July 24, 1951 O. E. NORBERG ET AL 2,562,057

REFRIGERATOR CABINET HAVING MEANS FOR REGULATING AIR FLOW AND MEANS FOR COLLECTING DRIP

Filed Oct. 4, 1949 4 Sheets-Sheet 1

Fig. 1

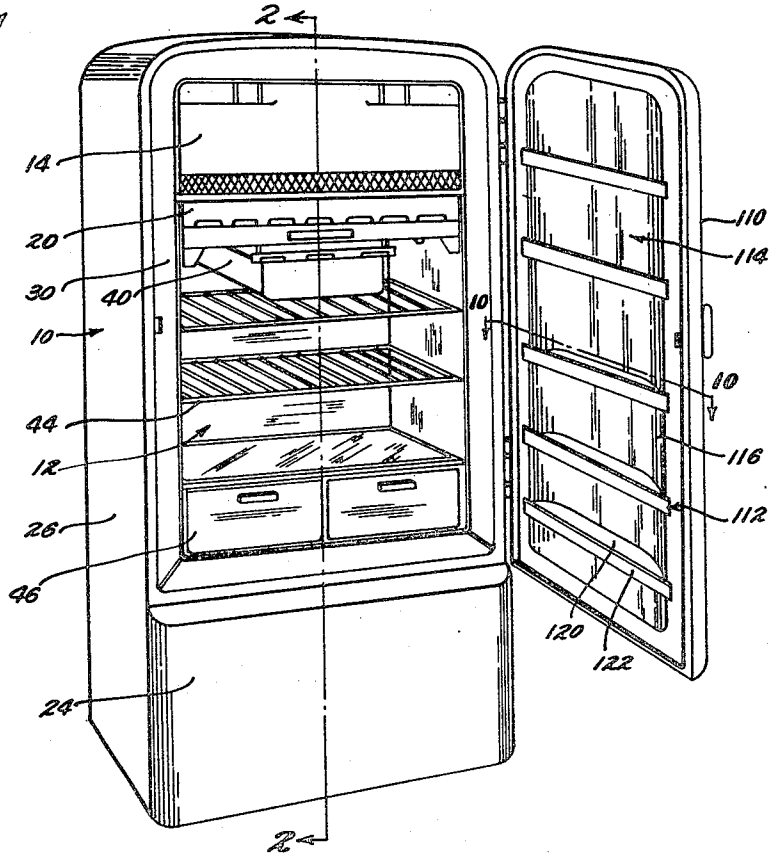

Fig. 10

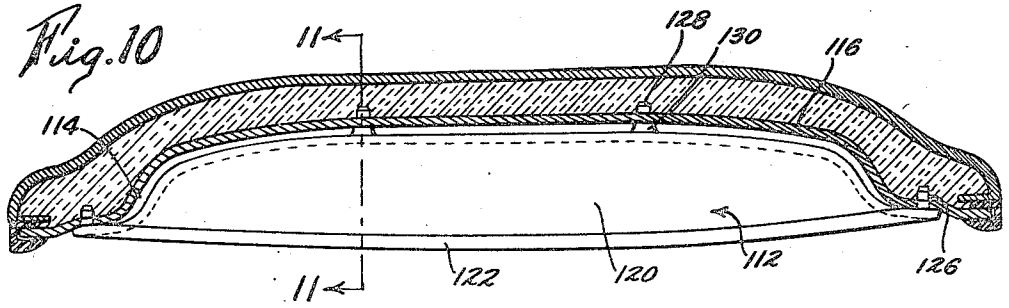

Fig. 11

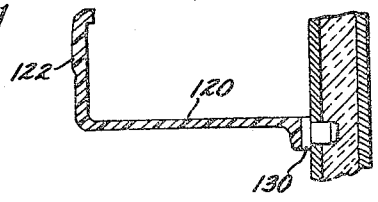

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Fig. 2

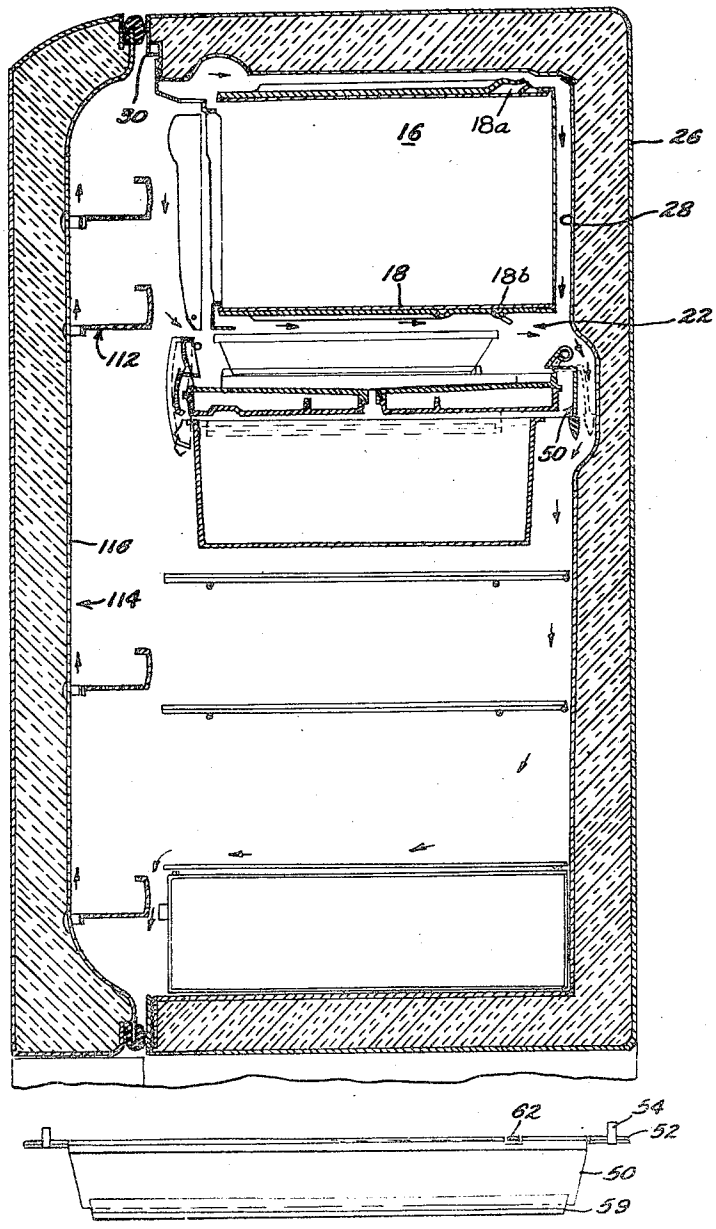

Fig. 9

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Fig. 3

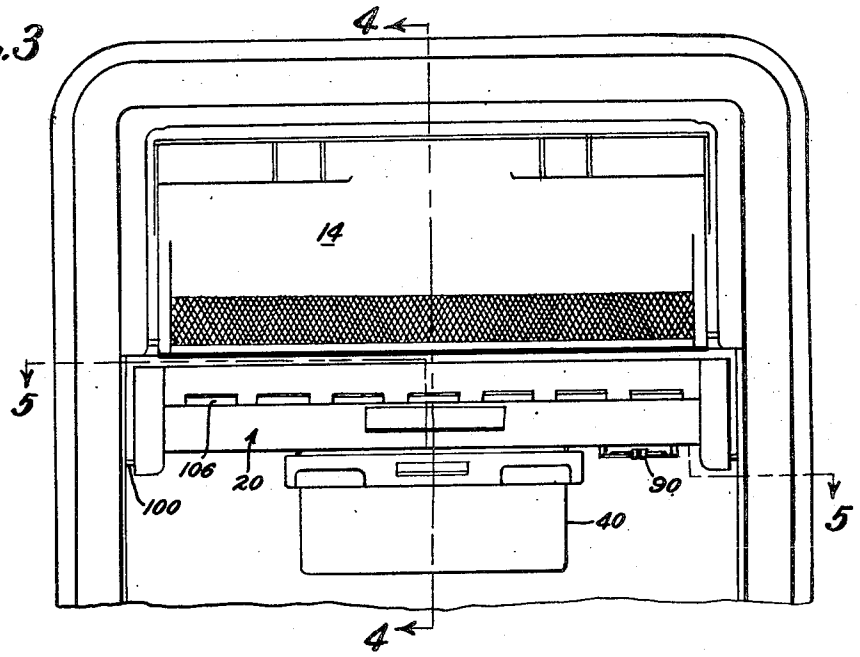

Fig. 4

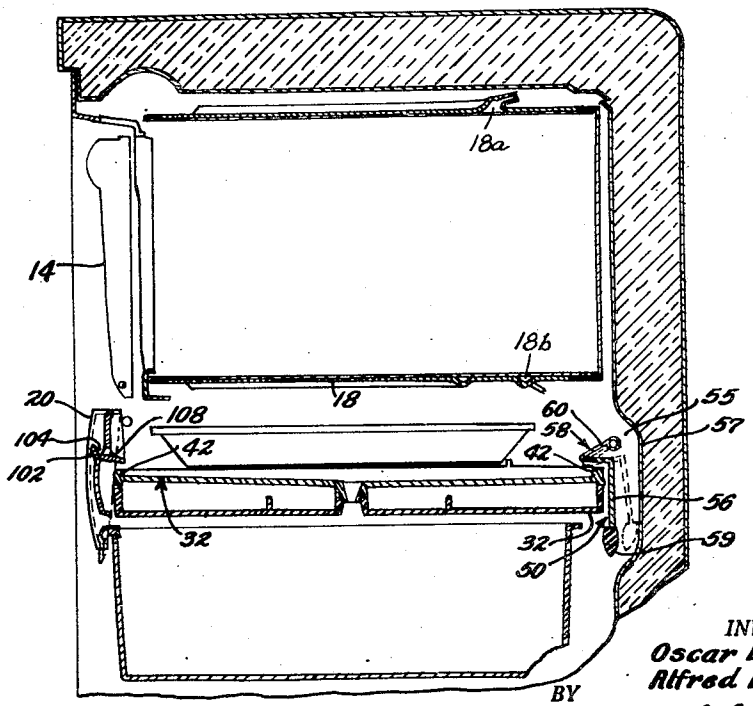

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Fig. 5

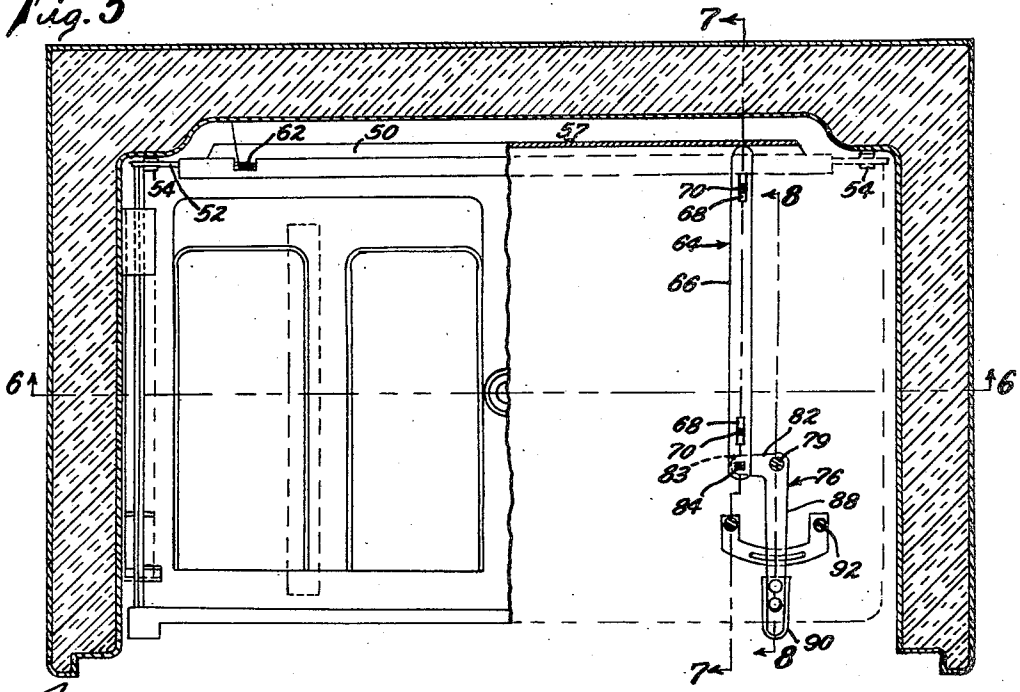


Fig. 6

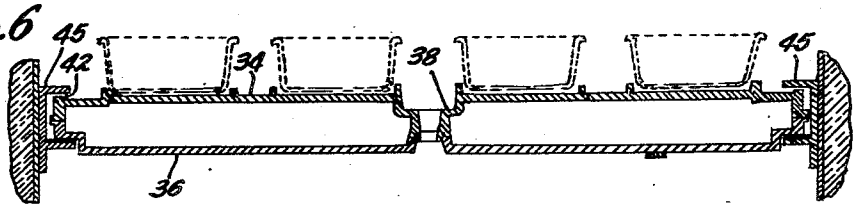


Fig. 7

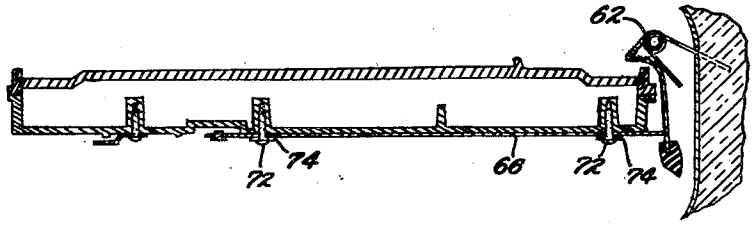
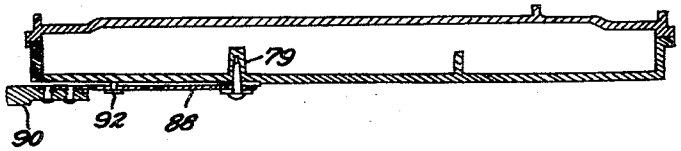


Fig. 8



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UNITED STATES PATENT OFFICE

2,562,057

REFRIGERATOR CABINET HAVING MEANS FOR REGULATING AIR FLOW AND MEANS FOR COLLECTING DRIP

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Application October 4, 1949, Serial No. 119,432

9 Claims. (Cl. 62—103)

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This invention relates to a refrigerator cabinet and more particularly to refrigerator cabinets of the household type having a plurality of compartments to be maintained at different temperatures.

An object of this invention is to provide a novel cabinet construction for a refrigerator cabinet which will provide for maximum storage space within the cabinet.

Another object of this invention is to provide a novel door shelf arrangement for permitting air flow between the door and the rear edge of the door shelves.

A further object of this invention is to provide a cabinet cooled by an evaporator and including a freezing compartment formed by a baffle spaced below the evaporator in which a novel air flow control means is positioned to direct drip water from the evaporator to the baffle during defrosting of the evaporator.

A still further object of the invention is to provide a novel door associated with a freezing compartment formed by a baffle disposed below an evaporator in which the door includes means for collecting drip water from the evaporator and means for directing such water onto the baffle during defrosting of the evaporator.

Another object of this invention is to provide, in a refrigerator of the class described, a novel damper for regulating air flow between the evaporator and food storage compartment, for regulating air flow through the freezing compartment located below the evaporator, for controlling the rate of air circulation through the door shelves and positioned to direct drip water from the evaporator onto the bottom wall of the freezing compartment.

A further object of this invention is to provide a novel door shelf arrangement whereby the rear edge of the door shelf is automatically spaced from the door liner when the shelf is mounted upon the liner.

These and other objects of this invention will be apparent from the following description and claims, taken in conjunction with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a perspective view of a refrigerator cabinet embodying the principles of this invention;

Fig. 2 is a vertical section of the refrigerator taken along the line 2—2 of Fig. 1 when the door is closed;

Fig. 3 is a front view of the upper portion of the cabinet illustrating the details of the relative location of the doors leading to the freezing compartments and a pan for retaining drip water;

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Fig. 4 is a sectional view taken along the line 4—4 of Fig. 3;

Fig. 5 is a partially sectional view taken along the line 5—5 of Fig. 3 in which the freezer storage compartment door is omitted and one side of the baffle is shown in phantom illustrating the damper control mechanism mounted on the baffle;

Fig. 6 is a sectional view taken along the line 6—6 of Fig. 5 further illustrating the horizontal baffle, and mounting means for the same;

Fig. 7 is a sectional view taken along the line 7—7 of Fig. 5 and including the damper at the rear of the baffle;

Fig. 8 is a sectional view taken along the line 8—8 of Fig. 5;

Fig. 9 is a front view of the damper;

Fig. 10 is a sectional view taken along the line 10—10 of Fig. 1;

Fig. 11 is a sectional view of the cabinet door inner liner and shelf taken along the line 11—11 of Fig. 10 illustrating the door shelf mounting on the liner.

In the drawings there is shown a refrigerator cabinet 10 having a food storage compartment 12 to be maintained at above-freezing temperatures, a door 14 for providing access to a first freezing compartment 16 which comprises the interior of an evaporator 18, a door 20 for providing access to a second freezing compartment 22 positioned immediately below the evaporator, and a machinery compartment 24 positioned below the food storage compartment 12. The evaporator 18 may be of the horizontal type extending across the full width of the refrigerator at the top thereof and formed of embossed plates secured together to provide passages 18a and 18b through which refrigerant flows in the process of evaporation. The walls of the cabinet are formed of an outer metal shell 26 and a spaced inner shell 28, preferably moulded of a material having good heat insulating qualities, with thermal insulation such as glass wool disposed in the space between the shells. A breaker strip 30 extends between the inner and outer shells and lies in the plane of the front wall of the cabinet to provide a cabinet having a "flat front." The evaporator serves to cool compartment 12 and to provide freezing temperatures in compartments 16 and 22. Shelves 44 and crispers 46 are placed within compartment 12 and extend forwardly in the cabinet to the plane of the front wall of the

cabinet (breaker strip 30) so that all of the space within compartment 12 becomes useful for the storage of food.

As particularly shown in Figs. 4 through 6, a horizontally disposed baffle 32 is positioned below and spaced from evaporator 18 a sufficient distance to form, together with the vertical walls of the inner liner, a freezing compartment immediately beneath the evaporator, which compartment is adapted to receive ice trays and frozen foods. Baffle 32 is formed of a top panel 34 of moulded plastic and a bottom dish-shaped panel 36 also of moulded plastic. Insulation such as glass wool (not shown) is disposed between the panels so that the baffle insulates compartment 12 from freezing compartment 22 throughout the width and depth of the baffle. Both panels are sealed together, preferably by use of a plastic solvent so that the baffle is impervious to moisture. A nozzle 38 extends downwardly from panel 34, which nozzle permits drip water from evaporator 18 to drain into a pan 40 mounted on baffle 32 during defrosting of the evaporator. A raised rim 42 extends entirely around the periphery of panel 34 to prevent drip water from running off of the baffle. Panel 34 is inclined downwardly from rim 42 to nozzle 38 to direct drip water caught by the baffle to the nozzle. The baffle is slidably supported in the cabinet by means of U-shaped channel sections 45 secured to each side wall of the inner liner (see Fig. 6). Pan 40 is slidably supported by baffle 32 by means of a pair of L-shaped supports secured to the under-surface of the baffle.

As particularly shown in Figs. 4 and 5, baffle 32 extends rearwardly in the cabinet so that rim 42 at the rear of baffle 32 is disposed beneath the rear wall of evaporator 18. The rear wall of the inner liner is bulged outwardly toward the outer shell as at 57 below the evaporator and rearwardly of baffle 32 to provide an air passage 55 rearwardly of the baffle. A damper 50 is positioned in the air passage and is supported for rotation about a horizontal axis formed by a rod 52 extending horizontally across the passage 55 and secured to the inner liner of the cabinet by means of spaced clips 54. The damper is preferably formed of sheet metal such as stainless steel and includes a generally V-shaped portion 58 and an arm 56 extending substantially at right angles to one side of the V-section. The other side of the V-section is curled at its end to receive the support rod 52. Thus, in its assembled position in the cabinet, the side of the damper by which the damper is supported for rotation about the rod presents a downwardly inclined surface 60 extending from the plane of the rear wall of the cabinet to a point above the baffle 32 and a downwardly extending surface 56 disposed in the cabinet recess rearwardly of the baffle and extending downwardly beneath the baffle. A rubber flap 59 is provided on the lower edge of surface 56 to insure a proper seal between the damper and cabinet recess when a minimum of air circulation into the food storage compartment is desired. A spring 62 mounted on rod 52 maintains the damper so that the damper is normally biased toward an "open" position in which maximum airflow is permitted through the air passage or cabinet recess. Spring 62, shown in side view in Fig. 7, has two outstanding ends, one bearing on the damper and the other engaging the rear wall of the cabinet. When the damper is in its "open" position as illustrated in Fig. 4, the airflow is primarily between the surface 56 and the rear wall 57 of the recess. When the damper is in its "closed" position as indicated by the dotted lines of Fig. 4, the airflow is of a very restricted nature and occurs through the narrow passage between arm 56 and the end of baffle 32. It is to be noted that the downwardly inclined surface 60 extends above baffle 32 and over rim 42 irrespective of the position of the damper in the air passage. Thus, surface 60 is positioned to direct drip water, which drops from the rear portion of evaporator 18 during defrosting, onto the baffle inwardly of the rim, irrespective of the position of the damper relative to the rear wall recess. When quick freezing or unusually low temperatures are desired in the evaporator or the second freezing compartment below the evaporator, the damper is adjusted to limit airflow into compartment 12 and through compartment 22 so that undesirably low temperatures do not occur in compartment 12. By limiting the airflow through the air passage colder temperatures are attained in compartment 22; and baffle 32 due to its insulation prevents undesirably low temperatures in compartment 12. Again, in the winter or when ambient temperatures external of the cabinet are relatively low, as for example, a room maintained at 60° F., it is desirable to restrict airflow into compartment 12 so that freezing temperatures may be maintained in the freezing compartments without having undesirable "freeze-ups" in compartment 12.

In order to control the position of damper 50 relative to the wall recess, a damper control generally indicated as 64 (see Figs. 5–8) is mounted on the bottom of baffle 32. The damper control includes a flat metal pusher plate 66 which is slidably mounted on the baffle by means of a pair of slots 68, each having a downwardly extending boss 70 depending from the baffle and extending therethrough. A screw or rivet 72 having a washer 74 thereon extends through each slot and into each boss to slidably retain the push rod on the baffle. A bell crank lever 76 is mounted for rotary movement about a downwardly extending boss 79 on the bottom of the baffle and offset from the line of travel of push rod 66. All of the aforementioned bosses extend through the mechanism mounted thereon so that the screw or rivet may not be tightened to such a degree as would prevent relative movement of the push rod and bell crank lever with respect to the baffle. The short arm 82, of bell crank lever 80 is provided with a struck-up prong or boss 83 which extends through an opening 84 in push rod 66 in order to transfer motion from the bell crank lever to the pusher plate. The long arm 88 of the bell crank lever extends forwardly of the baffle 32 and is provided with a handle 90 so that the bell crank lever may be moved about its pivot point 79. A curved bracket 92 mounted on the bottom of the baffle serves to support the arm 88 intermediate the pivot point of the bell crank lever and handle 90 to prevent breakage of the baffle due to downward pressure which might be applied to handle 90 (see Fig. 5).

In Figs. 3 and 4 details of door 20 are shown. The door is hinged for pivotal movement about a horizontal axis by means of conventional hinges 100 secured to the side walls of the cabinet. The door is preferably spring loaded to normally assume its closed position illustrated in Fig. 4. It will be noted that the top of door 20 is positioned outwardly from the bottom of door 14 so that most of the drip water from door

14 will normally fall on baffle 32 inwardly of door 20. Also, it will be noted that the top of door 20 is spaced below the bottom of door 14 to provide a free space for the flow of air into compartment 22 when the door is closed. In order to catch any drip water that may run down the outer surface of the door during defrosting of the evaporator 18, door 20 is provided with a raised rim 102 extending horizontally across the outer face of the door and providing a trough 104 between the raised portion 102 and the outer surface of the door. A plurality of openings 106 are provided in the door panel to permit water entering trough 104 to flow from the trough through the door panel. A downwardly inclined baffle 108, coextensive in length with trough 104, is provided on the inner surface of the door panel to direct water over the rim 42 at the front of the baffle 32. Thus, any defrost water running down either the front or rear surface of door 20 is directed onto baffle 32 inwardly of rim 42.

As shown in Figs. 1, 2, 10 and 11, the cabinet 10 is provided with a door 110 for providing access to the interior of the cabinet. Door 110 is provided with a plurality of door shelves 112 disposed substantially entirely within a door recess 114 on the inner door liner 116. In refrigerators of conventional design it has been common practice to mount door shelves on the refrigerator door. Such structures, however, have always been arranged to extend within the cabinet proper in order to insure proper cooling of foodstuffs placed on the door shelves. In order to accommodate the door shelves within the cabinet, it has been necessary to cut back the cabinet shelves so that no net storage space is provided over a cabinet having shelves extending forwardly to the front of the cabinet but not having door shelves. It will be noted in Fig. 2 that the door shelves are disposed substantially entirely within the door recess and lie forwardly of the plane of the front wall of the cabinet (breaker strip 30) when the door is closed. Thus, the cabinet shelves and crispers extend forwardly in the cabinet substantially to the breaker strip so that the door shelf space represents increased useful storage space while at the same time maximum use of shelf space within the cabinet is possible.

The refrigeration of foodstuffs consists both in the removal of heat from the food placed in the cabinet and in keeping outside heat from penetrating the refrigerated compartment. The removal of heat is accomplished by convention currents set up within the cabinet and heat leakage into the cabinet is minimized by the use of insulation. In spite of the insulation used to reduce heat flow into the cabinet, it is well known that a large percentage of the heat entering the cabinet leaks in through the door side of the cabinet since the door insulation is not normally as thick as that used in the remainder of the cabinet and due to other causes. The door shelves utilized for food storage are one-piece shelves of moulded plastic including a solid impervious base 120 and a vertical upstanding flange 122 at the front of the shelf.

The shelves are mounted to the door inner liner 116 by means of studs 126 and 128 bonded to the vertical rail 122 and the rear edge of horizontal base 120, respectively. Each stud extends through an opening in the door inner liner into the interior of the door and is adapted to receive a conventional fastener such as a nut or speed nut to prevent accidental removal of the shelf from the liner. Studs 128 are formed with a spacer boss 130 so that the rear edge of the shelf is automatically spaced from the door inner liner when assembled to the liner. At the same time, vertical rail 122 lies substantially flush with liner exterior of the door recess. By this arrangement, the door shelves may be quickly, easily, and inexpensively assembled to the inner liner of the door and the spacing between the rear edge of the shelves and the door liner accurately maintained in large scale manufacture.

Thus, a clear, unrestricted passage is provided between the rear edge of each shelf and the door liner throughout the door recess. In this manner any warm air leaking into the door recess is permitted to rapidly rise to the upper portion of the cabinet without entering the cabinet proper and without having an adverse effect upon foodstuffs placed on the door shelves.

As shown by the arrows in Fig. 2, the convection currents in the cabinet travel downwardly through air passage 55 rearwardly of damper 50 when the damper is open, then upwardly through compartment 12 and between the rear edge of the door shelves and the door liner so that heat entering the door recess is permitted to rise upwardly without entering compartment 12. The currents then pass through freezing compartment 22 in a rearwardly direction toward damper 50. Damper 50, as heretofore pointed out, at no time completely shuts off air passage 55, but in its "closed" position permits limited airflow between the baffle 32 and damper. Thus, damper 50 regulates air flow between compartment 12, compartment 22 and through the air passage rearwardly of the door shelves. Baffle 32 functions as a removable insulated wall between compartment 22 and 12, acts to collect drip water from evaporator 18, supports the manual means for varying the position of damper 50 in air passage 55, slidably supports a drip collecting pan, and directs condensation into the pan.

By this construction there is provided a novel cabinet construction in which the door shelves are automatically spaced from the door liner to provide a vertical flue for air flow when mounted to the liner, a horizontal baffle arranged to collect drip water and to provide a freezing compartment below the evaporator, a door adapted to collect drip water from the evaporator and to direct the same into the baffle, and a control baffle for regulating air flow through the freezing compartment, between the freezing compartment and a food storage compartment to be maintained at above freezing temperatures, and adapted to direct drip water from the evaporator to the horizontal baffle irrespective of the position of the control baffle in the cabinet.

What is claimed is:

1. In a household refrigerator of the type including an outer shell and an inner liner spaced from said outer shell forming the walls of the cabinet, insulation between said shell and liner, an evaporator within said cabinet forming a first freezing compartment, a horizontally disposed baffle spaced below said evaporator forming with the vertical walls of said inner liner a second freezing compartment between said evaporator and baffle adapted to receive ice trays, an air passage rearwardly of said baffle, a damper positioned in said air passage for regu-

lating airflow therethrough, said damper having a portion thereof extending over said baffle irrespective of the position of said damper in said passage for directing drip water from said evaporator onto said baffle, and means for moving said damper in said passage for regulating airflow therethrough.

2. In a household refrigerator of the type including an outer shell and an inner liner spaced from said outer shell forming the walls of the cabinet, insulation between said shell and liner, an evaporator within said cabinet forming a first freezing compartment, a horizontally disposed baffle spaced below said evaporator forming with the vertical walls of said liner a second freezing compartment between said evaporator and baffle adapted to receive ice trays, the rear walls of said inner liner below said evaporator being bulged outwardly toward the outer shell to provide an air passage rearwardly of said baffle, a damper positioned in said air passage for regulating air flow therethrough, said damper presenting a surface extending over said baffle irrespective of the position of said damper in said passage for directing drip water from said evaporator onto said baffle, and means for moving said damper in said passage for regulating airflow therethrough.

3. In a household refrigerator of the type including an outer shell and an inner liner spaced from said outer shell forming the walls of the cabinet, insulation between said shell and inner liner, an evaporator within said cabinet forming a first freezing compartment, a horizontally disposed baffle spaced below said evaporator and forming with the vertical walls of said liner a second freezing compartment between said evaporator and baffle adapted to receive ice trays, the rear wall of said inner liner below said evaporator and adjacent the rear of said baffle being bulged outwardly toward said outer shell to provide an air passage rearwardly of said baffle, a damper positioned for rotation about a horizontal axis in said passage, said damper including one surface adapted to be moved relative to the rear wall of said inner liner for varying the effective size of said passage and a second surface extending upwardly and rearwardly from one edge of said first surface, said second surface extending over said baffle irrespective of the position of said first surface in said passage for directing drip water from said evaporator onto said baffle, and manually operable means mounted on said baffle for rotating said damper about its axis of rotation.

4. In a household refrigerator of the type including an outer shell and an inner liner spaced from said outer shell forming the walls of the cabinet, insulation between said shell and liner, an evaporator within said cabinet forming a first freezing compartment, a horizontally disposed baffle spaced below said evaporator forming with the vertical walls of said inner liner a second freezing compartment between said evaporator and baffle adapted to receive ice trays, an air passage rearwardly of said baffle, means positioned in said passage for directing drip water from said evaporator onto said baffle, a door for providing access to said second freezing compartment, and means associated with said door for directing drip water from said evaporator onto said baffle.

5. In a refrigerator of the household type including an outer shell and an inner liner spaced from said outer shell forming the walls of the cabinet, insulation between said shell and liner, an evaporator within said cabinet forming a first freezing compartment, a horizontally disposed baffle spaced below said evaporator forming with the vertical walls of said liner a second freezing compartment adapted to receive ice trays, a door for providing access to said second freezing compartment, a trough on the outer side of said door for catching drip water from said evaporator, an opening extending through said door in communication with said trough, and an inclined surface extending inwardly from said door for directing drip water from said opening to said baffle.

6. In a household refrigerator of the type including an outer shell and an inner liner spaced from said outer shell forming the walls of the cabinet, insulation between said shell and liner, an evaporator within said cabinet forming a first freezing compartment, a horizontally disposed baffle spaced below said evaporator forming with the vertical walls of said liner a second freezing compartment adapted to receive ice trays, an air passage rearwardly of said baffle, an inclined surface positioned in said passage and extending over said baffle for directing drip water from said evaporator onto said baffle, a door for providing access to said second freezing compartment, a trough on the outer side of said door for catching drip water from said evaporator, an opening extending through said door in communication with said trough, and an inclined surface secured to the inner side of said door for directing drip water from said opening to said baffle.

7. In a household refrigerator of the type including an outer shell and an inner liner spaced from said outer shell forming the walls of the cabinet, insulation between said shell and liner, an evaporator within said cabinet forming a first freezing compartment, a horizontally disposed baffle spaced below said evaporator forming with the vertical walls of said liner a second freezing compartment adapted to receive ice trays, an air passage rearwardly of said baffle, a damper positioned in said passage, a door for providing access to said cabinet, a recess in said door for receiving door shelves, vertically spaced door shelves disposed wholly within said recess, shelves in said cabinet extending forwardly to the plane of the front wall of the cabinet, said door shelves being spaced from said door at the rear of each shelf to permit airflow intermediate the rear of the shelves and said door, and means for varying the position of said damper to regulate airflow through said cabinet and said door recess.

8. In a household refrigerator of the type having walls defining a main refrigerated cabinet accessible through an opening in the forward face thereof, a door pivotally secured to the cabinet adjacent the opening, said door being formed to define a recess in its inner face, a plurality of horizontally disposed shelves secured to the inner face of said door and positioned substantially within the recess thereof, said shelves comprising base portions having rear edges and integral spacer means positioned on said rear edges and abutting the inner face of said door, the rear edges of said shelves being spaced from the inner face of said door by said spacer means to define air flow passages adjacent the inner face of said door whereby thermally established air currents within the cabinet can circulate around said shelves and carry away warm air as it forms adjacent the inner face of said door.

9. In a refrigerator of the type including top,

bottom, side and rear walls defining a refrigerator cabinet; an evaporator within said cabinet forming a first freezing compartment; a horizontally disposed baffle spaced below said evaporator forming with the vertical side walls of said cabinet a second freezing compartment; an air passage rearwardly of said baffle; a door providing access to said cabinet, said door being formed to define a recess in the inner face thereof; horizontally disposed vertically spaced door shelves positioned within said recess, said door shelves having solid base portions spaced from said door at their rear edges adjacent the inner face of said door; whereby currents of air within said cabinet can move past said evaporator, through the air passage at the rear of said baffle, and

between the rear of said shelves and the inner face of said door.

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