

Aug. 4, 1942.

E. D. LINDBLOM
REFRIGERATOR CABINET

2,291,736

Filed May 29, 1941

3 Sheets-Sheet 1

FIG. 1.

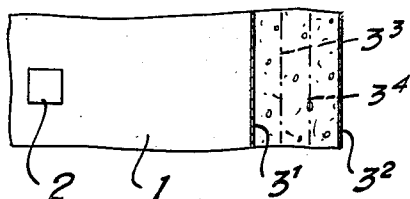


FIG. 2.

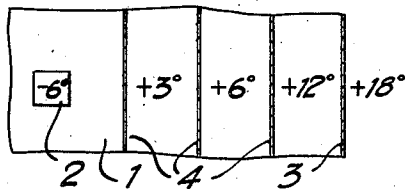


FIG. 3.

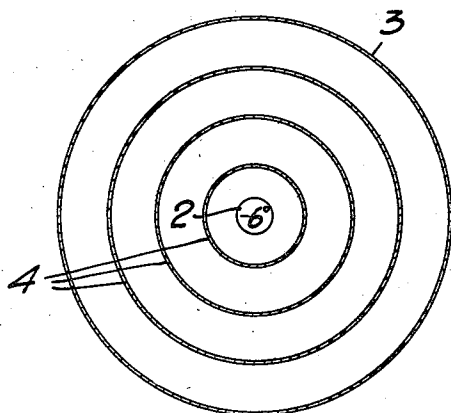


FIG. 5.

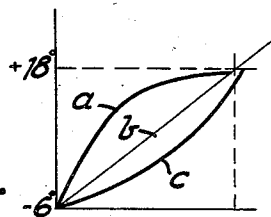


FIG. 4.

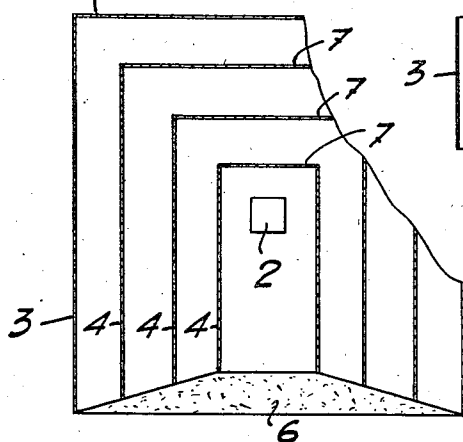
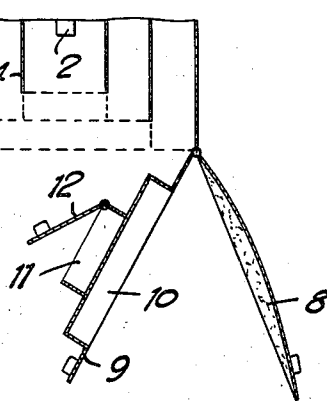


FIG. 6.



Inventor,
Erik D. Lindblom
by Sommers-Young,
Attorneys

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FIG. 7.

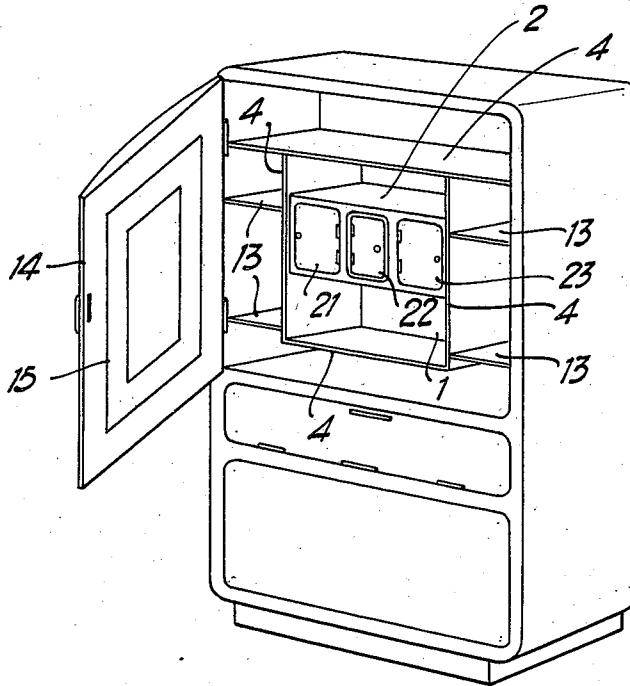


FIG. 8.

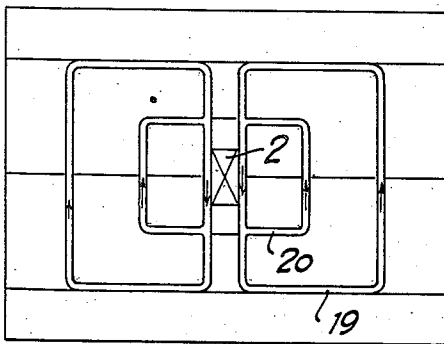
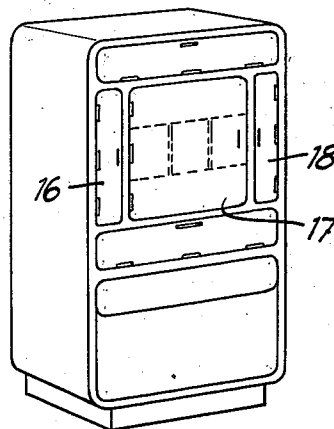


FIG. 9.



Inventor,
Erik D. Lindblom
by *Sommers & Young,*
Attorneys

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E. D. LINDBLOM

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Fig. 10.

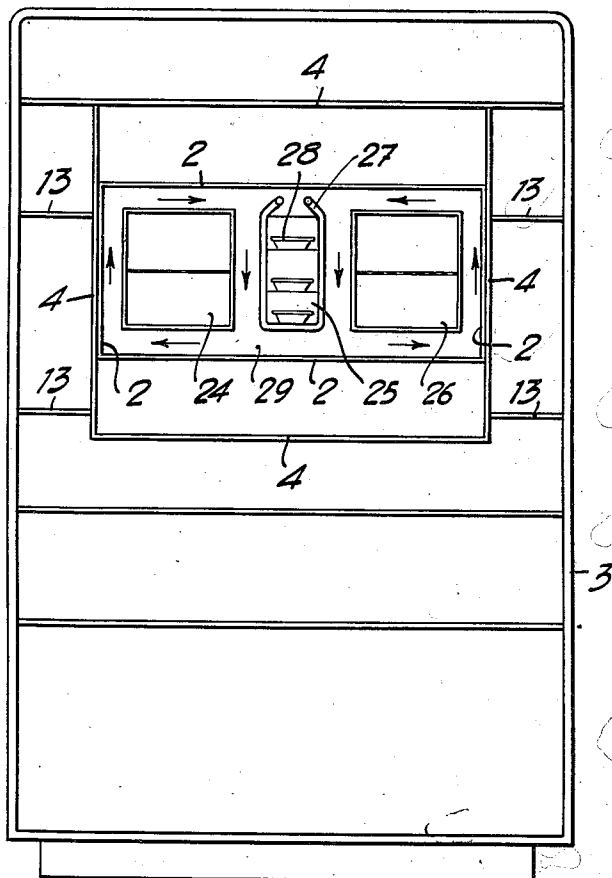
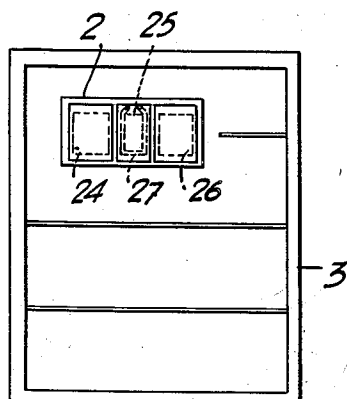


Fig. 11.



Inventor,
Erik D. Lindblom
by Sommers & Young,
Attorneys

UNITED STATES PATENT OFFICE

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REFRIGERATOR CABINET

Erik David Lindblom, Finspong, Sweden

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18 Claims. (Cl. 62—89)

This invention relates to refrigerating or heating devices, as refrigerating or heating cabinets or rooms adapted for cooling or heating foods or other articles and/or maintaining them at a predetermined temperature or temperatures.

In devices of this type it has hitherto been considered a matter of great importance effectively to insulate the outer wall of the device. To this end the outer wall of refrigerating or heating cabinets or rooms are usually provided with a coating or lining of an insulating material or made up of a plurality of thin walls separated from each other by closed air spaces. In either case such a wall takes up a great deal of the total volume of the cabinet or room. This is true especially of cabinets of small dimensions and renders such cabinets cumbersome in spite of their small capacity.

It is an object of this invention to render the use of such insulated or manifold walls unnecessary without reducing the effect or capacity of the cabinet or room.

A feature of the invention by which this object may be obtained, involves that the available space between an inner compartment of the cabinet or room containing a refrigerating, or heating, unit and the outer wall of the cabinet or room is divided into a plurality of compartments to receive foods or other articles to be cooled or heated, said compartments being air tightly separated from each other and arranged so as to surround each other in succession, so that the temperatures existing in the various compartments will increase, or decrease, gradually as reckoned from the compartment containing the refrigerating or heating unit towards the outer wall of the cabinet or room.

By this arrangement I obtain both the advantage of a reduced total volume of the cabinet or room for a given capacity thereof and the by far more important advantage of reduced consumption of material and reduced costs of material and erection too.

In the accompanying drawings several embodiments of the invention are illustrated as applied to refrigerators.

Fig. 1 is a diagrammatic view adapted to illustrate an insulating method hitherto used in connection with refrigerators;

Fig. 2 is a similar view to illustrate the insulating method according to this invention;

Fig. 3 is a diagrammatic cross section of a cylindrical refrigerator according to the invention;

Fig. 4 is a diagrammatic axial section of said refrigerator;

Fig. 5 shows a lot of curves for indicating the mean temperatures existing in the various compartments of the refrigerator shown in Figs. 3 and 4;

Fig. 6 is a cross sectional view of the door of a refrigerator to which a form of the invention has been applied;

Fig. 7 is a perspective view of a refrigerator according to the invention, showing one door of the cabinet in open condition;

Fig. 8 is a perspective view of a somewhat modified form of the refrigerator shown in Fig. 7;

Fig. 9 is a diagrammatic view of the cooling system of a refrigerator having circulating conduits for the refrigerant;

Fig. 10 is a front view of a refrigerator similar to that shown in Fig. 7, the refrigerating unit of which is provided with a sharp-freezing or ice-making compartment. In the figure the front wall of the cabinet, including a" doors, is removed.

Fig. 11 shows a front view, with front wall removed, of a refrigerating cabinet of conventional type provided with a refrigerating unit similar to that shown in Fig. 10.

With reference to Fig. 1, the numeral 1 indicates a food compartment of a refrigerator of conventional type. 2 indicates a refrigerating unit, and 3¹—3² are the inner and outer layers, respectively, of the wall of the cabinet, said layers consisting, for instance, of thin sheet metal walls. Between the walls 3¹ and 3² a thick layer of a heat insulating material is inserted. Instead of such heat insulating material thin intermediate walls, as indicated by dotted lines at 3³ and 3⁴ may be used to divide the space between the walls 3¹ and 3² into airtightly closed chambers. The refrigerating unit 2 is shown mounted in the food compartment 1 and the latter is assumed to take up the whole interior of the cabinet. In order to prevent to the greatest extent possible the transfer of heat between the surrounding air and the space 1, the outer wall 3¹—3² must be effectively insulated. For this purpose the outer wall requires a large amount of material, takes up a large space, and must be manufactured with great care, whether the one insulating method or the other of those above referred to are employed.

In Fig. 2 which is adapted to illustrate the principle of my insulating method, the insulation of the outer wall of the cabinet is dispensed with. The outer wall of the cabinet consists of a thin wall 3 only, which may comprise, for instance, a simple sheet metal wall. The space between

said wall 3 and the refrigerating unit 2 is divided into a series of compartments airtightly separated from each other by means of partitions 4. Said partitions are positioned at such distances apart as to allow the utilization of the spaces between them for receiving food or other goods to be cooled. By the provision of said spaces the compartment containing the refrigerating unit 2 may be effectively heat insulated with relation to the surrounding air, without causing any useful space to be lost by filling it with insulating material. Besides this gain in space and besides the gain resulting from the absence of insulating material, I obtain by the present invention a set of separate compartments of different temperatures. By this means foods that may influence upon each other detrimentally in the one respect or the other, may be placed in individual compartments and various kinds of foods may be kept at optimum temperatures. In the Fig. 2 I have indicated by way of example a series of temperatures likely existing in the compartments.

In a well-known refrigerator of the kind shown in Fig. 1 the temperature due to convection will be approximately equal at all points of the food compartment of the cabinet. With the interior of the cabinet divided into separate compartments as indicated in Fig. 2, said compartments will present different temperatures, even if the partitions between the compartments be made of a good heat conductor because of the fact that the partitions prevent the transfer of heat by direct convection from the individual compartments to the refrigerating unit.

In Fig. 3 is shown a fundamental form of a refrigerator according to the invention in which a refrigerating unit is mounted in the centre of a cylindrical cabinet between the outer wall 3 of which and the refrigerating unit 2 a plurality of partitions 4 are provided which are concentric with the outer wall 3 as well as with each other. It is to be noted that this embodiment should be considered as an extreme case which is of a theoretical interest rather than of a practical importance. In Fig. 4 I have shown more in detail how to build a refrigerator cabinet according to Fig. 3. The cylindrical outer wall 3 is closed at its upper end by a plan top wall 5 and at its lower end by an insulated bottom wall 6. The latter is further in engagement with the lower ends of the partitions 4 so as to close the compartments therebetween with respect both to each other and to the refrigerating unit. At their upper ends the partitions 4 are closed by flat top walls 7, one for each partition. Fig. 4 may thus be said to show how to build a refrigerator, in part, according to the principle of this invention and, in part, according to the conventional method hitherto used. The common insulated bottom wall 6 shown in Fig. 4 may, preferably, be constructed as a hinged door.

In Fig. 5 I have shown a set of curves representing the mean temperatures existing in the individual compartments of a refrigerator constructed according to Fig. 3, as a function of the distance from the refrigerating unit. The nature of the partitions (that is, the thickness or material thereof) and the distance between themselves as well as the condition of circulation are the predominant factors in determining the distribution of temperature. The curve b indicates the continuously rising temperature. The distribution of temperature as indicated by the curve a which approaches the number of degrees

of the outer temperature asymptotically, renders the use of any insulation of the outer wall unnecessary (but causes, on the other hand, the temperature of the outermost compartments to vary slightly with the outer temperature). With a distribution of temperature as indicated by the curve c, the outermost compartments become a little more cold so that they require an outer insulation, though not very thick, since the difference in temperature is but very small. In this case the influence of the outer temperature may be neglected.

Fig. 6 is a diagrammatic view of a form of door construction to which the principle of the invention has been applied. In addition to the door I have also shown the refrigerating unit 2 and part of the outer wall 3 and the partitions 4 of the cabinet. The door is shown by full lines in open state and indicated by dotted lines in closed state.

The door shown consists of an insulated outer member 8 and an inner member 9 provided with compartments 10, 11 for shelves adapted to support less bulky articles, as tinned provisions. The compartment 10 may be closed by the door member 8 and the compartment 11 may be closed by a separate hinged cover 12. The door member 8 and the hinged cover 12 may be locked to the door member 9 by locking means, not shown.

Fig. 7 illustrates an example of the invention as applied to a refrigerator which for the rest is of standard type. The refrigerating unit is indicated as a whole by the reference numeral 2. It comprises three compartments situated side by side which are closeable by individual doors 21, 22, 23, respectively. The refrigerating unit is mounted in an inner compartment 1 closed at its rear end by the rear wall of the refrigerator cabinet and bounded at its bottom, top and sides by walls 4, and there surrounded by separate compartments provided with shelves 13 to support the articles to be cooled. Because there are no compartments behind the compartment 1, the rear wall of the cabinet should be provided with insulation in well-known manner. The side walls and the top and bottom walls of the cabinet, on the contrary, do not require any insulation at all or only a very low degree of insulation. The door 14 is common to all compartments described. The door which may be insulated in well-known way or constructed according to Fig. 6, is provided with a frame-like packing 15 adapted to engage the edge of the wall 4 surrounding the space 1.

Fig. 8 shows a cabinet like the one shown in Fig. 7 but provided with three doors 16, 17, 18 in substitution of the single door 14 of Fig. 7. The use of three doors results in reduced costs of operation, since a reduced quantity of cold air is allowed to escape from inside the cabinet each time a door is opened.

It is to be noted that doors may, of course, be provided on more than one side of the cabinet, especially when the compartment containing the refrigerating unit is surrounded by insulating compartments on all sides.

In order to permit any desired distribution of the temperatures of the individual compartments the cabinet may be provided with means adapted to control the heat transmission in the way desired. Thus, for instance, the refrigerator may be provided with passages 19, 20, Fig. 9, in which air or other gaseous or liquid fluid may circulate. Instead of such passages I may use heat conducting elements, as plates or the like. The channels 19, 20 extending from the refrigerating unit 2 which are coupled in parallel as far as the direc-

tion of flow is concerned, are of different length, so as to afford correspondingly different resistance to the flow of the fluid, provided the areas of cross section of the passages are approximately equal. This difference in resistance, however, is balanced by the fact that the longest passage 19 extends through the outer and warmer compartments, so that the "motor power" of the passage 19 will be greater than that of the passage 20.

The circulating heat transmitting fluid may, preferably, be enclosed. By this means it will be prevented from coming into contact with the food and removing moisture therefrom. In addition, the fluid may be free from moisture, so that no formation of ice on the refrigerating unit can take place and no impairment of the heat transfer need be feared.

In Fig. 10 the numeral 2 is used to indicate the top, bottom, and side walls of the refrigerating unit indicated as a whole by the reference numeral 2 in Fig. 7. 4 indicates the top, bottom, and side walls of the compartment containing said refrigerating unit, and 13 are the shelves provided in the food compartment surrounding the walls 4.

The three compartments of the unit 2 closable by the doors 21, 22, 23 of Fig. 7, are shown at 24, 25, 26, respectively in Fig. 10. The central compartment 25 consists of a sharp-freezing element 27 and pans 28 for making ice cubes, while the compartments 24 and 26 are adapted to receive food requiring a very low temperature. The compartments 24, 25, 26 are surrounded by a passage 29 which are airtightly sealed by the front wall, not shown. Said passage contains a heat transferring medium, as air, which cannot come into contact with the food contained in the compartments 24, 26, or pass into the other compartment of the refrigerator, but is caused to circulate in the passage 29, as indicated by the arrows. Said medium is cooled by its contact with the refrigerating element 27, and in its turn cools the walls of the compartments 24, 26, as well as the surrounding walls 2, causing the box bounded by said walls 2 to act as the refrigerating unit for the surrounding compartments.

Although the sharp-freezing element 27 has a temperature sufficiently low for ice-production, this fact does not influence the content of moisture in the surrounding food compartments, since the element 27 is only in contact with the medium contained in the passage 29 of the box-like unit 2. Since the volume of said box-like unit 2 is comparatively small, it is obvious that the quantity of moisture frozen out from the medium will be very small and can be completely avoided by the use of a medium free from moisture.

Because of the fact that the area of contact between the walls 2 and the heat transferring medium is by far more larger than the area of contact between the element 27 and said medium, the temperature of said walls will be high as compared with that of the sharp-freezing element 27. For instance, though a temperature below 0° C. may be maintained in the element 27 for ice-production, the walls 2 may possess a temperature above 0° C. for avoiding the formation of frost and the freezing out of moisture from the compartments surrounding the unit 2.

In Fig. 10 the walls of the compartments 24, 26, and the walls 2 and 4 effect the division of the space between the refrigerating element

proper 27 and the outer wall 3 of the cabinet into a set of compartments surrounding each other in succession.

In Fig. 13 I have shown a refrigerating unit of the form above described in connection with Fig. 10, mounted in a standard refrigerator. Even in this case the available space between the refrigerating element proper 27 and the outer wall 3 of the refrigerator cabinet may be said to be subdivided into separate compartments surrounding each other in succession because of the provision of the compartments 24 and 26 and the wall 2.

Although the invention has been hereinbefore described in connection with refrigerators only, it is obvious that I may also apply the invention to other types of refrigerating devices as well as to heating cabinets and similar devices without departing from the principle or scope of the invention as defined by the appended claims.

What I claim is:

1. In a device of the character specified, the combination of a cabinet, or room, an inner compartment therein, a refrigerating unit in said compartment, and a set of other compartments for receiving goods to be cooled, said other compartments being so arranged between said inner compartment and the walls of the cabinet, or room, as to follow upon each other in series so as to hold temperatures gradually varying from said inner compartments towards the walls of the cabinet, or room.

2. In a refrigerator, the combination of a cabinet, an inner compartment therein, a refrigerating unit in said compartment, and a series of food compartments so arranged between said inner compartment and the walls of the cabinet as to be airtightly sealed with respect to each other and to hold temperatures gradually increasing as reckoned from the innermost compartment towards the walls of the cabinet.

3. In a refrigerator, the combination of a cabinet, an inner compartment therein, a refrigerating unit in said inner compartment, and partitions arranged in the space between said inner compartment and the walls of the cabinet in such a way as to divide said space into a series of food compartments in such a way as to allow said compartments to hold temperatures gradually increasing from said inner compartments towards the walls of the cabinet.

4. In a refrigerator, the combination of a cabinet, an inner compartment therein, a refrigerating unit in said compartment, a series of food compartments so arranged in the space between said inner compartment and the walls of the cabinet as to hold gradually increased temperatures as reckoned from the innermost compartment towards the walls of the cabinet, and a common door for said inner compartment containing the refrigerating unit and the food compartments.

5. In a refrigerator, the combination of a cabinet, an inner compartment therein, a refrigerating unit in said compartment, partitions so arranged in the space between said inner compartment and the walls of the cabinet as to divide said space into a series of food compartments following upon each other in succession in such a way as to hold gradually increased temperatures as reckoned from the inner compartment towards the walls of the cabinet, a common door for the inner compartment containing the refrigerating unit and the food compartments, and

packing means on said door for engaging the edges of said partitions so as to airtightly seal the respective compartments from each other.

6. In a refrigerator, the combination of a cabinet, an inner compartment therein, a refrigerating unit in said compartment, a series of food compartments so arranged between said inner compartment and the walls of the cabinet as to be airtightly sealed with respect to each other and to hold temperatures gradually increasing from the innermost compartment towards the walls of the cabinet, and a plurality of doors each belonging to one compartment at least.

7. In a refrigerator, the combination of a cabinet, an inner compartment therein, a refrigerating unit in said compartment, a series of food compartments so arranged in the space between said inner compartment and the walls of the cabinet as to hold gradually increased temperatures as reckoned from the innermost compartment towards the walls of the cabinet, and a common door for said inner compartment containing the refrigerating unit and said food compartments, said common door being provided with one airtightly closed space at least.

8. In a refrigerator, the combination of a cabinet, an inner compartment therein, a refrigerating unit in said compartment, a series of food compartments so arranged in the space between said inner compartment and the walls of the cabinet as to be airtightly closed with respect to each other and to hold temperatures gradually increasing from the innermost compartment towards the walls of the cabinet, and a plurality of doors each belonging to one compartment at least, and each provided with an airtightly closed space at least.

9. In a refrigerator, the combination of a cabinet, an inner compartment therein, a refrigerating unit in said compartment, a series of food compartments so arranged between said inner compartment and the walls of the cabinet as to hold gradually increased temperatures as reckoned from the innermost compartment towards the walls of the cabinet, a common door for said inner compartment and said food compartments, said common door being provided with one space at least for receiving food, and a door, or doors, to airtightly close said space or spaces.

10. In a device of the character specified, the combination with an open-ended cabinet of a series of open-ended receptacles of gradually varying sizes mounted in said cabinet so as to surround each other in succession, the innermost receptacle forming a compartment for receiving a refrigerating unit and the spaces between the various receptacles as well as between the outermost receptacle and the surrounding wall of the cabinet forming compartments for receiving goods to be cooled, or heated.

11. In a refrigerator, the combination of an open-ended cabinet, a series of open-ended receptacles mounted in said cabinet so as to surround each other in succession, the spaces between adjacent receptacles being adapted to form food compartments, a refrigerating unit in the innermost receptacle, and a common end wall to close the open ends of the receptacles as well as of the cabinet enclosing same.

12. In a refrigerator, the combination of an open-ended cabinet, a series of open-ended receptacles mounted in said cabinet so as to surround each other in succession, the spaces between the various receptacles as well as between the outermost receptacle and the walls of the

cabinet being adapted to form food compartments, a refrigerating unit in the innermost receptacle, and a common door to close the open ends of the cabinet and the receptacles contained therein.

13. In a refrigerator, the combination of an open-ended cabinet, a set of open-ended receptacles mounted therein so as to surround each other in succession, a refrigerating unit in the innermost compartment, and a common insulated door to close the open end of the cabinet as well as the open ends of the receptacles contained therein.

14. In a refrigerator, the combination of a cabinet, an inner compartment therein, a refrigerating unit in said compartment, a series of food compartments so arranged between said inner compartment and the walls of the cabinet as to hold gradually increased temperatures as reckoned from said inner compartment towards the walls of the cabinet, and passages for conveying a refrigerant through the food compartments to permit a control of the temperature in said compartments.

15. In a refrigerator, the combination of a cabinet, an inner compartment therein, a refrigerating unit in said compartment, a series of food compartments so arranged between said inner compartment and the walls of the cabinet as to hold gradually increased temperatures as reckoned from said inner compartment towards the walls of the cabinet, and sealed passages for conveying a refrigerant free from moisture through the food compartments to permit a control of the temperatures in said compartments without the risk of the formation of frost on the surfaces in contact with the refrigerant.

16. In a refrigerator, the combination of outer walls forming a cabinet, walls forming an inner compartment, said inner compartment walls being spaced from the walls of the cabinet, walls forming a housing in said compartment, at least some of said housing walls being spaced from the walls of the said compartment, a sharp freezing element in said housing, and food compartments in said housing surrounded by walls spaced from the walls of the housing so as to provide a passage for a heat transferring medium in said housing around said food compartments, the medium contained in said passage being in contact with said sharp freezing element but out of communication with the interior of said food compartments.

17. In a refrigerator, outer walls forming a cabinet, walls forming an inner compartment, the inner compartment walls being spaced inwardly from the walls of the cabinet so as to provide a space around the inner compartment for receiving food, walls forming a housing in said inner compartment, some of said housing walls being spaced from the walls of the compartment, a sharp freezing element in said housing, walls forming a food compartment in said housing with the walls thereof spaced from the walls of the housing so as to provide a passage for a heat transferring medium in the housing around the food compartment therein, the medium contained in said passage being in contact with said sharp freezing element but out of communication with the interior of said food compartment, said food compartment being provided with a door to permit independent access thereto, and the sharp freezing element being provided with a separate door to provide independent access thereto, the space in the housing which

constitutes the passage for heat transfer medium being closed at the front of the cabinet.

18. A refrigerator comprising in combination, a cabinet, a housing therein with the bottom, top and side walls thereof at least spaced from the respective walls of the cabinet to provide food compartments between the housing and the walls of the cabinet, a sharp freezing element and separate food compartments in said housing, said food compartments being spaced from said 10

element and from said walls of the housing to provide a passage for a heat transferring medium inside the housing, the medium contained in said passage being in contact with the sharp freezing element but out of communication with the interior of the food compartments, and separate doors to permit independent access to said sharp freezing element and to said food compartments.

ERIK DAVID LINDBLOM.