Dec. 6, 1938. D. C. CLARKE 2,139,441

REFRIGERATOR

Filed July 1, 1933 4 Sheets-Sheet 1

Fig. 1.

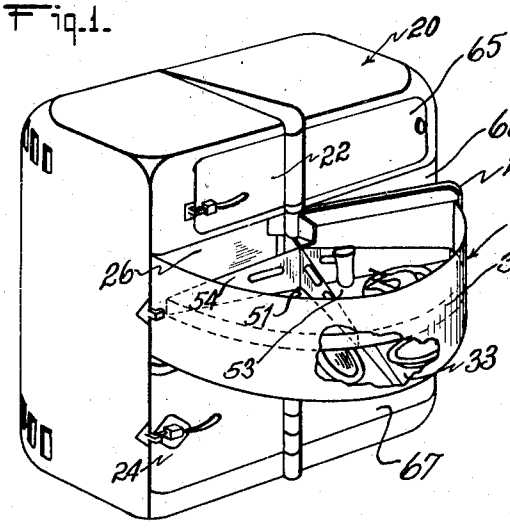


Fig. 2.

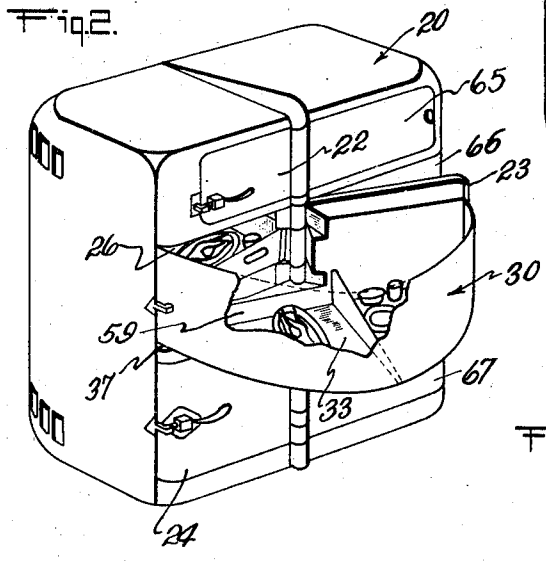


Fig. 3.

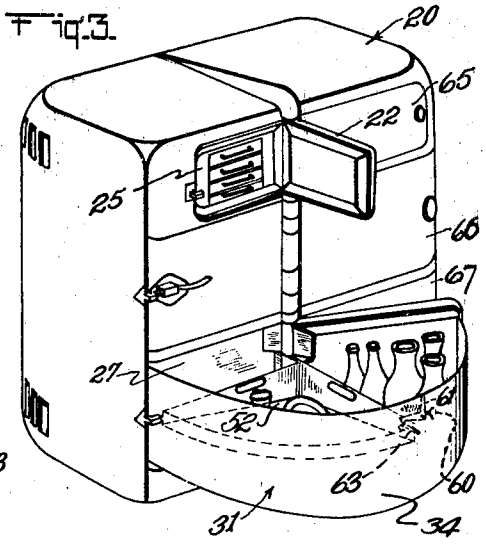
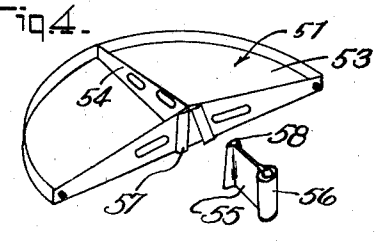


Fig. 4.



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Dec. 6, 1938. D. C. CLARKE 2,139,441

REFRIGERATOR

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Fig. 5.

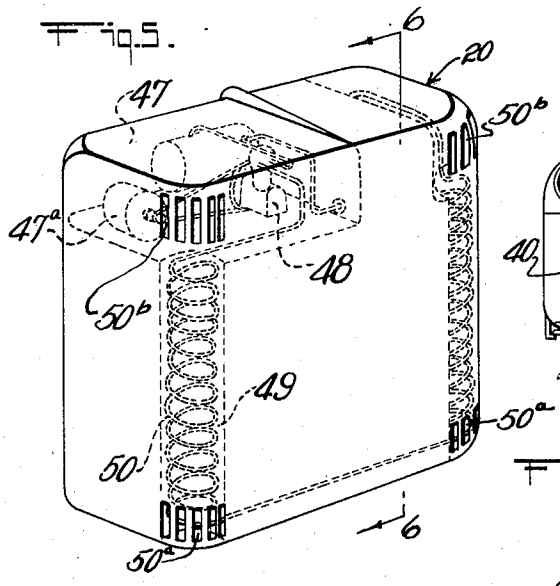


Fig. 7.

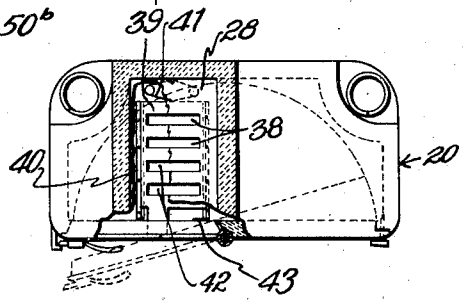


Fig. 8.

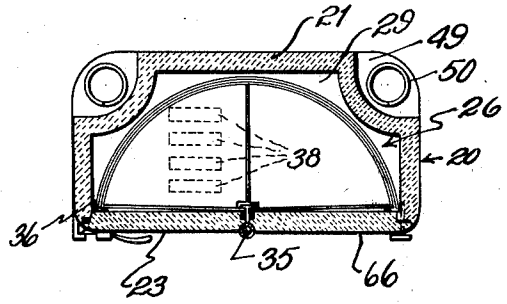


Fig. 6.

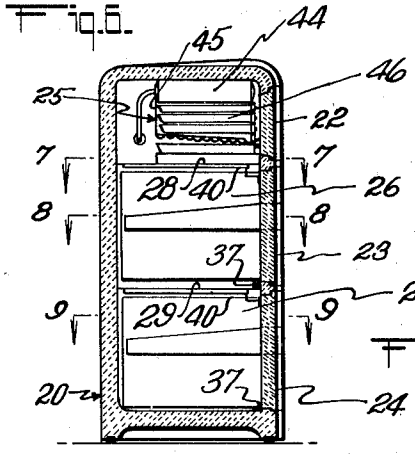
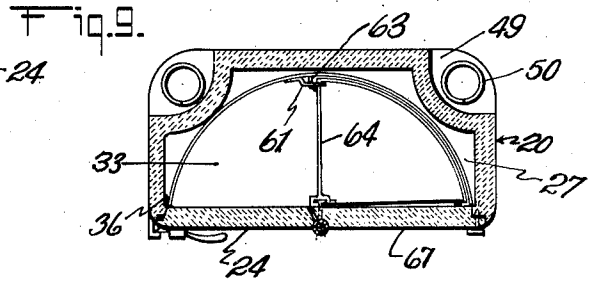


Fig. 9.



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REFRIGERATOR

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Fig. 10.

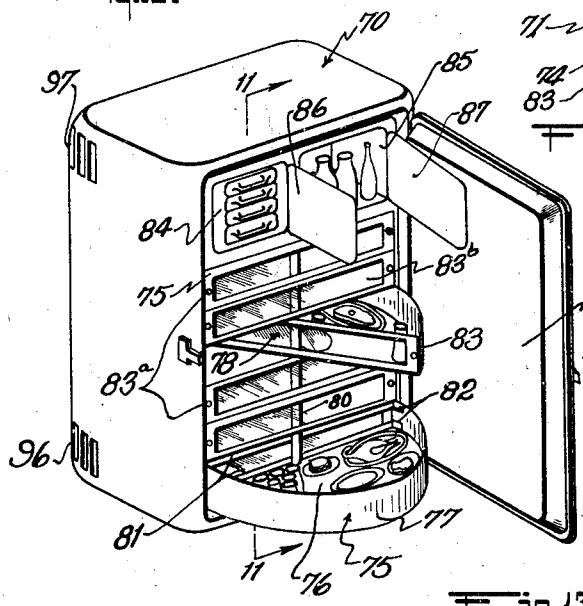


Fig. 12.

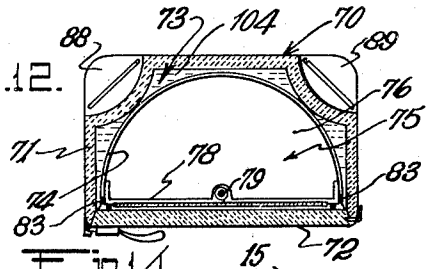


Fig. 14.

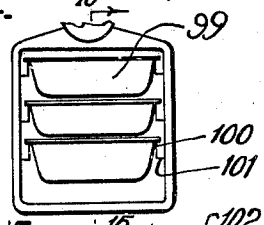


Fig. 15.

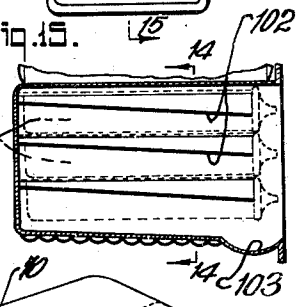


Fig. 13.

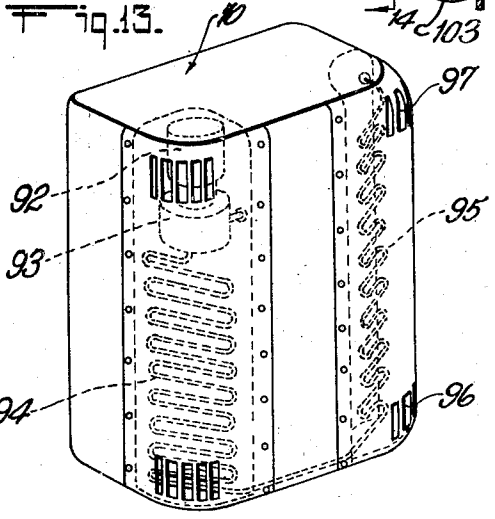


Fig. 11.

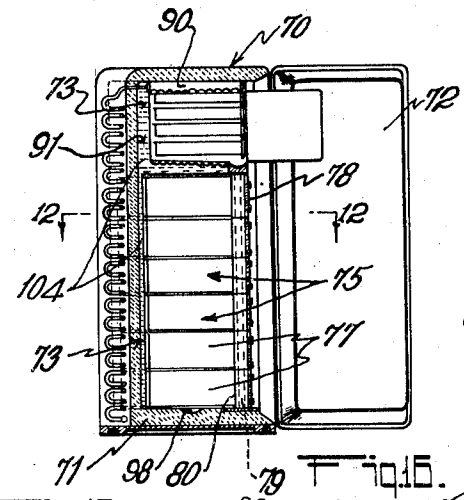


Fig. 16.

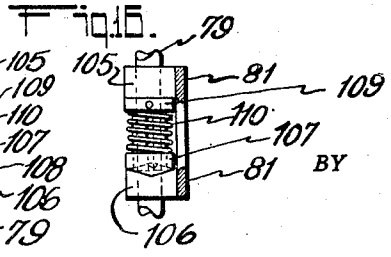
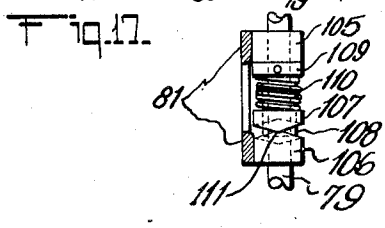


Fig. 17.



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REFRIGERATOR

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Fig. 18.

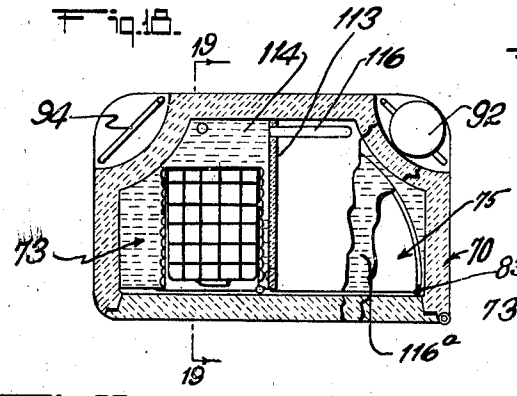


Fig. 19.

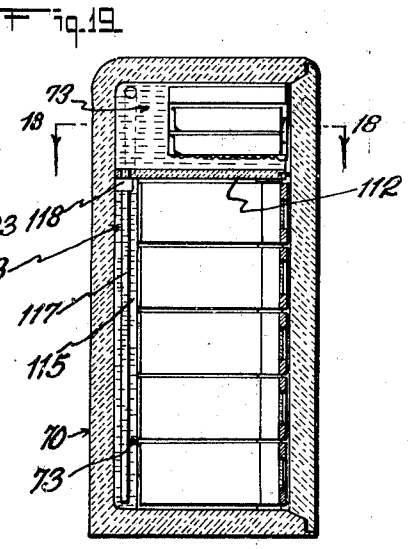


Fig. 20.

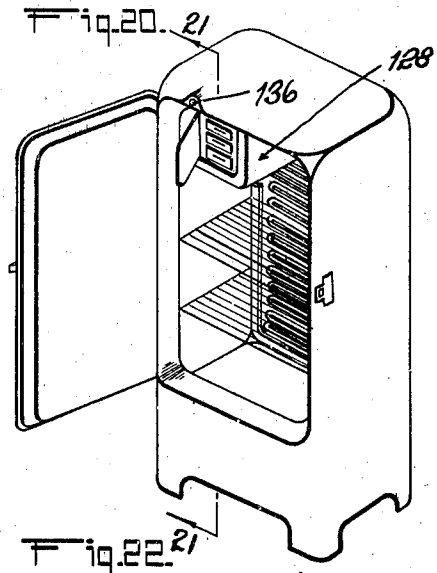


Fig. 21.

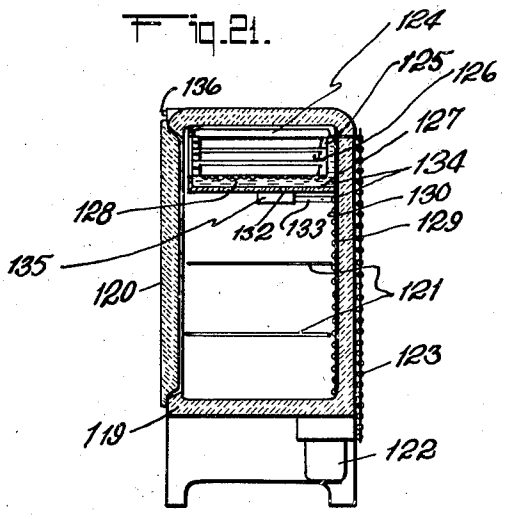
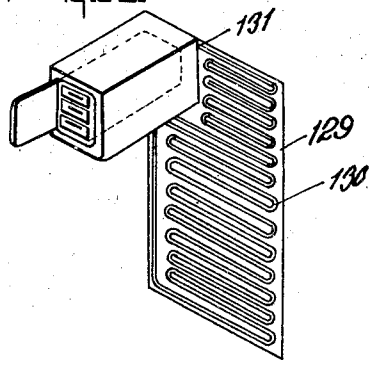


Fig. 22.



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Patented Dec. 6, 1938 2,139,441

UNITED STATES PATENT OFFICE

2,139,441

REFRIGERATOR

Douglas C. Clarke, Mountain Lakes, N. J., assignor to Edgar Alfred Self, New York, N. Y.

Application July 1, 1933, Serial No. 678,603

21 Claims. (Cl. 62—89)

This invention relates to refrigerators and more especially to refrigerators for domestic use.

An object of the invention is to provide a refrigerator which will conserve the cold air to an unusually large extent.

A further object is the provision of a refrigerator from which articles may be removed with a particularly high degree of ease and efficiency.

A still further object is the provision of a refrigerator which is particularly well adapted for household use.

An additional object is the provision of a refrigerator which can be economically manufactured and assembled, which has an attractive appearance, in which the available space is efficiently utilized, and which will effectively carry out the purposes for which it is intended.

Still another object is the provision of a refrigerator adapted for the efficient transfer of heat from the air chamber to the cooling unit in an indirect manner.

Another object is the provision of automatic refrigerators wherein freedom from frosting and dehydration problems may be obtained.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises an article of manufacture possessing the features, properties, and the relation of elements which will be exemplified in the article hereinafter described and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a perspective view of one form of refrigerator embodying the invention, showing one of the box-like trays with its associated supplemental tray both in outward position;

Fig. 2 is a similar view showing the supplemental tray in inward position;

Fig. 3 is a similar view showing the other box-like tray in outward position;

Fig. 4 is a detail perspective view of the supplemental tray shown in Fig. 1 and its mounting means;

Fig. 5 is a rear perspective view with the operating mechanism dotted in;

Fig. 6 is a vertical sectional view along the line 6—6 of Fig. 5;

Fig. 7 is a horizontal sectional view along the line 7—7 in Fig. 6, with certain parts broken away to reveal the details of the valve means;

Fig. 8 is a horizontal sectional view along the lines 8—8 of Fig. 6;

Fig. 9 is a similar view along the lines 9—9 of Fig. 6;

Fig. 10 is a perspective view of another form of refrigerator embodying the invention, showing one tray in an outward position and another tray partly projecting;

Fig. 11 is a vertical section along the line 11—11 in Fig. 10;

Fig. 12 is a horizontal sectional view along the line 12—12 of Fig. 11;

Fig. 13 is a rear perspective view with the operating mechanism dotted in;

Fig. 14 is a detail end view of the ice-cube trays in the ice-cube compartment;

Fig. 15 is a longitudinal sectional view along the line 15—15 of Fig. 14;

Fig. 16 is a sectional detailed view from a point just to the left of the pivot rod at Fig. 10 showing in detail a special form of mounting for the trays of Fig. 10;

Fig. 17 is a view similar to Fig. 16 showing the parts when the tray is in an outward position;

Figs. 18 and 19 are horizontal and vertical sectional views respectively of a modified form of the refrigerator shown in Figs. 10 through 15, Fig. 19 being a transverse section along the line 19—19 of Fig. 18;

Fig. 20 is a perspective view of still another form of construction embodying the invention;

Fig. 21 is a transverse section along the line 21—21 of Fig. 20; and

Fig. 22 is a perspective view of the cooling and heat-transfer portions of the construction shown in Fig. 20.

In ordinary refrigerators, particularly refrigerators designed for household use, the opening of a door permits the cold air contained in the refrigerator to pour out and hot air to move in. So marked is the rush of cold air from the refrigerator that a ribbon positioned near the bottom of the door will be blown outwardly by the flow. Since a household refrigerator is opened several times during the preparation of even a single meal, it will be seen that a large quantity of ice or power is required to constantly cool off the hot air which replaces the previously chilled air.

Another objection to the ordinary type of refrigerators lies in the fact that in the usual household refrigerator the contents remain wholly within the casing, and in order to be removed must be individually lifted and withdrawn, so that in order to lift out an article in the back

of the refrigerator, several articles in the front of the refrigerator must first be removed.

With the foregoing and other difficulties in view, the present invention contemplates the provision of a refrigerator having individual box-like, air-retaining trays which can be moved, preferably on a pivot, from the casing to permit ready access to all the contents thereof, and the provision of constructions of such nature that each box-like tray, either alone or together with a compartment which contains it, provides a basin for the retention of the cold air which was contained in the tray when it was within the refrigerator. The invention further contemplates the provision of a refrigerator wherein no flow of cold air from an upper tray to a lower tray can occur when the lower tray has been moved outwardly. Such outward flow of cold air would naturally result in a compensating flow of hot air into the upper tray and/or its compartment, and would further result in the wastage of a large quantity of cold air which would be pushed out of the lower tray as it was closed. In accordance with the invention, the flow of cold and warm air between several trays and/or compartments when a tray is moved outwardly may be prevented either by the provision of continuously acting flow-preventing means or by the provision of means for closing an upper opening when a lower door or tray is moved outwardly.

The invention also contemplates the provision of various features of construction whereby the operation, appearance or contour of a refrigerator may be enhanced. Among such features are the provision of trays which are adapted to be swung substantially 180° so as to project a minimum amount with respect to their capacity; the provision of trays which may be swung outwardly in either direction; the provision of supplemental trays whereby the holding capacity of one of the box-like trays may be increased; the location of various parts of the mechanism in the rear corner portions of the refrigerator; the provision of improved holding means for ice cube trays, etc.

The tendency toward condensation and frosting with accompanying dehydration of the contents of the refrigerator and necessity for defrosting is likewise a serious drawback to present day automatic refrigerators; and with these and other problems in view, the invention further contemplates the provision in a refrigerator arranged for the indirect cooling of an air chamber, of a liquid which will transfer heat in an especially effective and efficient manner; and the provision of a refrigerator with indirect cooling means so arranged as to maintain continued freezing temperatures in one compartment and normal refrigeration temperatures in another compartment.

In the drawings there are illustrated two of the many forms of refrigerators which may be constructed in accordance with the invention. The exemplified forms are particularly adapted for household use, and are of the electrically-operated type. It will be understood, however, that the invention is adapted for use with a wide variety of types of refrigerators.

The form of refrigerator exemplified in Figs. 1 through 9 includes a casing 20 which is generally rectangular in shape, and an enclosing body of insulating walls 21 including doors 22, 23 and 24. The door 22 opens into an ice cube compartment 25, the door 23 into a food compartment 26 and the door 24 into a food and bottle compartment 27. A plate 28 separates the compartments 25 and 26, and a plate 29 separates the compartments 26 and 27. The doors 23 and 24 form respectively a part of the box-like trays 30 and 31, each having a bottom wall 33 and an arcuate wall 34. The trays are mounted on a centrally disposed vertical rod 35, so that as a door is opened the tray of which it forms a part is swung outwardly. The trays in the present instance are semi-circular and the doors are adapted to swing through an arc of substantially 180°. Sealing means 36 and 37, which may be composed of rubber, are provided on the casing tightly to seal the space between the casing and the walls 33 and 34 of the trays when they are in an outward position. It will accordingly be seen that as either of the trays is swung outwardly the cold air in the tray-containing compartments cannot escape, but tends to settle into a basin provided by the bottom of the tray and the bottom of the compartment. The top of the tray and the compartment receives warm air from the outside, but the difference in temperature of the two layers of air will ordinarily be sufficient to prevent any considerable mixing until the door is again closed, when the closing action will result in pushing out of the tray a large part of the warm air which is contained in the upper part of the tray and compartment and in pushing out only a small part of the cold air which was originally contained in the compartment. Accordingly, there is a very marked saving in cold air and a relatively slight need for re-cooling after the opening of a door or the removal or deposit of an article from or in the refrigerator.

If the compartments are permanently sealed one from another, there will, as will be evident, be very little loss in he cold air from the refrigerator. However, it is often preferable from an economical standpoint to cool the entire refrigerator directly by the flow of air from a single cooling unit, and to this end the plates 28 (Fig. 7) and 29 (Fig. 8) are provided, in the present instance, with openings 38 (Fig. 7); the plate 29 being disposed sufficiently below the bottom wall of the tray 30 so that cold air may flow under the tray to the openings. In order, however, to prevent the warm air which flows into the top of a compartment when the tray is opened from replacing the cold air in the compartment above it, means are provided to close the opening above a tray at the beginning of the outward swinging movement of the tray. The particular mechanism exemplified in Fig. 7 comprises valve plates 39 riding in tracks 40. Each plate is pressed outwardly by a spring 41 and is formed with openings 42 adapted to register with the openings 38 when the door is closed. The outward movement of the plates 39 is limited by stops 43 at the ends of the tracks so that when the tray is opened the openings 42 will be in non-registering position as indicated in Fig. 7. By this means all flow of air between an upper and a lower compartment is prevented when a tray in the lower compartment is in outward position, whereas a free flow of air through the refrigerator is permitted when the doors are closed. It will be apparent that there is no need of sealing the space between the compartments 26 and 27 when the tray 30 is in outward position, since the cold air in the compartment 27 will not rise and the bottom of the tray 31 and the compartment 26 will still serve as a basin for the retention of the cold air which was originally therein.

The compartment 25 contains an expansion unit 44, portions of which surround supporting means 45 for ice trays 46. These ice-cube trays are preferably mounted by means such as illustrated in detail in Figs. 14 and 15. In a chamber 47 at one side of the compartment and outside of the insulation 21, there is disposed in the present instance a motor 47a and a compressor 48. In ordinary refrigerators, this space is made large enough to contain also a condenser unit or else the condenser unit is disposed outside of the casing. In the present instance, however, space is conserved by disposing condenser coils in the corner space 49 as indicated at 50 (see Fig. 5). If desired, and as hereinafter exemplified, other portions of the operating mechanism may be disposed in such space. By the provision of openings at the top and at the bottom of the chambers 49, a very efficient cooling of the condenser coils may be obtained due to the induced draft through the vertical chambers over the coils. Vent openings may be formed in the bottom, top or side walls of the casing as desired. In the present instance, openings 50a are provided in the side of the casing for admitting the air into the bottom of the chambers 49, and openings 50b are provided in the side of the casing for the escape of air from the top of these chambers. These corner chambers provide a large amount of space for the condenser means, which permits a particularly efficient cooling, and tends to reduce the frequency of the periods wherein the motor must be operated.

In order to reduce the number of compartments in the refrigerator, it is desirable that each tray have considerable depth. Since, however, the ordinary contents of a refrigerator are not particularly high, the invention includes as one of its features the provision of supplemental trays which, in the exemplified construction, provide an extra floor above the floor of each box-like tray. A supplemental tray 51 is provided in the box-like tray 30, and a supplemental tray 52 is provided in the box-like tray 31. The tray 51 is semi-circular in shape and comprises a floor 53 and bracing members 54, which are, in the present instance, suitably perforated to make handles for the removal of same. The tray is mounted upon an arm 55, carrying a sleeve 56, which extends about the pivot rod 35 so that the tray may be swung inwardly and outwardly with ease. In order to permit the tray 51 to be removed so as to clean the compartment 26, or so as to permit the high articles to be placed in the tray 30, the tray 51 is removably mounted on the arm 55 by means of a socket portion 57 adapted to fit over a wedge-shaped member 58 on the arm 55. It may be noted in this connection that the bracing members 54 serve to completely surround the floor of the tray 51 so that any liquid spilled on this floor will not flow back into the compartment but may be readily cleaned from the floor 53 of the tray. Similarly, the trays 30 and 31 are provided with guard rails 59 which, together with the walls 34, and the doors, serve to prevent materials spilled in these trays from running off on the floor thereof. As will be seen, the tray 51 swings independently of the tray 30, so that it may be left within the compartment, as indicated in Fig. 2, to permit the articles on the floor of the tray 30 to be removed, or may be swung outwardly, as shown in Fig. 1, to permit articles on the floor of the tray 51 to be removed. The tray 52 is similar to the tray 51, except that it is only half the size thereof. It is permits half of the tray 31 to be used as a bottle retainer, as indicated in Fig. 3. The tray 52 is normally held in the far end of the tray 31 by means of a catch mechanism 60, including a latch 61. When the tray 31 is moved outwardly the tray 52 moves outwardly with it, but may be pushed back into the compartment 27 upon the release of the latch. The box-like tray 31 is provided with a small arm 63, which limits the outward movement of the tray 52 and pushes the tray 52 into the far end of the compartment 27 when the door 24 is closed. The tray 52 is provided with strengthening members 64 similar to the strengthening members 54, and is removably mounted on an arm similar to the arm 55.

If desired there may also be provided doors 65, 66 and 67 opening respectively to the chamber 47, to the far side of the compartment 26, and to the far side of the compartment 27, so as to permit ready access to the chambers in question for the purpose of repair, cleaning, etc.

The form of refrigerator exemplified in Figs. 10 through 15 includes a casing 70, which is generally rectangular in shape, and an enclosing body of insulation 71 and an insulating door 72. Within the enclosing body 71 is a chamber 73 for a suitable cooling fluid which may be air, brine or other suitable fluid, but which is preferably a liquid of the type hereinafter exemplified. The inner wall 74 of the chamber 73 is formed of highly conductive material, such as sheet metal, and is semi-cylindrical in shape to provide a space for the accommodation of a plurality of semi-circular trays 75. In the present instance, these trays are closely juxtaposed and are each formed with an imperforate bottom wall 76, an upstanding imperforate semi-cylindrical wall 77, and an upstanding imperforate diametrical wall 78. Each tray thus forms a unit for retaining cold air. Egress of air from this unit can occur only over the top thereof, so that there is a minimum tendency for cold air therein to be displaced by hot air above the same.

Each tray 75 is mounted on a centrally-disposed vertical pivot rod 79 by means of a sleeve 80. This sleeve is mounted on the upstanding wall 78 of the tray. The wall 78 is desirably provided with re-enforcing means 81, preferably carrying bracing tabs 82 which are secured to the semi-cylindrical wall 77. Suitable ball-bearing means may be provided between the individual trays and roller bearings between the sleeves and the pivot rod, if desired. As will be seen, each tray 75 can be swung in either direction about its pivot so that pressure on either end thereof will initiate an outward swinging movement, which can be completed by drawing out the other end. Desirably, rubber friction members 83 are provided on the inside of the wall 74 so as to assist in setting the trays evenly within the refrigerator to permit the closing of the door 72, and so as to resist movement of the tray beyond a 180° position, so that the outward swinging movement will not automatically carry the tray back into the refrigerator. Rubber cushion members 83a are provided on the front walls of the trays. As will be seen, each tray provides, in itself, a basin for the retention of cold air. As the tray is pushed outwardly in either direction, warm air from the outside follows it in. This air, however, is pushed out when the tray is again closed, so that the only loss is through such slight chilling of this air as may occur during the short time when the tray is in an outward position. The air which is in the tray loses some of its chill, as by radiation, etc., while the tray is pulled out. In order to

permit the contents of the trays to be readily viewed when door 72 is opened each tray 75 is provided with a transparent window 83b.

In the present exemplification there is provided an ice cube compartment 84 and a bottle compartment 85, which are provided with individual doors 86 and 87, respectively. These compartments may be of any desired depth depending on the amount of space required for the operating mechanism. In the present instance they are of such depth as to permit corner portions 88 and 89, which are provided between the casing 70 and the insulation 71, to be extended upwardly to the top of the refrigerator. In the present instance, the entire operating mechanism is included in these corner spaces, an expansion chamber 90 being provided about the compartment 84 and a chamber 91, which communicates with the chamber 73. This mechanism comprises a motor 92 and a compressor pump 93, as well as condenser coils 94 and 95. Openings in the casing at these corner portions are provided as shown at 96 and 97 to permit a draft of air to flow over the mechanism. As above indicated, such a construction provides for efficient and economical operation, as well as for the economical utilization of space.

It is to be observed that since the chamber 73 is sealed, no condensation problems arise in connection therewith, and since the temperature of the fluid in chamber 73 is higher than the temperature of the fluid in the expansion chamber, and since a very small amount of hot moist air enters the refrigerator when it is opened, the tendency for condensation to form in the tray compartment is minimized. Such condensation as occurs may be caught in a sump 98, from which it may be removed when necessary. Ordinarily the temperature of the fluid in the chamber 73 will be kept higher than the freezing point of water, and in such case none of the frosting which has proved so troublesome in the ordinary refrigerator can occur. Furthermore, the marked tendency for dehydration which is a serious drawback in ordinary electric refrigerators is not present.

The ice cube trays 99 are mounted on edge supports 100, carried on members 101, forming a forwardly-inclined gutter 102. Any liquid spilling from the trays runs down the gutter and is collected in the sump 103, from which it may be readily removed by a cloth.

An additional feature of the invention resides in the provision, in a refrigerator having an air chamber and an elevated cooling unit, of improved means for cooling the air chamber. Such means as contemplated by the invention is an enclosure which embodies a wall of the cooling unit and a wall of the air chamber and which provides a completely enclosed heat transfer chamber containing a liquid of a particularly desirable type. One form of such construction is exemplified in Figs. 10 through 15, though it is to be understood that this feature as broadly contemplated by the invention is adapted for use in refrigerators wherein the air chamber, the trays therein, the cooling unit, the freezing unit, etc., are of any well known or suitable type. In the present exemplification the chamber 73 is nearly filled with a liquid 104 which has a freezing point lower than the temperature at the wall of the cooling unit and which has a large change in specific gravity between the normal upper temperature in the air chamber and the normal temperature of the freezing unit. For instance, when SO_2 is the gas utilized in the freezing unit, the liquid 104 should have a freezing point lower than 14° F. and should have a high degree of change in specific gravity between this temperature and 50° which embrace the normal temperature range of the air chamber. The liquid utilized should likewise be one which will not corrode the walls of the chamber, and, preferably, one which is relatively non-explosive so that it will not be dangerous if any leaks in the chamber should occur during operation.

Ethylene glycol (which is readily obtainable on the market as under the trade name "Prestone"), either alone or in admixture with water, is particularly desirable for this use. Pure ethylene glycol has a low freezing point (10° to 12° F.), has a change in specific gravity with temperature which is about twice that of water at ordinary refrigeration ranges, is a non-electrolytic compound which will not attack metal, and has good surface-wetting qualities which promote the rapid transfer of heat thereto from the back wall of the refrigerator and from it to the cooling unit. As is well known, most mixtures of ethylene glycol and water have a still lower freezing point than pure ethylene glycol,—a mixture containing 3 parts of water and 97 parts of ethylene glycol having a freezing point as low as —47° F.,—and have other desirable qualities of pure ethylene glycol in a high degree. In the event that the use of ethylene glycol, or mixtures containing it, is for any reason undesirable, various other liquids may be used, as, for example, mixtures of glycerin and water, methyl alcohol and water, ethyl alcohol and water, pure alcohols, diethylene glycol, suitable oils, etc. For instance, a mixture of 70 parts of glycerin and 30 parts of water has a freezing point of —38° F. and a good cubical expansion (i. e., a high change in specific gravity with temperature), and a mixture of 71 parts of ethyl alcohol and 29 parts of water has a freezing point of about —60° F. and a good cubical expansion.

In instances wherein more positive means than the members 83 are desired to assure that the trays are properly centered in an inward or in an outward position, these members may be supplemented or replaced by other suitable mechanism. One form of such mechanism is shown in Figs. 16 and 17. In this form of construction the diametric wall of the tray carries an upper sleeve 105 and also a lower sleeve 106 which is in the form of a cam with its upper surface inclined downwardly to the left of Fig. 10. Above this sleeve is a cam member 107 having a similarly inclined lower surface. This cam is vertically keyed on an extension 108 of an annulus 109 which is fixed to the pivot rod 78. The member 107 is resiliently held in a downward position by a spring 110 so that, as the tray is swung toward an inward position, the pressure of the spring on the member 107 will tend to center the sleeve 106 so as to bring the right and left-hand edges of the tray flush with the normal base of the refrigerator. In order to hold the trays in a fully accessible outward position, the sleeve 106 is formed with a detent 111 in which the lowermost point of the member 107 fits, as shown in Fig. 17, when the tray is in an outward position. It is to be noted that as soon as the tray is given a slight movement inwardly, the cam member 107 under the influence of the spring 110 will swing the tray around to a fully inward position.

A distinctly annoying feature in present-day automatic refrigerators is the necessity for defrosting at frequent intervals. The construction

shown in Figs. 10 through 15 eliminates all necessity of defrosting, since even if the liquid 104 reaches a temperature so that frosting will occur, the frost will disappear when the liquid returns to its normal higher temperature.

In many instances, however, it is desirable to maintain a low temperature in the ice-cube chamber for a long period of time, as throughout a hot summer day to provide ice cubes in quantity, and the invention contemplates the provision of a refrigerator wherein ice cube production may be maintained as desired without unduly cooling the air chamber of the refrigerator and without tendency toward undesirable freezing of the contents of the air chamber.

In Figs. 18 and 19 there is shown a modified form of the construction shown in Figs. 10 through 15, wherein such results are accomplished. In this construction insulating walls 112 and 113 are provided to divide the heat-transfer chamber 73 into a liquid-containing chamber 114 about the ice-cube compartment and the expansion unit, and a liquid-containing chamber 115 at the rear of the trays. Conduits 116 and 117 are provided for connecting respectively the tops and bottoms of the chambers thus formed, to provide for the circulation of fluid. A portion of the chamber 115 extends under the bottle compartment, as shown at 116a. In the conduit 117 there is provided a valve unit 118 which includes a thermostatic device of any well-known or suitable type, disposed in the fluid contained in the chamber 115. This valve is normally arranged to be closed and is arranged to be opened only when the temperature of the liquid in the chamber 115 rises above a degree at which it should efficiently cool the air chamber containing the trays. If ethylene glycol or other low-freezing-point liquid is used, the temperature in the chamber 114 and within the ice-cube compartment may be kept well below the freezing point for a long period of time without cooling the air chamber to a point where the contents will be frozen.

This feature of the invention is applicable to a wide variety of types of refrigerators.

There is exemplified in Figs. 20, 21 and 22 a conventional automatic refrigerator constructed to embody this feature. The refrigerator includes an insulated casing 119, an insulated door 120, stationary trays 121 in the refrigeration chamber, compressor and pump unit 122, condenser means 123, and an expansion unit 124 carrying an ice-cube compartment 125 in which ice-cube trays 126 are contained, all of conventional construction. An insulating wall 127 provides a chamber 128 for maintaining a heat-transfer fluid in contact with the cooling unit 124 and about the ice-cube compartment 126. At the back of the refrigerator there is installed a plate 129 which is bent out so as to provide, in conjunction with the rear wall of the refrigerator, a chamber 130 in the form of a long continuous conduit. This conduit communicates with the top of the chamber 128 at 131 and with the bottom of the chamber 128 at 132 through the medium of a pipe 133 so that the whole provides a heat transfer chamber 134. A valve unit 135, which is thermostatically controlled by any well known or suitable means in response to the air in the tray compartment, controls the flow between the division 128 and 130 of the chamber 134. The slightly chilled ethylene glycol or other fluid in the chamber 128 is admitted to conduit 130 only when the temperature in the air chamber rises to an undesired degree. Otherwise the low temperature liquid in the chamber 128 acts to assist in the rapid freezing of water in the ice-cube trays. Means such as are commonly employed in automatic refrigerators or other suitable means to expedite or reduce the freezing action may be employed. Such means may consist of a control lever 136 which may be suitably connected with conventional control means.

The feature of the invention here under consideration is adapted for use not only in so-called "automatic" refrigerators, but also in refrigerators wherein the cooling unit embodies a replaceable cooling medium which acts at a low temperature; since, as will be apparent, the advantages of maintaining a freezing chamber at a particularly low temperature and a refrigeration chamber at a relatively higher temperature will be present regardless of the type of low temperature cooling unit used. For instance, a dry-ice compartment may be utilized as the cooling unit in a construction such as shown in Figs. 18 and 19 or Figs. 20 through 22.

It will thus be seen that there may be provided in accordance with the invention refrigerators embodying one or more of several highly desirable features which make for efficiency, accessibility, convenience, and freedom from various drawbacks in the types of commercial refrigerators commonly provided for automatic used.

The invention accordingly comprises an article of manufacture possessing the features, properties, and the relation of elements which will be exemplified in the article hereinafter described and the scope of the application of which will be indicated in the claims.

It is also to be understood that the following claims are intended to cover all the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A refrigerator comprising a compartment, a box-like tray normally situated in said compartment and movable outwardly therefrom to permit the contents to be lifted from the tray, means providing a vertical pivot for mounting said tray so that it may be swung outwardly, said tray and said compartment being arranged to provide, when the tray is swung outwardly, a basin for the retention of the cold air which was contained in said tray, means permitting the entrance into said compartment of cold air when said tray is in said compartment and means for preventing the entrance into said compartment of additional cold air which would be pushed out of the refrigerator during the closing action of the tray.

2. A refrigerator comprising a semi-circular box-like tray, and means at the front of the refrigerator for centrally pivoting said tray, said tray having an imperforate bottom wall and a semi-cylindrical wall which prevents the egress of cold air when the tray is swung to an outward position, and means providing a compartment in the refrigerator for the reception of said tray, the space within said tray being substantially as great as the space within said compartment.

3. A refrigerator comprising a compartment, a semi-circular box-like tray normally situated in said compartment and movable outwardly therefrom to permit the contents to be lifted from the tray, means providing a centrally disposed vertical pivot to permit said tray to be swung out-

wardly by substantially a 180° movement, said tray and said compartment being arranged to provide when the tray is swung outwardly a basin for the retention of cold air which was contained in said tray, means permitting the entrance into said compartment of cold air when said tray is in said compartment and means for preventing the entrance into said compartment of additional cold air which would be pushed out of the refrigerator during the closing action of the tray.

4. A refrigerator comprising a compartment, a box-like tray normally situated in said compartment and movable outwardly therefrom to permit the contents to be lifted from the tray, said tray and said compartment being arranged to provide when the tray is moved outwardly, a basin for the retention of the cold air which was contained in said tray, an additional compartment above the aforesaid compartment, an opening between said compartments, and means for closing said opening in response to the initial outward movement of said tray.

5. A refrigerator comprising a pivoted box-like tray adapted to be swung out of said refrigerator to permit the contents to be lifted from the tray, and a supplemental tray normally positioned within the main tray and having a floor spaced above the floor of the main tray and adapted to be swung independently of the main tray when the main tray is in an outward position to permit the removal of the contents from the floor of the main tray or from the floor of the supplemental tray as desired.

6. A refrigerator comprising a compartment, a box-like tray normally situated in said compartment and movable outwardly therefrom to permit the contents to be lifted from the tray, means providing a vertical pivot for mounting said tray so that it may be swung outwardly, said tray and said compartment being arranged to provide, when the tray is swung outwardly, a basin for the retention of the cold air which was contained in said tray, means for preventing the entrance into said compartment of additional cold air which would be pushed out of the refrigerator during the closing action of the tray, and a supplemental tray removably mounted within the main tray and independently mounted on the same pivotal axis to permit the supplemental tray to be within the compartment when the main tray is in an outward position.

7. A refrigerator comprising a pivoted box-like tray adapted to be swung out of said refrigerator to permit materials to be lifted from the floor thereof, a supplemental tray which is a smaller segment of a circle than the main tray to permit articles of considerable height to be placed in the near portion of the main tray, means to mount said supplemental tray for movement independently of the main tray, and means to assure that said supplemental tray is drawn to an accessible position by the outward movement of the main tray.

8. A refrigerator comprising a pivoted box-like tray formed with an imperforate bottom wall and with imperforate upstanding straight and arcuate walls, and enclosure means within the refrigerator closely approaching the top and sides of said tray when the refrigerator is closed.

9. A refrigerator comprising a plurality of semi-circular centrally-pivoted trays each formed with imperforate bottom, semi-cylindrical, and diametrical walls, and disposed one above another with the bottom of one tray substantially in contact with the upper edge of the semi-cylindrical and diametrical walls of a lower tray whereby when a tray is opened no space for the reception of warm air above the open tray is provided.

10. A refrigerator comprising a food chamber and a plurality of pivoted box-like trays having imperforate front, bottom and arcuate walls, said trays substantially filling the space within said chamber.

11. A refrigerator comprising means providing a plurality of superimposed non-communicating compartments, a plurality of similarly arcuate, box-like trays, having imperforate bottom walls and arcuate side walls, and means for pivoting said trays so that in one position they are within said compartments, the space within each tray being substantially as great as the respective compartment.

12. A refrigerator comprising a pivoted box-like tray adapted to be swung out of said refrigerator, having an upstanding arcuate wall and having an opening in one of the sides of said tray, said opening leading from the interior of said tray to the interior of said refrigerator when said tray is not entirely within said refrigerator, and means poviding a compartment within said refrigerator for the reception of said tray, the space within said tray being substantially as great as the space within said compartment.

13. A refrigerator comprising a pivoted box-like tray adapted to be swung out of said refrigerator, and means providing a centrally disposed vertical pivot to permit said trays to be swung outwardly, said tray being formed with a wall which also constitutes at least a part of one of the walls of said refrigerator, said tray having an opening in one of the sides of said tray, said opening leading from the interior of said tray to the interior of said refrigerator when said tray is not entirely within said refrigerator whereby air in said tray may remain in said refrigerator when said tray is removed from said refrigerator.

14. A refrigerator comprising a pivoted box-like tray adapted to be swung out of said refrigerator, and means providing a centrally disposed vertical pivot to permit said trays to be swung outwardly, said tray being formed with a wall which also constitutes at least a part of one of the walls of said refrigerator, said tray having an opening on one of the sides of said tray, said opening leading from the interior of said tray to the interior of said refrigerator when said tray is not entirely within said refrigerator, said side, when said refrigerator is closed, being adjacent to another part of said wall of said refrigerator.

15. A refrigerator comprising a pivoted box-like tray adapted to be swung out of said refrigerator, said box-like tray having one wall which also at least in part constitutes at least a part of one of the walls of said refrigerator, and being rotatable about an axis in said wall of said tray, and having an upstanding arcuate wall connecting two points of said first-mentioned wall of said tray, and means providing a compartment in which said tray is situate when said refrigerator is closed, the space within said tray being substantially as great as the space within said compartment.

16. A refrigerator comprising a rectangular casing, and one or more box-like trays adapted to be swung out of said casing, each tray comprising an arcuate side portion and condenser means positioned in said casing adjacent said

arcuate portion and insulated therefrom, whereby said trays and said condenser means may occupy substantially all of the space at a predetermined level in said casing when said refrigerator is closed, and whereby said trays may be rotatably removed from the interior of said refrigerator without interference with said condenser means.

17. A refrigerator comprising a plurality of compartments, a plurality of box-like trays normally situated in the refrigerator and movable outwardly therefrom to permit the contents to be lifted from the tray, each tray being formed with wall portions to prevent the egress of cold air except in an upward direction when the tray is open, and means to prevent the flow of cold air from an upper compartment to a lower compartment when the lower tray is open to any material extent less than complete withdrawal.

18. A refrigerator comprising a casing having a predetermined volume, a semi-circular box-like tray having upstanding semi-cylindrical and diametrical imperforate walls and occupying only a part of said volume, means providing a centrally disposed vertical pivot to permit the tray to be swung outwardly of the refrigerator, and means to prevent the passage into the remainder of the refrigerator of warm air which moves inwardly as the tray is swung outwardly whereby substantially the entire body of warm air will be pushed out again as the tray is swung inwardly.

19. A refrigerator comprising a casing having a predetermined volume, a semi-circular box-like tray having upstanding semi-cylindrical and diametrical imperforate walls and occupying only a part of said volume, means providing a centrally disposed vertical pivot to permit the tray to be swung outwardly of the refrigerator by pressure on either side thereof, and means to prevent the passage into the remainder of the refrigerator of warm air which moves inwardly as the tray is swung outwardly whereby substantially the entire body of warm air will be pushed out again as the tray is swung inwardly.

20. A refrigerator comprising a casing having a predetermined volume, a plurality of vertically-disposed semi-circular centrally-pivoted trays and occupying only a part of said volume, each formed with an imperforate bottom wall and imperforate semi-cylindrical and diametrical walls to provide a basin for the retention of cold air, and each independently movable to a position outside of said refrigerator to permit the contents to be lifted therefrom, and means to prevent the passage into the remainder of the refrigerator of warm air which moves inwardly as a tray is swung outwardly whereby substantially again as the tray is swung inwardly.

21. A refrigerator comprising a pivoted box-like tray adapted to be swung out of said refrigerator to permit the contents to be lifted from the tray, and a supplemental tray normally positioned within the main tray and having a floor spaced above the floor of the main tray and adapted to be swung independently of the main tray when the main tray is in an outward position to permit the removal of the contents from the floor of the main tray or from the floor of the supplemental tray as desired, there being an opening in the wall of said box-like tray at least as large as, and in registry with, the vertical contour of said supplemental tray whereby said box-like tray may be swung out and said supplemental tray may remain in said refrigerator when said box-like tray is in outward position.

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