J. S. FORBES.

REFRIGERATOR.

APPLICATION FILED MAR. 11, 1919.

1,377,824.

Patented May 10, 1921.

8 SHEETS—SHEET 1.

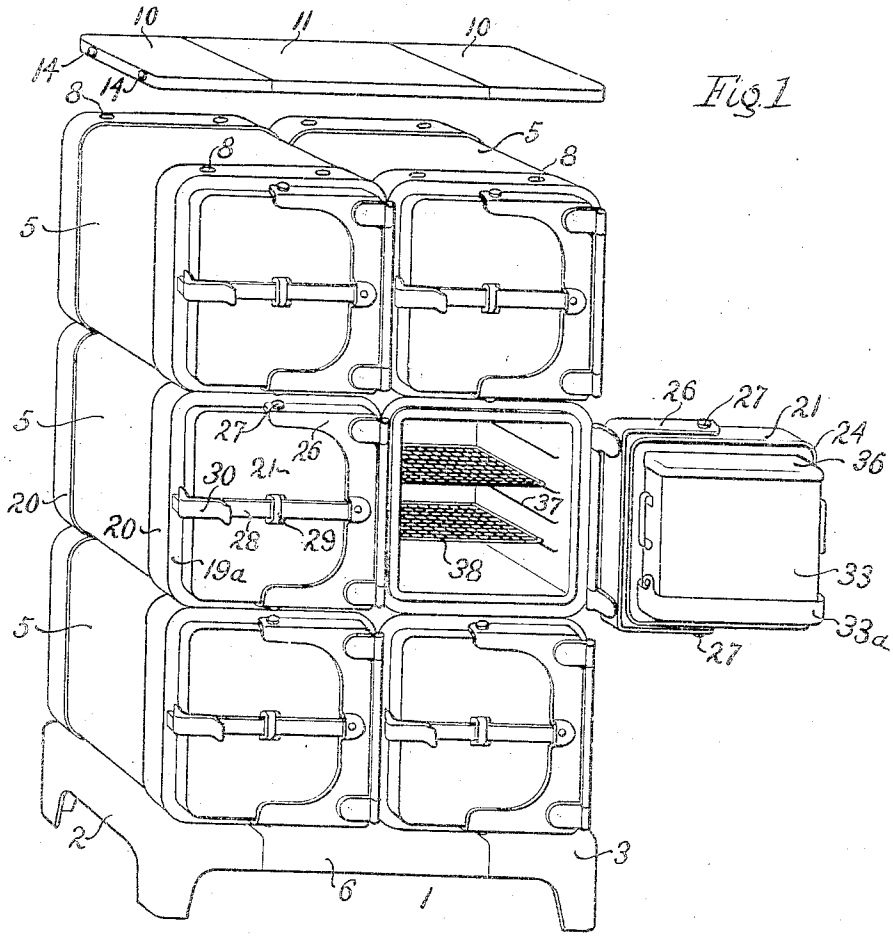


Fig. 1

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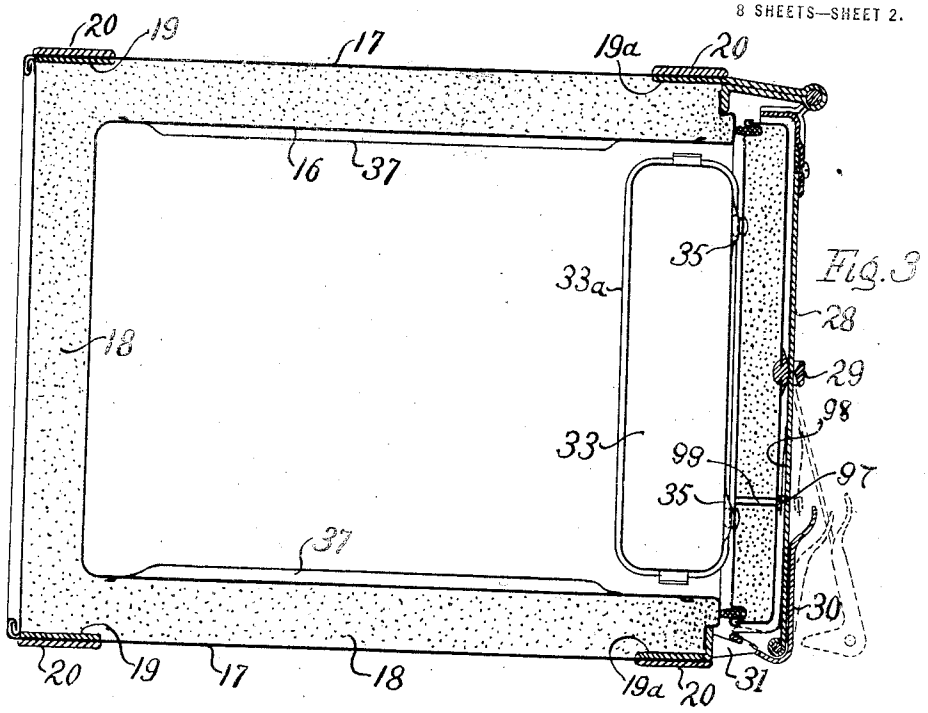


Fig. 3

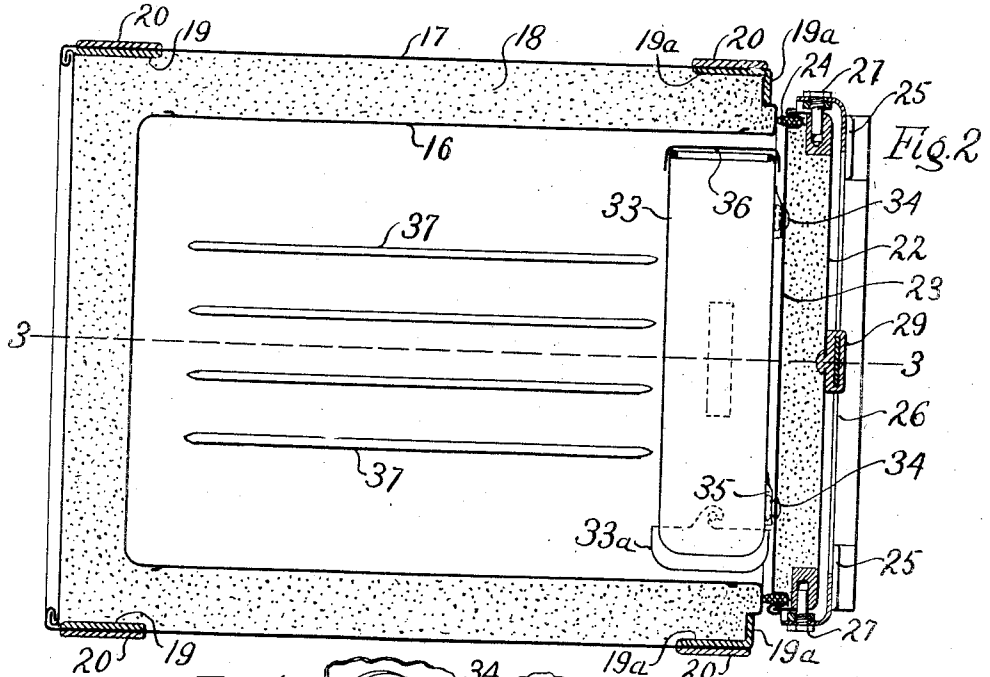


Fig. 2

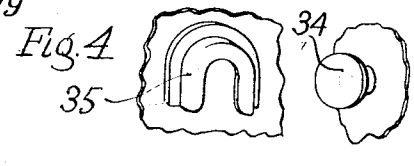


Fig. 4

Fig. 5

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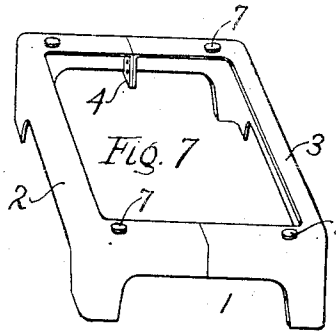


Fig. 7

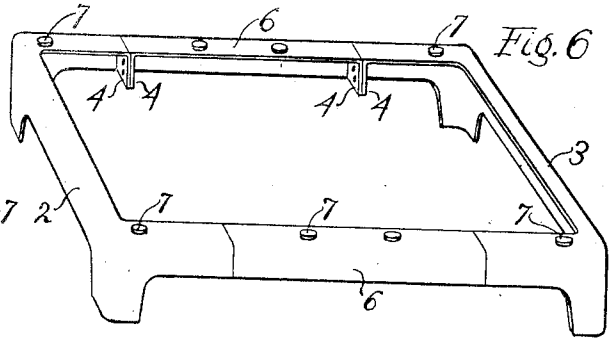


Fig. 6

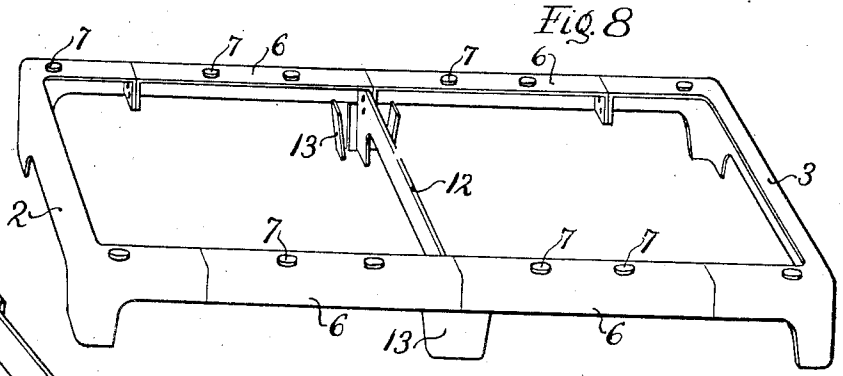


Fig. 8

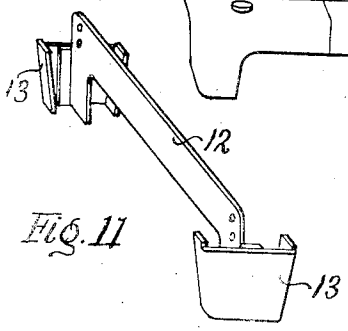


Fig. 11

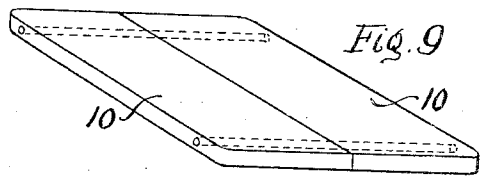


Fig. 9

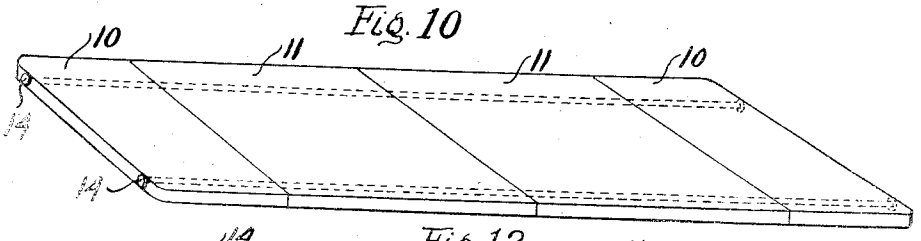


Fig. 10

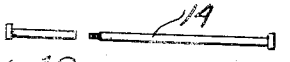


Fig. 12

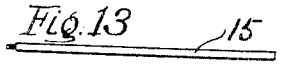


Fig. 13

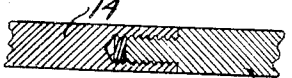


Fig. 14



Fig. 15

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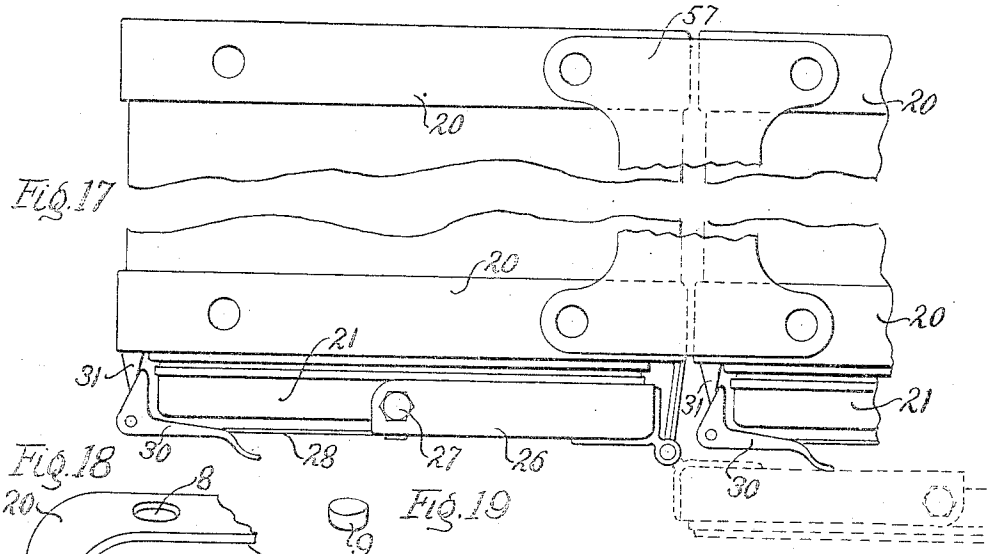


Fig. 17

Fig. 18

Fig. 19

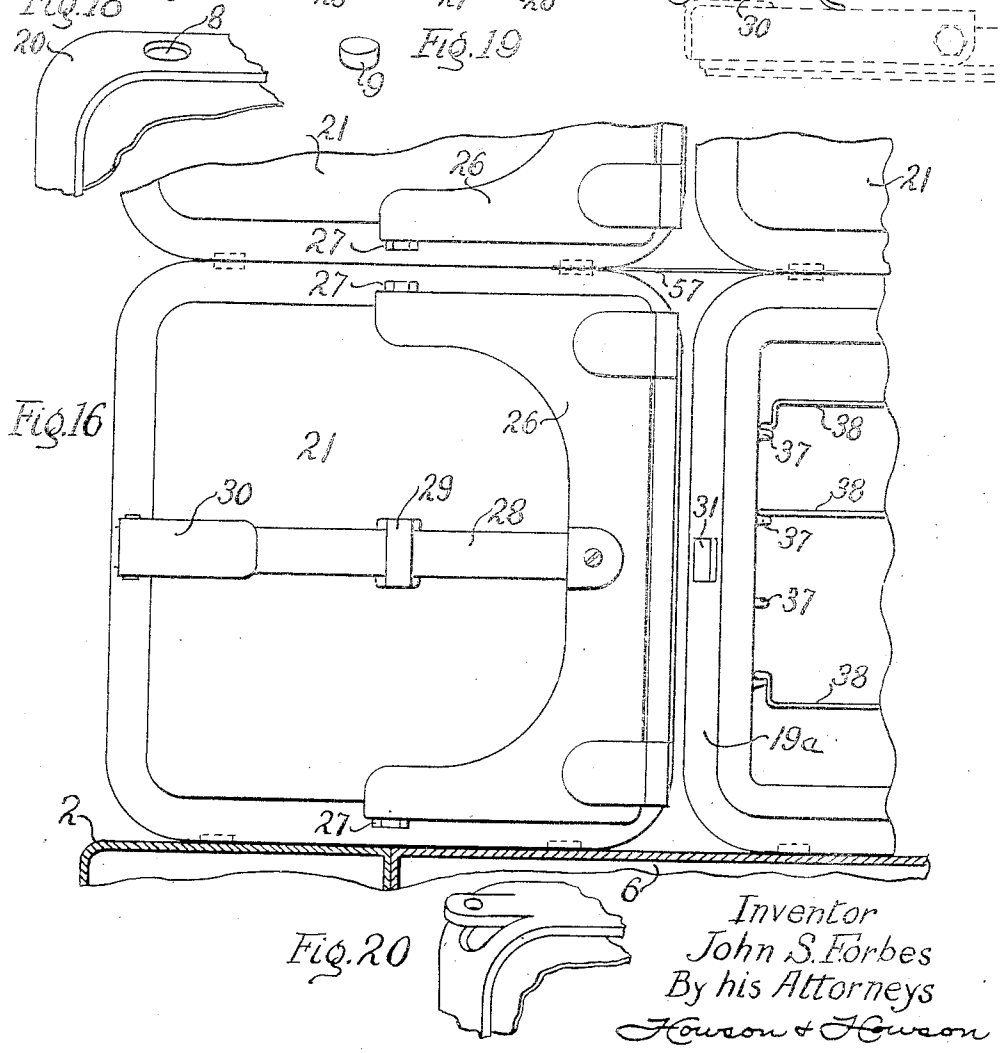


Fig. 16

Fig. 20

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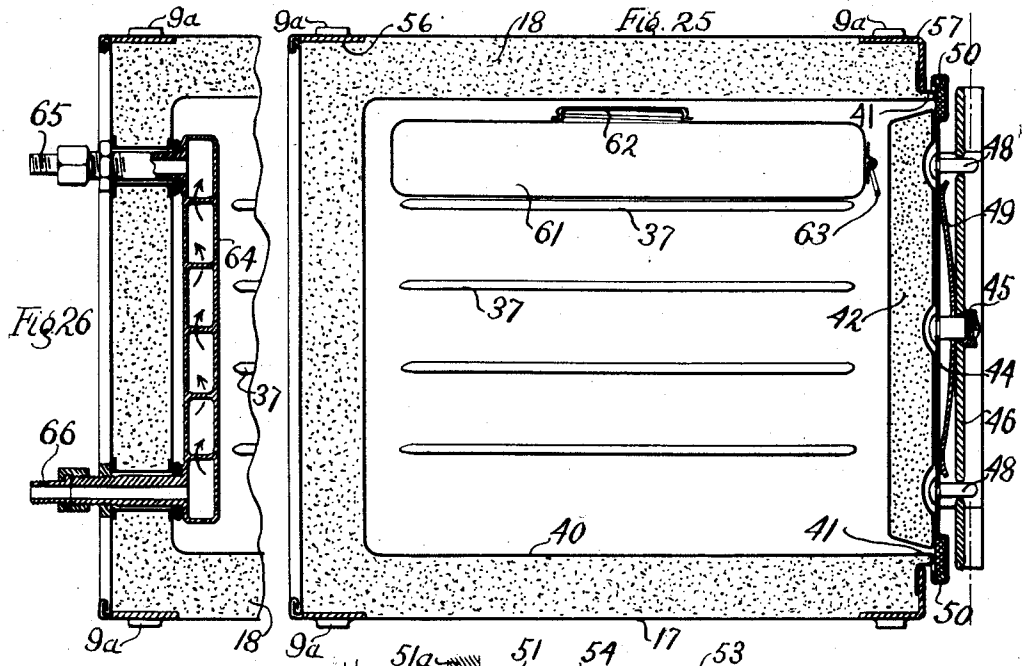
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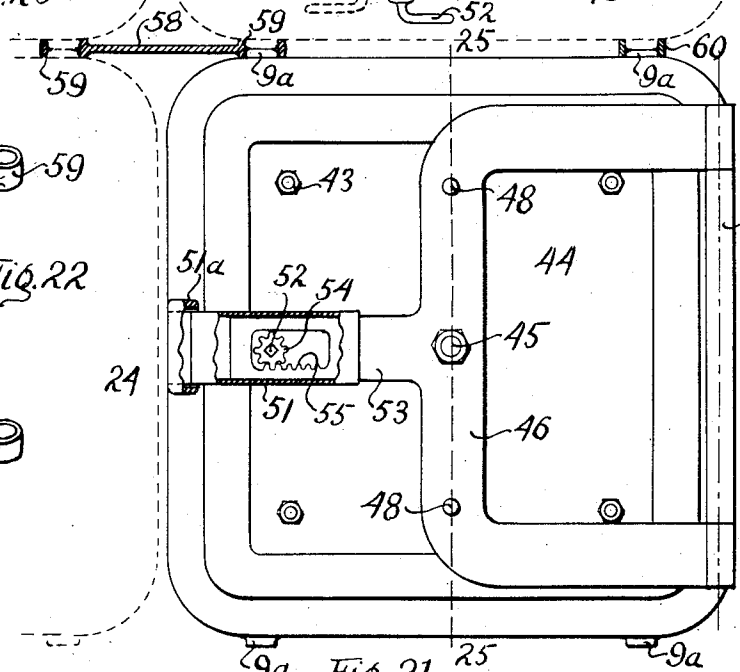
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1,377,824. **Patented May 10, 1921.**

8 SHEETS—SHEET 5.







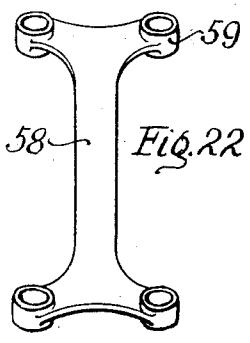


Fig. 21

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8 SHEETS—SHEET 6.

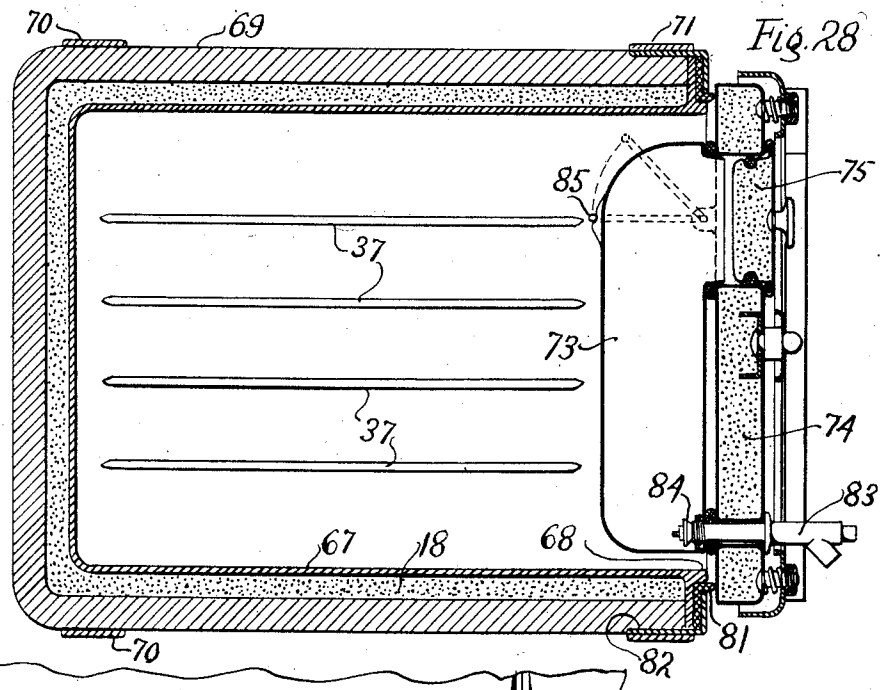


Fig. 28

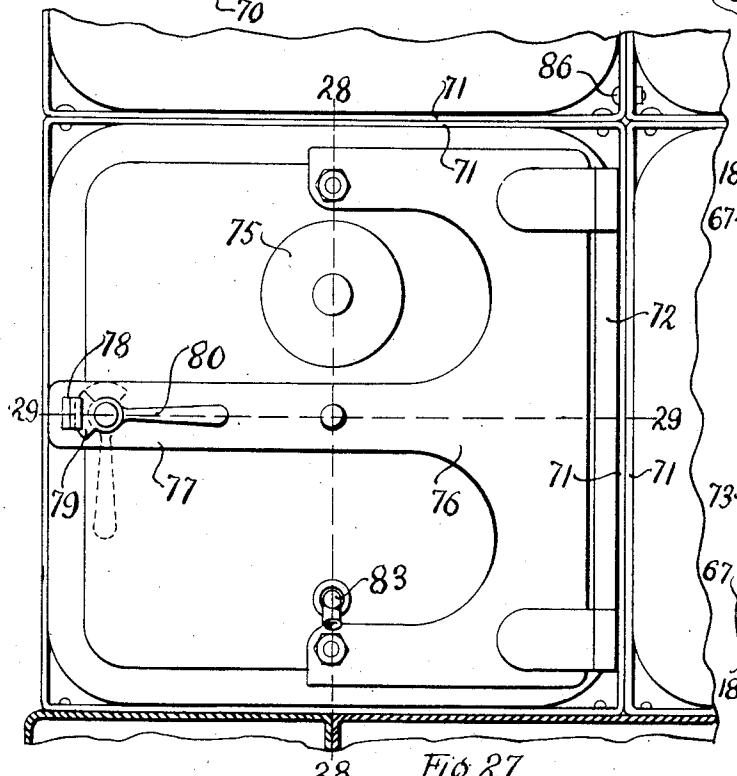


Fig. 27

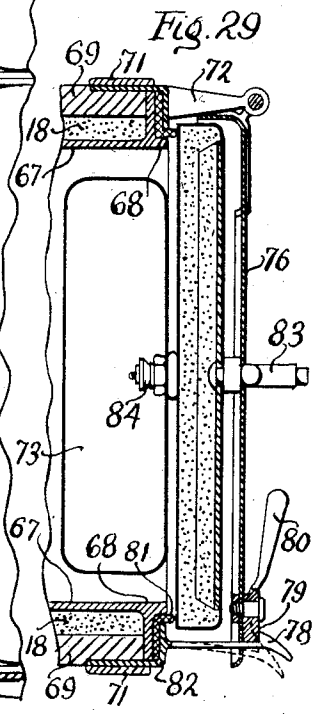


Fig. 29

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8 SHEETS—SHEET 7.

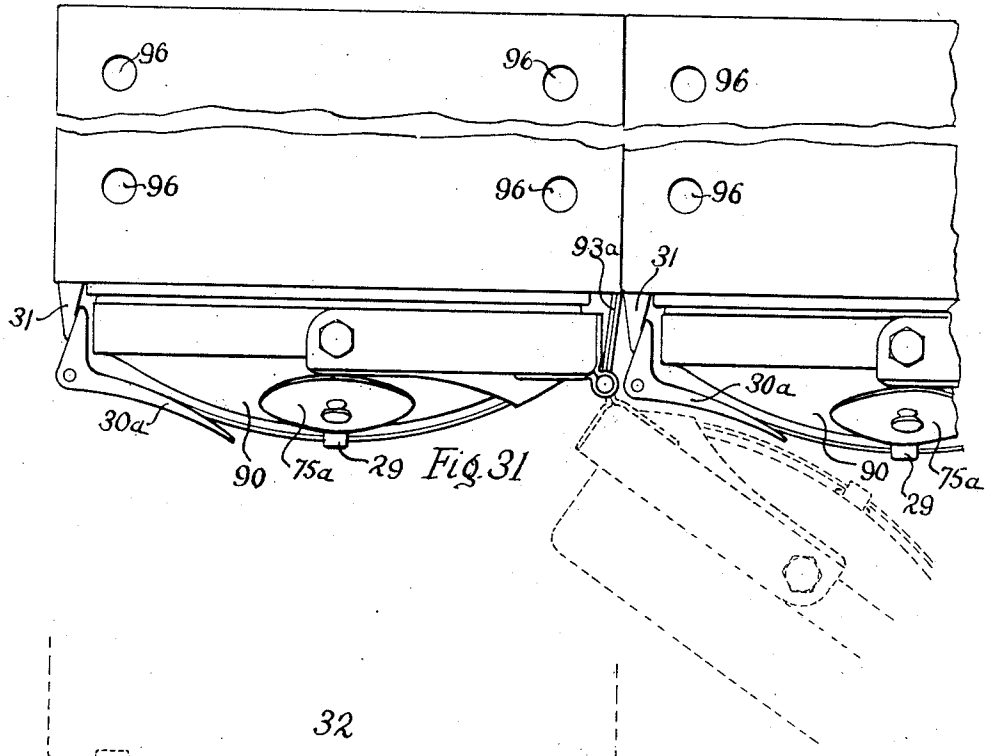


Fig. 31

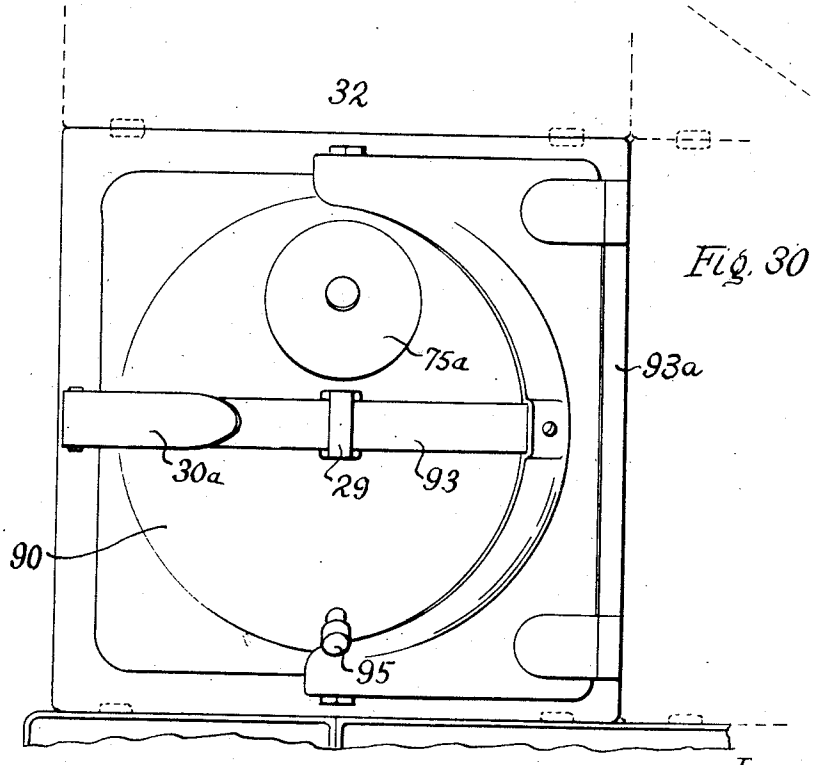


Fig. 30

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8 SHEETS—SHEET 8.

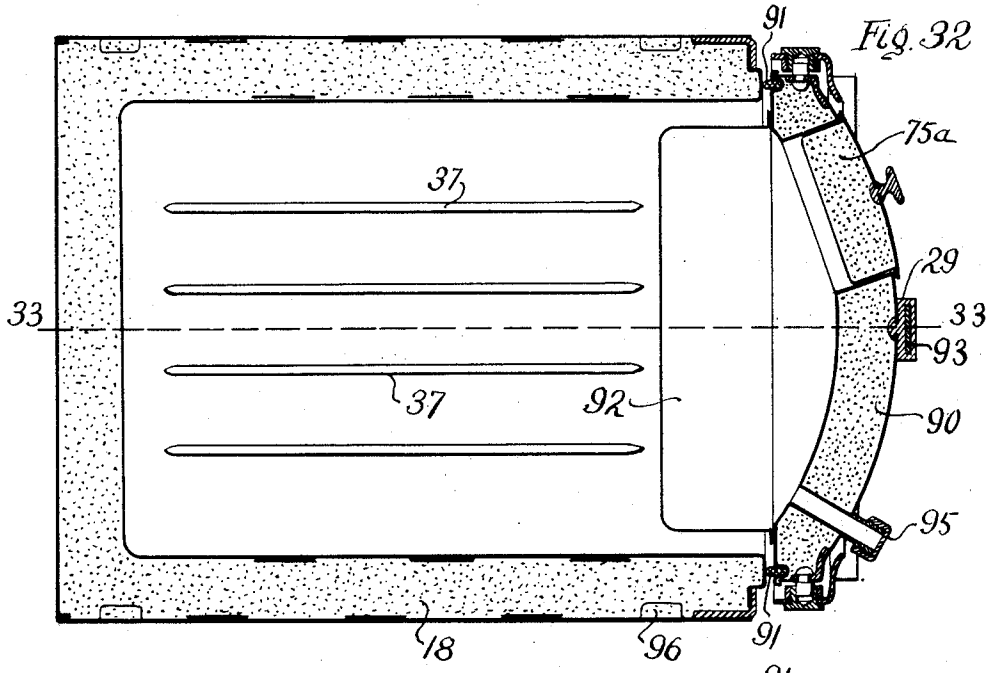


Fig. 32

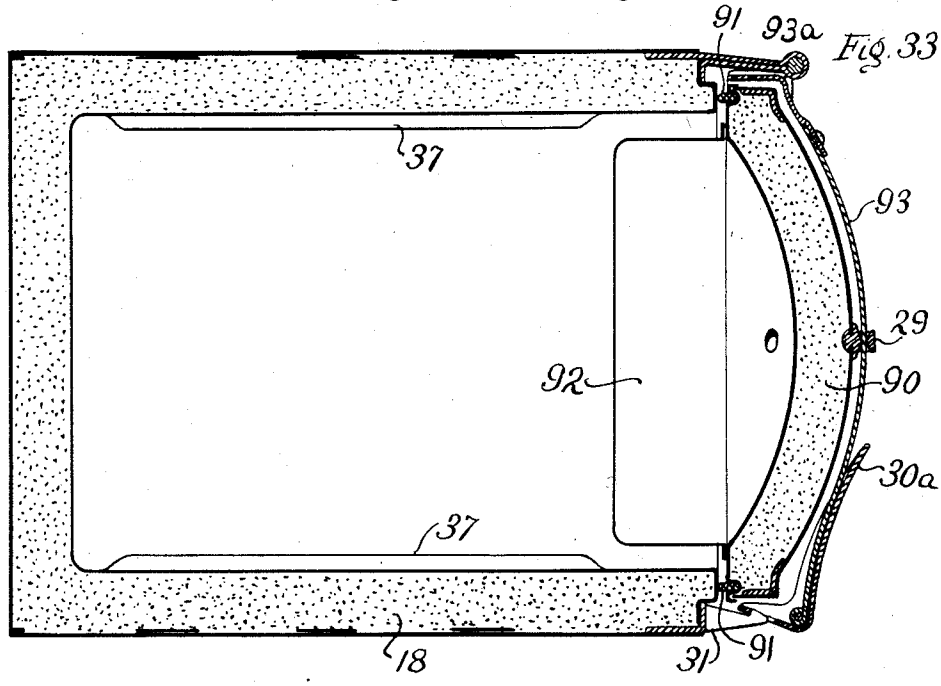


Fig. 33

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UNITED STATES PATENT OFFICE.

JOHN S. FORBES, OF PHILADELPHIA, PENNSYLVANIA.

REFRIGERATOR.

1,377,824. Specification of Letters Patent. Patented May 10, 1921.

Application filed March 11, 1919. Serial No. 282,012.

To all whom it may concern:

Be it known that I, JOHN S. FORBES, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented Refrigerators, of which the following is a specification.

One object of my invention is to provide a substantial, commercially practical form of household refrigerator whose detail construction and arrangement of parts shall be such as to permit of its form and capacity being indefinitely varied, for which purpose it is made to consist of a series of separably associated, functionally independent refrigerating cells;—the invention contemplating such an arrangement as will permit utilization of any desired fraction of the total capacity to the exclusion of the remainder with a corresponding decrease in the cost of operation as compared with that when all of the cells are employed.

A further object of the invention is to provide a novel form of refrigerator which, by reason of the isolated cellular construction characterizing its elements, shall effectually prevent the possibility of the material in one cell in any way affecting that in any of the other cells;—the invention further having to do with such an assemblage of parts as will permit of the convenient and economical removal and replacement of one or any desired number of the cells when these, by reason of excessive use or injury, shall become damaged or incapable of proper functioning.

Another object of my invention is to provide a refrigerator cell especially adapted for combination with other similar cells for the purpose of providing a refrigerator of variable capacity, particularly characterized by the ease and convenience with which its parts may be transported, assembled and arranged to suit it for use within spaces of varying forms and dimensions, the invention contemplating an arranemgement of cells of which certain may be made colder than others.

It is also desired to provide a refrigerator cell particularly adapted, by reason of its reversibility, for use in confined or otherwise inconvenient situations; the invention including a novel mounting for the ice container as well as a novel construction of door and latching means therefor.

Another object of the invention is to provide a novel form of frame structure and connecting means for holding together a number of independent refrigerating cells so that these shall coact to form a unitary refrigerator having an ornamental appearance and so constructed as to permit of the convenient use of certain of its cells to the exclusion of the others, with a resulting high degree of economy of operation.

These objects and other advantageous ends I attain as hereinafter set forth, reference being had to the accompanying drawings, in which,

Figure 1 is a perspective view of one form of my invention and showing the door of one of the cells open and the top retaining plate as detached from the body of the refrigerator for purposes of illustration;

Fig. 2 is a central vertical section taken from front to rear through one of the cells constituting part of my invention;

Fig. 3 is a horizontal section on the line 3—3, Fig. 2;

Figs. 4 and 5 are fragmentary perspective views of one form of separable holding device which may be employed for removably mounting the ice tank in the refrigerating cell;

Fig. 6 is a perspective view of the base frame for the refrigerator shown in Fig. 1;

Figs. 7 and 8 are perspective views of base frames for refrigerators having either one or three tiers or series of cells;

Figs. 9 and 10 are perspective views of top plates for such refrigerator structures as would employ the base frames shown in Figs. 7 and 8;

Fig. 11 is a perspective view of the tie structure employed for connecting the opposite sides of the base frame shown in Fig. 8;

Fig. 12 is an elevation of one of the tie rods used to connect the sections of the top plate;

Fig. 13 is an elevation of one of the intermediate sections for use with the parts of the tie rod shown in Fig. 12;

Fig. 14 is a fragmentary longitudinal section illustrating one form of connection for the sections of the tie rod;

Fig. 15 is a longitudinal section of one of the top plates taken through one of the tie rods thereof;

Fig. 16 is a fragmentary front elevation partly in section, illustrating certain detail features of my refrigerator;

Fig. 17 is a fragmentary plan of the structure shown in Fig. 16;

Fig. 18 is a fragmentary perspective of part of one of the refrigerator cells, showing the preferred construction for permitting it to be connected with a second similar cell or with the base frame or top plate;

Fig. 19 is a perspective view of a form of dowel which may be used to hold together the various parts of my refrigerator;

Fig. 20 is a fragmentary perspective view illustrating a slightly modified form of cell frame;

Fig. 21 is an elevation partly in section, illustrating a slightly modified form of refrigerating cell, together with a modified form of cell-connecting device;

Fig. 22 is a perspective view of one form of bracket or tie plate for holding the cells of two series from lateral separation;

Fig. 23 is a perspective view of one of the retaining collars for the reception of two superposed lugs in the modified form of cell construction shown in Fig. 21;

Fig. 24 is a horizontal section on the line 24—24, Fig. 21;

Fig. 25 is a vertical section on the line 25—25, Fig. 21;

Fig. 26 is a fragmentary vertical section similar to Fig. 25 showing a modified form of cell cooling device;

Fig. 27 is a fragmentary elevation, partly in vertical section, illustrating another modification of the invention;

Fig. 28 is a vertical section on the line 28—28, Fig. 27;

Fig. 29 is a fragmentary horizontal section on the line 29—29, Fig. 27;

Fig. 30 is a front elevation of another modified form of refrigerator cell;

Fig. 31 is a plan of the cell shown in Fig. 30;

Fig. 32 is a central vertical section on the line 32—32, Fig. 30; and

Fig. 33 is a horizontal section on the line 33—33, Fig. 32.

In the above drawings, 1 represents the supporting base of my refrigerator and this in its simplest form, may consist merely of two end sections 2 and 3, as shown in Fig. 7. These sections together form an open rectangular frame having feet at its corners and they are rigidly connected by bolts passing through two pairs of abutting flanges 4 respectively depending from the adjacent or coacting ends of the frame sections. In the particular case illustrated in Fig. 1 I have shown the refrigerator as including two tiers of independent refrigerating cells, so that the base of Fig. 6 is required, that of Fig. 7 being used when the refrigerator includes but a single tier of cells.

To suitably support the two tiers of cells I provide the frame shown in Fig. 7 with similar front and back extension pieces 6 of angle section and each having depending flanges 4 at its ends whereby it may be rigidly connected to the ends of the sections 2 and 3. Obviously any number of pairs of these may be used to provide a base for a refrigerator whose body is made up of more than two series or tiers of cells.

The body of the refrigerator consists of any desired number of complete independent refrigerator cells 5 arranged in vertical series of tiers and so made that while they are firmly held together to constitute a unitary structure, any one or more of them may be removed and replaced without injury to any of the others or interference with its functioning.

For holding the various series of cells in the desired relative positions, I form projecting pins or lugs 7 on the base sections and provide complementary recesses 8 in the adjacent portions of the cells 5 and where said cells rest upon each other I employ pins or dowels 9 which extend into the recesses of the top face of the lower cell and enter the similar recesses in the bottom face of the superposed cell. As shown in Fig. 1 the recesses may be formed in the reinforcing bands 20 or the latter may be pressed out to provide lugs in which said recesses are punched or dulled.

For covering and protecting the top of the body of the refrigerator and at the same time to assist in holding its cells from lateral separation, I employ a top plate formed of a suitable number of flat sections 10 and 11, of which those forming the ends 10 of the plate are similar and of a length substantially equal to one-half the transverse width of one cell. In the case of Fig. 1, which has two series of cells, a single intermediate plate section 11 is necessary and this has a length double that of one of the sections 10. For each additional tier or series of cells an extra intermediate cover section would be required, together with two additional intermediate base sections 6. When two or more pairs of these base sections 6 are necessary, I preferably support and tie them together by a cross member consisting of a tie bar having feet 13 and shaped to be bolted or riveted to the flanges 4 of the base sections. In order to further brace the several tiers or vertical series of cells against lateral separation I place a plate 57 between each two pairs of superposed cells and form it with holes for four dowel pins 9 which position said cells.

If but a single tier of cells 5 is employed in a particular refrigerator, the cover plate

is made up of the two end sections 10, which are rigidly connected by long bolts 14, embedded in and extending through them across the refrigerator, and each of these bolts is made in two parts which screw together. When, as in the case of the structure of Fig. 1, the refrigerator is two cells wide and requires one intermediate cover plate 11, each bolt is made up of the two end sections shown in Fig. 12, and an intermediate section 15, Fig. 13, which is suitably formed to be screwed to the same as illustrated in Fig. 14. Similarly a greater number of cover plate sections may be likewise connected and rigidly held together by the employment of additional intermediate bolt sections as shown in Fig. 15. In any case the complete cover plate is held in place over the top of the refrigerator body by the pins or dowels 9 which are carried by the uppermost cell or cells and enter suitably placed recesses in said plate.

In accordance with the preferred form of my invention, each of the refrigerator cells consists of a box or container of generally rectangular section (Figs. 2 and 3) formed of an inner casing 16 and an outer casing 17 surrounding but spaced away from the same, with a filling material 18 in the space between said casings. This material consists of a substance having poor heat conductivity, such as mineral wool, diatomaceous earth, spun glass, etc., and the two casings are preferably made of metal having the requisite stiffness and covered or suitably surfaced with protective and sanitary material such as enamel, though they may be made of porcelain, glazed earthenware or like substance without departing from my invention. The outer casing is encircled by stiff reinforcing bands 19, 19ª and 20, arranged in pairs at the front and back of the cell, one band of each pair being mounted within the casing and the other being on the outside thereof, in line or overlying the inner band. The recesses for the dowels 9 are preferably formed in the outer one of the bands of each pair and both of the latter may be fixed in position by any suitable means, as by riveting or welding.

The inner band 19ª at the front end of the cell is inwardly flanged and on one side is formed to receive a pin or pintle for the hinge of a closure or door 21 formed by two spaced and suitably connected sheets or plates 22 and 23 having the chamber between them filled with the same non-conducting material as that between the casings 16 and 17. This door has a ring or strip of packing 24 set in and positioned upon its inner face for engagement with the adjacent flat face of the front end of the cell and it is so supported by or upon its hinge as to be free to adjust itself relatively to the cell body so as to form a sealed or substantially hermetic joint therewith. For this purpose in accordance with one form of my invention, the hinge members 25 for connection with the door form part of or are connected to a U-shaped plate 26 having side flanges extending over the top and bottom edges of the door, to which they are pivotally and more or less loosely held by pins or trunnions 27;—the arrangement being such as to permit said door to swing or turn on its pivot as well as to yield in order that its packing ring 24 may come to a full continuous bearing upon the adjacent face of the cell so as to provide a substantially hermetic seal.

In order to firmly press and yieldingly maintain the door in its sealed position I provide a spring strip 28, fixed at one end to the plate 26 and passing through a bracket 29 mounted at or adjacent the center of the outer face of the door from which it extends to a point adjacent the free side of said door where it has pivoted to it a hooked handle 30. The turned over end of the latter is slotted for the reception of a hook 31 mounted on the adjacent face of the casing encircling band 19ª and the long arm of the handle (Fig. 3) is turned outwardly to permit it to be easily grasped. Said handle is so combined with the spring strip 28 as to normally tend to move into the position shown in dotted lines, so that when it is pulled outwardly to release it from the hook 31, the door is swung into a partially open position after such release, the act of pulling outwardly on the handle to open the door thus serving to free it from the hook as well as to swing it toward the open position. At the same time, when the handle is engaged with the hook 31, the packing ring is tightly engaged with the face of the cell body for its entire length and the chamber of the latter is sealed.

For cooling the cell I preferably employ an ice containing can or tank 33 removably hung on the inner face of the door 21 from headed lugs or pins 34 (Fig. 5) fixed to the inner plate 23 thereof, for which purpose said tank has on its outer face forked brackets or equivalent members 35 (Fig. 4). The preferred form of tank is flat and of generally rectangular outline and it has a cover 36 preferably tight fitting. The side walls of the inner casing 16 of the cell are formed with a number of horizontal ribs 37 on which may be supported shelves or trays 38.

With the above described arrangement and construction of parts it will be seen that I may utilize any desired number of the separate and independent refrigerating cells to build up a single unitary refrigerator whose capacity shall be dependent on such number and whose base frame and cover plate are assembled to suit the particular form and capacity required. The cells are arranged in vertical series or tiers held to-

gether and firmly supported as described and it will be noted that not only the number of the tiers of cells may be varied to secure any desired capacity, but the number of cells in each tier or series may likewise be altered to provide a refrigerator elongated either horizontally or vertically.

Under conditions of use one of the vital advantages of my invention is due to the fact that any one of the cells may be put in service, its tank filled with ice and its contents removed and replaced without in any way affecting any of the others of the cells, thus insuring that a substance or body in one cell cannot in any way affect the materials in the other cells. Moreover, since it is thus possible to use certain cells to the exclusion of others, it is possible to place all of those materials which are frequently desired for use in a cell situated in a position in the refrigerator where it may be most conveniently opened and utilized while the other cells need not be opened at such short intervals. As a consequence, there is a material economy in the amount of ice required since but a relatively small fraction of the cold air in the refrigerator escapes when one cell is opened and the temperature of air and materials in the remaining cells is not affected. By reason of the construction described it is possible to reverse the position of certain or all of the cells by turning them on a horizontal axis through an angle of 180° so that the doors will open oppositely to that shown and thus adapt the refrigerator for use in a position where it would ordinarily be impossible to open said doors. Obviously any cell may be iced independently of the others in which for any reason the rate of melting is different and in case it should be desirable to change the capacity of the refrigerator, this may be done with the utmost ease by adding to or subtracting from the number of its cells.

If by reason of the cooling of the air in the cells there should be formed a vacuum which would prevent the easy opening of the doors, I may provide a passage 99 through the latter and normally close this as long as the door is closed by means of the cap 97 carried on a spring strip 98 mounted on the spring member 28 so that by the outward movement of the latter occurring when the handle is drawn outwardly, the cap is forcibly pulled from over the opening to the passage 99 and air is admitted to the cell thereby breaking any vacuum.

In Figs. 21, 24 and 25 I have illustrated a refrigerating cell whose detail construction is slightly different from that shown in the preceding figures, particularly in so far as the construction of its door or closure is concerned. In this instance the inner casing 40 is formed to provide a projecting rib or lip 41 so placed as to extend around or define its opening and the body 42 of the door is designed to fit against said rib. This door body is held by a series of bolts 43 to a metal plate 44, which by means of a bolt 45 is more or less loosely or movably connected to the hinge plate 46 pivoted to the suitably formed hinge member 47 on the cell body. Also projecting outwardly from the door plate 44 are two pins 48 vertically above and below the connecting bolt 45 and these extend loosely through the hinge member 46 between which and the plate 44 is mounted a flat spring 49 tending to press apart the door body 42 and the hinge member 46.

The periphery of the outer portion of the door plate 44 is suitably flanged and turned upon itself to provide a holder for an annular body of packing 50 so positioned as to engage the lip or rib 41 on the cell body, when the door is moved to its closed position. As before the engagement of this packing with the cell body in such manner as to form a substantially hermetic seal is insured by reason of the yielding connection between the hinge member 46 and said door, for when the latter is moved to its closed position it is free to adjust itself to bring the packing for its entire length into engagement with the cell body. In this case I form the hinge member 46 with a flat extended portion on which is slidably mounted a latch or bolt 51 designed to engage a keeper 51^a on the front face of the cell body. This latch has journaled in it the spindle portion of a handle 52 on which is fixed within an elongated recess in the extension 53 a pinion 54. One edge of this recess is toothed as indicated at 55 so as to coact with the pinion, with the result that when the latter is rotated by a turning of the handle the latch 51 is moved longitudinally on said extension into or out of engagement with the keeper 51^a.

From Fig. 24 it will be noted that the outer end of the latch is preferably beveled or inclined in such manner that its point or edge is just able to enter the recess of the keeper 51^a when the door is held shut with its packing 50 engaging the rib 41. Thereafter if the latch 51 be forced outwardly by further turning of the handle 52, its inclined face in entering the keeper forces the door farther toward or more closely into engagement with the rib or lip 41, thus insuring a tight joint therewith. In this form of my invention I have shown the outer casing 17 of the cell as having but two reinforcing bands 56 and 57 encircling its front and back portions and welded or otherwise fixed to said casing.

The dowels or lugs for preventing lateral displacement of the cell when combined with its base structure and with other cells are illustrated as also welded to the outer cas-

ing 17 as indicated at 9ª and where in that form of the apparatus shown in Figs. 1 and 16 I have provided a flat plate 57 connecting the dowels of two adjacent tiers of cells for preventing their lateral separation, I may if desired, substitute for such plate an I-shaped member 58 (Figs. 21 and 22) having projecting lugs 59 at its corners each designed to receive the dowel projections 9ª of two superposed refrigerating cells. For positioning the outer portions of these cells relatively to each other, collars or bushings 60 are provided and these have a height equal to that of the tubular portions of the lugs 59 and like them each is designed to receive the two vertically alined dowel projections 9ª of a pair of superposed cells.

Instead of supporting the ice receiving tank on the door, it may in some cases be formed as a flat box container 61 having a cover 62 and designed to be slidably supported by a pair of opposite shelf ribs 37 within the top of the cell chamber, there being a handle 63 on its outer end for facilitating its manipulation. Obviously without departing from my invention, such a cooling device as that shown in Fig. 26 may be substituted for the ice tanks of the other forms of said invention and in such case I mount at the back of each cell chamber a hollow plate or flat vertically placed container 64 having through it a tortuous channel or passage and provided at its top and bottom with inlet and outlet pipes 65 and 66 through which brine or other cooling agent may be caused to flow. Suitable means are provided whereby tight joints are provided between the refrigerator body and the cooling element 64 or pipes 65 and 66.

In Figs. 27 to 29 I have shown another and relatively less expensive form of refrigerating cell also adapted for combination with any desired number of other similar cells to provide a unitary refrigerator having the characteristics above described. In this case the inner casing 67 is shown as made of thin cast iron projected at the front end of the cell in the form of a sealing lip 68 and outwardly flanged, the outer casing 69 being preferably formed of wood reinforced at the front and back by encircling bands or strips 70 and 71. Between the two casings heat insulating material such as diatomaceous earth, asbestos, spun glass or the like is packed and the door, which as before is hinged to a member 72 so as to have limited relative movement, carries an ice tank 73 removably held in place and designed to be filled through an opening in said door structure 74. This opening is normally closed tightly by a plug or cover 75 which upon removal permits of the introduction of ice to the tank 73 without opening of the door and escape of the cool air from the cell. The body of the door as before is movably mounted on a hinge member 76, having an extension 77 perforated for the reception of a hook 78 on the cell body and the latter is designed to be engaged by a cam 79 on a rotary handle 80 to cause the flat face of the door to form a substantially hermetic seal with a body of packing 81 confined between the flange of the casing 67 and an inwardly extending flange on one of the encircling bands 82 of the body itself.

If it be desired to utilize the water in the ice tank 73 for drinking purposes, I provide an outlet pipe 83 extending through the door 74 into the bottom of said tank which is removably held in place by a nut 84 threaded on the inner end of said pipe and by a swinging bail 85 pivoted to the inside of the door and capable of being moved into or out of holding engagement with the top of said tank. In this case the various cells may be rigidly though separably connected both vertically and horizontally by bolts 86 extended through the adjacent parallel portions of the reinforcing bands 71.

In another modification of my invention shown in Figs. 30 to 33 inclusive, the door 90 has a substantially spherical curvature and is provided with a packing ring 91 set in that portion of its face which comes adjacent the flat end or front of the cell body. A sheet metal structure 92 is so mounted on the inner face of the door as to form an ice tank, which as before projects into the chamber or hollow of the cell and which, as in the case shown in Figs. 27 to 29, is designed to be supplied with ice through an opening in the upper part of the door, which opening is normally closed by a lid or cover 75ª. As in the case shown in Figs. 2 and 3, the door is hung from a hinge member 93 pivoted to a second hinge member 93ª carried by the body, the parts being suitably curved to suit them for coöperation with the spherically curved door.

A drainage or outlet pipe 94 leads through the door from the lower portion of the ice tank, and has its outer end normally closed by a screw cap 95 which may be removed when it is desired to draw off the water. In this form of the invention I have shown the top and bottom faces of the cell body as having recesses 96 for the reception of the positioning dowel pins 9, and obviously this form of cell, like the others illustrated, is especially adapted for combination with any other number of similar cells to provide a unitary refrigerating apparatus characterized however by the possession of a number of refrigerating chambers each provided with its independent cooling means which in this last instance, is designed to be supplied with ice through an opening in the door without permitting escape of cool air from or the entrance of warm air to said chamber.

If there should be a collection of water upon and a dripping from the ice tanks 33 owing to the condensation upon them of moisture from the air I may provide a pan 33ª supported in any desired manner as from the tank itself in which such water may collect and from which it may be emptied or drained when necessary.

I claim:—

1. A refrigerator consisting of a series of structurally independent complete refrigerating units having substantially similar opposite faces adapting them for varied relative arrangement vertically and horizontally and each having independent cooling means, the normally exposed exterior of the unitary structure formed by a group of said units being made up of the directly exposed outer surfaces of the units themselves.

2. A refrigerator consisting of a series of structurally independent complete refrigerating units each having independent cooling means and a directly accessible door-controlled opening, the several units having substantially similar opposite faces adapted for varied relative arrangement vertically and horizontally and all the units having their openings in substantially the same vertical plane.

3. The combination in a refrigerator, of a plurality of independent containers each having an opening with a sealing closure, said containers having substantially similar opposite faces adapting them for inversion and varied relative arrangement vertically and horizontally; means for holding said containers together in a unitary structure, with their openings all in the same plane; and a separate cooling device for each of said containers.

4. The combination in a refrigerator of a series of structurally independent refrigerating cells each having an opening and a vertically hinged door therefor; independent cooling means for each of said cells; and means for holding the cells together to form a unitary structure, each of the cells having similar opposite faces to permit of its inversion when it is required to alter the direction in which its door shall open.

5. The combination in a refrigerator of a base structure of relatively low height; a series of functionally independent refrigerating closed cells mounted on said base structure and having similar opposite faces adapting said cells for inversion and ready interchange of position, said cells being separably connected one to the other and their combined outer walls forming the exterior of the unitary refrigerating structure; and an independent cooling device for each cell.

6. A caseless refrigerator having a separable base member of relatively low height and a plurality of structurally independent refrigerating units each having its own icing chamber and door controlled inlet, said units having substantially similar opposite faces permitting the units to be inverted and assembled in different relative positions vertically and horizontally.

In witness whereof I affix my signature.

JOHN S. FORBES.