Jan. 24, 1950 J. S. BOOTH 2,495,626

TWO-TEMPERATURE REFRIGERATOR

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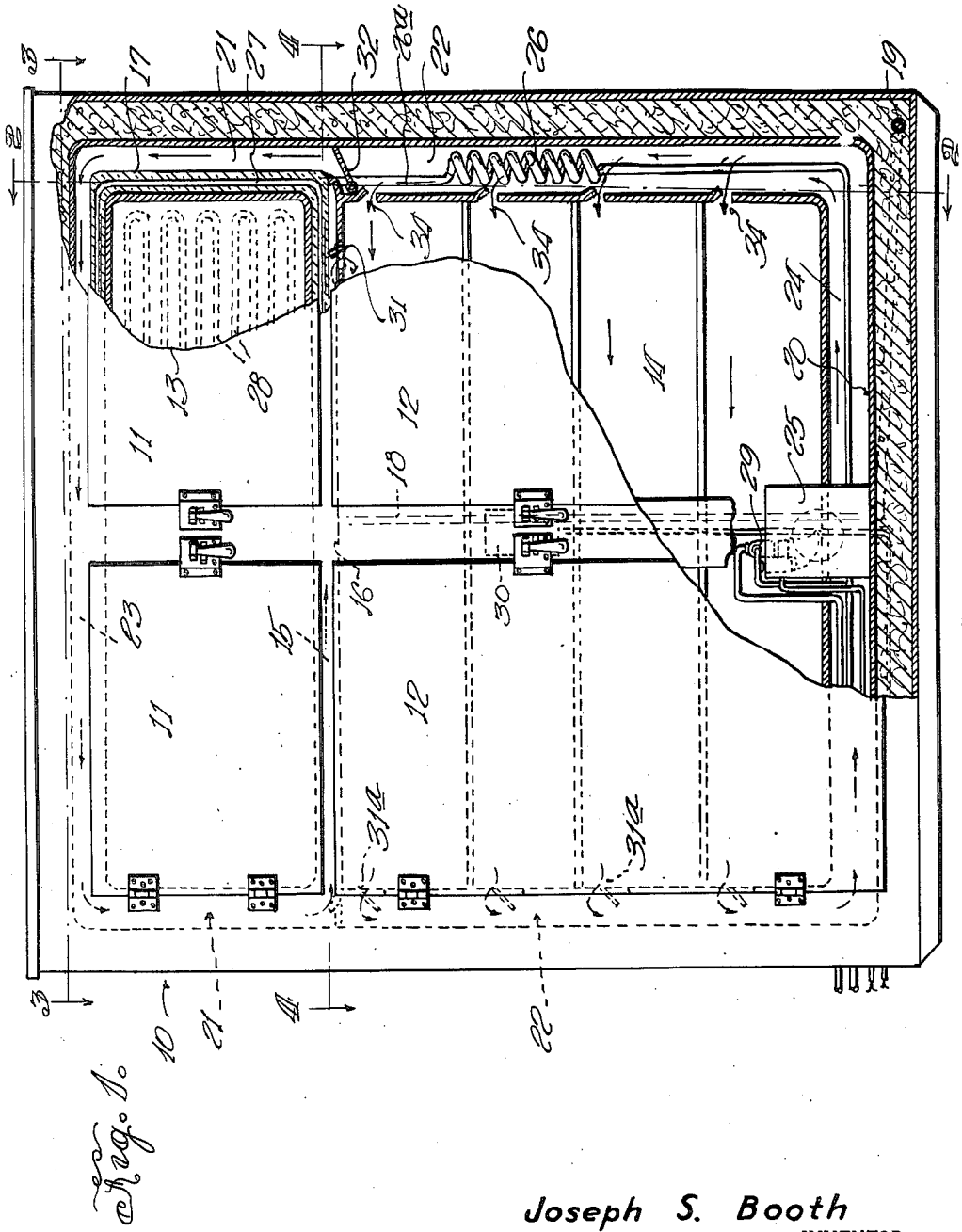


Fig. 1.

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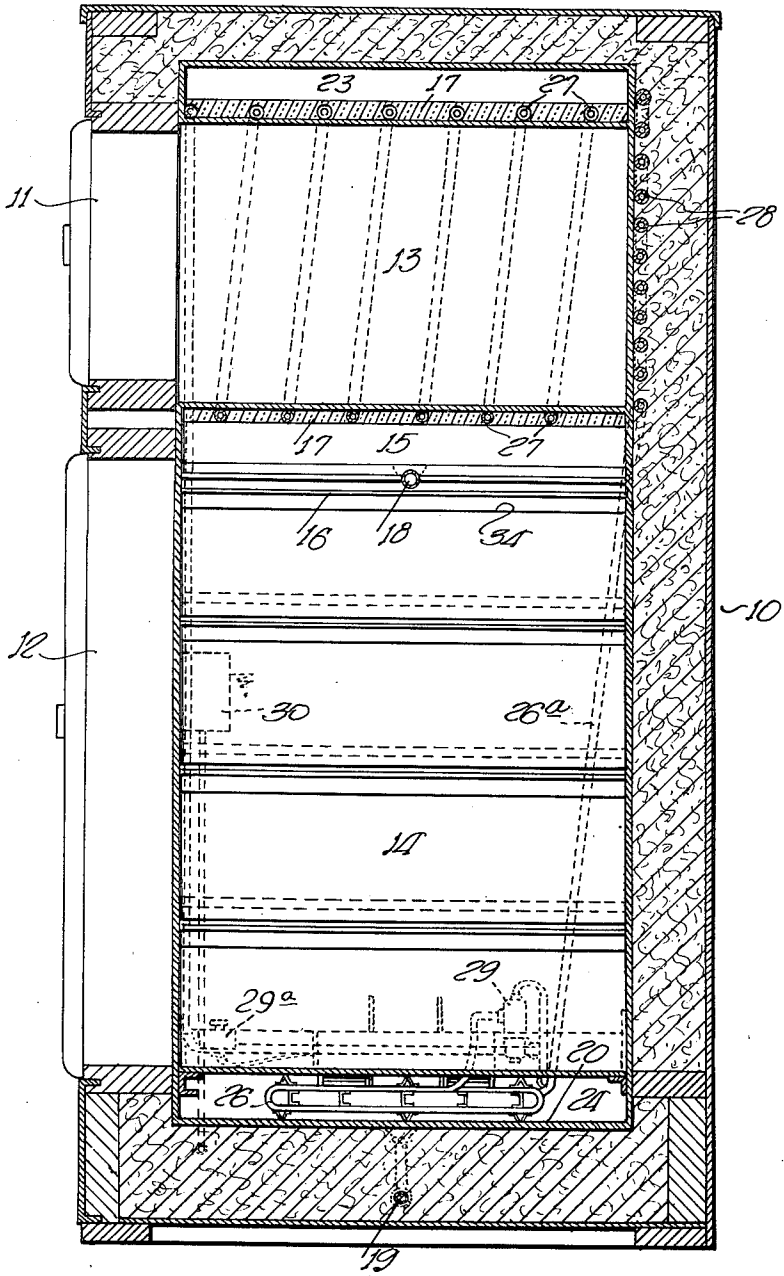


Fig. 2. Joseph S. Booth
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Fig. 3.

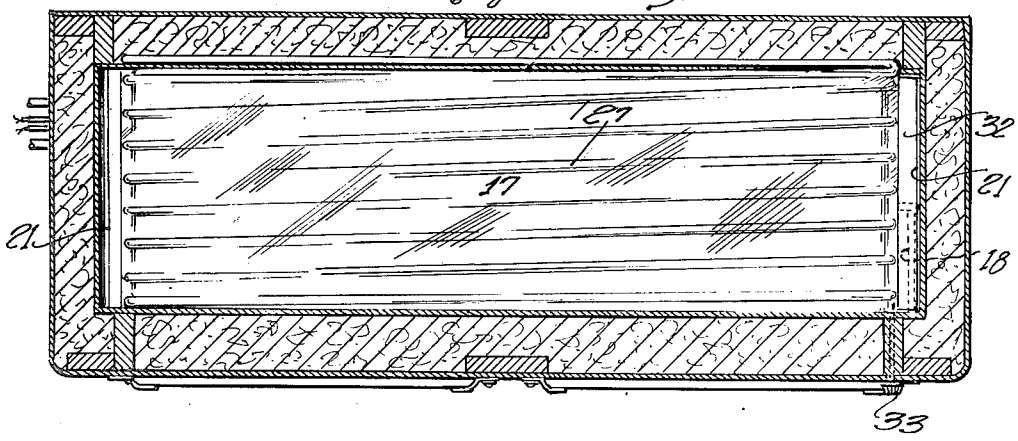
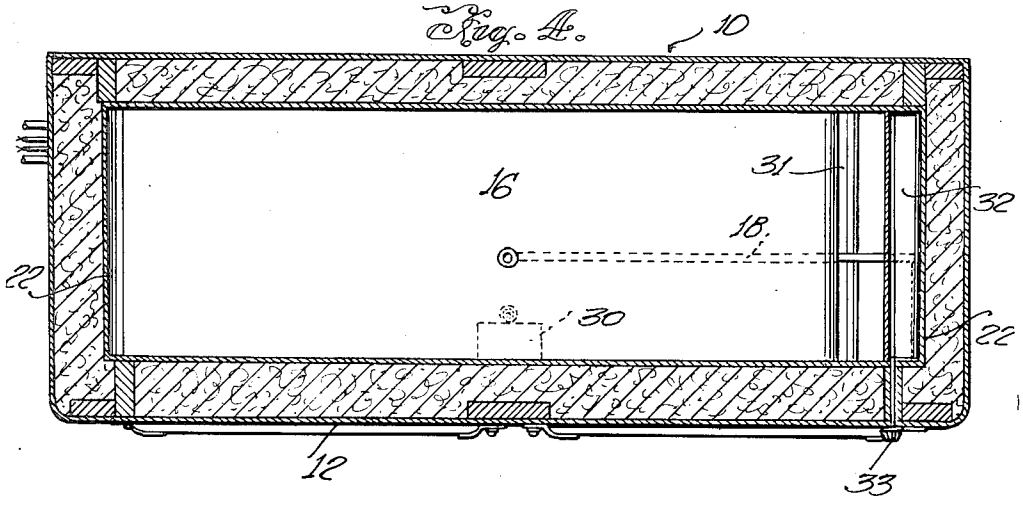


Fig. 4.



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TWO-TEMPERATURE REFRIGERATOR

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3 Claims. (Cl. 62—102)

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This invention relates to refrigerators and more particularly to refrigerators, both domestic and commercial, in which is maintained two separate and predetermined temperatures.

Two temperature refrigeration in a single cabinet is not in itself new since the advantages of the two temperature refrigerator have received increasing recognition with the advent of frozen foods. However, there are certain disadvantages yet to be overcome in refrigerators designed to preserve foodstuffs at or above 32° F. and near zero temperatures at one and the same time. Among these disadvantages is the thermal leakage through the insulated walls of the cabinet, increasing the duration of the on-cycle periods of the refrigerating mechanism and consequently increasing the cost of operation. Moreover, while efforts have been and are continually being made to secure and maintain optimum humidity requirements in food storage compartments of the two temperature refrigerators, dehydration of the foods, especially those having a relatively high rate of evaporation, continues to be the objectionable characteristic of this type of refrigeration.

The principal object of the present invention is to provide a refrigerator having two separate compartments for food storage but which are interconnected by air ducts, the upper of which is held at near zero temperature while the lower compartment is maintained at 32° F. or slightly above by virtue of a freezing coil surrounding the upper compartment, through which a refrigerant is circulated by a compressor unit in still another compartment of the refrigerator. This, combined with air circulated entirely around the upper compartment by forced convection from the lower compartment, causes a blanket of ice to form over the coils of the upper compartment, recurrent meltage of which, during the off-cycle periods of the compressor unit, provides moisture which is carried by air circulation into the lower and food storage compartment of the refrigerator to insure a degree of humidity therein determined by the prevailing temperature in the lower compartment.

Another object of the invention is to provide a two temperature refrigerator in which the coils around the upper compartment and those in the lower compartment are so balanced that a temperature of from zero to 5 degrees F. is maintained in the upper compartment while a temperature of from 32° F. to 36 degrees F. is maintained in the lower compartment.

Still another object of the invention is to provide means in the air duct between the upper and lower compartments of the refrigerator to regulate the volume of air permitted to flow around the upper compartment and to thereby regulate the depth to which ice is permitted to accumulate on the exposed surfaces of the upper or deep freeze compartment.

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With the foregoing objects in view, the invention has particular reference to certain features of accomplishment which will become apparent as the description proceeds, taken in connection with the accompanying drawings, wherein:

Figure 1 is a front elevational view of a two temperature refrigerator constructed according to the present invention, with portions of its walls broken away.

Figure 2 is a side view in vertical section taken on line 2—2 on Figure 1.

Figure 3 is a view in transverse section taken on line 3—3 on Figure 1.

Figure 4 is a view in transverse section, taken on line 4—4 on Figure 1,

Continuing with a more detailed description of the drawings, there is shown a cabinet 10, whose side and rear walls, top and bottom are adequately insulated by generally accepted practices. While a single door may suffice for both, the upper and lower compartments of the cabinet, it is preferred that pairs of doors 11 and 12 be provided for the upper and lower compartments, respectively, so that there will be minimum inflow of heat by permitting the opening of but one chamber at a time to atmosphere, although the coils employed for refrigeration will quickly return an unbalanced temperature of the compartments to normal.

The upper or freezing compartment, identified by reference numeral 13, is separated from the lower food storage compartment 14 only by a transverse air duct 15, below which is a drain pan 16 into which water precipitates from the melting of an ice blanket 17 surrounding the top, bottom and ends of the compartment 13. A drain pipe 18 transfers the water to a common drain outlet 19 for the pan 16 of the upper compartment and the pan 20 of the lower compartment 14.

At each end of the upper compartment 13 is a duct 21, which ducts are but continuations of the vertical ducts 22 alongside the lower compartment 14 and the horizontal duct 23 over the top of the compartment 13.

In the air duct or refrigeration chamber 24 below chamber 14, is a blower 25. A coil 26 is shown as being disposed in the duct 22 at the

right of the cabinet, although this coil or others like it may be placed in the other communicating ducts, as shown in Figure 2. The coil 26 is connected through a downward extending lead 26a to a coil 27 wound lengthwise on the compartment 13 and is convoluted at 28 to lie against the rear wall of the compartment. The convolutions 28 are embedded in the insulation material of the rear wall of the cabinet 10, as shown in Figure 2. Accordingly, the top, bottom and ends of the upper compartment are embraced by sections of the coil exposed to the flow of air in the ducts while the convolutions 28 thereof are not so exposed, yet are effective to preclude leakage of heat through the rear cabinet wall which would otherwise tend to destroy the temperature balance sought to be maintained by raising the temperature of the freezing compartment 13.

A thermostatic expansion valve 29 with its thermostatic control 29a is arranged in the line 26a connecting the coils 23 and 26 and after the line passes over the exposed sides and ends of the compartment 13 and the rear wall thereof to form the coil 27 and the convolutions 28, it continues into the chamber 24 below the storage compartment 14 to form the convection coil 26 as shown in Figure 1. Inasmuch as the refrigerating mechanism of the cabinet embraces none of the features of the invention except in combination herewith, it has been deleted from the drawing and only the lines through which the refrigerant is forced are disclosed, this being essential to a proper understanding of the invention.

The temperature in the freezing chamber is primarily determined by adjustment of the expansion valve 29, whose movement towards closed position lowers the temperature in the chamber 13. A control valve 29a for the refrigerant in the line is disclosed in dotted lines in Fig. 2.

When the desired freezing temperature is reached in chamber 13, the valve 29, in conjunction with a thermostatic control 30, maintain the desired temperatures in the two compartments, that is to say, from zero to 5 degrees F. in compartment 13 and from 32° F. to 36 degrees F. in compartment 14.

In Figure 1 the arrows denote the direction of flow of air as set up by the blower 25. The discharge side of the blower is directed towards the right in this figure, hence the air flow is along duct 24 to the duct 22 at the right of the compartment 14, thence upwardly into duct 21 to the right of the freezing compartment 13, its entrained moisture is deposited onto the colder surfaces of the coil and the compartment walls it congeals into an ice film or blanket 17, entirely surrounding the exposed surfaces of the compartment. Optimum results obtain when the thickness of the ice blanket is such that the coils are entirely covered thereby, the ice serving to insulate the compartment, yet having no effect to retard, but accelerates the function of the coil 27 to reduce the temperature within the compartment 13 to much lower temperatures.

On the suction side of the cabinet, the air is caused to pass downward and across beneath the compartment 13 above the drain pan 16 to the opposite side of the cabinet. At this point, the air is constrained to enter an opening 31 at the top of the lower compartment 14 and flowing in a counter direction across the latter compartment, the air emerges into the vertical duct 22 on the suction side of the cabinet and downward into chamber 24 for recirculation.

It will be understood that until the ice blanket has been created on the compartment 13, the desired temperatures within the two compartments 13 and 14 will not have been obtained. Nor will the desired humidity be present in the lower compartment, because it is through a normal melting process on the surface of the ice blanket that the air in transit collects sufficient moisture to properly humidify the compartment 14 when the temperature therein is sufficiently high to permit. The ice blanket 17, having once been formed, it shields the air from the freezing coil 27 for long periods of time, allowing the same to collect moisture rather than being deprived thereof in passing through the ducts surrounding the freezing chamber, such moisture being, in turn, deposited in the lower compartment 14 to maintain proper humidity therein under stated conditions.

As a means to control the flow of air from the lower compartment around the upper compartment, a damper 32 is pivotally mounted in the upper end of the duct 22 at the right of compartment 14. A control knob 33 is accessible exteriorly of the cabinet for actuating the damper and when the latter is moved towards closed position, a portion of the volume of air flowing upwardly in the duct 22 will be by-passed through the compartment 14 by way of the slots or louvers 34 in the side wall of the compartment, across the same, to emerge at the opposite side through slots or louvers 31a and into the suction duct 22 for recirculation by the blower 25. Conversely, when the damper 32 is opened, the full volume of air flows entirely around the upper compartment and into the lower compartment through the opening 31 in the manner and for the purposes previously set forth.

It is to be understood that convection coils may be arranged at any desired point in the ducts on the discharge or suction side of the blower 25, hence the showing in Figure 1 wherein the coil 26 is shown as being disposed in the vertical duct 21. In so locating the coil, the interim between the time the air crosses the coil 26 and when it comes into contact with the coil 27, is shortened, hence there will be no appreciable increase in temperature, thereby more closely controlling the temperature within the compartment 13.

It is apparent from the foregoing that during the off-cycle of the compressor unit, the blanket of ice which is formed by the circulation of air around the upper compartment during the on-cycle helps during the off-cycle to not only aid in refrigerating the lower compartment, thus causing a longer off-cycle, but also, the ice meltage during this period increases the humidity as stated in the lower compartment which is desirable in the preservation of foodstuffs.

It is likewise apparent that the system of refrigeration herein described is applicable to both domestic and commercial refrigeration including walk-in coolers, reach-in coolers, and various other types of food storage and freezing units.

Manifestly, the construction as shown and described is capable of some modification and such modification as may be construed to fall within the scope and meaning of the appended claims is also considered to be within the spirit and intent of the invention.

What is claimed is:

1. A two temperature refrigerator including a cabinet having an upper and a lower food storage compartment, said upper compartment having an air duct surrounding the same longitudinally, said lower compartment having air passages in

each side wall thereof in communication with said air duct, a coil in said air duct and surrounding said upper compartment longitudinally, coils in said duct and air passages, a blower for creating and maintaining forced circulation of air through said duct and through the air passages of said lower compartment to effect exchange of moisture between the exterior of said upper compartment and the interior of said lower compartment and in passing over said coils, to create on the surfaces of the upper compartment a blanket of ice and means for controlling the passage of air through said ducts and said passages.

2. A two temperature refrigerator including a cabinet having upper and lower compartments maintained at different temperatures, said compartments each having an air duct surrounding the same and discharging into said lower compartment, said ducts being in communication with each other, a coil surrounding said upper compartment, coils in portions of the duct next adjacent to said lower compartment, means for forcibly circulating air through said ducts and said lower compartment over said coils to effect exchange of moisture between the exterior of said upper compartment and the interior of said lower compartment to deposit moisture on the exterior of said upper compartment during on-cycle periods of said refrigerator and to transfer moisture from said exterior surface to the interior of said lower chamber during off-cycle periods, and means for controlling the passage of air through said ducts.

3. A two temperature refrigerator including a cabinet having an upper freezing compartment and a lower food storage compartment, an air duct surrounding each of said compartments and in communication, a coil embracing said upper compartment through which a refrigerant is circulated, a coil in said duct adjacent said lower compartment, means for circulating air through said ducts, around said upper compartment across said coils and through said lower compartment to effect exchange of moisture between the exterior of said upper compartment and the interior of said lower compartment, to create on the exterior of the upper compartment a blanket of ice during on-cycle periods of said refrigerator and to humidify said lower compartment during off-cycle periods thereof and means for controlling said circulation of air.

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