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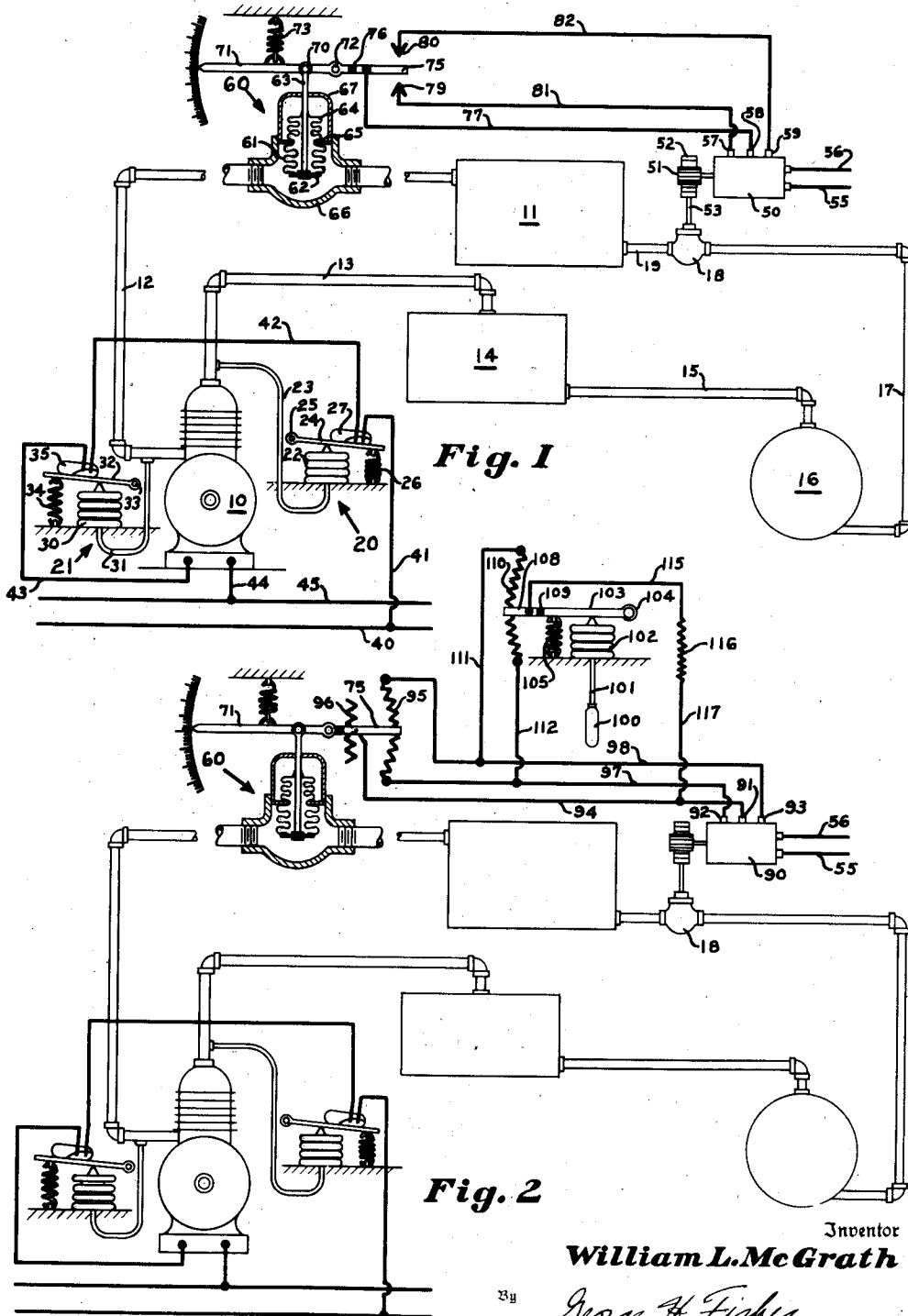
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2,195,220

REFRIGERATION SYSTEM

Filed Feb. 7, 1938

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

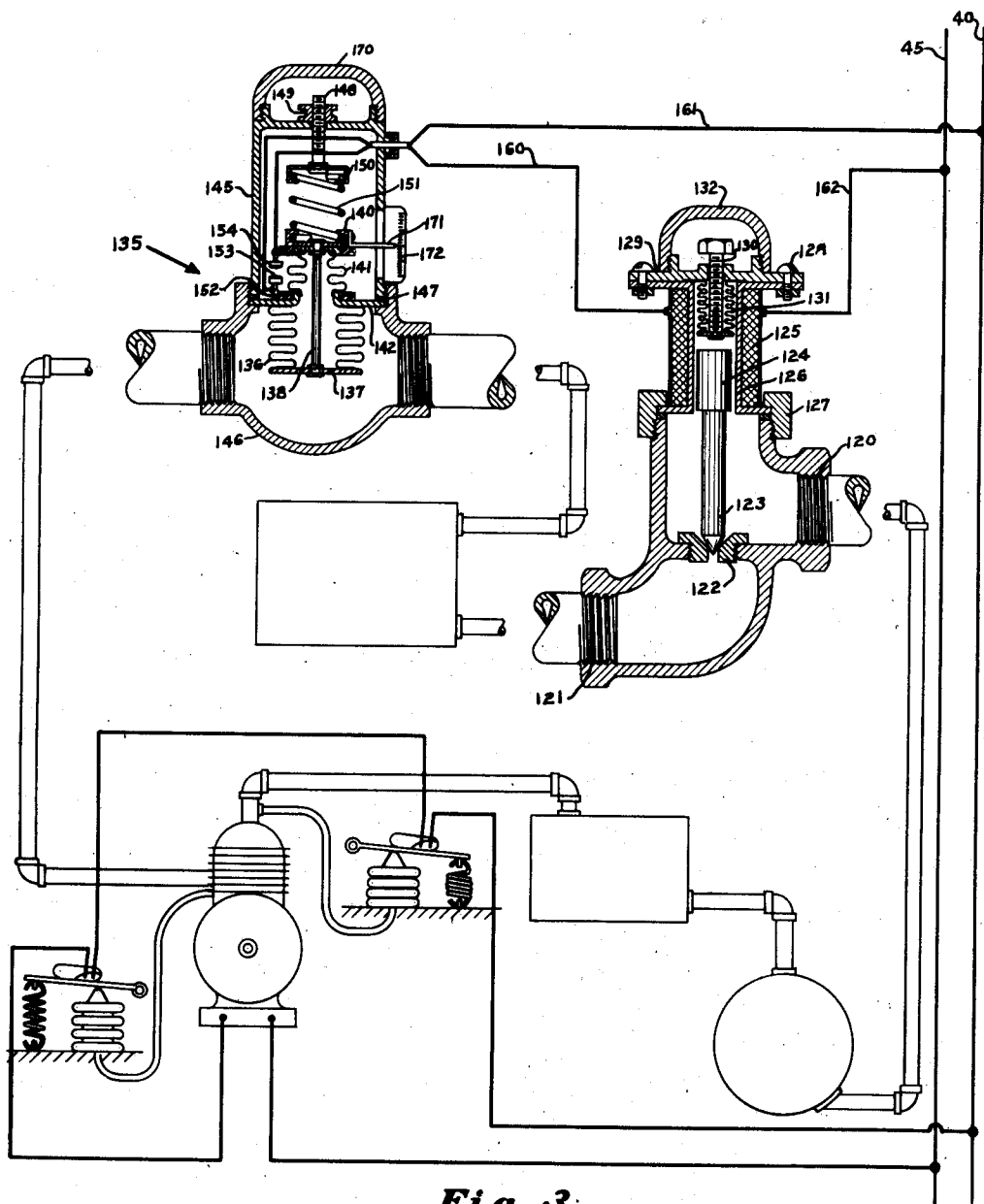


Fig. 3

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UNITED STATES PATENT OFFICE

2,195,220

REFRIGERATION SYSTEM

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15 Claims. (Cl. 62—8)

This invention relates to a refrigeration system and more particularly to means for operating the expansion valve commonly employed therein in accordance with the superheat existing at the outlet of the evaporator.

In order that a refrigeration system operate at a maximum efficiency the evaporator coils should contain liquid refrigerant throughout the major portion thereof, and this result may be obtained by operating the valve in accordance with a degree of superheat existing at the evaporator outlet.

The earliest expansion valves used in refrigeration systems were controlled by the pressure of the refrigerant at the inlet of the evaporator but this type of a control was not very successful in properly controlling the amount of liquid refrigerant contained in the evaporator. A diaphragm or bellows was provided to position the valve, this diaphragm or bellows responding to the pressure at the evaporator inlet. Subsequently the temperature existing at the evaporator outlet was also utilized in conjunction with the pressure at the evaporator inlet to control the position of the valve. The bellows for operating the valve was subjected on one side to the refrigerant passing into the evaporator, the other side of the bellows or diaphragm being connected by means of a capillary tube to a bulb filled with a volatile fluid and positioned on the evaporator outlet. This type of control proved more satisfactory than the earlier type when the valve was controlled solely by the pressure of the refrigerant entering the evaporator, but the superheat at the outlet of the evaporator was not accurately controlled since the pressure at the outlet of the evaporator is considerably lower than the pressure at the inlet of the evaporator to which the operating bellows or diaphragm was subjected due to the pressure drop through the evaporator. This is particularly true when refrigerant such as "Freon" or F-12 is used. Recently it has been the custom to seal-off the side of the bellows or diaphragm which was subjected to the refrigerant entering the evaporator and to connect this side of the bellows or diaphragm by what is known as an equalizer connection, or a tube connecting this side of the bellows or diaphragm with the evaporator outlet at a point closely adjacent the temperature bulb. In order that the side of the bellows or diaphragm which is connected by the equalizer connection to the evaporator outlet is not affected by the pressure of the incoming refrigerant, a packing gland is customarily employed which surrounds the stem by means of

which motion is transmitted from the operating bellows or diaphragm to the expansion valve. If this packing gland is sufficiently tight to prevent leakage of refrigerant therethrough from the inlet of the evaporator, a considerable change in the superheat at the evaporator outlet is required to cause operation of the valve. On the other hand if this packing is sufficiently loose so that the valve will respond to slight changes in superheat, it has been found that some leakage of refrigerant in this packing is inevitable so that the operating bellows or diaphragm will not accurately respond to the pressure at the evaporator outlet, but instead will respond to a pressure which is somewhere between the pressure at the evaporator inlet and the evaporator outlet. The result of this is that the valve does not respond as accurately as desired to changes in superheat at the outlet of the evaporator. This is particularly objectionable in commercial installations where very low evaporator temperatures must be maintained with the result that the degree of superheat available to operate the valve is very low.

Also, in large systems wherein a large valve is required to control the flow of refrigerant to the evaporator, the power required to operate the valve may be greater than is available with the conventional thermostatic expansion valve having a self contained operating unit.

In accordance with my invention I have successfully overcome these difficulties by providing a device which is remotely located from the expansion valve and is positioned in accordance with the amount of superheat existing at the evaporator outlet, and causing this device to position the valve as by an electrical means as for example, a motor directly connected to the valve, this motor being controlled by the remotely located device responsive to the superheat at the evaporator outlet. Since the only work that the superheat responsive device is required to do is to operate a controlling means such as an electrical circuit for the motor, the valve will accurately respond to very small changes in the degree of superheat at the evaporator outlet.

It is therefore an object of my invention to provide a refrigeration system wherein an expansion valve requiring a large amount of force to cause the operation thereof, is operated in accordance with the superheat at the evaporator outlet, the system being so arranged that the change of superheat required to operate the valve is maintained at a low degree.

More specifically, it is an object of my inven-

tion to provide an electrical operating means for a refrigeration expansion valve, and a self contained superheat responsive unit mounted within the evaporator outlet for controlling the electrical operating means.

A further object of my invention is the provision of an indicating means for indicating the degree of superheat of the refrigerant within said outlet, said means being operated by the same unit that controls the electrical operating means for the valve.

Other objects will become apparent upon a study of the specification, claims, and appended drawings, wherein like reference characters represent like parts in the various views, and in which

Figure 1 is a diagrammatic view of a refrigeration system illustrating one form of valve controlling means embodying my invention;

Figure 2 is a similar view illustrating a second form of valve controlling means, and

Figure 3 is a similar view illustrating a third form of valve controlling means.

Referring more specifically to Figure 1, the conventional compression type refrigeration system is illustrated. This system includes a compressor 10 for withdrawing refrigerant from evaporator 11 through a pipe 12, the refrigerant being compressed and then flowing through a pipe 13 to a condenser 14. The condensed refrigerant flows from the condenser 14 through pipe 15 to a receiver 16 whence it flows through pipe 17 to an expansion valve 18, and from this expansion valve the expanded refrigerant flows into the evaporator 11 through pipe 19.

The compressor 10 may be controlled in any well known manner and for purposes of illustration I have shown a high pressure cut-out 20 and a suction pressure controller 21. High pressure cut-out 20 may include a bellows 22 connected by means of a pipe 23 to the outlet of the compressor 10. A lever 24 pivoted at 25 is urged against the top of the bellows 22 by tension spring 26, lever 24 carrying a mercury switch 27. The suction pressure controller 21 may include a bellows 30 connected by means of a pipe 31 to the suction side of the compressor 10. Bellows 30 operates a lever 32 pivoted at 33, this lever being held against the upper portion of bellows 30 by means of a tension spring 34. A mercury switch 35 is carried by the lever 32. When the switches are in the positions illustrated, current flows through the compressor motor and the refrigeration system is in operation, the current flowing through the motor by means of the following circuit: from line wire 40, through conductor 41, mercury switch 27, conductor 42, mercury switch 35, conductor 43, through the compressor motor and through conductor 44 to a line wire 45. Line wires 40 and 45 may be connected to a suitable source of power (not shown). The compressor 10 will stop whenever the pressure on the high pressure side reaches an excessive value or when the pressure on the suction side drops to a low enough value, as will be apparent from the drawings.

Expansion valve 18 controls the flow of refrigerant from the receiver 16 to the evaporator 11 and a motor 50 is provided for operating the valve 18. A gear 51 is driven by the motor 50 and engages a rack 52 connected to valve stem 53 of the valve 18, and rotation of the motor in one direction or the other causes the opening or closing of the valve member 18. Power is conveyed to the motor 50 by means of line wires 55 and 56. Motor 50 may be a floating motor

of any suitable type and may comprise a pair of field windings, energization of one causing rotation of the motor in one direction and energization of the other causing rotation of the motor in the other direction. Terminals 57, 58, and 59 are provided on the motor and may be so connected to the field windings that when terminals 57 and 58 are connected together the motor 50 rotates in a direction to cause the valve to move towards closed position, and when terminals 58 and 59 are connected together the motor rotates in a direction to move the valve towards open position.

For controlling the direction of the rotation of the motor 50, a controller generally designated by the reference character 60 is provided, this controller being responsive to the degree of superheat at the outlet of the evaporator. This controller includes an operating bellows 61 mounted within the evaporator outlet and containing a volatile fill which may be the same as the refrigerant being used in the system. A plate 62 is connected to the bottom of the bellows 61 and a vertically extending rod 63 is connected to the plate 62. For preventing escape of refrigerant from the system about the rod 63, a sealing bellows 64 may be provided, this bellows being of smaller size than bellows 61. The operating bellows 61 and sealing bellows 64 may be connected to a plate 65 mounted in the enlargement 66 of the connection between the evaporator 11 and compressor 10. A cap member 67 may be provided for enclosing the sealing bellows 64. Rod 63 is connected at 70 to a lever 71 pivoted at 72. A spring member 73 biases the lever 71 in a clockwise direction. The opposite end of the lever 71 is formed of a suitable conducting material 75 insulated from the rest of the lever 71 by insulating material 76. Portion 75 of lever 71 is connected by means of a conductor 77 to the terminal 58 of the motor 50. Contacts 79 and 80 which are connected to the terminals 57 and 59 of the motor, respectively, by means of conductors 81 and 82 are arranged to be engaged by the portion 75 of the lever 71 upon the existence of certain conditions in the evaporator outlet, as will be hereinafter explained. Engagement of member 75 with contact 79 causes terminals 57 and 58 of the motor 50 to be electrically connected, whereupon the motor rotates in a direction to close the valve 18. Similarly, when member 75 engages contact 80, terminals 58 and 59 of the motor are connected together and the motor rotates in a direction to open the valve 18.

When the pressure at the outlet of the evaporator increases, an upward force is exerted on the bottom of the bellows 61, whereupon lever 71 tends to rotate in a clockwise direction. An increase in temperature at the outlet of the evaporator tends to expand the refrigerant sealed within the bellows 61 and thus a downward pressure is exerted on the bellows since bellows 61 is of larger size than bellows 64, and the lever 71 tends to rotate in the opposite direction. It will therefore be apparent that movement of lever 71 depends both upon the pressure of the refrigerant in the evaporator outlet and also upon the temperature of the refrigerant in the evaporator outlet. As the refrigerant becomes superheated, the force exerted downwardly on the bellows 61 becomes greater than the force exerted upwardly on the bellows, and the lever 71 tends to move in a counter-clockwise direction against the force of the spring 73, and after the

degree of superheat becomes high enough the lever 71 will move far enough so that the end 75 of the lever engages contact 80, whereupon motor 50 is energized and rotates in a direction to cause valve 18 to open thus allowing the passage of more refrigerant into the evaporator. As the amount of refrigerant passing into the evaporator increases, a large portion thereof becomes available for cooling purposes and the refrigerant leaving the evaporator becomes less superheated, whereupon the lever 71 tends to move in a clockwise direction and to break the circuit between terminals 58 and 59 of the motor 50, whereupon the motor and valve come to rest.

If the amount of refrigerant flowing through the evaporator is too high so that complete evaporation thereof does not take place within the evaporator, the refrigerant leaving the evaporator will be in a saturated state and as no superheat is available to move lever 71 in a counter-clockwise direction, the lever will rotate in the opposite direction until end 75 thereof engages contact 79, whereupon the motor rotates in a direction to cause the valve to move towards closed position.

In this manner, the position of the valve 18 is controlled in accordance with the superheat at the outlet of the evaporator and the major portion of the evaporator will be available for cooling purposes at all times.

In order to be able to ascertain what the degree of superheat of the refrigerant leaving the evaporator is at any time, an indicating scale is provided at the left end of the lever 71, this lever being pointed as illustrated and the scale being suitably graduated. The upper portion of the scale may represent a saturated condition of the refrigerant and the lower portion of the scale may indicate a condition of high superheat of the refrigerant. In this manner, lever 71 is utilized for controlling the operation of the motor 50 and also for indicating to the attendant at any time what the degree of superheat of the refrigerant leaving the evaporator is.

Referring now to Figure 2, a refrigeration system identical with that of Figure 1 is illustrated. In this figure, however, a different kind of motor for operating the valve 18 may be employed, this motor being represented by the reference character 90. This motor may be of the type illustrated in Patent No. 2,028,110 to D. G. Taylor issued on January 14, 1936, and may include a pair of opposed relay coils connected together at one end, the junction of these coils being connected to terminal 91 of the motor. The opposite ends of the coils may be connected to terminals 92 and 93, respectively. Motor 90 may also include a pair of field windings, one of these windings being energized when one of the relay coils becomes more highly energized than the other and causing the motor to rotate in one direction, and when the other relay coil becomes more highly energized the other field winding is energized and causes rotation of the motor in the opposite direction. The motor also includes a balancing potentiometer which causes the relay coils to be rebalanced after sufficient rotation of the motor.

Connected to the junction of the relay coils by means of a center tap resistance 96 and a conductor 94 is the portion 75 of lever 71, this lever being operated in the same manner as described in connection with Figure 1. The end 75 of the lever is arranged to move over a potentiometer resistance 95 as the degree of superheat of the refrigerant varies, this potentiometer coil being connected by means of conductors 97 and 98 to

terminals 92 and 93, respectively, and accordingly to the ends of the relay coils. Lines 55 and 56 are also connected to the ends of the relay coils and hence it will be seen that when portion 75 of lever 71 is in the mid position of the potentiometer coil 95, the relay coils within the motor will be equally energized. Upon upward movement of portion 75 of arm 71 over resistance 95, the coil connected between terminals 91 and 92 of the motor becomes the more highly energized coil and the motor is caused to rotate in a direction to cause the valve to move towards open position. After the motor has rotated an amount sufficient to cause the arm of the balancing potentiometer to move a distance sufficient to counteract the effect of the movement of the arm 75, the relay coils will again be equally energized, neither winding of the motor will be energized and the motor will come to rest. It is accordingly seen that the motor 90 will operate an amount proportional to the movement of arm 75 over resistance 95, or in other words, an amount proportional to the change in superheat of refrigerant in the evaporator outlet, whereby the degree of superheat may be maintained substantially uniform.

Mounted in the space being cooled is a bulb 100 containing a volatile fluid and being connected by means of a capillary tube 101 to a bulb 100 containing a volatile fill. An arm 103 pivoted at 104 is held against the top of bellows 102 by a spring 105. As the temperature within the space being cooled increases, the fluid within the bulb 100 expands and causes expansion of the bellows 102 and movement of the arm 103 upwardly. Conversely, as the temperature falls the arm 103 will move downwardly by reason of the contraction of the volatile fluid in the bellows 102. The arm 103 includes an end portion 108 electrically insulated at 109 from the rest of the arm 103, and the portion 108 is arranged to sweep over a resistance 110, this resistance being connected in parallel by means of conductors 111 and 112 to the potentiometer resistance 95. The portion 108 of the arm 103 is connected by means of a conductor 115, resistance 116, and conductor 117 to the conductor connecting terminal 91 of motor 90 and the member 75 of potentiometer 95. It will, therefore, be apparent that member 108 and resistance 110 form a potentiometer connected in parallel with the potentiometer 95. The provision of resistance 113 in the circuit connecting terminal 91 of the motor and arm 108 desensitizes this potentiometer. In other words, a greater movement of arm 108 over resistance 110 is required to give the same effect to the motor than a movement of arm 75 over resistance 95, so that the main controller for the motor is the superheat responsive device 60 and the potentiometer 110 operated by the space temperature responsive device produces a compensating effect on the motor. As the space temperature rises, the degree of superheat at the outlet of the evaporator should be reduced so that a greater portion of the evaporator coil is available for cooling purposes. This increase in temperature is accomplished by movement of arm 108 upwardly over resistance 110, which causes an increase in the energization of the relay coil connecting the terminals 91 and 92 of the motor whereupon the motor rotates in a direction to open the valve 18 until the effect of the movement of arm 108 over resistance 110 is balanced by the balancing potentiometer within the motor 90. This also shifts the control

range of potentiometer 95 downwardly, and the center tap resistance 96 insures that the width of the control range does not vary even though the position of the control range is shifted by potentiometer 110.

It will, accordingly, be seen that in this figure the valve 18 is controlled in the first place by the superheat in the outlet of the evaporator and is also controlled by the temperature in the space being cooled so that as the cooling requirements for the space increase the degree of superheat in the outlet of the evaporator will decrease thus making available for cooling purposes a greater portion of the surface of the evaporator.

In Figure 3 a refrigeration system similar to those of Figures 1 and 2 is illustrated. The expansion valve in this figure is shown in cross section, this valve including an inlet 120, an outlet 121, a valve seat 122, and a valve element 123 co-operating with the seat 122 for controlling the flow of refrigerant through the valve. The upper end of valve 123 is formed as an armature 124 which is located within a solenoid 125 and the position of the valve element 123 is controlled by the energization and deenergization of the solenoid 125. This solenoid may be wound on a cylindrical member 126 connected to the valve body by means of a nut 127. Mounted on top of the cylindrical member 126 by means of bolts 128 is a plate 129 and screw threaded within this plate is a bolt 130 which is enclosed by a sealing bellows 131, this sealing bellows being sealed at its upper end to the cylindrical member 126 in any suitable manner as by soldering it thereto. The lower portion of bolt 130 forms a limit for the upward movement of the valve element 123 thus limiting the amount of opening of the valve and by turning the bolt 130, the amount of opening of the valve may be varied as will be apparent. A cap member 132 may be screw-threaded to the plate 129 to enclose the top of the bolt 130.

A controller 135 responsive to superheat of the refrigerant leaving the evaporator is provided for controlling the energization of solenoid 125. This controller may include a power bellows 136 similar to the power bellows 61 of Figures 1 and 2 and sealed at the bottom to a plate 137, this bellows being mounted within the evaporator outlet and enclosing a volatile fill which may be the same as the refrigerant used in the system. Extending upwardly from plate 137 is a rod 138 connected at its upper end to a spring retaining assembly 140. A sealing bellows 141 is provided for sealing the upper end of this rod to a plate 142 to which the upper end of the power bellows 136 may be suitably connected. A housing 145 is screwed into the upper end of the enlargement 146 of the evaporator outlet and holds the plate 142 firmly in place, suitable packing 147 being provided to prevent leakage of refrigerant from the evaporator outlet. In the upper end of housing 145 is mounted a screw-threaded member 148 connected to a nut 149 supported by the exterior of the housing 145. The lower end of member 148 is connected to a spring retainer 150 and a tension spring 151 connected to the spring retainers 140 and 150 serves to urge the spring retainers towards one another. The downward movement of member 150 is limited by the nut 149 so that the spring 151 serves to contract the power bellows 136 and move the rod 138 upwardly.

Mounted on the plate 142 and suitably insulated therefrom by means of insulation 152 is a contact member 153. A second contact member suitably connected to the spring retainer assembly

140 and insulated therefrom is designated by the reference character 154. Contact 153 is connected by means of conductor 160 to the solenoid 125 and contact 154 is connected by means of conductor 161 to the line wire 40. The other end of solenoid 125 is connected by means of conductor 162 to the line wire 45. It will, therefore, be apparent that engagement of contacts 153 and 154 will close a circuit from the line wire 40 through the solenoid 125 and back to the line wire 45, thus energizing the solenoid and causing movement of valve member 123 to open position. Movement of the bellows 136 is effected in the same way as in Figure 1. Thus an increase in pressure in the evaporator outlet causes the bellows to contract whereas an increase in temperature at the evaporator outlet causes the volatile fill within the bellows 136 to expand and thus cause the bellows to move downwardly, this latter movement of the bellows being opposed by the spring 151. Thus when the degree of superheat at the evaporator outlet reaches a high enough value so that bellows 136 expands causing rod 138 to be moved downwardly thus moving contact 154 into engagement with contact 153, the solenoid 125 becomes energized thus opening the expansion valve and allowing more refrigerant to pass to the evaporator. After the degree of superheat has dropped to a low enough value, bellows 136 will be contracted due to the combined effects of the pressure within the evaporator outlet and the spring 151, thus moving contact 154 away from contact 153, deenergizing solenoid 125 and causing the valve 123 to again close. Thus in this form of the invention, the valve is at all times either in open or closed position so that instead of a modulating control, a two-position control is effected. The amount of superheat required to cause the valve to be opened may be varied by adjusting the nut 149 upon the threaded member 148. A cap 170 may be screw-threaded to the top of the housing 145 and enclose the adjusting nut 149.

The spring retainer assembly 140 may have connected thereto an arm 171 arranged to move across the graduated scale 172 whereby the degree of superheat of the refrigerant at all times at the outlet of the evaporator may be noted by an attendant.

If desired, a thermostat could be wired in series with the solenoid, so that when the temperature of the space being cooled dropped below a predetermined value, the valve would be closed, thus preventing the flow of refrigerant to the evaporator.

It will, accordingly, be seen that in the various forms of my invention an expansion valve has been provided which is operated by an electric motor or a solenoid, the motor or solenoid being controlled in turn by the superheat of the refrigerant at the outlet of the evaporator. In this manner, large expansion valves as may be used in large refrigeration systems may be controlled by the superheat at the evaporator outlet without requiring a large amount of superheat to effect the opening of the valve as may be the case where the valve is operated directly by a superheat responsive device. Accordingly, since less superheat is required to cause the opening of the valve, the superheat at the outlet of the evaporator may be maintained at a lower degree and a larger portion of the evaporator surface may be available for cooling purposes.

Having described three forms of my invention, other modifications may become apparent to

those skilled in the art, and I wish it to be understood that my invention is limited only by the scope of the appended claims.

I claim as my invention:

1. A refrigeration system including a condenser and an evaporator, a valve for controlling the flow of refrigerant from the condenser to the evaporator, means for controlling the position of said valve, movable means located adjacent the evaporator outlet positioned in accordance with the amount of superheat at the outlet of the evaporator for controlling said position controlling means in accordance with the position of said movable means, and means responsive to the condition of the air being cooled also in control of said position controlling means.
2. A refrigeration system including a condenser and an evaporator, a valve for controlling the flow of refrigerant from the condenser to the evaporator, electrical means for controlling the position of said valve, and means directly responsive to the amount of superheat at the outlet of the evaporator for controlling said electrical means.
3. In a refrigeration system including a condenser and an evaporator, a valve for controlling the flow of refrigerant from the condenser to the evaporator, an electric motor for causing movement of said valve to closed position upon rotation thereof in one direction and for causing movement of said valve to open position upon rotation of said motor in the other direction, means directly responsive to a condition of high superheat of refrigerant for causing rotation of said motor in valve opening direction, and means directly responsive to a condition of low superheat for causing movement of said motor in valve closing direction.
4. In a refrigeration system including a condenser and an evaporator, a valve for controlling the flow of refrigerant from the condenser to the evaporator, a bellows containing a volatile fluid positioned within the outlet of the evaporator and sealed therefrom, motor controlling means operated thereby in response to variations in pressure differential inside and outside of said bellows occasioned by variations in superheat of the refrigerant leaving the evaporator, and motor means controlled by said motor controlling means for operating said valve.
5. In a refrigeration system including a condenser and an evaporator, a valve for controlling the flow of refrigerant from the condenser to the evaporator, an electric motor for positioning said valve, circuit controlling means for said motor, a bellows containing a volatile fluid positioned within the outlet of the evaporator and sealed therefrom, and means operatively connecting said circuit controlling means and said bellows whereby said motor positions said valve in accordance with the amount of superheat of the refrigerant at the outlet of the evaporator.
6. In a refrigeration system including a condenser and an evaporator, a valve for controlling the flow of refrigerant from the condenser to the evaporator, a solenoid for causing the opening of said valve in response to the energization thereof, a bellows containing a volatile fluid, said bellows being positioned at the evaporator outlet so as to be subjected to variations in the superheat of the refrigerant at said outlet, and circuit controlling means for said solenoid operated by said bellows, whereby said solenoid is energized when the superheat at the evaporator outlet reaches a predetermined value.
7. In a refrigeration system including a condenser and an evaporator, a valve for controlling the flow of refrigerant from the condenser to the evaporator, a controller for said valve including an expansible chamber containing an expansible fluid, said chamber being remotely located from said valve, and being subjected to the refrigerant leaving the evaporator so as to expand and contract in accordance with the degree of superheat existing at the evaporator outlet, and means operated by said chamber to cause said valve to assume positions corresponding to the degree of superheat of the refrigerant at the evaporator outlet.
8. In a refrigeration system including a condenser and an evaporator, a valve for controlling the flow of refrigerant from the condenser to the evaporator, a controller for said valve including an expansible bellows located within the evaporator outlet and being sealed therefrom, said bellows containing a volatile fluid whereby said bellows expands and contracts in accordance with the degree of superheat existing at the evaporator outlet, said valve being operatively connected to said bellows whereby the amount of opening of said valve varies in accordance with the degree of superheat of the refrigerant at the evaporator outlet, and means operated by said bellows for indicating the degree of superheat of the refrigerant at said outlet.
9. In a refrigeration system including a condenser and an evaporator, a valve for controlling the flow of refrigerant from the condenser to the evaporator, a control device responsive to the degree of superheat of the refrigerant at the evaporator outlet, an indicator for indicating the degree of superheat of the refrigerant at the evaporator outlet, and means connecting said control device, and said valve and indicator whereby the valve is controlled in accordance with the degree of superheat and the degree of superheat is indicated by said indicator.
10. In a device of the class described, an enclosure for a fluid, an expansible chamber located within said enclosure and sealed therefrom, said chamber containing a volatile fluid, said chamber being subjected on the exterior thereof to the pressure of the fluid within said enclosure and on the interior thereof to a pressure corresponding to the temperature of the fluid within said enclosure whereby said chamber expands or contracts in accordance with the superheat of the fluid within said enclosure, and means operated by said chamber for indicating the degree of superheat of the fluid in said chamber.
11. In a refrigeration system including a condenser and an evaporator, a valve for controlling the flow of refrigerant from the condenser to the evaporator, an impervious bellows containing refrigerant located within the evaporator outlet and sealed therefrom, said bellows depending from the upper wall of said outlet, a rod extending upwardly through said bellows and connected to the lower portion thereof whereby changes in superheat of refrigerant surrounding said bellows causes vertical movements of said rod, and means responsive to movements of said rod for causing operation of said valve.
12. In a refrigeration system including a condenser and an evaporator, a valve for controlling the flow of refrigerant from the condenser to the evaporator, an impervious bellows containing refrigerant located within the evaporator outlet and sealed therefrom, said bellows depending from the upper wall of said outlet, a rod extend-

ing upwardly through said bellows and connected to the lower portion thereof whereby changes in superheat of refrigerant surrounding said bellows causes vertical movements of said rod, and indicating means operated by said rod for indicating the amount of superheat of refrigerant at the evaporator outlet.

13. In a refrigeration system including a condenser and an evaporator, a valve for controlling the flow of refrigerant from the condenser to the evaporator, an impervious bellows containing refrigerant located within the evaporator outlet and sealed therefrom, said bellows depending from the upper wall of said outlet, a rod extending upwardly through said bellows and connected to the lower portion thereof whereby changes in superheat of refrigerant surrounding said bellows causes vertical movements of said rod, means responsive to movements of said rod for causing operation of said valve, and indicating means operated by said rod for indicating the amount of superheat of refrigerant at the evaporator outlet.

14. A refrigeration system including a condenser and an evaporator, a valve for controlling the flow of refrigerant from the condenser to the evaporator, means for controlling the position

of said valve, movable means located adjacent the evaporator outlet positioned in accordance with the amount of superheat at the outlet of the evaporator for controlling said position controlling means in accordance with the position of said movable means, and means for varying the position of said valve for a given position of said movable means.

15. In a refrigeration system including a condenser and an evaporator, a valve for controlling the flow of refrigerant from the condenser to the evaporator, a controller for said valve including an expansible chamber containing an expansible fluid, said chamber being located adjacent the evaporator outlet and being subjected to the refrigerant leaving the evaporator so as to expand and contract in accordance with the degree of superheat existing at the evaporator outlet, power transmitting means between a movable wall of said chamber and said valve whereby the valve assumes positions corresponding to the degree of superheat of the refrigerant at the evaporator outlet, and means for adjusting the position of said valve for a given position of said movable wall.

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