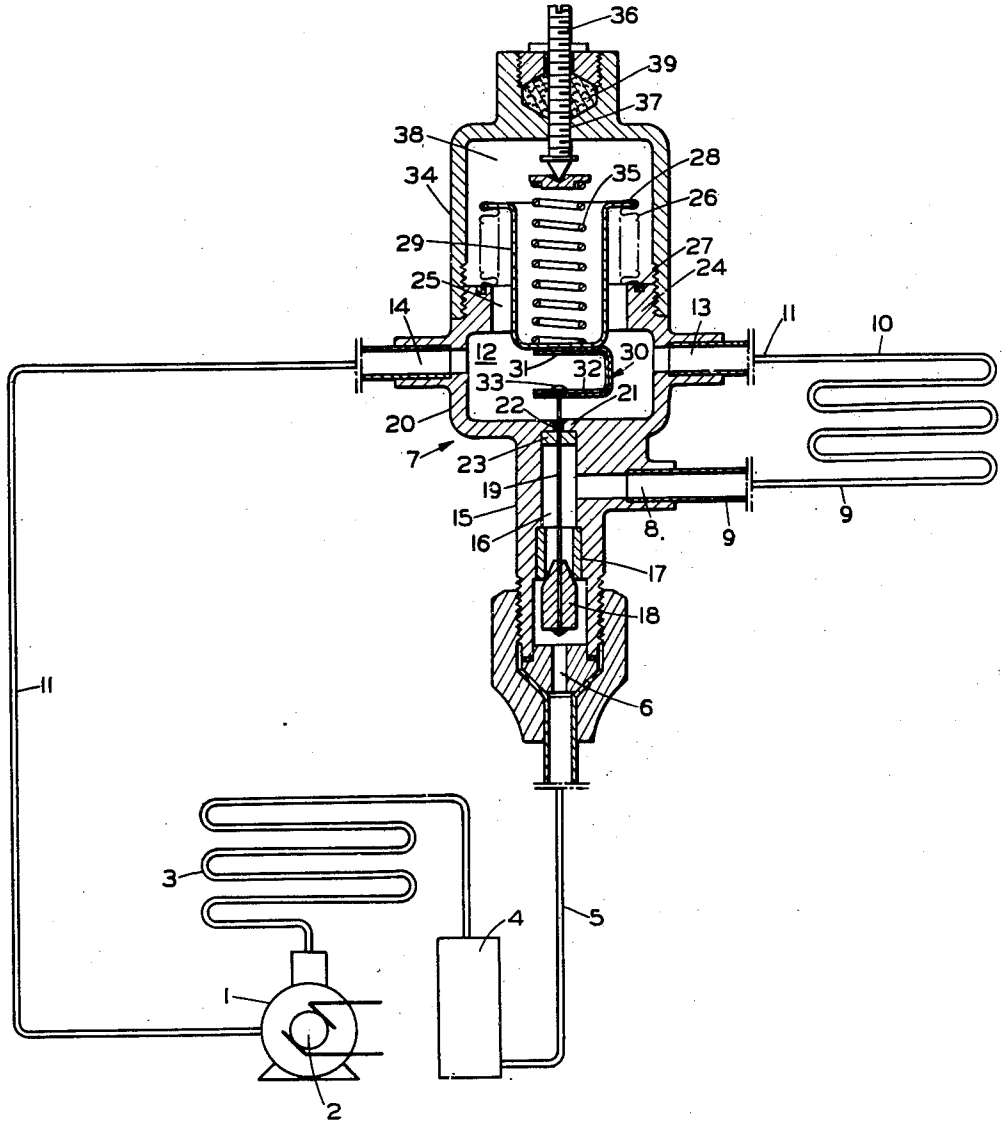
March 8, 1949. F. Y. CARTER 2,463,951

REFRIGERATION EXPANSION VALVE

Filed May 25, 1945



INVENTOR.
Franklyn Y. Carter
BY
Andrew K. Faulds
his ATTORNEY

Patented Mar. 8, 1949 2,463,951

UNITED STATES PATENT OFFICE

2,463,951

REFRIGERATION EXPANSION VALVE

Franklyn Y. Carter, Dearborn, Mich., assignor to Detroit Lubricator Company, Detroit, Mich., a corporation of Michigan

Application May 25, 1945, Serial No. 595,863

5 Claims. (Cl. 62—127)

1

This invention relates to new and useful improvements in thermostatic expansion valves for controlling the flow of refrigerant medium to the evaporator of a refrigerating apparatus.

An object of the invention is to provide a valve by which the superheat of the refrigerant medium withdrawn from the evaporator will be maintained substantially constant.

Another object is to provide means for throttling the valve in accordance with temperature and pressure of the refrigerant medium at the outlet of the evaporator in order to maintain the evaporator completely refrigerated.

Other and further objects will be apparent from the following description.

In the accompanying drawing, to be taken as a part of this specification, there is fully and clearly illustrated a preferred embodiment of the invention, in which drawing,

The figure is a diagrammatic view of a refrigerating apparatus having the valve of this invention operatively connected therein and shown in longitudinal central section.

Referring to the drawing by characters of reference, the numeral 1 designates a refrigerant medium compressor driven by an electric motor 2 and discharging into a condenser 3 having its outlet feeding into a receiver 4. From the receiver 4 a refrigerant liquid line or conduit 5 connects to the inlet 6 of a thermostatic expansion valve 7 having its outlet 8 connected by a conduit 9 to the inlet of an evaporator 10. The outlet of the evaporator 10 is connected by the usual suction line or conduit 11 to the inlet of the compressor 1. In the suction line 11 there is a pressure chamber 12 having an inlet 13 adjacent the evaporator 10 and connected thereto and having an outlet 14 for flow from the chamber 12 to the compressor 1. The compressor motor 2 may be controlled in any well known manner as, for example, by a pressure switch, not shown, responsive to pressure of the refrigerant medium in the suction line 11.

The expansion valve 7 has a valve casing 15 in which there is a passageway 16 connecting the inlet 6 to the outlet 8. In the passageway 16 there is a valve seat member 17 providing a valve port and with which a valve member 18 cooperates to control flow of refrigerant medium through the passageway 16. The valve member 18 is positioned on the inlet side of the seat member 17 and has an operating or thrust rod 19 extending longitudinally through the seat member 17. Rigid with the valve casing 15 and preferably cast integrally therewith there is a housing member 20 which contains the pressure chamber 12. The casing 15 and housing member 20 have a common dividing wall 21 which separates the passageway 16 from the chamber 12 and through which there is an aperture 22. The rod 19 extends through the aperture 22 into the chamber 12 and is provided with a packing disc 23 located in the passageway 16 and closing the aperture 22. The wall 24 of the housing member 20 opposite the aperture 22 has an opening 25 therethrough alined with the seat member 17. The opening 25 is closed by a pressure responsive member 26 such as a metal bellows having one end sealed to the wall 24 around the opening 25 as at 27 and having its other end sealed as at 28 to a head or end wall member 29. The member 29 is preferably in the form of a cup which extends through the bellows 26 and the opening 25 into the chamber 12. Interconnecting the responsive member 26 and the valve operating rod 19 there is a temperature responsive member 30 which is a U-shaped bimetal strip having its legs positioned horizontally or transverse to the thrust rod 19. One of the legs 31 is secured as by solder or the like to the base of the end wall 29. The other leg 32 has an aperture therethrough alined with the aperture 22 and through which the rod 19 extends. The rod 19 is secured to the leg 32 by a headed portion 33 which seats on the leg 32. Surrounding the bellows 26 there is a cap member 34 which forms part of the housing member 20 and is secured to the wall 24 as by screw threaded engagement therewith. Expansion or outward movement of the responsive member 26 by pressure in the chamber 12 is opposed by a helical coil spring 35 positioned within the cup-shaped end wall 29 and seating at its lower end against the bottom or base of the cup. The spring 35 is held under compression by an adjustment screw 36 which is adjustably screw threaded as at 37 through the end wall of the cap member 34. Leakage of the air around the screw 36 and into the spring containing chamber 38 within the cap member 34 is prevented by packing material 39 thereby eliminating the collection of frost on the spring 35 and pressure responsive member 26.

2

The operation of the expansion valve is as follows. The bimetal strip 30 contracts upon temperature decrease so that the legs 31 and 32 draw toward each other which lifts the leg 32 in valve closing direction and toward the responsive member 26. The movement of the strip 30 upon temperature change and which is imparted to the valve member 18 is predetermined with respect to the movement of the pressure responsive mem-

ber 26 upon pressure change in the chamber 12. The relation is such that the movement of the strip 30 will compensate for the movement of the responsive member 26 so that the valve member 18 will just come to closed position at the same superheat of the refrigerant medium in chamber 12 for varying refrigerant medium pressures in the chamber 12. Thus if the spring 35 exerts a force such that a reduction of pressure in the chamber 12 below 40 pounds per square inch will just open the valve member 18 when the temperature in the chamber 12 or of the strip 30 is say 59° F. which is a 5° superheat for methyl chloride, then when the spring 35 is adjusted for opening of the valve member 18 when the pressure in the chamber 12 is say 20 pounds per square inch, the temperature in the chamber 12 at which the strip 30 will have contracted to just close the valve member 18 will be 35° F. which is a 5° superheat of the refrigerant medium. Assuming that the compressor 1 is in operation and has reduced the pressure in the chamber 12 to say 40 pounds per square inch and the admission of refrigerant medium to the evaporator 10 has reduced the temperature in the chamber 12 to 59° F., the valve member 18 will just be in closed position. Continued operation of the compressor 1 will reduce the pressure in the chamber 12 and evaporator 10 so that the spring 35 will move the valve member 18 toward open position. This will admit refrigerant medium to the evaporator 10 which will reduce the temperature of the refrigerant gas drawn through the chamber 12 thereby causing the bimetal strip 30 to contract and move the valve member 18 toward closed position so as to prevent a decrease of superheat. The pressure in the chamber 12 will continue to decrease due to operation of the compressor 1 and the decreasing pressure will be counteracted by the contraction of the strip 30 so that the refrigerant medium will be throttled by the valve member 18 and a substantially constant degree of superheat will be maintained in the chamber 12. The reduction of pressure in the chamber 12 will continue until the cut-out point or desired low suction pressure in the conduit 11 is reached at which the motor 2 will be stopped. During the off cycle when the compressor 1 is stopped, the pressure will build up in the chamber 12 and will close the valve member 18, even though the temperature in the chamber 12 will expand the bimetal strip 30 tending to move the valve member 18 toward open position. Therefore when the cut-in point of the compressor 1 is reached, the valve member 18 will be closed. When the compressor is again placed in operation the reduction of pressure in the chamber 12 will move the valve member 18 to open position but the reduction in temperature of the refrigerant medium gas in the chamber 12 will cause the bimetal strip 30 to move the valve member 18 toward closed position as above described, thus maintaining a substantially constant superheat throughout the operating range.

What is claimed and is desired to be secured by Letters Patent of the United States is:

1. A thermostatic expansion valve for controlling flow to a refrigerant evaporator, comprising a valve casing having a passageway therethrough, a valve member in and controlling flow through said passageway, a housing member rigid with said casing and having a chamber with an inlet and an outlet for flow therethrough of refrigerant medium from the evaporator, a thrust member operatively connected to said valve member and extending into said chamber, means responsive to pressure changes in said chamber, thermostatic means in said chamber and operatively connecting said responsive means to said thrust member for movement of said valve member toward closed position upon increase of pressure in said chamber, said thermostatic means acting upon temperature increase to move said valve member toward open position, and means cooperable with said responsive means to determine for a given temperature of said thermostatic means the pressure in said chamber at which said valve member will be closed.

2. A thermostatic expansion valve for controlling flow to a refrigerant evaporator, comprising a valve casing having a passageway therethrough, a valve member in and controlling flow through said passageway, a housing member rigid with said casing and having a chamber with an inlet and an outlet for flow therethrough of refrigerant medium from the evaporator, a thrust member operatively connected to said valve member and extending into said chamber, means responsive to pressure changes in said chamber, a bimetal member in said chamber and operatively connecting said responsive means to said thrust member for movement of said valve member toward closed position upon increase of pressure in said chamber, said bimetal member having one end connected to said responsive means and having its other end connected to said thrust member and acting upon temperature increase to move said valve member toward open position, and means cooperable with said responsive means to determine for a given temperature of said bimetal member the pressure in said chamber at which said valve member will be closed.

3. A thermostatic expansion valve for controlling flow to a refrigerant evaporator, comprising a valve casing having a passageway therethrough and containing a valve seat, a valve member cooperable with said seat, a housing member rigid with said casing and having a chamber with an inlet and an outlet for flow of refrigerant medium therethrough from the evaporator, said chamber and said passageway having a common wall with an aperture therethrough alined with said valve seat, a thrust member connected to said valve member and extending through said aperture into said chamber, said chamber having an opening in its wall opposite said aperture, a pressure responsive member sealing said wall opening and responsive to pressure changes in said chamber, a spring opposing movement of said responsive member by pressure in said chamber, and temperature responsive means in said chamber and operatively connecting said responsive member to said thrust member.

4. A thermostatic expansion valve for controlling flow to a refrigerant evaporator, comprising a valve casing having a passageway therethrough and containing a valve seat, a valve member cooperable with said seat, a housing member rigid with said casing and having a chamber with an inlet and an outlet for flow of refrigerant medium therethrough from the evaporator, said chamber and said passageway having a common wall with an aperture therethrough alined with said valve seat, a thrust member connected to said valve member and extending through said aperture into said chamber, said chamber having an opening in its wall opposite said aperture, a pressure responsive member sealing said wall opening and

responsive to pressure changes in said chamber, a spring opposing movement of said responsive member by pressure in said chamber, and a U-shaped bimetal member in said chamber and operatively connecting said responsive member to said thrust member, said bimetal member having one leg secured to said responsive member and having its other leg secured to said thrust member, said bimetal member being so constructed that its legs draw toward each other on temperature decrease to compensate for reduction of pressure in said chamber.

5. In a refrigerating apparatus, the combination of a compressor, a condenser and an evaporator communicatively connected in circuit, and a thermostatic expansion valve comprising a valve casing having a passageway therethrough for flow of refrigerant medium from said condenser to said evaporator and having a valve seat, a valve member ccoperable with said seat to control flow through said passageway, a housing member rigid with said valve casing and having a chamber with an inlet and an outlet for connection of said chamber in the suction line from said evaporator to said compressor, a valve operating member responsive to change of pressure in said chamber and operable upon reduction of pressure to move said valve member

toward open position, a bimetal valve operating member in said chamber and operatively connecting said responsive member to said valve member and operable on temperature decrease in said chamber to move said valve member toward closed position, and a spring acting on said responsive member and determining for a given temperature in said chamber the pressure in said chamber to close said valve member, said bimetal member having its movement on temperature change so related to the movement of said responsive member on pressure change that said valve member will be throttled to maintain a substantially constant degree of superheat of the refrigerant medium passing through said chamber during operation of said compressor.

FRANKLYN Y. CARTER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,120,159	Pollard	Dec. 8, 1914
1,978,362	Fonseca	Oct. 23, 1934
2,291,898	Holmes	Aug. 4, 1942