

Oct. 21, 1958

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2,856,759

REFRIGERATING EVAPORATIVE APPARATUS

Filed Sept. 26, 1955

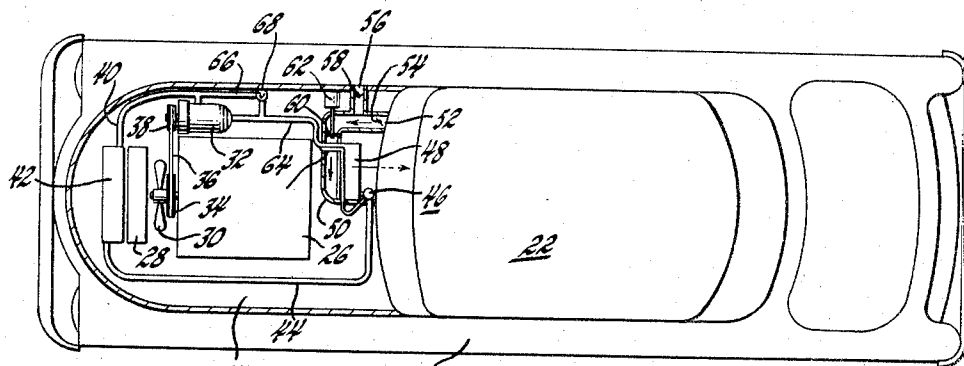


Fig. 1

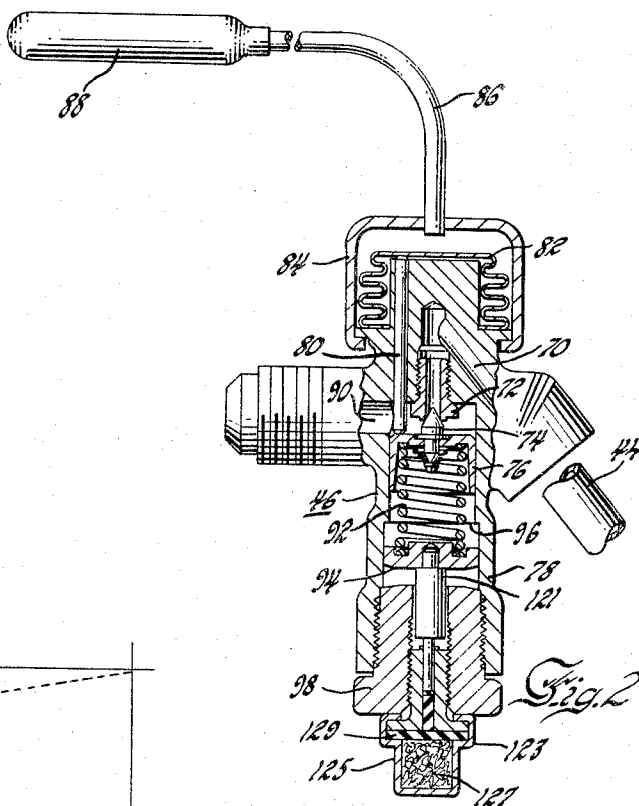


Fig. 2

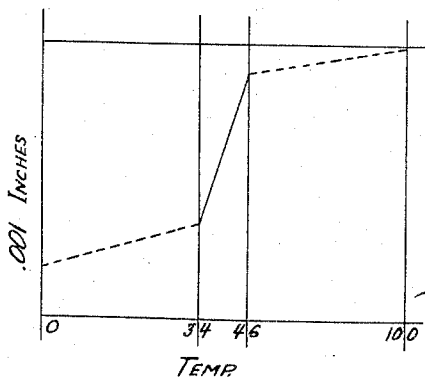


Fig. 3

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REFRIGERATING EVAPORATIVE APPARATUS

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Application September 26, 1955, Serial No. 536,477

1 Claim. (Cl. 62—211)

This invention relates to refrigerating apparatus and more particularly to the control of the flow of refrigerant into the evaporator means.

In automotive air conditioning means there is a considerable problem in maintaining maximum efficiency of evaporation and yet preventing frosting or icing of the evaporating means. One of the major contributing factors is the driving of the compressor according to the car speed instead of operating it in accordance with refrigerating requirements as is customary in other installations.

It is an object of this invention to provide an inlet control for air conditioning evaporator means which will maintain maximum evaporating efficiency without frosting or icing of the evaporator means.

It is another object of this invention to provide such an inlet control which will provide increased flow of refrigerant when the medium is cooled below a preselected temperature.

These and other objects are obtained in the form shown in the drawings in which the expansion valve is located in the outlet air stream of the evaporating means. The expansion valve is provided with the usual diaphragm valve opening means subject to the pressure created by the thermostat bulb located at the evaporator outlet and the pressure within the outlet of the valve. In addition, the valve is provided with an enclosure containing a temperature responsive medium which is effective below a certain temperature to reduce the tension of the valve closing spring to increase the refrigerant flow to raise the back pressure within the evaporator means as the medium is cooled below a predetermined temperature.

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

In the drawings:

Figure 1 is a diagrammatic view of an automobile provided with an air conditioning system embodying one form of my invention;

Figure 2 is a sectional view through the expansion control located in the outlet air stream; and

Figure 3 is a graph showing the characteristics of the temperature responsive element.

Referring now to the drawings and more particularly to Figure 1, there is shown diagrammatically, an automobile 20 having a passenger compartment 22 and an engine compartment 24. The engine compartment contains an internal combustion engine 26 having the customary cooling radiator 28 and a fan 30 driven by the engine for drawing air through the radiator. The engine is connected through a transmission to the rear wheels of the automobile in the customary manner. At one side of the engine 26 there is a refrigerant compressor 32 driven by a pulley 34 connected to the crankshaft of the engine. The pulley 34 through a belt 36 is connected to a pulley 38 upon the drive shaft of the compressor

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32. The compressor 32 is provided with an outlet connected by a conduit 40 with a condenser 42 located immediately in front of the radiator 28 wherein the compressed refrigerant is condensed. The condensed refrigerant is conducted from the outlet of the condenser 42 through a liquid line 44 to my improved expansion control 46.

This expansion control 46 connects to the inlet of an air conditioning evaporating means 48 which is located in an air duct 50 discharging into the passenger compartment 22. The air duct 50 has an inlet 52 communicating with the passenger compartment 22 and provided with a control damper 54. The air duct 50 has a second inlet 56 connected with the outside air provided with a control damper 58. These two inlets connect directly with a chamber containing a fan 60 operated by an electric motor 62 which draws the air in through the inlets 52 and 56 and forces the air through the evaporating means 48 into the passenger compartment 22. The expansion control 46 is located between the evaporating means and the passenger compartment 22 in the air duct 50.

The outlet of the evaporating means 48 is connected to the suction conduit 64 connecting with the inlet to the compressor 32. A bypass conduit 66 provided with a control valve 68 provides a connection between the compressor outlet and the suction conduit 64 whenever it is desired to reduce the flow of refrigerant through the evaporating means 48.

Referring now more particularly to Figure 2, the liquid line 44 connects to the inlet passage 70 in the control 46. The inlet passage 70 connects to the opening in a valve seat member 72 which is closed wholly or partially by a needle valve 74. The needle valve 74 is supported by a cup-shaped slide member 76 which is slidably mounted within the cylindrical portion 78 of the valve body. This cup-shaped member 76 is operably connected by three push pins 80 to the movable end wall of a bellows 82, the skirt of which is sealed to the valve body 46. A cap 84 encloses the bellows 82 and is likewise sealed to the valve body 46. The interior of this cap member 84 is connected by a capillary tube 86 to a thermostat bulb 88 which is connected to and responsive to the temperature of the suction line at the outlet of the evaporating means 48. Preferably, this bulb contains activated charcoal and it and the capillary tube 86 as well as the cap 84 are charged with a gas such as carbon dioxide which is non-condensable under the temperature conditions and which is adsorbed and evolved from the bulb 88 in accordance with temperature changes of the bulb 88 and the adjacent portions of the suction conduit 64.

When the valve 74 is opened, the fluid discharges directly into the outlet passage 90 in the valve which connects directly with the suction conduit 64. The push pins 80 pass through this passage 90 into contact with the cup member 76. The push pins 80 are sufficiently loose in the passage that the refrigerant may flow from the outlet passage up into the interior of the bellows 82 so that the interior of the bellows will be responsive to the pressure in the outlet passage 90. This pressure will be opposed by the pressure within the cap member 84 outside the bellows 82. Beneath the cup member 76 is a compression type coil spring 92 which urges the valve needle 74 to closed position and keeps the push pins 80 in contact with the closed end of the bellows 82. This spring 92 extends between the cup member 76 and a spring retainer 94 which is slidably mounted within the lower part of the cylindrical portion 78. The spring retainer 94 is limited in its upward movement by the shoulder 96 and in its downward movement by a plug 98 which is threaded into the bottom of the portion 78.

According to my invention this spring retainer 78 is connected by a follower 121 (which is slidably mounted in the plug 98) to the temperature responsive element 123. This temperature responsive element 123 is threaded into the interior of the plug 98. It includes an enclosure 125 containing a temperature responsive material 127 having temperature responsive characteristics of the character shown in the graph in Figure 3. As shown, this material 127 slowly contracts as the temperature is reduced until a temperature of about 46° is reached. Between 46° and 34° this material fuses and has an unusually rapid contraction but below 34° a normal rate of contraction is resumed. Above the material 127 in the element 123 is a soft rubber-like material 129 of some suitable soft natural or synthetic rubber. This material 129 acts as a hydraulic system to force the follower 121 upwardly or downwardly in accordance with the expansion or contraction of the material 127. As shown, the follower 121 has a pin extending downwardly into the coaxial passage provided in the threaded portion of the element 123.

Since the expansion control 46 is located in the outlet air stream of the evaporating means 48, it will be cooled by the air which has passed through the evaporating means. As long as the temperature of the air discharged from the evaporating means is above 46° the material 127 will be considerably expanded, thereby forcing the spring retainer upwardly to increase the tension of the valve closing spring 92 in order to lower the pressure in the outlet chamber 90 which has the effect of lowering the evaporating temperature within the evaporating means 46. This has the effect of providing cooler air for the compartment 22. When the air is cooled below 46° the material 127 will begin to contract at an abnormal rate to allow the follower 121 and the spring retainer 94 to move downwardly under the force of the spring 92, thereby reducing the tension of the spring 92. This reduces the force tending to hold the valve needle 74 in the closed position and thereby increases the pressure in the outlet passage 90. This increase in pressure raises the evaporating temperature and thereby tends to prevent freezing or frosting of the evaporator means 46. As the air becomes colder, the material 127 will contract more, thereby raising the evaporating temperature within the evaporator 48 still more so that frosting and icing will be prevented.

As one example of the material 127, I specify oleic acid and copper dust. These materials may be diluted or modified by other materials to obtain the characteristics shown in Figure 3. Any materials which fuse

and have an abnormally large rate of expansion within or near the range specified may be used if desired, such as p-dibromobenzene or bromoform intimately mixed with powdered or flaked copper.

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, as may come within the scope of the claim which follows.

What is claimed is as follows:

- 10 Refrigerating apparatus including an evaporating means having an inlet and an outlet, guiding means for guiding a medium to be cooled into heat exchange relation with said evaporating means and away from said evaporating means, an expansion control located within said
- 15 guiding means in said medium connected to the inlet of said evaporating means for controlling the flow of refrigerant into the evaporating means, said control comprising a valve provided with an operating diaphragm means having a first diaphragm area exposed and responsive to the pressure of the refrigerant within the evaporating means and a thermostat bulb connected to and responsive to the temperature of the outlet of the evaporating means provided with a fluid operating connection with a second diaphragm area located in opposed
- 25 relation to the first area of said diaphragm means, said valve being also provided with an operating connection with said diaphragm means for opening said valve in response to decreasing pressures in said evaporating means and increasing bulb temperatures, said control also
- 30 having an additional thermosensitive actuating means located in and responsive to the medium guided away from the evaporating means within said guiding means having an abrupt enlarged actuation only in the temperature zone immediately above 32° F., said actuating
- 35 means being operatively connected to said valve to increase the opening of said valve as the temperature of the medium guided away from the evaporating means is lowered into said temperature zone to prevent the lowering of the temperature of the evaporating means
- 40 below 32° F.

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