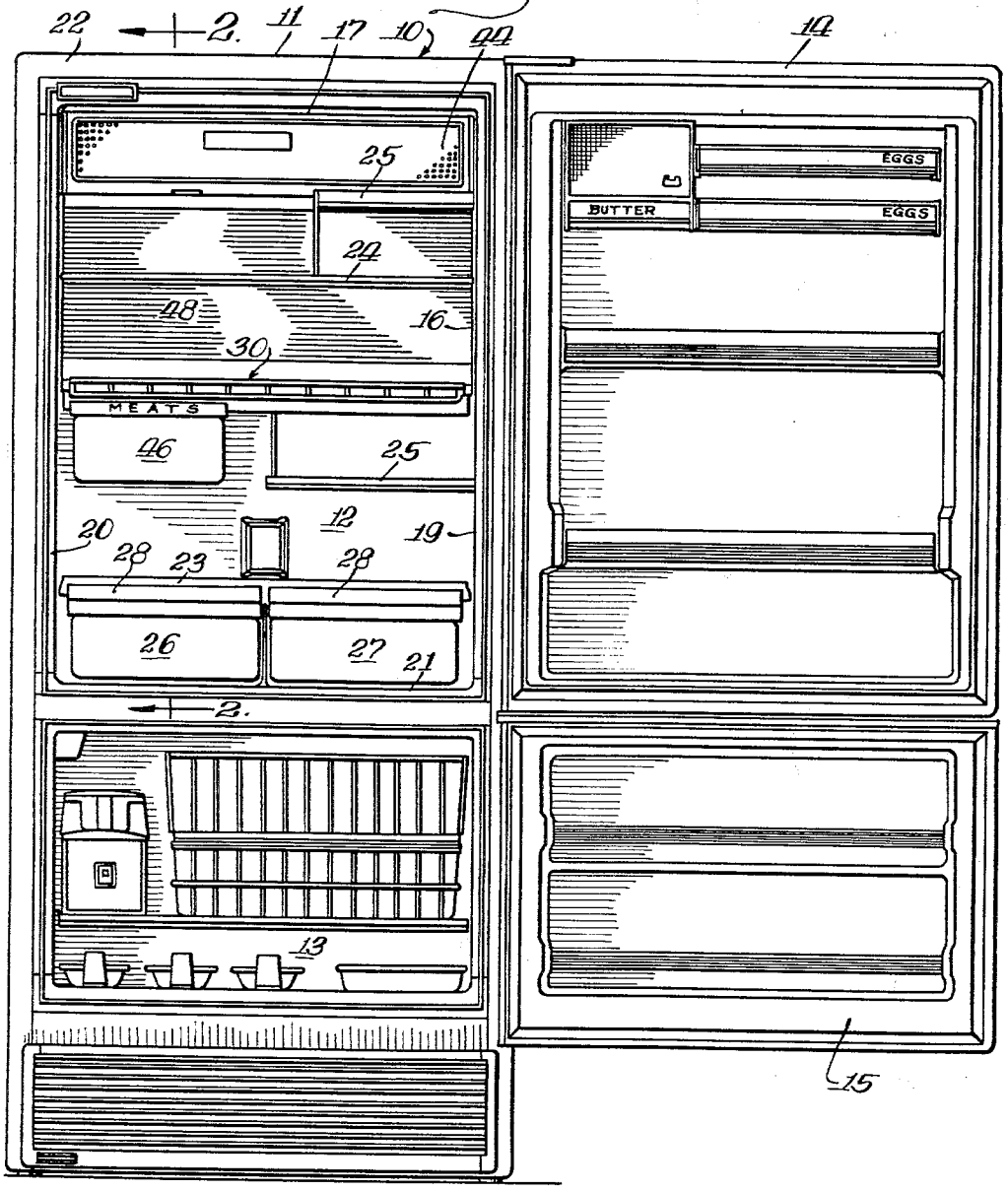
Feb. 16, 1965 E. T. MORTON ETAL 3,169,383

REFRIGERATOR WITH HOLLOW COLD SHELF

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Fig. 1.



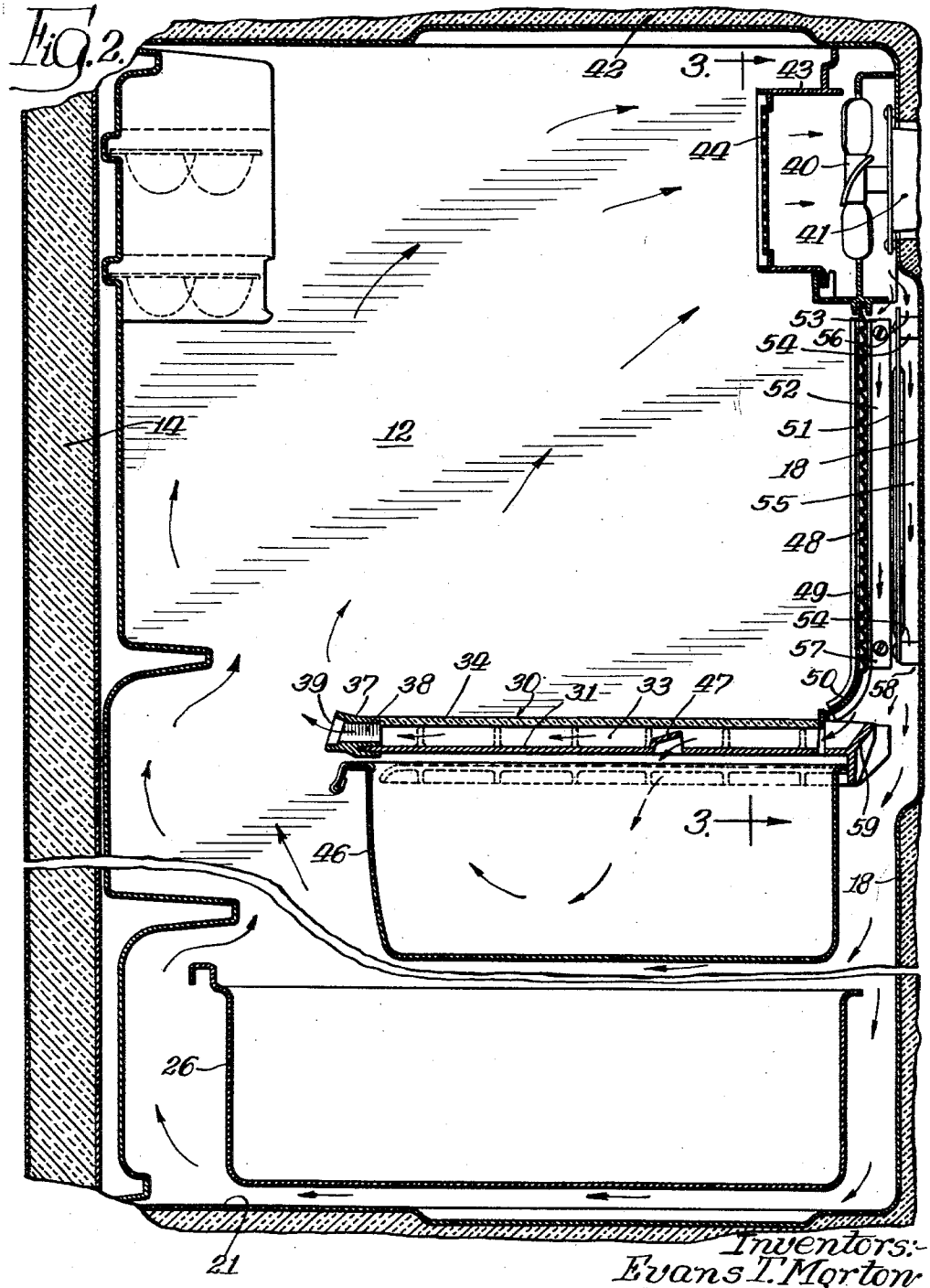

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Filed Nov. 25, 1958 4 Sheets-Sheet 2

Fig. 2.




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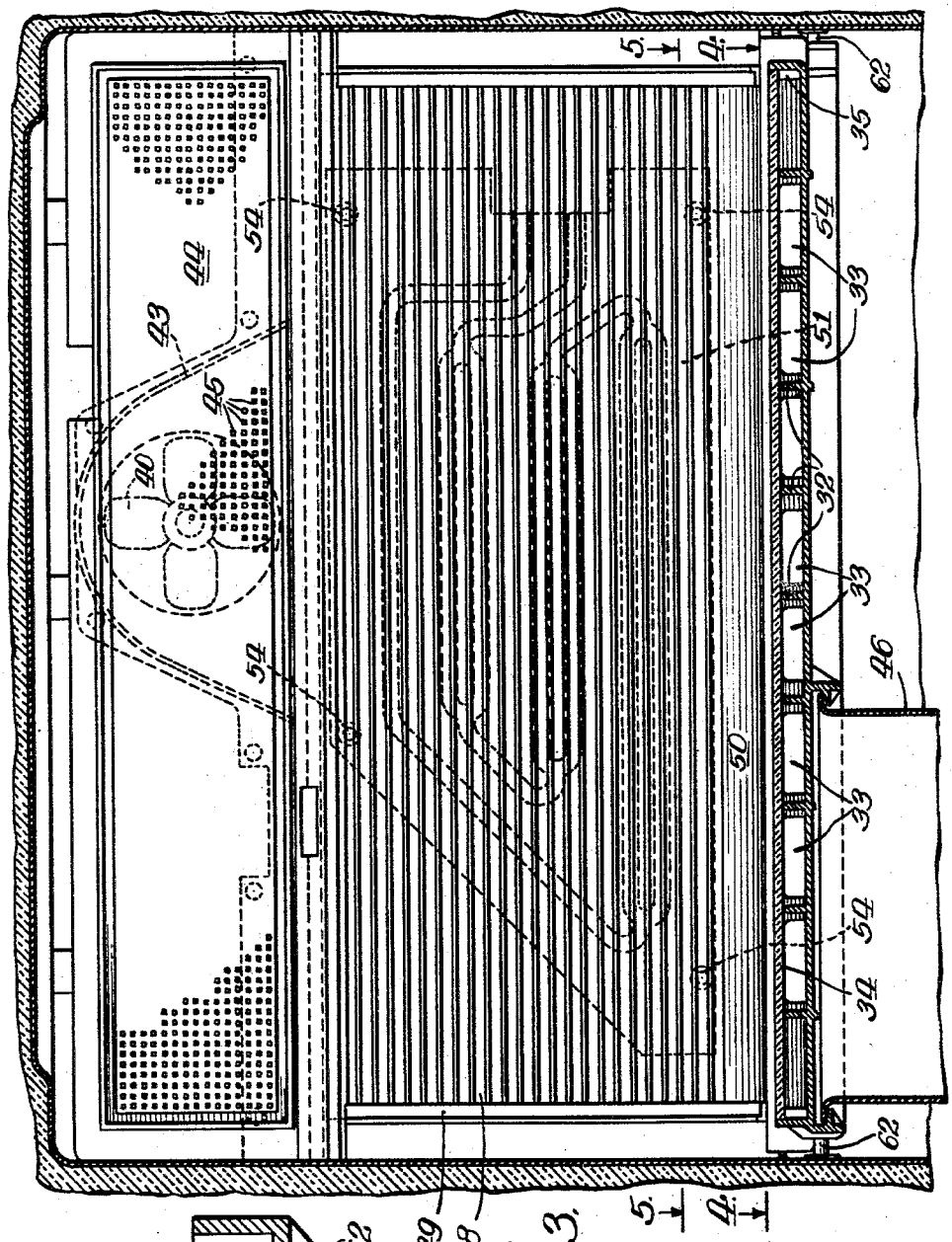



FIG. 3.

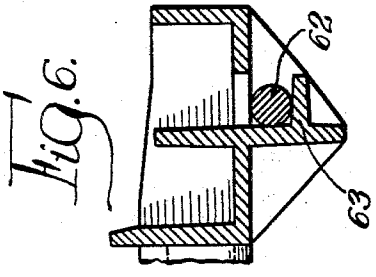



FIG. 6.

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REFRIGERATOR WITH HOLLOW COLD SHELF

Filed Nov. 25, 1958 4 Sheets-Sheet 4

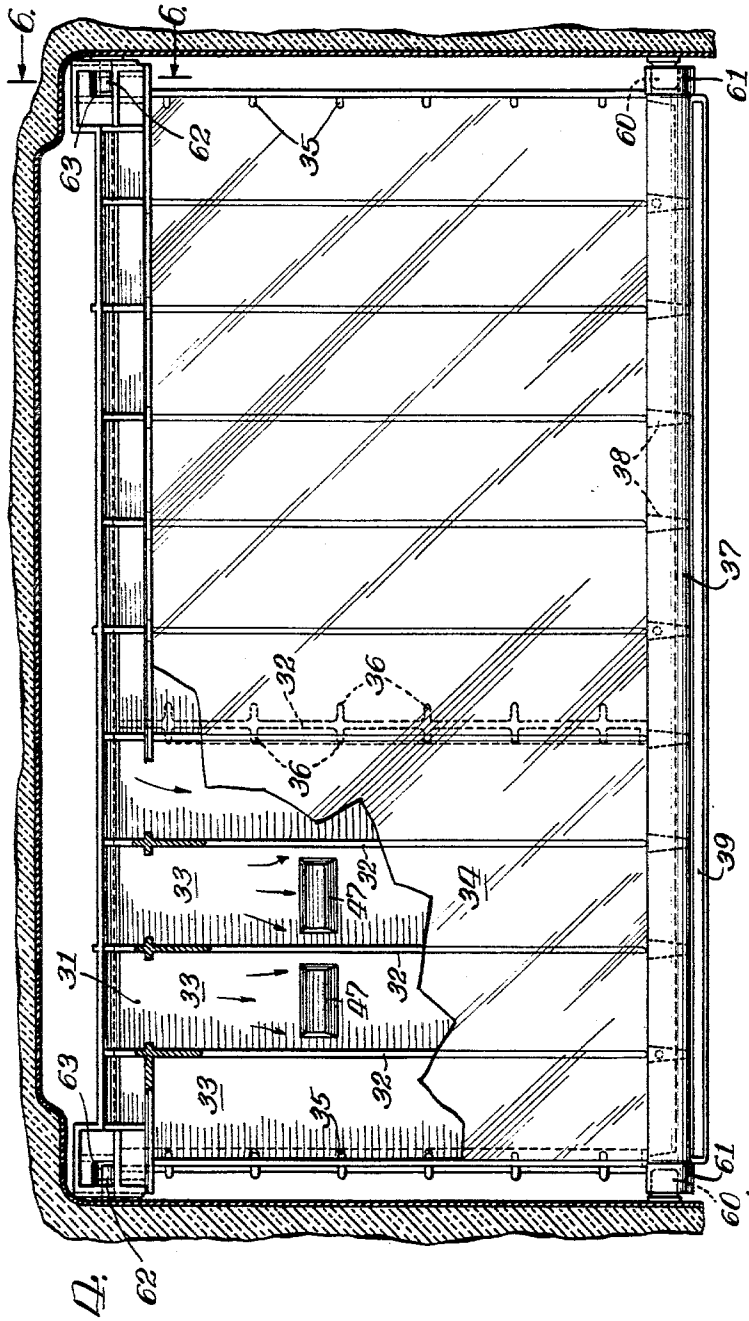



FIG. 4.

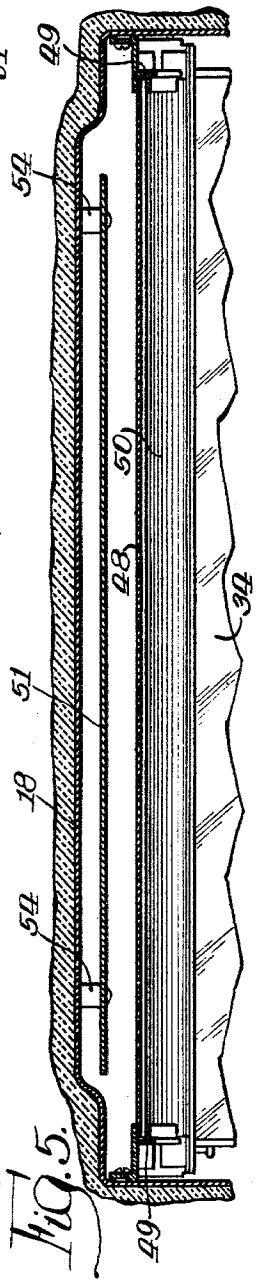



FIG. 5.

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United States Patent Office 3,169,383 Patented Feb. 16, 1965



3,169,383

# REFRIGERATOR WITH HOLLOW COLD SHELF

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Filed Nov. 25, 1958, Ser. No. 776,247
19 Claims. (Cl. 62—419)

This invention relates to a refrigerator.

One of the features of this invention is to provide an improved air circulation apparatus for circulating refrigerated air through the food compartment of a refrigerator and particularly in the area adjacent the door of the refrigerator.

Another feature of the invention is to provide an improved combined cooling and air circulating apparatus in which a part of the cooled air circulating apparatus includes a refrigerated member arranged to cool articles within the food compartment by a combination of convection, radiation and conduction.

Yet another and more specific feature of the invention is to provide an improved refrigerator in which an article supporting shelf is provided with cooled air ducts which are used to cool the shelf to a low temperature and simultaneously to distribute the cooled air through the food compartment of the refrigerator.

Other features of the invention will be apparent from the following description of one embodiment thereof taken in conjunction with the accompanying drawings. Of the drawings:

FIGURE 1 is a front elevational view of a combination refrigerator-freezer embodying the invention.

FIGURE 2 is an enlarged fragmentary sectional view taken substantially along line 2—2 of FIGURE 1.

FIGURE 3 is a fragmentary sectional view taken substantially along line 3—3 of FIGURE 2.

FIGURE 4 is a fragmentary sectional view, partially broken away for clarity of illustration, taken along line 4—4 of FIGURE 3.

FIGURE 5 is a fragmentary sectional view taken substantially along line 5—5 of FIGURE 3.

FIGURE 6 is a fragmentary sectional view taken substantially along line 6—6 of FIGURE 4.

The refrigerator and freezer combination shown in the accompanying drawings includes a cabinet 10 having an outer shell 11 and a pair of food storage compartments 12 and 13. The upper compartment 12 provides space for the storage of food at temperatures above freezing and thus operates as a refrigerator. The lower compartment 13 provides frozen food storage and operates as a freezer in which the temperature is ordinarily maintained at about 0° F. Each of the compartments 12 and 13 is provided with a corresponding door 14 and 15 in the customary manner. The upper or refrigerator compartment 12 includes a liner shell 16 having a top 17, back 18, sides 19 and 20 and bottom 21. Surrounding the refrigerator or fresh food compartment 12 and extending between this compartment and the outer shell 11 are conventional breaker strips 22. The compartments 12 and 13 are insulated in the usual manner.

Within the fresh food compartment 12 there is provided a conventional shelf 24 extending the full width of the compartment and two conventional short shelves 25. At the bottom of the compartment 12 are two vegetable crisper pans 26 and 27 arranged side by side and located beneath a shelf 23 and provided with cover 28. The doors 14 and 15 for the fresh food compartment 12 and freezer compartment 13 are provided with conventional shelves for storage of food articles and the top of the door 14 is provided with a conventional butter storage compartment and egg storage shelves.



At approximately the vertical center of the upper compartment or fresh food storage compartment 12 there is positioned a shelf 30 that is hollow and adapted to contain cold air ducts. In the embodiment shown, this shelf 30 has a bottom formed as a plastic tray 31 provided with spaced longitudinal, substantially parallel, ribs 32 to form parallel air channels 33. Supported on the top of the tray 31 and particularly on the tops of the ribs 32 is a rectangular flat section of glass 34. The side edges of the glass 34 are supported on short side ribs 35 that extend inwardly from the end ribs 32. An intermediate rib 32 is provided with vertical reinforcing ribs 36 extending vertically to serve as reinforcing means for the bottom tray 31 in this region.

The combination of the glass sheet 34 and the bottom tray 31 provides the plurality of air channels 33. These air channels, as is illustrated in the drawings, extend from adjacent the rear to adjacent the front of the fresh food compartment 12. Mounted on the front of the shelf bottom tray 31 is a trim strip 37 preferably made of die cast metal having vertical ribs 38 and openings therebetween in alignment with the channels 33 in the shelf proper. As is shown in FIGURE 2, the exit 39 of the strip 37 is angled generally upwardly and toward the inner surface of the door 14.

Mounted at the upper rear of compartment 12 is a fan 40 driven by a motor 41 positioned within the insulation 42. Surrounding the fan 40 is a shroud 43 opening downwardly adjacent the back liner 18. The fan 40 is hidden by a plastic shield 44 containing a plurality of small perforations 45 to permit air to flow therethrough. The usual illuminating bulbs, germicidal bulbs and the like (not shown) may be located behind this shroud which is preferably translucent.

Suspended beneath the shelf tray 31 at one side thereof is a meat pan 46 for the storage of fresh meats at temperatures of approximately 34° F. Immediately above the meat pan and rearwardly of the center thereof are located a pair of air scoops 47 in the shelf tray 31. Each scoop 47 is located in an air channel 33 and extends upwardly from the tray 31 in order to intercept a portion of the air flowing through the channels 33 in which the scoops are located and to direct this portion of cooled air downwardly into the pan 46, as illustrated most clearly in FIGURE 2. The scoops permit the withdrawal or diverting from the air channels of a sufficient quantity of chilled air into the meat pan to provide the proper meat storage temperatures.

Positioned forwardly of the rear wall 18 of the food storage compartment 12 is an evaporator shroud 48 which is a corrugated metal sheet that is flexible and whose sides are held in side guide channels 49. These guide channels 49 extend generally vertically and parallel to each other and have their bottoms 50 curved forwardly as shown in FIGURE 2. Because the shroud 48 is flexible it can be inserted into and removed from the guide channels 49 as desired.

The shroud 48 not only serves as a cover to hide the rearwardly located evaporator 51 but also serves to define the front side of a front air channel 52 whose rear side is defined by the evaporator 51. Thus air flows downwardly throught an upper entrance 53 of channel 52 from the fan 40 and in thermal contact with the evaporator 51. The evaporator 51 which is in the form of a plate is held spaced from the liner back 18 by a plurality of spacers 54, here shown as four, with each spacer being located at a corner of the evaporator plate 51. The positioning of the evaporator 51 forwardly of the rear 18 provides a second or rear air channel 55 having an upper entrance 56 downwardly through which air also flows from the fan 40 in thermal contact with the rear

surface of the evaporator 51. Thus, as is best shown in FIGURE 2, air from the fan 40 is forced rearwardly and downwardly through the channels 52 and 55 on opposite sides of the evaporator 51 to pass downwardly through lower exists 57 and 58 respectively, with these two air streams joining at the exits. At the exists 57 and 58 the air is at a temperature only slightly above freezing. Customary means (not shown) are provided for removing condensate as formed on and flowed down the evaporator 51. This condensate removal means forms no part of the present invention.

A portion of the chilled air at the exits 57 and 58 is diverted into the channels 33 in the shelf 30 by means of an upwardly and rearwardly extending scoop 59. This portion of air then flows forwardly through the plurality of channels 33 that extend across the full width of the shelf 30 and is then directed generally upwardly toward the door 14 as shown in FIGURE 2. As previously explained, a portion of this chilled air within the shelf 30 is diverted by the scoops 47 downwardly into and through the meat pan 46 in order to chill meat therein to the proper temperature which is preferably a few degrees above freezing.

A portion of the chilled air from the common exits 57 and 58 also passes behind the diverting scoop 59 where it flows downwardly along the liner back 18 where it again divides with part of the air passing below the meat pan 46 and above the crisper pans 26 and 27 and another part of the air flowing behind and beneath the crisper pans. All of this air then flows forwardly toward the front of the compartment 12 to flow upwardly along the inner surface of the door 14 to chill food stored thereon. All of the air then flows upwardly along the door and is drawn through the perforated shield 44 into the fan 40 and is then recirculated over the evaporator 51 in the manner previously described.

The shelf 30 is mounted for easy removal. Thus the front of the shelf at the trim strip 37 is supported at the sides by inwardly directly studs 60 that engage bottom opening sockets 61 at the ends of the strip 37. The rear of the shelf is similarly supported on inwardly directed studs 62 that engage forwardly extending sockets 63.

As is shown in FIGURES 2 and 3, the evaporator plate 51 is preferably of the single plate "roll-bond" construction provided with a plurality of interconnected passages for flow of refrigerant.

As can be seen from the above description, an important feature of the invention is the refrigerated shelf 30 which not only provides a supporting surface for the storage of fresh foods where they are cooled by conduction but also provides distribution ducts for distributing cooled air as it flows from the evaporator 51 surfaces. The cooled air enters this shelf 30 for distribution at approximately the coldest temperature of this air. The chilled air passing forwardly through the manifold shelf 30 is distributed efficiently throughout the entire fresh food compartment. This cooled air cools the food by air flow and by convection. Furthermore, as the shelf is at a relatively low temperature because it receives air directly from the evaporator it also serves to cool food within the compartment 12 by radiation, acting as a cold body within the food compartment. In addition, the upper glass surface 34 is of large extent so that it can support large quantities of food for cooling by direct conduction.

A very important advantage resulting from the cooled shelf 30 is that air emerging therefrom is adjacent to the storage portions of the inner surface of the door 14. This emerging air serves efficiently to cool food stored in the door and to maintain it at a safe temperature. This is ordinarily not possible with refrigerators of conventional construction.

Having described our invention as related to the embodiment shown in the accompanying drawings, it is



our intention that the invention be not limited by any of the details of description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

We claim:

1. In a refrigerator having refrigerating means a fixed but removable container having a top access opening; first means for refrigerating the container comprising a wall removably closing said access opening and means for directing air refrigerated by said refrigerating means against said wall; second means for refrigerating the container comprising means directing air refrigerated by said refrigerating means through said wall into the container; and third means for refrigerating the container comprising means directing air refrigerated by said refrigerating means against the exterior of the container.

2. The refrigerator structure of claim 1 wherein the wall is hollow and is refrigerated by conducting the refrigerated air therethrough.

3. A refrigerator, comprising: a cabinet having a food storage compartment defined by top, bottom, side and rear walls and an access opening; a door normally closing the opening; a refrigerated member associated with the cabinet; means for forcibly directing air within the storage compartment in thermal contact with the refrigerated member for cooling the air; duct means positioned intermediate said top and bottom walls for directing the cooled air in a stream across the interior of the cabinet and ejecting the cooled air toward the door at an area adjacent the door; a food storage receptacle adjacent said duct means; and means for diverting a portion only of the cooled air stream in said duct means into thermal contact with the interior of said receptacle.

4. A refrigerator, comprising: a cabinet having a food storage compartment defined by top, bottom, side and rear walls and a front access opening; a door normally closing the opening; a refrigerated member adjacent one of said side and rear walls; means for forcibly directing air within the storage compartment in thermal contact with the refrigerated member for cooling the air; and a generally horizontal shelf member positioned intermediate said top and bottom walls having a hollow interior providing a duct with an entrance adjacent said refrigerated member for receiving at least a portion of said forcibly directed cooled air at substantially its lowest temperature and an exit for the air more closely adjacent the closed door than the rear wall for directing the air in a jet toward the closed door, the shelf member being adapted to support food articles for cooling the same.

5. A refrigerator, comprising: a cabinet having a food storage compartment defined by top, bottom, side and rear walls and an access opening; a door normally closing the opening; a refrigerated member adjacent one of said side and rear walls; means for forcibly directing air within the storage compartment in thermal contact with the refrigerated member for cooling the air; a generally horizontal shelf member positioned intermediate said top and bottom walls having a hollow interior providing a duct with an entrance for receiving at least a portion of the cooled air and an exit for the air adjacent the closed door for directing the air toward the closed door, the shelf member being adapted to support food articles for cooling the same; a food storage receptacle adjacent the shelf member; and means for diverting a portion only of the cooled air stream in said duct into thermal contact with the interior of the receptacle.

6. The refrigerator of claim 5 wherein said receptacle is beneath the shelf member and the diverting means includes an air scoop extending into said duct.

7. A refrigerator, comprising: a cabinet having a food storage compartment defined by top, bottom, side and rear walls and a front access opening; a door normally closing the opening; a refrigerated member extending vertically adjacent but spaced from one of said side and rear walls; means defining a first air passage on one side

of the refrigerated member having an entrance at the top and an exit at the bottom; means defining a separate second air passage on the other side of the refrigerated member having an entrance at the top and an exit at the bottom, the air passages being interconnected at their bottom exits; blower means for forcing air from said compartment through said passages for cooling the air; means for directing a portion of the cooled air in a confined stream out of direct contact with food in said storage compartment across the interior of the cabinet and ejecting said confined cooled air stream toward the door at an area more closely adjacent the door than the rear wall; and means for directing another portion of the cooled air toward the bottom of said compartment.

8. A refrigerator, comprising: a cabinet having a food storage compartment defined by top, bottom, side and rear walls and an access opening; a door normally closing the opening; a vertically extending refrigerated member horizontally adjacent but spaced from said rear wall; means defining a first air passage on one side of the refrigerated member having an entrance at the top and an exit at the bottom; means defining a separate second air passage on the other side of the refrigerated member having an entrance at the top and an exit at the bottom; blower means at the top of said cabinet adjacent said entrances for forcing air from said compartment downwardly through said passages for cooling the air; and a generally horizontal shelf member positioned intermediate said top and bottom walls having a hollow interior providing a duct with an entrance adjacent said rear wall for receiving at least a portion of the cooled air from at least one of said exits, and an exit for the air more closely adjacent the closed door than the rear wall for directing air toward the closed door, the shelf member being adapted to support food articles for cooling the same.

9. A refrigerator, comprising: a cabinet having a food storage compartment defined by top, bottom, side and rear walls and an access opening; a door normally closing the opening; a refrigerated member extending vertically adjacent but spaced from said rear wall; means defining a first air passage on one side of the refrigerated member having an entrance at the top and an exit at the bottom; means defining a second air passage on the other side of the refrigerated member having an entrance at the top and an exit at the bottom; blower means at the top of said cabinet adjacent said entrances for forcing air from said compartment downwardly through said passages for cooling the air; a generally horizontal shelf member positioned intermediate said top and bottom walls having a hollow interior providing a duct with an entrance for receiving at least a portion of the cooled air from at least one of said exits, and an exit for the air adjacent the closed door for directing air toward the closed door, the shelf member being adapted to support food articles for cooling the same; a food storage receptacle adjacent the shelf member; and means for diverting a portion only of the cooled air stream in said duct into thermal contact with the interior of the receptacle.

10. A refrigerator, comprising: a cabinet having a food storage compartment defined by top, bottom, side and rear walls and an access opening; a door normally closing the opening; a refrigerated member extending vertically adjacent but spaced from said rear wall; means defining a first air passage on one side of the refrigerated member having an entrance at the top and an exit at the bottom; means defining a second air passage on the other side of the refrigerated member having an entrance at the top and an exit at the bottom, the air passages being interconnected at their bottom exits; blower means at the top of said cabinet adjacent said entrances for forcing air from said compartment downwardly through said passages for cooling the air; a generally horizontal shelf member positioned intermediate said top and bottom walls having a hollow interior providing a duct with an entrance adjacent said rear wall and an exit adjacent but spaced from the closed door; means directing a portion of the cooled air from the refrigerated member passage exits into the shelf duct entrance; means directing another portion of said cooled air toward the bottom of said compartment; a food storage receptacle beneath said shelf member; and means including a plurality of air scoops extending into the cooled air stream in the shelf duct in intercepting relationship to said air stream for diverting a portion only of said cooled air in the shelf duct into thermal contact with the interior of the receptacle.

11. A refrigerator, comprising: a cabinet having a food storage compartment defined by top, bottom, side and rear walls and an access opening; a door normally closing the opening; a refrigerated member adjacent one of said side and rear walls; means for forcibly directing air within the storage compartment in thermal contact with the refrigerated member for cooling the air; and a generally horizontal shelf member positioned intermediate said top and bottom walls having a hollow interior providing a duct with an entrance for receiving at least a portion of said forcibly directed cooled air and an exit for the air adjacent the closed door for directing the air in a jet toward the closed door, the shelf member including a bottom support with upstanding spaced ribs extending from front to back and an overlying substantially rigid sheet member, the bottom support and sheet member cooperating to divide said duct into a plurality of sections extending from front to rear of the shelf member.

12. A refrigerator, comprising: a cabinet having a food storage compartment defined by top, bottom, side and rear walls and an access opening; a door normally closing the opening; a refrigerated member extending vertically adjacent but spaced from said rear wall; means defining a first air passage on one side of the refrigerated member having an entrance at the top and an exit at the bottom; means defining a second air passage on the other side of the refrigerated member having an entrance at the top and an exit at the bottom, the air passages being interconnected at their bottom exits; blower means at the top of said cabinet adjacent said entrances for forcing air from said compartment downwardly through said passages for cooling the air; a generally horizontal shelf member positioned intermediate said top and bottom walls having a hollow interior providing a duct with an entrance adjacent said rear wall and an exit adjacent but spaced from the closed door, the shelf member including a bottom support with upstanding spaced ribs extending from front to back and an overlying substantially rigid glass sheet, the bottom support and glass sheet cooperating to divide said duct into a plurality of sections extending from front to rear of the shelf member; means directing a portion of the cooled air from the refrigerated member passage exits into said duct entrance; means directing another portion of said cooled air toward the bottom of said compartment; a food storage receptacle beneath said shelf member; and means including a plurality of air scoops extending into the cooled air stream in said duct in intercepting relationship to said air stream for diverting a portion only of said cooled air in said duct into thermal contact with the interior of the receptacle.

13. A refrigerator, comprising: a cabinet having a food storage compartment and an access opening; a door normally closing the opening; a refrigerated member associated with the cabinet; means for forcibly directing air within the storage compartment in thermal contact with the refrigerated member for cooling the air; and a hollow, substantially horizontally arranged, vertically shallow shelf having an entrance and an exit for receiving the cooled air at said entrance and directing the cooled air in a substantially horizontal confined stream out of direct contact with food in said storage compartment across the interior of the cabinet and ejecting said con-

fined cooled air stream to the compartment at said exit, said shelf means and said refrigerated member being located adjacent each other in order that said cooled air is at substantially its lowest temperature upon entering said shelf means, and said entrance and exit being spaced apart more than one-half the transverse dimension of the compartment.

14. A refrigerator including insulated walls enclosing a food compartment to be cooled, a removable container within said compartment adapted to contain food having especial requirements for good preservation, an evaporator for cooling said food compartment, means for circulating air into heat transfer relationship with said evaporator, a removable top cover for said container provided with an air duct having a wall forming its bottom and separating it from the interior of said container, and means for dividing and conducting air from said circulating means after it has been cooled by said evaporator to discharge a portion into said compartment to be cooled and to circulate a second portion through said air duct in said top cover in heat transfer relation with said container.

15. A refrigerator including insulated walls enclosing a food compartment to be cooled, a container within said compartment adapted to contain food having especial requirements for good preservation, an evaporator for cooling said food compartment, means for circulating air into heat transfer relationship with said evaporator and dividing said air, means for discharging one portion of said divided air into said compartment to be cooled, means for circulating another portion of said divided air into heat transfer relation with said container, and means for directing the flow of said another portion of said divided air into the interior of said container.

16. A refrigerator including insulated walls enclosing a food compartment to be cooled, an evaporator, means including a fan and a duct for drawing air from said compartment and circulating the air in heat transfer relation with said evaporator, said duct being provided with a first outlet, a container within said compartment adapted to contain food having especial requirements for good preservation, a removable support for said container, said support containing a second air duct having an inlet fitting connecting with said first outlet and extending therefrom into heat transfer relation with said container.

17. A refrigerator including insulated walls enclosing a food compartment to be cooled, an evaporator, means including a fan and a duct for drawing air from said compartment and circulating the air in heat transfer relation with said evaporator, said duct being provided with a first outlet, a removable shelf supported within said compartment provided with a second duct having an inlet fitting removably connected to said first outlet, a container within said food compartment removably supported beneath said shelf, said second duct extending over said container for conducting air therethrough in heat transfer relation with said container.

18. A refrigerator including insulated walls enclosing a food compartment to be cooled, an evaporator, means including a fan and a duct for drawing air from said compartment and circulating the air in heat transfer relation with said evaporator, said duct being provided with a first outlet, a removable shelf supported within said compartment provided with a second duct having an inlet fitting removably connected to said first outlet, a container with said food compartment removably supported beneath said shelf, said second duct extending over said container for conducting air therethrough in heat transfer relation with said container, said second duct having a lower wall between it and the interior of the container.

19. A refrigerator including insulated walls enclosing a food compartment to be cooled, an evaporator, means including a fan and a duct for drawing air from said compartment and circulating the air in heat transfer relation with said evaporator, said duct being provided with a first outlet, a removable shelf supported within said compartment provided with a second duct having an inlet fitting removably connected to said first outlet, a container within said food compartment removably supported beneath said shelf, said second duct having a removable bottom wall extending over said container whereby air in said second duct is in heat transfer relation with said container.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 1,961,901 | Hill | June 5, 1934 |
| 2,145,892 | Roberts | Feb. 7, 1939 |
| 2,482,222 | Strang | Sept. 20, 1949 |
| 2,487,584 | Patterson | Nov. 8, 1949 |
| 2,532,816 | Kurtz | Dec. 5, 1950 |
| 2,709,900 | Zearfoss | June 7, 1955 |
| 2,739,456 | Saunders | Mar. 27, 1956 |
| 2,763,136 | Salisbury | Sept. 18, 1956 |
| 2,767,558 | Wallenbrock | Oct. 23, 1956 |
| 2,836,039 | Weber | May 27, 1958 |
| 2,944,410 | Mann | July 12, 1960 |