Nov. 5, 1946. G. MUFFLY 2,410,672

REFRIGERATOR

Filed Oct. 3, 1941 4 Sheets-Sheet 1

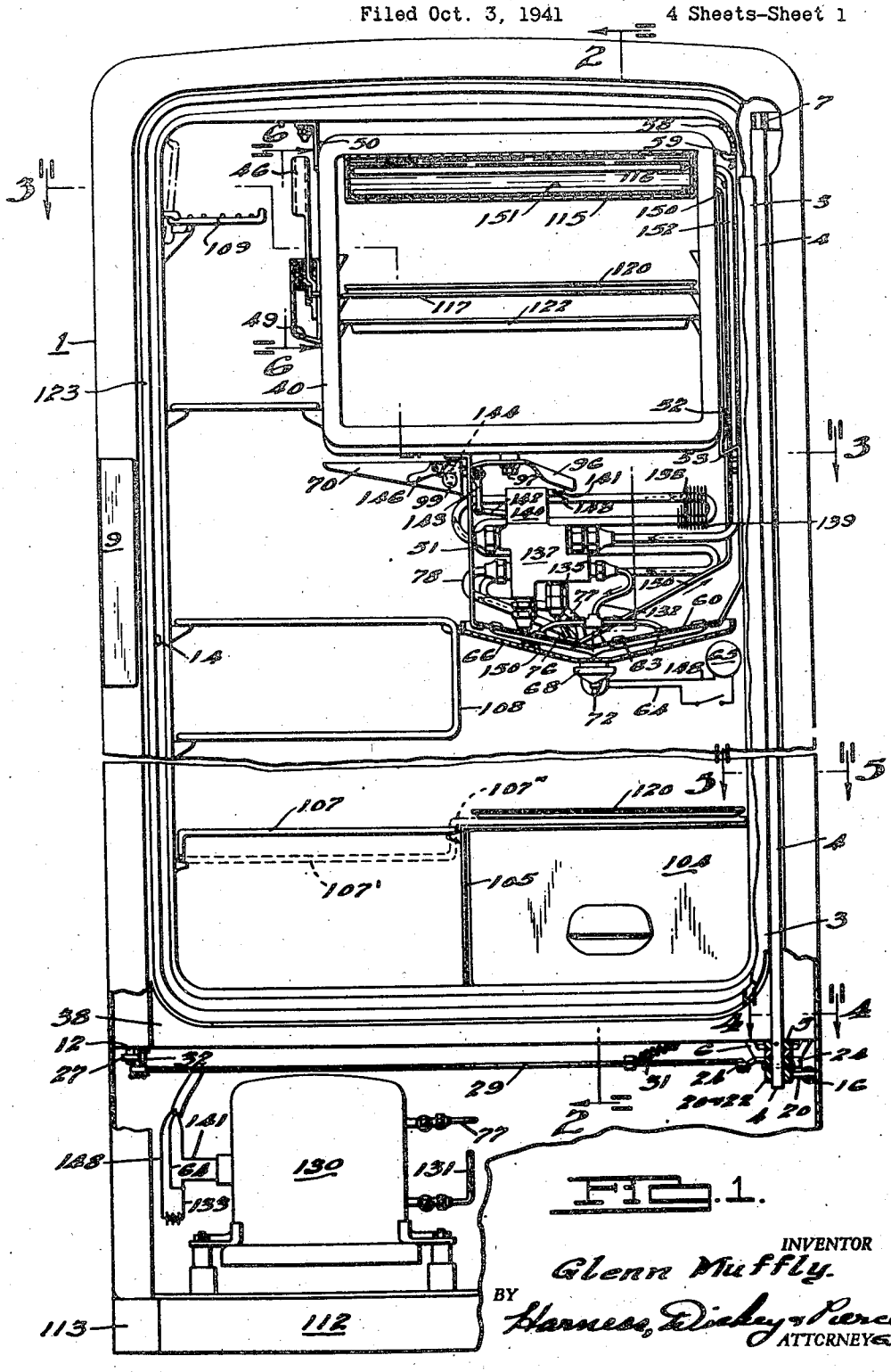


FIG. 1.

INVENTOR
Glenn Muffly.
BY Harness, Dickey & Pierce.
ATTORNEYS

Nov. 5, 1946. G. MUFFLY 2,410,672

REFRIGERATOR

Filed Oct. 3, 1941 4 Sheets-Sheet 2

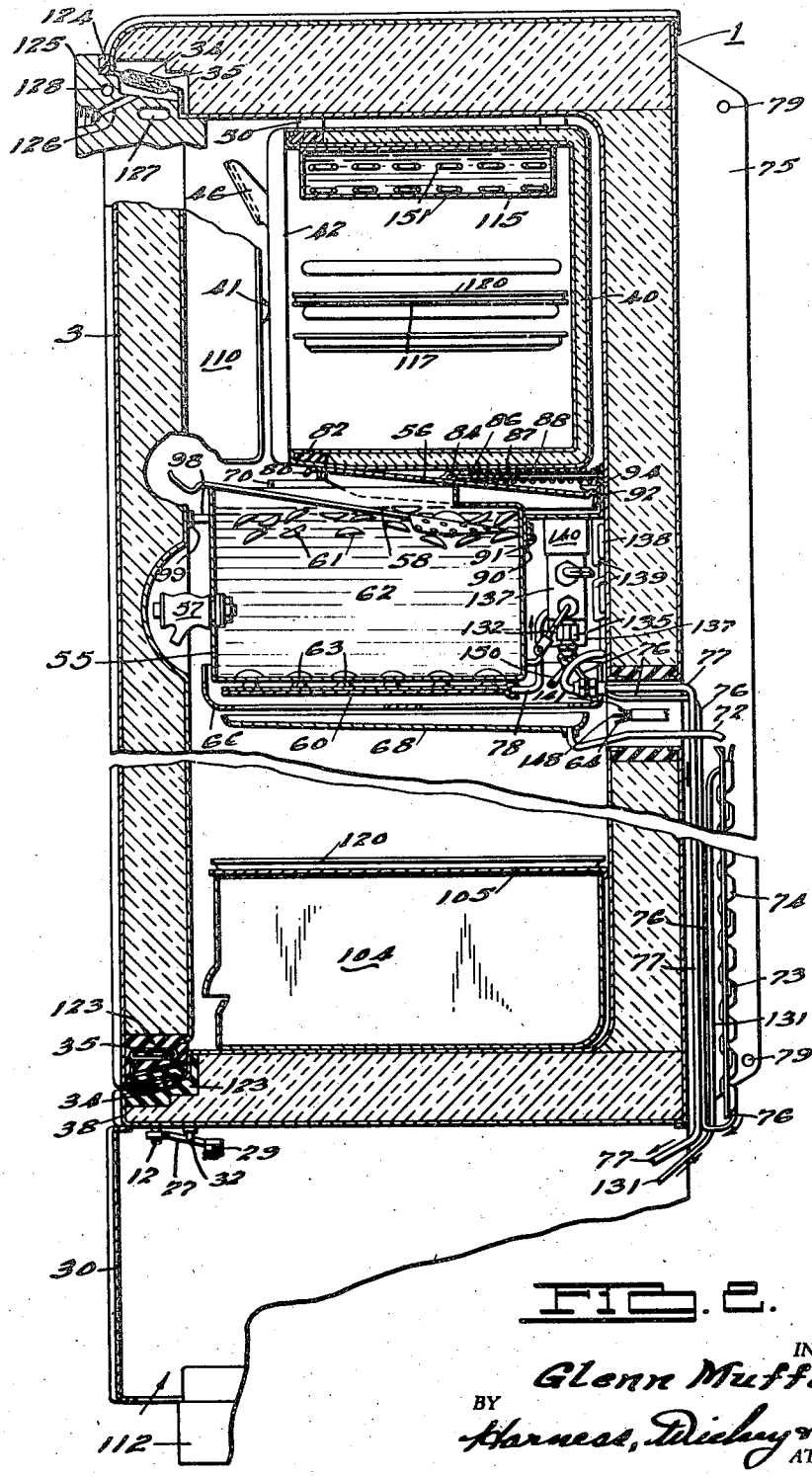


FIG. 2.

INVENTOR
Glenn Muffly.
BY
Harness, Dickey & Pierce
ATTORNEYS.

Nov. 5, 1946. G. MUFFLY 2,410,672

REFRIGERATOR

Filed Oct. 3, 1941 4 Sheets-Sheet 3

FIG. 3.

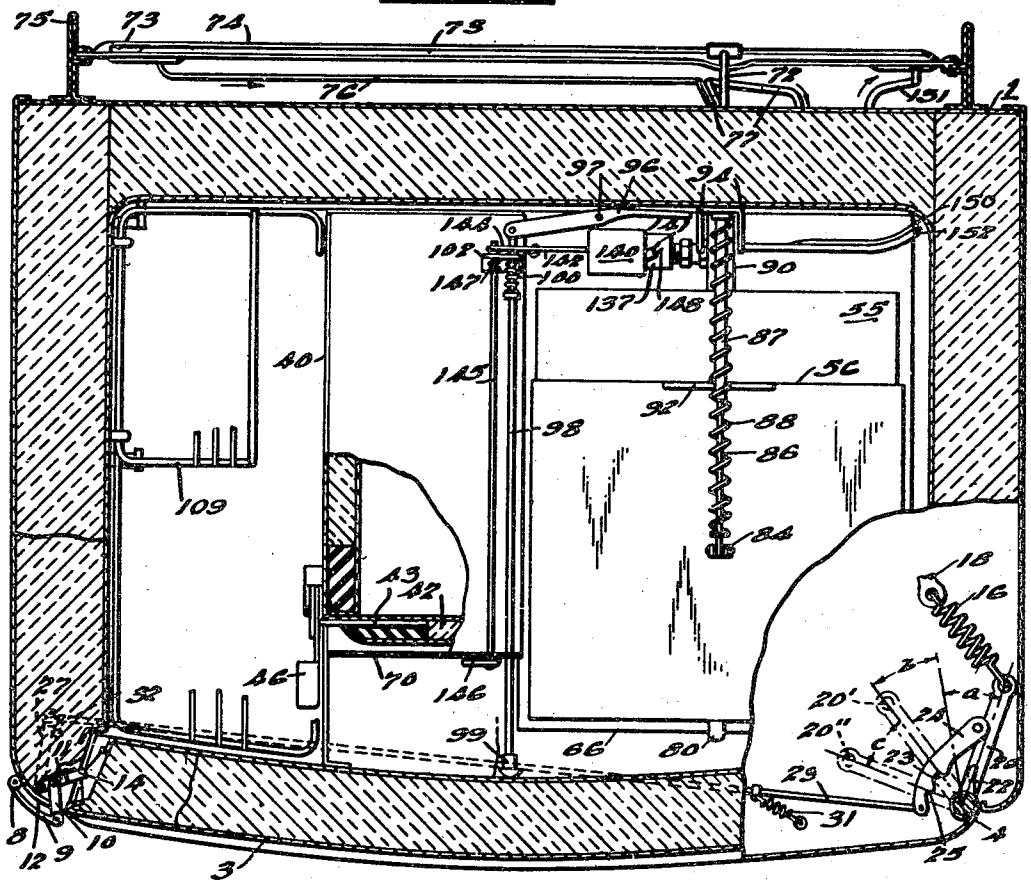




FIG. 4.

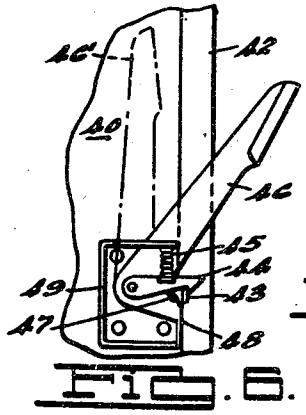


FIG. 6.

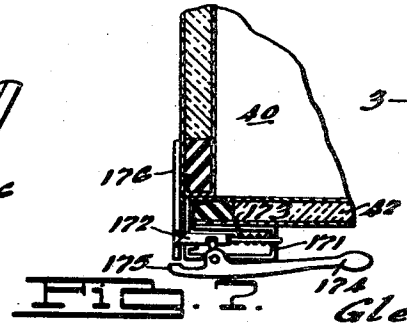


FIG. 7.

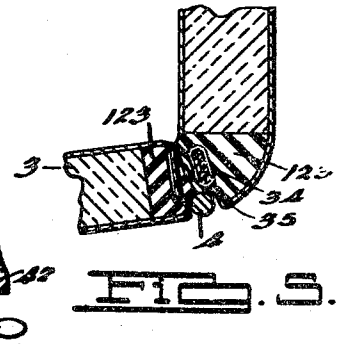


FIG. 5.

INVENTOR
Glenn Muffly.
BY
Howson, Dicky & Pierce
ATTORNEYS.

Nov. 5, 1946. G. MUFFLY 2,410,672

REFRIGERATOR

Filed Oct. 3, 1941 4 Sheets-Sheet 4

Fig. 8.

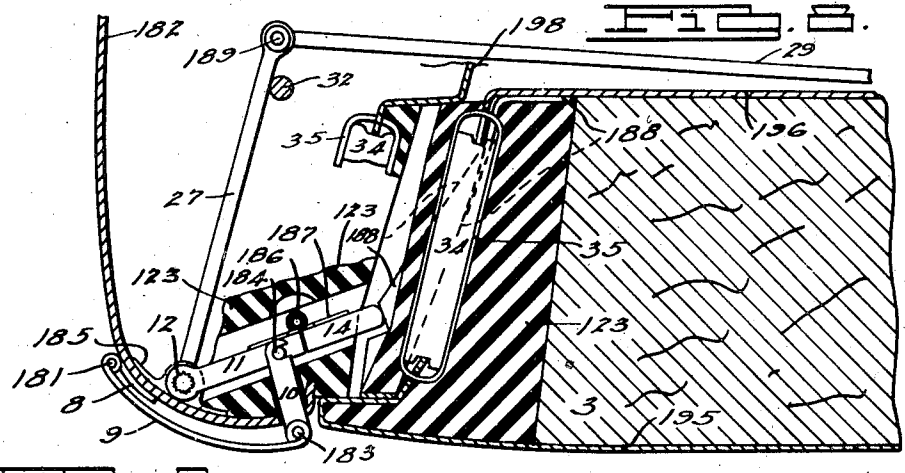


Fig. 9.

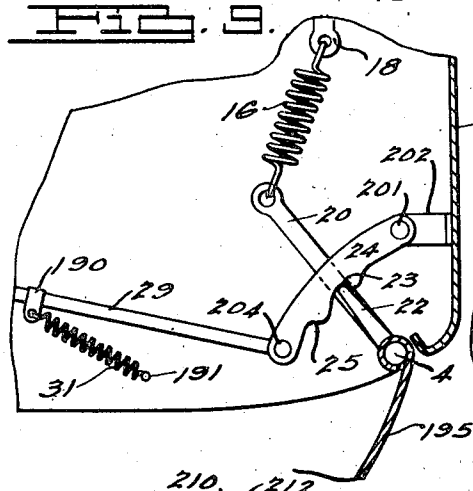
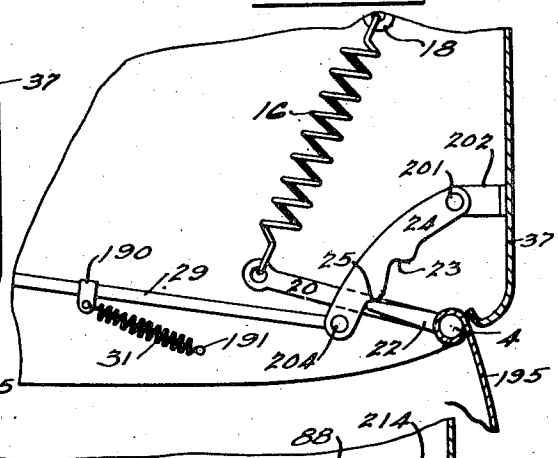


Fig. 10.



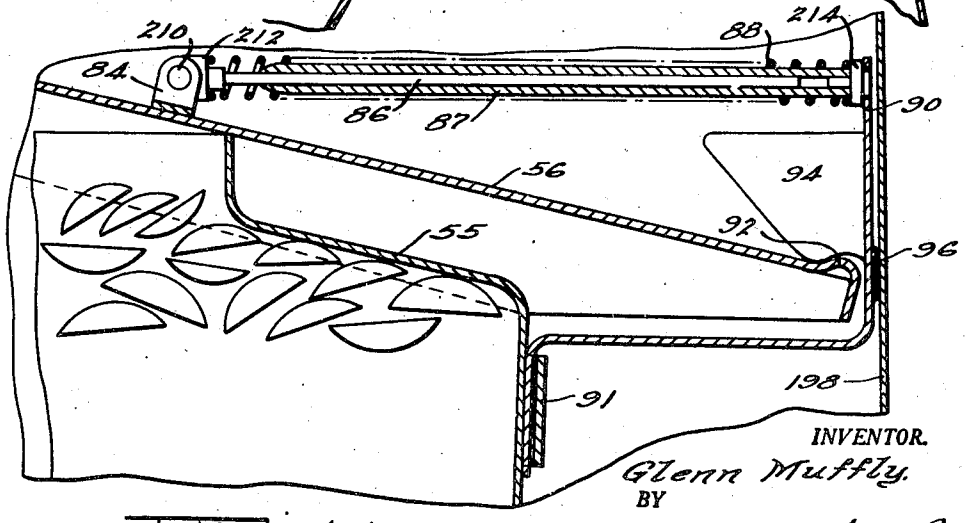


Fig. 11.

INVENTOR.
Glenn Muffly.
BY
Harness, Dickey & Pierce
ATTORNEYS.

Patented Nov. 5, 1946 2,410,672

UNITED STATES PATENT OFFICE

2,410,672

REFRIGERATOR

Glenn Muffly, Springfield, Ohio

Application October 3, 1941, Serial No. 413,495

14 Claims. (Cl. 312—192)

1

This invention pertains to refrigeration and particularly to mechanical refrigerators adapted for household use.

One of the objects is to provide a self-opening and self-closing outer door.

Another object is to provide operating means for such a door, employing spring means which acts at one time to open the door and at another time to close the door.

An additional object is to provide a door or cover for an inner receptacle of such a refrigerator which is self-closing as a result of closure of the outer door.

An additional object is to provide a refrigerator door with a latch which does not project forward farther than the door itself, thus simplifying the packing of the refrigerator for shipment and eliminating the use of a projecting handle or other part which might catch on a person's clothing.

Still another object is to provide for location of the door operating mechanism within the refrigerating machinery compartment of the refrigerator.

The accompanying drawings illustrate only one design without going into modifications except that Figure 7 shows an alternative type of latch for the freezer door. In these drawings similar reference numbers are used for similar parts throughout, and all figures except Figure 7 are tied together by the broken lines which indicate where sectional views are taken.

Figure 1 is a front elevation of the refrigerator, showing the outer door broken away, the freezer door removed and the ice-water tank removed for a clearer showing of internal parts.

Figure 2 is a sectional view of Figure 1 taken on line 2—2 thereof, showing the ice-water tank in position and illustrating the method employed to reclose the cover of this tank. This view also shows a section of the half mold used in forming the door frame from plastic material.

Figure 3 is a horizontal sectional view of Figure 1 taken mainly on the line 3—3 thereof and including broken portions. This view shows the spring devices for actuating the outer door and for reclosing the ice-water tank cover. It also shows details of the main door latch and its connection with the door closing mechanism.

Figure 4 is a detail sectional view of Figure 1 taken on the line 4—4 thereof to illustrate the relationship between the hinge rod of the outer door of the outer panel immediately below the door.

Figure 5 is a sectional view taken on the line

2

5—5 of Figure 1 to illustrate the relationship of the hinge rod to the door and to the cabinet and further to show sections of the molded door frame and of the molded frame for the door opening, illustrating the change of section of these frames on the hinge side of the door as compared with the sections seen in Figures 2 and 3.

Figure 6 is a detail view of the freezer latch as seen from the line 6—6 of Figure 1.

Figure 7 is a fractional horizontal sectional view of the freezer and its door, showing a modified form of latch.

Figure 8 is an enlarged sectional view showing a part of Figure 3 in greater detail.

Figure 9 is a detail of Figure 3 showing the door spring mechanism with door partially open.

Figure 10 is similar to Figure 9, but showing the door fully opened.

Figure 11 is an enlarged detail view showing the part of Figure 2 which includes the spring and latch means for the cover of the ice-maker tank.

The cabinet 1 is fitted with a door 3 adapted to open the full front of the food space. The door is attached to the hinge rod 4 which is connected with a spring-actuated mechanism for both opening and closing the door, as below described.

To open the door the striker plate 9 is pushed inwardly toward the cabinet, the plate being hinged at 8 (Figures 3 and 8). This moves the push rod 10 inwardly, moving the latch lever 11 in a counterclockwise direction together with the shaft 12, as viewed from above, thus withdrawing the hinged latch end 14 from engagement with the door, which is thereupon opened by the door spring 16. This spring is supported at one end by the fixed member 18 and acts upon the lever 20, which is secured to the hinge rod 4. This hinge rod is in turn secured to the outer wall member of the door, being free to rotate in bearings 6 and 7. Since the spring 16 is under tension when the door is closed, it acts in an opening direction on the door while the lever 20 moves through the angle *a*. The inertia of the door will thereupon stretch the spring 16 while the lever 20 and the door move through a slightly lesser angle, as seen in Fig. 9 and indicated at *b* in Fig. 3, bringing the lever 20 to the position 20'. At this point the pawl 22, which is also secured upon the rod 4, has engaged the notch 23 of the ratchet quadrant 24, thus holding the door open with the spring 16 partially extended.

It will thus be seen that a user coming to the refrigerator with both hands full can open the

door by merely touching the striker plate 9 with her elbow. While the door does not open wide, it opens far enough to provide ordinary access to the food compartment and it may be pushed to the 90° position of full opening (Fig. 10) without using the hands. When the door is so pushed the pawl 22 is moved into engagement with the second notch 25 in the quadrant 24. The lever 20 is at the same time moved to the dotted position 20'', further extending the spring 16.

To close the door from this full-open position it is only necessary to again depress the plate 9, which causes the shaft 12 to move counterclockwise as seen in Figs. 3 and 8, carrying with it the lever 27 and through the medium of pull-rod 29 moving the quadrant 24 away from the pawl 22. The plate 9 should preferably be held in its depressed position until the pawl 22 has passed the notch 23, then released before the door has fully closed, but the notch 23 is so formed that failure to do this will not prevent closing of the door. It will be noted that the angle *c* plus *b* is considerably greater than the angle *a*, hence the energy stored up in the spring 16 when the door is at its full-open position will impart sufficient momentum to the door to carry the lever 20 through the angle *a* and thereby load the spring 16 under tension with sufficient energy for reopening the door as above described.

As the door closes it engages the latch end 14, which is hinged upon the latch lever 11 in a direction to allow the door to close without moving the lever 11 and its associated parts. The hinge joining 11 and 14, is of a one-way type and provided with a spring acting to hold the part 14 in the position shown, with its arcuate end engaging the notch in the striker on the door. By means of a suitable angle and location of the notch surface, the latch end 14 is stopped by contact on its arcuate end rather than on one side, thus holding it slightly out of line with the lever 11, canted at an angle so that it holds the door securely closed. This angle is enough to allow for wear, but not enough to impose an excessive toggle load on the depression of the plate 9 for the next opening of the door.

The spring 31 is attached to the rod 29 and to a fixed support on the cabinet so as to be under some tension. It holds the lever 27 against its stop 32, thus establishing the normal position of the plate 9, the lever 11 and the quadrant 24. The spring 31 is located so as to pull at an angle upon the rod 29 and thus keep this rod from vibrating. The quadrant 24 is pivoted on the horizontal wall above the machinery compartment of the cabinet in a manner to allow the lever 20 to swing freely below it.

The notches 23 and 25 and the end of the pawl 22 are rounded or given a negative rake. This is not a great enough rake to allow the spring 16 to overcome the spring 31, but is sufficient to prevent injury to the parts in the event that the user forces the door in a closing direction instead of touching the plate 9. It is preferred that the negative rake of the notch 23 be greater than the negative rake of the notch 25, both because this notch has less spring tension to hold and so as to allow the user to push the door closed from its two-thirds open position without touching the plate 9.

The hinge rod 4 is provided with a rigidly attached collar 5 having a thrust bearing against the bottom support 6, which also forms the annular bearing at the lower end of the hinge rod. The upper end of the hinge rod has a bearing

in the support 7. The hinge rod 4 passes outside of the welded joint between the right-hand outer sheet 37 of the cabinet and panel 38 below the door, as seen in Figure 4, but its lower end is concealed behind the unit compartment door 30. Panel 38 may be one piece with the sheet of metal below the bottom insulation, as shown, to reduce the length of joints to be welded. The door 3 may be removed from the cabinet by removing the door 30, disconnecting the spring 16 and lever 20, loosening the lower support 6 from the cabinet, opening the door and dropping it down to withdraw the upper end of the rod 4 from its support 7.

The base 112 of the cabinet, seen in Figure 2, is set in at the front to allow toe room and for entry of air between it and door 30, as indicated by the arrow. The base 112 may also be set in at the sides of the cabinet to allow it to be placed closer to a wall on the right or left side. Removable corner pieces 113 may be furnished to fill the sides of the base so that the user may remove one to clear a quarter-round and set the cabinet closer to a wall, or may leave it on for appearance. This inset base and the corner pieces are also helpful in packing and moving the cabinet without damage.

The freezer 40 is similar to one shown in my co-pending application, Serial No. 237,629, filed Oct. 29, 1938, which has become Patent No. 2,359,780, dated Oct. 10, 1944, being located similarly with respect to the ice-maker tank 55 and to the basket 110 which is attached to the cabinet door 3. The eutectic tank 115 is similar to the tank 210 of this earlier application. It will be understood that the means for closing the freezer door disclosed in this prior application may be employed in connection with the present disclosure. A difference between the freezer and tank arrangement of the present application and that of the earlier application last mentioned above is that I have made the freezer wider and the ice-maker tank narrower. This is done to improve the visibility of the interior of the cabinet, particularly portions of shelves located below the ice-maker tank. The arrangement here shown places the ice-maker and the freezer in an inverted pyramid arrangement whereby the user is given an angle of vision which allows a clear view of the major portion of the food storage space.

The freezer 40 is an insulated enclosure which may be considered a small refrigerator within the main refrigerator. It is provided with insulated walls and with an insulated door 42, the latter being hinged at the right and fitted with a special latch which serves not only to hold the freezer door closed, but as a means for prying the door free when it is frozen shut. A freezer of this type should be held at a temperature considerably lower than that of the main food compartment and the latter should be held at a temperature above freezing with a high relative humidity. The air of the main food compartment of the refrigerator will therefore contain enough moisture to fall below its dew point at the junction of the freezer door and the fixed freezer walls. This causes frost to collect in the door joint, freezing the door shut. When the freezer door is opened after being closed for a considerable period it is necessary to break the ice thus formed, hence I have provided means for doing this.

Figure 6 is a fractional view showing a side elevation of the latch as it would be seen from

the left as indicated in Figure 1. The freezer 40 is closed by the hinged door 42, this door having rigidly attached thereto the latch plate or striker 43. When the door is pushed shut this striker engages and lifts the latch member 44, this latch or pawl being returned by the spring 45 to secure the door in its closed position. To open the latch the lever 46 is moved in the direction of its dotted position 46' and the lug 47 lifts the latch 44 clear of the striker 43 so that the door may be opened. Since the spring 45 is retained between the latch body 49 and the latch member 44, while the latch member engages the lug 47, it will be seen that the spring not only moves the latch down against the lug 47 but thereby moves the lever 46 forward to the position indicated by full lines in Figure 6.

Integral with the lever 46 and located below the lug 47 is a cam surface 48 which has increasing radii with reference to its pivot point. This surface is arranged to engage the striker 43 when the lever 46 is moved farther than enough to lift the latch 44 out of engagement with the striker 43. The purpose of this cam is to break any ice bond which may have been formed between the door 42 and the body of the freezer 40. One continuous movement of the lever 46 rearwardly first lifts the latch and then forcibly pushes the door open far enough to break any ice bond. In order that the door 42 may be slammed or pushed closed without danger of damage that might result from inertia of the lever 46 I have provided for movement of the latch 44 independently of the lever 46 in an upward direction. The parts 44 and 46 are pivoted upon a common pin but not attached together except that the lug 47 on the part 46 provides a positive means for lifting the latch 44.

The modified freezer door latch seen in Figure 7 is equipped with a bolt 172 which engages the striker plate 176, forming a conventional spring latch of the self-closing variety, which may be opened by means of the handle 174. The latch bolt 172 is arranged to slide within the latch body 171 against the action of spring 173 when handle 174 is pulled. I have added an extension 175 to this handle, so formed that it engages striker plate 176 after the bolt 172 has been withdrawn from the striker plate. It is thus seen that the user need only pull on the handle 174 to first withdraw the bolt 172 from the striker plate and then to use the handle 174 and its extension 175 as a lever to pry the door open by breaking the frost or ice around it. This one pull on the handle 174 will further open the freezer door 42.

With either type of latch, the freezer door is automatically closed by the closing of the outer door as disclosed in my application, Serial No. 237,629, filed October 29, 1938, the rubber bumper 41 finally pushing the door 42 closed to its latching position.

The insulating material for cabinet walls is preferably in board form or semi-rigid packages. This insulation is placed within the outer shell of the cabinet and then the cabinet liner is pushed into place. The blocks 34 of wood or other material, preferably having a low thermal conductivity but being substantially non-compressible, are forced into place between the edge of the liner and edge of the outer shell, as seen in Figures 2 and 5. Wires 35 are then tied or welded in place to hold these edges in position and secure the blocks 34. The plastic material 123 is molded in place by the use of a mold form on

the order of 125, which is clamped against the cabinet to form a substantially tight fit, preferably using one or more gaskets as shown at 124. The plastic material 123 is poured or forced into the space defined by the outer metal wall, the liner, the insulating material and the mold form 125 through the sprue 126, which may be in multiple, including one or more risers or vents to insure complete filling of the cavity with the plastic material. The mold form 125 is provided with cores 127 and 128 which may be used to circulate hot or cold fluids as required to heat or cool the plastic material to expedite its hardening or to form a hard skin on its exposed side next to the mold form. The drawings are section lined to indicate use of a rubber compound, but it is to be understood that any suitable plastic material may be used.

A mold half similar to 125, but of female form to receive the door 3, is used in like manner to cast the plastic frame or breaker which joins the inner and outer metal walls of the door and seals the insulating material between them. It will be noted that blocks 34 are not required on the door, but the wires 35 are used to secure the metal walls of the door together after assembling them with the insulating material between, preferably in a press which holds these metal walls together while the wires are tied or welded. The door thus assembled is then placed in the mold form and the plastic material injected as above described.

It will be noted that the angle of the contact surfaces between the door and the cabinet walls is different on the hinge side of the door as compared with other sides of the door. These surfaces blend into each other at the corners of the door adjacent to the hinge and all of the corners are rounded. The object is to form a smooth door frame in the cabinet and a smooth frame on the door itself, each of these frames serving the triple purpose of a frame, of a seal connecting the inner and outer metal walls in an airtight manner, and of a compressible contact surface to minimize air leakage when the door is closed. These contact surfaces are at different angles relative to the cabinet walls at different sides, as above described, but preferably they approach uniformity with respect to the axis upon which the door swings. The contact areas are modified from the conventional form in order that each of these surfaces may approach a plane radial with respect to the axis of the door hinge. This provides for bringing the surfaces together with the minimum of slippage relative to each other. The plastic material is preferably such as to provide a smooth, tough skin where exposed and where the two plastic frames make contact. One or both of the plastic frames is preferably soft enough to be slightly compressible for the purpose of improving the airtightness of the joint between them when the door is closed.

This construction eliminates the use of the usual breaker strip with its attendant joints and corner pieces. Being molded in place, the plastic frame itself provides both the seal for the insulation and the finish around the door and around its opening in the cabinet. It further provides two pairs of mating annular gasket surfaces for better sealing of the door when it is closed. The exposed plastic surfaces are preferably so rounded and smooth as to minimize their tendency to collect dirt and to make it easier to wipe them clean.

The ice and water tank 55, which will be under-

stood by reference to my several issued patents showing similar tanks used for making ice and storing it in flotation, is provided with a cover 56 and a faucet 57. The tank rests upon and is refrigerated by the evaporator 60, preferably formed of sheet metal and provided with a number of raised spots 63 which contact the bottom of the tank 55 for the purpose of refrigerating separated areas of the tank wall so that ice may be formed thereon and periodically released to float in the supply of water 62 which is stored in the tank 55.

The ice discs 61 are released to float in the water during each idle period of the evaporator 60, in accordance with the method disclosed in my several issued patents, particularly No. 2,145,773. The tank is provided with a cover 56 having a handle 80 by means of which it can be lifted and pushed back to the position shown in Figure 2.

When the cover is thus opened, ice blocks 61 may be scooped out by means of a perforated spoon or ladle 58 which is shown in Figure 2. The handle of this ladle is provided with a hole so that it can be hung upon the hook 59 seen at the upper right-hand corner of Figure 1. The handle extends beyond this hole in a curved form so related to the curvature of the cabinet lining that the ladle can be hung on the hook in only one position. Thus any water dripping from the ladle will find its way into the pan 66, which extends to the right slightly beyond the tank 55. The ladle preferably hangs clear of the cover 56 so that the cover may be opened while the ladle is in place and the ladle may be rehung upon its hook before the ice-maker tank cover is reclosed. This provides for allowing the ladle to hang in its position when the tank cover is opened merely to replenish the water supply. It will be noted that the tank extends considerably forward of the freezer door 42 and that the space above it in front of the freezer is clear when the door 3 is opened, since the basket 110 is attached to the door 3 and swings with it.

The cover 56 of the ice-maker tank is adapted to be opened by raising at the front and pushing rearwardly as shown in several of my issued patents, particularly No. 2,145,775, issued Jan. 31, 1939. In the present application I show an automatic mechanism for re-closing the tank cover, since it has been found that users sometimes neglect to do this. The cover 56 is provided with a handle 80 for lifting it, whereupon the cover is tilted upward against the freezer 40, which has a beveled portion 82 to allow clearance for a wider opening of the tank cover. Attached to the cover 56 by means of ears 84 is a rod 86 which slides within the tube 87, both being surrounded by the compression spring 88. The tube 87 is provided with a collar to act as a stop, the tube being freely fitted within a hole in the upper portion of the bracket 90 which is removably attached to the tank 55. As the cover is pushed rearwardly the spring 88 is compressed to provide energy for re-closing the cover.

At the rear extremity of the cover 56 there is a rib 92 formed by embossing the metal of the cover or by adding a part to it and this rib is adapted to engage the ears 94 of the bracket 90, these ears being notched to receive the rib 92. The forms of the rib and of the notches are such that the cover is retained in its open position against the action of the spring 88, but this anchorage may be broken by a slight forward movement of the cover, whereupon the spring 88 acts to close the cover.

The required push for initiating the spring closing of the cover is provided by means of the rocker 96 (seen in Figures 3 and 11), which is pivoted on the lower wall of the freezer 40 at 97 and connected with the push rod 98, which extends forward through the front vertical wall of the drip baffle 70 and is capped by the rubber bumper 99, adapted to be engaged by the inner wall of the cabinet door 3.

When the door is closed the button 99 is in contact with it and the rod 98 is thereby pushed to its rearward position, compressing the spring 100. When the door 3 is opened this spring moves the rod 98 forward and the rocker 96 is thereby moved counterclockwise until it is stopped by contact with a suitable stop or with the rear wall of the cabinet. If the ice-maker tank cover 56 is not opened, the reclosing of cabinet door 3 merely recompresses the spring 100, but if the cover 56 has been opened it is given a slight forward push by the lever 96 when the cabinet door is closed, thereby allowing the spring 88 to complete the closing of the cover 56.

The tank 55 is removable from the cabinet without disturbing any of the operating mechanism. After the tank is removed, as for washing, the cover 56 may be readily removed from the tank, whereupon the rod 86 is withdrawn from the tube 87 and the spring 88 is free. The tube 87 is freely removable from the bracket 90, since it is retained in position by the spring only, and the bracket 90 may also be removed from its support 91 on the tank. Since the rod 98 is required to move side-wise slightly with the movement of the lever 96 its rear support 102, which retains one end of the spring 100, is provided with an oversize or elongated hole to allow such movement.

The refrigerating system employed in cooling this cabinet includes a motor-compressor unit 130, preferably of the sealed type, which delivers compressed refrigerant vapor through tube 131 to the condenser 74, from which the liquid line 76 leads into heat exchange relation with the suction line 77 and thence to the expansion device 135, which is associated with the valve mechanism 137. This valve mechanism is similar to Figure 1 of my co-pending application No. 346,085, filed July 18, 1940, except that I have here shown the expansion device as a separate assembly.

The valve assembly 137 distributes refrigerant liquid either to the evaporator 60 through the tube 132 or to the evaporator 151 through the tube 150. Refrigerant flows through the active one of these evaporators back through the tube 152 from the freezer or tube 78 from the evaporator 60 to the valve assembly 137, to the dryer coil 138 and thence back to the suction side of the motor-compressor unit through the tube 77.

The valve mechanism 137 includes an element which acts in response to changes of evaporator pressures to actuate a valve controlling the flow of vapor from the warmer evaporator 60 to the suction line 77, a liquid valve controlling the flow of refrigerant to the colder evaporator, and the switch 140. The assembly 137 also includes a check valve through which suction vapor passes from the colder evaporator as it enters the assembly 137, and a check valve through which liquid refrigerant flows from the expansion device 135 to the inlet of the warmer evaporator 60. The warmer evaporator is the one associated with the ice-maker tank 55 and the colder evapo-

rator is the one within the eutectic tank 115. In addition to these two evaporators there is a third evaporator or dryer coil 138 connected in series between the vapor outlet of the valve assembly 137 and the suction line 77. This dryer coil is thus connected in series after whichever one of the two main evaporators is active.

The cycling of the system is as follows: When the unit 130 is idle, a pressure rise within the colder evaporator causes the opening of the valve which controls the passage of vapor from the warmer evaporator to the dryer coil 138. In the event that the warmer evaporator reaches its preselected maximum pressure prior to the time that the colder evaporator reaches its preselected maximum pressure, the higher pressure in the warmer evaporator acts directly to unseat the valve which controls the flow of vapor from the evaporator 60 to the dryer coil 138.

In either case the higher pressure of the warmer evaporator thus becomes effective upon a bellows which actuates the switch 140, thus closing the circuit which starts the operation of the motor-compressor unit 130 and refrigeration is thus started in the warmer evaporator 60 associated with the ice-maker tank. As refrigeration proceeds and the temperature of the evaporator 60 falls, the suction pressure is thereby reduced and the bellows or other pressure-responsive member moves in the direction of reclosing the valve in the assembly 137 which controls the passage of vapor from the evaporator 60 to the dryer coil 138. As this valve nears its closing point with the compressor continuing to operate, there is a rapid drop of pressure in the suction tube 77 and evaporator 138. This reduction of pressure causes a further flexure of the pressure-responsive element, which is on the downstream side of the closing valve. Such action on the pressure-responsive element effects a complete closing of the valve and there is a further drop in the suction pressure until it reaches the point where the lower pressure vapor in the colder evaporator lifts the check valve which controls its admission to the assembly 137, to the pressure-responsive element and by way of the dryer coil 138 to the suction line 77. The system now operates to cool the colder evaporator in the freezer and the evaporator 138. This operation continues until the evaporating pressure in the colder evaporator has fallen to its preselected minimum, at which point the pressure-responsive element causes the switch 140 to open, thus stopping the operation of the unit 130.

As will be seen in Figure 1 of the prior application last mentioned above, there is a check valve arranged to allow flow of liquid refrigerant from the expansion device to the warmer evaporator and there is also a valve controlling the flow of liquid refrigerant from the expansion device to the colder evaporator. This second valve is mechanically opened coincidentally with the closing of the pressure-actuated valve in the passage between the warmer evaporator and the dryer coil 138.

The check valve in the suction passage leading from the colder evaporator is for the purpose of preventing warm refrigerant vapor flowing from the warmer evaporator to the colder one. Likewise the check valve between the expansion device and the warmer evaporator is to prevent flow of refrigerant from the warmer evaporator to the colder evaporator through their liquid connections with the valve assembly 137. The valve controlling flow of liquid from the assembly 137 to the colder evaporator is closed whenever the warmer evaporator is operating so as to prevent liquid refrigerant from flowing into the colder evaporator at that time.

The dryer coil 138 is provided with fins 139 having their lower edges cut at an angle. The fins may be of parallelogram shape as shown, or may have some other shape at their upper edges, but the lower edge is inclined so as to provide a drip point whereby any condensate collected thereon will drip into the pan 66. It will be noted that the valve assembly 137 and all of the connecting tubes are likewise arranged so that condensate will drip from them into the pan 66. In order to provide for collection of condensate from the outer surface of the freezer 40, a drip baffle 70 is arranged below the side of the freezer which extends beyond the drip pan 66.

The tube 76 is preferably not a so-called "capillary tube," but is a tube of smaller inside diameter than the usual liquid line. This small diameter liquid line does not restrict the flow of liquid refrigerant to the extent of causing it to be cooled by its own expansion, since that would defeat the purpose of the heat exchanger. On the other hand the inside diameter of the liquid tube 76 is small enough so that there will be a clean drainage of liquid refrigerant from it and the bottom of the condenser, which would not occur if the inside diameter of the liquid line were large enough to allow vapor bubbles to pass drops of liquid within the liquid line. At the end of an operating cycle all of the liquid within the condenser is pushed up through the tube 76 and the expansion device 135 into the low pressure side of the system. This relieves the motor-compressor unit 130 of the high pressure on its discharge side and allows for the use of a split-phase motor without providing any additional mechanism for unloading the compressor. While this effect could be obtained if the tube 76 were either of a capillary size or of the usual liquid line size, there would be a loss of efficiency in either of these cases.

If the liquid line which forms a part of the heat exchanger were of capillary size the object of the heat exchanger would be defeated, both because of the high rate of flow through the capillary tube and because of the fact that partial evaporation of the liquid within the capillary tube cools the liquid by wasting some of its own refrigerating effect instead of by giving up its heat to the cold suction vapor. On the other hand if the tube 76 were of large enough diameter to allow liquid and vapor to pass each other within the tube, we would have this condition at the end of an operating period: There would be a quantity of liquid within the liquid line as the compressor stops and this liquid would run down in the tube while vapor from the condenser would pass through the capillary device 135. The liquid remaining in the bottom of the condenser and in the liquid line would then have to evaporate outside of the refrigerator and pass through the capillary device 135 in its vapor phase, thus carrying heat from the room into the refrigerator.

The control switch 140 is provided with a lever 142 designed to close the switch upon downward movement. By means of the rod 143, which is slotted at its upper end to allow some free movement of the pin located in the crank 144, a lost motion connection may be made between the lever 142 and the shaft 145. This shaft is fitted at its forward end with the handle 146. Clock-

wise rotation of the handle rotates the rod 145 against the resistance of the torsion spring 147, thus moving the arm 144 and after taking up any lost motion this movement opens the valve which admits vapor from the evaporator 60 to the dryer coil 138 and the suction line 77, then closes the switch so that the system starts operating to cool the ice-maker evaporator 60 and the evaporator 138.

The lamp 65, seen in Figure 1, is connected to one side of the power line 148 and through the wire 64 to the opposite side of the line. One of these wires is provided with a switch, which is indicated in Figure 1 but not described in detail. This switch is closed by the opening of the door and reopened when the door is closed by means commonly used in household refrigerators. The wire 133 from the current source leads to the motor of the motor-compressor unit 130 while the other line 148 from the current source leads to the switch 140. The opposite pole of the switch 140 is connected by means of the wire 141 with the other pole of the motor in the conventional manner. The motor-compressor unit 130, is mounted on rubber blocks or otherwise flexibly supported, as indicated in the lower portion of Figure 1, and includes a relay switch or starting circuit breaker, as usual.

The eutectic tank 115 is nearly filled with the eutectic freezing solution 116, leaving room for expansion when the solution freezes. This is a solution which freezes at a low temperature, preferably about 0° F. The quantity of the eutectic solution and its latent heat of fusion are such as to provide a substantial hold-over of refrigerating effect so that the freezer is maintained at its desired low temperature when the system is idle for a considerable length of time, as in a cold room. During operation of the evaporator coil 151 the eutectic solution freezes upon this coil, first at the bottom of the tank 115, since the refrigerant flows first through the lower legs of the coil 151. This method of freezing an eutectic solution from the bottom upwardly is covered in my issued patent, No. 1,827,097. Another fact contributing to the holding of a constant low temperature within the freezer 40 will be understood upon consideration of the method of operating the switch 140 and the valve mechanism 137. These mechanisms provide for starting refrigerating effect in the evaporator 151 whenever its temperature rises to a predetermined limit, regardless of what temperature may obtain within other portions of the refrigerator. This switch and valve mechanism are more fully described in my co-pending applications, No. 331,683, filed April 26, 1940, and 346,085, filed July 18, 1940. This system of control provides for starting operation of the system whenever either the freezer evaporator or the evaporator which cools the main food compartment of the refrigerator rises to its cut-in temperature. Refrigeration is thus supplied where needed instead of being controlled by a compromise method in response to some temperature between that of the main food space and that of the evaporator which cools the freezer or low temperature section of the refrigerator.

Since dew forms upon the outside of the tank 55 and the frost forms upon the evaporator 60, this frost being periodically melted during idle periods of the evaporator, I have provided the drip collecting pan 66 to collect the water thus deposited. The pan 66 is provided with one or more openings for draining such water into the trough 68 located below it.

Moisture will also condense on the outer walls of the freezer 40. Most of this water will drain down over the tank cover 56 into the pan 66, but an additional drip baffle 70 is provided to catch the moisture draining from that portion of the exterior surface of the freezer extending to the left of the ice-maker tank and deliver it to the drip pan 66. Thus all moisture collecting on exposed cooling surfaces within the refrigerator will finally reach the trough 68 and be drained out the back of the cabinet through the tube 72 to the condenser 74 on the back of the cabinet and be thereby re-evaporated to ambient air. This method of drip dissipation is more fully described in my U. S. Patent No. 2,145,776, issued Jan. 31, 1939.

In Figures 2 and 3 I have shown an improvement in the drip evaporator associated with the condenser 74. The drain tube 72 conducts water from the trough 68 to the upper one of the several drip channels 73 which are formed integrally with the condenser 74, on its rear (outer) side. The condensate collected within the refrigerator flows from the uppermost of these channels 73 out its open left end as seen in Figure 3 into the channel 73 next below it and so on down the exposed side of the condenser. It has been found that in any ordinary operation of a refrigerator of this type, where the exposed cooling surfaces are either maintained above the freezing point or are defrosted at each cycle of the system, this type of drip evaporator will dispose of all condensate before any of it reaches the lowermost one of the channels 73.

The advantage gained by forming this drip evaporator on the side of the condenser away from the cabinet rather than on the side next to the cabinet, as shown in my U. S. Patent No. 2,145,776, is that the channels 73 are thereby made readily cleanable.

There is a natural convection flow of air upward on both sides of the condenser, between it and the cabinet and between it and the wall against which the refrigerator is placed. In order to insure that the refrigerator is not placed too close to the wall, I have formed the condenser supports 75 so that they extend rearwardly of the condenser to contact the wall against which the refrigerator is placed. It will be seen that I have extended the supports 75 upwardly considerably farther than the condenser. This provides a vertical flue above the condenser so that when the refrigerator is properly placed against the wall of a room a flue is formed to provide an additional draft of thermal circulation drawing air from near the floor over the condenser and drip evaporator. The column of air above the condenser is lighter than ambient air, both because it has been heated by passage over the condenser and because water vapor has been added to it by the evaporation of drip water, water vapor being lighter than air.

The freezer assembly is supported in the cabinet 1 by means of brackets 50 and 52. The brackets 50 and latch housing 49 are beveled at their lower extremities so that any moisture collecting thereon will drain down the outer wall of the freezer 40 and drip onto baffle 70. It will likewise be seen that the evaporator supports 51, depending from the freezer to support the evaporator 60, are so located that any condensate running down them from the bottom of the freezer will fall into the drip pan 66. On the right-hand side of the freezer there are supports 52 which serve to support the right-hand side of the freezer and the

right-hand side of the ice-maker evaporator 60. Each of these parts 50, 51, and 52 is employed in duplicate at locations spaced from front to back. The supports 52 are formed so as to provide a drip point 53 on each, such drip points being located above the drip pan 66.

To facilitate packing of the refrigerator without the bad practice of putting screws into the back of the cabinet and thereby endangering the air-tightness of the outer wall, which is necessary to maintain the insulating material in good condition, I have provided the holes 79 in the parts 75. Suitable screw hooks or bolts may thus be used to hold the refrigerator securely against the back of the packing case.

In addition to providing the freezer with an adjustable shelf 117, I have provided means for facilitating the transfer of food stuffs contained in small dishes between the freezer and the main food storage compartment of the refrigerator as well as in and out of both. The tray 120, preferably of glass, is designed to fit closely within the freezer and also to fit in a fore-and-aft position on a shelf of the main food compartment. The inside width of the freezer is only slightly less than the inside depth of the main food compartment, so that the tray will just go into the freezer while it provides somewhat more clearance for air circulation when placed in a fore-and-aft position on one of the shelves of the main food compartment.

If desired, the tray may be designed with an extending flange or with straight sides and made of the correct length to be supported by the ribs which normally support the shelf 117 in the freezer. Such a modified tray, adapted to serve as a removable shelf, is shown in place in the freezer in Figure 1 and identified as 122.

The drawer 104, seen in the bottom of the cabinet, is arranged to slide within the cover or enclosure 105. Since the main food space of the cabinet is maintained in a high humidity condition because of being cooled by the exposed walls of the tank 55, by the non-frosting exterior walls of the freezer 40, by the periodically defrosted evaporator 60 and by the dryer coil 136, none of which is continuously frosted, it is not necessary that the drawer 104 be made particularly air tight, though this may be done if it is desired to maintain the drawer at a still higher humidity than that of the main food compartment.

The shelf 107 is of L form and of such proportions that it may be inverted to hang in the position indicated by 107' or it may be placed on top of the housing 105, as indicated by the dotted lines 107''. This latter position of the shelf is merely to provide for storing it out of the way when it is desired to place some bulky object in the large space at the left of the drawer 104.

The shelf 108 is of U form so as to provide a double shelf and prevent articles placed on its lower horizontal portion from sliding off. An additional shelf 109 is provided near the upper left-hand corner of the cabinet and preferably arranged so that it may be hinged to the position shown by dotted lines. This shelf is particularly useful for the storage of butter, since this corner of the refrigerator will be maintained at a somewhat higher temperature than the lower portions. It is desirable that butter for current use be stored at a higher temperature than is best for other food stuffs, and this refrigerator is designed to provide the desired higher temperature space without the use of heating or heat leaking means such as are resorted to in some present models.

The common practices with respect to gaskets on refrigerator doors are either to let the door gasket make contact with a flat surface such as the face of the cabinet and with step surfaces parallel with the face of the cabinet, or to have the gaskets contact against angular surfaces which converge inwardly toward the center of the door opening at a uniform angle to the cabinet face on each side of the door. Both of these practices cause the gasket to slide upon its contacting surface, either at the hinge side of the door or at the opposite side, according to the practice followed. Unlike these common practices I have designed the contact surfaces of the door and of the cabinet so as to approach as nearly as is practicable to planes that radiate from the hinge axis of the door. This causes the door gasket, which in my case is a part of one or both of the molded breaker frames, to make contact with its mating surface without the objectionable sliding motion.

Both of the door frames, namely the molded frame of the door itself and the molded frame of the door opening, are formed with compound curves joining their contact areas at least on the corners adjacent to the hinge side. It will be seen that the contact surfaces of these frames may be in one plane at the latch side, the top and the bottom of the door, hence the junctions of these surfaces at the corners on the latch side of the door or of its opening may be in one plane and this plane will still be substantially radial with respect to the hinge axis of the door. In order that the contact surfaces of the frames on the hinge side may be substantially radial with respect to the hinge axis, these surfaces can not be in the same plane as the contact surfaces at the top, bottom and latch side of the door, hence it is particularly at the corners of the door and of its opening adjacent to the hinge side of the door that these compound curves are required to provide smooth, continuous contact areas and have the door close with the minimum of sliding movement between contacting surfaces.

As will be seen from the horizontal section of the door in Figure 3, the axis of the door hinge is so located that the door will swing open to allow substantially unobstructed access to the interior of the refrigerator without swinging beyond the plane of the outer wall of the cabinet on the right-hand side. This and the absence of a projecting latch on the door allow the door to open fully when the cabinet is placed in a right-hand corner of a room without requiring any extra clearance space for the opening of the door.

The freezer 40 and its door 42 are preferably made with molded frames somewhat as described for the outer door of the cabinet, but it is not so important to provide the freezer door with gasket means, since heat leakage at this point aids in cooling the main food space of the refrigerator instead of representing a loss of refrigerating effect to the room as in the case of the outer door. Since the freezer door will normally be frozen shut when left closed for a length of time, there will be very little air leakage around the freezer door except for a limited period after each time it is open. This freezing shut of the freezer door is my reason for preferring to make the contacting surfaces between the freezer 40 and its door 42 of metal or of a harder-surfaced composition than is used around the outer door of the cabinet. A soft material, such as is preferred to provide

some gasket effect around the outer door, might be damaged by the forcible opening of the freezer door when it is frozen shut.

The enlarged detail of door latch seen in Fig. 8 shows how the latch plate 9 is attached by means of the pin 181 to the hinge member 8, which is secured to the outer wall sheet 182 of the cabinet. At the opposite side of the latch plate 9, it is pivoted by means of the pin 183 to the push rod 10, which is in turn pivoted to the latch lever 11 by means of the pin 184. For convenience in assembly, the member 10 is notched to receive the pin 184 as the assembly comprising parts 11 and 14 is inserted in the cabinet wall, whereupon the upper splined end of the rod 12 is inserted in the member 11 from below and suitably retained at its lower end to maintain the spline engagement. The shaft 12 is supported by bearings 185, which are secured to the sheet 182. The members 11 and 14 are hinged together by the pivot pin 186 and are urged into alignment with each other by means of the coil spring 187.

As the door 3 closes, the striker 188 engages the member 14, flexing the spring 187 so that the latch member 14 snaps into the position shown in Fig. 8 to retain the door in its closed position. The spring 187 is not stiff enough to cause such closing of the door to produce any material movement of parts 11, 12, 27, 29 and 24 since their weight and the action of the spring 31 oppose such movement. It will be seen that the spring 31 (seen in Figs. 3, 9 and 10) urges the rod 29 to the right and this rod is pivoted at 189 to lever 27. The location of parts 11 and 14 is determined by the angular position of lever 27 when it engages the stop 32, which is attached to the cabinet.

Spring 31 is attached to the rod 29 by means of the collar 190 and attached to the cabinet by means of support 191.

The main cabinet door, of which a fraction is seen in Fig. 8, includes an outer sheet of metal 195 and an inner sheet of metal 196. These two sheets of metal are separated by the compression members 34, as previously explained, and are tied together by means of wires 35. At the latch position on the door 3 it is permissible that the member 188 be welded or otherwise attached to both sheets 195 and 196. The section of member 188 may be reduced, or a member of low thermal conductivity interposed between 188 and one or both of the sheets 195 and 196, if desired to further minimize thermal conductivity between these two sheets. It will be noted that the greater portion of the part 188 is buried within the molded insulating material 123 in the same manner as the members 34 and wires 35 are buried.

It will be seen that the outer sheet 195 of the door 3 makes contact with the molded plastic material 123 of the cabinet wall, while the cabinet liner 198 makes contact with the molded material 123, which forms the frame of the door, thus providing a double seal. The part 10 may be a sufficiently close fit within the molded material 123 of the cabinet wall to substantially prevent circulation of air into and out of the space enclosing the members 11 and 14.

Due to the fact that the pivot 186 is not moved to any appreciable extent by the closing of the door 3, and this pivot point is not far out of line between the center line of shaft 12 and the point at which 14 contacts 188, the pressure of 188 against 14, due to the force exerted by spring 16 urging the door in an opening direction, does not produce sufficient force in a counter-clockwise direction upon the shaft 12 to move the lever 27 away from its stop 32. For this reason, the contours of contacting surfaces of 14 and 188 may be such as to allow for wear and still hold the door tightly closed, as previously explained.

It will further be noted that the path of the pivot 186 upon counter-clockwise movement of part 11 is on an arc having its center at the center of the shaft 12, thus the first movement of part 11 in a counter-clockwise direction moves the pivot 186 away from the surface of 188, which is contacted by the part 14. This arrangement insures that the door is held snugly closed and yet allows easy movement of parts 11 and 14 when manual contact is made with the plate 9.

In Fig. 8 I have shown sealing contacts between material 123 of the door with the cabinet liner 198 and of material 123 of the cabinet with the outer metal sheet 195 of the door. In accordance with the description herein of the shapes of these contacting surfaces, it is possible that it may be preferred to have the material 123 of the door make contact with material 123 of the cabinet at both the inner and outer contact areas. The choice will be governed to a large extent by production methods employed and the relative costs of the metal working dies of special contour and the permanent molds to produce the desired contours of the molded parts.

Fig. 9 may be considered as an enlarged detail of the lower right-hand corner of Fig. 3, showing the position of the spring 16, lever 20 and pawl 22 when the door 3 is in its partially opened position, previously mentioned as the one to which the door swings when released by depression of the latch plate 9. The ratchet quadrant 24, pivoted at 201 upon the fixed member 202, is urged toward the pawl 22 by means of the spring 31, its position being determined by the stop 32 and by 29 being linked to 24 by means of the pin 204. As the door swings open, due to the initial stress of the spring 16, force is released for re-energizing the spring 16 to the extent indicated in Fig. 9, so that the pawl 22 is retained in the notch 23 of quadrant 24 and the door stands open at an angle of approximately 60°.

Should the user wish to have the door more fully opened, she pushes it open and the pawl 22 engages the notch 25 of quadrant 24, retaining the door in its fully opened position, as seen in Fig. 10. The spring 16 is now stressed to a greater degree than it was when the door was closed, so that when the user depresses the plate 9, thus moving the quadrant 24 out of engagement with pawl 22, the spring 16 causes the door to swing fully closed and be retained in that position by means of the latch member 14 engaging the striker 188. The user will naturally release the latch plate 9 just prior to the full closing of the door, so as to allow the latch 14 to retain the door in the closed position.

Referring to Fig. 11, which shows an enlarged detail of Fig. 2, it is seen that the ears 84 on the tank cover 56 carry a pin 210 pivoting thereto the member 212 to which one end of the rod 86 is rigidly attached. Likewise, a member 214 attached to the end of the tube 87 forms the support and stop for this tube with reference to the bracket 90, which is supported on the tank by means of the support 91. The left-hand end of the tube 87 is preferably tapered or chamfered, so as to allow free movement thereover of the coils of the spring 88. As the rod 86 slides within the tube 87 with movement of the cover 56, the spring 88 urges the cover 56 toward its closed

position, but the cover is here shown open and is retained in the open position by means of its rib 92 engaging the ears 94 of bracket 90. The form of this rib, the form of the ears 94 and the position of the line of contact between the cover 56 and the tank 55 when the cover is open are so related to the pivot point 210 and the action of the spring 63 that the cover will rest in the position shown in Fig. 11 regardless of the fact that the spring 88 is urging the cover toward its closed position.

In Fig. 11 we also see an end of the rocker 96 (seen in Fig. 3), which is in position to make contact with the cover 56 upon a slight movement of the rod 98. When the rocker 96 contacts the cover 56 and moves it so that rib 92 is no longer retained by the notches in the bottom of the ears 94, the spring 88 acts to complete the closing of the cover 56 on the tank 55.

Features shown in the drawings and not claimed herein form the subject matter of my application for Letters Patent of the United States, Serial No. 633,371, filed December 7, 1945, for improvements in Refrigerator, the same being a division of the present application.

I claim as my invention:

1. A cabinet, a door for said cabinet, latch means for retaining said door in its closed position, means for releasing said latch means, means acting to open said door partially from closed position and close said door from fully open position, and means for holding said door in an open position in opposition to the force of the last-mentioned means, the third-mentioned means being so constructed and arranged as to close and latch said door in response to the release of the last said means.

2. A cabinet including an outer door, a power element connected with said door to actuate the same, means for energizing said element in a direction to open said door partially from a closed position or in a direction to close said door from a fully open position, and means for latching said door in either closed or open position, manually actuated means for controlling the actuation of said door by said first mentioned means to moye said door from its closed position toward an open position or to move it from an open position toward its closed position.

3. A cabinet, a door for said cabinet, mechanical means for swinging said door in either direction power means for actuating said mechanical means, and manually actuated means located clear of the swing of said door at door level for controlling the action of the first two said means.

4. A cabinet, a door for said cabinet, mechanical means for swinging said door in either direction, power means for actuating said mechanical means, and manually actuated means located clear of the swing of said door for controlling the action of the first two said means.

5. A cabinet, a door for said cabinet, mechanical means for closing said door, power means for actuating said mechanical means, and manully actuated means located at door level for controlling the action of the first two said means.

6. A cabinet, a door for said cabinet, mechanical means for actuating said door, a power element for said means cooperable therewith to close said door from fully open position and to open said door partially from closed position, and manually actuated means for controlling said mechanical actuating means, said manually actuated means including a control element in the form of a plate conforming approximately to the form of an external face portion of said cabinet and located in close and approximately parallel relation to said face portion.

7. A cabinet, a door for said cabinet, a power element connected to said door for actuating the same in either its closing or opening direction, and manually actuated means for controlling said power element, said means including a control element located on a level with a portion of said door and clear of its swing.

8. A cabinet, a door for said cabinet, a power element for actuating said door, said power element being adapted to be energized by manual movement of said door in either direction beyond an intermediate position of opening, latching means for holding said door in closed position, and manual means for releasing said door from said closed position for actuation by said power element, said manual means including a plate conforming closely to the external form of the portion of said cabinet upon which it is located.

9. A cabinet, a door for said cabinet, power means operatively connected with said door operable to move it away from its opposite limits of movement, and manual means for controlling movement of said door under the effects of said power means, the last said means including a depressible member formed to simulate, when in normally inoperative position, an area of an exterior wall of the cabinet.

10. In a cabinet, a door, power means operably connected to said door for moving said door in either the opening or the closing direction from a closed or fully open position, respectively, and manually operable means controlling said power means, the manually operable means including a part providing a smooth surface for manual contact, said surface being located clear of the door swing and on a level with a portion of said door.

11. A refrigerator comprising an insulated storage space and a machinery compartment, a door for said space, energy means located in said compartment operatively connected to said door and operable to move said door from either a fully closed or a fully open position, a latch for holding said door closed in opposition to said energy means, and manual control means operable to release said latch, said manual control means including a control element exposed on the exterior of said refrigerator.

12. A cabinet, an outer door for said cabinet, latch means for holding said door closed, additional latch means for holding said door open, means operable to move said door toward open position upon release of the first-mentioned latch means and to move said door toward closed position upon release of the second-mentioned latch means, and means for controlling the first-mentioned latch means including manually operable means on a fixed outer wall of said cabinet.

13. A cabinet having an outer door, latch means adapted to hold said door in a sufficiently open position to permit ready access to the interior thereof, resilient means tending to close said door from a fully open position, and manually operable releasing means for said latch means, said manual means including a part located at elbow height on a fixed wall of the cabinet.

14. In a cabinet, a door for said cabinet, latch means for holding said door closed, spring means energized in the direction of opening said door when the door is closed, means for releasing said

latch means so that the door will be partially opened by said spring means, said door and spring means being so constructed and arranged that momentum imparted to said door in the initial stages of its opening by said spring means will partially re-energize said spring means in the direction of reclosing said door, additional latch means for preventing the reclosing of said door by said spring means, said additional latch means also being adapted for holding said door in

a wider open position with said spring means more fully energized after said door has been manually opened to said wider open position, said additional latch means being operable to allow said door to close, said spring means being sufficiently energized by said wider opening of the door to provide energy for fully reclosing said door and re-energizing said spring means as before in the direction of reopening the door.

GLENN MUFFLY.