

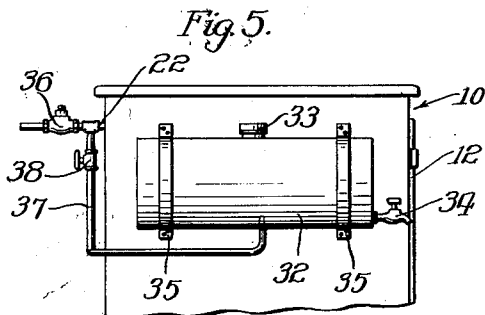
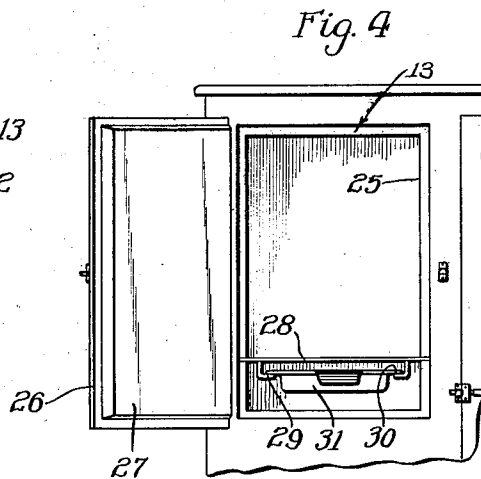
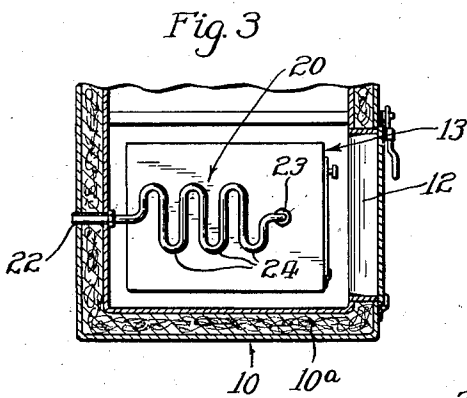
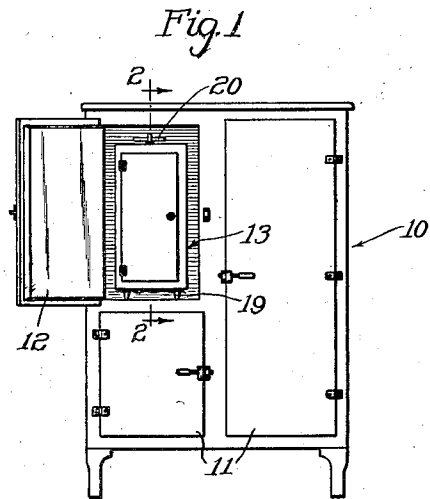
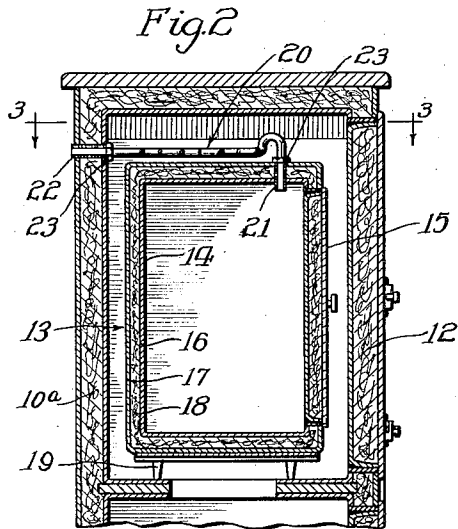
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REFRIGERATOR

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REFRIGERATOR

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6 Claims. (Cl. 62—91.5)

The invention relates generally to refrigerators and more particularly to refrigerators adapted to employ as a refrigerant a substance having a temperature lower than that of water ice.

5 An object of the invention is to provide a refrigerator of new and improved construction and arrangement of parts for using with maximum efficiency the entire refrigerating effect of substances having a temperature lower than 32° Fahrenheit. Solid carbon-dioxide, preferably in the form of compressed snow and known commercially as dry ice, is given as an example of such a substance.

15 Another object of the invention is to provide a refrigerator for this type of refrigerating substance which embodies a substance container capable of being constructed either as an integral part of a household refrigerator, or as an attachment for existing household refrigerators and wherein the structure of the container and its relationship to the refrigerator proper maintains a constant predetermined refrigerating temperature within the refrigerator regardless of the quantity of substance in the container.

25 A further object of the invention resides in the provision of a novel means for utilizing the waste gas from a refrigerator employing solid carbon-dioxide as a refrigerant to carbonate beverages.

30 Other objects and advantages will become apparent in the following description and from the accompanying drawing, in which:

Figure 1 is a front elevation on a reduced scale of a household refrigerator embodying the features of the invention.

35 Fig. 2 is a vertical section through the ice compartment as indicated by the line 2—2 in Fig. 1.

Fig. 3 is a transverse section through the ice compartment taken along the line 3—3 in Fig. 2.

40 Fig. 4 is a front elevation of the ice compartment of a refrigerator showing a modification of the invention.

Fig. 5 is a fragmentary side view of a refrigerator illustrating another modification.

45 While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawing and will herein describe in detail the preferred embodiment, but it is to be understood that I do not thereby intend to limit the invention to the specific form disclosed, but intend to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

55 In the following description, the use of dry

ice or solid carbon-dioxide will be described in connection with a household refrigerator as being illustrative of the use of a refrigerant which has a temperature of less than 32° Fahrenheit.

Referring to Fig. 1, the numeral 10 designates 5 generally a household refrigerator having doors 11 and 12 opening into food and refrigerant compartments respectively. This construction is substantially the same as that which is at present conventional in water ice refrigerators. In such constructions, it is customary to arrange the refrigerator interior so that by convection, heated air therein flows from the top of the food compartment into the top of the ice compartment, downwardly over and past all sides of the refrigerant to become cooled, out of the ice compartment into the food compartment, and thence upwardly in the food compartment as the gas becomes heated. Obviously, the amount of heat absorbed is in direct proportion to the surface area of the 20 refrigerant exposed to air circulation. Consequently, there is, in any water ice refrigerator, an undesirable and unavoidable wide variation in internal temperatures as a large volume of water ice melts away to nothing. 25

An important feature of the present invention resides in the provision of means for eliminating this temperature variation in household refrigerators. To this end, a dry ice container 13 is provided for installation in the ice compartment 30 of a household refrigerator, said container being in the form of a box 14 having a closure 15 permitting of access thereto. The container, when closed, is gas tight. In the present construction the container construction embodies inner walls 35 16, spaced outer walls 17, both being of a good heat-conducting material, and a separating layer 18 of heat insulating material therebetween. The closure 15 is of similar construction.

40 The container is supported in spaced relation to the bottom wall of the ice compartment by suitable members 19. It will be evident that the refrigerator may be manufactured with the container as an integral part thereof or that the container may be produced as an attachment unit for incorporation in existing refrigerators. Moreover, it is possible, as will become apparent, to construct and arrange the assembly so that the container is readily detachable from the refrigerator whereby a refrigerator is produced which is convertible for consumption of dry ice or water ice. 45

As has been mentioned, the inner and outer container walls 16, 17 are heat conducting. 55

When, therefore, a quantity of dry ice is placed in the container, the conductivity of the walls equalizes the temperature and insures that the temperature over the external surface of the container is uniform. For the same reason, the temperature remains constant regardless of the quantity of dry ice therein. The temperature within the container is approximately minus 110° Fahrenheit when the dry ice is surrounded by pure carbon-dioxide.

Advantage is taken of the fact that carbon-dioxide gas is heavier than air to maintain an atmosphere of pure carbon-dioxide gas about the dry ice by providing a small duct or conduit 20 from the top of the container. This surrounding gas further insures that the temperature will remain constant and uniform. The conduit 20 communicates with the interior of the container through an extension 21 and discharges to atmosphere externally of the refrigerator through a similar extension 22 mounted in a side wall. Detachable glands 23 of a conventional type connect the conduit and extensions. The extensions are formed of a suitable heat insulating material to prevent heat transfer from the exterior to the interior of the refrigerator through the extension 22 and thence to the interior of the container through the extension 21. If one or the other of the glands 23 is disconnected, the container may be readily removed from the ice compartment to adapt the refrigerator for water ice.

In mounting the container within the ice compartment, the most efficient refrigeration or heat transfer is obtained when the walls of the container are all spaced from the opposing walls of the compartment, as shown in Figs. 2 and 3, whereby free circulation of air about the container is obtained. Since the external area and temperature of the container is constant, the quantity of heat energy taken up as the air within the refrigerator circulates will also be constant.

It will be evident that the reduced temperature which might be obtained by the use of dry ice in a small refrigerator would be much too low for ordinary refrigeration purposes. An important feature of the invention is a novel arrangement whereby a predetermined temperature within the refrigerator is positively and efficiently maintained without mechanical control. The customary construction of a household refrigerator includes a layer of insulation 10^a (Fig. 2) as a part of the outer wall structure. This insulation does not entirely prevent the transfer of heat energy through the walls of the refrigerator and the effect of the insulation is, therefore, to determine the mean refrigerating temperature within the refrigerator. In my refrigerator, the total heat transfer through the container walls 16, 17 and insulation 18 is, as nearly as is practically possible, arranged to be the same as, or to balance, the total heat transfer through the walls of the refrigerator. For a practical example, it is presumed that the insulating effect of the refrigerator walls maintains a mean internal temperature of 40° Fahrenheit. The quantity of heat energy which is absorbed through the insulated walls of the refrigerator to produce this temperature may be readily calculated. The container walls are, therefore, insulated to permit the absorption therethrough of the same quantity of heat energy. As a result, the heat transfer or loss of the refrigerator is balanced by the heat loss

of the container and the temperature within the refrigerator will be maintained at the proper point.

The entire specific heat of the gas is utilized in the present device up to or slightly beyond the internal temperature of the refrigerator by forming a number of convolutions, indicated generally at 24 (Fig. 3), in the conduit 20 and by locating the conduit adjacent the top surface of the container where it is in the path of the air of highest temperature. Consequently, the specific heat of the exhaust carbon-dioxide gas is utilized to absorb the maximum of heat energy before it is discharged.

In Fig. 4 is shown a slightly modified form of the invention wherein a dry-ice container 25 is built into the ice compartment as a permanent part of the refrigerator. In this construction, the open face of the container is substantially coincident with the opening in the ice compartment, the container walls which define said open face being secured to the refrigerator frame. A single closure 26 for the ice compartment opening will, therefore, close the container and should, of course, seal the container against gas leakage. This construction eliminates one closure in the double closure construction but, of course, only exposes five sides of the container to air circulation. The latter objection is not serious, however, since the insulation of the container may be arranged to compensate for the elimination of the sixth side. The closure 26 should be very well insulated against heat transfer and for this reason the inner surface thereof is preferably of an insulating material such as a sheet 27 of fibrous material.

If desired, the present invention may be readily adapted to freeze ice cubes. In one arrangement for this purpose the container is provided with a horizontal partition 28 (Fig. 4) having opposed L-shaped brackets 29 thereon for engaging the flanges 30 customarily provided on an ice cube tray or pan 31. Water in the pan will be subjected to the exceedingly low temperature within the container and may, therefore, be frozen in a very short time.

With reference to Fig. 5, one form of means for utilizing the otherwise wasted carbon-dioxide gas for carbonating beverage is illustrated. Thus, a closed carbonating tank 32 or the like, having a filling opening 33 and an outlet faucet 34, is supported by suitable brackets 35 on one side of the refrigerator. The conduit extension 22 has a relief valve 36 of well known construction attached thereto and a duct 37 connects the extension with the tank. If the relief valve 36 is adjusted to open at a pressure greater than the usual carbonating pressure (generally about ten pounds per square inch) the gas, until that pressure is reached, will be by-passed to the liquid in the tank to carbonate it. All gas not required for carbonation purposes will, of course, be exhausted to atmosphere through the relief valve 36. Preferably, the flow of gas to the tank 32 is controlled by a suitable valve 38 interposed in the duct 37.

It will be evident from the foregoing that a novel refrigerator has been provided which is simple in construction and is efficient in operation. Dry-ice or a similar low temperature refrigerant is efficiently utilized to maintain a definite refrigerating temperature within the refrigerator without mechanical control means which are apt to fail because of the extremely low temperatures to which they are necessarily sub-

jected. Moreover, the present device is advantageous in that no waste gas can escape into the food compartment whereby the injurious effect of the gas on the food stuffs therein is not encountered.

I claim as my invention:

1. A refrigerator comprising, in combination, an insulated box-like structure having internal food and refrigerant receiving compartments, an insulated container for solid carbon-dioxide mounted in the refrigerant compartment in spaced relation to the walls of the compartment to permit air to flow about the container, said container structure including spaced walls of heat conducting material and heat insulating material separating the walls, and a conduit for conveying waste gas from the upper part of the container interior to atmosphere, said container having a heat transferring capacity substantially equal to the heat transferring capacity of the walls of the box-like structure.

2. In a refrigerator, the combination of a closed container for solid carbon-dioxide as a refrigerant, means for mounting said container in a refrigerator, and a waste gas conduit communicating with the interior of the container, said conduit having an end of material which is a non-conductor of heat extending through a wall of the container to minimize heat transfer by the conduit.

3. A refrigerator comprising, in combination, an insulated refrigerator structure embodying substantial interior compartment space, an insulated container for a subliming refrigerant and removably mounted in said structure, means for supporting said container in spaced relation to the walls of the compartment to permit air flow thereabout, means for gaining access to the interior of said container for refilling the same with refrigerant, and a conduit for conveying waste gas from the interior of said container to the exterior of said structure, said container including spaced walls of a material substantially impenetrable by gas and separated by heat insulating material for retarding the passage of heat into said container, said container walls having a heat transfer capacity substantially equal to the heat transfer capacity of the walls of the refrigerator structure whereby the heat transfer through said structure will be balanced by heat transfer through said container and sublimation of said refrigerant.

4. In a refrigerator adapted for the use of solid carbon-dioxide as a refrigerating medium, the combination of a refrigeration structure adapted for convection circulation of enclosed air and having a sealed container therein for solid car-

bon dioxide, said container being arranged for air circulation in contact therewith so as to transfer heat to said container to effect sublimation of said solid carbon dioxide and cooling of the air, a gas conduit extending from the container to the exterior of said structure for conducting waste gas from the container, a carbonating tank for liquors mounted on said structure and connected with said conduit, and a relief valve interposed in said conduit between said container and said tank and arranged to exhaust to atmosphere all waste gas in excess of that required to maintain a predetermined maximum pressure in said tank.

5. In refrigeration apparatus adapted for household use, an insulated-wall refrigerator structure having therein a container for solid carbon-dioxide for maintaining a refrigerating temperature by sublimation of said solid carbon-dioxide, a tank of limited capacity containing a liquid to be carbonated and including means for withdrawing liquid as required, a gas conduit leading from said container and communicating with said tank to convey waste carbon-dioxide gas to the tank for carbonating the liquid, and pressure controlling means in said gas conduit for maintaining the gas at a low pressure sufficient for carbonating the liquid in said tank for household use, said pressure controlling means being disposed to permit escape of excess gas from said conduit to atmosphere exteriorly of said structure so as to relieve said container of the insulating effect of the gas and permit free heat transfer to the solid carbon-dioxide from the atmosphere within said structure.

6. In combination, an insulated refrigerator structure, a container for solid carbon-dioxide supported in spaced relation within said structure to permit air flow by convection about the container, said container including insulated walls having a heat transfer capacity substantially equal to the heat transfer capacity of the walls of said structure for maintaining a balanced temperature within the structure by sublimation of the solid carbon-dioxide, a gas conduit for conveying waste carbon-dioxide gas from said container to atmosphere exteriorly of said structure and including pressure controlling means for maintaining said gas at a predetermined pressure, a carbonating tank for liquids, a duct communicating at one end with said conduit intermediate said relief valve and said container and at its other end with said tank for conducting waste gas to the latter, and a valve in said duct for controlling the flow of gas to said tank.

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