April 9, 1940. G. E. CLANCY 2,196,291

REFRIGERATOR DEFROSTING SYSTEM

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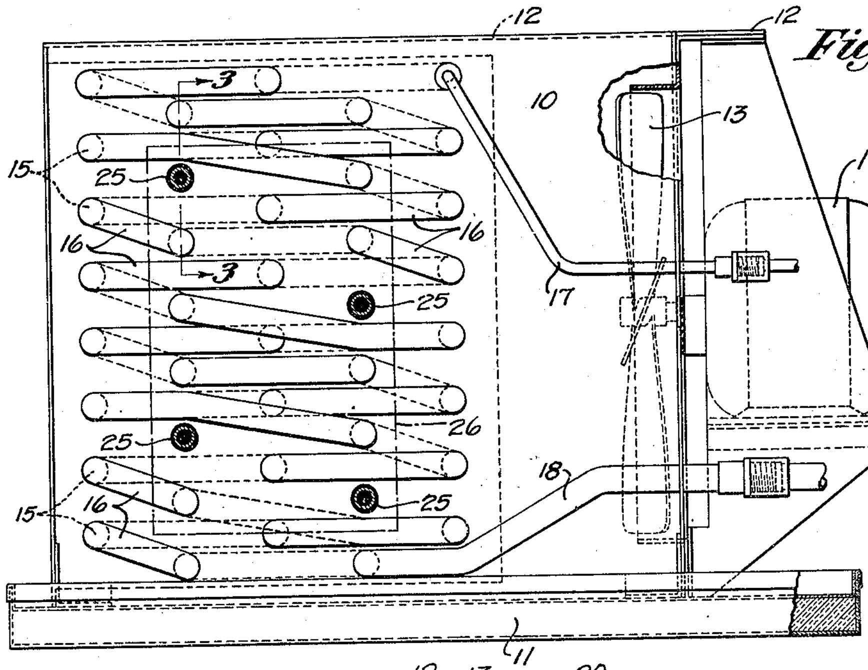
Fig. 1.



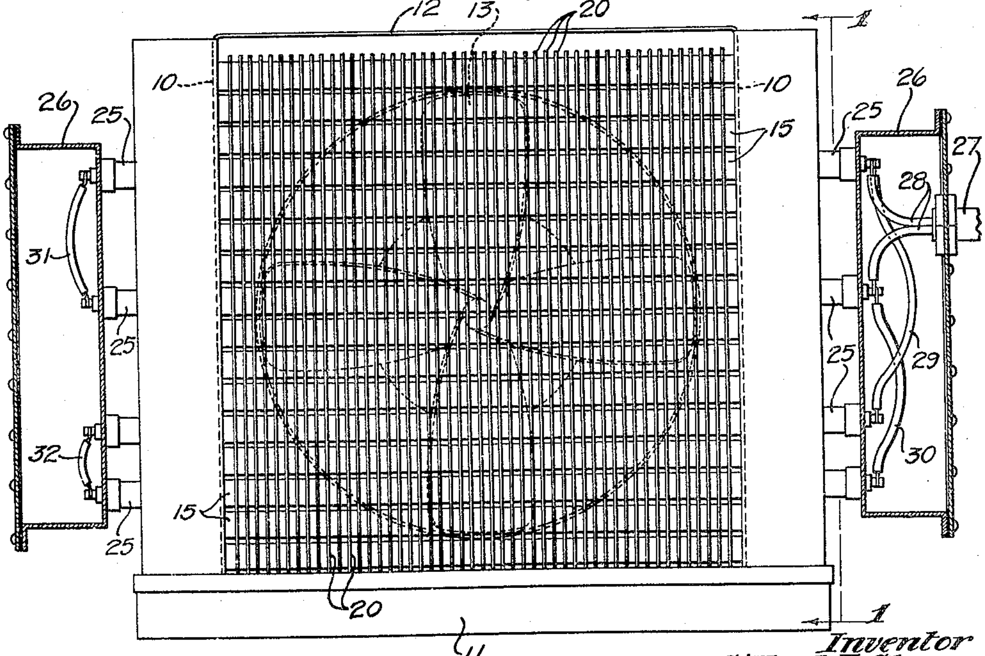


Fig. 2.

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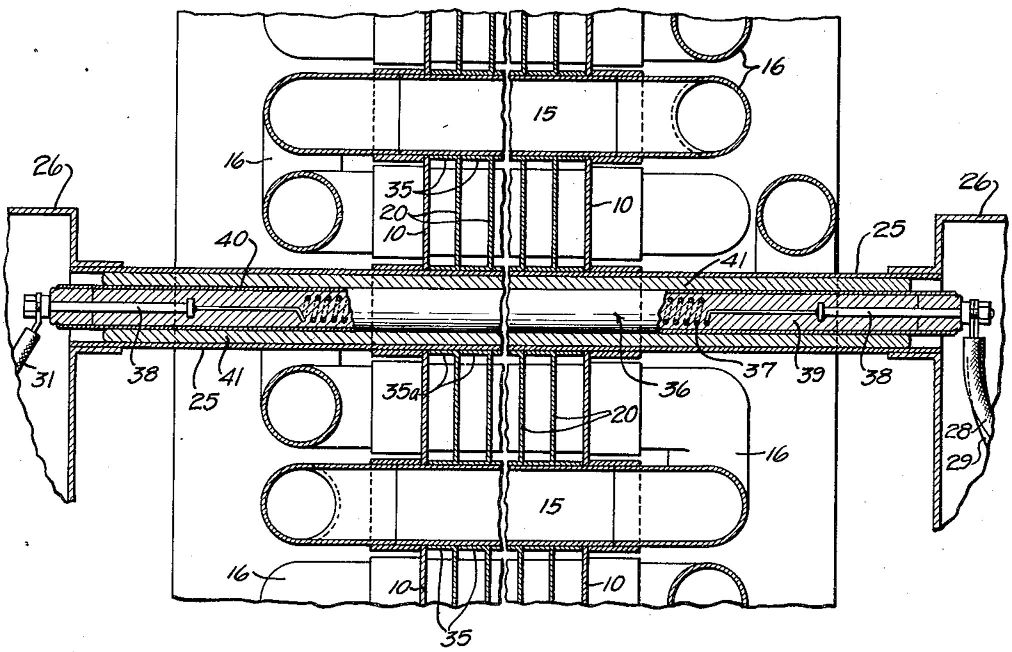
Fig. 3.



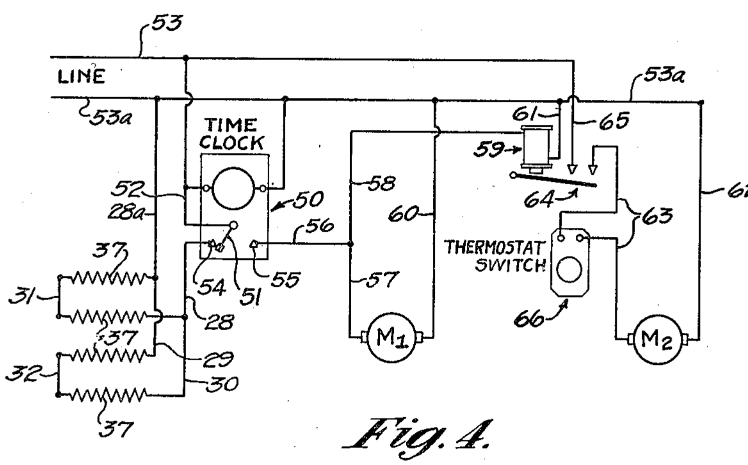


Fig. 4.

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REFRIGERATOR DEFROSTING SYSTEM

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2 Claims. (Cl. 62—115)

This invention has to do with the defrosting of refrigerator units, particularly of that type of refrigerator unit that is used for cooling a circulating air system. It is a general object of the invention to provide a defrosting system of great simplicity and that is easily incorporated with the refrigerating unit, and to provide a system of operation that may be automatically controlled and that achieves efficiency and quick defrosting.

In a type of refrigerating system to which this invention applies, the refrigerating unit is located in an air circulating system, either within the space which is cooled by the refrigerated air, or within a circulating system connected with such space or spaces. Whatever the circulating system may be, the air is usually circulated in a closed circuit through the system and through the refrigerating unit, picking up heat and moisture in the cooling compartments contained in the system, and dropping its heat, and also a part of its contained moisture, as the air passes through the refrigerating unit.

The rate at which frost is thus deposited upon the cooling surfaces of the refrigerating unit varies in different installations, and to a certain extent it varies in any given installation depending upon the kind or quantity of goods which are being cooled. However, for any given installation, and for an average quantity and kind of goods being cooled, it has been found quite practicable to determine a time period for defrosting; and my present invention provides an automatic time control for the defrosting system. Thus, for instance, the system may be defrosted once in each twenty-four hours, the defrosting period lasting say for fifteen minutes. And during the defrosting system the automatic control not only applies heat to the refrigerating unit but also preferably simultaneously stops the circulation of refrigerant and of air.

Another feature of the invention resides in its provision for direct application of heat by metallic conduction, directly to the heat conducting elements of the refrigerating unit; and resides in the simplicity of design and construction involved in such application of heat. Another feature of the invention resides in the design and construction which enables the application of the heating elements to the refrigerator unit without any other change or modification in the design of the refrigerator unit.

The invention will be most fully understood from a consideration of the accompanying drawings and the following specification, wherein a preferred and illustrative form of the invention is described in detail.

In the drawings:

Fig. 1 is a side elevation, with parts broken away and with parts shown in section on line 1—1 of Fig. 2, of a typical refrigerating unit equipped with my invention;

Fig. 2 is an end elevation of the same with parts in section;

Fig. 3 is an enlarged fragmentary section taken as indicated by line 3—3 on Fig. 1; and

Fig. 4 is a diagram indicating the automatic electrical control of the defrosting system.

The typical refrigerator unit shown in the drawings comprises an open-ended casing with side walls 10, base 11 and top wall 12. In one end of this casing an air circulating fan 13 is driven by motor M1. Extending across the interior of the casing is a bank of refrigerant tubes 15, connected at their ends by return bends 16 in such a manner that all the tubes are interconnected, as here shown, in a continuous series. The connecting pipes 17 and 18 provide the means for circulating the refrigerant through the series of tubes. The refrigerating system to which pipes 17 and 18 connect is not shown and is not necessary to describe, as it may be of any standard kind. It is only necessary to mention that the motor M2 shown in Fig. 4 is the compressor driving motor of the refrigerating system, and is thus the motor which causes the circulation of the refrigerant.

A series of air cooling fins 20 is mounted within the refrigerating unit casing, these fins lying in planes longitudinal of the casing, being preferably equally spaced apart, and joined in metallic heat conductive relation to the refrigerating tubes. The refrigerating tubes themselves, as will be seen best from inspection of Fig. 1, are spaced from each other and preferably although not necessarily arranged in staggered relation, so as to allow for relatively free and unobstructed flow of air longitudinally through the space between the fins. The staggered spacing of the refrigerating tubes is, for the main part, regular and symmetric with relation to a central longitudinal plane through the center of the bank of tubes. However, at certain locations in the bank of tubes, as illustrated in Fig. 1, a refrigerating tube is omitted and its place is taken by a heater tube 25. Or, the arrangement of all the tubes, including both refrigerating and heating, may be described by saying that the bank of tubes includes a fully symmetric arrangement of spaced tubes, some of which, though in practice relatively few, are utilized for heating and defrosting purposes, and not for the purpose of carrying the refrigerant. As will be noted later, however, those tubes which are utilized for heating purposes are also utilized for air cooling functions when the refrigerating unit is in its normal operation and air is being circulated through it.

In a typical refrigerating unit of the size and proportions here illustrated, I may utilize say four tubes 25 as heating tubes. And in Fig. 1 it will be plainly seen, without the necessity of detailed description, that each one of these heating tubes 25 takes the place or position of what would otherwise be a refrigerating tube in a fully symmetric arrangement of refrigerating tubes only.

The four heater tubes 25 that are shown in the drawings project their ends beyond the side walls 10 of the casing, and their ends enter or are otherwise tightly joined with electrical conduit boxes 26, arranged one at each side of the refrigerating unit and containing the electrical connections for the heaters. A conduit 27 enters one of the boxes 26 to carry the current supply to wires 28 which carry current to the heaters. And in this mentioned conduit box 26 the connecting wires 29 and 30, and in the other conduit box 26 the connecting wires 31 and 32, so interconnect the heaters that they are connected to the supply wires 28 in two sets, each of which contains two heaters in series.

As shown in detail in Figure 3, each refrigerant tube 15 is set in each of the fins 20 in such a manner as to have direct metallic heat conduction therefrom. Each of the fins has, around each opening through which a tube passes, a cylindric lip or flange 35 which is preferably of such length as to contact with the next adjacent fin, and is of such internal diameter that tube 15 fits tightly within it. The tube 15 is forced through the flanged openings in the assembled fin structure, and then tube 15 is expanded in diameter, by use of a suitable internal expanding tool, so that the tube then fits the fin flanges 35 very tightly.

The foregoing describes the method of assembly when the refrigerating unit, or the tubes, are of copper or some similar metal. Some units, or tubes, are however made of steel or similar metal. In that case, instead of expanding the tubes they are first fitted snugly in the fin structure and then the whole assembly hot-galvanized. But, obviously, the tubes may be assembled with the fin structure in any other suitable manner that provides direct metallic heat conduction.

The heater tubes 25 are mounted in and are thermally joined to the fins in the same manner, the fins having the flanges 35*a* surrounding and engaging the heater tubes in the same manner as just described, and the tubes 25 being expanded in the same manner as described. The heater tube is thus in direct heat conductive relation with the metal fins.

Inside each heater tube there is a heating element, designated generally by the numeral 36, tubular in form and preferably somewhat smaller in diameter than the internal diameter of tube 25. This heating element 36 comprises a resistance coil 37 connected to suitable leads 38 which extend to the outer ends of the heating element. The resistance element 37 is embedded in and enclosed by a cylindric body 39 of suitable material, as manganese dioxide. Surrounding the rod shaped body of material 39, the heater element has an outer metallic tubular container 40. The heating element, such as described, is inserted in place within the heater tube 25, and then the annular space between them is filled with some suitable metallic heat conductor, as shown at 41. For instance, lead is suitable for this purpose. As a result of this construction and arrangement it will be seen that the heating element is in direct metallic heat conductive relation to the fin structure.

A suitable circuiting for the automatic control of the defrosting apparatus is shown in Fig. 4. The time clock shown at 50 may be of any suitable type which may be set to control the circuits at periodic intervals. In the diagram the time clock is shown as having a switch arm 51 connected to wire 52 which leads from one supply line 53. In one position of the switch arm 51 it engages contact 54 which is connected to the lead 28 that goes to the sets of resistance elements 37. The other lead 28*a* going to the resistance elements is connected to the other supply line 53*a*. In the other position of the time clock switch arm 51 it engages a contact 55 which connects by wire 56 with the wires 57 and 58 which go, respectively, to the fan motor M1 and to relay winding 59. The other side of fan motor M1 is connected by wire 60 to supply line 53*a*, and the other side of the relay winding is connected by wire 61 to the supply line 53*a*. One side of compressor motor M2 is connected by wire 62 with supply line 53*a*; the other side of motor M2 is connected by wire 63 through thermostatic switch 66 with one contact of relay switch 64, the other contact of the relay being connected by wire 65 with supply line 53. The usual thermostatic switch 66 is inserted in the wire 63 for thermostatic control of compressor motor M2, for controlling and maintaining the desired refrigerating temperature.

In normal operation the switch arm 51 of the time clock is in engagement with contact 55, thus breaking the circuit to the resistance elements 37 and completing the circuit of fan motor M1 (from supply line 53, through wire 52, switch arm 51, contact 55, wires 56 and 57, motor M1, and wire 60 to supply line 53*a*) and also closing the circuit of relay 59 (from wire 56 through wire 58, the winding of the relay and wire 61 at supply line 53*a*). The relay, energized, closes the circuit at its switch 64, and thus closes the circuit of compressor motor M2 (supply line 53, wire 65, relay switch 64, wire 63, motor M2, and wire 62 back to supply line 53*a*).

During normal operation, when refrigerant is being circulated through the refrigerating tubes 15, and fan 13 is operating to circulate air through the refrigerating unit, the air will be cooled not only by contact with the fin structure, but also by direct contact with the refrigerating tubes 15, or the fin flanges 35 which are in thermal contact with those tubes. Also, the heater tubes 25, or the fine flanges 35*a* which immediately thermally contact the heater tubes, present effective cooling surfaces to the air flowing through the fin structure. During normal operation the heater tube structure thus affords the same heat conductive inter-connection between the several fins as do the refrigerating tubes; and also, like the refrigerating tubes, provides air cooling surfaces.

When the time clock operates to defrost the refrigerating unit, the switch arm 51 is thrown to the position shown in Fig. 4. The circuit to both motors M1 and M2 is thus broken and circulation of both refrigerant and air is stopped. By stopping the circulation of refrigerant it results that the heat supplied to the refrigerating unit for purposes of defrosting will not be carried away by the circulating refrigerating medium. By stopping the circulation of air, it is provided that the heat supplied for defrosting will not be carried away by circulating air and will not be carried into other parts of the system where goods are being cooled.

At the same time that the circuits of the motors M1 and M2 are opened, the circuit leading to the resistance element 37 is closed, and heat is thus applied to the refrigerating unit from the heating elements. The heating elements being in highly efficient heat conductive relation to the fins, and through them to the refrigerating tubes, the supplied heat is substantially evenly distributed through the whole structure, and the deposited frost is quickly and uniformly melted. The time clock will be set to apply the heat and stop circulation for a period sufficient to thoroughly defrost, and then the time clock will again operate its control switch to break the circuit to the resistance elements and again close the circuits to the circulating motors.

Although I have here described, as one preferred method of control, a time controlling system, I have done so only as a matter of preference and as illustrative of various other initial controls that may be utilized. In instance, as will be obvious, the initial control of the system may be by manual operation, or actuated by any other suitable and conveniently usable determining factor that indicates the need of defrosting.

These and various other changes and modifications which will be apparent to those skilled in the art are included within my invention, which is only limited as set out in the appended claims.

I claim:

1. In a refrigerating system having a refrigerating unit comprising, an assemblage of a plurality of parallel spaced heat conductive fins and means for circulating a fluid through the fin assemblage in a direction longitudinal of the fin planes, a plurality of identic heat conductive tubes extending transversely through the fin assemblage, each of said tubes being in identic direct metallic heat conductive contact with each of said fins, some of said tubes being refrigerant tubes and others of said tubes being heater tubes, means for circulating refrigerant through the refrigerating tubes, an electrical resistance element within each of the heater tubes and spaced from the tube wall, and a non-heat-insulating filling in the space between the element and the tube wall.

2. In a refrigerating system having a refrigerating unit comprising, an assemblage of a plurality of parallel spaced heat conductive fins and means for circulating a fluid through the fin assemblage in a direction longitudinal of the fin planes, a plurality of identic heat conductive tubes extending transversely through the fin assemblage, each of said tubes being in identic direct metallic heat conductive contact with each of said fins, some of said tubes being refrigerant tubes and others of said tubes being heater tubes, means for circulating refrigerant through the refrigerating tubes, a cylindric electric heating element within each of the heater tubes and annularly spaced therefrom, and a metallic filling for said annular space.

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