

March 14, 1939.

C. G. MUNTERS

2,150,182

INSULATION

Filed March 12, 1936

3 Sheets-Sheet 1

Fig. 1.

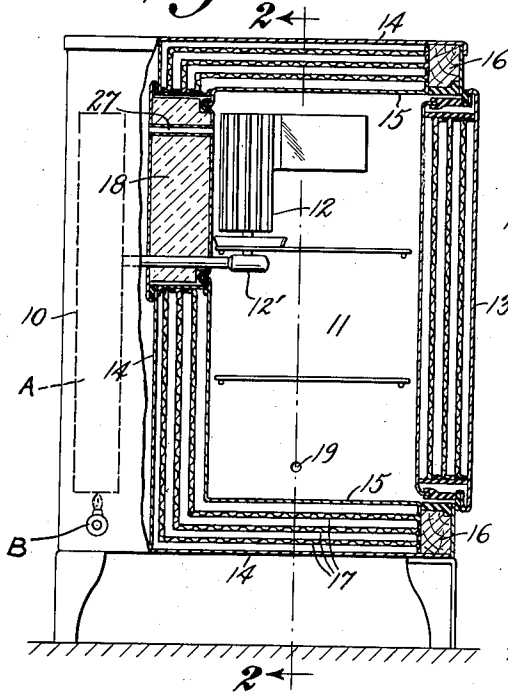


Fig. 2.

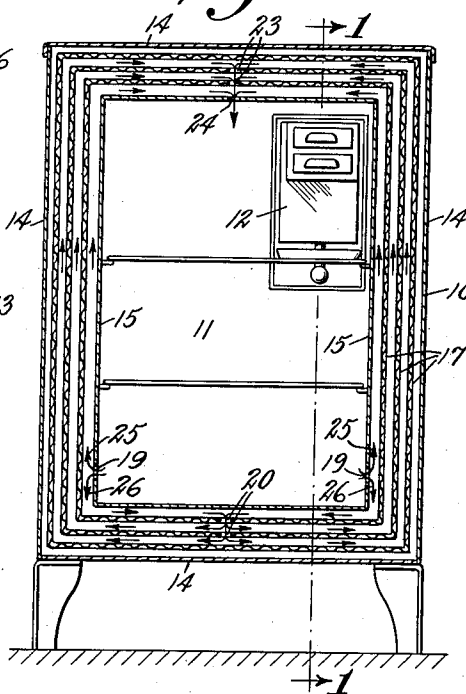


Fig. 3.

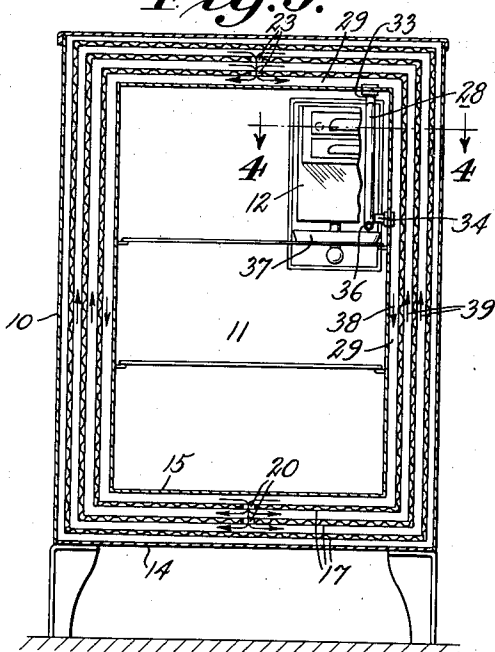
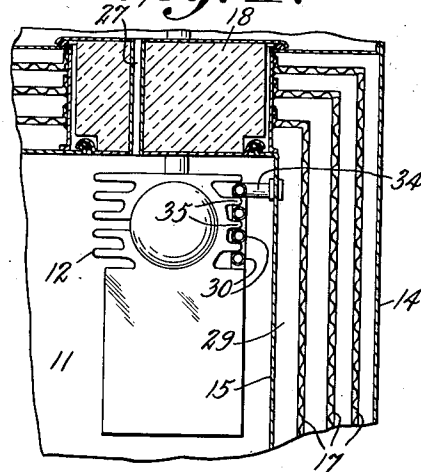


Fig. 4.



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Fig. 5.

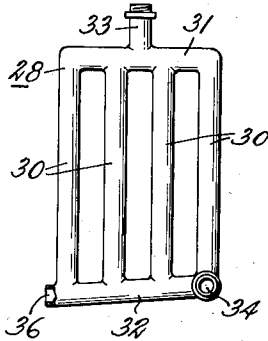


Fig. 6.

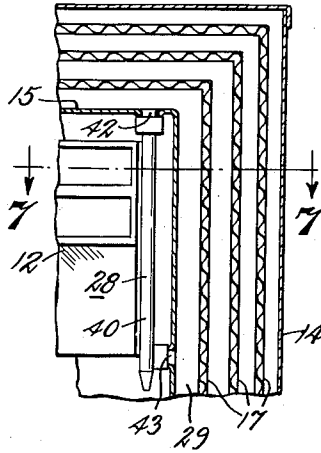


Fig. 7.

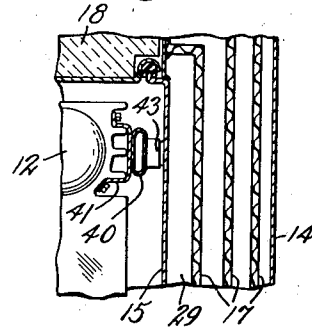


Fig. 9.

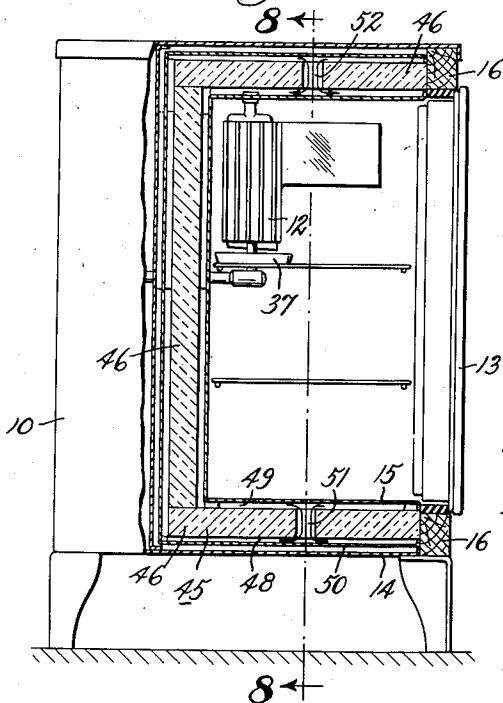
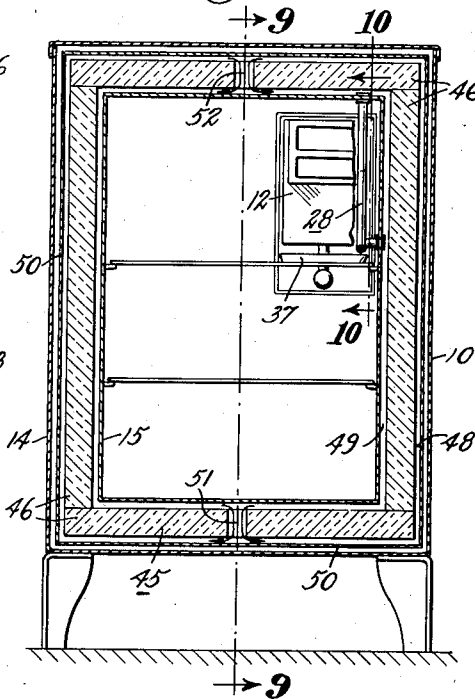


Fig. 8.



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Fig. 10.

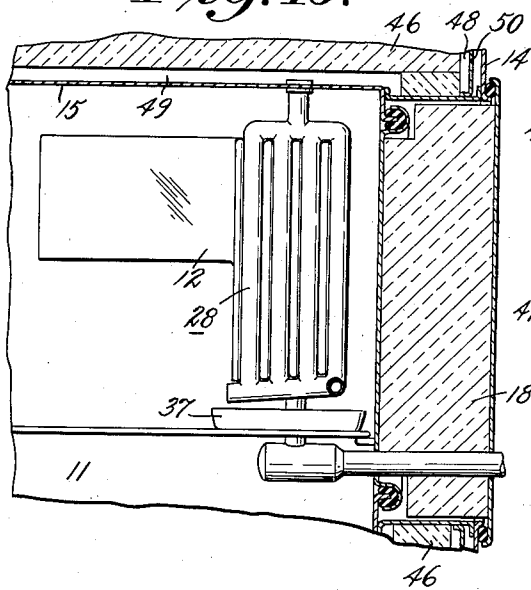


Fig. 11.

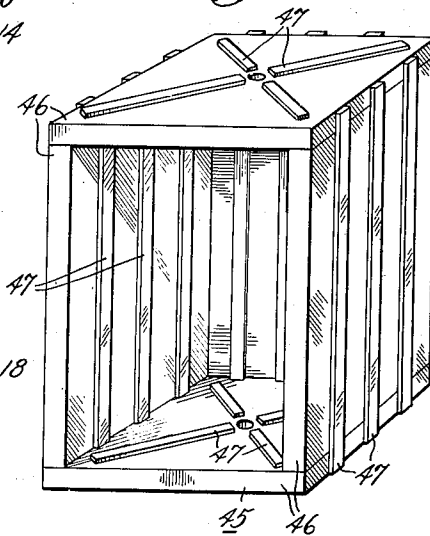
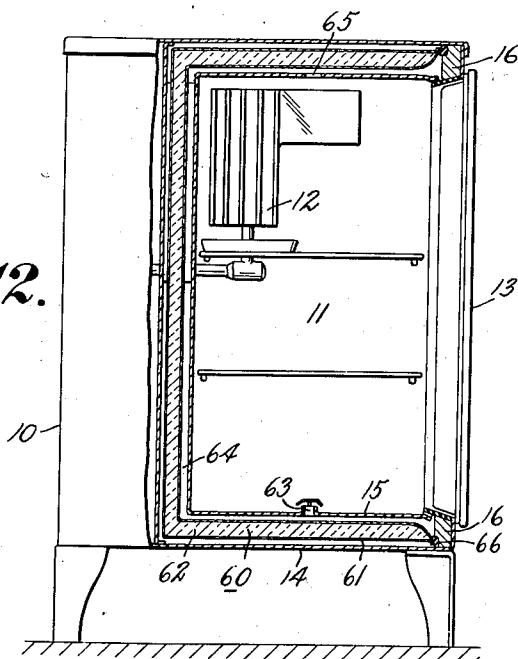


Fig. 12.



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UNITED STATES PATENT OFFICE

2,150,182

INSULATION

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Application March 12, 1936, Serial No. 68,391
In Sweden March 13, 1935

3 Claims. (Cl. 62—89)

My invention relates to heat insulation and particularly to such insulation for use in connection with refrigerator cabinets or other containers in which it is desired to maintain a low temperature.

The chief object of my invention is to prevent the condensation of moisture within the insulation, and to assure the rapid evaporation of any moisture which may be formed in the insulation. A further object of my invention is to remove water vapor from the air within the insulation. Further objects and advantages of my invention will be apparent from the following description considered in connection with the accompanying drawings forming part of this specification and of which:

Fig. 1 is a cross-sectional view of a refrigerator cabinet including one embodiment of my invention and is taken on the line 1—1 of Fig. 2;

Fig. 2 is a cross-sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a cross-sectional view similar to Fig. 2 but showing a different embodiment of my invention;

Fig. 4 is a cross-sectional view taken on the line 4—4 of Fig. 3;

Fig. 5 is a view on an enlarged scale of an element shown in Figs. 3 and 4;

Fig. 6 is a view partially in cross-section showing a modification of a part of the device shown in Figs. 3 and 4;

Fig. 7 is a cross-sectional view taken on the line 7—7 of Fig. 6;

Fig. 8 is a cross-sectional view of a still further embodiment of my invention and is taken on the line 8—8 of Fig. 9;

Fig. 9 is a cross-sectional view taken on the line 9—9 of Fig. 8;

Fig. 10 is a cross-sectional view taken on the line 10—10 of Fig. 8;

Fig. 11 is a perspective view of a portion of the device shown in Figs. 8 and 9; and

Fig. 12 is a cross-sectional view of a still further embodiment of my invention.

Referring more particularly to Figs. 1 and 2 reference character 10 designates generally a refrigerator cabinet including a food storage space 11 adapted to be cooled by an evaporator or other cooling unit 12. Access to space 11 is had by means of a door 13.

That portion of the cabinet 10 which encloses the space 11 includes an outer shell 14 and an inner shell 15, preferably made of sheet metal and secured to a framework 16. In the space between shells 14 and 15 there is disposed in

spaced relation a plurality of layers of insulating material 17. As shown, insulation 17 consists of so-called "double bottom corrugated cardboard", in other words, a corrugated piece of cardboard disposed between two flat sheets of cardboard. Preferably, lustrous metal foil, such as aluminum, is applied to the outer sides of both of the flat sheets. Layers 17 constitute intermediate shells and are supported from the framework 16, the shells having sufficient rigidity so that no further support is required.

Outer shell 14 is substantially air-tight, but in practice it is impossible to effect a perfect seal between the shell and the framework 16 and the wall section 18 which supports evaporator 12. Consequently it is impossible to absolutely prevent the leakage of warm air into the space between the shells 14 and 15. Inasmuch as this air always contains a certain amount of moisture, there is a tendency for this moisture to condense due to the reduction in temperature of the air caused by the reduced temperature existing within the space 11. In order to prevent this condensation, inner shell 15 is formed with one or more openings 19 adjacent the lower part of the shell which establishes communication between the space 11 and the space formed between shell 15 and the innermost layer of insulation 17. The layers 17, or some of them, are formed with openings 20 in their lower parts which establish communication between the spaces defined by the layers. In the embodiment shown, all except the outermost layer 17 are formed with openings 20. At the top, the layers 17 are formed with openings 23, while inner shell 15 is formed with an opening 24.

The support 12' constitutes a heat exchanger which forms a part of an absorption refrigeration system and is connected to the evaporator 12 and to other parts of the system indicated diagrammatically at A. The refrigeration system is adapted to be operated by heat, as by a burner B, for example. The refrigeration system including the portion diagrammatically indicated at A, heat exchanger 12' and evaporator 12 may be of a type well-known in the art and like that generally disclosed in Patents No. 1,609,334 to von Platen and Munters, No. 1,910,853 to Munters and No. 2,037,782 to Hainsworth. While an absorption type of refrigeration system is illustrated, the invention may be employed with any type of refrigeration system.

During the operation of the refrigerator, air within food compartment 11 is chilled by contact with evaporator 12 and flows downwardly through

the space due to an increase in its specific gravity. A part of this chilled air passes through openings 19 and displaces warm air upwardly in the direction of arrows 25, which air flows into the food space 11 through opening 24. A part of the chilled air which is passed through openings 19 passes downwardly in the direction of the arrows 26 and through the openings 20 into the spaces between the layers of insulation and displaces warm air contained therein upwardly and finally through the openings 23 and 24 into the food space 11. In space 11, the warm air comes in contact with the evaporator 12 and moisture contained therein is condensed on the evaporator. Consequently there is a continuous thermal circulation of cold dry air from the food space 11 into and through the spaces formed between shells 14 and 15 by the insulating layer 17. This assures that warm moist air does not remain in these spaces, where it would be cooled and its moisture condensed. If, particularly when the refrigerator is first started, the cooling of the air in these spaces does result in some condensation, the liquid thus formed will be evaporated and removed from the insulation by the circulating air.

The cold air descending from the neighborhood of evaporator 12 causes that portion of inner shell 15 which lies directly beneath the evaporator to be cooled to a temperature lower than other parts of the shell. Consequently, the greatest tendency for condensation within the insulation occurs in that portion of the insulation adjacent to said portion of the shell 15. However, the air in this space, admitted thereto through openings 19, previously has been chilled to a still lower temperature by the evaporator 12 and its moisture content lowered to such an extent that no condensation can take place in even this coldest part of the insulation. If, when the machine is first started, some moisture is condensed at this place before the cold dry air circulates thereto, it will evaporate and be removed when the circulation is established.

A conduit 27 is provided, preferably extending through wall section 18, for establishing communication between the space 11 and the atmosphere for the purpose of permitting an equalization of pressure within space 11 and in the insulation to take place upon changes in atmospheric pressure, or upon changes in pressure resulting from temperature changes. Thus air flowing in from the outside on account of these pressure variations can enter the insulation only after having been dried by passing through space 11.

In the embodiment shown in Figs. 3 through 5, the inner shell 15 as well as shell 14 is formed as air-tight as possible. Consequently no circulation of air may take place between the food space 11 and the spaces between the shells 14 and 15. A condenser member 28 is disposed in heat exchange relationship with evaporator 12 and includes a conduit connected at different levels with the space 29 between the shell 15 and the innermost insulating layer 17. As shown, condenser 28 includes a series of parallel conduits 30 connected together at their upper ends by means of a header 31 and at their lower ends by means of an inclined header 32. A conduit 33 connects header 31 with the upper part of space 29 while a conduit 34 connects header 32 with space 29 at a lower level. Conduits 30 are preferably disposed between ribs 35 formed on evaporator 12 in order to assure a good heat transfer between the evaporator and the conduits. Header 32 at its lower end is formed with an opening 36 which

is arranged to discharge above a drip pan 37 located below evaporator 12.

The operation of this embodiment is similar to that described in connection with Figs. 1 and 2, except that the drying of the air in the insulation is produced by the condenser 28. Air contained within the conduits 30 of the condenser is cooled and moisture condensed therefrom. This moisture may drain through opening 36 into the drip pan 37. The air thus cooled passes from the condenser to conduit 34 and downwardly through the space 29 in the direction indicated by the arrow 38. From space 29 this air passes through the openings 20 formed within insulating layer 17 and causes warmer air contained between the layers to be displaced upwardly in the direction of the arrows 39 and to pass through the openings 23 formed in the insulating layers at their uppermost portions. This warm air, or a portion of it, is admitted to condenser 28 through conduit 33, where it is cooled and moisture condensed therefrom. Thus, in this embodiment, thermal circulation of air is maintained through the spaces in the insulation which assures that warm air will be displaced and cooled to reduce its moisture content.

The embodiments shown in Figs. 6 and 7 differ from that shown in Figs. 3 through 5 only in the construction of the condenser. As shown in Figs. 6 and 7 the condenser 28 includes a flattened tubular member 40 which is secured in heat exchange relationship with the evaporator 12 by means of a sheet metal member 41 preferably welded to tubular member 40 and bolted to the evaporator. Tubular member 40 is connected to the space 29 by means of conduits 42 and 43 which correspond to conduits 33 and 34, respectively, in the previous embodiment.

The embodiment shown in Figs. 8 through 11 differs from that shown in Figs. 3 through 5 in the nature of the insulating material. Instead of employing a plurality of layers 17 of insulation of the nature described in connection with the previous embodiments, a cork insulation 45 is employed. This insulation includes sheets of cork 46 suitably secured together to form a box-like structure. The cork sheets may be provided with a protective coating, such as asphalt or paraffin, or they may be wrapped in paper impregnated with such material. Laths 47 are secured to the inside and outside of the box-like structure to assure the provision of spaces 48 and 49 between the insulation and the shells 14 and 15, respectively. A sheet metal shell 50 is preferably disposed in the space 48 in order to prevent as far as possible the entrance of warm atmospheric air into the insulation. Insulation 45 is provided with an opening 51 in its lower part connecting spaces 48 and 49 and with a similar opening 52 in its upper part. A condenser 28 is connected to space 49 in the same manner as described in connection with Figs. 3 through 5.

Air contained within the insulation is cooled in condenser 28 and moisture condensed therefrom. The circulation of air through the condenser is maintained by the force created by the difference in specific gravity of the cooler air in condenser and the warmer air in the space 49. Through and between spaces 49 and 48 a thermal circulation of air also takes place. The air in space 49 being cooler than that in space 48, all the air in the insulation by thermal circulation thus is brought into contact with the cool surface of the condenser 28 and deprived of water.

The embodiment shown in Fig. 12 employs a

heat insulation 60 which comprises a hermetically sealed double-walled shell 61, within which a partial vacuum exists, the walls of which are supported from collapse by means of granular material 62. Inner shell 15 is formed with a lower opening 63 which establishes communication between food space 11 and the space 64 formed between inner shell 15 and insulation 60. An opening 65 in the upper part of shell 15 serves the same purpose at the top. The operation of this device is similar to that described in connection with Figs. 1 and 2. Air cooled by contact with evaporator 12 passes downwardly through food space 11 and through opening 63 and displaces warm air upwardly through space 64, from which it escapes through opening 65 to within food space 11, where it is chilled by the evaporator 12. Admission of warm atmospheric air, which may leak through outer shell 14, to space 64, is prevented as far as possible by means of a seal 66 between insulation 60 and the frame 16.

It will thus be seen that in all embodiments thermal circulation of air through the insulation is maintained for the purpose of removing therefrom warm moist air. Such air is passed in contact with either the evaporator of the refrigerating unit, or a condenser cooled thereby, in order that the moisture content of the air may be reduced to such an extent that condensation within the insulation is prevented. Also, it will be noted, that communication between the interior of the insulation and the atmosphere is prevented, insofar as this is practicably possible.

While I have shown and described several embodiments of my invention it is to be understood that this has been done for purposes of illustration only and that my invention is to be limited only by the appended claims viewed in the light of the prior art.

What is claimed is:

1. In a refrigerator cabinet, an inner shell open

on a vertical side and having top, bottom and side walls and forming a food storage compartment, insulation outside of and spaced from said top, bottom and side walls and constructed and arranged to provide communicating vertical and horizontal interspaces, means to substantially seal the insulation exteriorly against inflow of air, air chilling means for cooling said food compartment, said inner shell and said insulation being apertured for circulation of air in a closed path including said food compartment and both horizontal and vertical interspaces, the horizontal and vertical inner spaces being so related that flow in horizontal interspaces is induced by flow in vertical spaces.

2. Structure as set forth in claim 1 in which the air chilling means is an evaporator disposed within the inner shell and the food compartment part of the closed path includes a conduit in heat transfer relation with said chilling means and communicating with the apertures in said inner shell.

3. In a refrigerator cabinet, an inner shell open on a vertical side and having top, bottom and side walls and forming a food storage compartment, one or more self-sustaining boxlike cardboard members surfaced with aluminum foil and disposed outside of and spaced from said top, bottom and side walls and constructed and arranged to provide communicating vertical and horizontal interspaces, means to substantially seal the insulation exteriorly against inflow of air, means to cool said food compartment, said storage compartment and said interspaces being connected in such manner that circulation of air can take place in a closed path including said food compartment and both horizontal and vertical interspaces, said boxlike members being so disposed that flow in horizontal interspaces is induced by flow in vertical interspaces.

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