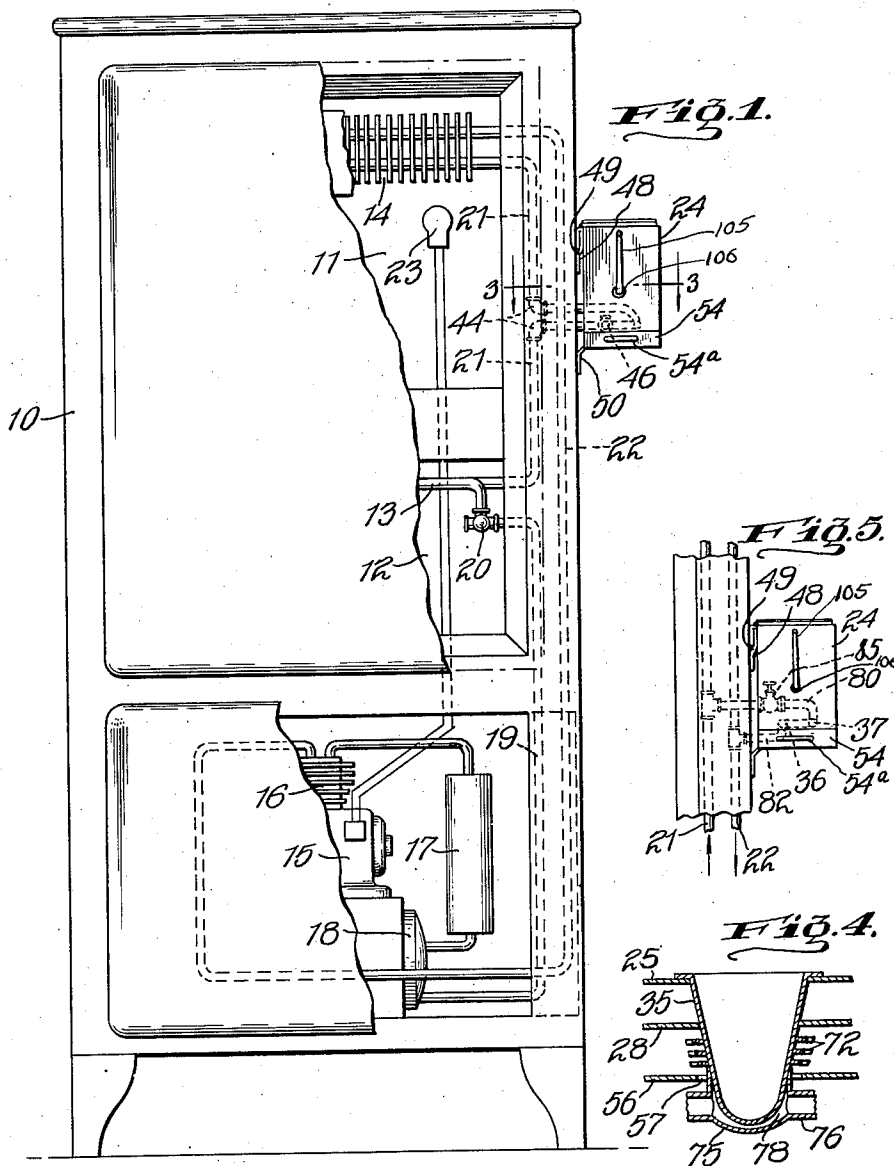


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T. I. POTTER
ICE-MAKING APPARATUS
Filed March 12, 1937

2,220,001

2 Sheets-Sheet 1



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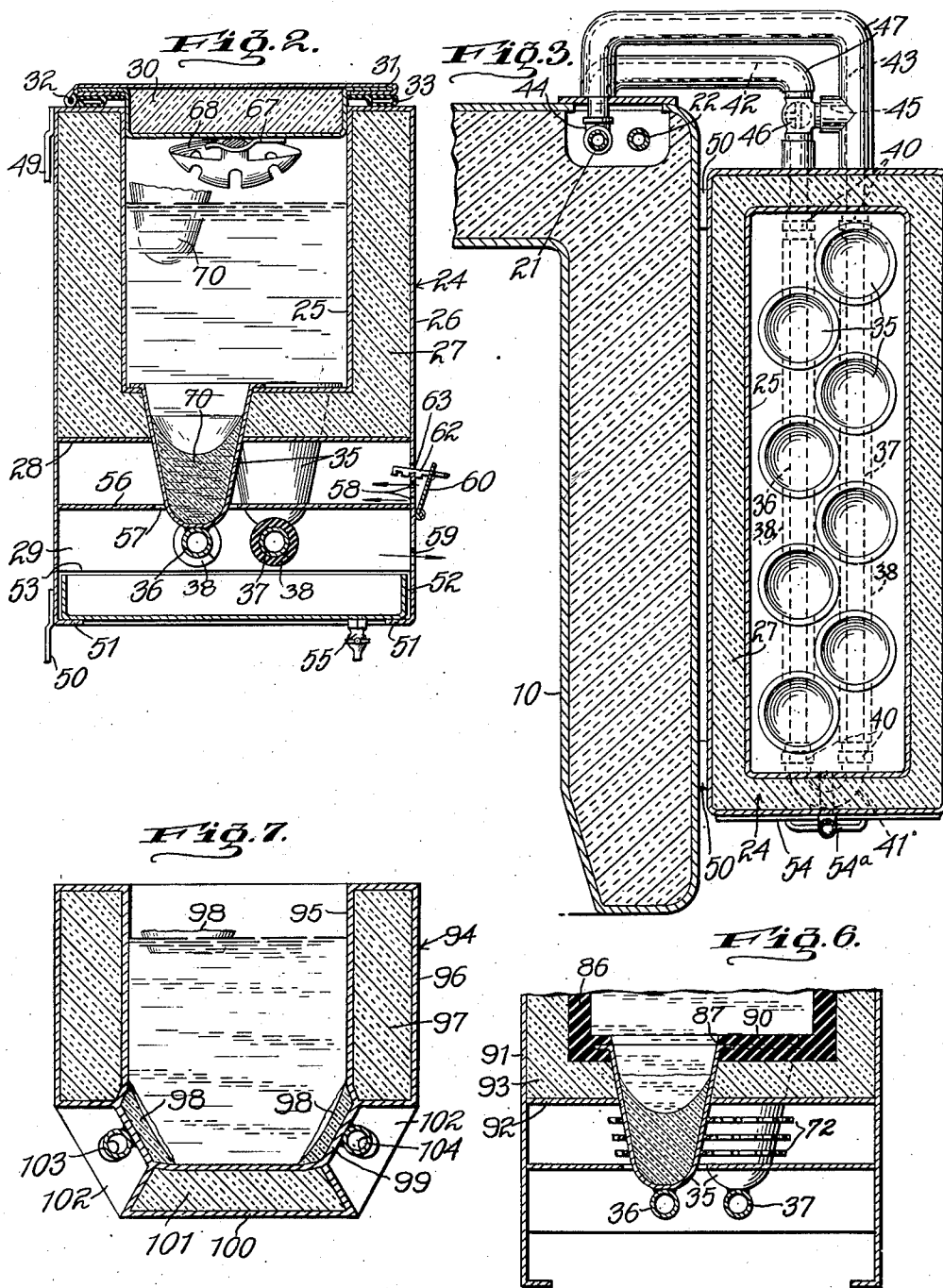
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ICE-MAKING APPARATUS

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2 Sheets-Sheet 2



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2,220,001

ICE-MAKING APPARATUS

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Application March 12, 1937, Serial No. 130,432

17 Claims. (Cl. 62-108.5)

The present invention relates to improvements in ice-making apparatus of the type in which individual blocks of ice are formed in a body of water and periodically floated to the surface of the water, whence they may be ladled out as desired.

An object of the invention is to provide an apparatus adapted for use with a refrigerating system of the intermittent type in which the ice blocks are formed during the operating period and released during the idle period of the system. Thus, the apparatus is particularly adapted for use as an auxiliary to a household refrigerator of the intermittently operating type, the apparatus being connected either in series or in parallel with the chilling unit of said refrigerator and being operable on the normal "on" and "off" cycle of said refrigerator.

A further object of the invention is to provide means for utilizing heat of the surrounding atmosphere to release the ice, during the idle period of the system, from the surfaces on which it is frozen.

A more specific object of the invention is to provide a thermally insulated water tank having ice molds of heat conducting material at or near the bottom of the tank, such molds being intermittently chilled to form the ice blocks and being exposed to the heat of the surrounding atmosphere whereby the ice blocks will be floated free from the molds during intervening idle periods of the refrigerating system.

Another object of the invention is to provide means for controlling the heat supplied to the mold.

Another object of the invention is to form the ice-making apparatus as a self-contained unit which may be readily attached to an existing household refrigerator and be coupled to the refrigerating circuit thereof.

Still another object of the invention is to make the apparatus reversible so that it may be attached to either side of a refrigerator cabinet, as desired.

Other objects of my invention will appear in the following description of a preferred embodiment and certain modifications thereof and thereafter the novelty and scope of the invention will be pointed out in the claims.

In the accompanying drawings:

Figure 1 is a view in front elevation and partly broken away, of a household refrigerator with my ice-making apparatus attached to the cabinet of the refrigerator and with the chilling ele-

ment of said apparatus connected in series with the chilling units of said refrigerator.

Fig. 2 is a view in transverse vertical section of the ice-making apparatus detached from the refrigerator;

Fig. 3 is a view in horizontal section taken substantially on the line 3-3 of Fig. 1;

Fig. 4 is a fragmental view in vertical section of a mold for forming an ice block and refrigerating means therefor providing a large contact area for heat transfer therebetween;

Fig. 5 is a fragmental view in front elevation showing the ice-making apparatus connected in parallel across the high and low pressure lines of the refrigerator;

Fig. 6 is a view in vertical section similar to that shown in Fig. 2, but showing another form of my invention; and

Fig. 7 is a similar view in section showing still another form of my invention.

As explained above my ice-making apparatus is particularly adapted to be connected to a household refrigerator of practically any standard type operating on an intermittent cycle, and, for purposes of illustration, I have shown, in Fig. 1, a refrigerator of a type well known in the art. This refrigerator comprises a cabinet 10 formed with two mutually insulated refrigerating chambers 11 and 12 disposed one above the other. A chilling unit 13 is adapted to maintain a freezing temperature in the lower chamber 12, and a non-frosting chilling unit 14 is adapted to maintain the upper chamber 11 at a refrigerating temperature above the freezing point of water.

A standard heat pumping unit is provided in the lower part of the cabinet. This unit comprises a motor 15, a compressor 16 driven thereby, a condenser 17 adapted to receive and condense refrigerant compressed by the compressor and a receiver 18 adapted to accumulate refrigerant liquefied by the condenser. A high pressure line 19 conveys refrigerant from the receiver 18 to the chilling unit 13, the refrigerant being admitted to said unit through an expansion valve 20. The chilling unit 14 is connected in series with the chilling unit 13, and to this end a pipe line 21 leads upwardly from the outlet end of unit 13. As heretofore constructed this line 21 would lead directly to the intake end of the unit 14, but, as shown in the drawings the line is cut and the chilling element of the ice-making apparatus is inserted in series between the units 13 and 14. The outlet end of the unit 14 is connected by a line 22 to the compressor 16. By means of suitable thermosensitive means

23 the motor 15 is turned "on" and "off" intermittently to maintain the temperature of the warmer chamber within a predetermined range.

As shown in Fig. 2 a water tank 24 is provided which is formed of an inner metal shell 25 surrounded by an outer metal shell 26 with a filling 27 of insulation material between the shells. The outer shell 26 extends well below the shell 25 but is provided with a transverse partition wall 28 which supports the insulation 27 extending under the bottom of the shell 25. The downwardly extending shell 26 provides a compartment 29 through which the refrigerant lines pass, as will be explained presently. The exposed surfaces of the shells 25 and 26 are preferably coated with enamel or porcelain for sanitary purposes and also to enhance the appearance of the apparatus. The top of the tank is closed by a lid formed with a heavily insulated body portion 30 which fits into the tank opening, and a peripheral flange portion 31 which overlaps the upper edge of the tank and is hinged to the tank 24 at 32. A gasket 33 secured to the flange 31 serves to provide a thermal seal when the lid is in closed position.

At the bottom of the tank 24 are two rows of molds 35. Each mold is formed of a metal having high thermal conductivity and is preferable in the form of a tapering or conical cup with the mouth of the cup open to the tank and soldered to the inner shell 25. Each cup projects downwardly through the wall 28 and into the compartment 29. As shown in Fig. 3, the molds of one row are staggered with respect to the molds of the other row. Extending under one row and soldered to the bottom of each mold in said row is a refrigerant pipe line 36 and similarly a refrigerant line 37 is soldered to the molds of the other row. The molds are preferably rounded at their lower ends and are slightly flattened at the bottom to provide broad bearing surfaces in contact with said refrigerant lines. The pipes 36 and 37 may be thermally insulated between the molds by means of sleeves 38 of rubber or other insulating material which are slit longitudinally and then forced over the pipes.

Each end of each refrigerant line 36 and 37 is provided with coupling device 40. The two lines are connected together at the forward end of the tank by a U-shaped pipe 41 attached thereto by means of the couplings 40. At the rear of the tank the couplings 40 are used to connect line 36 to an inlet pipe 42 and line 37 to an outlet pipe 43. As explained above, the line 21 is cut and the severed ends thereof are connected to the lines 42 and 43 respectively by means of suitable fittings 44 so that the refrigerant lines 36 and 37 form a continuation of the line 21 and are connected in series with and between the chilling units 13 and 14. A by-pass 45 may be provided between pipes 42 and 43, this by-pass being normally closed by a three-way valve 46. This valve may be operated to cause the refrigerant to by-pass the lines 36 and 37 whenever it is desired to dispense with the operation of the ice-making apparatus. Sleeves 47 of insulating material may be fitted on the pipes 42 and 43.

The tank 24 is preferably mounted on one side of the refrigerator cabinet 10 and to this end a strip of metal 48 is secured to said side of the cabinet. The upper edge of this strip is off-set from the cabinet, as shown in Fig. 1, so as to receive a downwardly projecting lip 49 secured to and off-set from the adjacent face of the tank 24 near the top thereof. By this means the tank

is hooked upon the strip 48. To fix the tank against displacement ears 50 are formed at the lower end of the shell 26 on the side facing the cabinet 10. These ears are apertured to receive screws which are threaded into the cabinet wall. The standard household refrigerator cabinet is made of sheet metal through which so called "sheet metal" screws may readily be introduced to secure the strip 48, as well as the ears 50, to the cabinet.

The lower end of the outer shell 26 is formed at opposite sides thereof with inwardly turned flanges 51 which serve to support a drip pan 52. The latter may be arranged to slide as a drawer out of openings 53 at the front and rear end of the shell so as to provide access to the parts in the compartment 29. The drip pan may be provided with an end wall 54 adapted to close the front opening 53 and with a drawer handle 54a secured to said end wall. The pan 52 is adapted to collect condensed moisture that may drip from the molds during the "off" period of the refrigerant cycle. Preferably, a pet-cock 55 is provided in the bottom of the drip pan to permit of draining out the accumulated water whenever desired.

It is necessary to provide circulation of air in contact with the projecting molds so as to warm the molds sufficiently to release the ice-blocks formed therein. To promote such circulation I provide a horizontal partition wall 56 having openings 57 therein through which the lower ends of the molds project with a wide clearance. In the outer side wall of the compartment 29 a row of apertures 58 is provided above the partition 56 and another row of apertures 59 is provided below the partition 56. Air entering the upper row of apertures 58 will be chilled by contact with the molds and will drop through the openings 57 and pass out through the apertures 59. To control the flow of air, and hence the degree of heating of the molds, I provide a damper 60 which is hinged to the shell 26 adjacent the apertures 58, so that it may be swung upwardly to close the apertures 58. A rack 62 hinged to the damper 60 passes through an opening 63 in the outer shell wall and serves to hold the damper at various adjustments more or less closing the apertures 58.

Attached to the inner face of the lid 30, 31 by means of a clip 67 is an apertured ladle 68, which may be used to dip out the blocks of ice.

The operation of the device as so far disclosed is as follows: The tank 24 is filled with water to a suitable level below the ladle 68 and the valve 46 is operated to cut off the by-pass 45, so that refrigerant from the chilling unit 13 will pass through the pipes 36 and 37 and thence through the chilling unit 14. While the motor is operating the refrigerant will chill the molds and thus reduce the temperature of the water in the tank. After a few cycles of the refrigerating system the temperature of the water will drop so low that upon the next "on" period of the motor, ice will be formed in the molds 35. This ice will first form at the bottom of the mold and will build up along the sides, producing a cup-shaped ice block, such as indicated at 70 in Fig. 2. During the "off" period air from the surrounding atmosphere flowing through apertures 58 and out of apertures 59 will warm the molds, and such heat supplemented by heat from the water in the tank, will cause a thin film of water to form between the ice blocks and the molds, breaking the adhesion between the ice and the molds. The ice 75

blocks thus released will float to the surface of the water in the tank, so that they may be ladled out, as desired. At each operating period of the refrigerant cycle, fresh ice blocks will be formed in the molds, and at each idle period these ice blocks will be released and floated to the surface. The temperature of the water in the tank is maintained slightly above the freezing point, being chilled by the ice blocks floating therein and being warmed by the leakage of heat through the insulated walls of the tank and heat supplied to the molds during idle periods of the refrigerating cycle.

Manifestly, the ice-making apparatus must be thermally proportioned to operate on the refrigerating cycle of the particular make of refrigerator to which it is applied. The "on" and "off" periods of different makes of refrigerators vary considerably. Also, the refrigerating media employed in different systems are operated at widely different temperatures. The areas of contact between the molds and the refrigerant lines 36 and 37 must be proportioned to freeze blocks of desired size in the molds during each "on" period. The damper 60 may be adjusted to vary the heat supplied during the "off" period. If the off period is short it may be necessary to provide fins on the molds so as to increase their heat absorbing surfaces. Thus, in Fig. 4, I show a mold 35 with fins 72 soldered thereto. These fins may be of any desired form, but, as shown, consist of annular disks fitted upon and soldered to the mold. The outer periphery of each disk may be notched to facilitate the flow of air through the openings 57 in the partition wall 56. Since the chilling of the mold takes place while the relatively warm air is flowing through compartment 34, the damper 60 provides means for controlling the size of the ice blocks formed in the molds.

If it be desired to increase the chilling effect, cups 75 are introduced into the refrigerant line. One of these lines is shown at 76, in Fig. 4. The lower end of each mold projects into a cup 75 and the lip of the cup is soldered to the mold. A space 78 is provided between the bottom of the mold and the cup, which fills with refrigerant, thereby exposing a large area of the mold to the chilling action of the refrigerant fed through the line.

It will be understood that the fins 72 may, if desired or necessary, be applied to the mold 35 even though it merely contacts with the outer wall of the refrigerant pipe line, as in Fig. 1, instead of having direct contact with the refrigerating medium, as in Fig. 4. In other words, my invention covers means for varying the chilling area of the mold as well as the heating area thereof, so that the apparatus may be thermally proportioned for different refrigerating systems.

The shape of the molds may be varied, but I find it desirable to taper the molds to a larger cross-section at the top so that the ice blocks will be more readily released. If cylindrical molds were used the cylindrical ice blocks would act like pistons and would not so readily float out of the molds. Obviously, the molds could be made of pyramidal form if desired. Because the freezing takes place initially on the wall surface of the mold, each block has a concavity in its upper face. This concavity increases the surface area of the block so that its cooling action is expedited.

The ice-making apparatus is reversible so that it may be mounted on either side of a refrigerator cabinet. Fig. 1 shows the apparatus mounted on the right hand side of the cabinet 10. If it be preferred to apply the device to the left hand side

the strip 48 is secured to the left hand side of the cabinet and the apparatus is reversed by coupling the U-shaped pipe 41 to the opposite ends of the lines 36 and 37, because the rear end of the tank, as shown in Fig. 1, will now become the front end of the tank. The pipes 42 and 43 will then be coupled to the opposite ends of the lines 36 and 37.

Fig. 5 shows how the apparatus may be connected in parallel instead of in series in the refrigerating circuit of the refrigerator. Thus, in place of the line 43 there would be a line 80 connecting the line 37 to the refrigerant line 21, while the line 22 would be connected by a line 82 to the refrigerant line 36. A valve 85 in the line 80 controls the flow of refrigerant through the ice-making apparatus. This valve may be closed to cut off the ice-making apparatus whenever desired.

It will be understood that it is not necessary to apply the ice-making apparatus to a refrigerator of two-temperature type. The ice-making apparatus may be connected to any standard household refrigerator either in series or in parallel with the chilling unit or units thereof. It is not necessary to mount the apparatus on the cabinet 10. The apparatus could be mounted on any other support adjacent the cabinet or it could be operated in conjunction with any suitable intermittently operating refrigerating system whether the heat pumping unit thereof be installed in the cabinet or not.

Under certain conditions even the small area of chilling surface shown in Fig. 2 may be too large for proper operation of the system without further modifications. I have found, for instance, that the ice is apt to creep up over the top of the molds and form upon the floor of the inner shell line 25 because this shell, being of metal is chilled, by its contact with the cold mold. This difficulty may be overcome in the manner indicated in Fig. 6. Instead of the metallic inner shell 25 I employ a shell 86 of a material which is a poor conductor of heat. Such a shell may be formed of plastic material such as a phenolic condensation product. The lips 87 of the molds 35 depending from this shell are embedded in the floor 90 of the shell. Surrounding the shell 86 is an outer shell 91 which may be of the same form as the shell 26 with a transverse wall 92 spaced from the floor wall 90. Insulation material 93 is packed between the inner and outer shells and around the molds between walls 90 and 92. With this construction ice forming in the molds 35 will not creep over upon the floor 90 because the latter will not be chilled below the freezing point during the chilling period, since it is a poor heat conductor.

The construction shown in Fig. 7 differs from that shown in Fig. 2, mainly, in the fact that instead of forming cones of ice, the ice will be formed in the shape of buttons or disks with beveled edges. The apparatus shown in Fig. 7 comprises a tank indicated generally by the reference numeral 94. This tank comprises an inner shell 95 and an outer shell 96 between which there is a filling 97 of insulating material. Along the opposite sides of the inner shell 95 at the bottom of the tank there are off sets or recesses 98 which form molds in which ice may be frozen. These molds are of disk shape and the peripheral walls of the disk taper from a smaller diameter at the floor of the recess to a larger diameter at the mouth thereof. The outer shell 96 terminates at the upper end of the floor walls 99 of the mold and there is a separate wall 100 spaced from the bottom of the inner shell 95 with a filling of in-

sulation 101 therebetween. Webs 102 connect the shell 96 to the bottom wall 100, leaving an open channel exposing the floor walls 99 of the molds to atmospheric heat. Extending lengthwise of the tank in said channels are two refrigerant lines 103 and 104, respectively, which are soldered to the floor walls 99 of the molds. The lines 103 and 104 may be coupled together at one end in the same way as are the pipes 36 and 37 of the construction shown in Fig. 3, and at the opposite end the pipes 103 and 104 may be connected to the refrigerant circuit of a refrigerator, either in parallel or in series with the chilling unit or units of said refrigerator. In order to limit the chilling effect, the pipes 103 and 104 are preferably formed with offsets, as indicated in the drawing, so that they will make spot contacts of limited area with the floor walls 99 of the molds. If the refrigerant is operated at a relatively high temperature such spot contacts may be insufficient. In such cases the offsets are omitted and the area of contact will then extend across the full diameter of each floor wall.

The operation of this device is similar to that shown in Fig. 2. During the "on" period, buttons of ice will form in the recesses 98 and during the "off" period these buttons will be released by action of atmospheric heat against the outside of the molds. The buttons thus released will float to the surface of the water in the tank 94. It will be understood, of course, that this tank, as well as the tank shown in Fig. 6, is provided with a suitable lid such as that shown in Fig. 2.

The water tank in any of the constructions shown may serve to supply ice water. To this end, a water spout may be provided, as shown in Figs. 1 and 5. This water spout is preferably of the type comprising an open pipe 105 having swivel connection with a nipple 106 extending through the wall of the tank near the bottom thereof. Normally the spout is turned up to vertical position with its free end extending above the water level in the tank. When it is desired to draw off some ice water the spout is swung downwardly to or toward the horizontal position, permitting water from the tank to run out. Spouts of this general character are well known and need no detailed explanation. Obviously, other well known means of drawing off water may be employed.

It will be noted that in all of the embodiments illustrated, the heat that melts the ice blocks is supplied from the air outside of the tank, no auxiliary heating means being necessary. This heat flows directly through the molds into the contents thereof, whether frozen or not. Heat also flows by way of the molds into the water in the tank and to a limited extent directly through the insulated walls of the tank. During the "off" period the heating of the molds by direct contact with the surrounding air is aided by the heat stored in the water, such auxiliary heat being conducted by the mold walls and as soon as the ice blocks melt along the mold walls a film of water supplied initially by melting of the ice, is augmented by water flowing in from the tank, thereby helping to part the block from the mold and causing the block to float to the surface. Thus, there is a constant inflow of heat during the "on," as well as the "off" period of the refrigerant cycle, and the parts are so proportioned that during the "on" period the heat will be drawn off by the refrigerant so much faster than it can enter the molds that the water

in the molds will be frozen. By exposing the molds continuously to heat I avoid the necessity of employing special valves or other mechanism to turn the heat on and off. The only intermittent action is that of the refrigerating system, and since the ordinary domestic refrigerator is equipped with an intermittently operating refrigerating system the ice freezing apparatus is ideally suited for operation as an auxiliary to such a refrigerator.

Whether the ice-making apparatus is used as an auxiliary to an intermittently operating refrigerating system, or is provided with its own intermittently operating refrigerating system, it must be thermally proportioned to provide sufficient chilling to form ice blocks of desired size during the "on" period and to provide sufficient heating to release the blocks during the "off" period and, incidentally, to prevent the water in the tank from being chilled to or below the freezing point. I find, for example, that a desirable balance is struck when the temperature of the water averages 36 to 38 degrees Fahrenheit.

In summer time the operating periods of the ordinary household refrigerator are automatically increased and the "off" periods are reduced, and this variation of the refrigerating cycle is influenced to a certain degree by the ice-making apparatus connected into the circuit, so that the higher temperature of the surrounding air will be compensated for. However, the damper 60 may be regulated to cut down the heat supply in extremely hot weather, when the automatic compensation is insufficient.

While I have described several embodiments of my invention it will be understood that these are to be taken as illustrative and not limitative and that I reserve the right to make various changes in form, construction and arrangement of parts without departing from the spirit and scope of my invention as set forth in the following claims.

I claim:

1. The combination with a refrigerator equipped with a refrigerating system having alternate chilling and idle periods, of an ice-making apparatus comprising a water tank, means thermally insulating said tank from atmospheric heat but leaving a submerged portion thereof exposed externally to the atmosphere, said portion being formed of a material having high thermal conductivity, and a refrigerant line thermally connected to said exposed portion and connected into the refrigerant circuit of said system, said apparatus being so thermally proportioned with respect to said system that ice blocks will form on said portion during said chilling periods and will be detached therefrom by atmospheric heat during said idle periods.

2. The combination with a refrigerator equipped with a refrigerating system having alternate chilling and idle periods of an ice-making apparatus comprising a water tank, means thermally insulating said tank from atmospheric heat, cup shaped molds open to the tank and projecting from the bottom of the tank well below the insulation thereof so that they will be exposed to the atmosphere, said molds being formed of a material having high thermal conductivity, a refrigerant line thermally connected to the bottom of the molds and connected into the refrigerant circuit of said system, said apparatus being so thermally proportioned with respect to said system that ice blocks will form in said molds during said chilling periods and will be detached

therefrom by atmospheric heat during said idle periods.

3. The combination with a refrigerator equipped with a refrigerating system having alternate chilling and idle periods, of an ice-making apparatus comprising a water tank, means thermally insulating said tank from atmospheric heat, cup shaped molds open to the tank and projecting from the bottom of the tank well below the insulation thereof so that they will be exposed to the atmosphere, said molds being formed of a material having high thermal conductivity and flaring to a larger cross-sectional area at their upper ends, a refrigerant line thermally connected to the bottom of the molds and connected into the refrigerant circuit of said system, said apparatus being so thermally proportioned with respect to said system that ice blocks will form in said molds during said chilling periods and will be detached therefrom by atmospheric heat during said idle periods.

4. The combination with a refrigerator equipped with a refrigerating system having alternate chilling and idle periods, of an ice-making apparatus comprising a water tank, means thermally insulating said tank from atmospheric heat, cup shaped molds open to the tank and projecting from the bottom of the tank well below the insulation thereof so that they will be exposed to the atmosphere, said molds being formed of a material having high thermal conductivity and flaring to a larger cross-sectional area at their upper ends, heat absorbing projections formed on the exposed surfaces of said molds, a refrigerant line thermally connected to the bottom of the molds and connected into the refrigerant circuit of said system, said apparatus being so thermally proportioned with respect to said system that ice blocks will form in said molds during said chilling periods and will be detached therefrom by atmospheric heat during said idle periods.

5. The combination with a refrigerator equipped with a refrigerating system having alternate chilling and idle periods, of an ice-making apparatus comprising a water tank, means thermally insulating said tank from atmospheric heat, cup shaped molds open to the tank and projecting from the bottom of the tank well below the insulation thereof so that they will be exposed to the atmosphere, said molds being formed of a material having high thermal conductivity and flaring to a larger cross-sectional area at their upper ends, notched annular flanges on the exposed surface of each mold, a refrigerant line thermally connected to the bottom of the molds and connected into the refrigerant circuit of said system, said apparatus being so thermally proportioned with respect to said system that ice blocks will form in said molds during said chilling periods and will be detached therefrom by atmospheric heat during said idle periods.

6. The combination with a refrigerator equipped with a refrigerating system having alternate chilling and idle periods, of an ice-making apparatus comprising a water tank, the floor of the tank being made of a material having low thermal conductivity, cup shaped molds open to the tank and depending from said floor, the rim of each mold being embedded in said floor, said molds being formed of a material having high thermal conductivity, means thermally insulating said tank from atmospheric heat but leaving said molds exposed externally to the atmosphere, a refrigerant line thermally connected to the exposed portions of the molds and connected into

the refrigerant circuit of said system, said apparatus being so thermally proportioned with respect to said system that ice blocks will form in said molds during said chilling periods and will be detached therefrom by atmospheric heat during said idle periods.

7. The combination with a refrigerator having a food cooling compartment, and a refrigerating system for cooling said compartment having alternate chilling and idle periods, of an ice-making apparatus comprising a water tank thermally insulated from atmospheric heat, means forming an air chamber beneath the tank, cup shaped molds open to the tank and projecting therefrom into the chamber, said molds being formed of a material having high thermal conductivity, a conduit for a volatile refrigerant thermally connected to the bottom of the molds and connected into the refrigerant circuit of said refrigerating system, and means for ventilating said air chamber, said apparatus being so thermally proportioned with respect to said system that ice will form in the molds during the chilling periods and will be detached therefrom during the idle periods.

8. The combination with a refrigerator having a food cooling compartment, and a refrigerating system for cooling said compartment having alternate chilling and idle periods, of an ice-making apparatus comprising a water tank thermally insulated from atmospheric heat, means forming an air chamber beneath the tank, cup shaped molds opening into the tank and projecting therefrom into the chamber, said molds being formed of a material having high thermal conductivity, a conduit for a volatile refrigerant thermally connected to the bottom of the molds and connected into the refrigerant circuit of said refrigerating system, ventilation ports in the chamber, and means for controlling the flow of air through said ports, said apparatus being so thermally proportioned with respect to said system that ice will form in the molds during the chilling periods and will be detached therefrom during the idle periods.

9. The combination with a refrigerator having a food cooling compartment, and a refrigerating system for cooling said compartment having alternate chilling and idle periods, of an ice-making apparatus comprising a water tank thermally insulated from atmospheric heat, means forming an air chamber beneath the tank, cup shaped molds opening into the tank and projecting therefrom into the chamber, said molds being formed of a material having high thermal conductivity, a conduit for a volatile refrigerant thermally connected to the bottom of the molds and connected into the refrigerant circuit of said refrigerating system, ventilation ports in the chamber, and means for guiding the air flowing between said ports into contact with said molds, said apparatus being so thermally proportioned with respect to said system that ice will form in the molds during the chilling periods and will be detached therefrom during the idle periods.

10. The combination with a refrigerating system having alternate chilling and idle periods, of an ice-making apparatus comprising a water tank thermally insulated from atmospheric heat, means providing an air chamber below the tank, an apertured diaphragm sub-dividing the chamber into upper and lower compartments, inlet and outlet ports in the chamber disposed respectively above and below the diaphragm, a cup shaped mold open to the tank and depending

therefrom through the aperture in the diaphragm and in spaced relation to the perimeter of the aperture, and a conduit for volatile refrigerant thermally connected to the bottom of the mold and connected into the refrigerant circuit of said refrigerating system, said apparatus being so thermally proportioned with respect to said system that ice will form in the molds during the chilling periods and will be detached therefrom during the idle periods.

11. The combination with a refrigerating system having alternate chilling and idle periods, of an ice-making apparatus comprising a water tank thermally insulated from atmospheric heat, means providing an air chamber below the tank, an apertured diaphragm sub-dividing the chamber into upper and lower compartments, inlet and outlet ports in the chamber disposed respectively above and below the diaphragm, a cup shaped mold open to the tank and depending therefrom through the aperture in the diaphragm and in spaced relation to the perimeter of the aperture, a conduit for volatile refrigerant thermally connected to the bottom of the mold and connected into the refrigerant circuit of said refrigerating system, and a damper adapted to control the air flow through said ports, said apparatus being so thermally proportioned with respect to said system that ice will form in the molds during the chilling periods and will be detached therefrom during the idle periods.

12. The combination with a refrigerating system having alternate chilling and idle periods, of an ice-making apparatus comprising a water tank thermally insulated from atmospheric heat, means providing an air chamber below the tank, a removable drip pan forming the bottom of said chamber, an apertured diaphragm sub-dividing the chamber into upper and lower compartments, inlet and outlet ports in the chamber disposed respectively above and below the diaphragm, a cup shaped mold open to the tank and depending therefrom through the aperture in the diaphragm and in spaced relation to the perimeter of the aperture, a conduit for volatile refrigerant thermally connected to the bottom of the mold and connected into the refrigerant circuit of said refrigerating system, said apparatus being so thermally proportioned with respect to said system that ice will form in the molds during the chilling periods and will be detached therefrom during the idle periods.

13. In combination with a household refrigerator having a refrigerating system of intermittently operating type, an ice-making apparatus comprising a water tank mounted on the outside of the refrigerator, cup shaped molds opening upwardly into the tank, means thermally insulating the tank but leaving said molds exposed at least in part to atmospheric heat, a refrigerant line thermally connected to each mold and connected into the refrigerant circuit of said refrigerator, the parts being so thermally proportioned that ice will be formed in the molds during the "on" periods of the refrigerating system and will be freed from the molds by atmospheric heat during the "off" periods of said system.

14. In combination with a household refrigerator having a refrigerating system of inter-

mittently operating type, an ice-making apparatus mounted exteriorly upon said refrigerator, said apparatus comprising a water tank, two rows of cup shaped molds open to the tank and depending from the floor thereof, means thermally insulating the tank but leaving said molds exposed at least in part to atmospheric heat, a refrigerant line thermally connected to each row of molds, said lines being connected together at one end, means at the other end connecting said lines into the refrigerant circuit of said refrigerator, the apparatus being so thermally proportioned that ice will be formed in the molds during the "on" periods of the refrigerating system and the ice will be freed from the molds by atmospheric heat during the "off" periods of said system.

15. The combination with a refrigerator equipped with a refrigerating system having alternate chilling and idle periods, of an ice-making apparatus comprising a water tank, cup shaped molds opening into the tank and depending from the floor of the tank, means thermally insulating said tank from atmospheric heat but leaving said molds exposed externally at least in part to the atmosphere, said molds being formed of a material having high thermal conductivity, a refrigerant conduit connected into the refrigerant circuit of said system, said conduit being formed with pockets for the refrigerating medium into which the molds dip, the rim of each pocket being sealed to the mold projecting therein, said apparatus being so thermally proportioned with respect to said system that ice blocks will form in said molds during said chilling periods and will be detached therefrom by atmospheric heat during said idle periods.

16. In combination with a household refrigerator having a refrigerating system of intermittently operating type, an ice-making apparatus mounted on the refrigerator, said apparatus comprising a tank for holding a body of water, said tank being thermally insulated against inflow of heat from the air surrounding the tank and including a submerged portion of high thermal conductivity externally exposed to such heat, a refrigerant line thermally connected to said exposed portion and connected into the refrigerant circuit of said system, said apparatus being so thermally proportioned with respect to said system that ice blocks will form on said exposed portions during said chilling periods and will be detached therefrom by said heat during the idle periods of the system.

17. The combination with a refrigerator equipped with a refrigerating system having alternate chilling and idle periods, of an ice making apparatus comprising a water tank thermally insulated except for a submerged portion thereof exposed externally to the atmosphere, said portion being formed of a material having high thermal conductivity, said refrigerating system including a refrigerant line thermally associated with said exposed portion, said apparatus being so thermally proportioned with respect to said system that ice blocks will form on said portion during said chilling periods and will be detached therefrom by atmospheric heat during said idle periods.

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