Feb. 20, 1940. R. E. GOULD 2,191,198

REFRIGERATING APPARATUS

Filed Feb. 26, 1937 2 Sheets-Sheet 1

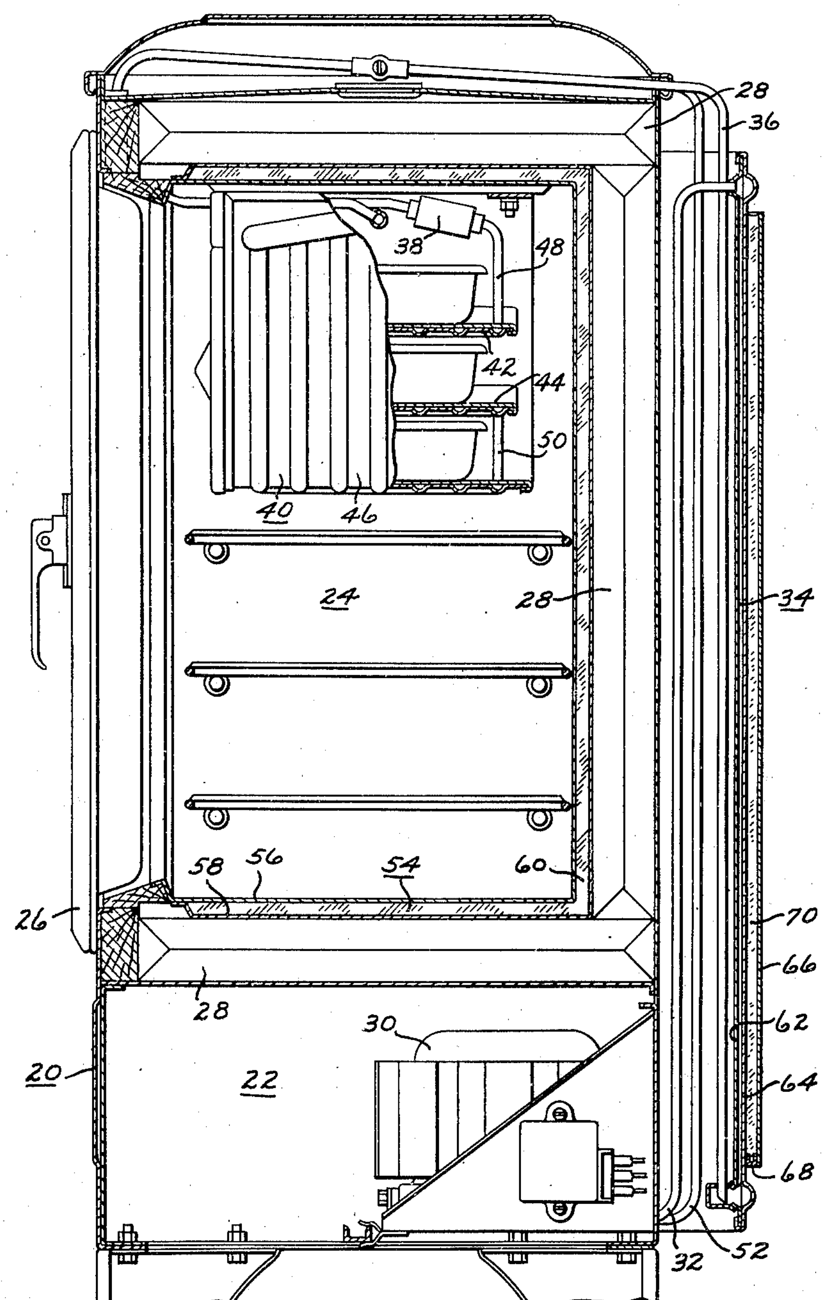


Fig. 1

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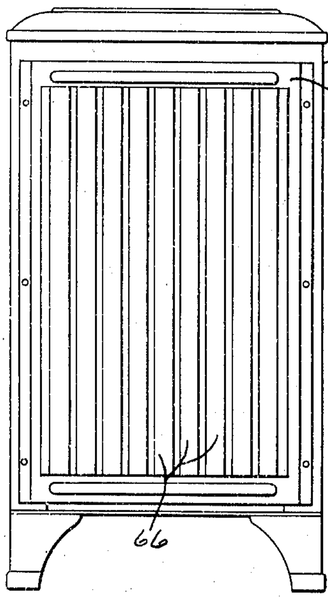


Fig. 2

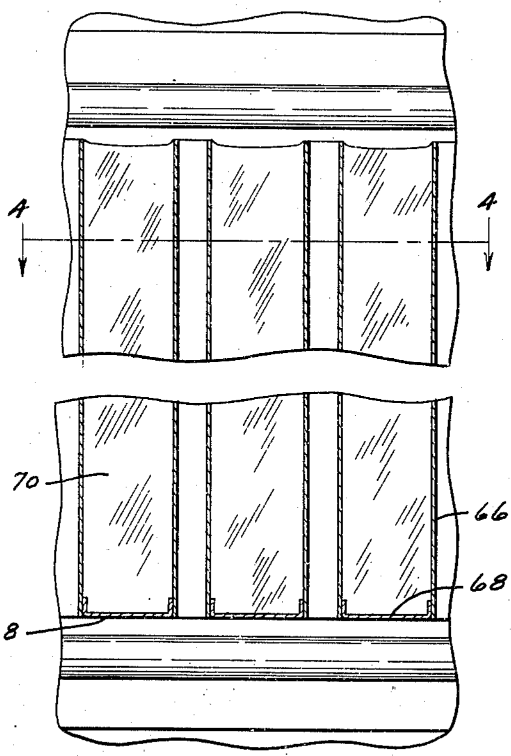


Fig. 3

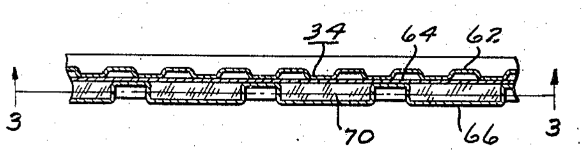


Fig. 4

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2,191,198

## REFRIGERATING APPARATUS

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6 Claims. (Cl. 62—116)

This invention relates to refrigerating apparatus and more particularly to means for relieving heavy load conditions of refrigerating apparatus, particularly household refrigerators.

In order to obtain best freezing in household refrigerators, it is customary to supply liquid refrigerant first to the freezing shelves and thence to the varying surfaces for cooling the air within the cabinet.

In order to meet the standards set for high grade domestic electric refrigerators, it is necessary that a satisfactory box temperature be maintained at a room temperature as high as 110° F. when a full ice freezing load and a full food load are applied simultaneously. This, of course, provides a refrigeration demand which is much greater than normal, and consequently it is necessary to provide a refrigerating system having under ordinary circumstances an excess capacity to take care of this. This makes the apparatus more expensive in first cost and less efficient in operation under ordinary conditions.

One of the causes of the excessive load upon the motor-compressor unit under maximum ice freezing and refrigerating conditions is that the head pressure or condenser pressure rises abnormally when warm ice trays are placed within the cooling unit under high room temperature conditions.

It is an object of my invention to provide means for reducing the peak load in such a system by providing a congealed liquid which will assume a portion of the refrigerating load under peak load conditions.

It is another object of my invention to provide a refrigerator provided with a less than customary refrigerating capacity and having means for reducing and distributing the peak refrigerating loads.

It is another object of my invention to provide a domestic refrigerator with a hollow walled food compartment liner provided with a congealed liquid adapted to provide refrigeration whenever the food compartment temperature rises above normal.

It is another object of my invention to provide a natural draft air cooled condenser with means for providing additional cooling when condensing temperatures and pressure rises abnormally.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is the vertical section of a domestic electric refrigerator using my invention;

Fig. 2 is a view of the back of the refrigerator cabinet shown in Fig. 1;

Fig. 3 is a vertical sectional view of the condenser taken along the line **3—3** of Fig. 4; and

Fig. 4 is the sectional view taken on the line **4—4** of Fig. 3.

Briefly, in the drawings, I have disclosed a domestic electrical refrigerator provided with a natural draft condenser at the back of the cabinet. The evaporator within the food compartment is provided with refrigerated shelves which first receive the liquid refrigerant from the condenser, after which the refrigerant is supplied to hollow metal walls forming the outer surface of the cooling unit for cooling the air within the food compartment. The condenser is provided with a jacket extending over one of its surfaces which contains congealed liquid adapted to melt between 150 and 160° F. The inner liner is also provided with a jacket containing a congealed liquid which preferably melts at about 48° F. These bodies of congealed liquid supplement each other in reducing the load upon the compressor during peak load conditions and help to maintain proper refrigerating conditions.

Referring now to the drawings and more particularly to Fig. 1, there is shown a domestic electric refrigerator having a cabinet formed of outer sheet metal walls **20** provided with a machine compartment **22** and a food compartment **24**. The food compartment **24** is provided with an insulated door **26** and is surrounded by insulating slabs **28** at the top, bottom, sides and back of the cabinet.

Within the machine compartment **22** is a sealed motor-compressor unit **30** which is cooled by a natural circulation of air surrounding it. This motor-compressor unit compresses the refrigerant and feeds the compressed refrigerant through a supply conduit **32** to a flat plate type condenser **34** which is fastened to the back of the cabinet. Within this condenser **34** the compressed refrigerant is cooled and liquefied. The liquefied refrigerant is cooled at the bottom of the condenser and is forwarded through a supply conduit **36** to an elongated orifice, commonly called a restrictor. This restrictor **38** controls the flow of liquid refrigerant into the cooling unit **40**.

The cooling unit **40** is provided with hollow ice tray shelves **42** and **44** which are enclosed within hollow metal walls 46 which form the outer walls of the cooling unit 40. The liquid refrigerant from the restrictor 38 first passes through a conduit 48 to the upper shelf 42 from which the refrigerant passes into the lower freezing shelf 44. After the refrigerant passes through the lower freezing shelf 44, it is conducted through a conduit 50 to the hollow outer walls of the evaporator 46 where it cools the air within the food compartment 24. After the refrigerant passes through the hollow walls of the cooling unit 40, it becomes completely evaporated and is returned through the compressor through the return conduit 52.

In such a system, under normal conditions, even at high room temperatures, it is possible to maintain a temperature of the food compartment at a satisfactory refrigerating temperature with a comparatively small motor-compressor unit and condenser. However, when operating in a warm room and when ice trays filled with warm water are placed upon the hollow refrigerated shelves 42 and 44, substantially all of the liquid refrigerant supplied to the cooling unit is evaporated within these hollow freezing shelves and little or no liquid refrigerant is left to evaporate and cool the outer walls 46 of the cooling unit. This causes the pressure of the evaporated refrigerant to rise and also causes a rise in temperature of the air in the food compartment, often above the proper refrigerating temperatures. The rise in evaporator pressure causes the compressor to compress more gas which in turn causes the rise in head or condenser pressure. This rise in head or condenser pressure imposes a greater load upon the compressor and the motor driving the compressor. At the same time, it is possible for warm food to be placed in the food compartment, thus adding to the refrigerating load.

It must be remembered that this condition is very unusual and continues until the water in the ice trays is frozen. It is seldom that all the trays are filled with water and warm food placed in the food compartment at the same time under the maximum room temperature conditions. Thus, under ordinary conditions, the refrigerating load is much less.

In my invention, I provide means for maintaining proper refrigerating temperature in the food compartment under such conditions and for maintaining a more constant condenser pressure and temperature.

In order to do this, I provide a hollow walled inner liner member 54 formed of the ordinary inner liner 56 and a jacket 58 which surrounds the member 56. Between the metal members 56 and 58, I provide a congealed liquid 60 which preferably has a congealing and melting temperature between 45 and 50° F. More specifically, I prefer that this temperature be about 48°, but it may be varied according to the particular conditions it is desired to maintain. One example of such a congealed liquid which I deem suitable is 1-4 dioxan (CH2—O—CH2—CH2—O—CH2). This liquid when absolutely pure has a melting point and a congealing point of about 50° F. It is completely miscible with water and with a small percentage of water its freezing point may be lowered to about 48°. If it contains about 5% water, the freezing and melting point of this liquid is about 45° F.

Instead of 1-4 dioxan, butyl stearate with a small amount of carbon-tetra-chloride may be used. Pure butyl stearate melts at about 60° and the addition of a small amount of carbon-tetra-chloride will lower the melting temperature to about 48°. From 5 to 10% carbon-tetra-chloride may be used to bring this melting point down to refrigerating temperature.

Thus, by providing this congealed liquid which melts at about 48° F. whenever there is insufficient refrigeration to maintain the temperature of the food compartment 24 below 48° F. or the melting temperature of the congealed liquid, the congealed liquid will melt and provide refrigeration in maintaining the food compartment 24 at about 48° until the congealed liquid has entirely melted. The congealed liquid should be sufficient in amount to provide refrigeration over a period of time equal or greater than the normal freezing time in the warmest room temperature likely to be encountered. After the freezing period, the cooling unit provides more refrigeration to the food compartment, thus reducing the temperature of the food compartment and the temperature of the liquid below its congealing point, so that the liquid is again congealed and ready for another freezing period.

The condenser 34 is made of an inner sheet 62 and an outer sheet 64 which are fused together to provide a hollow metal member within which the refrigerant is condensed. Under conditions of heavy load when warm ice trays are placed on the shelves within the cabinet, the pressure within the condenser rises because more refrigerant is forced into it, and it cannot condense at this rate unless the temperature rises. Because of this condition, the refrigerant condenses more rapidly and fills a portion of the condenser. This reduces the condensing area, causing a further rise in condenser pressure. In order to prevent this abnormal rise in condensing pressure, I provide a jacket 66 which is fused to outer sheet 64 of the condenser. This jacket is formed of a zigzag sheet of metal, which when affused to the outer sheet 64 of the condenser, provides vertical enclosures, each of which is sealed at the bottom by additional members 68. These vertical enclosures are provided with a congealed liquid designated by the reference character 70.

One example of a congealed liquid I propose to employ in this jacket is paraffin, having a melting point of 155° F. and a latent heat of fusion of 42 calories per gram or 46 B. t. u. per pound. Another example is diphenyl, which congeals and melts at about 158° F. It has a latent heat of fusion of about 28.8 calories per gram. A third example is stearic acid which melts at about 156° F. and has a latent heat of fusion of 47.6 calories per gram. When found necessary, a chromatic inhibitor may be employed with any one of the congealed liquids in order to prevent corrosion. However, some of these materials are relatively inert and will cause little or no corrosion.

By providing the congealed liquid upon the back of the condenser, whenever warm ice trays are placed within the refrigerator and the condenser pressure and temperature rises above the melting temperature of the congealed liquid, the congealed liquid will melt and in so melting will absorb its latent heat of fusion from the refrigerant in the condenser to limit the condensing temperature to about the melting temperature of the congealed liquid. Sufficient congealed liquid should be provided to cool the condenser refrigerant during a normal freezing period. When the freezing period is over, the condenser temperature will be reduced below the melting and congealing temperatures of the congealed liquid provided on the condenser, so that the congealed liquid will again congeal and be prepared for another ice freezing period at normal demand.

By providing these congealed liquids, it is possible to provide a refrigerator capable of maintaining the same refrigerating temperatures and capable of providing the same refrigerating performance with a refrigerating system and particularly a motor-compressor condenser unit having a lesser capacity. It further makes it possible to design and use a more efficient smaller sized system. However, the use of these congealed liquids in the customary high capacity system will improve the ice freezing and insure the maintenance of proper food compartment temperatures.

It is not necessary that congealed liquids be provided on both the food compartment liner and upon the condenser, but it is only necessary to use one of these bodies of congealed liquid if sufficient capacity is provided in it to reduce the peak load to an amount which can be accommodated by the compressor.

While the form of embodiment of the present invention, as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. Refrigerating apparatus comprising compressing means, condensing means, means for cooling the condensing means, and evaporating means, and a congealable liquid in heat exchange relation with the condensing means and with the cooling means for cooling the condensing means, said congealable liquid having a congealing and melting point above normal condensing temperatures but below excessive condensing temperatures.

2. Refrigerating apparatus including insulated walls enclosing a compartment to be cooled, said compartment being provided with an inner lining member lining the insulated walls, said inner lining member being provided with hollow walls and a congealable liquid within said hollow walls, a refrigerating system including compressing means, air cooled condensing means, said condensing means being provided with a jacket, a congealable liquid in said jacket, a cooling means operably connected to said compressing and condensing means, said cooling means being located in heat exchange relation with the compartment to be cooled.

3. Refrigerating apparatus including insulated walls enclosing a compartment to be cooled, said compartment being provided with an inner lining member lining the insulated walls, said inner lining member being provided with hollow walls and a congealable liquid within said hollow walls, a refrigerating system including compressing means, air cooled condensing means, said condensing means being provided with a jacket, a congealable liquid in said jacket, a cooling means operably connected to said compressing and condensing means, said cooling means being located in heat exchange relation with the compartment to be cooled, said cooling means including an ice freezing section and a compartment cooling section, said cooling means including means for first conducting refrigerant to the ice freezing section and thence conducting the refrigerant to the compartment cooling section.

4. Refrigerating apparatus including liquefying means provided with air cooled condensing means, and an evaporating means, a congealable liquid in heat exchange relation with the condensing means and with the air for cooling the condensing means, said congealable liquid having a congealing and melting point above normal condensing temperatures but below excessive condensing temperatures.

5. Refrigerating apparatus including liquefying means provided with air cooled condensing means, and evaporating means, said condensing means including a container portion for refrigerant and a second container portion containing a congealable liquid, said congealable liquid being in heat exchange relationship with said first mentioned container portion, each of said container portions being exposed directly to the air.

6. Refrigerating apparatus including an insulated household refrigerator cabinet containing an insulated food storage compartment, said compartment being provided with an inner lining member lining the insulated walls, said inner lining member being provided with hollow walls, a congealable liquid within said hollow walls, an evaporating means within said compartment, said evaporating means being provided with means for freezing ice cubes as well as for cooling the air and articles within said compartment, said inner lining member being in heat exchange relation with the air in said compartment and exposed to radiant energy transfer with said evaporating means, and refrigerant liquefying means operatively connected to said evaporating means.

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