Feb. 1, 1938. C. S. EVANS 2,106,909

REFRIGERATOR

Filed March 9, 1936 3 Sheets-Sheet 1

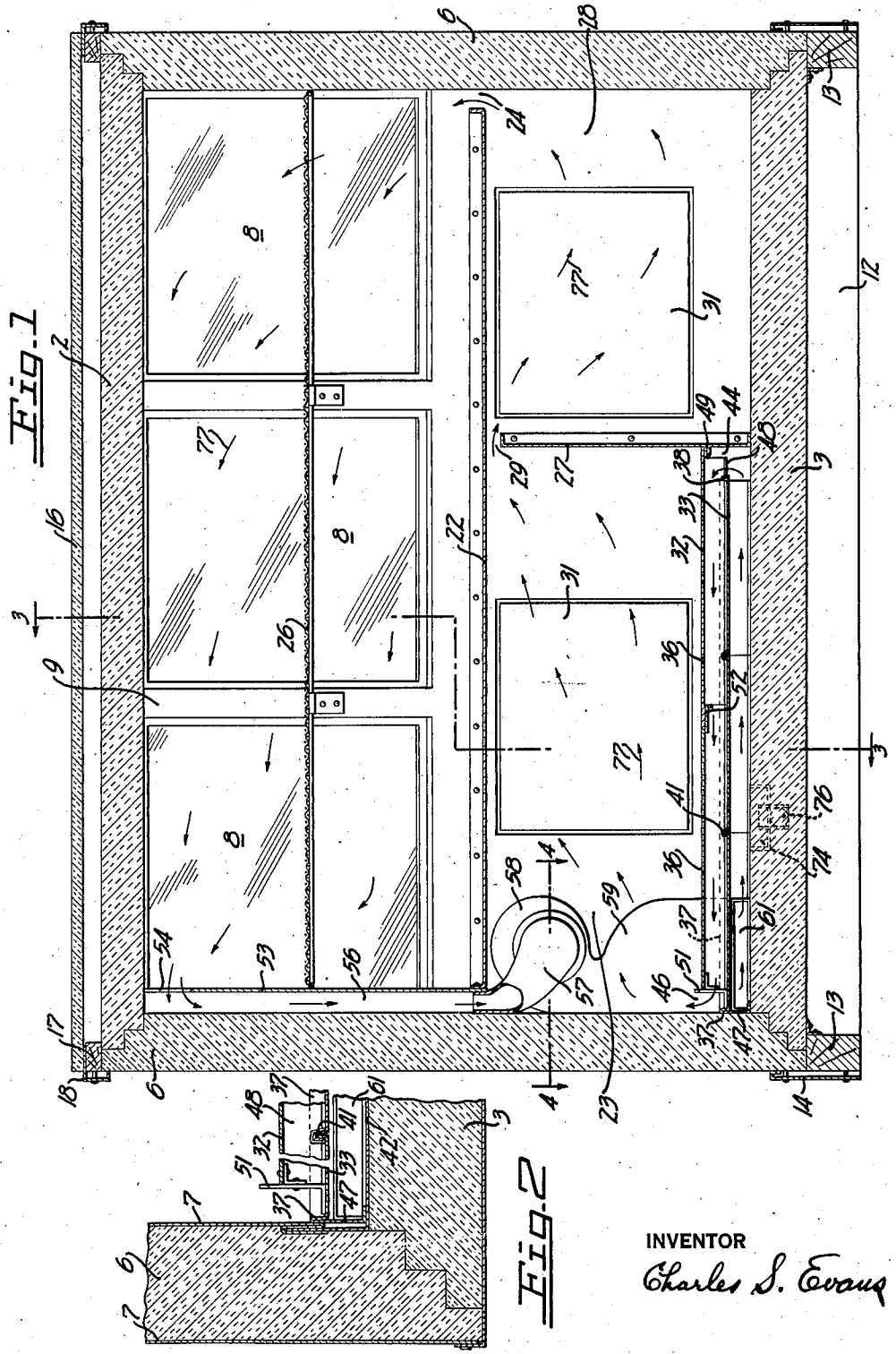


Fig. 1

Fig. 2

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Fig. 3

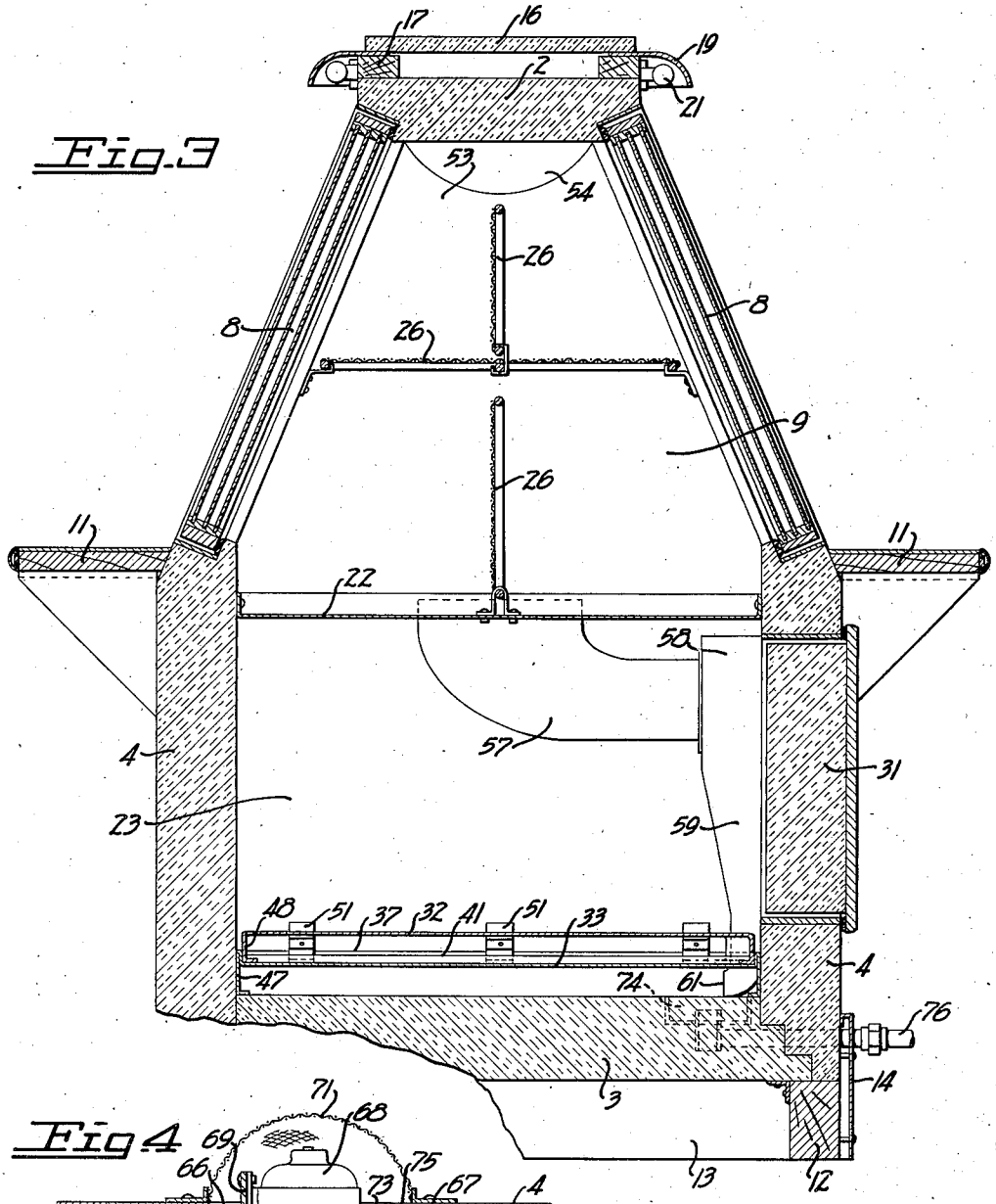
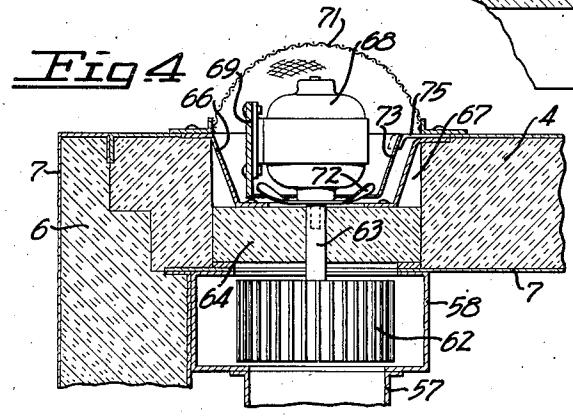


Fig. 4



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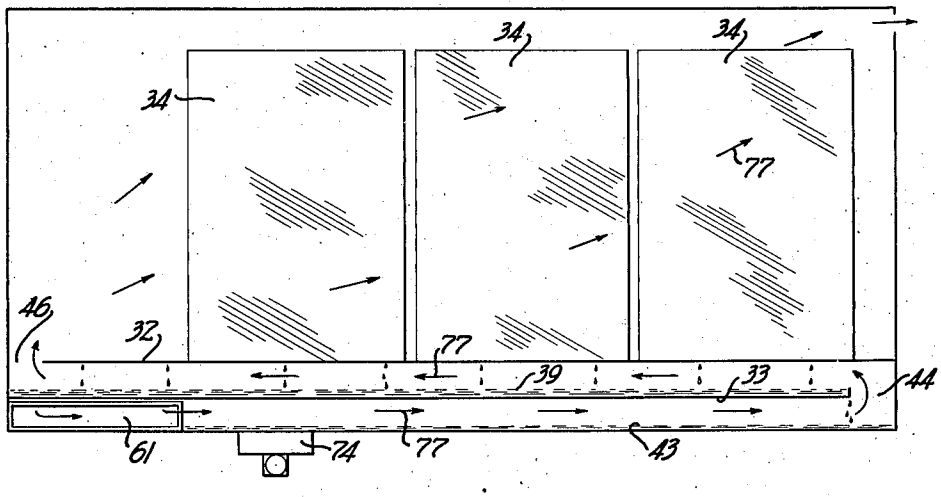
Charles S. Evans

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Fig. 5



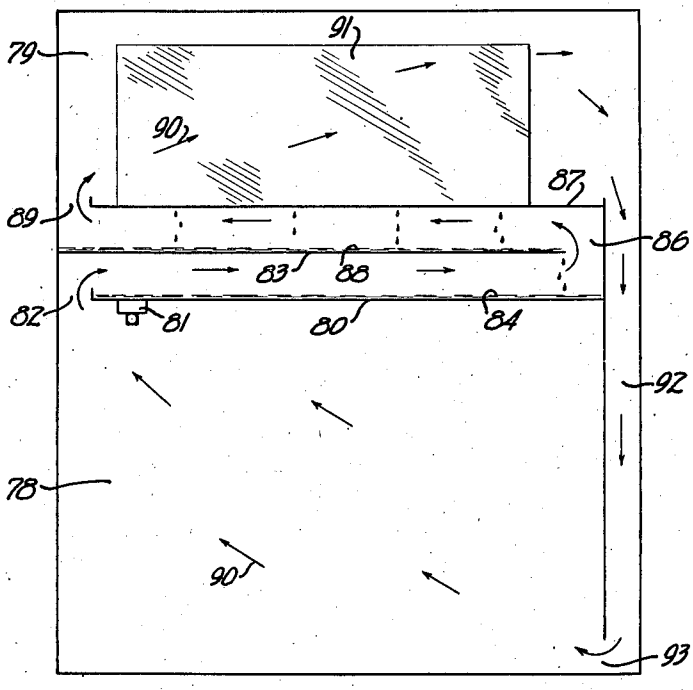


Fig. 6

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UNITED STATES PATENT OFFICE

2,106,909

REFRIGERATOR

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Application March 9, 1936, Serial No. 67,781

3 Claims. (Cl. 62—63)

My invention relates to ice refrigerators; and the broad object of my invention is to provide means for lowering the temperature in the food chamber of such a refrigerator.

Another object of my invention is to provide means for maintaining the lower temperature with the consumption of less ice.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of my invention. It is to be understood that I do not limit myself to this disclosure of species of my invention, as I may adopt variant embodiments thereof within the scope of the claims.

Referring to the drawings:

Figure 1 is a longitudinal vertical sectional view of a refrigerator embodying the improvements of my invention; and

Figure 2 is a detail vertical sectional view on larger scale showing the manner of supporting the plates in the bottom of the cooling chamber.

Figure 3 is a transverse vertical sectional view of the refrigerator, taken in a plane indicated by the line 3—3 of Figure 1.

Figure 4 is a detail horizontal sectional view on larger scale showing the blower mounting, the plane of section being indicated by the line 4—4 of Figure 1; and

Figure 5 is a diagrammatic longitudinal vertical sectional view of the cooling chamber.

Figure 6 is a diagrammatic longitudinal vertical sectional view of a modified form of refrigerator construction embodying my invention.

In terms of broad inclusion, the refrigerator embodying my invention comprises a food chamber, a cooling chamber, and means in the cooling chamber for holding ice water in a sheet over the surface of which air from the food chamber may pass. Means are provided for supporting ice in the cooling chamber, and the ice water holding means preferably comprises a drip plate or pan underlying the ice and upon which the ice water may drip and spread out in a film or layer.

The drip plate is preferably spaced between the bottom of the cooling chamber and the ice supporting means, and is also preferably spaced from one end of the cooling chamber, to provide a zigzag path for the air. The bottom of the cooling chamber is also preferably constructed to provide means for holding the ice water dripping from the overlying plate in a sheet under the plate.

Air from the food chamber first passes in a thin layer through the passage between the lower cooling surface of the drip plate and the surface of the ice water on the bottom of the cooling chamber, and then through the passage between the lower cooling surface of the ice supporting means and the surface of the ice water on the drip pan. After this, the air passes over the surfaces of the ice in the cooling chamber, and then flows into the food chamber. If the cooling chamber is below the food chamber, means are also preferably provided for withdrawing air from the food chamber and discharging it into the cooling chamber.

In greater detail, and referring particularly to Figures 1 to 5, a refrigerator embodying my invention having an upper food chamber comprises an insulated box having top and bottom walls 2 and 3, and side and end walls 4 and 6. These walls may be made of any suitable insulating material, such as cork, and are preferably faced inside and out with metal sheets 7. See Figures 2 and 4. The joints between the walls at the corners of the box are preferably compound rabbeted and cemented to provide a strong, well-insulated construction.

As best shown in Figure 3, the side walls 4 are only carried up part way, the upper portions of the box sloping inwardly toward the top and having multiple pane glass doors 8 giving entrance to the upper food chamber 9. This type of cabinet is a combination show case and refrigerator, and is well suited for stores where the customer takes out the articles being purchased. As an added convenience, suitable shelves 11 may be provided along the outside of the box.

Base strips 12 and 13 are preferably provided under the side and end walls to provide legs for the box, and a finishing border 14 of metal is preferably fastened to the outer surface of the box around its base. A top 16 is supported above the upper wall 2 by spacers 17, and a suitable finishing band 18 of metal is also preferably provided along the end walls at this point. Along the sides of the box, above the doors 8, suitable reflectors 19 may be provided for throwing light from lamps 21 into the food chamber.

The box is provided with a horizontal plate or partition 22 extending transversely across the box to divide the cabinet into the upper food chamber 9 and a lower cooling chamber 23. This partition forms the bottom of the food chamber, and is spaced from one end of the box to provide an opening or passage 24 between the lower portion of the box and the upper food chamber 9.

Suitable shelves and partitions 26 are arranged in the food chamber, and a vertical plate or partition 27 is provided in the lower portion of the box to separate the cooling chamber 23 from

a food storage chamber 28. Partition 27 extends transversely across the box and is spaced from the partition 22 to provide an opening or passage 29 between the upper end of the cooling chamber 23 and the food storage chamber 28. This extra food storage space is made possible in my construction, because my refrigerator consumes less ice and therefore uses a smaller cooling chamber, as compared with the usual type of refrigerator construction in which the entire lower portions of a box are needed for ice.

Entrance to the cooling chamber 23 and food storage chamber 28 is gained by suitable doors 31 provided in the side wall 4 of the box.

The refrigerator box or cabinet above described may be varied within wide limits, it being understood that the particular construction shown and described is merely for purposes of illustration.

The improvements of my invention reside largely in the construction of the cooling chamber 23, in which a pair of plates 32 and 33 are arranged in overlying relation adjacent the bottom wall 3 of the chamber. Upper plate 32 forms an ice supporting shelf upon which the blocks 34 of ice may rest; while the underlying plate 33 provides an additional cooling element upon which ice water may drip from apertures 36 provided in the ice shelf.

Preferably the drip plate 33 is provided with upturned flanges 37 and 38 to form a pan for holding the ice water in a sheet or layer 39 underlying the ice holding shelf 32. The end flange 38 is slightly shorter than the other flanges, so that the water will overflow this end of the pan. The drip pan is preferably made of sheet metal, and may conveniently be made up in sections interlocked by flanges 41. The latter flanges are made by turning up a lip along an edge of one section, and forming an inverted V-shaped bead on the adjacent section for engaging the upturned lip. See Figure 2. These flanges are of substantially the same height as end flange 38, and provide riffles across the pan.

If desired the end and riffle flanges may be omitted to simply provide a flat plate on which the ice water may drip. In this event the water would not collect, but would merely be present as a thin film on the surface of the plate.

The bottom wall 3 of the cooling chamber is also lined with a metallic sheet 42 turned up along the vertical walls of the box and crimped with the liner sheet 7. See Figure 2. This forms a pan on the bottom of the chamber, in which water dripping from pan 33 may collect in a sheet or layer 43 beneath the drip pan 33. This layer of ice water not only provides an additional cooling surface, but also serves as an added heat insulating layer for the bottom of the cooling chamber.

Pan 33 is spaced between the bottom of the cooling chamber and the ice supporting shelf 32 to provide air passages, and pan 33 is spaced from one end of the chamber to provide an opening 44 connecting the passages. Ice shelf 32 is spaced from the opposite end of the chamber to provide an opening 46 connecting the upper passage with the main portion of the cooling chamber. Support for pan 33 is provided by down turned flanges 47 resting on the bottom of the chamber; while ice shelf 32 receives its support by flanges 48 turned down from the side edges of the shelf and resting on pan 33.

The inner end of the shelf rests on a flange 49 provided on partition 27 above the opening 44, and the other end of the shelf is supported by angle brackets 51 fastened to the shelf and resting on the pan 33. Like pan 33, the ice supporting plate or shelf 32 is also made of sheet metal, and is built up in sections. In this case the edge of one section may be turned down to provide an offset portion 52, upon which the adjacent edge of the other section may rest.

Means are also provided for withdrawing air from the upper end of the food chamber and discharging it under the drip pan 33. For this purpose a partition 53 having an opening 54 adjacent the upper wall 2 is provided across one end of the food chamber 9 to form a downwardly extending air passage 56. A duct 57 connects with the lower end of this passage and opens into a fan chamber 58 of a blower. From this chamber a discharge duct 59 continues downwardly to an opening 61 under the end of the drip pan 33 opposite the opening 44. As shown in Figure 3, the air from opening 61 is directed transversely across the cooling chamber, under pan 33. This discharged air is reflected back by the opposite wall, so that the air follows a zig-zag path under the drip pan.

As shown in Figure 4, the blower comprises a fan 62 mounted on a shaft 63 passing thru a block 64. This block is supported by a conical bracket 66 in an aperture 67 provided in the side wall 4. The motor 68 for driving the fan is mounted in bracket 66 on a cross plate 69 extending vertically across and connected to the side walls of the bracket; and a foraminated hood 71 is provided over the mouth of the aperture to protect the motor against dust. Ventilation for the motor is provided by a small fan 72 fastened to the motor shaft, and adapted to draw cold air through a passage between the conical bracket and inside cup 73. This inside cup is also conical in shape, extending from one end of plate 69 and around the motor to the other end of the plate. Support for the cup is provided by welding the cup to plate 69 and to a supporting arm 75.

Air drawn in through the passage between cup 73 and bracket 66 is then blown out past the motor. This carries the heat from the motor away from block 64, and keeps the surface of the latter cool. This is important because insulating block 64 is only about half the thickness of wall 4.

A drain for the water on the bottom of the cooling chamber is provided by a small sump 74 adjacent the air inlet 61 and arranged on the same side of the cooling chamber. Water dripping from the end of pan 33 spreads out in a thin layer or film over the bottom of the chamber, and then drains into the sump 74. From this sump the water is conducted out through the side of the box by a drain pipe 76. The particular positioning of the sump 74 is important because, as shown in Figures 1 and 3, the discharging air from opening 61 does not blow the water away from the sump. As the air rebounds from the opposite wall it travels back in a zig-zag path under pan 33, and this back flow of air is traveling toward sump 74 and assists in directing the water on the floor of the chamber toward the sump.

During the use of the refrigerator it is desirable to remove the ice shelf 32 and drip pan 33, preferably each time the box is re-iced, for the purpose of cleaning. In my design this removal is made easy by the sectional construction of the ice shelf and drip pan. The inner section of the ice shelf is first lifted up and pulled out through the door, followed by the other section. This exposes

the drip pan, which may then also be removed in sections.

During operation of the refrigerator, air circulates through the cooling chamber 23 and food chambers 28 and 9 as indicated by arrows 77 in Figures 1 and 5. The latter figure is purely diagrammatic and illustrates the path taken by the air through the cooling chamber. After the warm air drawn from the food chamber is discharged into the cooling chamber, it passes in a thin layer through the narrow passage between the surface of the ice water 43 on the bottom of the chamber and the under cooling surface of the drip pan 33. At this time heat from the air is taken up both by the ice water and the cold metallic surface of the overlying pan.

After travelling through this lower passage the air blows through the dripping ice water over the edge of pan 33 and is directed back in its zig-zag path through the narrow passage between the surface of the ice water 39 in the drip pan and the under cooling surface of the ice supporting shelf 32. Additional heat from the air is thus taken up both by the ice water in the pan and the cold metallic surface of the ice shelf. Also, as the air flows through this upper passage it blows through the dripping ice water, which operates to further cool the air. Finally the air passes through the opening 46 and is directed over the surfaces of the ice blocks 36.

By this arrangement the ice water, which is normally discharged as waste water, is utilized to precool the air before the latter passes over the ice. Consequently the water discharging from my refrigerator is at a higher temperature than is ordinarily the case, due to the additional heat which it has taken up from the air. When the air finally reaches the ice it is already chilled, and the ice itself is required to take up less heat. As a result the rate of melting is lowered, and the ice consumption of the refrigerator is decreased. Also, the air is discharged into the food chamber at a lower temperature than in the ordinary refrigerator.

As compared with an ordinary refrigerator of a size consuming 100 lbs. of ice in a given period, I have found that a refrigerator of similar cabinet design and of equal size embodying my invention consumes less than 60 lbs. of ice for the same period. At the same time, the temperature in the food chamber was lowered. Thermometers placed adjacent the air inlet, central and air outlet portions of the upper food chamber in the ordinary refrigerator registered 40° F., 41° F., and 42° F., respectively.

Similarly located thermometers in my refrigerator registered 35° F., 36° F., and 37° F., respectively. In other words, my improvements resulted in lowering the temperature on an average of about 5° F. throughout the food chamber, while at the same time effecting a saving of about 40% in the ice consumption.

Figure 6 shows diagrammatically the improvements of my invention as embodied in a refrigerator where the food chamber 78 is below the cooling chamber 79, as is the case in the usual domestic refrigerator. In this design the lower drip plate or pan 80 lies above the food chamber, and connects with a suitable drain 81 extending down along the back of the cabinet. The pan is spaced from one end of the box to provide an opening 82, through which the warm air in the food chamber may rise into the passage between the upper drip plate 83 and the surface of the water film 84 in the lower pan 81.

Drip plate 83 is spaced from the opposite end of the box to provide an opening 86, through which the air may rise into the passage between the ice shelf 87 and the surface of the water film 88 on the drip plate 83. Plate 83 may be provided with an end flange to form a pan for collecting a body of water, as in the construction shown in Figure 5; or it may be a simple plate on which the water merely spreads out in a thin film before running off, as is indicated in Figure 6.

Shelf 87 is spaced from the end of the box, opposite opening 86, to provide an outlet 89 through which the air may pass into the main portion of the cooling chamber. The air, as indicated by arrows 90, passes over the surfaces of the ice block 91, and then flows down through a suitable passage 92 to an outlet 93 opening into the lower portions of the food chamber.

Circulation in this type of refrigerator is automatic, because the warm air in the food chamber tends to rise into the cooling chamber through the top opening 82, and the cold air in the cooling chamber tends to flow down through the side duct 92.

In this type of refrigerator the ice is usually inserted through a suitable door in the top of the cabinet, and I prefer to use a similar construction. This also gives opportunity to remove the ice shelf 87 and drip plate 83, which are preferably made removable for purposes of cleaning.

I claim:

1. A refrigerator comprising a food chamber, a cooling chamber, an elevated shelf in the cooling chamber for supporting the ice so that the ice water may drip into the space below the shelf, a plate in the space below the shelf for receiving the drip and for dividing said space into passages and means for withdrawing air from the food chamber and discharging it into the passage below said plate.

2. A refrigerator comprising a food chamber, a cooling chamber, an ice supporting shelf in the cooling chamber, a drip pan underlying said shelf, means for withdrawing air from the food chamber and discharging it beneath the drip pan, and means for directing said air along the under surface of the drip pan and then thru the passage between the drip pan and said shelf.

3. A refrigerator comprising a food chamber, a cooling chamber, an ice supporting shelf in the cooling chamber, a drip pan underlying said shelf, the bottom of the cooling chamber providing means for holding ice water in a sheet underlying the drip pan, and means for withdrawing air from the food chamber and discharging it beneath the drip pan, said air being first directed thru the passage between the drip pan and the surface of the ice water on the bottom of the cooling chamber and then thru the passage between the surface of the ice water in the drip pan and the ice shelf.

4. A refrigerator comprising a food chamber, a cooling chamber, an ice supporting shelf extending transversely across the cooling chamber, a drip pan under the shelf and spaced from said shelf and the bottom of the cooling chamber to provide air passages, said drip pan having an opening at one end of the chamber to connect said passages, and said shelf having an opening at the opposite end of the chamber to provide an outlet for the passage above the drip pan, and

means for withdrawing air from the food chamber and discharging it beneath the drip pan.

5. A refrigerator comprising a food chamber, a chamber for holding ice, a plate for collecting a film of ice water upon its upper surface, means providing communicating passages for air above and below said plate, an inlet for admitting air from the food chamber into one of said passages, an outlet for discharging the air from the other passage into said ice chamber, and means for directing the air from the ice chamber to the food chamber, whereby the air passes through said passages and then over the surfaces of the ice prior to entering the food chamber.

6. A refrigerator comprising a food chamber, a chamber for holding ice, a plate for collecting a film of ice water upon its upper surface, means providing communicating passages for air above and below said plate, an inlet for admitting air from the food chamber into the passage below said plate, an outlet for discharging the air from the passage above the plate into said ice chamber, and means for directing the air from the ice chamber to the food chamber, whereby the air passes through said passages and then over the surfaces of the ice prior to entering the food chamber.

7. A refrigerator comprising a food chamber, a chamber for holding ice, a plurality of plates arranged at different levels for collecting films of ice water upon their upper surfaces and to provide zig-zag passages for directing air over first one and then another of said ice water layers, means for admitting air from the food chamber into one of said passages, means for discharging air from another of said passages into said ice chamber, and means for directing the air from the ice chamber to the food chamber, whereby the air passes through said passages and then over the surfaces of the ice prior to entering the food chamber.

8. A refrigerator comprising a food chamber, a chamber for holding ice, a plate for collecting a film of ice water upon its upper surface, means for withdrawing air from the food chamber and discharging it beneath said plate, and means for directing the air along the under surface of the plate and then over the surface of the ice water film on the upper side of the plate.

CHARLES S. EVANS.