

April 21, 1936.

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2,038,153

REFRIGERATING APPARATUS

Filed March 30, 1929

2 Sheets-Sheet 1

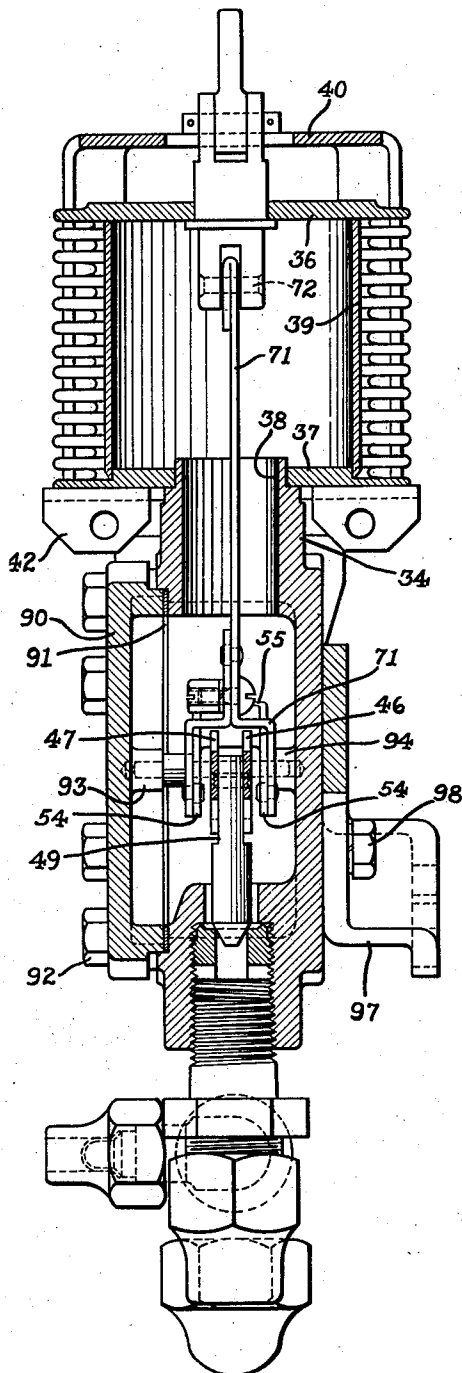


Fig. 3

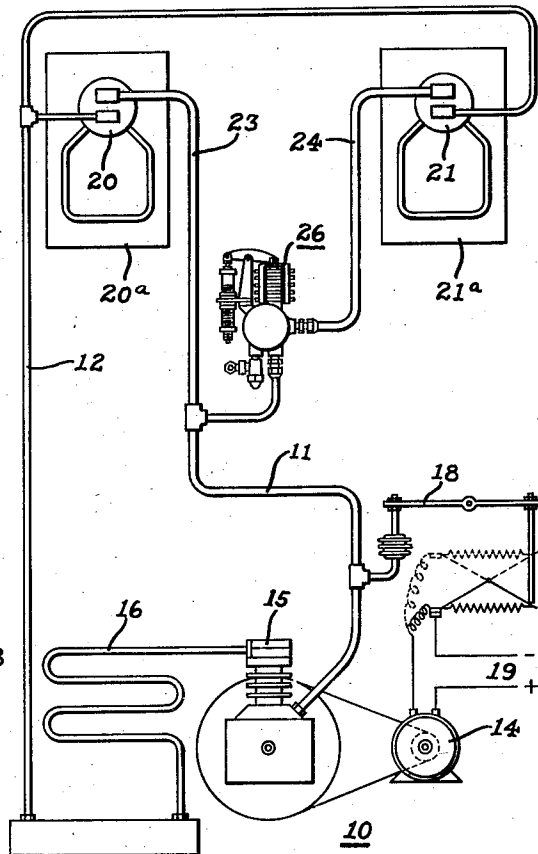


Fig. 1

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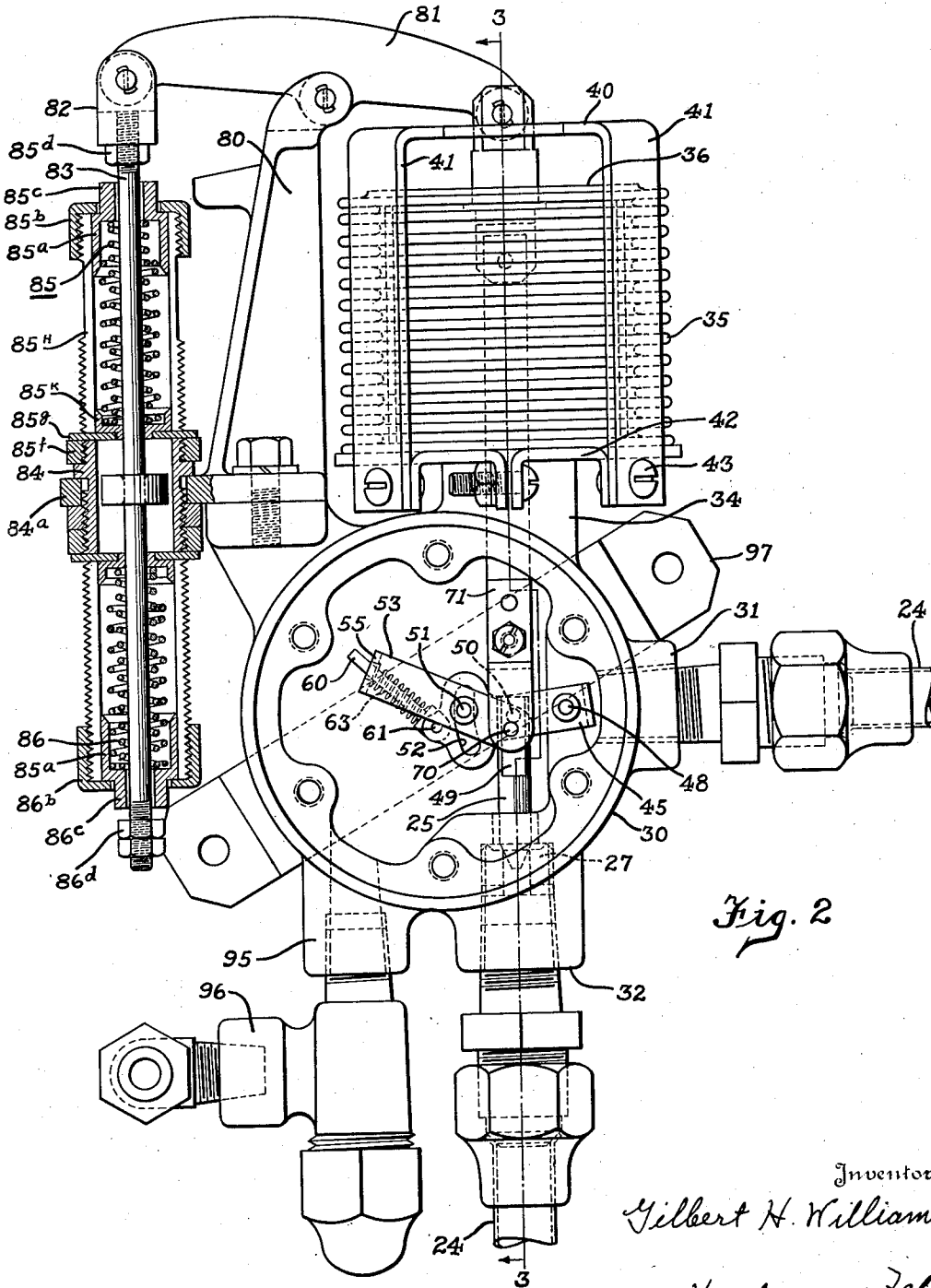


Fig. 2

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## UNITED STATES PATENT OFFICE

2,038,153

## REFRIGERATING APPARATUS

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mesne assignments, to General Motors Corpo-  
ration, a corporation of Delaware

Application March 30, 1929, Serial No. 351,363

5 Claims. (Cl. 137—153)

This invention relates to refrigerating apparatus and particularly to arrangements for controlling the circulation of refrigerant in such apparatus.

One of the objects of the invention is to provide an improved control system particularly adapted to multiple installations which automatically prevents the circulation of refrigerant in such unit or units of the system as do not need refrigeration.

Another object of the invention is to provide an improved refrigerating system in which one condensing element supplies a number of evaporating elements with refrigerant and automatically maintains each of them within predetermined temperature limits independent of the remaining elements.

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 form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatic representation of one form of refrigerating system embodying my invention.

Fig. 2 is a sectional view showing the construction of a control valve of the system, and

Fig. 3 is a section on the line 3—3 of Fig. 2.

It has previously been proposed to provide a number of evaporators which are supplied with refrigerant from a common condensing element and to operate the system so as to maintain the different evaporators at different temperatures. In the previously known systems of this character the different evaporators are not entirely independent of each other and the condensing element does not circulate refrigerant through the various evaporators in accordance with the refrigerating demand upon each. The difficulties experienced have been the more pronounced in cases in which it is sought to maintain widely different temperatures. My invention is concerned with providing a simple, economical and reliable system which will satisfactorily maintain widely different temperatures and in which the various refrigerating elements are operated independently of one another.

Referring to the drawings 10 designates in general a condensing element for withdrawing gaseous refrigerant from a vapor conduit 11, liquefying the refrigerant and delivering it to a liquid supply conduit 12. The condensing element may be of any desired type, for example it may include the usual motor 14, compressor 15 and con-

denser 16, the motor being actuated in response to the pressure within the conduit 11 by means of an automatic switch 18 which connects the motor to power mains 19. Evaporators 20 and 21 are connected in parallel between the liquid supply conduit and the vapor exhaust conduit 11 for cooling compartment 20a and 21a. The evaporators are connected to the conduit 11 by means of independent outlet conduits 23 and 24. Preferably each of the evaporators is of the flooded type and includes a reservoir for liquid refrigerant which is kept at a constant level therein by means of a float valve, not shown herein but fully disclosed in the patent to Osborn, 1,556,708, October 13, 1925. Since the evaporators are of the flooded type, the pressure of the refrigerant in each will correspond to its temperature. Assuming that the evaporator 21 is to be kept at the higher temperature and pressure, I place in the outlet of this evaporator a shut-off valve 26, the construction of which is illustrated in Figs. 2 and 3.

A valve casing 30 having an inlet 31 and an outlet 32 is connected in the conduit 24. Within the casing is a removable valve seat 27 and a valve proper 25 which is either raised to permit unrestricted communication between the inlet and outlet, or else is lowered against the seat to positively close the outlet, by means about to be described. The casing 30 is provided with a boss 34 to which is sealed the open end of a flexible metal bellows 35, the other end of which is closed in any suitable manner. Preferably the bellows is closed at its upper end by a cap 36 soldered to the bellows and its lower end is soldered to an end cap 37 secured to the boss 34 in any suitable manner, the boss having an opening 38 to provide communication between the bellows and the casing 30. Undue contraction of the bellows is prevented by a stop formed by a rigid tube 39 secured to the lower end cap 37 against which the upper end cap rests when the bellows is contracted. Undue expansion of the bellows is prevented by a cage including a stop member 40 adapted to limit upward movement of the cap 36, and arms 41 which cooperate with members 42 and screws 43 to clamp the cage to the cap 37. The bellows forms a motor for operating the valve 25 in response to the pressure within the casing 30.

A link 45 consisting of a pair of spaced cheeks 46 and 47 (see Fig. 3) is pivoted to a stationary pin 48 supported by the side walls of the casing 30. The valve stem 25 has a flattened portion 49 which is inserted between the cheeks 46 and 47 of the

link 45 and is pivoted thereto by a pivot pin 50. A second stationary pin 51 is supported by the side walls of the casing and passes thru an arcuate slot 52 near the other end of the link 45. The link may be rotated about the pivot 48 between two positions defined by the ends of the slot 52 and pin 51. A U shaped member 53 consisting of a pair of spaced cheeks 54 joined by a bridge member 55 forms a second link, pivoted to the pin 51, the cheeks 54 and 55 lying outside of the link 45. The link 53 is connected to the free end of the link 45 by means of a spring guide 60, which is pivoted at 61 to the link 45 and passes thru bridge member 55, and a compression spring 63 placed around the spring guide between the bridge 55 and the link 45. The link 53 extends beyond the pivot 50 and is connected at its free end by means of pivots 70 to the bifurcated end of a bar 71 which extends into the bellows 35 and is pivoted at 72 to the upper end cap 36.

The apparatus above described constitutes a snap acting mechanism for operating the valve 25 in response to the pressure within the casing 30. Fig. 2 shows the positions of the parts when the pressure is low and the valve has closed. When the pressure is low the bellows is contracted against the stop 39 and holds the rod 71 against further downward movement. In this position the valve 25 is positively closed by the pressure of the spring 63 between the link 45 and the link 53, held stationary by the rod 71. As the pressure increases the bellows expands and moves the rod 71 upward. This rotates the link 53 counter clockwise about the pivot 51 further compressing the spring 63 between the bridge member 55 and the link 45. This compression of the spring urges the link 45 downwardly and thus holds the valve 25 seated until the bellows rotates the link 53 so that the spring guide 60, pivot 61 and pivot 70 are in alignment. At this point the spring is under maximum compression and any further expansion of the bellows, however slight, carries the spring guide out of alignment with the pivots 61 and 70. This permits the spring to expand and throw the link 45 abruptly upward until stopped by the pin 51 in the lower end of the slot 51. This abruptly opens the valve 25. The valve being open the pressure is high as the pressure is reduced by the compressor 15 the bellows contracts to move the rod 71 downward. At a predetermined low pressure the bellows carries the spring thru its point of maximum compression in the opposite direction and snaps the valve closed. The valve is held positively closed by the tension of the spring 63 acting as before explained.

In order to adjust the pressure value at which the valve operates I provide adjustable means for resisting the movement of the bellows in each direction. Referring to Fig. 2, the casing 30 carries a support 80 to which is pivoted a lever 81, one end of which is pivoted to the bellows cap 36 and the other end of which carries a link 82 which supports a rod 83. A spring barrel 84 is secured to an extension 84a the support 80 and the rod 83 passes thru the spring barrel. Springs 85 and 86 under compression act upwardly and downwardly respectively with respect to the support 84a on plungers 85a and 86a respectively. The springs are confined to the barrel by means of screw caps 85b and 86b respectively which enclose the plungers but permit reduced portions 85c and 86c of the plungers to protrude beyond the caps. The rod 83 passes thru the plungers and springs and is provided adjacent each reduced portion of the

plungers 86c and 85c with nuts 85d and 86d respectively.

Upon a predetermined expansion of the bellows the nut 85d contacts with the portion 85c of the plunger 85a and the spring 85 resists any further movement of the bellows. The tension of the spring determines the value of the resistance which is offered to the movement of the bellows, that is it determines the value of pressure at which the bellows expands sufficiently to open the valve. The tension of the spring is determined by the position of a nut 85f threaded on the outside of the spring barrel 84. The nut supports a spring abutment 85g which protrudes thru slots 85h in the spring barrel and carries a spring cup 85k which in turn supports the spring 85. The spring may be any desired form of compression spring, but preferably a compound spring composed of two separate springs wound in opposite directions to prevent enmeshing of the convolutions, all as more fully disclosed in the application of Jesse G. King Serial No. 124,160, filed July 22, 1926. The spring 86 and its adjusting mechanism are in all respects the counterparts of the spring 85 and its adjusting mechanism just described, except that the spring 86 opposes closing of the valve and thus determines the pressure in the valve casing 30 at which the valve is closed. It will be observed that the means for adjusting the valve opening pressure is independent of the means for adjusting the valve closing pressure, since when the bellows is moving in one direction the means for resisting its movement in the other direction is inoperative.

The valve casing 30 is closed and hermetically sealed by a cover 90 and gasket 91 which are clamped to the casing by bolts, 92. The cover is provided with bosses 93, disposed opposite similar bosses 94 in the casing which form supports for the pins 48 and 51.

The valve casing also has a boss 95 forming a connection for a valve or fitting 96 which permits the ready attachment of a gauge. If desired a bracket 97 is attached to the back of the casing 30 by screws 98 and provides means for supporting the entire valve mechanism.

The automatic switch 18 is set to operate at low pressures corresponding to the temperatures to be maintained in the evaporator 20. Whenever the temperature of 20 is above the maximum permissible value, the pressure of the refrigerant will actuate the switch 18 to operate the condensing element. Under these conditions refrigerant will not be evaporated in the evaporator 21 unless the valve 26 is open. Whenever the valve is open, the condensing element will reduce the pressure and temperature of the evaporator 21 to its lowest permissible value (which is above the setting of the switch 18) at which point the valve will close to prevent further refrigeration in 21. If the evaporator 20 should at any time be within its normal temperature limits, and the condensing element consequently be idle, and the evaporator 21 should become too warm, the pressure in 21 will open the valve and allow the high pressure to be communicated to the conduit 11 and switch 18. Since this high pressure is above the value which closes the switch, the switch will be operated immediately to start the condensing element. Refrigerant will then be withdrawn from both evaporators until both have reached their minimum permissible temperature. If the evaporator 21 reaches its minimum temperature first, the valve 26 will

close to prevent further refrigeration, and the condensing element will continue to refrigerate the evaporator 20. If, however, the evaporator 20 should reach its minimum temperature first, the valve will remain open, and the pressure of the refrigerant evaporated in 21 will keep the switch open. However, since each evaporator contains a relatively large quantity of liquid refrigerant, whose pressure corresponds to its temperature, the rates of evaporation of the liquid will correspond with the pressures. Hence refrigerant will be evaporated rapidly in 21 and quickly reduce its temperature, whereas refrigerant will be evaporated but slowly in 20, and thus its temperature will not be reduced to a value appreciably below its normal minimum value.

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. Apparatus of the class described comprising in combination a snap valve, a pressure-responsive motor for opening and closing the valve, and means for controlling the opening and closing of the valve including a pair of compression springs in axial alignment, a rod connected to the motor and passing thru the springs, and abutment means on the rod adapted to compress either of said springs, said abutment means having a lost motion connection with said springs.

2. Apparatus of the class described comprising in combination a snap valve, a pressure-responsive motor for opening and closing the valve, and means for controlling the opening and closing of the valve including a pair of compression springs in axial alignment, a rod connected to the motor and passing thru the springs, and abutment means on the rod adapted to compress either of said springs, said abutment means having a lost motion connection with said springs, and means for adjusting the tension of each spring independently of the other spring with-

out affecting the space relation of the springs and abutment means.

3. Apparatus of the class described comprising in combination a snap valve, a pressure-responsive motor for opening and closing the valve, and means for controlling the pressures at which the motor opens and closes the valve including a slotted spring barrel, a pair of spring supports within the barrel and protruding thru the slots, a pair of resistance members protruding from the barrel, a pair of oppositely acting springs confined in the barrel each between a resistance member and a support, a rod secured to the motor and passing thru the springs and resistance members, an abutment on the rod for contacting with each resistance member, and means outside of the barrel for adjusting the position of the spring supports.

4. Apparatus of the class described comprising in combination a snap valve, a pressure responsive motor for operating the valve, and means for controlling the pressure at which the valve operates including a spring barrel, a spring support within and protruding from the barrel, a resistance member protruding from the barrel, a spring confined in the barrel between the support and resistance member, a member secured to the motor and adapted to contact with the resistance member, and means outside of the barrel for adjusting the position of the support.

5. A pressure operated fluid control means including a valve, a pressure responsive means for opening and closing the valve, snap acting means for controlling the opening and closing of the valve, a plurality of separately confined spring means, one acting upon the pressure responsive means solely during one portion of its movement and another acting upon the pressure responsive means solely during an entirely different portion of its movement, means for separately adjusting said one and said another separately confined spring means, and means for preventing the full expansion of the spring means.

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