May 22, 1951 W. E. RICHARD 2,553,832

REFRIGERATOR DOOR

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Fig. 2

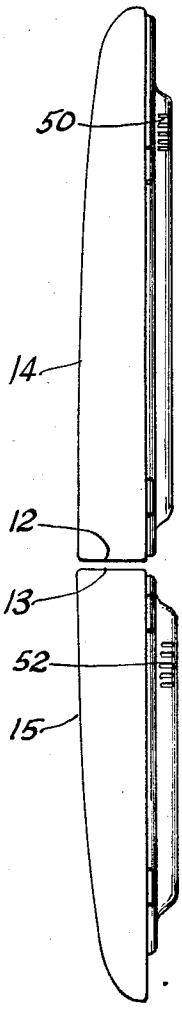


Fig. 1

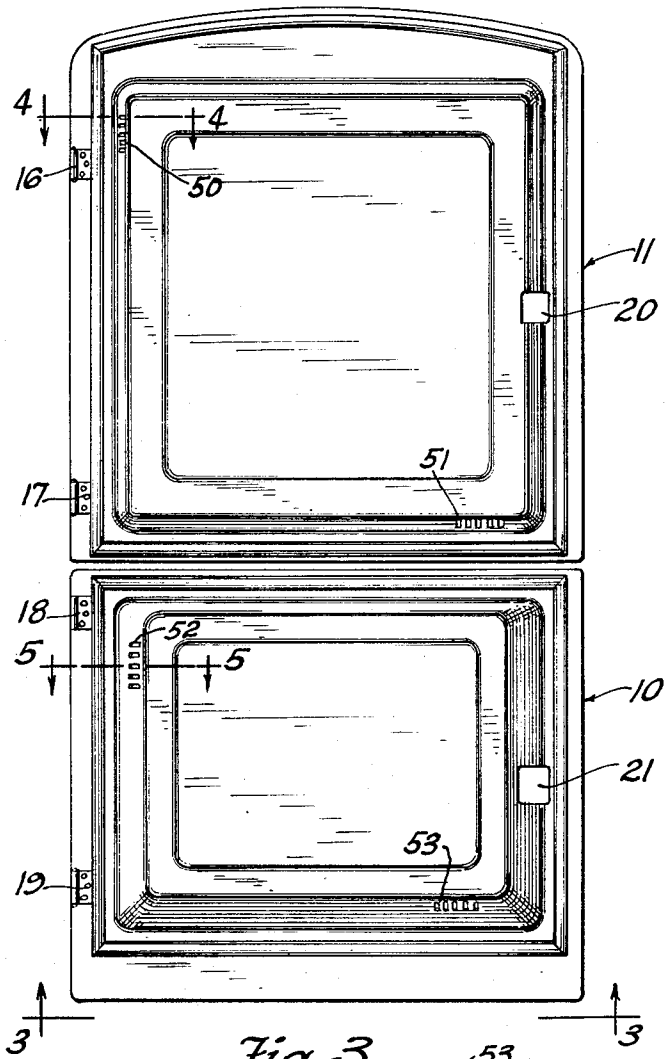
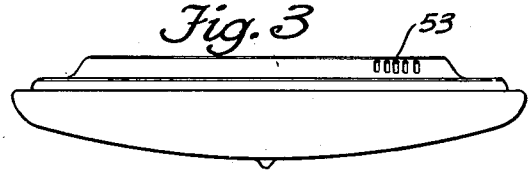


Fig. 3



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Fig. 4

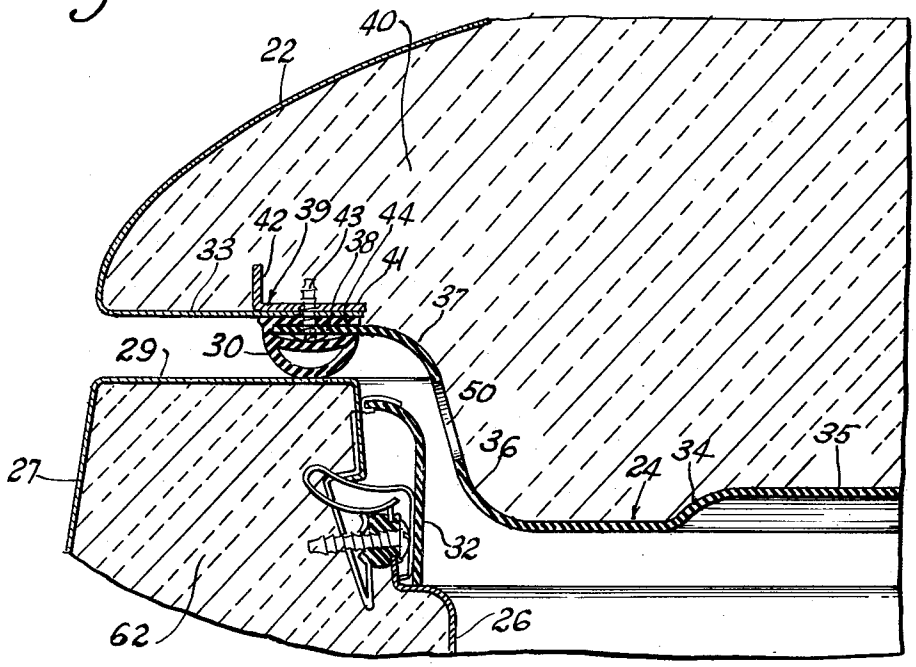
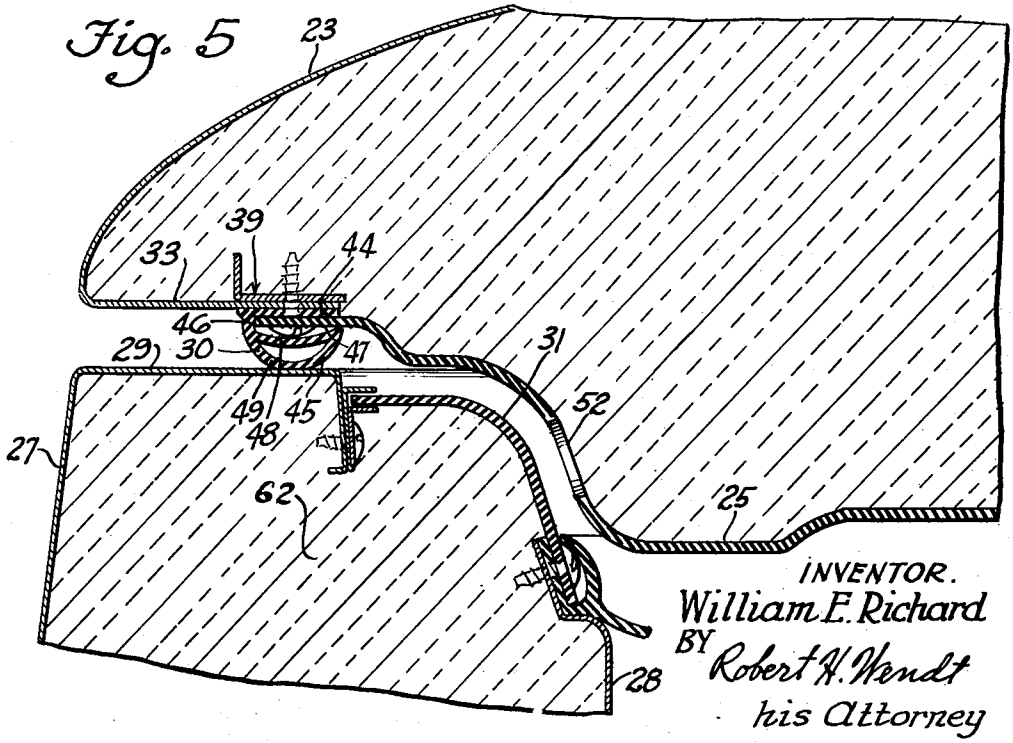


Fig. 5



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REFRIGERATOR DOOR

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2 Claims. (Cl. 20—35)

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The present invention relates to refrigerator doors, and is concerned particularly with the maintenance of the fibrous, heat, insulating materials of the doors in good condition.

One of the objects of the invention is the provision of an improved refrigerator door construction which is adapted to prevent substantially the deterioration of the insulation which would be caused by the accumulation of moisture within the refrigerator wall structure.

Refrigerator cabinets and doors are usually constructed at the present time of an outer shell of metal or other suitable material, an inner shell of metal or other suitable material, and the space between these shells is filled with fibrous insulation such as rock wool. It is important that the inner liner or inner shell be hermetically sealed from the outside atmosphere, because otherwise there would be leakage of air into and out of the refrigerator, which would involve the constant cooling of new air resulting in a waste of power. It is customary, therefore, to make the inner and outer shells of the cabinet and of the doors as nearly air tight as possible and the door engages the cabinet by means of a sealing gasket, which effects an airtight seal between the edges of the door and the front of the cabinet.

In order to prevent or minimize the transmission of heat from the outer shell to the inner shell of a door or cabinet, these shells usually have a minimum number of metal connections and they are joined at their edges, which is the front of the cabinet or the outer rear edge of the door, by means of insulated breaker strips which close the space between the shells and prevent the transmission of heat by conduction from an inner shell to an outer shell.

Since there is a low temperature inside the cabinet and a higher room temperature outside the cabinet, there is necessarily a gradient of temperatures from the inside to the outside, and the outer surface of the inner liner, which is adjacent to the rock wool, is necessarily cooler than the outer shell. Therefore, there is a tendency for moisture to condense on the outer surface of the inner lining inside the rock wool or other fibrous insulation.

The condensation on the interior surface of the door panel, making the insulation wet, would greatly reduce its insulating value, because the efficiency of the insulation depends upon the presence of a large number of dead air spaces which are found in rock wool insulation. Moisture inside the space between the shells of a door

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cabinet will also tend to cause the metal portions to rust.

One of the objects of the present invention is the provision of an improved refrigerator door structure, which may also be employed for refrigerator cabinets, by means of which the insulation between the inner and outer panels of the door may be kept substantially dry and of high insulation value and by means of which all moisture in the insulation space may be substantially eliminated.

Another object of the invention is the provision of an insulation ventilating system which is effective, inconspicuous and low in cost, and which is adapted to eliminate condensation throughout substantially the whole space in the door by virtue of the location of the vent holes, which are so located as to cause an effective air circulation by means of a limited amount of convection circulation.

Another object of the invention is the provision of an improved structure for eliminating condensation and moisture in the insulation of refrigerator doors, which is not visible to the user under ordinary conditions since the ordinary consumer would not be cognizant of the reasons for such ventilation apertures and might reach an erroneous conclusion as to the value of a door having such apertures.

Another object of the invention is the provision of an improved refrigerator door structure which is relatively strong, light, durable, of high insulation value, and adapted to be manufactured at a very low cost, so that refrigerators embodying such doors may be manufactured cheaply and placed within the price range of a larger number of the public.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the two sheets of drawings accompanying this specification,

Fig. 1 is a rear elevational view of a pair of refrigerator doors embodying the invention, this being a view taken on a vertical plane immediately inside the doors and looking toward the rear side of the doors;

Fig. 2 is a side elevational view taken from the left side of Fig. 1;

Fig. 3 is a bottom plan view of the lower door taken on the plane of the line 3—3 of Fig. 1;

Fig. 4 is a full size fragmentary sectional view taken through a portion of the door and adja-

cent cabinet on a plane corresponding to the plane 4—4 of Fig. 1 looking in the direction of the arrows, but differing from Fig. 1 in that the adjacent cabinet wall is also shown;

Fig. 5 is a similar fragmentary full size view taken on a plane corresponding to the line 5—5 of Fig. 1 looking in the direction of the arrows.

The present door structure is illustrated in connection with a cabinet adapted to have a lower freezing chamber closed by the door 10 and an upper high humidity chamber closed by the door 11. As the high humidity chamber is generally of larger size, the door 11 is longer and of a larger area than the door 10, and the door 11, being the upper door, has a lower flat wall 12, while the door 10, being the lower door, has an upper flat wall 13, these walls being adjacent to each other so that the faces 14 and 15 of the doors may present a substantially smooth flush surface with a minimum size crack between the end walls 12 and 13. In substantially all other respects, except shape, the doors 10 and 11 may be identical in structure.

Each door is preferably provided with a pair of suitable hinges 16, 17, 18, 19, which may be of any desired type for mounting the doors on the cabinets and each door is provided with a suitable lock mechanism 20, 21 for locking the free edge of the door to the cabinet. The type of hinge and lock mechanism is not essential to the invention, but the location of the vents with respect to the hinges and locks is a matter of importance.

Each of the doors 10 and 11 is preferably constructed of an outer shell 22 or 23, and an inner shell 24 or 25. The inner lining of the high humidity compartment may be indicated 26 and the outer shell of the cabinet at 27 (Fig. 4). The inner lining of the freezer compartment (Fig. 5) may be indicated 28, while the same outer shell 27 is located on the outside of this part of the cabinet as well.

The outer shell preferably comprises a bottom wall, two sides and a top wall bent into a shape corresponding to the outer outline of the doors (Fig. 1), and all constructed of a single piece secured together at the bottom by welding at the middle or either corner, the back of the cabinet preferably comprising a single sheet extending to an inner wall of the cabinet at the back.

At the front of the outer shell it is preferably provided with an inwardly extending face flange 29, which extends all around the outside of the cabinet and projects inwardly far enough to be engaged by a sealing gasket 30. There is also a face flange extending across the front of the cabinet in position to engage the sealing gasket at the bottom of the top door and at the top of the bottom door.

The inner liners 26 and 28 are joined to the outer shell by means of suitable pre-formed heat insulating fiber breaker strips 31, 32, and the spaces between the inner and outer shells of the cabinet are filled with rock wool at the spaces indicated by 62. The outer shell 22 of each door is preferably made of sheet metal and comprises a stamping which is convex on its outer side and concave on its inner side and is substantially rectangular in shape and provided with the inwardly extending border flange 33, which is substantially parallel to the face flange 20 on the cabinet.

The inner panel 24 is preferably formed of a suitably molded plastic heat insulating member, which is of substantially rectangular shape and of sufficient size to overlap the inwardly extending flange 33, as shown in Figs. 4 and 5. This pre-formed molded inner panel 24 is preferably provided with an offset at 34 and an inner depressed panel 35 for increasing the strength of the door and for preventing a tendency toward vibration or buckling of the door at the inner portion of its panel.

The inner panel 24 preferably curves inward at 36 just inside the breaker strip 32 of the cabinet and extends outwardly to the plane of the inwardly extending flange 33 where it is bent outward again at 37, having an attaching portion 38, which is substantially parallel to the flange 33 of the outer shell 22.

In order to stiffen the door and to provide a common securing member for all of the screw bolts, which has more body than the sheet metal flange 33, flange 33 is preferably provided with a stiffening frame 39, which extends in rectangular form all around the edges of the inwardly extending flange 33 and overlaps this flange on the inside of the flange 33, that is the side toward the rock wool filling 40.

The stiffening frame 39 may be made of four lengths of sheet metal strips of right angle form having an attaching flange 41 and a transverse flange 42. The thickness of the flange 41 corresponds substantially to the width of the groove between the threads on the screw bolts 43 of a self-threading type. The flange 33 and angle iron members 39 of the stiffening frame are provided with a multiplicity of regularly spaced apertures for fastening the screw bolts 43, which pass through the apertures in the flange 33 and are threaded into the stiffening member apertures 39.

Apertures are also provided in the attaching flange 38 of the inner shell 24, and apertures are also provided in the attaching flange 44 of the sealing gasket 30. In order that the fastening members between the inner and outer shells may be concealed, the gasket 30 comprises a hollow crescent shaped body 45, which is integrally joined by an extension 46 to an attaching flange 44, there being a deep crack 47 between the body 45 and the attaching flange 44.

The screw bolts 43 pass through the inner shell 24, the attaching flange 44 of the sealing gasket 30, the flange 33 of the outer shell, and are secured in the stiffening strips 39. The concavity of the inner wall 48 of the crescent body 45 provides space for the heads of the screw bolts 43 and the outer convex wall 49 of the body 45 provides a rounded portion which may engage the face flange 29 of the cabinet and may be deformed as necessary to conform thereto and produce an airtight shell between the door and the cabinet around all edges of both doors.

It should be noted that the seal 30 is located outside the breaker strips 32 and outside of the equivalent portion 37 in the inner door panel, which, being of insulating material, takes the place of the breaker strip. In order to assure some circulation by convection the inner panel of each door is provided with a plurality of series of vents 50, 51, 52, 53. For example, the vents 50 are shown in Figs. 1, 2 and 4 and they comprises elongated rectangular slots located close to each other in the upper left corner of the door in Fig. 1.

Being located adjacent to the hinge 16 and facing the hinge, the vents 50 will be in such a position that they will rarely ever become visible to the user. They are, however, located at one of the upper corners of the door and opposite to

the vents 51. The vents 51 are preferably located on the lower side of the inwardly extending portion of the inner panel 24 of the upper door and thus they will also be so located that they will rarely, if ever, be seen by the user. They could only be seen by kneeling down and looking upward at the bottom of the door.

In the same way the vents 52 are preferably located adjacent to hinges 18 on the innerward turned portion of the panel 25 of the lower door 10 in such a manner that they face the hinges and breaker strip 31 and are turned away from the user who opens the door. They become visible only when the door is fully opened, which will seldom occur.

Similar to the vents 51, the vents 53 in the lower door panel 25 are located on the lower part of the inwardly extending portion of the lower inner panel 25. Thus the vents of the upper door at 50 are uppermost and opposite the vents 51, which are lowermost.

While circulation of air is limited due to the packing of the space between the shelves with insulation, yet it does occur, and any moisture which finds its way into the space between the shells in the rock wool or other fibrous insulation will eventually be drawn out of this insulation by the circulation of the air and by the travel of the moisture from a warmer place inside the door to the coldest place inside the cabinet.

It is found that any moisture which might find its way into the insulation will eventually be condensed in the form of frost on the colder surfaces, which are located inside the compartments of the refrigerator. Thus the cooling evaporator or evaporators for the cabinet may be employed for dehydrating the insulation and for maintaining it in a dry and efficient condition. As the vents are located above and below on each door, this facilitates circulation of air by convection, the warmer air passing upward and the colder air coming in at the bottom, and this eliminates the necessity for disfiguring the inner panel by vents which in devices of the prior art may have extended from the top to the bottom.

The number of vents is greatly reduced from those required in the prior art because of their location and a smaller number of vents can efficiently be used to dehydrate a large door space, because the vents are so located as to effect circulation of air by convection. As the vents are located so that they will hardly be visible to the user, it is not necessary to provide baffles or other covering for the events for hiding them from sight. This also renders it possible to use a smaller number of vents as the covered vents lose their efficiency by virtue of the baffles or covers that are used. The constantly open vents of the present construction are designed to render their efficiency equal to a larger number of vents of the closed or baffled type. A small number of vents also involves less expense in the construction of the inner shell.

It will thus be observed that I have invented an improved ventilated door structure by means of which the insulation of the door may be constantly dehydrated and maintained in a highly insulating and efficient condition. The present door structure is simpler in construction and requires less vents than the devices of the prior art because the vents are located so that they are not visible and, therefore, they do not need to be covered. The circulation of air by convection through the door insulation from vent to vent practically covers the full area of the door and assures dehydration throughout all insulation of the door.

The present door construction is more rigid and durable because of the location of the vents and because of the reduced number of vents, since it is not necessary to cut away so much of the interior panel for purposes of ventilation of the insulation.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a refrigerator door structure, the combination of a stamped sheet metal outer shell of substantially rectangular form in elevation, the said shell being outwardly convex and inwardly concave and curving inwardly around three edges of the shell to a common plane, said shell having a substantially right angular edge wall at its fourth edge extending to said plane, and said shell being provided with an inwardly extending plane flange on its back side about all of its edges at said plane, an inner panel formed of initially plastic heat insulating composition and being substantially rectangular in elevation and of a size overlapping said inwardly extending flange, said inwardly extending flange and said panel being provided with registering apertures at a plurality of spaced points about the shell and panel, a door seal comprising a deformable body portion and an inwardly extending flange spaced from the body portion and having a groove between said latter flange and the body portion for receiving the edge of the panel, an angle stiffening member located on the inner side of said plane flange of the shell along each side and the top and bottom and having registering apertures located with respect to the apertures in the panel and threaded members extending through the panel, the seal flange and the shell flange, and threaded into said angular member, which is of greater thickness than the shell and adapted to stiffen the door about all of its edges, and a fibrous insulation located in said door between the shell and panel thereof, said panel being provided with ventilation apertures adjacent its top on one side and adjacent its bottom on the other side inside said door seal for bringing about convection air currents through the door, resulting in the dehydration in the insulation of the door by an evaporator located in any refrigerator to which the door may be attached.

2. In a refrigerator door structure, the combination of a stamped sheet metal outer shell of substantially rectangular form in elevation, the said shell being outwardly convex and inwardly cancave and curving inwardly around three edges of the shell to a common plane, said shell having a substantially right angular edge wall at its fourth edge extending to said plane, and said shell being provided with an inwardly extending plane flange on its back side about all of its edges at said plane, an inner panel formed of initially plastic heat insulating composition and being substantially rectangular in elevation and of a

size overlapping said inwardly extending flange, said inwardly extending flange and said panel being provided with registering apertures at a plurality of spaced points about the shell and panel, a door seal comprising a deformable body portion and an inwardly extending flange spaced from the body portion and having a groove between said latter flange and the body portion for receiving the edge of the panel, an angle stiffening member located on the inner side of said plane flange of the shell along each side and the top and bottom and having registering apertures located with respect to the apertures in the panel and threaded members extending through the panel, the seal flange and the shell flange, and threaded into said angular member, which is of greater thickness than the shell and adapted to stiffen the door about all of its edges, and a fibrous insulation located in said door between the shell and panel thereof, said panel being provided with ventilation apertures adjacent its top on one side and adjacent its bottom on the other side inside said door seal for bringing about convection air currents through the door, resulting in the dehydration in the insulation of the

door by an evaporator located in any refrigerator to which the door may be attached, the said panel having a curved portion adjacent the the apertured edge portions of the panel, and having a flange extending away from said outer shell to another curved portion which is joined to the body portion of said panel to provide additional thickness and insulating value for the door inside said door seal.

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