May 6, 1941. L. F. CLERC 2,240,760

REFRIGERATING APPARATUS

Filed Feb. 13, 1939 4 Sheets-Sheet 1

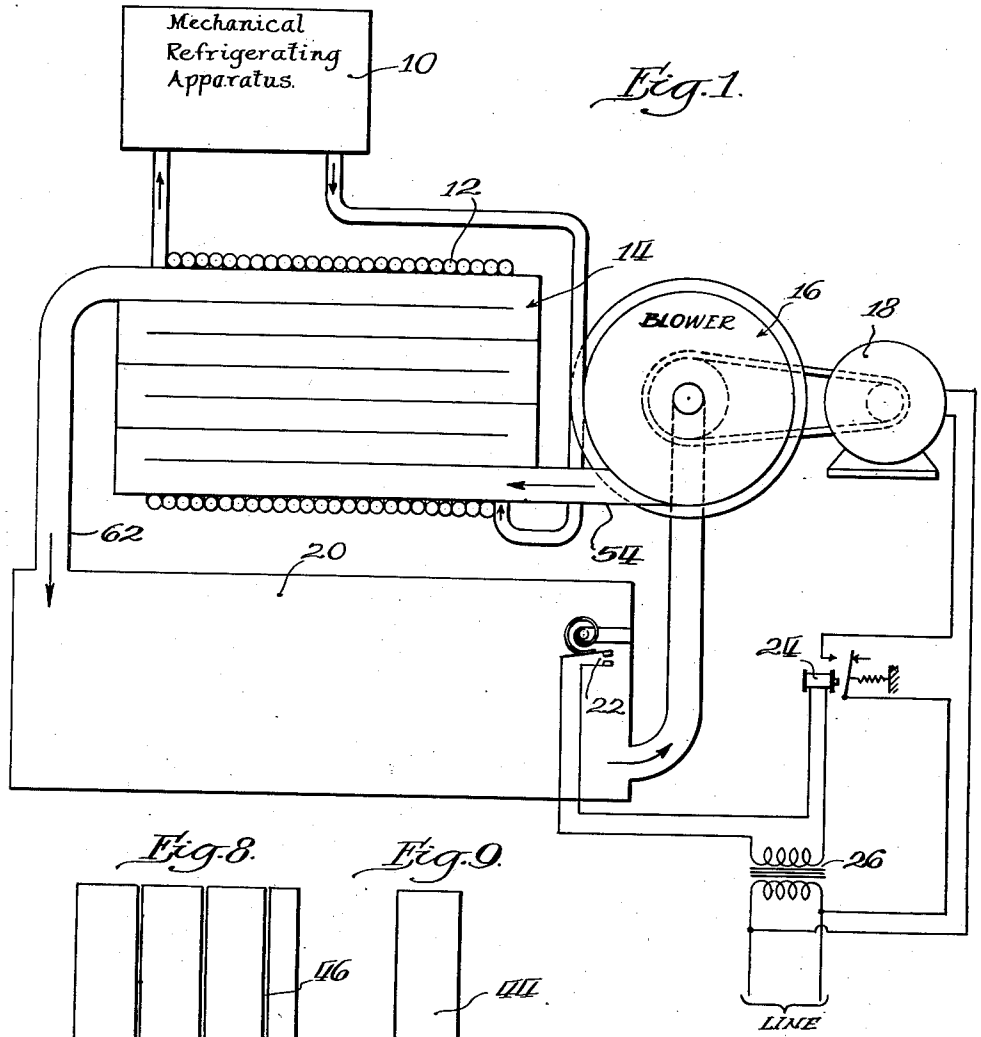


Fig. 1.

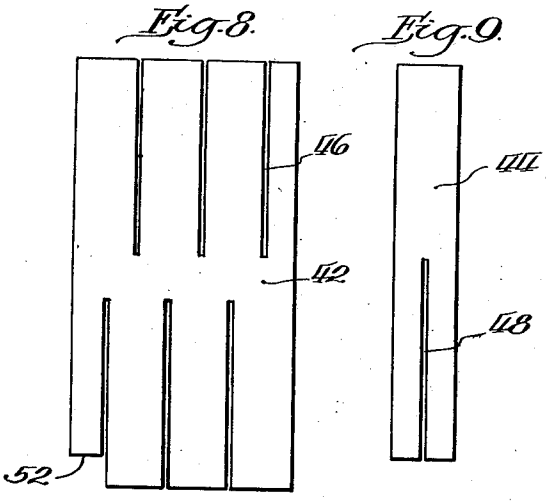


Fig. 8.

Fig. 9.

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Fig. 2

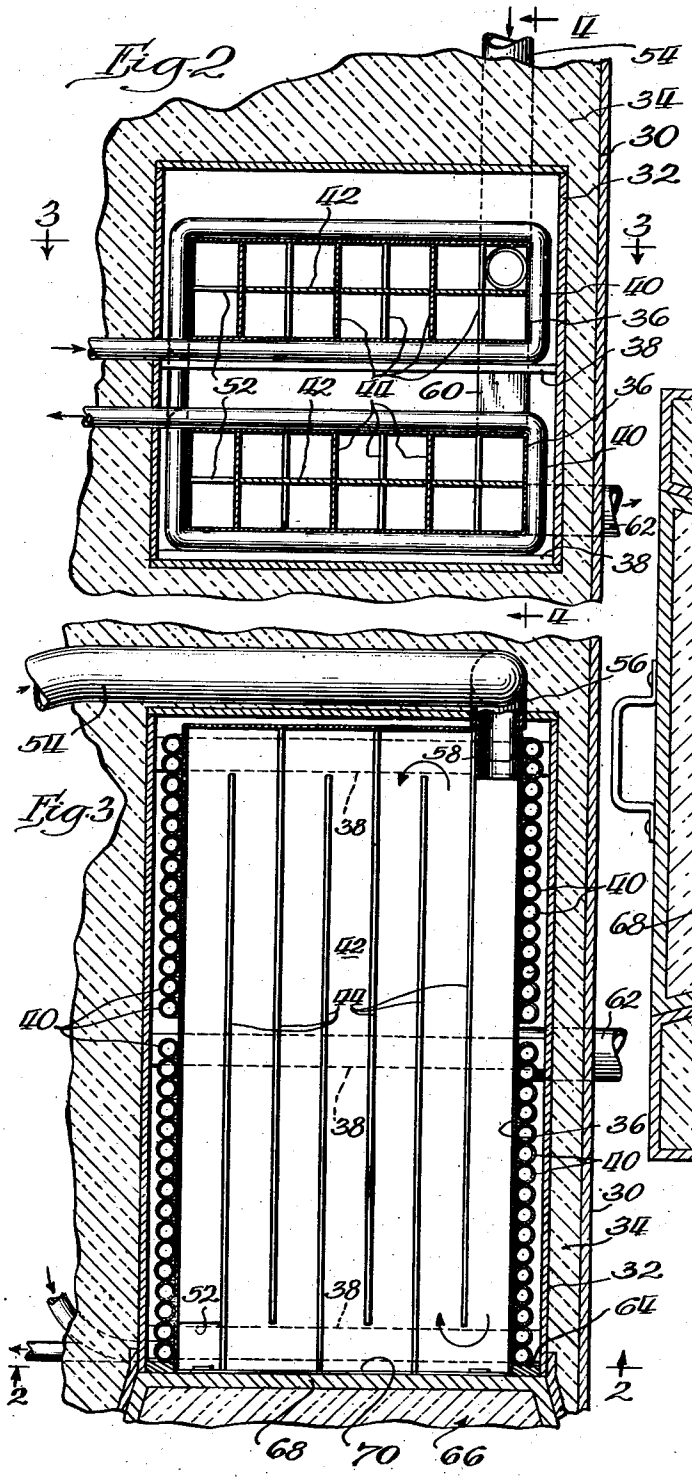


Fig. 4

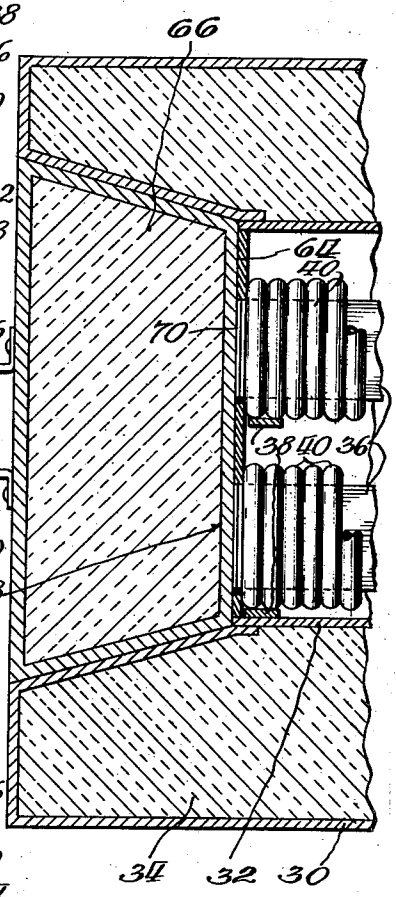


Fig. 3

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Fig. 5.

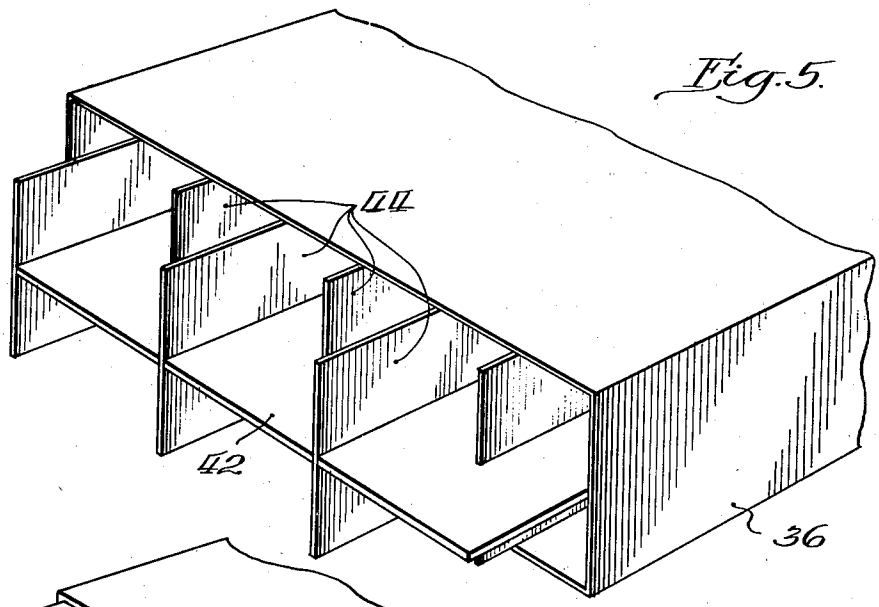
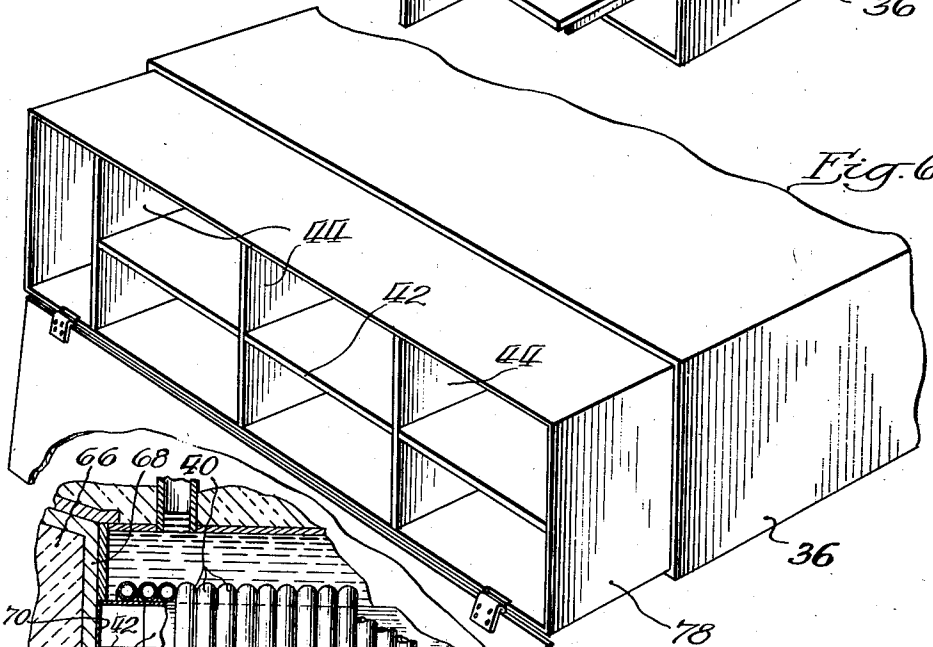


Fig. 6.



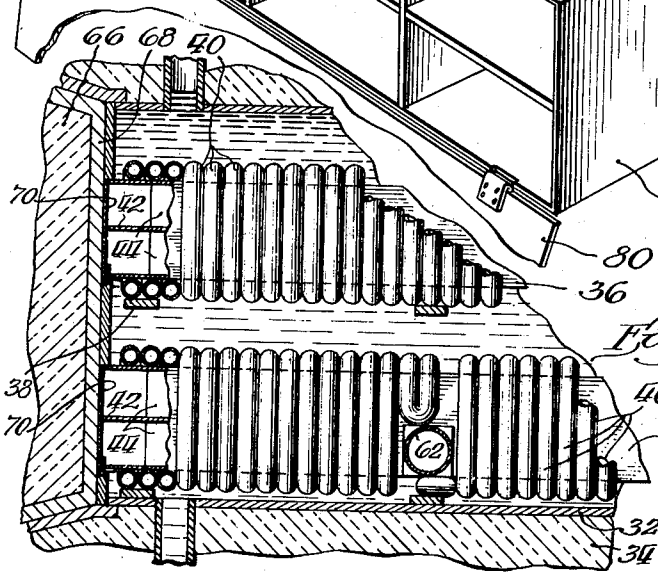


Fig. 7.

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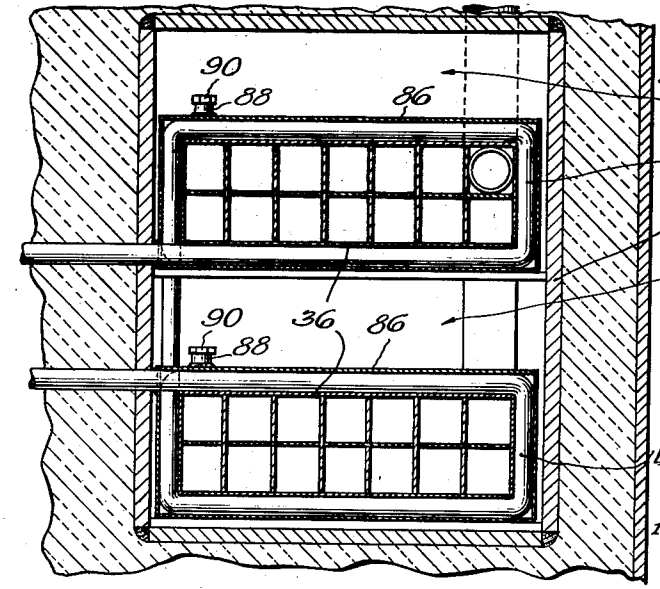


Fig. 10

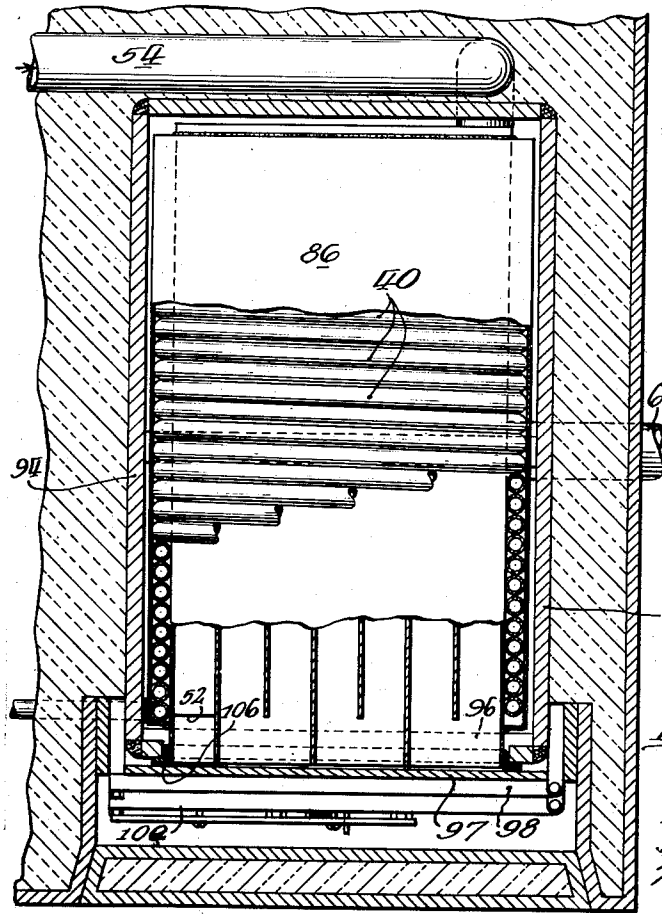


Fig. 11.

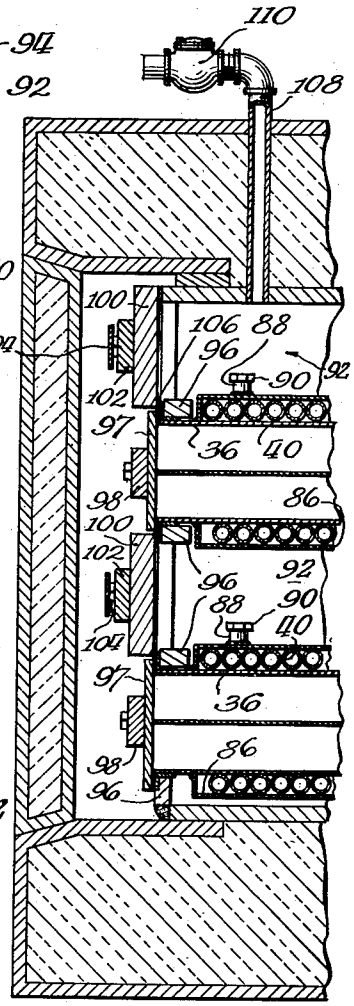


Fig. 12.

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UNITED STATES PATENT OFFICE

2,240,760

REFRIGERATING APPARATUS

Leonard F. Clerc, Chicago, Ill.

Application February 13, 1939, Serial No. 256,028

8 Claims. (Cl. 62—140)

My invention relates generally to refrigerating apparatus, and more particularly to improvements in the heat transfer means of refrigerating apparatus.

It is an object of my invention to provide an improved heat transfer device for refrigerating apparatus by which the defrosting operation is facilitated.

A further object is to provide an improved heat transfer means in which a portion is easily removable from the apparatus for defrosting.

A further object is to provide an improved heating transfer apparatus in which the cooling coils are immersed in a nonfreezing medium.

A further object is to provide an improved refrigerating apparatus in which a dry ice refrigerant may be used alternatively with a mechanical refrigerating means.

A further object is to provide an improved refrigerating apparatus for use in cooling refrigerating cabinets as employed in grocery, meat stores, and the like, for cooling chambers in which food or other products are to be stored at a low temperature, for supplying the cooling medium for the quick freezing of food products, and for various other air conditioning and cooling applications.

Other objects will appear from the following description, reference being had to the accompanying drawings, in which:

Fig. 1 is a diagrammatic view of a refrigerating system embodying the invention;

Fig. 2 is a vertical sectional view of the heat transfer device;

Fig. 3 is a horizontal sectional view of the heat transfer device;

Fig. 4 is a vertical sectional view of the forward end of the heat transfer device;

Fig. 5 is a fragmentary perspective view of the heat transfer case showing the defrosting baffle partially removed;

Fig. 6 is a view similar to Fig. 5 showing a modified form of the defrosting tray;

Fig. 7 is a vertical sectional view of a modified form of the heat transfer device;

Figs. 8 and 9 are plan views of the elements of which the defrosting baffle of Figs. 5 and 6 are constructed;

Fig. 10 is a vertical sectional view of a modified form of the heat transfer device in which dry ice may be used as an alternative refrigerant;

Fig. 11 is a fragmentary horizontal sectional view of one of the heat transfer units of Fig. 10; and

Fig. 12 is a fragmentary vertical sectional view of the apparatus of Fig. 10 showing particularly the closures for the dry ice compartments and defrosting baffle chambers.

The invention is usable in any one of a variety of different refrigerating systems, one of which is diagrammatically illustrated in Fig. 1 as comprising a mechanical refrigerating apparatus 10 having an evaporating coil 12 connected thereto. The coil 12 surrounds a heat exchange device 14 having a circuitous passageway through which air to be cooled is forced by a blower 16 driven by a motor 18. The cooled air is transmitted from the heat exchange device 14 to a chamber 20, the air in which or the contents of which are to be cooled. The operation of the motor 18 is controlled by a thermostatically operated switch 22 which closes whenever the temperature of the chamber 20 rises above a predetermined maximum temperature, and completes a circuit to a relay 24 which derives current from a transformer 26, the primary of which is connected to the power supply line. Energization of the relay 24 closes a circuit from the line to the motor 18.

In a system of the type shown in Fig. 1, difficulty has been experienced in maintaining the heat exchange device 14 free from frost, especially when the apparatus is made for cooling a relatively large chamber containing moist articles, or which is frequently opened, thereby admitting warm air. To enable the defrosting of the heat exchange device to be accomplished easily and quickly, the partitions forming the circuitous passageway through the casing are made removable as a unit. As shown in Figs. 2, 3, and 4, the heat exchange device is mounted in a cabinet having a wall 30, being enclosed in a hermetically sealed chamber 32 which may be made of steel sheets welded together. The chamber 32 is surrounded by a suitable heat insulating material 34. Within the chamber 32 is a pair of casings 36 which are similar in shape and are supported by transverse bars 38. The casings 36 are surrounded by the evaporator coils 40. Within each of the casings is a baffle member forming the circuitous passageway through the casing and comprising a horizontal plate 42 having vertical plates 44 secured thereto. As shown in Figs. 8 and 9, the plate 8 has a plurality of slots 46 extending from the opposite ends of the plate toward the central portion thereof, while the plates 44 have single slots 48 formed therein. By virtue of the arrangement of the slots, the plates 44 may be assembled on the plate 42 in a manner such that the plates 44 form a circuitous passageway on each side of the plate 42. The

plate 42 has a corner cut away, as indicated at 52 (Fig. 3) connecting the circuitous passageway above the plate 42 with that formed beneath the plate. The plates 44 are secured to the plate 42, preferably by welding.

The air to be cooled is supplied by the blower through a pipe 54 (Fig. 3) which terminates in an elbow 56 having a nipple extension 58 which projects into a suitable hole formed in the rear end wall of the casing 36 and is secured thereto. The upper casing 36 is joined to the lower casing by a pipe 60, and an outlet pipe 62 is connected to the end of the circuitous passageway at the bottom casing 36. The forward end of the chamber 32 is closed by a plate 64 which has rectangular apertures conformed to receive the casings 36 and to which the ends of the casings are welded. The forward ends of the casings 36 are closed by a door 66, the inner wall 68 of which may be provided with a gasket capable of sealing against the end edges of the plates 42 and 44, or as shown in Figs. 3 and 4, the forward ends of the casings 36 may be provided with hinged doors 70.

It will be understood that in operation, the coils 12 will be heated by the air forced through the circuitous passageways in the casings 36, and the cooled air will be discharged into the chamber 20, the temperature of which is to be lowered. The blower 16 preferably draws air from the chamber 20 so as to reduce the amount of heat which must be extracted from the air to maintain the chamber at the desired temperature.

If the chamber 20 contains moist food, or is otherwise subject to admission of moisture-containing air, considerable frost will be deposited upon the baffle plates 42, 44, and upon the inside walls of the casings 36. By making the passageway assembly formed by the plates 42 and 44 removable from the casing 36, the operation of defrosting is greatly facilitated, since, upon the removal of the plates 42, 44, the frost may be easily scraped from the inside walls of the casing, and the frost adhering to the plates 42 and 44 may, of course, be readily removed by plunging the assembly in water.

In order to avoid the necessity of scraping the inside walls of the casing 36, the modified form of the invention shown in Fig. 6 may be utilized. In this construction, the plates 42 and 44 are permanently secured in a box like baffle structure 78 which is telescopable into the casing 36 and which is provided at its forward end with a hinged door 80. The box-like baffle structure 78 is, of course, provided with openings adapted to register with the inlet and outlet pipes, and may be removed as a unit from the casing, and quickly and easily defrosted by plunging it in water. While the construction shown in Fig. 6 has the slight disadvantage that the heat must travel through an additional sheet of metal, the heat conduction between the baffle structure and the casing 36 is sufficient to accomplish the desired results, since the baffle structure 78 may fit the casing 36 quite closely so as to have a minimum air space between these parts.

The efficiency of the system may be improved by surrounding the evaporator coils 40 with a liquid, as illustrated in Fig. 7, wherein the parts may be of substantially the same construction as those previously described, the only difference being that the chamber 32 is completely or partially filled with a suitable liquid having a low freezing point, a liquid such as alcohol. The evaporator coils being thus immersed in the liquid, the rate of heat conduction from the casing 36 to the evaporator coils is increased.

By providing the long circuitous passageways through the heat exchange devices and forcing air through these passageways under pressure by means of the blower, the air in the chamber 20 may be cooled to a temperature substantially as low as that attained in the evaporator coils, and much lower than is obtained in the usual refrigerator construction wherein convection of the air is relied upon for the transfer of heat from the articles contained in the chamber to the evaporator coils.

In the modification of my invention, shown in Figs. 10, 11 and 12, the coils 40 connected to the mechanical refrigerating apparatus are enclosed by pressure-tight housings 86 provided with filling necks 88 closed by plugs 90. The housings for the two heat transfer units are spaced sufficiently apart, and the chamber in which they are enclosed is sufficiently large to provide spaces 92 above each of the housings for the reception of blocks or slabs of dry ice. The walls 94 of the chamber are sufficiently heavy to withstand relatively high internal pressures in the order of fifty pounds per square inch. The walls 94 are therefore preferably welded together so as to make the chamber fluid tight and strong and rigid. The side walls of the chamber are preferably reinforced by transverse sills 96, to which the casings 36 are welded (Fig. 12). The forward ends of the casings 36 may be closed by suitable doors 97, which may be held in closed position by suitable clamping devices 98. Access to the spaces 92 for the reception of dry ice is obtained through heavy doors 100, which are held in place by clamping bars 102, suitable strong clamping means 104 being provided to hold the doors closed, and the gaskets 106, preferably of buckskin, are provided to make a gas-tight seal. A pipe 108 leads from the top of the dry ice compartment 92, and has a pressure loaded check valve 110 connected thereto. This valve 110 may be set to relieve the pressure in the spaces 92 whenever it exceeds a predetermined maximum such as 55 pounds per square inch.

The object of providing the housings 86 is to furnish containers surrounding the coils 40, which may be filled with alcohol, or other suitable liquid having a very low freezing point. The alcohol serves as a medium for facilitating conduction of heat from the casings 36 to the coils 40 when the mechanical refrigerating apparatus is in use, and similarly serves as a conducting medium for conducting heat from the casings 36 to the housings 86 when dry ice is used as the refrigerating medium.

By providing the construction shown in Figs. 10, 11 and 12, the apparatus may alternatively employ the mechanical refrigerating apparatus or dry ice as the means for extraction of heat from the air which is forced through the circuitous passageways formed in the casings 36. This is of considerable advantage when the apparatus is to be used under circumstances requiring uninterrupted performance for extended periods. Under such circumstances, the mechanical refrigerating apparatus may be disconnected from the unit for repair or replacement, and during the interval that it is removed, dry ice may be placed in the spaces 92 so that the cooling of the air forced through the circuitous passageways in the casings 36 may proceed without interruption. A further advantage of the modified form of the apparatus

shown in Figs. 10, 11 and 12 is that the spaces 92 provide a convenient place for the storage of dry ice, and for the utilization of such dry ice as may have served its initial purpose, and would otherwise have to be discarded. For example, many foods are now shipped to grocery stores, meat markets, and the like, in frozen condition, and the shipping containers are provided with dry ice to maintain the products frozen during transit. Upon receipt of such packages of food, the remaining unevaporated dry ice in such packages is usually discarded, whereas with the apparatus of Figs. 10, 11 and 12, such remaining dry ice could be efficiently utilized.

The doors 100 are provided with suitable means of any well known construction to permit release of the gas pressure within the spaces 92 prior to opening the doors and thereby to prevent possibility of accident due to opening the doors while the contents of the chamber are under pressure. It will be understood that in other respects the apparatus shown in Figs. 10, 11 and 12, may be similar to that shown in Figs. 1 to 9, inclusive.

While I have shown and described particular embodiments of my invention, it will be apparent to those skilled in the art that the invention may be embodied in various similar and equivalent forms. I therefore intend by the following claims to include within the scope of my invention all such modifications and variations by which substantially the results of my invention may be obtained by the use of substantially the same or equivalent means.

I claim:

1. In a heat exchange device for refrigerating apparatus, the combination of a casing, a horizontal plate having a plurality of vertical plates secured thereto to form a baffle structure which, when inserted in said casing, will form a relatively long circuitous passageway, and means in the walls of said casing for admitting air to one end of said circuitous passageway and discharging air from the other end of said passageway.

2. In apparatus of the class described, the combination of a casing, a coil of heat conducting tubing wound around said casing in heat conducting relationship therewith, means for circulating a cooling fluid through said tubing, a plurality of interconnected partitions in said casing to form a relatively long circuitous passageway therethrough, said partitions being removable as a unit from said casing for defrosting, and means for circulating a gaseous medium to be cooled through said circuitous passageway.

3. A removable defrosting baffle structure for a heat exchange device comprising a frame plate having a plurality of open end slots formed therein from opposite edges thereof, the slots leading from one end of said frame plate being spaced intermediate the slots from the other end of said frame plate, a plurality of partition plates secured to said frame plate, said partition plates being intermeshed with said frame plate and having longitudinal slots therein for engagement with said frame plate, the unslotted portions of the partition plates being received by the slots in said frame plate, and means for rigidly securing said partition plates to said frame plate.

4. In apparatus of the class described, the combination of a tank, a casing in said tank, a coil of heat conducting tubing in said tank, means for circulating a cooling fluid through said tubing, a plurality of interconnected partitions in said casing to form a relatively long circuitous passageway therethrough, said partitions being removable as a unit from said casing for defrosting, means for circulating a gaseous medium to be cooled through said circuitous passageway, and a low freezing point liquid in said tank and surrounding said casing and said tubing.

5. In a heat exchange device for refrigerating apparatus, the combination of a casing having a circuitous passageway therein for a fluid to be cooled, a coil surrounding said casing for conveying a cooling medium, a housing surrounding said coil and forming a fluid-tight enclosure therefor, a liquid having a low freezing point contained in said housing and forming a heat transmitting medium between said housing, said coil, and said casing, a pressure-tight chamber enclosing said housing and having space for the reception of dry ice, and means to relieve the pressure in said chamber when it attains a predetermined maximum value.

6. In a heat exchange device for refrigerating apparatus, the combination of a casing having a circuitous passageway therein for a fluid to be cooled, a coil surrounding said casing for conveying a cooling medium, a pressure-tight chamber enclosing said casing and coil, said chamber having a space above said housing for the reception of dry ice, and means to relieve the pressure in said chamber upon attainment of a predetermined maximum pressure therein.

7. In a heat exchange device for refrigerating apparatus, a casing having one side thereof in heat conducting relationship with a cooling fluid, inlet and outlet conduits connected to said casing, and a removable partition device fitting snugly within said casing and forming a long circuitous passageway connecting said inlet conduit with said outlet conduit, said partition device comprising a metal sheet substantially dividing said casing in half, and a plurality of sheet metal strips secured to said sheet and fitting snugly in said casing to provide said circuitous passageway in the form of interconnected passageways on opposite sides of said sheet.

8. In a heat exchange device for refrigerating apparatus, a casing having one side thereof in heat conducting resationship with a cooling fluid, inlet and outlet conduits connected to said casing, and a removable partition device fitting snugly within said casing and forming a long circuitous passageway connecting said inlet conduit with said outlet conduit, said partition device comprising a box-like element having sheet metal partitions therein to form said circuitous passageway, said box-like element fitting snugly in said casing in heat conducting relationship therewith.

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