May 8, 1934. J. H. SHAFNER 1,958,403

HEAT TRANSFER STRUCTURE

Filed May 25, 1931

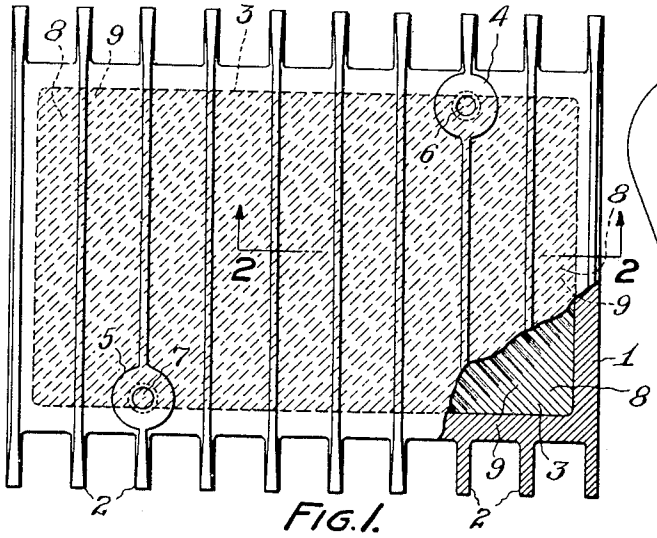


FIG. 1.

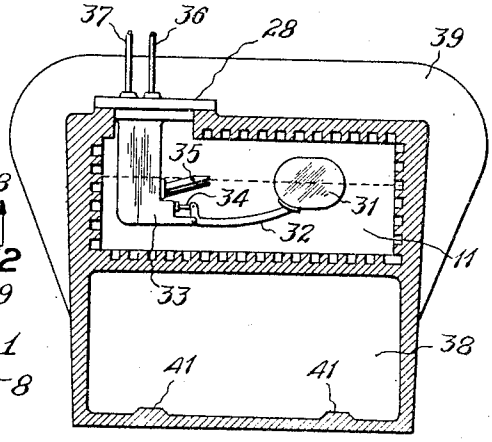


FIG. 6

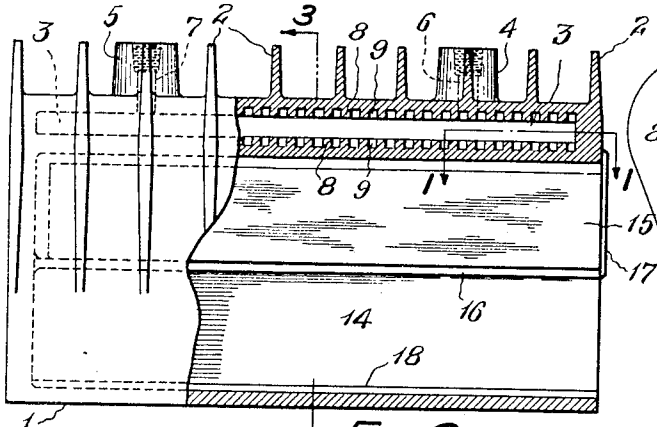


FIG. 2

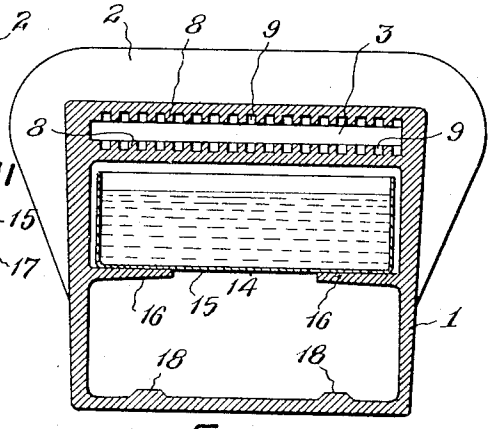


FIG. 3

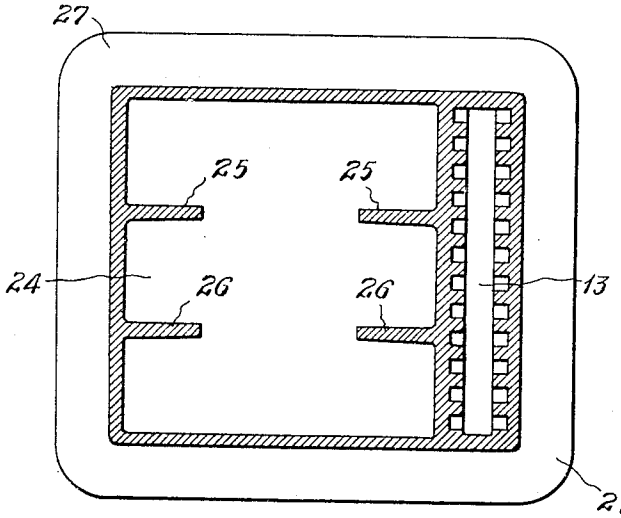


FIG. 5

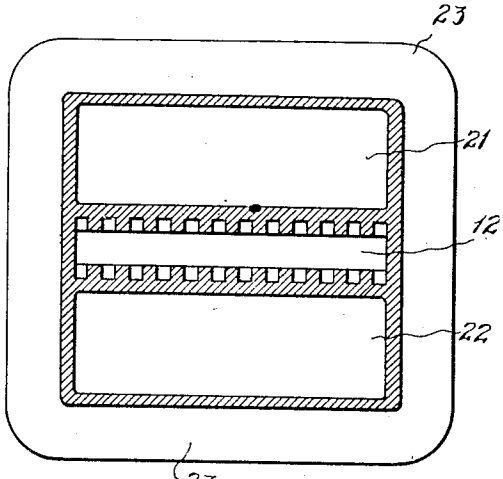


FIG. 4

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HEAT TRANSFER STRUCTURE

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10 Claims. (Cl. 62—95)

This invention as indicated relates to a heat transfer structure and method of making the same. More particularly it comprises an integral structure of cast metal providing a passageway for a temperature regulating medium having an extended area within the same, such chamber preferably being associated with a chamber for receiving the material to be subjected to predetermined temperature conditions.

The invention also includes the method of producing a cast metal structure wherein a temperature conditioning chamber is juxtaposed to a material receiving chamber in a single integral structure whereby the temperature conditioning effect will be readily transmitted from the first chamber to the second.

The invention as shown has particularly in view the provision of a refrigerating unit such as may be installed within mechanical refrigerators of conventional type and provide means for absorbing the heat within the refrigerator as well as means for cooling material within the chamber formed integrally with such unit. Such integral chamber may be formed as provided for the reception of trays within which ice cubes may be formed or ice cream and the like prepared. But obviously it is not intended to restrict the invention to such particular construction.

The invention is also adapted for the use in imparting heat to a chamber and to a compartment formed integrally with the chamber within which the temperature conditioning medium circulates.

The temperature controlling medium circulated through the heat transfer chamber thus may be either a heating or a cooling agent. When used in connection with refrigerating apparatus some suitable cooling agent is used such as methyl chloride, butane, sulphur dioxide or the like. In such forms of apparatus the cooling chamber serves as an expansion chamber wherein the latent heat of vaporization within such a chamber withdraws heat from the walls of the refrigerating unit and from the atmosphere in contact with such walls, as well as through adjacent parts of the structure associated with said walls. The surface area of the walls of such expansion chamber both exteriorly and interiorly thereby may be increased through the use of fins or like structural elements providing the more extended surface for contacting with the surrounding atmosphere and causing temperature modification thereby.

Another feature of the invention comprises the supplying of an integral structure formed of material having high capacity for heat conduction as well as one which is unaffected by the chemical action of the cooling medium employed, and which at the same time can be so constructed as to be free of structural imperfections which would permit leakage of the cooling element, sometimes referred to in the trade as a "coolant", from such a chamber because of the porosity of the metal used in the construction of such chamber.

Another feature of the invention comprises means for evenly distributing a fluid throughout a chamber or passageway by incorporating in the walls thereof integrally formed baffling elements preferably in the form of ribs or grooves, and preferably in series arranged obliquely with reference to each other on the wall surfaces opposite each other.

Heretofore cooling chambers for refrigerators have been prepared wherein metal of a high degree of conductivity, such as aluminum and its alloys, has been used, but the porosity of such structures has been so great that some special means of preventing leakage of the cooling agent from the aluminum block has been found necessary. Such means has included various coatings, and in some instances has included the incorporation within the aluminum block of passageways for the circulation of the cooling agent which had been in the form of a liner of some impervious material to prevent leakage. In some structures tubing of a metal other than aluminum has been employed in the form of a conduit for the circulation of the cooling agent through the aluminum block.

The principal object of the present invention is to provide an improved structure for heat transfer purposes which will be of cast metal of high heat conductivity and which also will be capable of withstanding a high degree of pressure from the heat transfer medium.

Another object of the invention is to provide an integral cast metal unit provided with a chamber for receiving a heat transfer medium in association with a chamber for material to be acted on thereby and also providing special means for more effectively transferring heat from one of said elements to the other.

Another object of the invention is to provide a unit particularly adapted for refrigerators wherein there is cast in a single block a chamber for receiving the cooling medium and a chamber for receiving material to be acted on thereby.

Another object of the invention is to provide

a refrigerating unit of a material of high conductivity which is provided exteriorly of such unit with means, such as fins, for acting upon the atmosphere surrounding such chamber and having additional means for transferring heat relatively to an interior chamber within such unit with a high degree of efficiency.

Another object of the invention is to provide a cast metal refrigerating unit formed of metal having a high degree of heat conductivity and having heat transferring elements with an increased exterior and interior surface so related to the chamber for the cooling medium, that a predetermined ratio of refrigerating action will be established for such unit with relation to the refrigerating chamber within which such unit is positioned and also with relation to a smaller cooling chamber closely associated with the chamber for the cooling agent.

Another object of the invention is to provide an apparatus of the character described wherein the metal employed for such apparatus not only has a high capacity for heat conduction but is substantially unaffected chemically beyond a negligible surface modification in some instances, by the refrigerating agent employed, and which also has sufficient density and uniformity of structure to make such unit free of leakage of the refrigerating agents within the same even when such agents are under relatively high pressure.

A further object of the invention is to provide a chamber for receiving the cooling fluid which embodies within itself means for insuring further distribution of the cooling agent circulated therethrough and which also is provided with an increased surface within the chamber for enhancing the heat transfer action of the unit in relation to such cooling medium. Other and further objects of the invention will appear in the course of the following description.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims. The annexed drawing and the following description set forth in detail certain structures embodying such an invention, and the method of making the same, such disclosed means and method constituting, however, but several of various applications of the principle of my invention.

In said annexed drawing, Fig. 1, is a top plan view partly broken along the line 1—1 as shown in Fig. 2, of the preferred form of construction embodying the principles of the invention;

Fig. 2, is side elevation of the structure shown in Fig. 1, partly shown in vertical section along the line 2—2, shown in Fig. 1;

Fig. 3, is a transverse vertical sectional view taken at the plane indicated in line 3—3 in Fig. 2, looking in the direction of the arrows;

Fig. 4, is a view similar to Fig. 3, but showing a modified form of construction;

Fig. 5, is a view similar to Fig. 3, showing another modified form of construction; and,

Fig. 6, is a view similar to Fig. 3, showing another modified form of construction with a float valve mechanism in an expansion chamber.

As will appear from Figures 1, 2 and 3 the preferred form of construction comprises a refrigerating unit 1, formed of cast metal and provided exteriorly thereof with a series of parallel fins 2, which as shown in Fig. 3, more particularly, extend across the top of said unit and taper downwardly at each of the sides thereof to a distance somewhat greater than the central horizontal plane of the unit. For convenience in casting the fins may be tapered slightly upwardly and downwardly as seen in cross-section to provide the necessary draft in the casting operations.

Within the top of the unit a chamber 3, is provided which is of substantially the full width of said unit, but of shallow depth said chamber being adapted to serve as the cooling or expansion chamber for the structure when used as a refrigerating unit. Said unit, as is shown in Figs. 1 and 2, is provided on its upper side with bosses, 4, 5, on opposite sides of the top and adjacent opposite ends thereof through which bosses passageways 6, 7, to the interior of said expansion chamber are formed, said bosses preferably being counter-bored and screw-threaded to provide for the attachment of conduits to carry the cooling medium into the expansion chamber and to permit the discharge of said medium therefrom.

The expansion chamber is preferably formed on the inner faces of its upper and lower walls with a series of alternate ribs, 8, and grooves, 9, which provide for an increased area of inner surface for such expansion chamber. As will be noted particularly in Figure 1, the ribs and grooves in the upper wall of the expansion chamber extend obliquely in one direction. This arrangement provides for the even distribution of the fluid within the expansion chamber and prevents localized action of the cooling medium through the formation of eddy currents or uneven movement of the fluids into and out of such chamber.

In Figs. 1, 2 and 3, the expansion chamber 3 is shown at the top of the unit and in Fig. 4, the expansion chamber 12 is shown at an intermediate position in the unit and in Fig. 5, the expansion chamber 13 is shown at the right hand side of the unit. Still other positions for the expansion chamber may be provided and a single expansion chamber may be formed to extend about more than one side of the unit or may be so positioned to be insulated substantially from the side walls of the unit thereby having space chambers about the same on substantially all sides.

In the preferred form of construction which shows a unit adapted to be placed in mechanical refrigerators of conventional type, there is formed immediately beneath the expansion chamber a large chamber 14 open at one end of the unit and adapted to receive trays 15 for the reception of water for ice cubes, or of various frozen mixtures, such as ice cream and the like, which are to be exposed to the cooling action of the medium within the expansion chamber.

The lower chamber in the form illustrated shows a pair of integrally formed supporting members or flanges 16 extending centrally of each of the inner side walls of the unit from front to back upon which the upper tray for the material to be cooled is adapted to be slidably engaged. Said tray preferably is formed with an extension member 17 at its outer end which overlaps the adjacent side wall of the unit and forms a closure for the opening at that point. A similar tray may be provided for the lower portion of the opening and be formed with a similar extension member to serve as a closure therefor. The lower tray will preferably be slidably engaged upon a pair of longitudinally extending members 18 formed integrally with

the bottom wall of said unit and raised slightly above the upper surface of said wall.

In the form of construction shown in Figure 4, two chambers 21, 22 are provided, being located respectively above and below the expansion chamber 12 within which the material to be cooled may be placed and obviously trays may be engaged therein in a manner similar to that illustrated in Figures 2 and 3. The cooling chamber being thus at the bottom of one of the trays and above the other of said trays. The parallel rows of fins 23 in the form of construction shown in Figure 4 may extend completely around the refrigerating unit.

In the form of construction illustrated in Figure 5, the expansion chamber 13 is positioned at one side of the refrigerating unit and the chamber 24 for the reception of the material to be cooled is positioned at the other side of said unit and in the form shown is formed with a double set of supporting members or flanges 25, 26, on each of its side walls, so that three trays may be positioned within such space. The fins 27 in this form of construction are shown as extending completely about the unit instead of merely adjacent to the cooling chamber thereof.

In the form of construction shown in Figure 6, the expansion chamber 11 is of a different type than is shown in the other forms of the apparatus. It is of larger size than the previously described chambers and has a ribbed or corrugated surface on its upper and lower walls and also along its side walls. By means of a large aperture in its top wall the float and its associated mechanism may be introduced within the expansion chamber, such mechanism being supported upon a closure cap 28 adapted to be engaged in sealing relation with said opening. The float mechanism is of conventional type comprising a float member 31 supported at the end of a bell crank lever 32 pivoted at the lower end of a casing 33 co-operating with the stem 34 of a valve (not shown) for the admission of cooling liquid positioned within said casing. An oil return passageway 35 is provided from the normal liquid level from such a chamber downwardly into the casing so as to free the cooling medium of oil which is carried through from the pump mechanism (not shown). Inlet and outlet pipes 36, 37 connect with the casing through the closure member above referred to. In said construction a chamber 38 is provided for the reception of a tray or other receptacle for the material to be cooled. Fins 39 across the top of the unit may be provided similar to those shown in Figures 1 to 3, inclusive. Ribs 41 may be formed on the bottom of the receptacle extending longitudinally of the chamber.

What I claim is:

1. A metal structure providing a substantially rectangular passageway for fluids and having on inner opposing wall surfaces thereof oppositely directed diagonal series of baffling elements, providing parallel elements on one wall running at an acute angle to the corner edges of the passageway, and parallel elements on the opposing wall running at substantially a corresponding angle in the opposite direction.

2. A cast metal structure providing a substantially rectangular passageway for fluids and having on inner opposing wall surfaces thereof oppositely directed diagonal series of baffling elements formed integrally therewith, providing parallel elements on one wall running at an acute angle to the corner edges of the passageway, and parallel elements on the opposing wall running at substantially a corresponding angle in the opposite direction.

3. A cast metal structure providing a substantially rectangular passageway for fluids and having on inner opposing wall surfaces thereof oppositely directed diagonal series of parallel ribs formed integrally therewith, the ribs on one wall surface running at an acute angle to the corner edges of the passageway, and the ribs on the opposing wall surface running at substantially a corresponding angle in the opposite direction

4. A cast metal structure providing a substantially rectangular chamber for the reception of a temperature conditioning medium within the same, and provided with ribs on the inner and outer walls thereof to increase the normal heat transfer surface thereof, the ribs on the inner walls being diagonally positioned and running at an acute angle to the corner edges of the chamber to evenly distribute fluid passing thereadjacent.

5. A cast metal structure providing a substantially rectangular chamber for the reception of a temperature conditioning medium within the same, and provided with integrally formed ribs on the inner and outer walls thereof to increase the normal heat transfer surface thereof, the ribs on the inner walls being diagonally positioned and running at an acute angle to the corner edges of the chamber to evenly distribute fluid passing thereadjacent.

6. A cooling unit for refrigerators comprising an integral cast metal block having formed therein a substantially rectangular evaporating chamber and a material receiving chamber closely associated therewith, said evaporating chamber having diagonally extending alternate ridges and depressions within the interior surface thereof, running at an acute angle to the corner edges of said chamber to cause turbulence and even distribution of the fluid passing thereadjacent.

7. An integral casting comprising a refrigerating unit formed of aluminum alloy, said unit including an expansion chamber and a material receiving chamber adjacent thereto and a plurality of fins formed on exterior surfaces of said unit for heat transfer purposes from the surrounding air to the cooling fluid within said expansion chamber, and a plurality of areas offset from the normal planes of the interior surfaces of said expansion chamber to provide diagonally extending ribs for increasing the surface area thereof and evenly distributing fluid passing thereadjacent.

8. An integral casting comprising a refrigerating unit formed of aluminum alloy, said unit including an expansion chamber and a material receiving chamber adjacent thereto and a plurality of fins formed on exterior surfaces of said unit for heat transfer purposes from the surrounding air to the cooling fluid within said expansion chamber, and a plurality of areas offset from the normal planes of the interior surfaces of said expansion chamber to provide diagonally extending ribs for increasing the surface area thereof and evenly distributing fluid passing thereadjacent, and an integral chamber formed within said casting for receiving material to be acted on by the cooling agent within said expansion chamber.

9. An integral casting providing a substantially rectangular expansion chamber interiorly thereof and having enlarged surface areas on inner and outer walls thereof, said inner walls

being formed with a plurality of ribs extending at an acute angle to the adjacent corner edges of said chamber.

10. An integral casting providing a substantially rectangular expansion chamber interiorly thereof and having enlarged surface areas on inner and outer walls thereof, said inner walls being formed with a plurality of ribs extending at an acute angle to the adjacent corner edges of said chamber, said expansion chamber having a series of ribs on its upper and lower walls, each series extending at an acute angle to the adjacent corner edges of said chamber, the ribs on said respective surfaces being disposed in opposite direction to each other.

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