Nov. 9, 1954 M. WINGER ET AL 2,693,682

REFRIGERATING SYSTEM WITH DEFROSTING ARRANGEMENT

Filed June 25, 1952 2 Sheets-Sheet 1

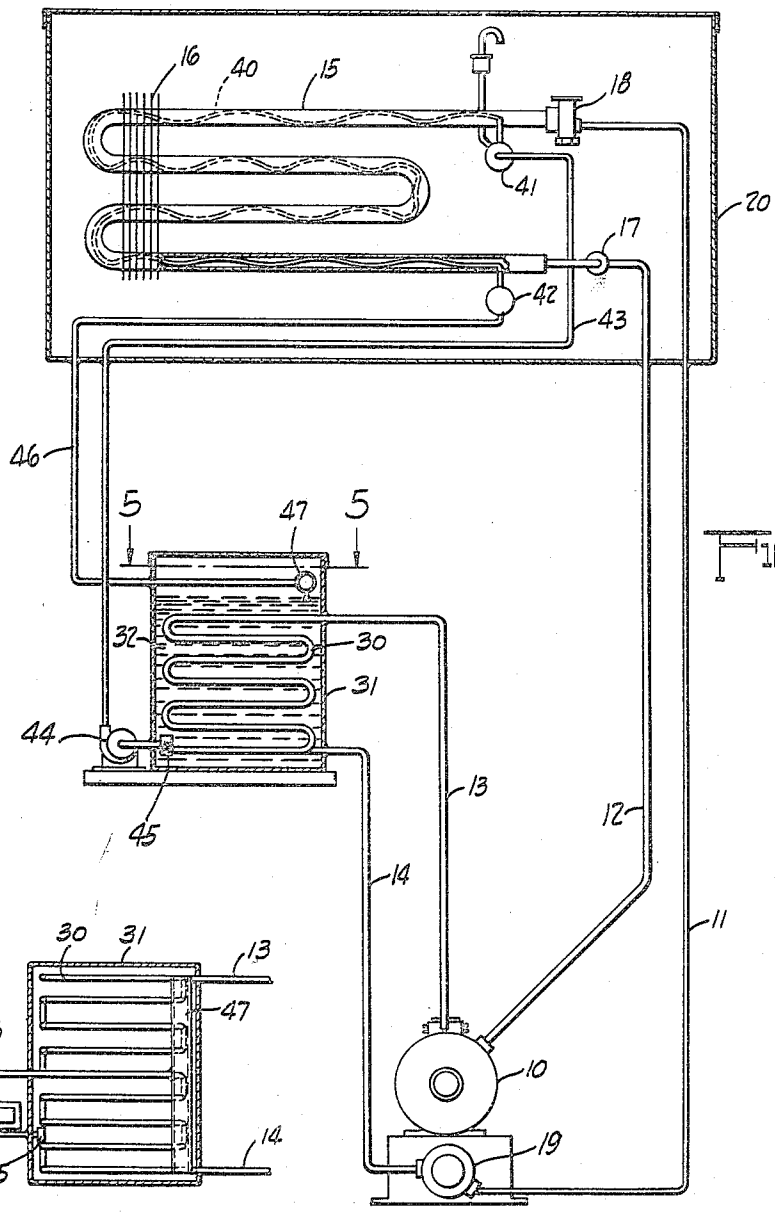


FIG. 1

FIG. 5

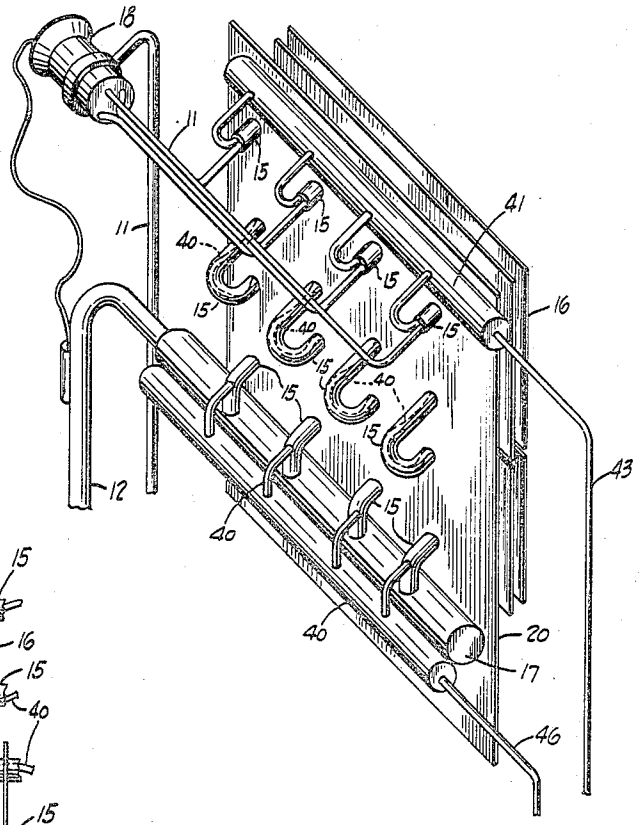
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Filed June 25, 1952 2 Sheets-Sheet 2

FIG. 2



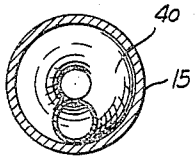


FIG. 6

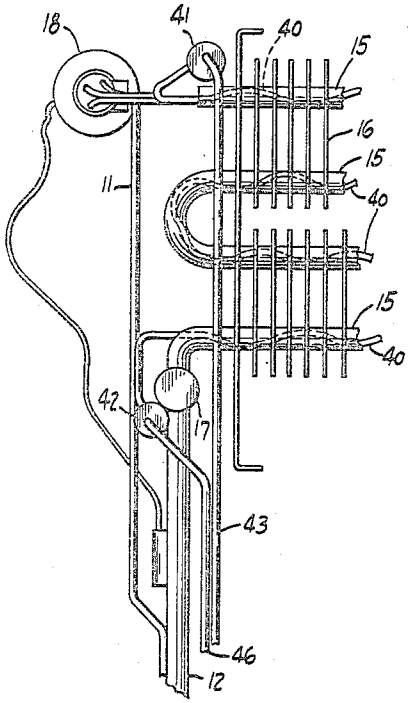


FIG. 3

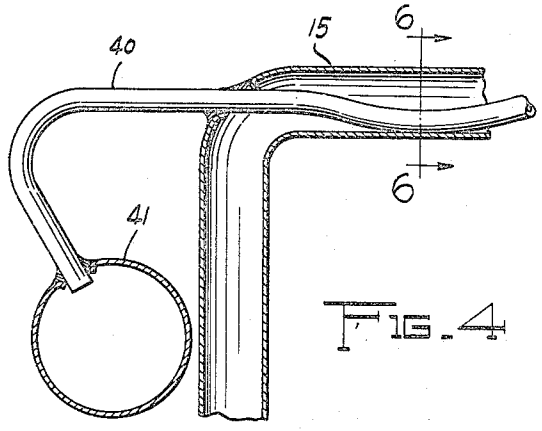


FIG. 4

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REFRIGERATING SYSTEM WITH DEFROSTING ARRANGEMENT

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1 Claim. (Cl. 62—115)

This invention relates to improved apparatus for effecting defrosting of the heat absorbing elements of mechanical refrigerators.

The primary object of this invention is to store and later utilize the heat removed from the area cooled by a mechanical refrigeration system, to periodically defrost the heat absorbing element of said system.

Another object is to provide a closed defrosting circuit that is entirely separate from its associated refrigerating system, but which derives its heat energy solely from the heat given off by the condensing unit of said refrigerating system.

A further object is to provide a method of defrosting a mechanical refrigerating system that uses a captive volume of fluid to cool the refrigerating system condenser, thereby doing away with the large volume of fluid normally necessary in conventional systems.

Still other objects are to provide a defrosting system that is simple in structure, economical in operation and easy to maintain.

These and other objects of the invention will become apparent from a reading of the following specification and claim, together with the accompanying drawings wherein like parts are referred to and indicated by like reference numerals and wherein:

Figure 1 is a schematic outline of a conventional mechanical refrigerating system and the associated defrosting system that is the subject of this invention;

Figure 2 is an end view, in perspective, of the refrigerating element showing the defrost conduit associated therewith;

Figure 3 is a front elevation of one end of the refrigerating element and the defrost conduit associated therewith;

Figure 4 is an enlarged vertical sectional view through a portion of the refrigerating element showing the defrost conduit mounted therein;

Figure 5 is a top plan view of the condenser case taken along the line and in the direction of the arrows **5—5** of the Figure 1; and

Figure 6 is a vertical sectional view taken along the line and in the direction of the arrows **6—6** of the Figure 4.

Referring more particularly to the drawings, there is seen in the Figure 1 a schematic layout of a mechanical refrigeration system having a compression pump **10** connected on its vacuum side to the refrigerating element **20** through the line **12** and on its compression side to the condenser **30** through the line **13**. A second pump **19** draws the liquified refrigerant from the condenser **30** through the line **14** and returns it to the refrigerating element **20** through the line **11**.

The refrigerating element **20** comprises an expansion chamber formed of a plurality of tubes **15** bent back and forth upon themselves in order to occupy a minimum of cubical space. The length, diameter and number of the expansion tubes or elements **15** is dependent upon the capacity of the system which is in turn dependent upon the space or type of material to be refrigerated and the speed with which the area or materials are to be brought to the minimum temperature. In an illustrative system the refrigerating tubes **15** are ⅝" in diameter. One end of each of the refrigerator tubes is brought out to a manifolded expansion valve **18** of the conventional type which is in turn connected to the line **11**. The other end of each tube **15** is connected to a common manifold **17** which is connected to the vacuum side of the pump **10** through the line **12**.

Reference numeral **16** indicates a plurality of closely spaced heat absorption fins through which the tubes **15** run and which act to increase the surface area of the refrigerating element by reason of their mechanical contact with the outside of the tubes **15**.

The condenser **30** consists of a single length of tubing bent back and forth upon itself in the conventional manner and positioned within a liquid tight case **31** which is filled with a coolant fluid **32**, as shown in the Figure 1.

The refrigerating system just described is filled with any one of the well known refrigerating gases such as ammonia, sulfur dioxide, or one of the Freeon gases. The choice of the particular refrigerant being dependent upon safety factors and the lowest temperature which the system is expected to attain and maintain.

Reference numeral **40** indicates a defrost conduit of about ¼" diameter which is shaped in the form of an open helix and positioned with the refrigerating tube **15** as shown in the Figures 1, 2, 3, 4 and 6. There is one of these defrost conduits in each of the tubes **15** that make up the refrigerating element **20**. The diameter of the helix formed by the conduit **40** is such that the conduit will contact the interior of the tube **15** along its entire length as is shown most clearly in the Figures 4 and 6. This intimate contact assures the maximum efficiency in heat transferance between the defrost conduit **40** and the refrigerating tube **15**. One end of each of the conduits **40** is connected to a common intake manifold **41** which in turn is connected through line **43** to the defrost pump **44**. The other end of each conduit **40** is connected to a common exhaust manifold **42** that is connected by means of line **46** to a spray manifold **47** located near the top of the condenser case **30**. Reference numeral **45** indicates a screened outlet located at the bottom of the case **30** which leads to the vacuum side of the defroster pump **44**.

The condenser case or tank **30** is filled with a liquid fluid such as a light oil whose solidification point is a safe distance below the minimum temperature expected to be developed within the refrigerating element tubes **15**. The fluid capacity of the case **30** is dependent upon the use to which the refrigerating system is to be put. In the case of a system that is intended to hold approximately 2000 lbs. of meat at a constant freezing temperature in a 6 x 8 foot freezer, a one horse-power installation will be required, in which case approximately 10 gallons of oil will be needed. The quantity of fluid will of course vary with the capacity of the system, the amount of heat to be extracted and the heat storing factor of the oil or other fluid mixture that is used.

In operation, the refrigerating system acts in the conventional manner, the liquified refrigerant being delivered by the pump **19** to the expansion valve **18** through which it enters the refrigerating tubes **15** which are kept under partial vacuum by the pump **10**. The expanding refrigerant draws heat from the area surrounding the finned tubes **15**. The presence of the helical defrost conduit **40** within the refrigerating tube **15** causes the expanding refrigerant to be swirled around inside the tube **15** thereby making for more uniform and speedier cooling action the full length of the tube than occurs in conventional installations having unobstructed tube bores.

The expanded refrigerant, now in gaseous form, is drawn through the manifold **17** and line **12** by the pump **10** which then compresses the gas and sends it through the line **13** to the oil cooled condenser **30**. The refrigerant now contains both the heat of expansion and compression which is absorbed by the oil bath **32**. At the pressure under which the refrigerant is held in the condenser, the lowering of the temperature of the refrigerant due to the absorption of its heat by the oil **32** causes the refrigerant to become liquid. The liquid refrigerant is then returned to the expansion valve through the line **14** and pump **19** to repeat the cycle. As the cycles are continuously repeated, the heat absorbed by the condenser oil **32** accumulates until the temperature of the oil **32** may rise as high as 100° F. or more. At the same time, water vapor within the refrigerated area condenses upon the fins and tubes **16** and **15** respectively in the form of frost which eventually acts to insulate the

tubes **15** which seriously reduces the efficiency of the system.

The refrigerating element **20** is defrosted by stopping the refrigeration cycle and activating the defroster pump **44**. Hot oil is drawn from the bottom of the case **30** through the screened outlet **45** by the pump **44** and delivered to the defrost conduit **40** through the line **43** and manifold **41**. The hot oil then passes through the conduit **40** and is returned to the case **30** through the exhaust manifold **42** and line **46**. The oil which has given up a part of its heat by passage through the conduit **40** is sprayed back into the bulk of hot oil in the case, through the manifold **47** which has a number of small spray holes along the lower face thereof. The cooled oil then mixes with the oil remaining in the case to equalize the average temperature of the defrost oil as a whole. The oil is then re-circulated through the defrost system until the frost on the tubes **15** is melted. Inasmuch as the oil is at a temperature of approximately 100° F. to begin with and the refrigerating tubes **15** may be at −30° or −40° F., there is an instantaneous rise in the temperature of the tubes **15** which quickly defrosts them. Since it is only necessary to raise the temperature of the tubes **15** to 32° F. to assure complete defrosting, the starting temperature of 100° F. of the hot oil is more than adequate to do this and especially so since the oil is kept circulating in the defrost system. As soon as the frost is melted, the defrost pump **44** is stopped and the refrigerating compressor **10** is started again. The action of the refrigerating cycle then causes heat to be re-accumulated in the defrost oil **32** in preparation for the next defrosting cycle. Since the defrost system is a closed one, the same oil is used over and over again to both cool the condenser and defrost the system. The cost of operating the defrost system is negligible since the only expense is that of periodically operating the pump **44**. Furthermore, a defrost system of this type will not run out of heat since the volume of the oil can be regulated to store more heat than will ever be needed to defrost the heaviest accumulation of ice. The length of time between defrost cycles is dependent upon the type of work being done. If materials having a high water content are being frozen, more frost will accumulate within a given time than if the system were only performing a holding operation.

A defrost system of this type is most economical in operation because it not only uses the heat derived from the freezing cycle to do the defrosting, but also because the use of a fixed volume of fluid to cool the condenser of the refrigerating unit saves the cost of the great quantity of water which is necessary to operate the conventional commercial refrigerating system.

Furthermore, if this defrost system is used with an air-cooled refrigerating unit, a much smaller volume of air need be handled to provide efficient operation of the system since the excess heat is stored in the defrost oil and put to useful work during the defrost period.

It will now be clear that there is provided a device which accomplishes the objectives heretofore set forth. While the invention has been disclosed in its preferred form, it is to be understood that the specific embodiment thereof as described and illustrated herein is not to be considered in a limited sense as there may be other forms or modifications of the invention which should also be construed to come within the scope of the appended claim.

We claim:

In a refrigerant system, the combination of a tubular refrigerating element normally subject to accumulation of frost thereon, a compressor for circulating refrigerant vapor, a condenser for normally supplying the refrigerant after condensation to the refrigerating element to vaporize therein and cool the same, a case surrounding the condenser, the said case having fluid therein adapted to cool said condenser by receiving the heat of condensation therefrom, a helically wound conduit positioned within the said tubular refrigerating element in continuous contact with the inner wall thereof and extending the full length thereof, a closed conduit circuit including a pump connecting the ends of said conduit with the said fluid filled case, and means for periodically operating the said conduit circuit pump to circulate hot fluid from the case through the conduit to raise the temperature of the refrigerating element sufficient to rapidly defrost the same.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,121,253	McGuffey	June 21, 1938
2,245,454	Baker	June 10, 1941
2,526,032	La Porte	Oct. 17, 1950
2,538,660	Shreve	Jan. 16, 1951