to open when the temperature in the condensing zone rises above the desired operating temperature. Thus where freon, sulphur dioxide and the like are employed the valve is adjusted so as to open when the temperature rises above 90 degrees Fahrenheit.

In the normal operation of the condenser shown in Figs. 2 and 3 it operates as an evaporator condenser. Thus the water is sprayed on the coil from spray pipe 6 and the unevaporated portion thereof is received in the drip pan 8. The blower or fan 7 directs a current of air over and through the water spray and over the coil causing rapid evaporation of a small quantity of water, cooling the remainder of the water in the coil. The unevaporated water that is received in the drip pan 8 is recirculated through conduit 11 by means of pump 12 and is again sprayed on the coil. In the event of failure of either the pump or fan the condenser ceases to function properly with the result that the temperature in the condenser rises. When the temperature in the condensing zone rises above the desired operating temperature which, as stated above, is 90 degrees in the case of freon, sulphur dioxide or the like pressure operated valve 22 begins to open due to the increased pressure in thermobulb 59 resulting from the rise in temperature. However, water cannot circulate from supply pipe 14 through conduits 21, 20 and 19 due to the fact that valve 23 remains closed until the temperature rises to within 25 degrees of the fusing temperature of the plug 57. When this point is reached pressure actuated switch 52 is operated closing the circuit of the solenoid winding 46 with the result that valve 23 is open permitting the water from the supply pipe to flow through conduits 21, 20 and 19 into the atmospheric spray pipe 18. Sufficient water is then sprayed upon the coil 5 to cause it to function as an atmospheric condenser. The surplus water that is received in drip pan 8 passes outwardly through drain pipe 17. After switch 52 has been operated to close the circuit of the solenoid it remains open until manually reset by means of the reset button 55. Since the pressure operated valve 22 is adjusted so as to open when the temperature in the condensing zone rises above 90 degrees the system will operate to maintain the temperature at approximately this level. When the evaporator condenser system has been repaired so as to again operate the atmospheric system may be shut off by means of manually reset button 55 on the switch 52. It will be appreciated that the atmospheric system is then in a position to operate again when, due to failure of the evaporator system, the temperature in the condensing zone approaches within 25 degrees of the fusing point of the plug 57. In the modified form of my invention I also provide the conduit 24 and valve 25 which may be manually operated so as to convert the system to function as an atmospheric condenser.

From the foregoing description of my invention it will be appreciated that I have provided an improved condenser which may function both as an evaporator condenser or as an atmospheric condenser. It will also be appreciated that in normal operation the condenser operates economically as an evaporator type condenser but that upon failure of the pump or fan the system is automatically converted so as to function as an atmospheric condenser. While in the accompanying drawings I have illustrated two specific embodiments of my invention it is to be understood that modifications may be made in the particular mechanical or physical embodiments of my invention without departing from the invention as set forth in the accompanying claims.

I claim:

1. In a refrigerating condenser a condenser coil; evaporator type of cooling means for cooling the coil comprising means for spraying water on the coil, a fan for directing a current of air over the coil so as to evaporate a portion of the water, a drip pan positioned beneath the coil for receiving the unevaporated portion of the water, and a pump for recirculating the unevaporated portion of the water from the drip pan to the spray means; and auxiliary cooling means for cooling the coil comprising means for spraying sufficient additional water on the coil to cause it to operate as an atmospheric condenser, a first valve for controlling said last-named means operatively connected to the coil so as to open when the physical condition of the refrigerant varies a predetermined amount from the normal physical condition of the refrigerant in the condenser coil and a second valve controlling said last-named means and operatively connected to the coil so as to open when the physical condition of the refrigerant varies a predetermined greater amount, said predetermined greater variation being clearly beyond the conditions encountered when the condenser coil is functioning properly whereby the auxiliary cooling means is caused to operate only upon the failure of the evaporator cooling means, said second valve remaining open even after the physical condition of the refrigerant returns to normal while the setting of the first valve varies proportionally to variations in the physical condition of the refrigerant so that the flow of water in the auxiliary cooling means is proportional to variations in the physical condition of the refrigerant.

2. In a refrigerating condenser a condenser coil; evaporator type of cooling means for cooling the coil comprising means for spraying water on the coil, a fan for directing a current of air over the coil so as to evaporate a portion of the water, a drip pan positioned beneath the coil for receiving the unevaporated portion of the water, and a pump for recirculating the unevaporated portion of the water from the drip pan to the spray means; and auxiliary cooling means for cooling the coil comprising means for spraying sufficient additional water on the coil to cause it to operate as an atmospheric condenser, a first valve for controlling said last-named means operatively connected to the coil so as to open when the pressure of the refrigerant rises above the normal operating pressure of the condenser and a second valve controlling said last-named means

and operatively connected to the coil so as to open when the pressure of the refrigerant rises above a predetermined higher pressure, said predetermined higher pressure being clearly above pressures encountered in the cooling coil when the evaporator cooling means is functioning properly whereby the auxiliary cooling means is caused to operate only upon the failure of the evaporating cooling means, said second valve remaining open even after the pressure of the refrigerant returns to normal while the setting of the first valve varies in proportion to increases in the pressure of the refrigerant in the condenser coil above normal pressure so that the flow of the water in the auxiliary cooling means is proportional to the pressure of the refrigerant in the condenser coil.

3. In a refrigerating condenser a condenser coil; evaporator type of cooling means for cooling the coil comprising means for spraying water on the coil, a fan for directing a current of air over the coil so as to evaporate a portion of the water, a drip pan positioned beneath the coil for receiving the unevaporated portion of the water, and a pump for recirculating the unevaporated portion of the water from the drip pan to the spray means; and auxiliary cooling means for cooling the coil comprising means for spraying sufficient additional water on the coil to cause it to operate as an atmospheric condenser, a first valve controlling said auxiliary cooling means and operatively connected to the condensing zone of the coil so as to open when the temperature of the refrigerant rises above the normal operating temperature and a second valve controlling said last-named means and operatively connected to the condensing zone of the coil so as to open when the temperature rises above a predetermined higher temperature, said predetermined higher temperature being clearly above temperatures encountered in the cooling coil when the evaporator cooling means is functioning properly whereby the auxiliary cooling means is caused to operate only upon the failure of the evaporating cooling means, said second valve remaining open even after the temperature of the refrigerant returns to normal while the setting of the first valve varies in proportion to increases in the temperature of the refrigerant in the condenser coil above normal temperature so that the flow of the water in the auxiliary cooling means is proportional to the temperature of the refrigerant in the condenser coil.

THOMAS S. WETTER.