Nov. 28, 1944. G. K. IWASHITA 2,363,530

REFRIGERATOR

Filed Sept. 29, 1942 2 Sheets-Sheet 1

Fig. 1

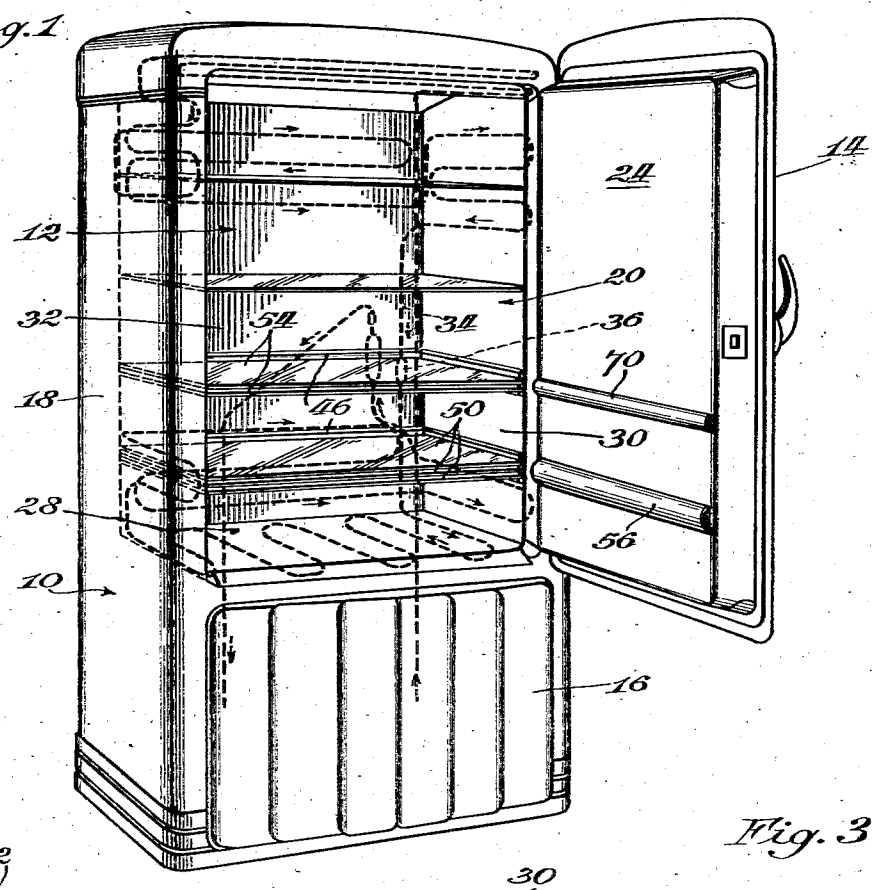
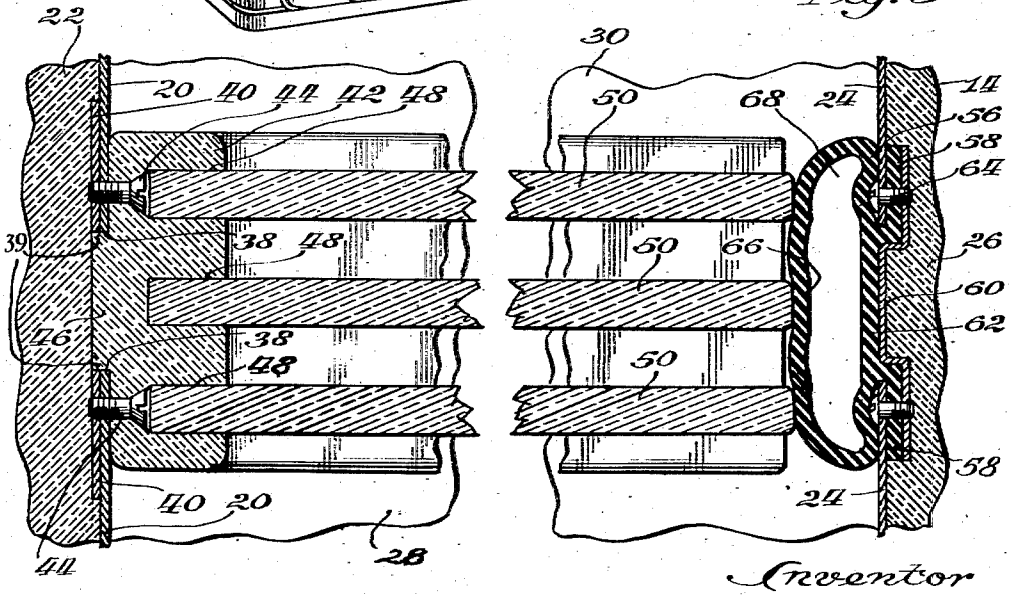


Fig. 3



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REFRIGERATOR

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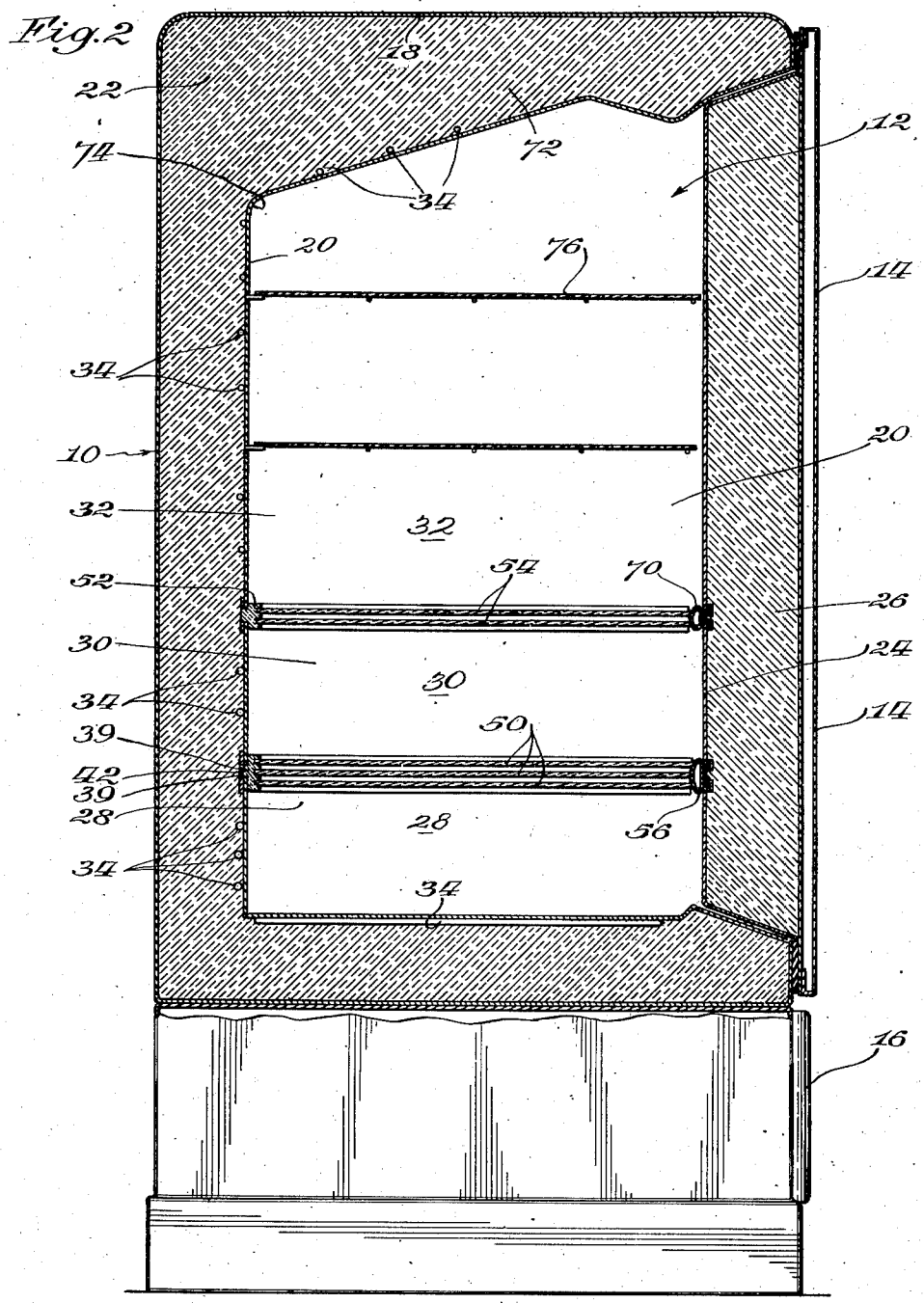
Fig. 2



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UNITED STATES PATENT OFFICE

2,363,530

REFRIGERATOR

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8 Claims. (Cl. 62—89)

The present invention relates to refrigerators, and more particularly, refrigerators of the household type.

It is one of the objects of the present invention to provide a novel refrigerator of the household type having two or more zones or compartments differing from each other in temperature and relative humidity.

Yet another object of the present invention is to provide a novel refrigerator of the above type which can be manufactured at comparatively low cost.

Still another object of the present invention is to provide an improved household refrigerator having a freezing compartment, a dry cold zone, and a moist cold zone, all within the same cabinet liner.

Yet another object of the present invention is to provide a novel refrigerator of the household type which has no refrigerating coils located within the food compartment, which includes separate refrigerated spaces differing from each other in temperature and specific humidity, and in which the temperature of one of the spaces has a minimum effect upon the temperature of the other space or spaces.

Yet another object of the present invention is to provide a novel refrigerator so constructed and arranged as to provide separate compartments or zones differing from each other in temperature and relative humidity, and in which the temperature of one of the compartments has a minimum effect upon the temperature of the other compartment or compartments.

Yet another object of the present invention is to provide a novel refrigerator accomplishing any or all of the above objectives within a refrigerator cabinet constructed essentially as a single chamber.

Yet another object of the present invention is to provide a novel refrigerator of the household type having a refrigerated compartment of high relative humidity in which condensed moisture is prevented from dripping upon the contents of the compartment.

Other objects and advantages will become apparent from the following description of a preferred embodiment of my invention which is illustrated in the accompanying drawings, in which

Fig. 1 is a perspective view of a refrigerator embodying the present invention shown with the door open. The location of the refrigerator food compartment liner and the refrigerant coils is indicated in this figure.

Fig. 2 is a vertical transverse sectional view from front to back through the refrigerator shown in Fig. 1. In this view the door is illustrated in closed position; and

Fig. 3 is a detail sectional view drawn on an enlarged scale of a portion of the apparatus illustrated in Fig. 2. This figure may be considered as taken in the same plane as Fig. 2.

The refrigerator embodying the present invention and illustrated in the drawings is comprised primarily of a cabinet 10, having a food space, indicated generally by the numeral 12, which is closed by a door 14. Below the food space a door 16 closes a compartment wherein the compressing unit is housed. The particular compressing unit used forms no part of the present invention and therefore is not illustrated.

The refrigerator cabinet may be of generally conventional construction excepting as pointed out subsequently, and is comprised of an outer shell 18 within which is disposed a liner 20, the liner being separated from the outer shell by rock-wool 22 or other insulating material. Similarly, the door is formed of an outer panel and an inner liner 24, the space between these members being filled with insulating material 26. The open front of the cabinet 10 is formed with a comparatively deep sill which, together with the inwardly projecting portion of the door, serves effectively to insulate the interior of the space from the exterior when the door is closed.

Essentially, the invention is concerned with an arrangement for effectively and economically dividing the food space 12 of the refrigerator into a plurality of separate zones differing from each other in temperature and relative humidity. In the present instance three of these zones are shown. The lower of these zones or compartments indicated by the numeral 28, I have termed a freezing locker. The temperature in this space is normally maintained well below freezing and it is in this compartment that ice cubes are frozen or in which meats or like foods are frozen to be preserved for comparatively long intervals of time.

Above the freezing locker is provided a dry cold space 30, wherein the temperature is maintained slightly below 40° F. The relative humidity in this compartment is comparatively low, that is approximately 50% R. H., which is well suited for preserving such foods as cold cuts and the like, which preferably should be neither frozen, nor kept in a moist atmosphere.

The upper compartment in the refrigerator, indicated by the numeral 32, is maintained at

a temperature of approximately 40° F., or somewhat higher, and at a humidity of approximately 80 R. H. This moist cold compartment is admirably suited for preserving most foods.

The refrigerant coil 34 is located against the back, side walls, top and bottom of the food space liner. The refrigerant enters this coil from the compressor compartment, closed by the door 16, and passes upwardly through an expansion valve, not shown, into a sinuous series type coil arranged about the top, back and side walls of the upper food space 32. The refrigerant then passes downwardly through a dual pressure control valve 36, which still further reduces the pressure, thus enabling the refrigerant to boil at a lower temperature. The refrigerant, after passing the dual pressure control valve, flows into a sinuous series type coil arranged beneath the bottom and behind the back and side walls of the food space about its lower portion.

The above arrangement thus provides, in effect, two separate refrigerating systems, the upper portion of the cabinet being cooled by a refrigerant coil of moderate temperature, while the lower portion of the cabinet is cooled by a refrigerant coil of considerably lower temperature.

Preferably the liner 20 is formed of sheet aluminum, although other materials can be used if desired. Sheet aluminum, or in fact any metal, is a comparatively good conductor of heat, and, therefore, will conduct heat from one zone to another. For this reason, I prefer to interrupt this heat flow at the junctures between the separate temperature zones. This is accomplished in the manner best seen in Figure 3, wherein is shown a portion of the structure at the juncture between the freezing locker and the dry cold space. The back wall of the refrigerator is indicated at the left hand portion of this figure where it will be seen that the liner 20 is interrupted for a considerable distance, the ends of the two pieces of the liner being indicated by the numeral 38. In other words, it may be considered that the liner has a horizontal slot 39 formed therein at the three sides of the food space. The edges of the liner adjacent the slot 39 are backed up by steel tapping plates 40 and are secured against the rearward face of a plastic strip 42, or other strip formed of a material of low heat conductivity, by means of screws 44 threaded into the tapping strips. Preferably a rib 46 formed upon the rear surface of the plastic strip 42 projects between the edges 38 of the liner pieces 20 and adds rigidity to the structure.

The plastic strip 42 used to interrupt thermally, but to connect together mechanically, the side and rear walls of the liner 20 at the juncture between the freezing locker and the dry cold space has its exposed face provided with three horizontally extending grooves 48 into which three glass sheets 50 are slid. The upper of these sheets serves as a shelf upon which articles of food may be deposited, while the middle and lower sheets serve together with the air spaces between the sheets to insulate the upper compartment from the lower.

At the juncture between the moist cold space 32 and the dry cold space 30 I prefer to use a similar arrangement, that is, I prefer to use a Bakelite or other suitable plastic or wood strip 52 to interrupt the sheet metal liner and to support glass shelves 54. Inasmuch as the temperature differential between the moist cold space and the dry cold space is inconsiderable, two glass sheets are sufficient for the purpose, whereas three are used to insulate the dry cold space from the freezing locker. In both cases, the adjacent compartments are insulated from each other by the air spaces between the glass sheets, while the plastic strips 52 and 42 prevent heat from being conducted by the liner from one compartment to the other.

If desired, the front edges of the shelves, composed of the glass sheets 54 and 50 may be sealed together to insure dead air spaces between these sheets. Or, if desired, the spaces thus provided may be evacuated to provide even better insulation. In the drawings, however, I have indicated an expedient for sealing the front edges of the shelves while at the same time sealing the several compartments from each other along the inner face of the door 14. This arrangement is shown in detail to the right in Figure 3.

As shown in the right hand portion of Figure 3, the door liner 24 is interrupted in the same manner as the back and side panels of the refrigerator liner so as to prevent heat conduction by way of the door panel from one compartment to the other. Instead of using a Bakelite or other plastic strip, however, I use a soft rubber bumper strip 56. This bumper strip has a pair of flanges 58 which underlie the contiguous edges of the liners 24. A metal strip 60 is positioned behind these flanges and extends across from one panel to the other immediately behind the central portion 62 of the bumper strip 56. The metal strip is tapped at appropriate intervals and screws 64 extend through the liner, the soft rubber flanges 58, and into the tapped openings in the strip 60. With this arrangement, it will be seen that excepting for the very slight amount of heat conducted through the rubber of the bumper strip 62 and the screws 64, heat cannot be conducted from one compartment to the other along the front edge.

The rubber bumper 62 has an inwardly extending tubular portion 66, which is easily distorted and compressed, because of a hollow space 68 located therein. This forwardly projecting portion bears against the front edges of the glass sheets 50 when the door is closed. Preferably, contact should be made between the bumper strip and the edges of the glass sheets slightly prior to complete closing of the door so that upon completion of the door closing operation, the bumper strip will be slightly compressed, thus insuring good contact and, therefore, good sealing along the edge of the sheets. As may be seen in Figure 3, when the door is in closed position, the bumper effectively seals one compartment from the other and also seals the spaces between the three glass sheets which form the dividing elements between the freezing locker and the dry cold space.

Although not shown, it will be appreciated that, if desired, a small inner door may be used to close the freezing locker, so that warm air will not enter this compartment when the large door is opened to give access to the dry cold space or the moist cold space.

A similar bumper 70 is arranged upon the inner surface of the door in alignment with the front edge of the dividing shelf which separates the moist cold space from the dry cold space. This bumper similarly serves to seal the space between the glass sheets 54 and also prevents the flow of air between the intermediate and upper compartments. As in the case of the bumper strip 56, the strip 70 is used together with a back-

ing plate to join together two liner elements which form the inner surface of the door 14, thus interrupting heat conductivity through the door liner between the intermediate and top compartments.

I have found that a refrigerator as thus constructed effectively maintains a sub-freezing zone in the lower compartment previously referred to as the freezing locker. Above the lower divider shelf, composed of the glass sheets 50, the temperature will be more moderate, however, and no frost will form upon the food space liner immediately above this dividing shelf as would be the case if the liner were not thermally interrupted. I find further that the use of glass sheets gives a neat and massive appearance, inasmuch as the whole interior of the refrigerator may be seen at one time. I have found further that the intermediate space 30 is maintained at comparatively low humidity, which is proper for preserving certain types of food articles. On the other hand, the upper space 32, which I have referred to as the moist cold space, is slightly warmer than the dry cold space but considerably more moist. In fact, frequently moisture will condense from the air upon the walls of the upper compartment refrigerator liner, inasmuch as the liner is arranged in intimate heat transfer relation with the refrigerator coils.

Under some conditions, if the interior of the refrigerator has the usual shape, this moisture may gather in large drops and drip upon the food located within the moist cool space. To overcome this objection I have provided the arrangement shown in Figure 2, wherein it will be seen that the rearward portion of the upper surface 72 of the food space liner is arranged so as to slope comparatively sharply downwardly toward the rear wall. At the point where it joins the rear wall, the corner 74 is well rounded. Further, it will be noticed that the refrigerant coils 34 located against the surface of the top of the food space liner are spaced somewhat rearwardly of the forward edge and are arranged only upon the downwardly sloping portion of the liner 72. I have found that with this arrangement the moisture will not normally collect forwardly of the downwardly sloping portion 72 and further, that moisture collected upon this downwardly sloping portion will flow backwardly, around the corner 74 and down along the back wall. It, therefore, does not drip into the food located within the moist cold space.

Preferably upper and intermediate, or any desired number of shelves 76, are located within the moist cold space and are formed of glass sheets. These sheets are arranged with their edges spaced slightly from the surface of the refrigerator liner and rest upon pins or other supporting means secured to the refrigerator liner. There is thus provided a thin slot along the edges of the shelves through which condensed moisture may flow downwardly along the walls to the plastic strip 52 which supports the glass sheets 54.

The small amount of moisture which condenses and eventually finds its way into a position along the upper surface of the strip 52 will remain there at the corner formed between the strip and the liner because of the surface tension of the water. Occasionally, whenever sufficient moisture has collected to justify it, this moisture can be removed with a rag or sponge. Although not shown, it will be appreciated that if desired, the upper surface of the strip 52 may be formed to provide a channel in which the moisture collects and along which the moisture may flow to a drain tube leading either to a cup located lower down within the refrigerator, or to the outside. If this arrangement is provided, the moisture collecting upon the walls of the refrigerated space will eventually find its way into the cup, and this cup may be removed and emptied from time to time.

While I have shown and described particular embodiments of my invention, it will be apparent to those skilled in the art that numerous modifications and variations may be made without departing from the underlying principles of the invention. I therefore desire, by the following claims, to include within the scope of the invention all such modifications and variations by which substantially the results thereof may be obtained by substantially the same or equivalent means.

I claim:

1. In a refrigerator, a cabinet providing a food space, a sheet metal liner for said food space, an impervious shelf dividing said food space into separate zones, said shelf being comprised of a plurality of spaced apart glass sheets, shelf supporting means formed of material of low heat conductivity arranged to engage the edges of said sheets on three sides, said liner being interrupted mechanically to form a slot, means connecting the edges of said liner on each side of said slot to said supporting means, the portions of the liner on opposite sides of said slot thus being isolated thermally from each other but mechanically connected, a refrigerant coil located upon and in heat conducting relation to said liner, said coil being disposed upon one surface of said liner, partially upon one side of said slot and partially upon the other side of said slot, a door for said refrigerator, and means associated with said door adapted to seal the space between said glass sheets at the fourth edges of said sheets and to seal one of said zones from the other when said door is closed.

2. In a refrigerator, a cabinet providing a food space, a sheet metal liner for said food space and means for dividing said food space into separate food zones, the last said means comprising a partition having heat insulating characteristics, said liner being interrupted in the plane of said partition to form a slot, a heat insulating strip joined to the edges of said liner at said slot to unite said liner elements into a unitary whole and being in substantially heat sealing relationship with said partition at three of its edges, and means to inhibit the flow of air from one zone to the other at the fourth edge of said partition.

3. In a refrigerator, a cabinet providing a food space, a sheet metal liner for said food space, said liner being formed of upper and lower portions, a strip of heat insulating material united to both said portions to form a solid wall, and a shelf having heat insulating characteristics supported by said strip in substantially airtight association with said liner at approximately the level of said heat insulating strip.

4. In a refrigerator, a shelf formed of insulating material, a strip formed of insulating material substantially sealed to three of the edges of said shelf, a food space liner formed of sheet metal extending upwardly from said strip and downwardly from said strip, said liner having a slot therein located behind said strip, means to refrigerate said liner, a door having an inner

metal panel for closing said refrigerator, said panel having a resilient strip adapted to abut against the free edge of said shelf when said door is closed, the last said strip being formed of heat insulating material, a slot in the panel of said door located behind at least a portion of the last said strip, the last said strip covering said slot and the edges of said panel contiguous to said slot being united to said strip.

5. In a refrigerator, a liner providing a food space, said liner being formed of upper and lower portions, a strip of plastic material united to both said portions to form a solid wall, a shelf formed of a plurality of sheets of glass supported by said strip in spaced relation to form air spaces between said sheets, means to seal the exposed edges of said sheets to enclose the spaces between said sheets, and refrigerating means adapted to maintain the space on one side of said shelf at a different temperature than the space on the other side of said shelf.

6. In a refrigerator, a cabinet providing a food space, a sheet metal liner for said food space, said liner being formed of upper and lower portions, a strip of plastic material united to both said portions to form a solid wall, a shelf formed of a plurality of sheets of glass supported by said strip in spaced relation to form air spaces between said sheets, means to seal the exposed edges of said sheets to enclose the spaces between said sheets, means adapted to maintain the space below said shelf at a lower temperature than the space above said shelf, the rearward portion of the top wall of said sheet metal liner being sloped from front to back, and refrigerating means in heat transfer relation to said portion, said strip forming means to collect moisture at the edges of said shelf.

7. In a refrigerator, a cabinet providing a food space, a sheet metal liner for said food space, said liner being formed in upper and lower portions, a strip of heat insulating material uniting said portions to form a solid wall, a shelf having heat insulating characteristics supported by said strip in substantially airtight association with said liner at approximately the level of said heat insulating strip, a refrigerating coil in heat exchange relation to said liner in a position above said strip, a plurality of glass shelves in the food space above the first said shelf, and the edges of said shelves being spaced from said liner sufficiently to permit moisture condensed upon said liner to flow past the edges of said shelves into a position adjacent said strip.

8. In a refrigerator, a cabinet providing a food space, a door for said cabinet, a sheet metal liner for said food space, means for dividing said food space into separate food zones, the last said means comprising a shelf having heat insulating characteristics, said liner being interrupted in a plane substantially coextensive with said shelf, heat insulating means joining together the edges of said liner at said interrupted portion mechanically to unite said liner elements into a unitary whole, said shelf being substantially sealed by said heat insulating means to said liner at three of its edges, and means to inhibit the flow of air from one zone to the other at the fourth edge of said shelf, the last said means comprising a resilient strip secured to the inner face of said door.

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