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REFRIGERATION APPARATUS

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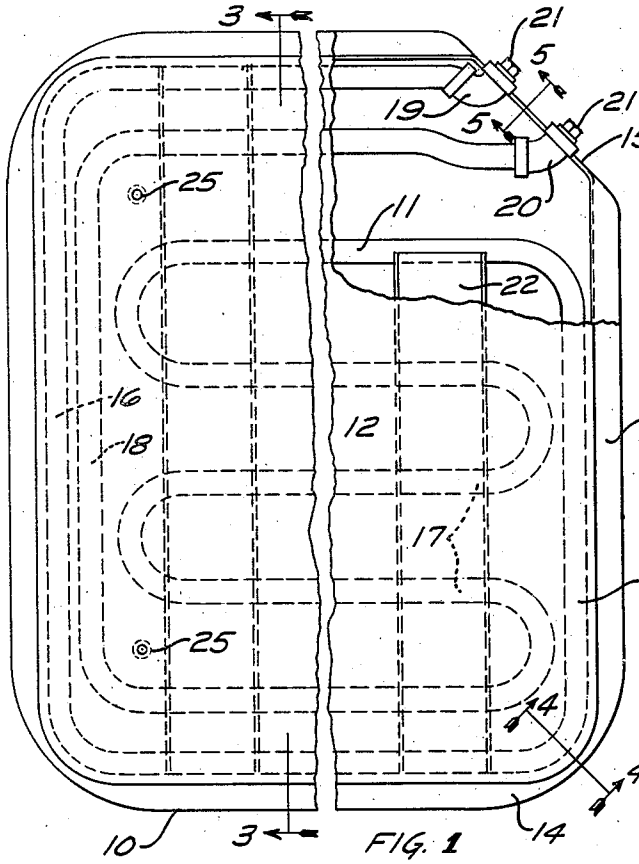


FIG. 1

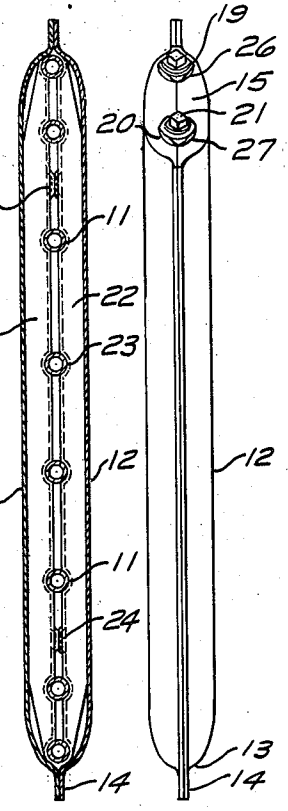


FIG. 3

FIG. 2

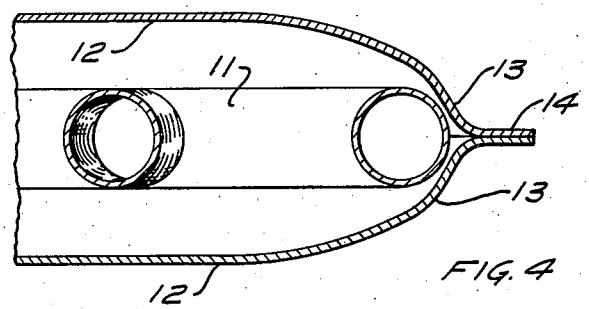


FIG. 4

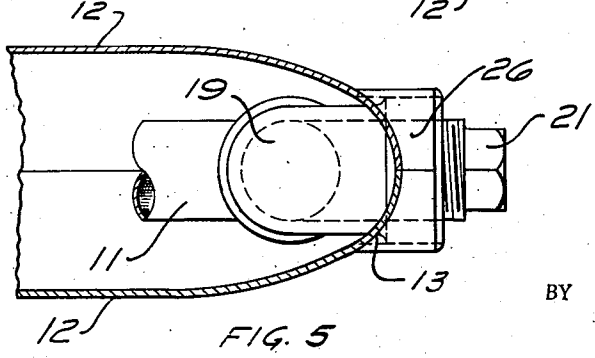


FIG. 5

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REFRIGERATION APPARATUS

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4 Claims. (Cl. 62—95)

This invention relates to refrigerating apparatus of the "hold-over" type, and particularly to the refrigerating units used in connection therewith.

Refrigerating apparatus of the "hold-over" type includes one or more refrigerating units. Each unit comprises a sealed container, an evaporator coil inside of the container, and a quantity of freezable solution within the container and surrounding the evaporator coil. Usually the container is substantially in the shape of a flat rectangular parallopiped, as that shape has been found to have a particularly high efficiency. The evaporator coil consists of a continuous tube bent into serpentine form and having its ends brought out through a wall of the container. The coil is adapted to be connected to a refrigerant source such as a compressor. The freezable solution is preferably a eutectic.

The freezable solution is frozen into ice by connecting the evaporator coil to a compressor and passing ammonia or other refrigerant through the coil. After the ice is formed the flow of refrigerant is stopped. The melting ice cools the space surrounding the refrigerating unit.

This type of refrigeration is particularly useful in the transportation field as it eliminates the necessity of carrying a compressor on the truck, railway car, or other vehicle. The solution may be frozen at any convenient place, the compressor disconnected, and during the trip the melting ice keeps the vehicle at the proper temperature.

Heretofore difficulty has been experienced with apparatus of the type mentioned because of the rupturing of the containers after a relatively short period of use. This is due to the stressing of the container walls beyond their elastic limit when the solution solidifies and forms ice.

In a refrigerating unit of the type mentioned, that is, a unit in which the container is relatively shallow, considerably more surface per unit of volume is exposed at the edges than in the central part of the container. Since the walls of the container have a high heat conductivity, heat is absorbed and transmitted to the solution at the edges more rapidly than to the liquid in the center. As a result the solution at the edges of the container is more difficult to freeze and when frozen, melts more quickly than that in the center part. Therefore, a frequent occurrence in units of this type is that the liquid about the coils in the central part of the container freezes first and that at the edges, or in some cases at one edge, is the last to freeze. This is particularly true in the corners where the greatest wall surface per unit of volume is present.

Such a condition is harmful for this reason. The solution within the container has characteristics similar to water. As the temperature of the solution decreases, its volume decreases until the temperature nears the freezing point of the solution. Thereafter the solution expands very sharply until it solidifies. When freezing first occurs near the center of the container and progresses outwardly therefrom, the final expansion takes place at the edges where the container walls have little flexibility. The unit stress in the container walls is thus very high, in fact, more than the elastic limit of the material in the walls. Repeated freezing and melting of the solution will eventually cause the side walls to rupture and leakage will occur. This is true whenever small quantities of solution are trapped adjacent the side walls, no matter how freezing progresses elsewhere within the container.

Therefore, the principal object of this invention is to provide a refrigerating unit of the type mentioned which will not fail from repeated freezing and thawing of the solution. This object is attained by shaping the container and arranging the evaporator coil therein in such a manner that freezing will first occur adjacent the edges of the container, and as freezing progresses the unfrozen liquid will migrate toward the center of the container. The last liquid to freeze will then be in the central part of the container and when it expands the force exerted against the container walls will be distributed over a large wall area. Consequently, the unit stress in the walls will not exceed the elastic limit of the material of which they are composed.

Another object of the invention is the provision of a container which can be easily and economically manufactured.

Still another object is the provision of a novel form of heat conducting fin which is readily attachable to the freezing coils.

These objects will more fully appear in the following specification when read in connection with the accompanying drawing, wherein—

Figure 1 is a fragmentary front elevational view of a hold-over refrigerating unit embodying the invention;

Figure 2 is a side elevational view of the device shown in Figure 1;

Figure 3 is a cross-sectional view taken on substantially the line 3—3 of Figure 1;

Figure 4 is a fragmentary cross-sectional view

taken on substantially the line 4—4 of Figure 1; and

Figure 5 is a fragmentary cross-sectional view taken on substantially the line 5—5 of Figure 1.

The drawing discloses a refrigerating unit comprising a sealed hollow container 10 and an evaporator coil 11 within the container.

The container is made up of two shallow pan-like metal stampings. The stampings are practically identical. Each stamping consists of a large flat wall 12, an upturned side wall 13, and a marginal flange 14. The side wall 13 is curved in cross section (see Figures 3 and 4) and merges smoothly into the large flat wall 12 about the periphery of the latter. Three corners of the stamping are smoothly rounded on curves of relatively great radii.

The fourth corner 15 is not rounded, as is the case with the other three, but is formed at an angle, preferably 45°, to the adjoining sides of the stamping. Furthermore, the side wall 13, at the corner 15, is pressed out at two spaced points to form a pair of semi-circular flanges 26 and 27, for a purpose which will appear presently.

The flange 14 is of uniform width along the straight sides of the container, but the flange is eliminated at the corner 15 and is of reduced width at the other three corners. This reduction in width is accomplished by curving the edges of the flange on a radius greater than that of the rounded corners.

The two stampings are arranged in inverted relation to each other with their open sides together. The flanges 14 are seam welded together, and the edges of the walls 13 at the corner 15 are butt welded together. It will be noted that when the stampings are secured together the semi-circular flanges 26 and 27 in the corners 15 are superimposed, thereby forming a pair of openings through the side wall of the container.

The evaporator coil 11 within the container comprises a tubular coil bent into the serpentine shape shown in Fig. 1. The coil winds about within the container and forms an outer, nearly closed, loop 16, then a series of narrow U-shaped loops 17, and terminates in a wide U-shaped loop 18 between the loop 16 and the loops 17.

The loop 16 is concentric with the side walls of the container and as close thereto as it can be. The loop 18 is just within and concentric with three sides of the loop 16. The other loops 17 are spread uniformly throughout the remaining space.

The ends of the coil 11 are connected to a pair of elbows 19 and 20. The outer ends of the elbows fit within the openings between the flanges 26 and 27 at the corner 15 and are welded to the flanges. The elbows are internally threaded to receive removable plugs 21 or connections from a suitable refrigerant compressor system.

On the opposite sides of the coil 11 are a plurality of channel members 22 which serve the dual purpose of holding various passes of the coil in proper relationship to the container and to each other, and of absorbing heat and transmitting it to the coil.

The webs of the channel members are provided at spaced intervals with transversely extending arcuate grooves 23 to receive the outer walls of the tube forming the coil 11. The webs are also provided adjacent their ends with a pair of bosses 24. The bosses project outwardly from the webs of the channels far enough so that when the channels are mounted web to web, as shown in Figure 3, the adjacent bosses touch each other and are welded or otherwise secured together. When the channels 22 are thus secured together the arcuate grooves in the webs are in contact with the walls of the coil tube. The flanges of the channels 22 project outwardly into contact with, or at least closely adjacent to, the walls 12 and 13 of the container.

The container is about 90% filled with a suitable freezable eutectic solution, through filler holes 25 in the wall 12. The holes 25 are then plugged.

When in use the elbows 19 and 20 are connected by suitable pipe fittings to a compressor, and refrigerant is piped through the coil 11 to freeze the solution in the container. The refrigerant enters the coil through the elbow 19 and flows through the coil to the elbow 20 and thence to the compressor. Obviously, the refrigerant is at its coldest in the loop 16 when it first enters the coil. Furthermore the loop 16 of the coil is very close to the narrow side walls of the container. Therefore, the solution around the loop 16 freezes first, and fills the space at the sides and in the corners of the container with ice before the solution freezes sufficiently elsewhere to trap any isolated liquid. This initial freezing is quite uniform because of the concentricity of the loop 16 with the side walls 13 and corners of the container, as well as because the reduction in width of the flange 14 at the corner equalizes the exposed metal surface about the periphery of the container.

Thereafter, as freezing continues, the unfrozen liquid tends to migrate toward the center of the unit and eventually just before the solution becomes completely frozen all of the solution which remains in a liquid condition will be contained within a zone at the center of the container. When this solution freezes it will expand and exert a pressure against the opposite large walls 12 of the container. However, the latter are free to bulge outwardly to permit the expansion without exceeding the elastic limit of the material.

Thus it will be seen that with the construction described there is no possibility of pocketing small quantities of liquid in the container in zones where the walls are not free to take care of the expansion. As a result, the container will never become unfit for use by reason of bursting of the side walls. Furthermore, the container is readily manufactured from but two simple and easily formed metallic stampings. The corners and sides of the container walls are smoothly rounded and there is little likelihood of the metal tearing in the dies in which the halves of the container are formed. It will also be seen that the heat absorbing fins employed in connection with the evaporator coil are relatively simple and easily and economically fabricated and assembled.

The scope of the invention is indicated in the appended claims.

I claim:

1. A hold over refrigeration unit including, in combination, a sealed sheet metal tank having closely spaced opposed side walls of relatively large area, the interior of said tank being free from abrupt corners and being substantially filled with a liquid hold over solution, and means for freezing said hold over solution progressively from the perimeter of the tank toward the center thereof comprising an elongated evaporator tube disposed within the tank in spaced relation to said side walls and having inlet and outlet ends communicating with the exterior of the tank,

said evaporator tube including a first portion extending substantially around the perimeter of the tank in closely spaced relation thereto and other portions distributed substantially uniformly throughout the remainder of the tank, the first portion being arranged to receive refrigerant before said other portions and the maximum distance between the said first portion of the tube and the adjacent walls of the tank being substantially less than the maximum distance between any other portion of the tube and the walls of the tank adjacent thereto.

2. A hold over refrigeration unit including, in combination, a sealed sheet metal tank having opposed side walls of relatively large area, said tank including a zone extending around the tank adjacent its perimeter of a smaller internal cross-sectional area than that of the remainder of the tank, the interior of said tank being free from abrupt corners and being substantially filled with a freezable hold over solution, and an evaporator tube disposed within the tank in spaced relation to the side walls thereof and having inlet and outlet ends communicating with the exterior of the tank, said evaporator tube including a first portion disposed in said zone of reduced cross-sectional area and extending substantially around the perimeter of the tank, said evaporator tube including other portions distributed substantially uniformly throughout the remainder of the tank, the said first portion of the evaporator tube being arranged to receive refrigerant before said other portions.

3. A hold over refrigeration unit including, in combination, a sealed sheet metal tank having closely spaced opposed side walls of relatively large area, said tank being of substantially uniform internal cross-sectional area in the central portion thereof and of gradually decreasing cross-sectional area toward the perimeter in the region of the perimeter thereof, the interior of said tank being free from abrupt corners and being substantially filled with a freezable hold over solution, and an evaporator tube disposed within the tank having inlet and outlet ends communicating with the exterior of the tank, said evaporator tube including a first portion disposed in said zone of gradually decreasing cross-sectional area and extending around the perimeter of the tank in closely spaced relation thereto, said evaporator tube including other portions distributed substantially uniformly throughout the remainder of the tank, the said first portion of the evaporator tube being arranged to receive refrigerant before said other portions.

4. A hold over refrigeration unit as defined in claim 3 wherein the spacing between the said first portion of the evaporator tube and the walls of the tank is closer in the region of the smallest cross-sectional area than in the other regions of the tank and wherein said other portions of the evaporator tube are spaced at least as great a distance from the adjacent walls of the tank as the maximum spacing of said first portion from the walls of the tank adjacent thereto.

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