March 17, 1942. S. B. WARD 2,276,811

REFRIGERATOR

Filed June 3, 1939

Fig. 1

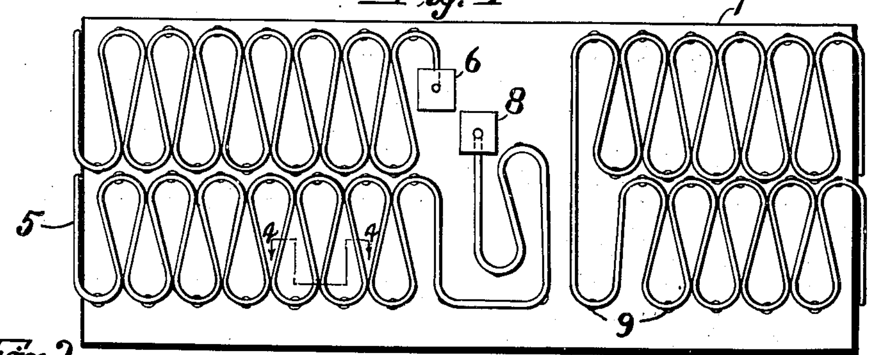


Fig. 2

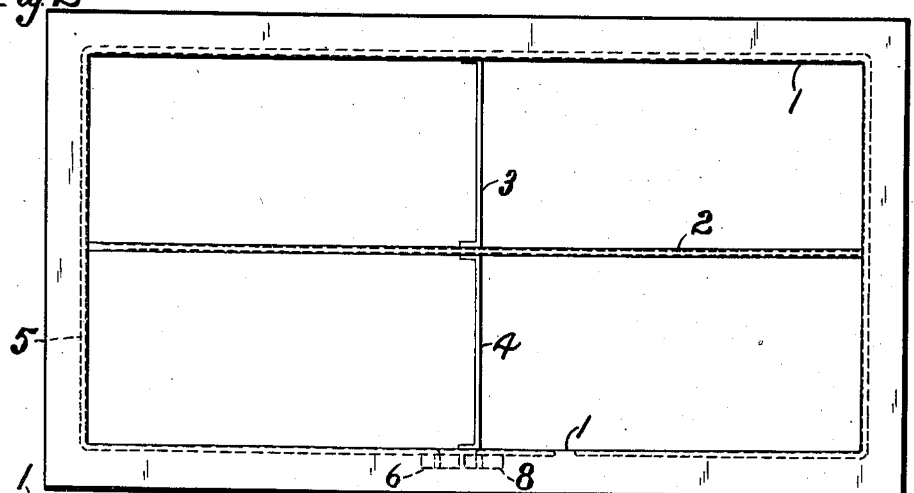


Fig. 4

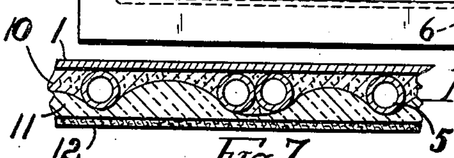


Fig. 7

Fig. 3

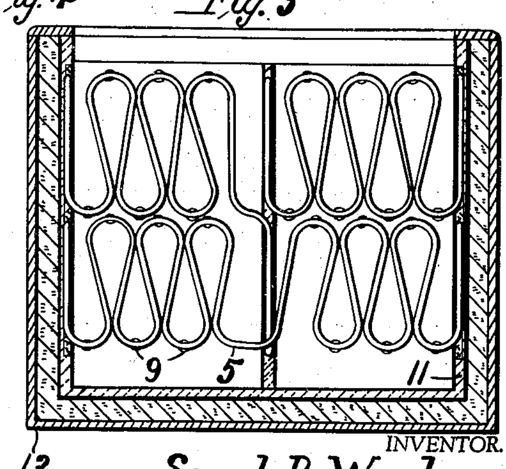


Fig. 5

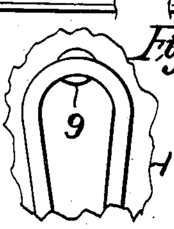
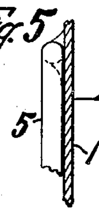


Fig. 6



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BY

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UNITED STATES PATENT OFFICE

2,276,811

REFRIGERATOR

Samuel B. Ward, Chester Heights, Pa., assignor to H. H. Ward Company, Chester, Pa., a corporation of Pennsylvania

Application June 3, 1939, Serial No. 277,191

5 Claims. (Cl. 62—126)

My invention relates to heat exchangers and particularly to the transmission of heat through a conducting wall of a compartment to a refrigerant expanding in a metallic tube contacting with or connected to the wall, as in ice cream cabinets and other refrigerators.

In accordance with my improvements, the heat conductance between the compartment wall and the portion of the expansion tube contacting therewith, and which is preferably spot-bonded to the wall, is augmented by heat conductance through metallic particles, of high conductivity, such as aluminum or copper chips, making direct contact with one another and with the surfaces of the wall and tube, such particles being positioned by a heat insulating binder.

My improvements result in great savings in labor and expense in attaching the tube and wall together, since it permits soldering them together at spaced intervals instead of continuously throughout the length of the tube, and my improvements further result in increased efficiency due to the fact that heat may be conducted from the compartment wall through metallic conductors not merely to the surface of the tube adjacent to the wall but to the entire periphery of the tube.

Preferably, the heat conducting metallic particles or chips are mixed with a bituminous heat insulator, such as hydrolene viz., a substantially odorless petroleum asphalt which is fluent when hot and is solidified or rendered non-fluent by extracting heat therefrom in excess of normal room temperatures, and hence is commonly designated thermoplastic. The bulk of the mix consists of metallic particles, with only sufficient of the binder to hold the metallic particles together and to the shell and tube. This compound is applied, while plastic, to the shell wall to a depth sufficient to cover the tube thereon, and the heat conducting layer thus formed has applied thereto a coating or layer of hydrolene, or the like, devoid of metallic particles. The outer coating of hydrolene bonds homogeneously to the binder of the inner layer and prevents ingress of heat thereto from the outside and the precipitation of moisture on the refrigerating unit.

My improvements are particularly applicable to an evaporating unit comprising a metallic shell containing a compartment having therein a longitudinally extending hollow metallic partition. Preferably, the tubing is sinuously bent so as to form closely adjacent bights or loops which are spot soldered or welded adjacent to their apexes to the metallic shell. The height of the tube loops engaging the external wall of the shell is preferably less than the height of the shell so that a plurality of vertical rows of loops may be attached to the peripheral wall of the shell. To unify the temperature in different portions of the compartment, a row of vertical tube loops may be attached to the upper portion of the exterior of the shell throughout the bulk of the periphery thereof: horizontally extending loops of the tube may be then passed longitudinally through the partition, beginning the upper portion of the partition and ending at the lower portion of the partition: vertical loops may then be attached to the remainder of the upper portion of the external periphery of the shell until the tubing loops approach the inlet to the tube: the tube may be then bent reversely upon itself to form a series of vertical loops about the entire periphery of the lower portion of the external surface of the shell and terminated at a connection to a suction line adjacent to the inlet from which the tubing is supplied with liquid refrigerant from an expansion valve.

By this arrangement of the tubing, the refrigerant has its greatest heat absorbing capacity in passing around the upper portion of the shell and thereby counteracts the effect of the accumulation of the warmer portion of the air in the compartment in the upper part thereof.

The characteristic features and advantages of my improvements will further appear from the following description and the accompanying drawing in illustration thereof.

In the drawing, Fig. 1 is a side elevation of an ice cream cabinet evaporating unit having my improvements applied thereto; Fig. 2 is a top plan view of the unit shown in Fig. 1; Fig. 3 is an elevation of the right-hand end of the unit shown in Fig. 1; Fig. 4 is an enlarged fragmentary detached sectional view taken on the line 4—4 of Fig. 1; Fig. 5 is an enlarged fragmentary elevation showing the spot-soldering of the apex of the bight of a loop to the conducting wall of the evaporating unit; Fig. 6 is a side elevation of the structure shown in Fig. 5; and Fig. 7 is a detached elevation of the evaporator tubing of the central partition of the unit.

In the drawing, my invention is shown applied to a conducting metallic shell 1 containing a hollow metallic longitudinal partition 2 and transverse partitions 3 and 4 dividing the interior of the shell into a plurality of refrigerating chambers.

An expansion tube 5 of copper or the like has one end connected with a liquid inlet plate 6 fixed to the front wall of the shell intermediate the ends thereof. Sigmoidally bent sections of the tube extend along the left half of the upper portion of the shell's front wall, left end wall, back, and half of the right end wall of the shell. At the center of the right end wall of the shell, the tubing enters the top of the hollow partition 2 and is bent back and forth therein, as shown in Fig. 7, and emerges from the central partition at the lower part of the center of the right end wall of the shell. From there the tubing extends upward to the front half of the upper portion of the right end wall of the shell, and extends in sigmoidal loops along the same and along the right half of the upper portion of the front wall of the shell. The tubing is then bent downwardly and sigmoidal loops thereof are attached to the lower portion of the periphery of the shell, extending from the downtake along the lower right front wall, lower right end wall, lower rear wall, lower left end wall and lower left front portion of the wall of the shell to a suction line outlet plate 8 which is preferably disposed between the liquid inlet plate 6 and the downcomer connecting the upper and lower rows of sigmoidal loops.

Each of the vertically disposed sigmoidal loops has its apex spot-soldered to the metallic wall of the shell by a spot of metallic solder 9 and the tube lies throughout its length in close contact with the walls of the shell and partition.

A compound 10 composed of metallic particles, such as aluminum or copper chips, borings, or the like, and a binder, such as hydrolene, or the like, is applied to the external wall of the shell 1 so as to cover the tubing attached thereto. The compound should be composed of such proportion of metallic particles and binder as will insure metal-to-metal contact between the particles and provide heat conducting paths between the surface of the shell 1 and the periphery of the tubing. A compound composed of 90 parts of metal particles by volume to 10 parts of hydrolene is suitable.

The layer of metal-filled compound preferably has homogeneously bonded thereto a layer 11 of heat insulating material, such as hydrolene, and the external surface of the hydrolene layer is covered with waterproof paper 12 which adheres thereto.

Such a shell may be housed in a suitable insulating cabinet 13.

My improvements not only improve the operation of evaporating units, but also facilitate the manufacture of such units by effecting rapid cooling of the molten hydrolene after the application of the compound to the shell, for the metallic filler in the compound rapidly conducts the heat thereof to the shell whose inner surface provides a large cooling area.

Having described my invention, I claim:

1. In apparatus of the character described, the combination with a shell, of a refrigerant coil having a row of sigmoidally bent vertical loops around the upper portion of said shell with one end forming a refrigerant inlet and a row of sigmoidally bent vertical loops around the lower portion of said shell having one end connected with an end of said row first named and an end forming a refrigerant outlet.

2. In apparatus of the character described, the combination with a hollow shell of a refrigerant coil comprising a row of bent vertical loops attached to the exterior of said shell, a layer of thermoplastic material containing small particles of non-ferrous metal of high thermal conductivity attached to the exterior of such shell and substantially covering said loops, said layer being of less thickness between said coils than adjacent thereto, and a layer of thermoplastic material of low conductivity homogeneously bonded to said layer first named, said second named layer having a greater thickness between said coils than adjacent thereto.

3. A refrigerator comprising a hollow metallic shell having a partition therein dividing it into a plurality of compartments; expansion tubing looped along and bonded to the upper portion of the exterior of the shell throughout the bulk of the periphery thereof, then passing through said partition, and then looped along and bonded to the lower portion of the exterior of the shell throughout the bulk of the periphery thereof; and a coating of metallic particles bonded to the exterior of said shell and tubing by a thermoplastic binder.

4. A refrigerator comprising a hollow metallic shell having convoluted tubing spot-bonded to the external wall thereof, a coating of metallic particles bonded to the exterior of said shell and tubing by a thermoplastic binder of low heat conductivity, and a coating homogeneous with said binder and substantially devoid of metallic particles bonded to said coating first named; said last named coating being thicker between the convolutions of said tubing than adjacent thereto.

5. A method of forming refrigerators which comprises spot bonding a bent tube to the external wall of a hollow metallic shell; applying to the external surface of the shell, to a depth sufficient to cover the tube thereon, a compound comprising metallic particles of high heat conductivity and a binder of low heat conductivity which is fluid when hot and solid when cold; said compound being applied while the binder is hot; applying a homogeneous coating of said binder, while hot and substantially devoid of metallic particles, to said compound; and facilitating the hardening of said binder materials by rapidly transmitting heat therefrom through said metallic particles to said tube and metallic shell.

SAMUEL B. WARD.