

Oct. 31, 1939.

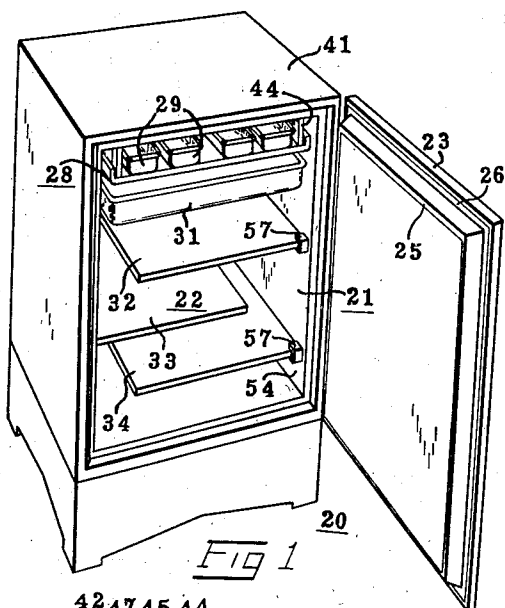
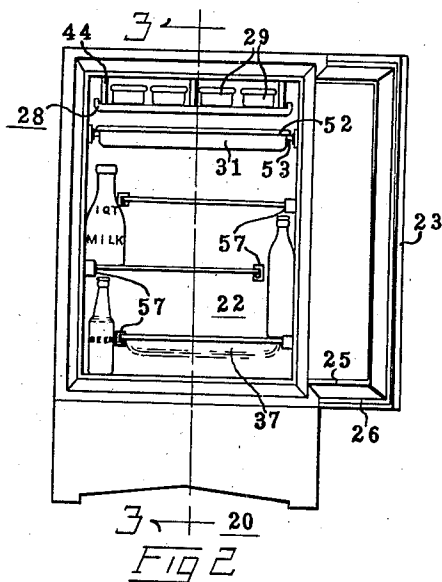
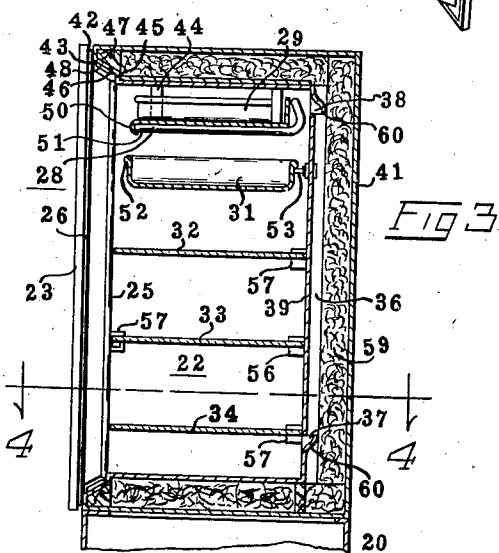
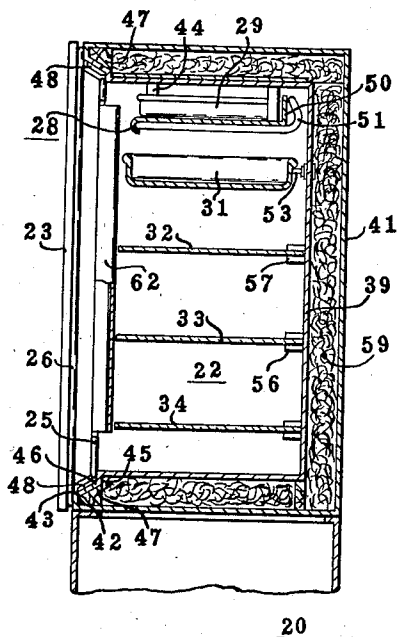
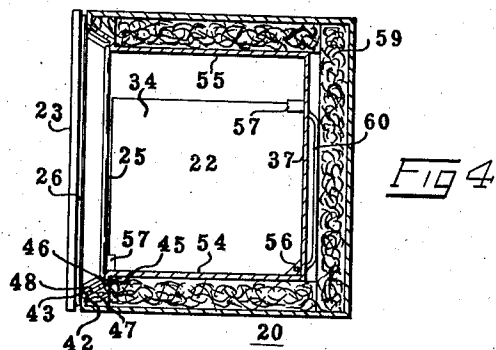
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2,177,663

REFRIGERATING APPARATUS

Filed March 1, 1937

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

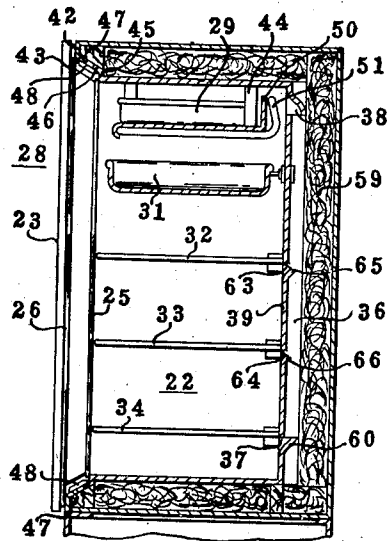


Fig 6 20

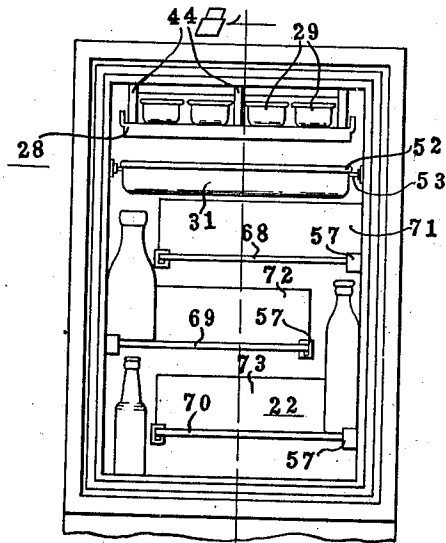


Fig 7 20

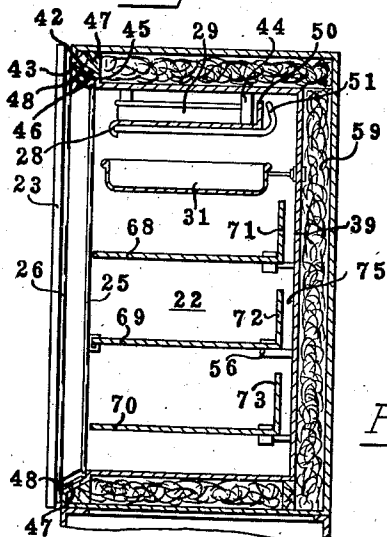


Fig 8

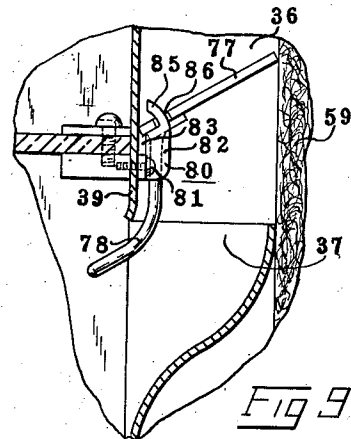


Fig 9

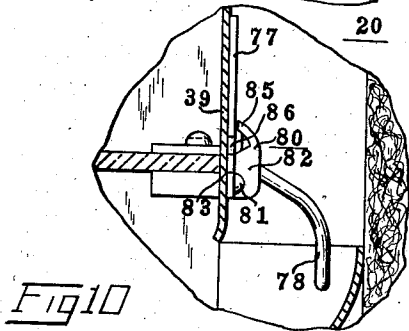


Fig 10

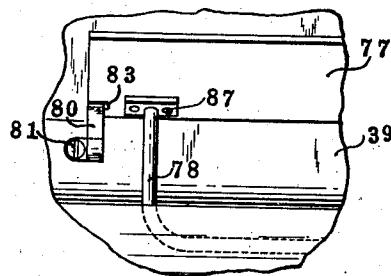


Fig 11

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2,177,663

REFRIGERATING APPARATUS

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Application March 1, 1937, Serial No. 128,305

10 Claims. (Cl. 62-89)

The present invention relates to refrigerating apparatus and particularly to the method of circulating cooling air within the refrigerated storage compartment of the refrigerator cabinet.

5 In my copending application Serial No. 112,309, filed November 23, 1936, I provide a plurality of vertically spaced, horizontally disposed shelves constructed and arranged within the refrigerated compartment in such manner that the air flowed
10 downwardly and upwardly, predominantly in zigzag paths whereby a relatively high relative humidity of the air as well as a relatively wide temperature differential was maintained between different parts of the storage compartment.

15 Under certain conditions it is desirable to maintain a more uniform temperature throughout the entire storage compartment. One of the objects of the present invention is to cause at least part of the cooling air to follow a circuitous course including the zigzag path of the refrigerator compartment wherein the air flows in one general direction, for example, either upwardly or downwardly and which circuitous course also includes
20 another path for the flow of air in an opposite direction to thereby complete the air circuit.

More specifically, it is an object of my invention to establish a course for the flow of air in which a path, separate from the zigzag path, is utilized for completing a circuit for the flow of at least
25 part of the air so that air can flow into one end of the zigzag path and out of the other end thereof.

Another object of the invention is to provide an air control device, such as a damper, for controlling the direction of the flow of air in the zigzag path and more specifically, to provide a damper which will, when in one position, permit air to flow through a circuitous course, and, which will, when in another position, cause the air to
30 flow in zigzag paths to and from the environment of the heat absorber.

The insulations employed for refrigerator cabinets are usually hygroscopic and will in time absorb such quantity of moisture as to impair the
35 insulating effects thereof. A further object of the present invention is to cause relatively dry air to circulate over the insulation so as to absorb moisture therefrom.

Other and further objects and advantages will be apparent from the following description, reference being had to the accompanying drawings wherein preferred forms of embodiments of the present invention are clearly shown.

Referring to the drawings:

55 Fig. 1 is a perspective view of one form of my

improved refrigerator showing the food compartment door open;

Fig. 2 is a front view of the refrigerator also showing the door open;

Figure 3 is a longitudinal sectional view taken 5 on line 3-3 of Fig. 2;

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

Fig. 5 is a longitudinal sectional view similar to Fig. 3 but showing the air duct or flue carried by 10 the door of the cabinet;

Fig. 6 is also a longitudinal sectional view showing another embodiment of the invention;

Fig. 7 is a front view of a refrigerator cabinet with the door removed and showing still another 15 embodiment of the invention;

Fig. 8 is a sectional view taken on line 8-8 of Fig. 7;

Fig. 9 is a fragmentary sectional view of the lower part of the refrigerator cabinet showing in 20 detail a damper;

Fig. 10 is a view similar to Fig. 9 but showing the damper in the open position; and

Fig. 11 is a fragmentary view showing the rear side of part of the damper. 25

Referring in general to the drawings, a refrigerator cabinet 20 is shown provided with an inner lining 21 forming a compartment 22. The compartment 22 is closed by a door 23 which carries rubber gaskets 25 and 26. A heat absorber in 30 the form of an evaporator 28 is disposed in the upper part of the compartment 22 and supports a plurality of ice trays 29. A pan 31 for foods to be frozen is carried below the evaporator 28. A plurality of glass shelves 32, 33 and 34 having a 35 bead on each edge are suitably carried by the lining 21 and are disposed one above the other and in staggered relation. These shelves form a zigzag space within the storage compartment 22.

The air, cooled by the heat absorber 28, can 40 follow a circuitous course and at least part of the air does follow the circuitous course when a path is opened to complete the course. To accomplish this, a path, in addition to the zigzag path, is provided and the air may flow either upwardly 45 or downwardly by properly positioning the inlet and outlet openings thereto. In the embodiment illustrated in Figs. 2 and 3, a duct 36 is formed in the rear of the cabinet by spacing the rear wall 39 of the lining 21 from the insulation. This 50 rear wall is provided with openings 37 and 38. In this embodiment at least part of the air falling through the zigzag path in compartment 22 will pass from below the lower shelf 34 and through the opening 37 into the duct 36, whence it will 55

flow through the opening 33 and to the environment of the evaporator 28. In this manner air is continuously circulating through the entire zigzag shaped space in compartment 22 and therefore reduces the temperature differential between remote parts of the storage compartment.

Referring more to the details of the invention, the outer sheet metal shell 41 of the cabinet is provided at the front with inwardly turned flanges 42 and rearwardly turned flanges 43. The lining 21 is provided at the front with outwardly turned flanges 45 and forwardly turned flanges 46. The flanges 43 of shell 41 and the flanges 46 of lining 21 are aligned and four frame members 47 (the vertical frame members at opposite sides not being shown) surround these flanges 43 and 46. Four breaker strips 48 are disposed on the sides opposite the frame members 47 and are secured to the frame members 47, as by screws (not shown), and thereby clamp the flanges 43 and 46, the frame members 47 and the breaker strips 48 in position. This in effect seals the insulating space between the outer shell 41 and the lining 21. It will be noted that gasket 25 seals with flanges 43 so that outside air cannot flow toward the joint between the breaker strips 48 and flanges 43 and 46 when the door is closed. The cabinet is more fully disclosed in my copending application Serial No. 102,368, filed September 24, 1936.

The evaporator 28 comprises a shelf 50 and a serpentine coil of pipe 51 extending substantially throughout the length and depth of the shelf 50 and hermetically joined thereto. The evaporator hangers 44 are suitably secured to the top of the lining and to the shelf for supporting the shelf spaced from the top of the lining. The evaporator extends substantially across and substantially from front to rear of compartment 22 and the shelf 50 thereof supports four ice trays 29. The pan 31 is provided with lips 52 which are carried by rods 53. Each rod is suitably connected with a side wall and the rear wall of the lining 21. The pan 31 spans the evaporator 28 so as to catch all drip therefrom but is spaced from the walls of the lining and the door 23 to permit the circulation of air thereabove. The pan 31, being disposed directly below the evaporator, can be used as the frozen food container and as an absorber for absorbing heat from the air thereabout.

The shelves 32, 33 and 34 are each supported at three points; namely, at three corners. The rear edge of each shelf is disposed adjacent the rear wall 39 of the lining and an edge of shelf 32 and an edge of shelf 34 are disposed adjacent the right side wall 54 of lining 21 and an edge of shelf 33 is disposed adjacent the left side wall 55 of the lining. The right rear corner of lining 21 is provided with shelf supports 56 for shelves 32 and 34 and a like support is provided in the left rear corner of the lining for shelf 33. Shelf supports 57 are provided for the right front edges of shelves 32 and 34 and a like support is provided for the left front edge of shelf 33. Similar supports 57 are provided at the rear of the lining, which supports are positioned at the edge of the shelf remote from the respective rear corner support. These supports 56 and 57 are suitably attached to the lining 21. The shelves and supports are more clearly shown and described in my copending application Serial No. 112,309.

Insulation 58 is disposed between the lining 21 and the outer shell 41 and usually this insulation is hygroscopic. If moist air comes in contact

therewith, the insulation is apt to absorb such an amount of moisture so as to impair the insulating effects thereof. To obviate this difficulty I cause the relatively cold dry air from compartment 22 to circulate over the insulation and thereby prevent an accumulation of moisture within the insulation in the event that outside air seeps into the insulating space. This is accomplished by arranging the duct 36 between the rear wall 39 and the insulating material 59. The openings 37 and 38 are formed by merely cutting the rear wall 39 and bending the adjacent material rearwardly.

In the embodiment shown in Figs. 2 and 3, the duct 36 acts as an up flue for the air but it is apparent to those skilled in the art that the opening 38 could be arranged below the evaporator 28 and the opening 37 could be placed at the extreme bottom of the lining 21 so that air would enter the opening 38, flow downwardly through the duct 36 and enter the extreme bottom of the compartment 22 through the opening 37. The air on entering the compartment 22 would flow upwardly therein and after passing therethrough would be recooled by the evaporator 28. In that construction, the space intermediate shelves 32 and 34 would be the warmer due to the fact that cold air is entering the space below shelf 34 and the space above shelf 32 would be cooled partly by the pan 31.

It will be noted that in the embodiment illustrated in Figs. 2 and 3, the air inlet to the duct 36 is directly below the lower shelf 34 to withdraw the warm air from the space immediately below the shelf 34 and that the opening 38 is placed at the extreme upper end of the lining 21 so that the air, entering the environment of the evaporator and passing thereover, will be cooled and fall within the compartment. The left edges of shelves 32 and 34 stop short of the left side wall 55 of lining 21 and the right edge of shelf 33 stops short of the right side wall 54. The shelves are imperforate, preferably being formed of glass, and, due to the staggered arrangement thereof, form a zigzag shaped storage space, the shelves, therefore, form barriers to the free circulation i. e., the free vertical movement of the air and thus cause the air to flow horizontally between the shelves. Due to convection, the air, which is cooled in the upper part of the compartment by the evaporator 28 and the adjacent elements including the pan 31, will flow downwardly as well as horizontally and therefore in the zigzag space. This path provided by this zigzag space, is predominately horizontal as each space above a shelf is a horizontal path. Eddies will be established throughout the zigzag path of the air and some of the air, due to being heated, will rise and return via this zigzag path to be recooled by the evaporator and pan and return to the zigzag path. However, at least part of the air will continue throughout the length of the zigzag path and enter the flue 36. Since some of the air flows entirely through the zigzag path, it will tend to cool the entire compartment to the same temperature. However, due to the absorption of heat from the commodities stored within the compartment 22, the air will be gradually increased in temperature but not to the same degree as when no circuitous path is provided. In other words, due to the fact that some of the air will flow in a circuitous path including the outer flue 36, a more uniform temperature is maintained than when no such flue is provided, in which latter

case, all of the air must pass upwardly and downwardly through the zigzag path.

The lining 21 being made of sheet material will absorb heat from the interior of the compartment and will conduct the same to the upper part where it is absorbed by the evaporator. Likewise, due to the smooth surface area of the polished glass shelves, and the smoothly finished, preferably porcelain, lining 21, heat from the food will be reflected by the shelves and lining and thereby assist in minimizing the temperature differential between remote parts of the compartment 22. It will be understood that some of the reflected heat will be absorbed by the relatively cold lining and conducted upwardly. These phenomena, in addition to the aforementioned eddies and the circuitous course, will minimize materially the differential in temperature between the remote parts of the food compartment. In this manner, desirable temperatures are maintained in the cabinet with minimal circulation. This is advantageous in that food will not be dehydrated quickly, particularly in the space below the lowest shelf 34, and in this manner, the so-called "hydrator" can be eliminated, for in effect the entire lower portion of the compartment functions as a high humidity chamber.

Although, as previously explained, the differential in temperature, between remote parts of the compartment, are minimized, nevertheless there will be a temperature gradient between these remote parts of the compartment. This temperature gradient is not a disadvantage; in fact there is an advantage in maintaining a temperature gradient in the compartment. Some foods, such as vegetables can be maintained at a relatively warm temperature and when stored in the lowest part of the compartment they are maintained at the desired temperature and, in addition to this, the relative humidity is high enough to prevent dehydration of the food while the circulation of air is sufficient to prevent molding of the food.

It has been found in actual practice that the space between the left hand edges of the shelves 32 and 34 and the left side of the lining and the space between the right hand edge of shelf 33 and the right wall of the lining can be materially reduced without detrimental effects upon the circulation of air through the circuitous course including the flue 36. However, these spaces have been maintained as shown so as to serve as spaces for receiving the upper parts of articles such as milk and beverage bottles. Therefore although these spaces are filled with cylindrical bottles, the space between the bottles is sufficiently large to permit adequate circulation in the circuitous course.

Still another embodiment of the invention is shown in Fig. 5 in which the rear lining 39 lies flush against the rear insulation and is impermeable. In this embodiment the duct for completing the circuitous course comprises a sheet metal channel shaped member 62 of substantially the same width and depth as the duct 36 and in which the side flanges are permanently secured to the inside of the door 23. The lower part of the duct 62 forms the inlet thereto and the upper part thereof is also open and forms an outlet leading to the environment of the evaporator 28. It will of course be understood that this duct could be lowered so that the air would flow downwardly therethrough and feed the extreme bottom of the compartment 22 with cold air.

Another embodiment of the invention is shown in Fig. 6 wherein the rear wall 39 of the lining is provided with openings 63 and 64 directly below

the shelves 32 and 33 in addition to the opening 37 below the shelf 34. In this embodiment an outlet for warm air is provided below each of the shelves so as to further enhance the circulation and thereby provide a still closer differential in temperature between the upper part of the compartment 22 and the lower part thereof. It will be noted that the bent out portions 65 and 66 do not extend rearwardly as far as the bent out portion 60 of opening 37 and thereby permit the free flow of air through the duct 36. Those schooled in the art will readily understand that all of the openings 37, 64, 63 and 38 can be lowered so that the air flows downwardly in the duct 36 whereby cold air will enter the compartment 22 directly above the bottom wall of the lining and directly above the shelves 32, 33 and 34.

Still another embodiment of the invention is shown in Figs. 7 and 8 wherein the more direct path of the circuitous course is formed also directly by the shelves. Here each of the shelves 68, 69, and 70 includes a rear portion 71, 72 and 73, respectively, and these portions extend throughout the width of the shelves and are aligned one above the other and are spaced from the rear wall 39 of the lining and thereby provide in effect an air duct 75. It will be understood that the portions 72 and 73 can extend high enough so as to engage or substantially engage the shelf above the same and the portion 71 can extend to the top of the lining 21 so as to form a duct having the function of the duct 36 in Figs. 2 and 3, but in the embodiment illustrated, the portions 72 and 73 stop short of the shelf immediately thereabove so as to provide passages leading from below each of the shelves. As illustrated the device will function similarly to the device shown and described in connection with Fig. 6. Also, it is obvious that the portions 71, 72 and 73 can be arranged so that the air will flow downwardly through the channel or duct 75 and thereby supply air to the compartment directly above the bottom wall of the lining 21 and directly above the shelves 68, 69 and 70.

Under certain conditions it is desirable to maintain a higher temperature differential between the remote parts of the compartment 22 and therefore I have provided a damper 77 for controlling the flow of air in the more direct or straighter duct of the circuitous course. Although such damper may be incorporated in any of the embodiments illustrated, Figs. 9, 10 and 11 illustrate the same as directly applicable to the embodiments shown in Figs. 2, 3 and 6. The damper 77 is preferably disposed in the channel 36 and carries a handle 78 for manipulating the same. This handle extends through the opening 37 and can be reached when the door 23 is open. Brackets 80 are secured on the back side of the lining wall 39 by screws 81. These brackets are each bent rearwardly to form extensions 82 which extensions are spaced, as at 83, from the lining so as to provide a socket for receiving the bottom part of the damper 77 as shown in Fig. 10. The extensions 82 are each provided with a curved finger 85 and the damper 77 is provided with openings 86 which receive the fingers 85. The handle 78 is secured to the damper 77 by rivets 87. When it is desirable to close the damper the handle 78 is pushed rearwardly and the damper 77 will be guided by the curved fingers 85 so as to assume a vertical position and when it assumes the vertical position it will fall within the socket 83 and thereby is retained in place. When it is desirable to close the damper, it is merely necessary to push upwardly and slightly forwardly so

that the fingers 85 will enter the openings 86 and then the damper 77 will fall of its own weight to the position shown in Fig. 9.

Thus, since this damper is provided, the refrigerator may be operated with a relatively wide differential of temperature between the remote parts of the food compartment or a relatively narrower differential of temperature. When the damper is open, a circuitous course is established for the entire space within the food compartment whereby the differential of temperature between the remote parts is less than when the circuitous course is minimized in effect, or completely eliminated.

From the foregoing it will be seen that I have provided a refrigerating system in which several regions of desirably distinct temperatures can be maintained. Due to the limited flow of air through the circuitous course, I have insured circulation, through certain regions, of such value that desirable temperatures are maintained but the circulation is so limited as to prevent the dehydration of foods stored therein. Furthermore, by providing the controllable damper, the same refrigerator may be utilized as a refrigerator having relatively wider temperature differentials between remote parts thereof. In either event the circulation is such that the evaporator can be decreased to a relatively low temperature whereby water, within the ice trays 29, can be frozen quickly and yet the food storage compartment will not be decreased to an undesirable temperature. Also the region directly below the evaporator; namely, that containing the pan 31, will be maintained below freezing temperature at all times for storing frozen foods therein.

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

I claim:

1. In the art of refrigeration in which air is cooled and circulated in a cabinet employing hygroscopic insulation, that step in the method which consists in establishing a substantially vertical path open to the insulation and a zigzag path in the cabinet and interconnected with the vertical path, and cooling the air to promote circulation thereof and directing the cooled air first through one of the paths and then through the other.

2. In combination, a refrigerator cabinet having a cooling compartment, a heat absorber in the upper part thereof, a substantially imperforate horizontally disposed shelf interposed between and spaced from the heat absorber and the bottom of the compartment, one edge of the shelf stopping short of a vertical wall of the compartment so as to divide the compartment into interconnected upper and lower sub-compartments, another edge of said shelf being spaced from another vertical wall of the compartment and having a part extending vertically and spaced from the second mentioned vertical wall and cooperating with the latter to form a flue in said cooling compartment alongside one of said sub-compartments.

3. In combination, a refrigerator cabinet having a cooling compartment, a heat absorber in the upper part thereof, a plurality of substantially imperforate shelves horizontally disposed within the compartment and vertically spaced from one another to provide a plurality of sub-compartments, adjacent shelves being spaced

from different vertical walls of the compartment for providing a zigzag path for air, means disposed alongside a plurality of the sub-compartments and spaced from a vertical wall of the cooling compartment and cooperating therewith to form a flue, said means being open to a plurality of lower sub-compartments.

4. In combination, a refrigerator cabinet having a cooling compartment, a heat absorber in the upper part thereof, a plurality of substantially imperforate shelves horizontally disposed within the compartment and vertically spaced from one another to provide a plurality of sub-compartments, one of the shelves having an edge thereof spaced from a vertical wall of the compartment and the next lower shelf having an edge thereof spaced from a wall of the compartment confronting the first mentioned wall for providing a zigzag path for air, each of said shelves having a second edge spaced from a third vertical wall of the compartment and having a part extending vertically, said parts being aligned with one another vertically and spaced from the third wall to form therewith a flue.

5. In combination, a refrigerator cabinet including a door cooperating therewith to form a compartment, means within the cabinet and on the door forming a lining for the compartment, a heat absorber within the upper part of the compartment, a substantially imperforate shelf interposed between and spaced from the heat absorber and the bottom of the compartment, one edge of the shelf stopping short of a vertical wall of the compartment so as to divide the cabinet into sub-compartments, a flue outside of said compartment and disposed alongside of another vertical wall of the upper sub-compartment, said lining having an opening interconnecting the space directly below the shelf with the flue and having an opening interconnecting the upper part of the flue with the space adjacent the heat absorber.

6. In combination, a refrigerator cabinet including a door cooperating therewith to form a compartment, means within the cabinet and on the door forming a lining for the compartment, a heat absorber within the upper part of the compartment, a plurality of substantially imperforate shelves horizontally disposed within the compartment and vertically spaced from one another to provide a plurality of sub-compartments, one of the shelves having an edge thereof spaced from a vertical wall of the compartment and the next lower shelf having an edge thereof spaced from a wall of the compartment confronting the first mentioned wall for providing a zigzag path for air, a flue outside of said compartment and disposed along side a third vertical wall of the compartment, said lining having openings interconnecting the space directly below the shelves with the flue and having an opening interconnecting the upper part of the flue with the space adjacent the heat absorber.

7. In combination, a refrigerator cabinet having a cooling compartment, a heat absorber in the upper part thereof, a substantially imperforate horizontally disposed shelf interposed between and spaced from the heat absorber and the bottom of the compartment, one edge of the shelf stopping short of a vertical wall of the compartment so as to divide the compartment into interconnected upper and lower sub-compartments, means disposed alongside the upper sub-compartment and forming a flue interconnecting the lower sub-compartment with the

space adjacent the heat absorber, and a controllable damper in said flue.

5 8. In combination, a refrigerator cabinet having a cooling compartment, a heat absorber in the upper part thereof, the lower part of the compartment forming a storage space cooled by convection currents due to a complete cycle of upward and downward movement of the air, means forming a flue alongside the compartment
10 and interconnected with the lower part of the said space and the space adjacent the heat absorber, and a controllable damper in said flue adapted to be opened for causing a predominant flow through the flue in one direction and through
15 the storage space in the opposite direction.

9. The improved method of quickly freezing water in a household type refrigerator cabinet and reducing the temperature differential between remote food storage parts of the cabinet
20 which consists in establishing a zone of sub-freezing temperature within the upper part of the cabinet for quickly freezing water and for cooling air thereby providing a cold zone about the sub-freezing zone to thereby promote circulation
25 of air and to thereby shield the sub-freezing zone from the direct influence of warm circulating

air, and directing at least part of said circulating air from one end of a zigzag shaped food storage space to the other end of the said space in one direction and directing air in the opposite direction through another path distinct from the first mentioned path to complete the circuit for the air to and from the cold air zone. 5

10. The improved method of quickly freezing water in a household type refrigerator cabinet and reducing the temperature differential between remote food storage parts of the cabinet which consists in establishing a zone of sub-freezing temperature within the upper part of the cabinet for quickly freezing water and for cooling air thereby providing a cold zone about the sub-freezing zone to thereby promote circulation of air and to thereby shield the sub-freezing zone from the direct influence of warm circulating air, and directing downwardly flowing air through a zigzag shaped food storage space and directing air from the bottom of the zigzag shaped space through another path distinct from the path providing the zigzag shaped food storage space and leading to the cold air zone. 10 15 20 25

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