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C. E. L. LIPMAN
REFRIGERATING SYSTEM
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Fig. 1.

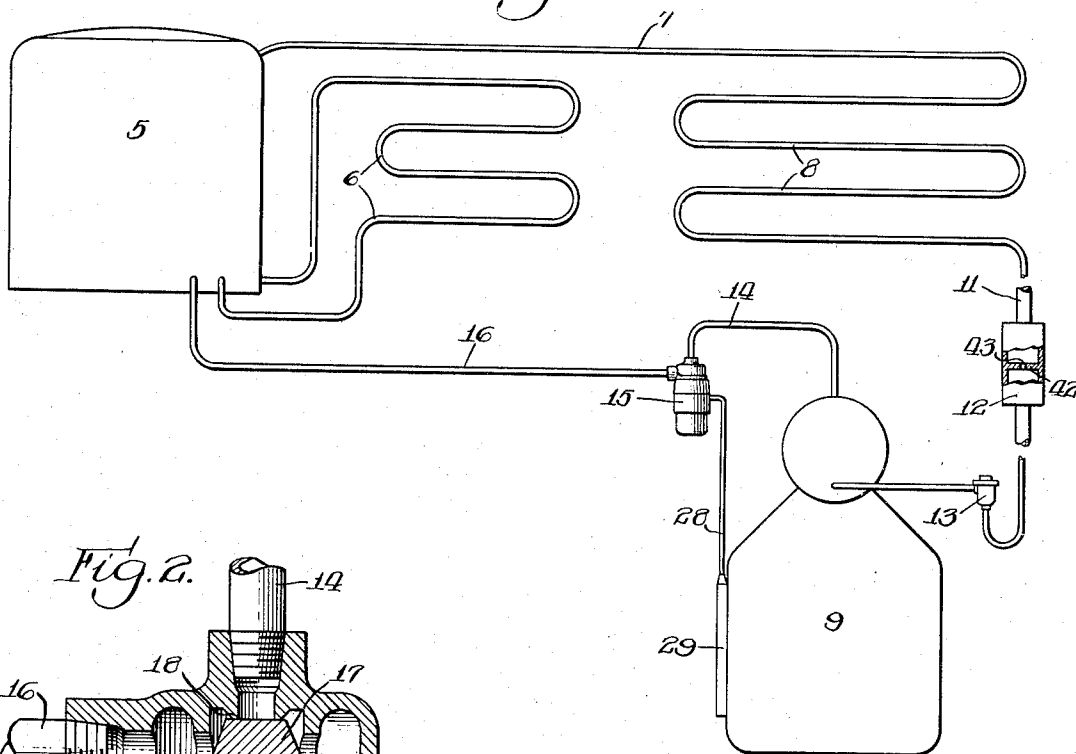


Fig. 2.

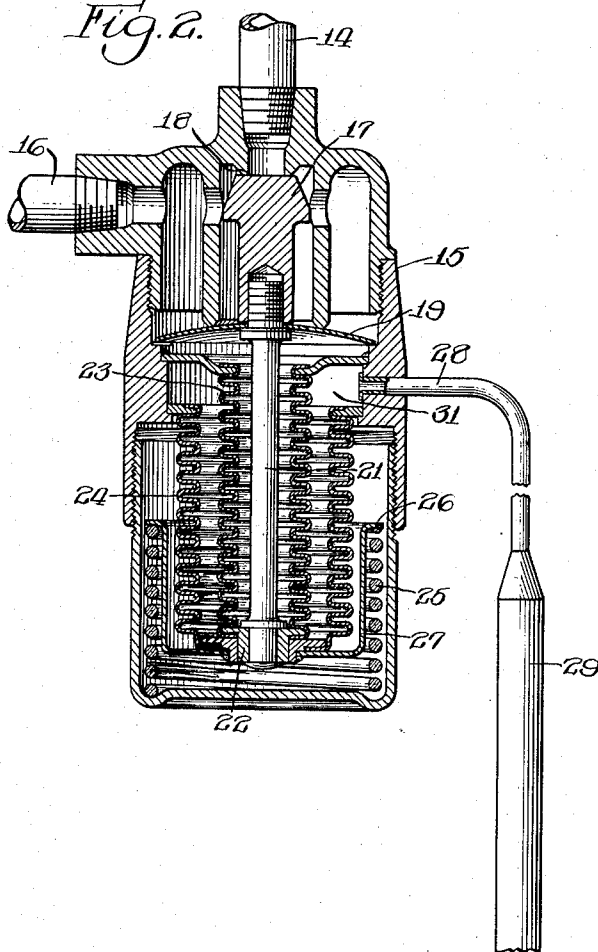
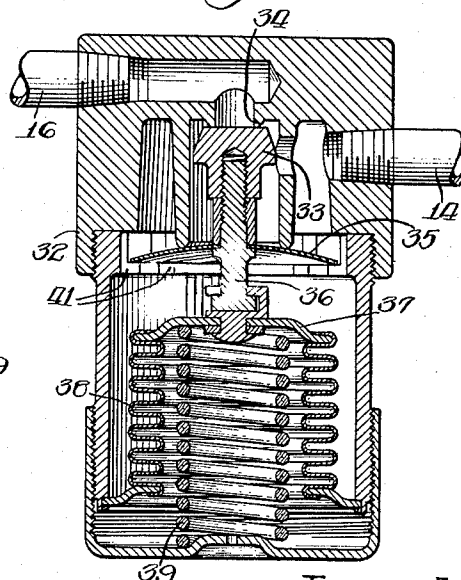


Fig. 3.



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REFRIGERATING SYSTEM

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2 Claims. (Cl. 62—115)

This invention relates to mechanical refrigerating systems and although not restricted thereto, is here illustrated in connection with a small system suitable for household purposes.

The usual practice in the operation of systems of this general type is to interpose a thermostatically controlled switch in the power line to the electric motor which drives the compressor, whereby the switch will be opened to stop the motor when a predetermined low temperature has been produced in the vicinity of the evaporator, and will be closed to start the motor and compressor when a predetermined higher temperature in the vicinity of the evaporator has been reached after an idle period of the apparatus. This stopping and starting of the motor compressor is uneconomical in the use of electric current and imposes a heavy strain upon the motor and compressor when they are started against a high head pressure of the refrigerant on the discharge side of the compressor. In an endeavor to reduce this excessive strain and current consumption, unloading devices of various types have been devised to reduce the head pressure during idle periods, but such devices are not always reliable and satisfactory in operation and furthermore their employment entails additional complications in the system and increases the cost of production.

My present invention aims not only to eliminate the unloading device but also to obviate the excessive stresses and strains and high current consumption involved in starting the compressor against a high head pressure. In the accomplishment of these results my invention contemplates a continuously running compressor which is rendered ineffective for refrigerant circulation by shutting off the suction line thereto when a predetermined refrigerating effect has been produced by the evaporator, the line being again automatically opened when further refrigerating effect is required. In order that the compressor may not be required to work during the idle or inoperative periods against a high head pressure, provision is made for an equalization of the condenser and evaporator pressures by permitting the high condenser pressure to pass on into the evaporator in the early stages of each non-circulating period. The high head pressure at the discharge side of the compressor is thereby reduced to a nominal pressure so that the motor and compressor may idle under substantially no load and, therefore, very economically.

To insure against a rise of pressure in the condenser when the evaporator pressure rises during the non-circulating periods, provision is made in the line between the condenser and evaporator to prevent reverse pressure flow from the evaporator back to the condenser.

In order to facilitate an understanding of this invention I have illustrated on the accompanying drawing a preferred embodiment thereof from which, when considered in connection with the following description, the principles of my invention and its attendant advantages should be readily appreciated.

Referring to the drawing:

Fig. 1 is a diagrammatic view, partially in enlarged section, of a refrigerating system embodying my invention;

Fig. 2 is a vertical sectional view through the automatic shut-off valve interposed between the evaporator and the compressor; and

Fig. 3 is a similar view of a modified form of shut-off valve.

Referring to the drawing more in detail, reference character 5 indicates generally a hermetically sealed motor compressor unit of any suitable type, such for instance as the automatic temperature control type disclosed in my copending application Serial No. 535,638, filed May 7, 1931. The excess heat units generated by the motor and compressor disposed within the sealed case are, in the type of unit disclosed in said application, dissipated to atmosphere by circulating cooling and lubricating oil through a cooling coil 6 disposed outside the case.

The compressed refrigerant is delivered from the case of the motor compressor unit through a pipe line 7 to a condenser 8 of any preferred construction, but here conventionally shown as a coil. From the condenser the cooled liquid refrigerant is delivered to the evaporator 9 through a pipe 11 in which is interposed a flow control device 12 and a check valve 13 precluding back pressure flow from the evaporator to the condenser.

A pipe line 14 from the evaporator is connected to a shut-off valve case 15 which in turn is connected to the suction side of the compressor by a pipe line 16. It will be obvious that the system illustrated provides a closed circuit in which the refrigerant is circulated, the circuit including the motor compressor, the condenser, and the evaporator, all of which may be of any suitable construction.

The details of the shut-off valve 15 are clearly shown in Fig. 2 from which it will be observed that communication between the inlet pipe 14 and the outlet pipe 16 is controlled by the shut-off valve proper 17 held against its seat 18 by a spring 25 and a resilient snap-over disc 19. A stem 21 fixed at its upper end to the valve 17 and the disc 19 is secured at its lower end to a head 22 closing the lower ends of the inner and outer syphons 23 and 24, respectively. A coiled spring 25 interposed between the lower end of the valve case and the radial flange 26 of a sleeve 27 and

also carried by the head 22, normally urges the valve into the closed position shown.

The space between the sylphons is connected by a pipe or tube 28 with a thermostatic bulb or chamber 29 disposed against or in proximity to the side of the evaporator 9 so as to be influenced by the temperature of the evaporator. When the temperature of the evaporator is low the expansible fluid contained in the bulb 29, tube 28, and chamber 31 being of minimum volume will permit the valve 17 to be held against its seat by the spring 25 and the disc 19 as shown. A rise of temperature in the evaporator will cause an expansion of this fluid which, through the action of sylphons 23 and 24, will depress the head 22 against the force of spring 25 to withdraw the valve 17 from its seat, and when this opening movement has progressed sufficiently to depress the center of the disc 19 below its periphery the disc will snap over into reverse position to hold the valve fully open until such time as contraction of the fluid in the syphon chamber permits reverse closing movement of the valve by the spring 25.

Since the temperature of the evaporator corresponds very closely with the pressure within the evaporator it is entirely feasible to control the shut-off valve by evaporator pressure rather than evaporator temperature, and a valve controlled by pressure which may be substituted for the temperature controlled valve 15 is illustrated in Fig. 3. This valve comprises a case 32 adapted to be connected to the pipes 14 and 16, communication between these pipes being controlled by a valve 33 adapted to close against its seat 34. A snap disc 35 similar to the disc 19 is secured to the valve stem 36, the lower end of which is attached to the upper closure end 37 of a syphon 38. A spring 39 corresponding in function to spring 25 normally urges the valve toward its seat. Passageways 41 are provided around the disc 35 so that the gaseous refrigerant under pressure entering the case from the pipe 14 may surround the syphon 38 and contract the same against the force of the spring 39 to open the valve. A predetermined pressure reduction in the case will, of course, permit the valve to close again.

The housing 12 interposed in the pipe 11 between the condenser and the evaporator is constructed to provide a continuously open restriction controlling the flow of refrigerant from the condenser to the evaporator. The details of this construction are immaterial and in the present instance I have simply illustrated the housing 12 as provided with a transverse wall 42 provided with a minute opening 43 permitting a restricted refrigerant flow.

The operation of my improved system is substantially as follows. Assuming that the valve 15 is open and the system is performing its normal refrigerating work, the refrigerant gas is being drawn off from the evaporator by the compressor and delivered by the compressor under pressure to the condenser where it is cooled and converted into liquid. This liquid flows in restricted amounts through the aperture 43 to the evaporator, the aperture being so small that a wide difference in pressure is established between the condenser and evaporator. The evaporator during running periods is reduced to a minus pressure while a rather high plus pressure is established in the condenser.

Assuming that the pressure and temperature of the evaporator have now been reduced to a point where the temperature controlled shut-off valve

17 or the pressure controlled shut-off valve 33, as the case may be, will automatically close, further withdrawal of the refrigerant gas from the evaporator will be prevented. The motor compressor unit will continue to operate, but because of the continuously open aperture 43 the liquid under pressure in the condenser will continue to flow into the evaporator until the condenser pressure has been reduced to the evaporator pressure, so that the compressor will be operating against only a very slight head pressure and, therefore, will idle with very little consumption of current.

The temperature and pressure of the evaporator will now begin to rise as heat is absorbed from the surrounding air, but the pressure rise is prevented from backing up into the condenser by the check valve 13 of any suitable construction. When the evaporator temperature and pressure have risen to a point where refrigeration is again required the shut-off valve will be automatically opened in the manner previously described, whereupon refrigerant will be withdrawn from the evaporator by the compressor and normal refrigerative work will be performed until the evaporator temperature and pressure have been reduced to a predetermined point, which will result in the closing of the shut-off valve thereby causing another idle or non-circulating period.

The details of construction illustrated and described may obviously be varied within considerable limits without departing from the essence of this invention as defined in the following claims.

I claim:

1. A refrigerating system comprising a continuously operating compressor, a condenser, an evaporator of the flooded type located below the level of the condenser, all connected by pipe lines to form a closed refrigerant circuit, means interposed in the line between the condenser and the evaporator providing a constant area restriction for restricting the flow of refrigerant to the evaporator during refrigerant circulating periods and permitting the contents of the condenser to collect by gravity in the evaporator during non-circulating periods, means in the line leading to the evaporator for preventing back flow of collected refrigerant from the evaporator to the condenser, and means in the line between the evaporator and the compressor responsive to evaporator conditions for automatically opening and closing said line in accordance with the load on said evaporator to permit and prevent respectively refrigerant circulation.

2. A refrigerating system comprising a continuously operating compressor, a condenser, an evaporator of the flooded type located to receive refrigerant by gravity from the condenser, pipe lines connecting said compressor, evaporator and condenser to form a closed refrigerant circuit, means in the line between the condenser and evaporator for restricting the flow of refrigerant to the evaporator during refrigerant circulating periods while permitting the contents of the condenser to collect by gravity in the evaporator during non-circulating periods, means for preventing back flow of collected refrigerant from the evaporator to the condenser, and means for automatically shutting off the suction line between the compressor and evaporator to initiate a non-circulating period upon the development of a predetermined temperature in the evaporator.

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