Aug. 8, 1939. F. R. PIERCE 2,168,537

REFRIGERATING APPARATUS

Filed Oct. 14, 1937 2 Sheets-Sheet 1

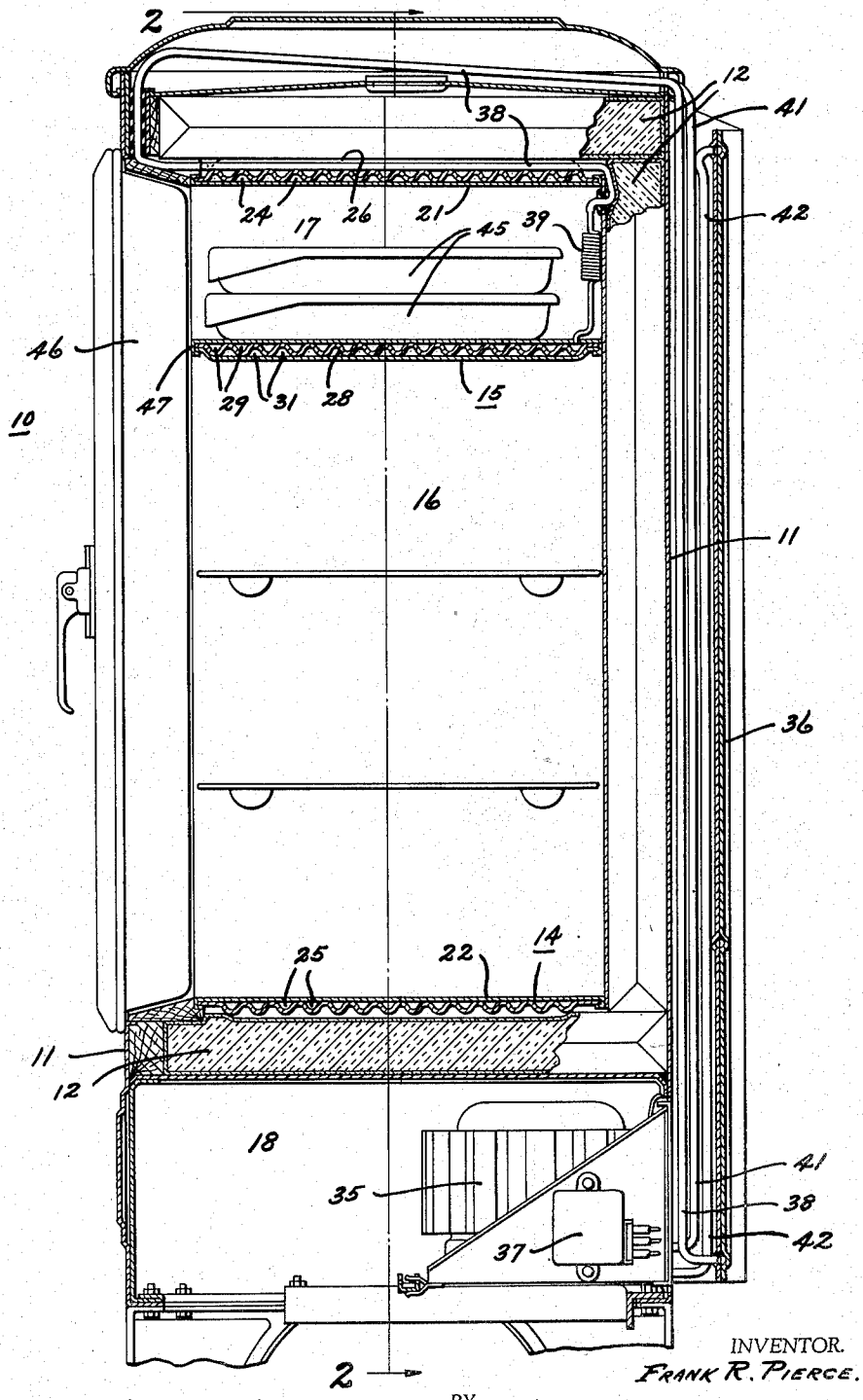

Fig. 1

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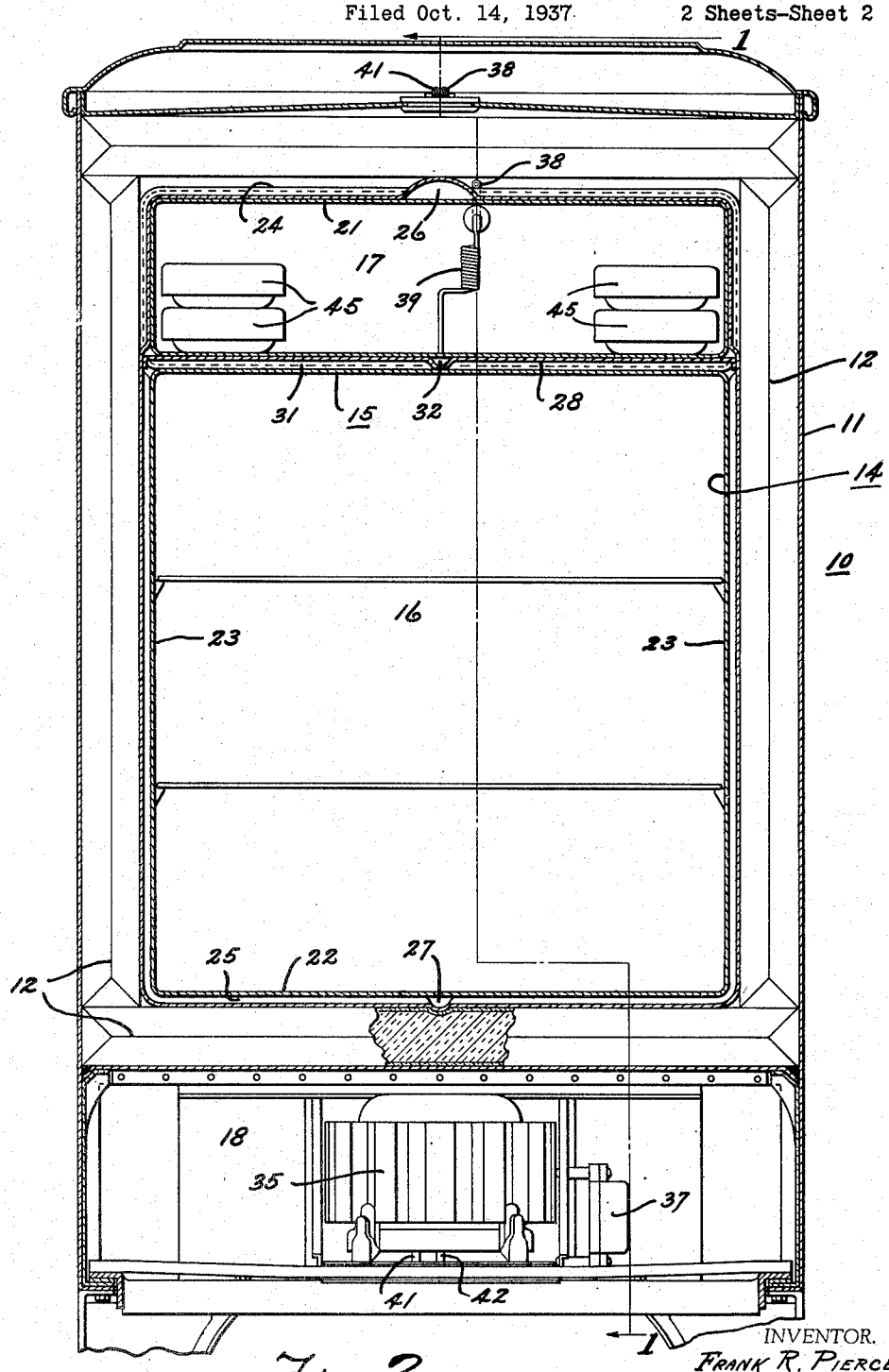

Fig. 2

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REFRIGERATING APPARATUS

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Application October 14, 1937, Serial No. 168,949

2 Claims. (Cl. 62—116)

This invention relates to refrigeration and more particularly to refrigerating apparatus of the household type utilizing a plurality of separate closed refrigerant circuits.

One of the objects of my invention is to provide an improved household refrigerating apparatus which prevents dehydration of food by the uniform cooling of a food compartment at a relatively high refrigerating temperature and which at the same time provides a freezing compartment maintained at a relatively low temperature.

A further object of my invention is to utilize a plurality of closed refrigerant circuits to accomplish the preceding object and to provide a wide variation of temperatures between the freezing and food storage compartments.

In carrying out the foregoing objects it is a still further and more specific object of my invention to utilize a heat exchange portion provided between a plurality of separate closed refrigerant circuits to divide a chamber of a refrigerator cabinet into a freezing compartment and a food storage compartment to thereby eliminate the provision of an insulating wall between the compartments.

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 a vertical sectional view taken on the line 1—1 of Fig. 2 of a household refrigerating apparatus having my invention embodied therein; and

Fig. 2 is a vertical sectional view of the refrigerating apparatus shown in Fig. 1 and is taken on the line 2—2 thereof.

Referring to the drawings the numeral 10 designates, in general, a unitary refrigerating apparatus embodying features of the present invention. The unitary apparatus 10 includes a cabinet 11 having insulating walls 12 surrounding a metal member, generally designated by the reference character 14, which forms walls of a chamber within cabinet and has a partitioning portion, generally designated by the reference character 15, dividing the chamber into a food storage compartment 16 and a freezing compartment 17. The compartment 16 may be provided with a plurality of shelves to divide same into a plurality of food storage spaces. The exterior metal walls of cabinet 11 extend downwardly beyond the bottom insulated wall 12 of compartment 16 and form a machine compartment 18. The apparatus 10 also includes a closed primary refrigerating system for maintaining a relatively low temperature in compartment 17, such as for freezing, and a closed secondary refrigerating system for the maintenance of a higher temperature such as is suitable for refrigerating food articles stored in the food compartment 16. The partitioning portion 15 of metal member 14 serves as a thermal heat exchange means between the primary and secondary closed systems in a manner to be more fully described hereinafter.

Referring more in detail to the drawings the metal member 14 of cabinet 11 comprises upper and lower horizontal double walls 21 and 22 respectively and vertical double side walls 23. One of the metal plates of walls 21, 22 and 23 is corrugated to provide a plurality of separate refrigerant passages 24 and 25 therebetween (see Fig. 2). This plate is also corrugated transversely to passages 24 to provide a header 26 in wall 21 which header communicates with the passages 24 in the upper part of metal member 14. This plate is further corrugated transversely to passages 25 to provide a header 27 in wall 22 which header communicates with the passages 25 in the lower portion of member 14. The partitioning portion 15 of metal member 14 includes a metal plate 28 interposed between the inner and outer metal plates thereof and which plate 28 is corrugated to provide a double set of separated refrigerant passages 29 and 31 in the partition 15. Plate 28 is further corrugated in a direction transverse to the extension of passages 29 and 31 to provide a header 32. The header 32 is constructed and arranged to communicate with the refrigerant passages 29 and to provide a wall in the partition 15 dividing the passages 31 therein into two portions. The plate 28 in partition 15 of metal member 14 is furthermore constructed and arranged to prevent communication between the refrigerant passages 24 and 31 which extend around walls of freezing compartment 17 and between the refrigerant passages 25 and 29 which extend around walls of food storage compartment 16 for a purpose to be more fully described hereinafter. Header 32 and passages 29 in partition 15, passages 24 in the upper portion of walls 23, and passages 24 and header 26 in wall 21 form the refrigerant evaporating element of a closed primary refrigerating system associated with the apparatus 10. Passages 31 in partition 15, passages 25 and header 27 in the wall 22 form the closed secondary refrigerant circuit of apparatus 10 and have a suitable refrigerant fluid sealed therein. A re-

frigerant liquefying and condensing apparatus, including a motor-compressor unit 35, a condenser 36 and a control device 37, is connected with the refrigerant evaporating element or portion of the primary refrigerating system. The lower portion of condenser 36 is connected, by a pipe 38, with the header 32 of the primary evaporator for conducting liquid refrigerant to this evaporator under the regulation or restriction of a suitable expansion valve or restrictor device 39 in a conventional manner. The evaporated or gaseous refrigerant header 26 of the evaporator of the primary refrigerating system is connected, by a pipe 41, with motor-compressor 35 which is adapted to withdraw the evaporated refrigerant from the evaporator to compress same and forward the compressed refrigerant, through a pipe 42, to the uppermost portion of condenser 36. The control device 37 may be constructed to be actuated in response to the temperature of compartment 16 or it may be actuated in response to the temperature of compartment 17 in any manner well-known to those skilled in the art to cause operation of the motor-compressor unit 35 for circulating refrigerant throughout the closed primary refrigerating system of the apparatus 10. In either event the automatic control device 37, which connects the motor of the unit 35 with the power mains, is regulated to maintain the refrigerant evaporating portion of the primary refrigerating system between predetermined temperature limits sufficiently low to cause freezing of a substance contained in trays or receptacles 45 placed within compartment 17 and supported upon the partitioning portion 15 of the metal member 14. The remainder of the space within compartment 17 may be utilized for the storage of frozen food products such as ice cream, fish, meats, etc.

The chamber within cabinet 11 of the apparatus 10 which is formed by metal member 14 has a door opening providing access to both compartments 16 and 17. This opening is normally closed by a door 46 and it will be noted that the inner face of this door 46 is disposed closely adjacent the front edge 47 of the portion 15, when the door is in closed position, to substantially isolate the compartments 16 and 17 from air circulation therebetween. If desired a rubber or other resilient sealing member may be secured to the door 46 or to the front edge 47 of partition 15 for insuring the isolation of compartments 16 and 17 from air circulation therebetween. It will also be noted that the refrigerant passages of the evaporator of the primary refrigerating system substantially surround the freezing compartment 17 and that the refrigerant passages of the secondary refrigerant circuit substantially surround the food storage compartment 16. The compartment 16 is thereby uniformly cooled at a predetermined relatively high temperature by the present arrangement to thus prevent dehydration of foods stored therein.

The operation of the refrigerating apparatus 10 is as follows. The temperature of the evaporator of the primary refrigerating system is reduced to a point to cause freezing of substance in trays 45 or to maintain ice cream, fish, meats etc., stored within compartment 17 in a frozen condition. The low temperature of the evaporator of the primary refrigerating system is in direct thermal contact with the refrigerant within the secondary refrigerating system. Therefore refrigerant in the refrigerant passages 25 of the secondary refrigerant circuit upon absorbing heat from foods stored within compartment 16 vaporizes or evaporates and rises into the passages 31 provided in partition 15 of metal member 14. Here the low temperature of refrigerant within passages 29 of the evaporator of the primary refrigerating system causes the refrigerant of the secondary refrigerating system to condense and liquefy. The condensed liquid refrigerant in the secondary system flows downwardly in passages 25 to header 27 where it is again distributed to the plurality of passages 25 for reevaporation in the process of cooling compartment 16. Thus it will be seen that the portion 15 of metal member 14 not only serves as a partition between compartments 16 and 17 but also forms the heat exchanger or heat transfer device between the primary and secondary refrigerating systems. The liquid refrigerant distributing header 32 in the evaporator portion of the primary refrigerating system divides the passages 31 formed in partition 15 of the secondary refrigerating system into two portions. Therefore there will be a continuous back and forth flow of refrigerant in the walls 22, 23 and 15 of the secondary refrigerating system and the dividing of the refrigerant passages thereof by header 32 provides an improved method of uniformly cooling the compartment 16 and food stored therein.

If the motor-compressor unit 35 of the primary refrigerating system is controlled by control 37 in response to the temperature of compartment 17 the temperature difference between compartment 17 and compartment 16 can be predetermined by an amount of gas such as air, non-condensable at temperatures prevailing in the secondary system, injected into the secondary system and mixed with the refrigerant contained therein. In such case the refrigerant within the secondary refrigerating system or circuit should preferably be a volatile liquid such as a halogen derivative of an aliphatic hydrocarbon, and, for instance, dichlorodifluoro methane.

It will be seen from the foregoing that I have provided an improved refrigerating apparatus particularly of the household refrigerator type in which refrigerator a plurality of different temperatured compartments are obtained. My improved apparatus provides for the storage of foods in a frozen condition, the freezing of substances contained in trays and the storage of other food products without causing dehydration of these other food products. By utilizing the heat exchanger between the primary and secondary refrigerating systems as a partitioning wall between the food storage compartments of my improved apparatus I eliminate the necessity of insulating the one compartment from the other and also eliminate the provision of separate doors for sealing each compartment. Thus it will be seen that upon opening the single door of my improved apparatus access may be had to either the freezing compartment or the higher temperatured food storage compartment.

While the form of embodiment of the invention as herein disclosed constitutes a prefererd 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 in combination, a cabinet having a chamber therein, a unitary member encircling said chamber and providing a refrigerant evaporator of a primary refrigerating system and a closed secondary refrigerating system, said unitary member having

integral portions thereof extending across said chamber and dividing same into upper and lower food storage compartments, said integral portions of said unitary member having parts thereof spaced apart to provide a passageway therebetween, means disposed within the passageway provided between said integral portions of said member to divide the passageway into sets of passages sealed from one another, said means being constructed and arranged to provide communication between said refrigerant evaporator of said primary refrigerating system and one set of said passages and to provide communication between said secondary refrigerating system and the other set of said passages, and said means positioning a part of the refrigerant evaporator of said primary refrigerating system in intimate thermal contact with a part of said secondary refrigerating system to provide with said integral portions of said unitary member a heat exchanger between said systems.

2. Refrigerating apparatus comprising in combination, a cabinet having a chamber therein, a unitary member encircling said chamber and providing a refrigerant evaporator of a primary refrigerating system and a closed secondary refrigerating system, said unitary member having integral portions thereof extending across said chamber and dividing same into upper and lower food storage compartments, said integral portions of said unitary member having parts thereof spaced apart to provide a passageway therebetween, means disposed within the passageway provided between said integral portions of said member to divide the passageway into sets of passages sealed from one another, said means being constructed and arranged to provide communication between said refrigerant evaporator of said primary refrigerating system and one set of said passages and to provide communication between said secondary refrigerating system and the other set of said passages, said means positioning a part of the refrigerant evaporator of said primary refrigerating system in intimate thermal contact with a part of said secondary refrigerating system to provide with said integral portions of said unitary member a heat exchanger between said systems, a single door for closing said compartments, and said heat exchanger being constructed and arranged to cooperate with said door to substantially isolate said compartments from air circulation therebetween.

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