United States Patent

Carlin et al.

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[54] **DEFROST WATER DRAIN TRAP**

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[73] Assignee: **General Motors Corporation,** Detroit, Mich.

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[52] **U.S. Cl.** **62/285,** 62/291, 62/410, 62/404

[51] **Int. Cl.**.....**F25d 21/14**

[58] **Field of Search**.....62/285, 286, 410, 288, 289, 62/291

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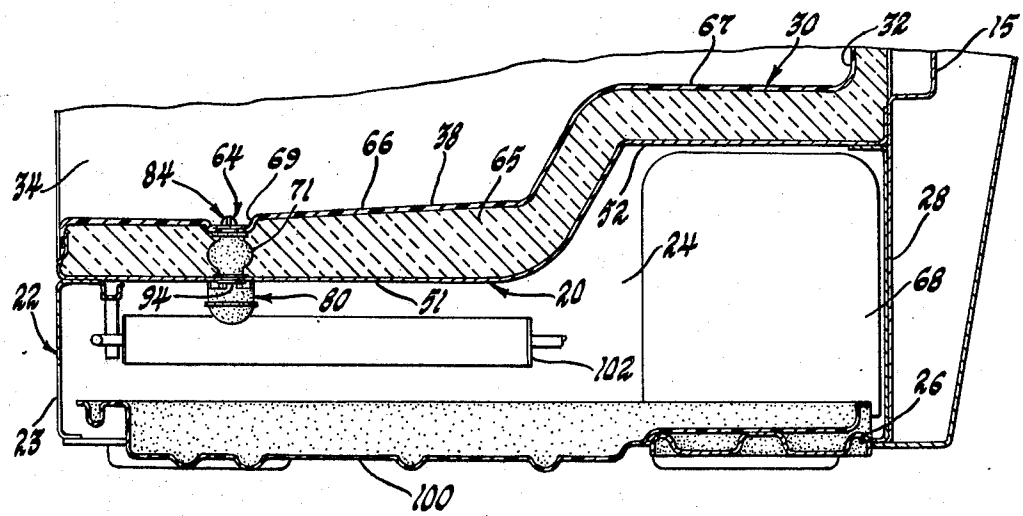
[57] **ABSTRACT**

A refrigerator cabinet defrost water drain trap positioned in the bottom wall of the front opening cabinet which provides a liquid trap in the form of a cup-shaped container designed to receive the lower discharge end of a drain tube. The container encloses the lower end of the drain tube such that the container's free overflow edge determining liquid level is positioned a defined distance above the discharge end of the drain tube whereby the liquid in the container provides a hydraulic suction head which normally seals the drain tube against entry of outside air into the cabinet. The differential movement of the liquid levels provides a momentary vacuum release air passage through the drain tube to permit the entrance of a limited quantity of outside air into the compartment whereby substantial equalization of pressures between the interior and exterior of the cabinet is achieved to allow the cabinet door to be reopened immediately with greater ease after closing.

4 Claims, 5 Drawing Figures



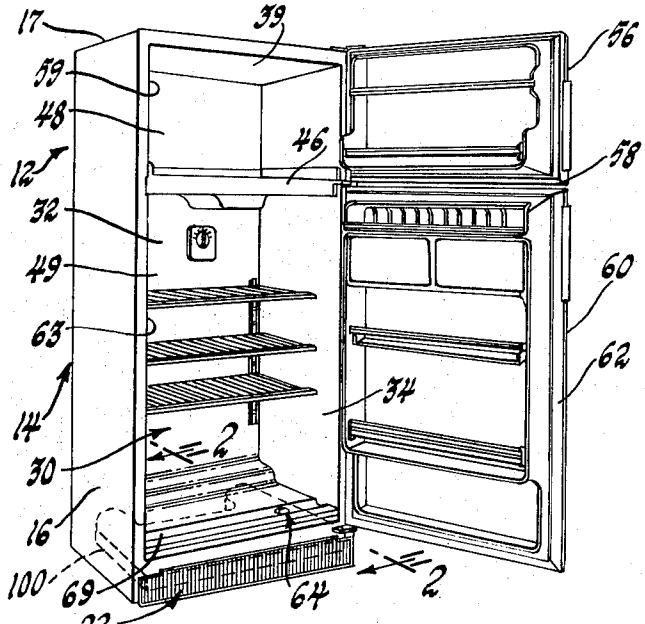


Fig. 1

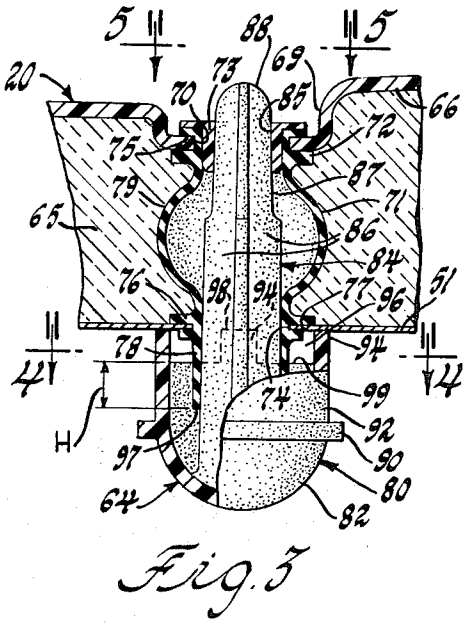


Fig. 3

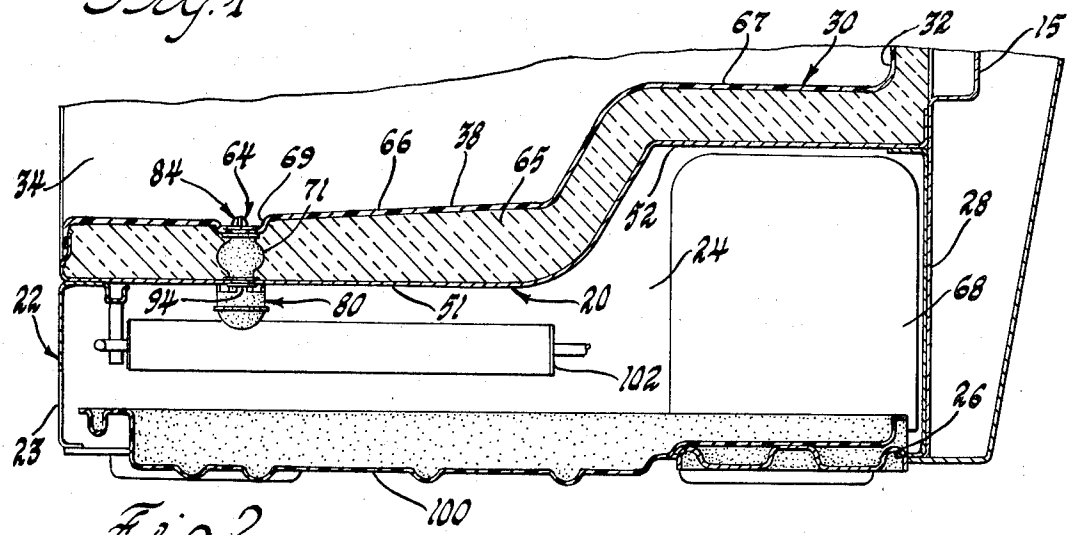


Fig. 2

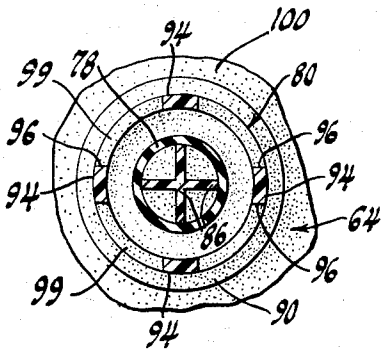


Fig. 4

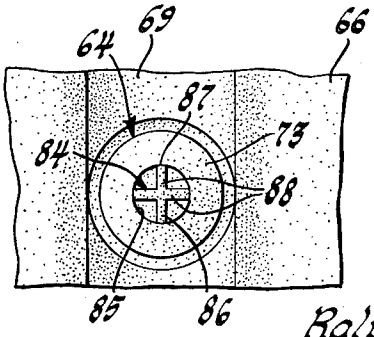


Fig. 5

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DEFROST WATER DRAIN TRAP

This invention relates to refrigerating apparatus and particularly to household refrigerator defrost water drain traps permitting vacuum release which equalizes inside and outside pressures to allow the door to be reopened immediately with greater ease after closing, when the freezer or refrigerator is operating.

Present day household refrigerators are usually of the two-compartment type having above and below freezing refrigerated cabinets commonly referred to as over- and-under or side-by-side refrigerators, wherein each compartment is arranged with a front access opening that is covered with a hingedly mounted door or closure member. In such two door refrigerators it has been found necessary to minimize inner leakage around the access openings of the compartments and accordingly very efficient and highly effective gasket seals have been developed. With the advent of magnetic gaskets or seals it has been possible not only to improve the sealing of the refrigerator compartments but also to have such seals serve as the sole means for holding the doors closed. An example of such a magnetic gasket is disclosed in U.S. Pat. No. 3,075,258 issued Jan. 29, 1963, assigned to the same assignee as the instant application. Some prior art refrigerator cabinets have dealt with the problem of a vacuum release for refrigerators by the provision of a vacuum release passage located on the access door controlled by a valve arrangement to prevent the escape from the cabinet of cold air but which opens to allow room air to flow through the passage to relieve any vacuum condition which may exist in the refrigerator compartment. Examples of this type of solution may be found in U.S. Pat. No. 3,027,735 issued Apr. 3, 1962 to J. J. Preatle et al. and U.S. Pat. No. 3,167,931 issued Feb. 2, 1965 to Bryson.

It is accordingly an object of the present invention to provide a condensate collecting means for a front opening refrigerator cabinet that is effective at all times for sealing the drain tube against the entrance of foreign matter while functioning to reduce the difference in pressure between the interior and exterior of the cabinet to facilitate the opening of the refrigerator door closing the cabinet opening.

It is still another object of the invention to provide an improved defrost water drain trap for a refrigerator cabinet that includes cooperative engaging means between a drain tube and liquid trap container whereby the container and drain tube are positioned to establish a hydraulic suction head which normally seals the drain tube against entry of outside air into the cabinet while providing a momentary vacuum release air passage through the drain tube operative to permit the entrance of a sufficient quantity of outside air into the compartment such that substantial equalization of air pressures occurs to allow the refrigerator cabinet door to be reopened after closing with greater ease.

In the drawings:

FIG. 1 is a perspective view of a refrigerator cabinet of the top freezer type incorporating the present invention;

FIG. 2 is a vertical section of the bottom wall portion of the refrigerator cabinet taken along the lines 2—2 of FIG. 1;

FIG. 3 is an enlarged vertical section with portions broken away of the drain trap assembly of FIG. 2;

FIG. 4 is a horizontal section taken on the line 4—4 of FIG. 3;

FIG. 5 is a top plan view of a portion of the bottom wall of the refrigerator taken on the line 5—5 of FIG. 3.

Referring now to the drawings, in FIG. 1 there is illustrated an insulated refrigerator cabinet 12 having an upright outer shell 14 formed in part by a rear wall portion 15 (FIG. 2) joining spaced apart side walls, only side wall 16 being shown, a top wall 17 and an irregular bottom wall 20. The insulated cabinet includes, as seen in FIG. 2, a support base 22 in part defined by depending skirt 23 thereon which encloses a machinery compartment 24 having a rear access opening 26 formed in the back of the support base 22 closed by a plate 28. Within the outer shell 14 of the cabinet 12 is located an inner liner indicated at 30 having a rear wall 32, spaced apart side walls, only one of which is shown at 34, a bottom wall 38, and a top 39. Suitable insulation (not shown) fills the space between liner 30 and the outer shell 14 of the cabinet.

Within the liner 30 is located a horizontally disposed thermally insulated partition assembly 46 which divides the liner 30 into an upper or top freezer compartment 48 at the top of the cabinet and a bottom above-freezing space or compartment 49 for general food storage. The top freezer compartment 48 is closed by a top door closure 56 that is representatively illustrated as being hinged on the cabinet 12 and movable from the open position shown in FIG. 1 to a closed position where a continuously formed magnetic door gasket or seal 58 on the inside face of the door 56 engages the cabinet 12 around a front cabinet opening 59 to the freezer compartment.

The refrigerator further includes a bottom door 60 having a magnetic sealing gasket 62 on the inside surface thereof formed continuously around the outer perimeter thereof that is engageable with the cabinet 12 to close lower front cabinet opening 63 into the compartment 49. Certain features of this type refrigerator are shown in U.S. Pat. No. 3,455,119, issued July 15, 1969, assigned to the assignee of the instant application the disclosure of which is incorporated by reference herein.

The refrigerator cabinet 12 includes an air flow cooling system of the type more specifically set forth in U.S. Pat. No. 3,261,173 issued July 19, 1966, to I. L. Gould, assigned to the same assignee as the instant application, the disclosure of which is incorporated by reference herein. For purposes of the present invention it is only necessary to indicate that the cooling system includes a motor driven fan (not shown) for directing air through the freezer compartment 48, thence through grille openings (not shown) for distribution throughout the above freezing food storage compartment 49.

As seen in FIG. 2 the bottom wall 20 includes a horizontal sheet metal lower front portion 51 and higher rear portion 52 of the outer shell 14. Spaced from and substantially parallel to the portions 51 and 52 of wall 20 is the irregular bottom 38 of plastic liner 30 of the refrigerator and supported from the adjacent outer shell wall 20 by thermal foam insulation 65. The liner bottom 38 has a lower front insulated wall 66 and a stepped-up rear wall 67 which is raised substantially above the front wall 66 to provide adequate space beneath for the sealed motor compressor unit 68.

The lower liner wall 66 is inclined toward the front of the refrigerator and is formed with a depressed trough or recess 69 extending transversely across the lower liner wall 66 to each of the inner side walls of the liner 30. The trough 69 is sloped inwardly from both side walls toward a circular opening 70 therein positioned adjacent side wall 34 for location of drain assembly 64. The trough 69 received drain tube member 71, which is tightly secured in the opening 70 by an upper sealing grommet 72 formed integral with and surrounding the upper end of the drain tube 71 such that it envelops the rim of the opening 70. A flanged insert sleeve 73 preferably formed of high density plastic material is inserted into the upper sealing grommet 72 to provide an airtight fit to prevent air flow between the machinery compartment 24 and the above-freezing compartment 49. The portion 51 of bottom wall 20 has a circular opening 74 such that a lower sealing grommet 76 formed integral with intermediate portion of the drain tube 71 envelops the rim of opening 74. The lower end of the drain tube 71 includes a drain pipe 78 that is adapted to extend below the wall portion 51 a defined distance which in the instant form is about 0.43 in. for a purpose to be explained. As a specific example the drain tube member 71 is formed from a suitable rubber material such as ethylene propylene terpolymer having a material thickness of about 0.040 in. and a shore hardness of about 50. The drain pipe 78 has an outside diameter of about 0.60 in. and an inside diameter of about 0.52 in. The portion of the drain tube member 71 between the grommets 72 and 76 is formed as a bulbous conduit 79 to allow for the drain tube member 71 to adjust to variations in spacing between the walls 51 and 66.

The water container portion of the drain assembly 64, indicated generally at 80, is preferably formed of high density polyethylene plastic having a lower hemispheric bowl portion 82 and an upstanding stem portion 84 formed integral with the bowl portion 82 and positioned on the principal vertical axis thereof. The stem portion 84 is spider like in cross section preferably providing four upwardly tapered ribs 86 in a cross or X-shaped grid pattern to block the entrance of solid food particles or the like. Each of the ribs 86 has its upper free end offset to form a reduced section 87 that is adapted to extend through the insert sleeve central opening 85 while the upper edges 88 of the ribs terminate in a smooth curve manner for ease of assembly with the drain tube member 71. The upwardly tapered ribs 86 are adapted for wedge-like engagement with the opening of the lower grommet 76 to insure an interference or friction fit to fixedly retain the container assembly 80 as shown in FIG. 3 and provide a substantially airtight seal between peripheral groove 77 of the lower grommet 76 and the rim of the lower circular opening 74. The insert sleeve 73 is dimensioned to establish a friction or force fit in the central opening of upper grommet 72 to provide a substantially airtight sealed closure between the peripheral groove 75 of the upper grommet 72 and the opening 70.

The bowl portion 82 has its hemispheric shape terminating in a circular horizontal flange 90 defining a cylindrical barrel 92 having uniformly spaced upwardly projecting spacers or cogs 94 defining a plurality of annular spaced overflow openings 96 as shown in FIG. 4. The spaced openings 96 have their horizontal arcuate overflow rims 99 located a defined vertical distance above the bottom edge 97 of drain pipe 78, by virtue of the upper faces 98 of spacers 94 contacting the wall 51, to thereby establish a defined suction head indicated by the dimension H of FIG. 3.

As a specific example the water container 80 has an inside diameter of about 1.00 in. and a maximum depth of about 0.85 in. from the bowl center to the overflow rims 99, while the spacers 94 have a height of about 0.22 in. The dimension H or suction head for the disclosed form is about 0.30 in.

As the evaporator is defrosted the moisture of a condensate draining therefrom will flow down the liner 30 sidewalls to the liner bottom 38 and thence via front and rear walls 66, 67 to be collected in trough 69 which is sloped from each liner side wall toward the insert sleeve opening 85 permitting the drain water to rise in the container 80 until it reaches the overflow rims 99 whence it will overflow and fall into drain pan 100 where it will be evaporated by the exposure to the atmosphere assisted by the heat generated in the machine compartment 24. It will be noted that super heat coil 102 in the machinery compartment is a tube and fin coil located adjacent the center of the compartment and is laterally spaced from the drain assembly 64 to insure that the coil 102 will not be splashed by the overflow. As seen in FIG. 1 the drain pan 100 extends substantially throughout the floor of the machinery compartment to provide a maximum liquid exposure such that additional heating means is not required for evaporation of the drain water.

In operation when the door 60 is opened some of the cold air in the compartment 49 will fall out into the room, and when the door is reclosed and the warmer air from the room which is moved into the compartment immediately starts cooling and upon cooling contracts, thus reducing the pressure therewithin and forming a negative pressure. Because the above freezing space 49 is in communication with the compartment 48 the pressure differential between the compartments 48 and 49 and the room may become sufficient to prevent the reopening of the doors or else require an abnormal amount of force to allow the doors to be reopened. It was found by tests that if a suction head H is maintained in the drain assembly 64 as described this differential pressure is sufficient to force a portion of the drain water in the container 80 upwardly into the drain tube 71 thereby creating a momentary air passage through the drain tube into the compartment 49 to substantially equalize the pressure differential inside and outside the cabinet 14 to again permit easy opening of the doors. The drain water is automatically returned to the container 80 by gravity flow from the drain tube 71 to again return the condensate to its first maximum predetermined level in the container 80 and drain pipe 78, determined by the overflow rims or free edges 99, the distance H above the second predetermined level determined by the discharge or bottom drain pipe end 97 to again seal the drain tube 71.

The liner 30, defining upper and lower refrigerated compartments 48, 49, has a total volume in the instant embodiment in the general range of about 15 to 17 cubic feet with the lower compartment 49 varying in volume in the general range of about 10 to 12 cubic

feet and the upper compartment having a volume of approximately 5 cubic feet.

While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is:

1. The combination of a refrigerating cabinet including outer walls surrounding and spaced from an inner liner means, said liner means forming a box-like sealed food storage compartment within said cabinet and having an access opening, a refrigerating system for cooling said compartment and at times causing moisture to condense out of the air therein in the form of condensate, a door hingedly mounted with respect to said cabinet and adapted to close the access opening for said food storage compartment, magnetic door gaskets circumscribing the jointure of said door with said inner liner means for sealing said access opening in an airtight manner, said liner means having a drain opening in the bottom thereof for draining said condensate from said food storage compartment, a gravity drain tube having an inlet end connected to said drain opening and a discharge end below said inlet end and outside said food storage compartment, means for sealing the connection of said inlet end of said drain tube with said drain opening in an airtight manner, an open-top container below said discharge end of said drain tube for collecting said condensate and for enclosing said discharge end to submerge said discharge end in said condensate and forming a trap to prevent the entrance of contaminants from the atmosphere into said food storage compartment, whereby successive openings of said door with respect to said food storage compartment in a relatively short time interval is resisted by a negative pressure in said compartment effected by said refrigerating system and the airtight manner of openings leading to said compartment, means for retaining said container in fixed relation with said drain tube, said container in forming said trap being adapted when said door is closed to maintain said condensate at a first maximum predetermined level in said container and said drain tube with respect to the discharge end of said drain tube, said first maximum predetermined level in said container tending to lower toward the discharge end of said drain tube to a second predetermined level while said first predetermined level in said drain tube tends to raise as the result of said door being opened against the resistance of said negative pressure to the opening of said door, said discharge end located a predetermined height below said first maximum predetermined level of condensate in said container, said predetermined height being sufficient to establish a suction head substantially equal to the difference between said first and second predetermined levels whereby a limited quantity of outside air is admitted into said drain tube through said discharge end and thence into said food storage compartment to reduce said negative pressure and thereby the resistance to opening said door.

2. The combination of a refrigerating cabinet including outer side, top, bottom and back walls surrounding and spaced from an inner liner means, said liner means forming a box-like sealed food storage compartment within said cabinet and having an access opening, a refrigerating system for cooling said compartment and at times causing moisture to condense out of the air therein in the form of condensate, a door hingedly mounted with respect to said cabinet and adapted to close the access opening for said food storage compartment, magnetic door gaskets circumscribing the jointure of said door with said inner liner means for sealing said access opening in an airtight manner, said liner means having a bottom wall spaced from said cabinet bottom wall, said liner bottom wall and said cabinet bottom wall having aligned drain openings therein for draining the condensate from said food storage compartment, a gravity drain tube having an inlet end connected to said liner drain opening and a discharge end extending through said cabinet bottom wall drain opening and outside said food storage compartment, said drain tube formed of rubber-like material having upper and lower integral resilient sealing grommets fastened in said liner and cabinet bottom wall openings respectively, means for sealing said drain tube grommets with said aligned openings in an airtight manner, an open-top container below said discharge end of said drain tube for collecting the condensate and for enclosing said discharge end to submerge said discharge end in the condensate and forming a trap to prevent the entrance of contaminants from the atmosphere into said food storage compartment, whereby successive openings of said door with respect to said food storage compartment in a relatively short time interval is resisted by a negative pressure in said compartment effected by said refrigerating system and the airtight manner of openings leading to said compartment, means for retaining said container in fixed relation with said drain tube, said container in forming said trap being adapted when said door is closed to maintain said condensate at a first maximum predetermined level in said container and said drain tube with respect to the discharge end of said drain tube, said container having its upper condensate overflow rim provided with a plurality of spaced vertically extending cogs contacting the outer face of said cabinet bottom wall whereby a predetermined height is established between said drain tube discharge end and said container overflow rim, said first maximum predetermined level in said container established by said overflow rim tending to lower to a second predetermined level established by said discharge end while said first predetermined level in said drain tube tends to raise as the result of said door being opened against the resistance of said negative pressure to the opening of said door, said predetermined height being sufficient to establish a suction head substantially equal to the difference between said first and second predetermined levels whereby a limited quantity of outside air is admitted into said drain tube through said discharge end and thence into said food storage compartment to reduce said negative pressure and thereby the resistance to opening said door.

3. The combination of a refrigerating cabinet including outer side, top, bottom and back walls surrounding and spaced from an inner liner means, said liner means forming a lower box-like sealed food storage compartment within the range of 10 to 12 cubic foot capacity within said cabinet and having an access opening, said liner forming an upper box-like sealed freezer compartment of approximately five cubic feet capacity and hav-

ing an access opening, a refrigerating system for cooling said upper and lower compartments and at times causing moisture to condense out of the air therein in the form of condensate, a pair of doors hingedly mounted with respect to said cabinet and adapted to close each of the access openings for said food storage compartment, magnetic door gaskets circumscribing the jointure of said doors with said inner liner means for sealing said access openings in an airtight manner, said liner means having a bottom wall spaced from said cabinet bottom wall, said liner bottom wall and said cabinet bottom wall having aligned drain openings therein for draining the condensate from said food storage compartment, a gravity drain tube having an inlet end connected to said liner drain opening and a discharge end extending through said inlet end and outside said food storage compartment, said drain tube formed of rubber-like material having upper and lower integral resilient sealing grommets fastened in said liner and cabinet bottom wall openings respectively, each said grommet having a central opening and a peripheral groove for receiving the peripheral edge of its associated opening, said upper grommet opening having a sleeve inserted therein dimensioned to establish a substantially airtight seal with said liner opening, an open-top container below said discharge end of said drain tube for collecting said condensate and for enclosing said discharge end to submerge said discharge end in said condensate and forming a trap to prevent the entrance of contaminants from the atmosphere into said food storage compartment, whereby successive opening of said doors with respect to their respective compartments in a relatively short time interval is resisted by a negative pressure in said compartments effected by said refrigerating system and the airtight manner of openings leading to said compartments, said container comprising an integrally formed semi-cylindrical bowl having an upwardly tapered vertical stem extending from the inner face of said bowl such that the axis of said stem coincides with the principal axis of said bowl, said stem having a spider-like cross section forming radial rib members, said stem extending through said lower grommet opening and said insert sleeve whereby said upwardly tapered ribs provide wedge-like engagement with said lower grommet opening to provide an interference fit therebetween whereby said container is retained in fixed relation with said drain tube while forming a substantially airtight seal between said lower grommet and its associated bottom wall opening, said container having its upper condensate overflow rim provided with a plurality of spaced vertically extending cogs contacting the outer face of said cabinet bottom wall whereby a predetermined height is established between said drain tube discharge end and said container overflow free edge, said container in forming said trap being adapted when said door is closed to maintain said condensate at a first maximum predetermined level in said container and said drain tube with respect to the discharge end of said drain tube, said first maximum predetermined level in said container established by said overflow rim tending to lower to a second predetermined level established by said drain tube discharge end while said first predetermined level in said drain tube tends to raise as the result of said door being opened against the resistance of said negative pressure to the opening of said door, said discharge end located a predetermined height of the order of 0.30 in. below said overflow rim of said container, said predetermined height being sufficient to establish a suction head substantially equal to the difference between said first and second predetermined condensate levels whereby a limited quantity of outside air is admitted into said drain tube through said discharge end and thence into said lower food storage compartment and thence to said upper freezer compartment to reduce said negative pressure and thereby the resistance to opening said doors.

4. The combination as defined in claim 3 wherein said radial rib members extend above said upper grommet opening to guard against foreign matter blocking said upper grommet opening.

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