

Jan. 19, 1932.

F. A. BROWNE

1,841,935

REFRIGERATING APPARATUS

Filed Feb. 13, 1928

3 Sheets-Sheet 1

FIG. 1.

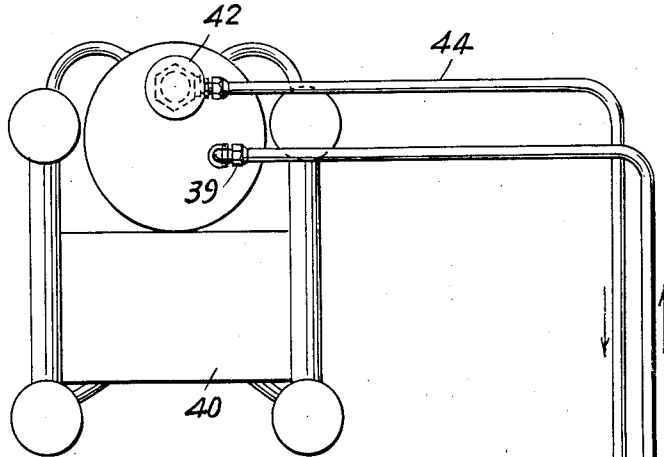
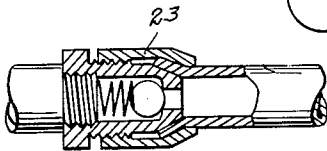
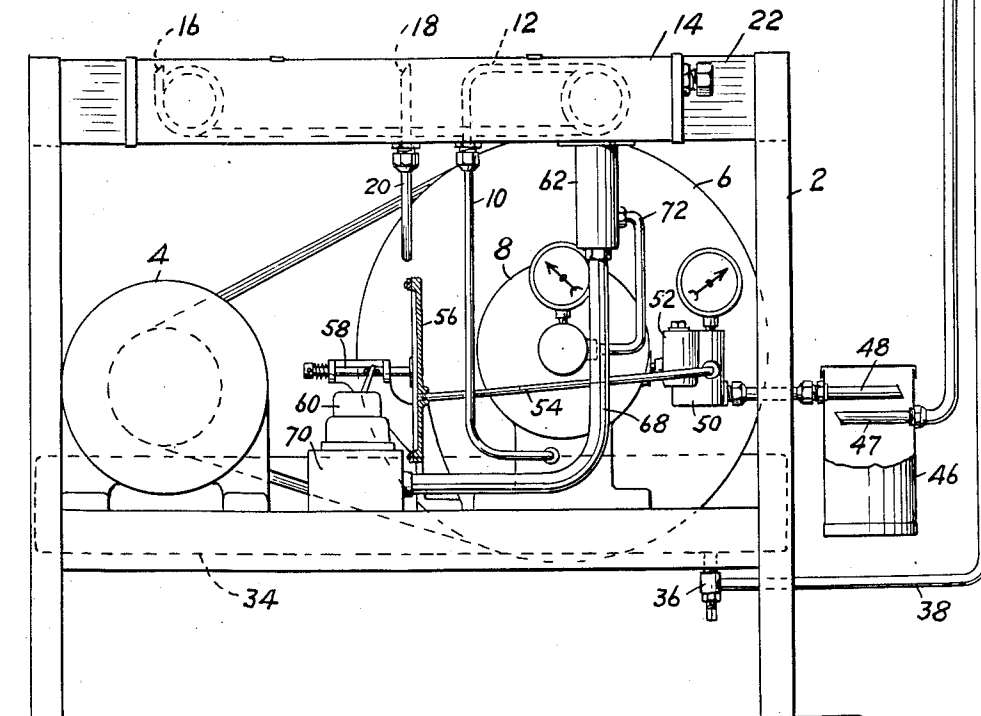


FIG. 5.



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3 Sheets-Sheet 2

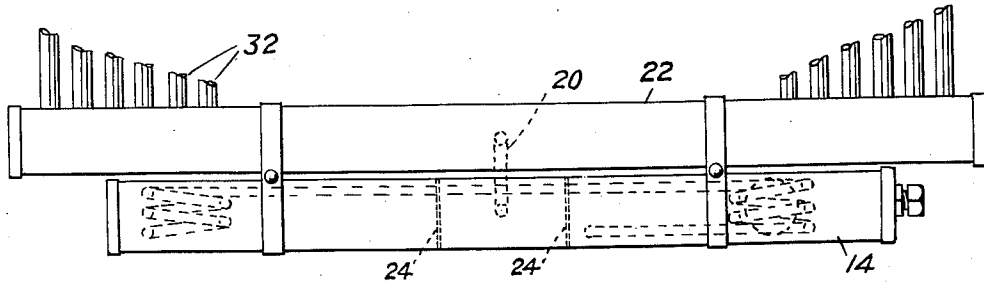


FIG. 2.

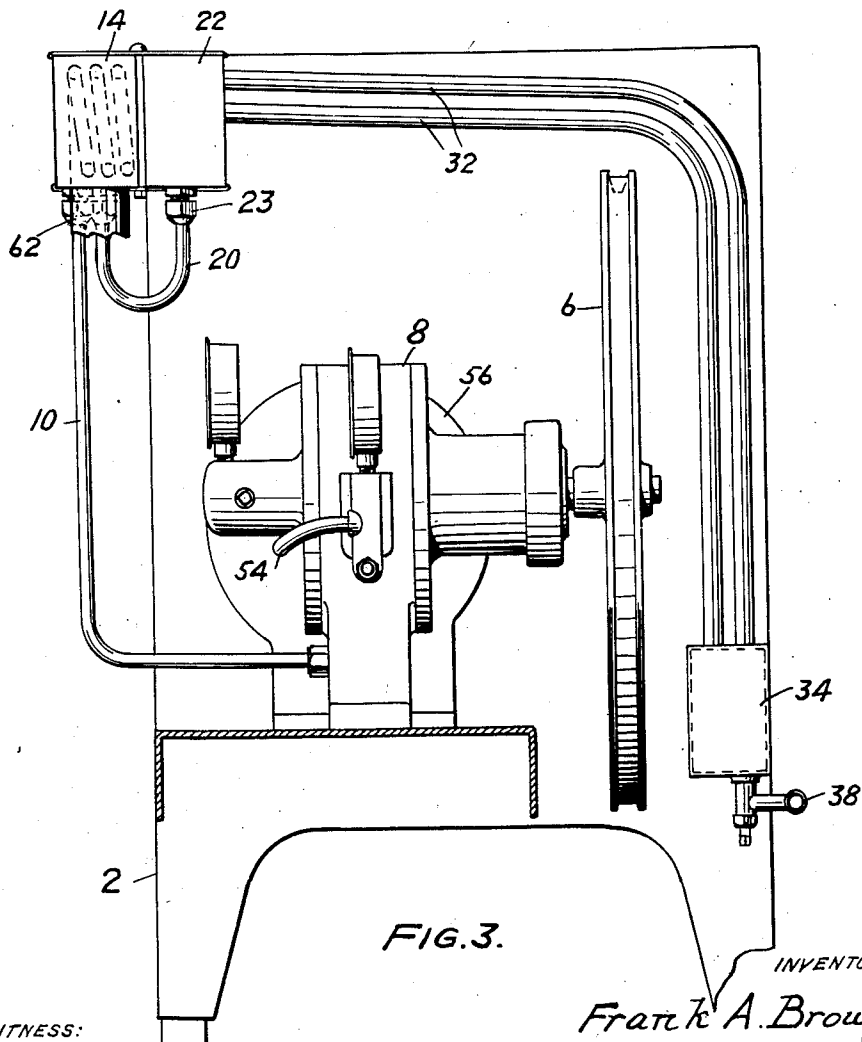


FIG. 3.

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3 Sheets-Sheet 3

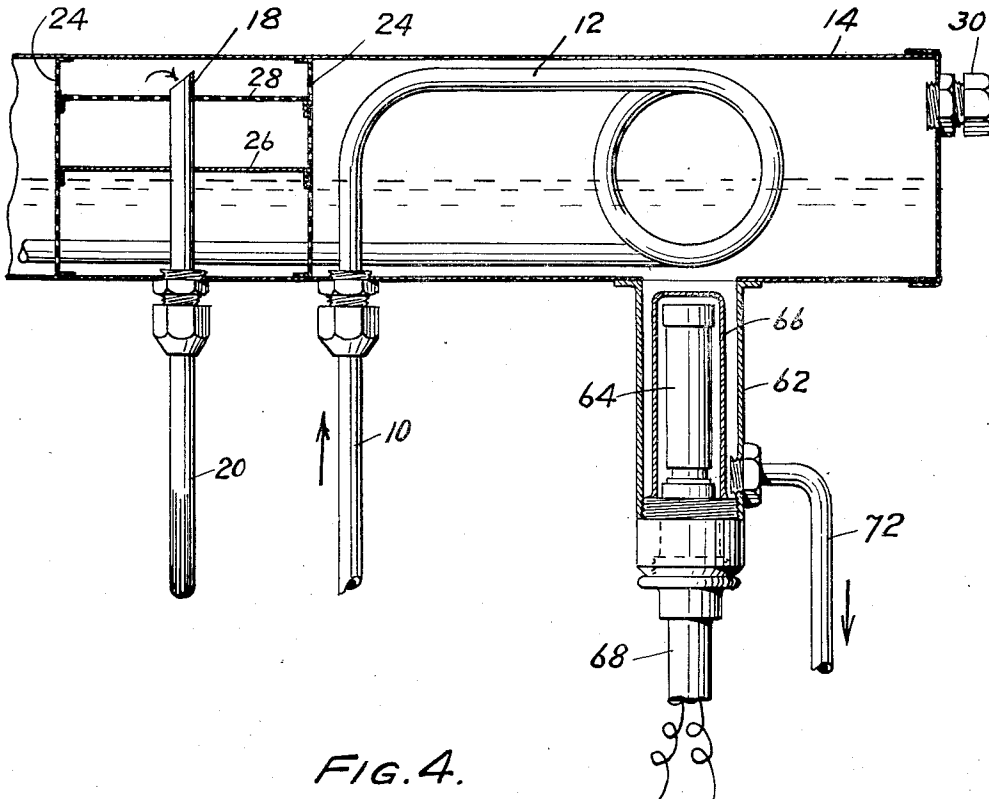


FIG. 4.

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UNITED STATES PATENT OFFICE

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REFRIGERATING APPARATUS

Application filed February 13, 1928. Serial No. 253,961.

This invention relates to a refrigerating apparatus and more particularly to that type of refrigerating apparatus designed for use in homes or other places where small units are desired and the refrigerating effect of which is accomplished by the cyclical compression of the vapors of a volatile refrigerant into a liquid followed by the evaporation of the liquid under reduced pressure with the absorption of heat.

One of the objects of this invention is the provision of a refrigerating apparatus which is capable of utilizing a refrigerant which is soluble in, and which in the liquid form dissolves, lubricating oil.

Another object of the invention is the provision of means for shutting down the apparatus, either temporarily or for an extended period of time, which means is arranged so that the apparatus may be again started without unnecessary delay.

A further object is the provision of means for preventing the flow of liquid refrigerant into the compressor where it might so dilute the lubricant as to render it ineffective for lubricating action.

These and other objects will be more clearly understood and may be better pointed out in the following detailed description of the apparatus with reference to the accompanying drawings in which:

Fig. 1 is a diagrammatic elevation of a refrigerating apparatus partly in section;

Fig. 2 is a plan view of an oil separator and the upper header of a condenser;

Fig. 3 is a side elevation of a compressor unit;

Fig. 4 is a sectional view showing details of the oil separator; and

Fig. 5 is a sectional view of a check valve used in the apparatus.

Heretofore when ethyl chloride has been used as refrigerant, glycerine has been used as a lubricant because of the substantial insolubility of ethyl chloride in glycerine. It is desirable, however, to use ordinary petroleum lubricating oil rather than glycerine, but difficulties of operation arise due to the solubility of ethyl chloride in lubricating oil. As has been indicated, one of the objects of the

present invention is to utilize a refrigerant which is soluble in the lubricant used, and although the description will be made with reference to the use of ethyl chloride and petroleum oil, it will be understood that the features of the apparatus rendering such use possible also make the apparatus capable of using other mutually soluble refrigerants and lubricants.

The complete apparatus consists of a compressor unit and a boiler or cooling unit. The various parts of the former unit are mounted on a frame 2 which carries an electric motor 4 belt connected to a pulley 6 mounted on the shaft of a rotary compressor 8 of ordinary construction. The ethyl chloride vapor is compressed by the compressor and delivered together with lubricating oil through a tube 10 to a coiled tube 12 located within an oil separator 14. The ethyl chloride vapor from the compressor carries the oil in the form of a mist of minute droplets which are found very difficult to condense, and it is found that by passing the mist carrying vapors through a coiled tube of small diameter and of a length of about five feet the droplets coalesce forming larger drops which separate readily from the vapors of the refrigerant. The ethyl chloride and lubricant leaving the exit 16 of the tube 12 readily separate, the lubricant forming a body in the bottom of the separator while the ethyl chloride vapors pass into the upper end of a separator tube 18 and thence through a pipe 20 into the upper header 22 of the condenser. A check valve 23 of the type shown in Fig. 5 is placed in pipe 20, permitting the free passage of vapors from the separator into the condenser but preventing the passage of either vapors or liquid in the reverse direction.

The lubricant contains ethyl chloride in solution and separation of ethyl chloride from this solution is attended with a considerable amount of foaming. To prevent this foam from rising to the open end of separator tube 18 and thus causing oil to be carried into the condenser, baffles are located about the open end of tube 18. An arrangement which is found effective is illustrated in Fig. 4 and consists of a pair of vertically extend-

ing perforated plates 24 extending completely across the separator 14 on opposite sides of the separator tube and connected by horizontal unperforated and perforated baffle plates 26 and 28, respectively, extending between the front and rear walls of the separator. The unperforated baffle plate 26 is located at or above the normal surface of the oil body in the separator so that if foaming occurs in the vicinity of tube 18 the foam must pass about the ends of plate 26 to the outside of plates 24 and before reaching the open end of tube 18 would be required to pass through both plates 24 and 28, which, however, break up the foam and protect tube 18 therefrom.

Oil may be introduced when necessary into the separator through a filling plug 30.

The compressed ethyl chloride vapors pass from the upper header 22 into the series of condenser tubes 32 which may be cooled by a current of air produced by a fan suitably driven by motor 4. During the passage through these tubes the vapors condense to liquid which collects in the reservoir 34.

The liquid refrigerant passes through a suitable shut-off valve 36 to pressure line 38 from which it passes through a check valve 39 into boiler 40 which may be of any suitable construction. Check valve 39 may be of the ordinary ball check type illustrated in Fig. 5 and permits flow into the boiler while preventing flow therefrom. In the boiler the ethyl chloride vaporizes with absorption of heat and the vapors pass through a shut off valve 42, which will be hereinafter referred to as a defrosting valve, into line 44 leading back to the low pressure side of the compressor.

Interposed in line 44 between the boiler and compressor is a sump 46 constructed as shown in Fig. 1 with the entrance and exit pipes 47 and 48 overlapping and opening in opposite directions. The purpose of the sump is to prevent liquid from entering the compressor from the boiler.

Exit tube 48 from the sump communicates with a casing 50 which at its exit side is provided with a check valve 52 arranged to prevent flow of fluid from the compressor while allowing free flow of fluid thereinto. Casing 50 may be provided with a pressure gauge to indicate the pressure on the low side of the compressor.

A pipe 54 communicates at one end with casing 50 and at the other end with a pressure controlled switch 56 of ordinary construction consisting of a diaphragm which, upon fall of pressure in pipe 54, moves plunger 58 to stop motor 4 by interrupting the electric circuit through switch 60, actuated by the plunger.

Since the oil in separator 14 dissolves a large quantity of ethyl chloride, it is necessary to remove this ethyl chloride before allowing the oil to return to the compressor.

The means for accomplishing this is shown in Fig. 4 in which 62 designates the outer shell of an oil heater communicating with the bottom of the separator. The heating element proper is designated at 64 and may consist of an ordinary heating coil encased in a shell 66 screwed into the bottom of shell 62. An electrical conduit 68 contains the wires extending from the heater to a junction box 70. An oil receiving chamber is formed between the shells 62 and 66 of the heater and communicates with the compressor through tube 72. The circuit through heating element 64 is not interrupted when the motor is stopped so that the oil is maintained heated and mobile even though the apparatus is at a low temperature.

When the apparatus is in operation, ethyl chloride vapors are compressed and together with lubricant are forced through coil 12, where droplets of oil coalesce to form readily separable globules, into separator 14. The oil here settles to the bottom while the compressed vapors pass through separator tube 18 into the condenser where they condense to liquid which flows through check valve 39 into the boiler. The boiler is located in a refrigerator which is cooled by the evaporation of the liquid ethyl chloride. The ethyl chloride vapors then pass through line 44 to the compressor where they are again compressed and the cycle repeated. As the temperature in the refrigerator drops, the vapor pressure of the liquid ethyl chloride in the boiler also drops and a vacuum is produced on the low side of the compressor. A movement of the diaphragm is thus caused and motor 4 is stopped. Motor 4 will then remain inactive until the temperature in the boiler rises sufficiently to render the vapor pressure of the ethyl chloride liquid sufficient to again close the circuit through the motor.

During the above operation, the lubricating oil circulates from the compressor into the separator and thence back through heater 62 to the compressor. As it passes through the heater the temperature rises sufficiently to cause an evolution of the dissolved ethyl chloride vapors which pass upwardly into the separator and thence out through separator tube 18. It will thus be seen that substantial dilution of the lubricant by ethyl chloride is effectively prevented.

To best illustrate the action of the defrosting valve 42, the results obtained by closing down the apparatus by interrupting the circuit through the motor 4 will first be considered. Also let it be assumed that sump 46 is not present in the line. If the motor is thus stopped, the temperature of the boiler will rise and the liquid therein will be converted into vapor. It is common when using a refrigerator in a home to have the refrigerator upstairs and the compressor unit in the cellar

which during the winter may become quite cold. The vapors would, under such conditions, pass from the relatively warm boiler and condense in the compressor or lines leading thereto. And if check valve 39 were not present the vapors would pass into solution in the lubricating oil diluting the same. If then, after standing for a time under such conditions, the motor is started, liquid ethyl chloride will be pumped by the compressor into the separator and will mix with the oil causing the liquid level to rise above the open end of tube 18 and consequent flow of lubricant to the boiler from which, of course, it cannot return to the system.

The object of the provision of the sump will now be apparent since it will be seen that it will receive any liquid condensate from line 44. The liquid trapped thereby will then evaporate under reduced pressure and pass to the compressor as a vapor. It will be seen that liquid ethyl chloride will be kept in this way from entering the compressor with consequent dilution or carrying over of the lubricant.

It has been assumed above that the apparatus has been closed down by interrupting the motor circuit otherwise than through switch 60. The apparatus is properly closed down by merely closing valve 42. If this is done the compressor can no longer pump vapors from the boiler and a vacuum is produced in line 44 with resultant stopping of the motor by the opening of switch 60. Breaking of the vacuum by leakage of refrigerant through the compressor backwardly into switch 56 is prevented by check valve 52. If the apparatus is thus closed down, valves 39 and 42 prevent any refrigerant from leaving the boiler and consequently no ethyl chloride except the small amount already in the compressor unit may condense therein. If valve 42 is then opened pressure is restored to line 44 and the compressor started.

While check valve 39 will prevent flow of refrigerant backwards into the condenser and separator when the machine is closed down, there will still be a considerable quantity of refrigerant in the condenser. To prevent the passage of this refrigerant into the separator where it would dissolve in the lubricant, check valve 23 is placed between the condenser and separator. It will be seen therefore that passage of refrigerant into the separator when the machine is closed down is prevented by check valves 23 and 39 and defrosting valve 42.

Valve 42 has been designated as a defrosting valve since closure thereof offers a ready means of stopping the compressor and allowing the temperature of the boiler to rise and frost to melt therefrom. Valve 42 is also useful if any repairs to the compressor unit are to be made since substantially all of the refrigerant is trapped in the boiler and the

apparatus may be dismantled with little loss thereof.

Heater 62 is desirably left heated at all times since the lubricant is thus maintained in a mobile condition irrespective of possible low temperature of the apparatus.

Although the vaporizer in the system described is shown as a boiler it will be understood that any suitable vaporizer, for example, an expansion valve, may be used to produce an expansion or evaporation of the refrigerant.

The oil separator and heater are not claimed herein per se since they form the subject matter of an application, Serial Number 253,962, filed February 13, 1928.

Having now fully described my invention, what I claim and desire to protect by Letters Patent is:—

1. In a refrigerating system, a refrigerant compressor, a vaporizer, a pressure line through which refrigerant passes from the compressor to the vaporizer, a lubricant separator in said pressure line including a spiral tube of small diameter through which fluid from the compressor passes, and a vapor line through which refrigerant passes from the vaporizer to the compressor.

2. In a refrigerating system, a refrigerant compressor, a vaporizer, a pressure line through which refrigerant passes from the compressor to the vaporizer, a lubricant separator in said pressure line, a check valve in said pressure line between the lubricant separator and the vaporizer arranged to allow passage of refrigerant to the vaporizer and to prevent passage of refrigerant therefrom, a vapor line through which refrigerant passes from the vaporizer to the compressor, a pressure responsive device communicating with the vapor line and operative when the pressure in the vapor line drops below a predetermined point to stop the operation of the compressor, and a valve located in said vapor line between the vaporizer and the point of communication between said device and vapor line and operable to close said vapor line.

3. In a refrigerating system, a refrigerant compressor, a vaporizer, a pressure line through which refrigerant passes from the compressor to the vaporizer, a lubricant separator in said pressure line, a condenser in said pressure line between the lubricant separator and the vaporizer, a check valve in said pressure line between the lubricant separator and the condenser arranged to allow passage of refrigerant to the vaporizer and to prevent passage of refrigerant therefrom, a vapor line through which refrigerant passes from the vaporizer to the compressor, a pressure responsive device communicating with the vapor line and operative when the pressure in the vapor line drops below a predetermined point to stop the operation of the

compressor, and a valve located in said vapor line between the vaporizer and the point of communication between said device and vapor line and operable to close said vapor line.

5 In testimony of which invention, I have hereunto set my hand, at Philadelphia, on this fourth day of February, 1928.

FRANK A. BROWNE.

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