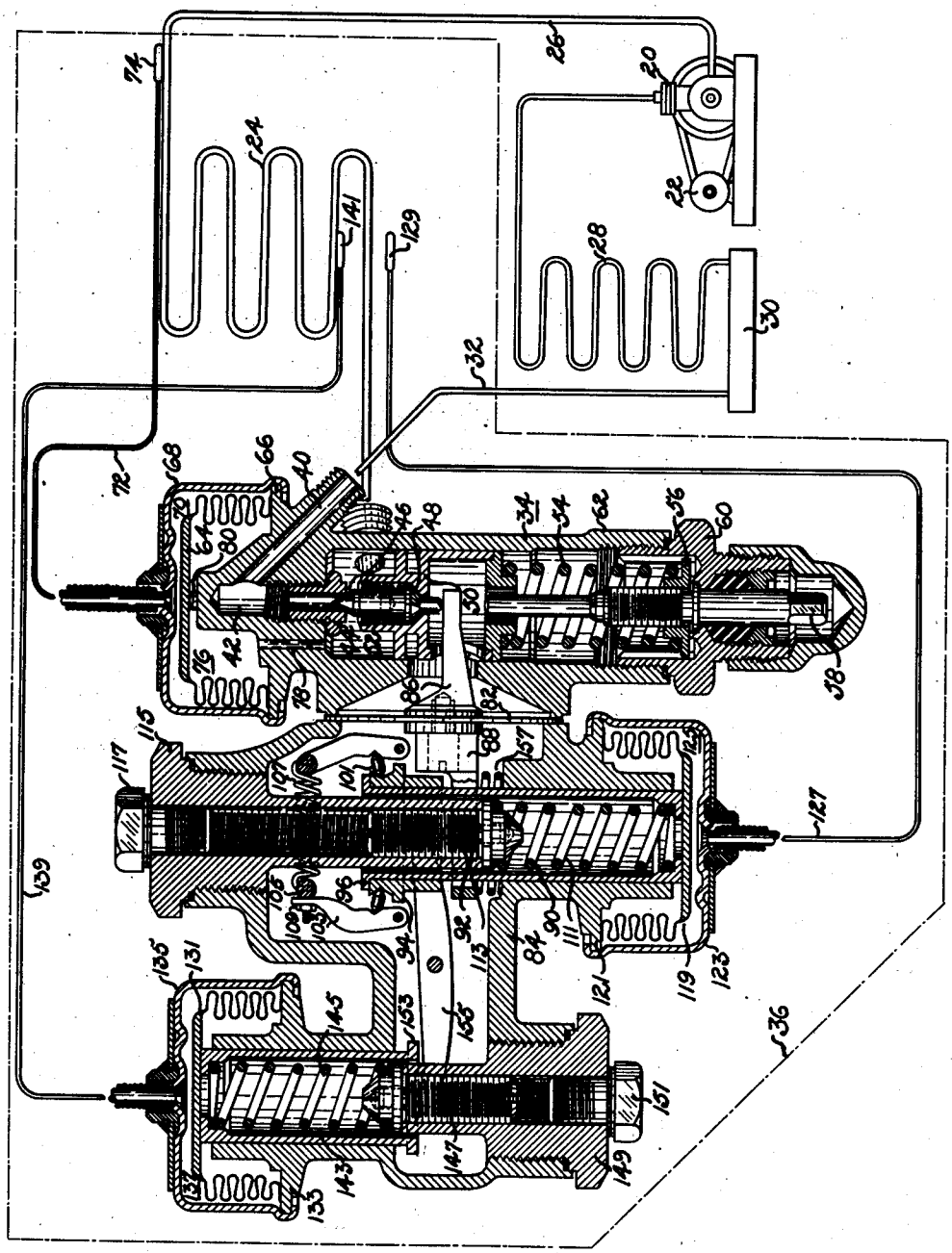
May 25, 1943. C. A. STICKEL 2,320,055

REFRIGERATING APPARATUS

Filed Oct. 28, 1940



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Patented May 25, 1943

2,320,055

UNITED STATES PATENT OFFICE

2,320,055

REFRIGERATING APPARATUS

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Application October 28, 1940, Serial No. 363,088

5 Claims. (Cl. 62—8)

This invention relates to refrigerating apparatus and more particularly to means for controlling the circulation of refrigerant through evaporating means.

Ordinarily, expansion valves are controlled by the pressure of the refrigerant in the evaporator and by the temperature adjacent the outlet of the evaporator. Such valves tend to maintain the evaporator filled with refrigerant at a substantially constant temperature. This is satisfactory as long as the environment temperature remains constant and the evaporator is operated above freezing temperatures. When the environment temperature rises or falls, the amount of refrigeration should be increased or decreased. It is also desirable to defrost the evaporator periodically when it is operated at freezing temperatures.

It is an object of my invention to provide a control for individual evaporators which will control the amount of refrigeration provided according to environment or box temperature by a snap acting mechanical control acting upon a valve.

It is another object of my invention to provide an evaporating means for cooling a medium in which the expansion valve is cycled within limits governed by evaporator temperature and/or the temperature of the medium cooled.

It is still another object of my invention to provide a means for closing an expansion valve when the temperature of the medium cooled reaches a predetermined low temperature and to open the valve when the evaporator reaches a predetermined high temperature which is sufficiently high to provide defrosting of the evaporator.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form of the present invention is clearly shown.

In the drawing:

The figure illustrates a diagrammatic refrigerating system provided with an expansion valve embodying one form of my invention.

Briefly, I have disclosed a refrigerating system in which a thermostatic automatic expansion valve has an additional snap-acting control added thereto which moves the valve to closed position when the medium cooled reaches a predetermined low limit and which allows the valve to open when the evaporator reaches a predetermined high temperature limit sufficient to insure defrosting.

Referring now to the drawing, there is shown a motor-compressor unit including a compressor 20 driven by an electric motor 22 for withdrawing evaporated refrigerant from an evaporating means 24 through a suction conduit 26. From the compressor 20 the compressed refrigerant is forwarded to a condenser 28 where it is liquefied and collected in a receiver 30. From the receiver 30, the liquid refrigerant is forwarded through a liquid supply conduit 32 to an expansion valve generally designated by the reference character 34 which controls the supply of liquid refrigerant into the evaporating means 24. The evaporating means 24 and the expansion valve 34 are located within an insulated compartment designated by the dot and dash line 36. This compartment contains a medium such as air which is to be cooled by the evaporating means 24. The evaporating means 24 is merely indicated diagrammatically and may represent any style of evaporating means. Normally, such evaporating means will be of the cross-finned type with either forced draft or natural air circulation.

The expansion valve 34 includes an inlet 40 leading to a vertical passage 42, the lower end of which is provided with a valve seat bushing 44. The valve seat bushing 44 is provided with a passage leading to a valve seat which may be closed by the valve needle 46. This valve needle 46 is provided with a tapered collar 48 which is normally held against its seat within the valve guide member 50 by a light compression type coil spring 52 which is retained within the valve guide 50. A compression type coil spring 54 is located beneath the valve guide 50 and tends to hold the valve needle 46 against its valve seat to keep the expansion valve 34 closed. This coil spring 54 is adjusted by a spring retainer 56 which is threaded upon an adjusting screw 58 rotatably mounted in a nipple 60 provided upon the lower end of the valve housing 62.

The valve needle 46 is normally held slightly open by a bellows 64 which is provided at the upper end of the valve housing 62. The lower rim of this bellows 64 is sealed to a flange 66 provided upon the valve housing to which is also sealed the rim of a cap member 68 which surrounds the bellows 64 and provides a thermostatic chamber 70 therebetween. This thermostatic chamber is connected by a tube 72 to a thermostat bulb 74 located adjacent the outlet of the evaporating means 24. Preferably, the thermostat bulb 74 is filled with activated charcoal of some suitable grade, and the chamber 70 as well as the tubing 72 and the bulb 74 are also

charged with a suitable gas, such as carbon dioxide, which will be adsorbed and evolved from the activated charcoal in the bulb 74 according to temperature changes at the outlet of the evaporating means 24.

This control tends to maintain the evaporating means 24 substantially filled with liquid refrigerant. Within the bellows 64 is a pressure chamber 76 which is provided with access to the outlet side of the expansion valve through the passage 78. In this way, the interior of the bellows 64 is subject to the pressure of the refrigerant within the expansion valve 24. The bellows 64 is connected to the valve guide 50 by three symmetrically positioned operating pins 80 in order to move the valve needle 46 to open position. This portion of the valve is conventional in its general aspects.

At the side of the valve housing 62, I provide a mechanical control which is superimposed upon the valve in order to control the evaporator 24 according to the temperature of the medium within the compartment 36. In order to do this, I have provided a flexible diaphragm 82 at one side of the expansion valve. This diaphragm 82 has its edge portions clamped between a bead provided upon the valve housing 62 and the face of a supplementary housing 84. This diaphragm 82 carries a lever having an arm 86 extending upon one side of the diaphragm 82 into the interior of the valve guide 50 so that its end is in a position to engage the lower end of the valve needle 46 in order to forcibly move the valve needle 46 to closed position against the tension of the spring 52 regardless of the position of the valve guide 50.

The other end of this lever has an arm 88 which surrounds a thimble 90, slidably mounted within a cylindrical passage provided in the supplementary housing 84. This lever arm 88 is provided with a projection 92 which engages the lower rim of a collar 94 which is slidably mounted upon the thimble 90. The upper end of the thimble 90 is provided with a flange 96 which serves as a stop to retain the collar 94 on the thimble 90 for the purpose of providing a lost motion or one-way connection between the thimble 90 and the collar 94. The collar 94 is provided with a snap action mechanism including a set of toggle pins 101 which are seated at one end in notches provided in the collar 94 and seated at their other end in pivoted arms 103 which are connected by the transverse bars 105 and a pair of tension coil springs 107 extending between the ends of the bars and provided with adjusting nuts 109. Through this adjustment, the snap acting mechanism may be adjusted to increase or decrease its differential.

The thimble 90 has an inner flange which receives the lower end of a compression type coil spring 111. The upper end of this compression type coil spring is supported by a spring retainer which is provided at the lower end of an adjusting screw 113. This adjusting screw 113 is provided within a plug 115 threaded into the supplementary housing 84 and closed by a cap screw 117. The lower end of the thimble 90 is held by the spring 111 against the closed end of a flexible metal bellows 119 having its open end sealed to the flange 121 provided upon the housing 84. A cap member 123 surrounds the bellows 119 and has its rim sealed to the flange 121. This provides a thermostatic chamber 125 between the bellows 119 and the cap 123. This thermostatic chamber is connected by the tubing 127 to a thermostatic bulb 129 located in the medium to be cooled at some point which is most likely to respond rapidly to the temperature of the medium. As shown, it is located beneath the evaporating means 24 so that it will be in the path of the air circulation. Preferably, this bulb 129 is also filled with some grade of activated charcoal and the bulb, tubing and the thermostat chamber 125 are charged with some suitable gas such as carbon dioxide.

At the end of the supplementary housing 84 there is provided a second bellows mechanism including a bellows 131 having its open end sealed to a flange 133 provided on the housing 84. Surrounding this bellows 131 is a cap member 135 having its rim likewise sealed to the flange 133. This provides a thermostatic chamber 137 between the bellows 131 and the cap member 135 which is connected by the tubing 139 to the thermostat bulb 141 which is preferably clamped to that portion of evaporating means 24 at which the frost disappears last when the expansion valve 34 is closed. This bulb 141 preferably is likewise filled with some suitable grade of activated charcoal and the bulb 141, the tubing 139 and the chamber 137 are charged with a suitable gas such as carbon dioxide.

The bellows 131 is acted upon by a thimble 143 held against the bellows by a compression type coil spring 145 which has its tension adjusted by an adjusting screw 147, threaded into the plug 149. This plug 149 is threaded into the housing 84 and is sealed by a cap screw 151. The thimble 143 is provided with a flange 153 at its lower end which bears upon a pair of levers 155 having their opposite ends bearing upon a flange provided upon the collar 94.

With this arrangement, when the temperature of the medium within the compartment 36 reaches a predetermined low temperature, the bulb 129 is cooled sufficiently to allow the thimble 90 to move downwardly carrying the collar 94 across the dead-center position of the snap acting mechanism to the position shown in the figure. In this position, the lower flange of the collar 94 is shown resting upon the projection 92 of the lever arm 88. The lever, constituting the lever arms 86 and 88, has been pivoted in a counter-clockwise direction with the diaphragm 82 as its pivot point. This causes the end of the lever arm 86 to bear firmly against the lower end of the valve needle 46 in order to hold it in closed position. This shuts off the supply of refrigerant to the evaporating means 24, thus allowing the temperature of the evaporating means 24 to rise and to gradually reduce the amount of refrigeration provided. This will arrest the fall in temperature of the medium within the compartment 36 and will cause this temperature to rise slowly.

As the temperature of the medium within the compartment 36 rises, the pressure within the thermostatic chamber 125 will gradually increase in accordance with the temperature of the bulb 129. This, however, will not produce any movement since it will merely cause the flange 96 on the thimble 90 to move away from the collar 94. However, at the same time, the temperature of the thermostat bulb 141 will gradually increase, thereby increasing the pressure within the thermostatic chamber 137. This pressure, however, will be opposed by the compression spring 145 and the snap action mechanism which has a certain differential to which it has been adjusted.

The tension of the spring 145 is so adjusted that when the temperature of the bulb 141 reaches about 34° or 35° F., the pressure within the chamber 137 will be sufficient to force the thimble 143 downwardly to move the levers 155 in a counter-clockwise direction so that their opposite ends will raise the collar 94 and throw it across the dead-center position of the snap action mechanism. This will release the lever 86, 88 so that it can pivot in a clockwise direction under the influence of the light compression spring 157 to release the valve needle 46 and allow the expansion valve 34 to operate normally without interference from the supplementary control until the medium again reaches the predetermined low temperature limit.

In this way, the evaporating means is cycled by the open and closed periods of the expansion valve which is closed when the medium reaches a predetermined low temperature, and which is opened when the evaporator reaches a defrosting temperature. The temperature at which the valve is closed is adjusted by the adjusting screw 92 which may be reached by removing the cap nut 117 while the evaporator defrosting temperature may be adjusted by adjusting the screw 147 which may be reached by removing the cap screw 151. Thus, by this mechanical mechanism which I have added to the expansion valve, I have provided intermittent defrosting together with a control of the temperature of the medium. The expansion valve is open as long as is necessary to bring the temperature of the medium to the low limit, and is closed as long as is necessary to insure defrosting.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. Refrigerating apparatus including liquefying and evaporating means, a medium to be cooled, said evaporating means being located in heat exchange relation with said medium, valve means for controlling circulation of refrigerant between the liquefying and the evaporating means, mechanical closing means responsive solely to the temperature of the medium for mechanically closing said valve means, and mechanical means responsive solely to the temperature of a portion of the evaporating means for mechanically releasing said mechanical closing means.

2. Refrigerating apparatus including refrigerant liquefying and evaporating means, an expansion valve for controlling the flow of refrigerant from the liquefying means to the evaporating means, a medium to be cooled, said evaporating means being located in heat exchange relationship with said medium, said expansion valve including normal control means responsive to the refrigerant in the evaporating means for normally controlling the operation of the valve, an additional independent closing means independent of the normal control of the valve responsive to the temperature of said medium for overcoming the normal control of the valve to close the valve, and means responsive to the temperature of a portion of said evaporating means for releasing said closing means.

3. Refrigerating apparatus including refrigerant liquefying and evaporating means, an expansion valve for controlling the flow of refrigerant from the liquefying means to the evaporating means, a medium to be cooled, said evaporating means being located in heat exchange relationship with said medium, said expansion valve including normal control means responsive to the refrigerant in the evaporating means for normally controlling the operation of the valve, an additional independent closing means independent of the normal control of the valve responsive to the temperature of said medium for overcoming the normal control of the valve to close the valve, snap acting means for controlling said closing means, and means responsive to the temperature of a portion of said evaporating means for overcoming said snap acting means and releasing said closing means.

4. Refrigerating apparatus including refrigerant liquefying and evaporating means, an expansion valve for controlling the flow of refrigerant from the liquefying means to the evaporating means, a medium to be cooled, said evaporating means being located in heat exchange relationship with said medium, said expansion valve including normal control means responsive to the pressure of the refrigerant in the evaporating means and to the temperature of the refrigerant adjacent the outlet of the evaporating means for normally controlling the operation of the valve, an additional independent means independent of the normal control of the valve for overcoming said normal control of said valve to provide a closing function and an opening function including means responsive to the temperature of said medium for cotrolling one of said functions and means responsive to evaporator temperature for controlling the other of said functions.

5. Refrigerating apparatus including refrigerant liquefying and evaporating means, an expansion valve for controlling the flow of refrigerant from the liquefying means to the evaporating means, a medium to be cooled, said evaporating means being located in heat exchange relationship with said medium, said expansion valve including normal control means responsive to the pressure of the refrigerant in the evaporating means and to the temperature of the refrigerant adjacent the outlet of the evaporating means for normally controlling the operation of the valve, an additional independent means independent of the normal control of the valve for overcoming said normal control of said valve to provide a closing function and an opening function, snap-acting means for controlling said independent means, said independent means including means solely responsive to the temperature of said medium for controlling one of said functions, and means solely responsive to evaporator temperature for controlling the other of said functions.

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