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REFRIGERATING APPARATUS

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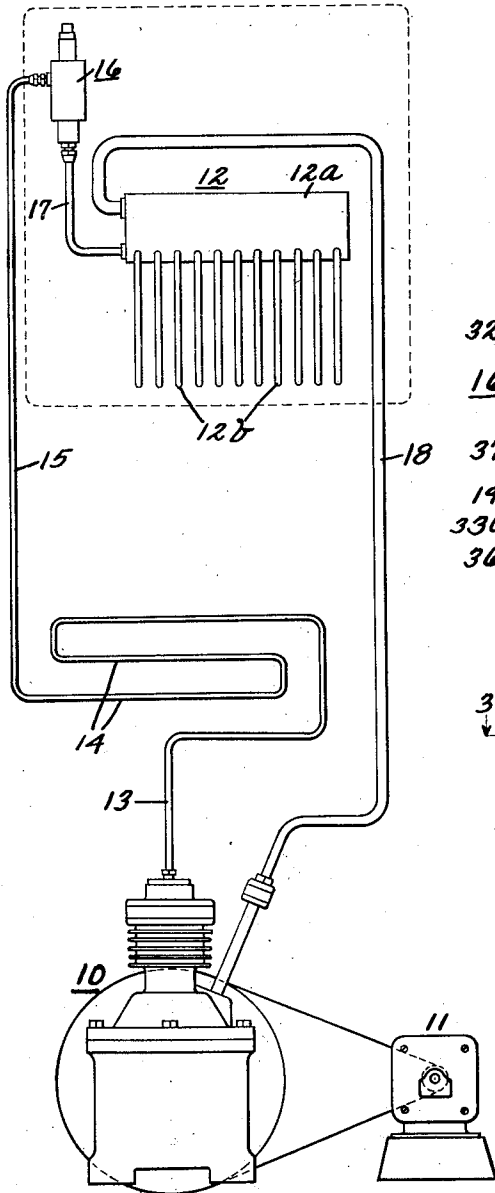


Fig. 1

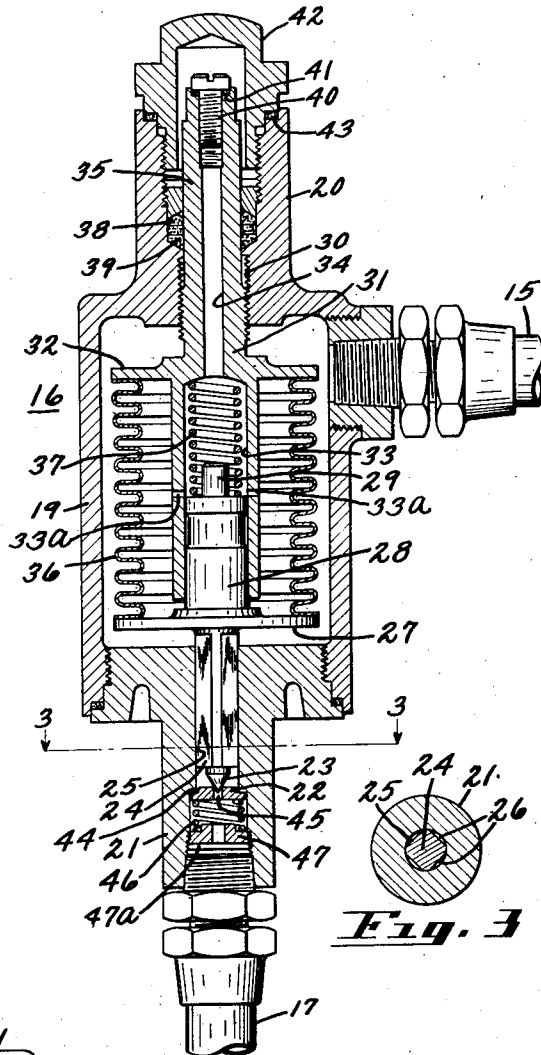


Fig. 2

Fig. 3

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REFRIGERATING APPARATUS

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This invention relates to refrigerating apparatus of the compressor-condenser-expander circuit type, and more particularly to means for regulating and controlling the supply of liquid refrigerant supplied from the high pressure side of a refrigerating machine to the expander or boiler which constitutes the cooling unit.

The principal object of the invention is to safeguard the apparatus in the event that the automatic means for controlling the supply of liquid refrigerant to the cooling unit fails to function.

The invention consists in means responsive to pressure to open a passage from the high pressure or liquid conduit to the expanding unit, and in means responsive to variations of pressure cooperating with a means responding to variations of temperature to regulate the escape of fluid to said expanding unit. It further consists in the combinations and details of structure specifically described hereinafter, illustrated in the accompanying drawings and defined in the appended claims.

In the accompanying drawings, Fig. 1 is a diagram of a refrigerating apparatus of the compressor-condenser-expander circuit type, showing the preferred location of the device that is the subject of this application with respect to the entire apparatus; Fig. 2 is a vertical section of the regulating device to which the invention particularly relates, and Fig. 3 is a cross section on line 3—3 of Fig. 2.

In the diagram (Fig. 1) 10 indicates a compressor as a whole which is driven by a motor 11; 12 an expansion element or "boiler" comprising an evaporating tank 12^a and a coil 12^b. The high pressure or liquid line comprises the piping 13 from the high pressure side of the compressor to the condenser, the condenser 14, piping 15 from the condenser to the regulating device, and the regulating device 16. The low pressure line comprises the piping 17 from the regulating device to the expander or "boiler" 12, said expander, and the return pipe or vapor line 18 from the expander 12 to the low pressure side of the compressor 10. The expander ele-

ment and the device 16 are intended to be housed in a cooling compartment of a refrigerating cabinet indicated by dotted lines in Fig. 1.

This invention relates to the regulating device 16 which is, in part, of previously known construction, but will be described in full in order to make clear the relation of the new elements to that which was previously known.

The regulating device 16 comprises a body having a chambered portion 19 which may be conveniently of circular cross section and from which a reduced tubular portion 20 extends upward from one end in an axial direction and a reduced tubular portion 21 extends downward from the other end coaxially with the chambered portion 19 and extension 20. The extension 21 is separably connected to the portion 19 as shown. The high pressure or liquid line pipe 15 is tapped into the side of chambered portion 19 near the upper end of the chamber and the low pressure pipe section 17 is connected to lower end of the tubular extension 21 within which is a means for opening and closing the passage there-through comprising a valve and valve seat adapted automatically to regulate the passage of refrigerant, as will be presently explained. Refrigerant enters the chamber within the chambered portion 19 through pipe 15, and leaves it through the lower tubular extension 21 and pipe 17.

The valve seat referred to as within the tubular extension 21 is formed in a perforated valve member 22 and cooperates with a valve 23. The valve 23 may move toward or from the seat member 22 in response to variations of pressure within the chamber, or, should the valve 23 fail to function as intended, the seat member 22 may be moved to open the passageway after sufficient pressure has been built up in said chamber. The means for regulating and controlling the movements of the valve in response to changes of degree of heat, or temperature changes and changes of pressure, will be described first.

Valve 23 is preferably conical or of needle valve type. It has a stem 24 guided in the bore 25 that traverses the lower extension

21 and is so formed as to permit fluid to pass along side of it in the bore 25, as by shaping flat surfaces 26 thereon. The stem 24 carries a wide flange 27 disposed within the lower part of the chamber portion 19, and beyond the flange, on the upper side, is a piston-like member 28, having on its upper extremity a spring-centering stud 29. Threaded at 30 in the lower end of the bore that traverses the upper extension 20 is a tubular member 31 enlarged between its ends into a wide flange 32. That portion of the member 31 that reaches below flange 32 contains a bore 33 that fits over and telescopes with the piston-like portion 28 described as connected to the valve stem 24 and flange 27. Small holes 33* may penetrate to the bore from the exterior. A smaller bore 34 traverses the upper part of member 31 from the bore 33 completely through said part. A metallic, transversely corrugated, longitudinally collapsible and expansible tubular body or bellows like member 36 is hermetically sealed at opposite ends to the flanges 27 and 32, respectively. At its upper end member 31 is formed exteriorly at 35 so that it may be engaged by a socket wrench or other suitable tool and rotated in either direction. A coiled compression spring 37 is disposed within the bore 33 between its upper end and the upper end of the piston like member 28 whereon it is centered by the stud 29.

It will thus be evident that expansion of the bellows tends to move the valve in a direction to reduce or cut off the flow of fluid into pipe 17 and contraction of said bellows tends to move the valve upward away from its seat to permit the flow of fluid into pipe 17; also that by rotating the member 31 in one direction it will be screwed downward to increase the pressure of spring 37, and by rotating it in the opposite direction it will be screwed upward thereby decreasing its pressure.

Leakage of fluid from or into the chamber within body 19 is prevented by an adjustable stuffing box 38 disposed above a shoulder 39 formed by an enlargement of the passage in extension 20. The upper end of the bore or duct 34 in part 31 is closed by a headed screw plug 40 beneath the head of which there may be a packing gasket 41. The upper end of the passage through upper extension 20 may be closed by a screw cap 42 that may be fitted in said extension fluid tight by the aid of a packing gasket 43.

When the space within the bellows 36 is charged with a suitable quantity of the same kind of fluid (such as sulphur dioxide) that is used in the circulatory system as a refrigerant, the bellows with the flanges to which it is sealed constitute a thermostatic device that will move the valve 23 under the influence of changes of temperature within the

range it is constructed and adjusted to respond to. The fluid may be charged into the thermostatic chamber through the upper end of bore 34 in member 31 after removal of cap 42 and screw plug 40, and may be hermetically sealed therein by replacing of screw plug 40. There is intended to be sufficient looseness of fit between the piston like body 28 and the inside surface of the large bore 33 in member 31 to permit the thermostatic fluid to pass around the piston to the bellows chamber although the holes 33* are intended as passages for this fluid.

The thermostatic device, by itself, is not herein claimed, the invention which is the subject of this application relating particularly to the combination with the thermostatic device of a pressure sensitive means, and in said pressure sensitive means itself, adapted to operate to open a passage from the high pressure to the low pressure side under abnormal conditions, that is in case the valve stem should stick in the guide or the pressures within and without the bellows should become equalized through leakage of fluid through the bellows or around the upper portion 31 into the bore 33, or if for any other reason the valve 23 should fail to open according to its ordained law of operation.

The lower end of lower extension 21 of body 19 is counterbored forming thereby an internal shoulder 44, and is reamed to a tapered entrance provided with internal threads to engage the coupling used to connect pipe 17 thereto. The member 22, previously referred to, which is provided centrally with a fluid port 45 adapted to be opened or closed by valve 23, is disposed within the counterbore and pressed yieldingly into contact with shoulder 44, as by a coiled spring 46 that is located between the under side of said ported member 22 and upper side of a ported adjustable abutment 47, threaded in place below the member 22. The ported abutment 47 has a slot 47* in its lower face for engagement by a screw driver to effect the adjustment. Fluid can escape around the edge of member 22 should the latter be followed, when separated from shoulder 44, by valve 23. Member 22 moves away from shoulder 44 when the pressure built up by the fluid within the chambered body 19 is sufficient to overcome the pressure of spring 46.

Since the fluid within the bellows 36 is the same as that outside of it and is subject to the same laws as respects heat and pressure, it will be apparent that the bellows will remain stationary when the pressure is substantially the same on the inside and the outside of the bellows. The spring 37 maintains the valve 23 on its seat member 22 when the pressure in the chamber portion 19 is substantially the same as the pressure within bellows 36. When the compressor operates, the refriger-

ant fluid will be compressed, cooled by the condenser 14 and liquefied. The liquid refrigerant adjacent valve 16 will be somewhat colder than the refrigerant in pipe 13 and that in the first part of condenser 14 due to the cooling effect of the condenser. The compressor, however, tends to raise the pressure of the fluid in the pipe 13 and the first part of the condenser to the condensing pressure. The pressure of the fluid within bellows 36 is responsive to the temperature of the liquid refrigerant within chamber portion 19. When the differential between the pressure on the exterior of the bellows 36 and the pressure in the bellows exceeds that of spring 37 due to the operation of the compressor, the bellows will collapse to raise valve 23 from its seat.

The liquid refrigerant then flows from the chamber into the pipe 17 and thence to the expander or evaporating element 12. After the temperature of the evaporating element or its surroundings have been cooled to the desired degree, the motor 11 may be stopped by any known means or in any known manner. The compressor then stops and during this condition of quiescence no refrigerant liquid will enter the chamber around the thermostat. The temperatures and pressures within the bellows and surrounding chamber will therefore equalize. As a result the valve 23 will again close the port 22. During the operation of the motor and compressor, the bellows 36 is collapsed periodically to permit accumulation and release of liquid refrigerant without stoppage of the motor and compressor.

Should the valve stem stick, by reason of corrosion of the stem 24 so that the bellows cannot lift the valve from its seat, or should a leak develop anywhere so that fluid passes between the interior and exterior of the bellows rendering a differential impossible and the valve remains in its closed position while the chamber is being charged with liquid by the compressor, valve seat member 22 will be pressed away from shoulder 44 and let the liquid pass into pipe 17 when the predetermined pressure sufficient to overcome the elastic pressure of the spring 46 has been built up by the compressor. Fluid may pass around the member 22 even though the needle valve 23 should follow its movement away from the seat. Under these abnormal conditions the refrigerant would circulate harmlessly through the circulating system.

While the form of mechanism herein shown and described constitutes a preferred embodiment of one form of invention, it is to be understood that other forms might be adopted and various changes and alterations made in the shape, size, and proportion of the elements therein without departing from the spirit and scope of the invention.

What is claimed is as follows:

1. A refrigerating system comprising in combination, a fluid circuit having high and low pressure portions; means for circulating refrigerating fluid within said circuit; and means responsive to normal conditions of the fluid in said circuit for controlling the flow of fluid from the high pressure portion to the low pressure portion, said means including a second means responsive to an abnormal condition of said fluid for interconnecting the low pressure portion with the high pressure portion.

2. A refrigerating system comprising in combination, a fluid circuit having high and low pressure portions; means for circulating refrigerating fluid within said circuit; and a pressure reducing valve including a movable valve member responsive to normal conditions of the fluid in said circuit for controlling the flow of fluid from the high pressure portion to the low pressure portion, and a movable valve seat member associated with said first valve member and responsive to an abnormal condition of said fluid for interconnecting the low pressure portion with the high pressure portion.

3. A refrigerating system comprising in combination, a fluid circuit having high and low pressure portions; means for circulating refrigerating fluid within said circuit; and means responsive to normal conditions of the fluid in said circuit for controlling the flow thereof from the high pressure portion to the low pressure portion, said means including a second means responsive to abnormal pressure of said fluid in said high pressure portion for interconnecting the low pressure portion with the high pressure portion.

In testimony whereof I hereto affix my signature.

SYLVESTER M. SCHWELLER.