Oct. 27, 1936. D. P. HEATH 2,058,871

REFRIGERATION APPARATUS

Original Filed Jan. 2, 1931

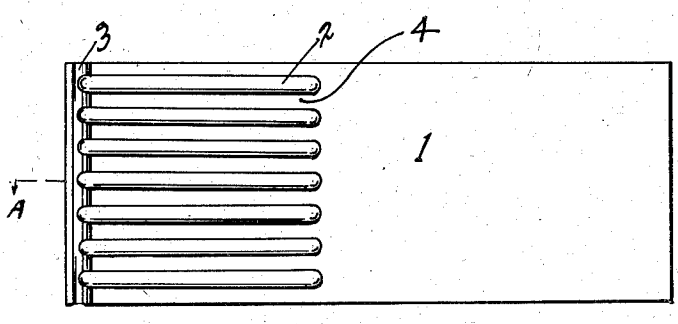


Fig. 1

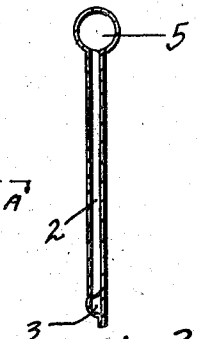


Fig. 2

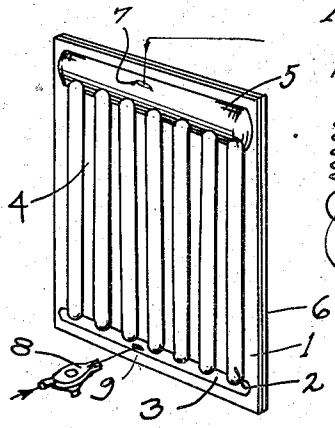


Fig. 3

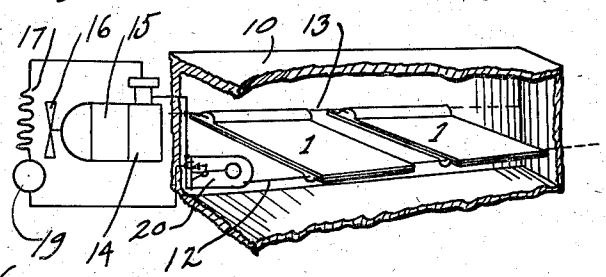


Fig. 5

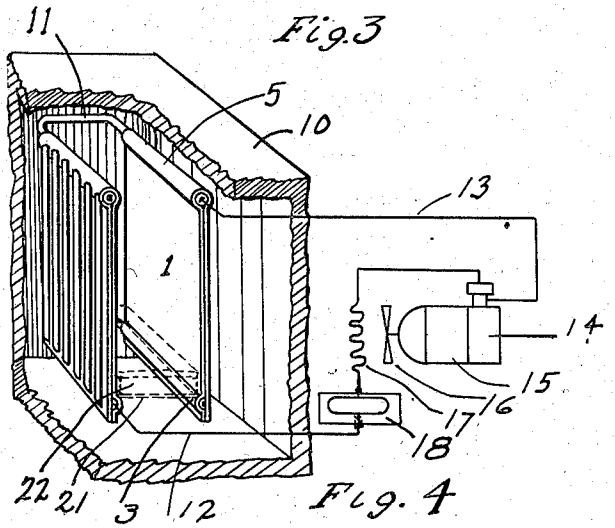


Fig. 4

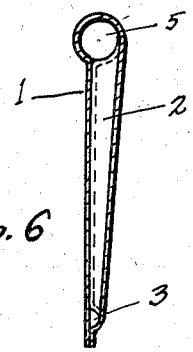


Fig. 6

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REFRIGERATION APPARATUS

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Application January 2, 1931, Serial No. 506,287
Renewed April 12, 1934

8 Claims. (Cl. 62—126)

This invention relates to refrigerators and is of particular use in the construction of refrigerant heat exchangers. It is an object to provide a system of cooling a refrigerator, wherein a sheet metal corrugated wall expansion chamber is provided as a heat exchanger within the refrigerator.

It is an object to provide a heat exchanger structure that may be readily formed from one sheet of metal, and which is conveniently adaptable for multiple assembly, either in a vertical or a horizontal plane.

It is an object to provide a corrugated sheet metal evaporator which has flues within the corrugation of an increasing cross sectional area, that liquid or gaseous refrigerant boiling within these corrugations or expanding therein may have its rate of ebullition accelerated.

As disclosed in my application, Serial No. 450,361, filed March 9, 1921, and as shown in my Patent No. 1,726,486, of August 27, 1929, I have found a corrugated sheet metal refrigerant expansion chamber, efficient and cheaper to build than the usual copper tube coil, or a cast iron evaporator, and it is now the purpose of this specification to recite certain improvements in construction of the evaporator itself and to disclose certain uses of this evaporator in multiple arrangement, which I have found to be most efficient.

In the drawing:

Fig. 1 is a plan view of the single sheet evaporator, after corrugating, but before bending.

Fig. 2 is a sectional view and elevation along line AA of Fig. 1, after bending the single sheet evaporator.

Fig. 3 is a perspective view of a modification of Fig. 1, showing the evaporator formed of two sheets.

Fig. 4 is a perspective view showing the multiple assembly of the evaporators in a vertical position within a refrigerator, and operatively connected to a motor-compressor-condenser float control system exterior to the refrigerator.

Fig. 5 is a perspective view, showing a multiple arrangement of the evaporator in a horizontal position, within a refrigerator, and operatively connected to a float within the refrigerator, and a motor-compressor-condenser system exterior to the refrigerator heat insulation.

Fig. 6 shows a cross section in elevation along line AA of Fig. 1, and illustrates a modification of the corrugation in the walls of the tank to provide a space of varying cross sectional area.

The device may be formed of any material which may be rolled into a sheet form, pressed, bent and fixed or welded together between the corrugations and at its periphery. However, I prefer to form my tank of sheet steel and to fix the walls together by the welding process.

Like reference characters, refer to like parts in the different figures of the drawing.

1 indicates a sheet which may be of any outline, but is best cut in a rectangular shape.

2 and 3 are corrugations formed in 1 by the stamping process, or by other methods. The corrugations 2 connect with the space within corrugation 3. The sheet is then bent to form the circular dome 5, as shown in Fig. 2, communicating with the passages of corrugation 2. The flat portions between corrugation 2 and other contiguous parts of the bent sheet are then welded together to form an air tight pressure chamber. The openings in the ends of the parallel headers, 3 and 5, are utilized to make proper connections for the inlet refrigerant liquid and the outlet expanded refrigerant gas respectively.

In Fig. 3 I show a modification in which sheet 1 is corrugated with not only corrugations 2 and 3, but also corrugation 5, and a sheet 6 is welded to sheet 1 to form the expansion chamber. In this modification, the ends of 3 and 5 are closed by the metal of 1 during forming, and openings 7 and 9 are made in 5 and 3 for the passage of the refrigerant into and out of the evaporator. Numeral 8 is an expansion valve.

In Fig. 4 the evaporator 1 is connected in multiple by the U tubes 11 at the corrugations 3 and 5. Any number of the vertical evaporator sections 1, may be assembled in this manner. The conduit 12 admits liquid refrigerant and the conduit 13 draws off the expanded refrigerant gas, returning it to compressor 14, which is driven by motor 15. Fan 16 is also driven by motor 15 and cools condenser 17 which flows its liquid refrigerant into the shell of high pressure refrigerant float valve 18.

In Fig. 5 I show a multiple installation of the evaporator 1 in the horizontal position. Numeral 20 here indicates a low pressure refrigerant float valve placed at the proper level within the refrigerator 19, in respect to evaporator 1, to maintain a uniform level of liquid refrigerant within the corrugated walls of 1. 18 represents a liquid refrigerant receiver.

In operation, the motor compressor unit in Figure 4 withdraws gaseous refrigerant from dome corrugation 5, causing the liquid refrigerant in the vertical corrugations 2 to boil, because the pressure is lowered in the evaporator. Heat

is removed from the refrigerator 10 by this boiling refrigerant, and carried to the condenser 17 where the refrigerant is cooled by the fan 16, or by other suitable means, and again condensed to a liquid which flows into the shell of float valve 18, causing the float to rise and open its valve in the customary manner. The liquid refrigerant then flows thru conduit 12 into the horizontal headers, 3 of the multiple assembly of the evaporator 1. Articles may be placed within the compartment formed by adjacent units of the multiple evaporator assembly for the purpose of cooling them rapidly or freezing them. I have provided shelves 21 for the purpose of efficiently conducting the heat away from articles placed on them, to the inwardly projecting horizontal headers 3. Because liquid refrigerant is under the shelf in intimate thermo-relationship with the material of the shelf, or the material of a removable tray such as 22, cooling and freezing operations take place in a minimum of time.

In Fig. 5, the corrugations 2 of the multiple evaporators 1, are substantially in a horizontal position, and this arrangement therefore provides a support for articles to be frozen, directly in contact with a large area of the evaporator 1. The large size of the header 5 permits it to serve as a gas dome that the boiling liquid within the evaporator may not prime over into the gas section line of the compressor 14. The header 3 and the corrugations 2 in this construction are placed at the bottom, that a slightly upward flow of gas may be permitted. In the operation of the system shown in Figure 5, the evaporator, motor-compressor-condenser unit act as before described, but the refrigerant float valve control is within the refrigerator 10 and admits liquid refrigerant when the compressor 14 has drawn off sufficient gas to reduce the liquid level in the evaporator 1 and the shell of the low pressure float 20.

Fig. 6 construction provides that the corrugation 2 be varied in cross section and increasing in size from header 3 to the header 5. This allows accelerated boiling action, as the bubbles of gaseous refrigerant formed within the liquid refrigerant within the corrugations 2 rapidly increase in size and in passing to header 5, tend to drive liquid ahead of them in the well known percolator action. This work done by the boiling liquid refrigerant is minimized if space may be provided for the bubble of gas and also space for the liquid refrigerant which remains behind within the same corrugation. It is also possible to keep the maximum amount of surface of the corrugations 2 as wet surface for better heat transmission with the tapered construction, as shown in Figure 6.

The construction described is of light weight and great strength, and can be most economically produced and efficiently operated. I find that it may be made of materials of a rust-proof nature, or of material such as steel, which may be protected by rust-proof processes. The steel construction is particularly adapted for welding, and for porcelain enameling. As the interior surfaces of a refrigerator food chamber must be cleaned at frequent intervals to maintain sanitary conditions, I prefer to make my evaporator of steel and of a wall thickness which will permit a structure that is not subject to serious deflection under pressure conditions, and which will be satisfactory to receive the baked porcelain enamel.

The invention is defined in the following claims, and it is to be considered as including all forms of structure coming within their range, irrespective of the particular use to which put.

I claim:

1. In a refrigeration apparatus a refrigerator having a heat insulated chamber, a refrigerant condensing unit exterior to said chamber, a flooded type refrigerant evaporator within said chamber operatively connected to said condensing unit, said evaporator comprising a plurality of adjacent flat walled sheet metal expansion chambers arranged in substantially a horizontal plane, each of said chambers having a plurality of substantially parallel corrugations terminating in transverse headers embossed at opposite ends of the chamber, the walls of said chambers being fused together at contiguous flat portions between the corrugations and at or near the peripheries of the chambers.

2. In a refrigeration apparatus, a refrigerator having an insulated compartment, a refrigerant liquefying and condensing unit exteriorly of said compartment an evaporator within said compartment and connected to said unit, said evaporator including a plurality of horizontally disposed substantially flat plate-like double walled members having a plurality of parallel corrugations formed in a wall thereof and defining refrigerant expansion passages, said plurality of expansion passages terminating in transverse headers embossed in a wall of the plate-like evaporator members, the walls of said plate-like members being secured together at or near their peripheries and at contiguous portions between the corrugations, and said plurality of flat plate-like evaporator members being disposed in substantially the same horizontal plane and having means inter-connecting the same to maintain a common refrigerant level therein.

3. An evaporator for a refrigerating system comprising a single sheet of metal bent to provide a header and having continuations thereof pressed into face-to-face relationship and secured together and defining a continuous radiating surface extending from the header, said continuations having corrugations formed therein defining passageways communicating with said header, and said passageways formed by the corrugations being of gradually increased cross-sectional area toward said header.

4. An evaporator for a refrigerating system comprising a single sheet of metal bent to provide a header and having continuations thereof pressed into face-to-face relationship and secured together and defining a continuous radiating surface extending from the header, said continuations having corrugations formed therein defining a second header smaller than said first named header and a plurality of passageways communicating with both of said headers, and said passageways formed by the corrugations being of gradually increased cross-sectional area from said second named header to said first named header.

5. An evaporator for a refrigerating system comprising, sheet metal portions secured together in face-to-face relationship, one of said sheet metal portions having a corrugation formed therein providing a header, one of said sheet metal portions having a plurality of corrugations formed therein and providing a plurality of passageways communicating with said header, and said passageways being of gradually increased cross-sectional area toward said header.

6. An evaporator for a refrigerating system

comprising, sheet metal portions secured together in face-to-face relationship, one of said sheet metal portions having corrugations formed therein providing spaced apart headers, one of said sheet metal portions having a plurality of corrugations formed therein and providing a plurality of passageways communicating with the spaced apart headers, and said passageways being of gradually increased cross-sectional area toward one of the spaced apart headers.

7. An evaporator for a refrigerating system comprising, sheet metal portions secured together in face-to-face relationship, one of said sheet metal portions having a corrugation formed therein providing a header, one of said sheet metal portions having a corrugation formed therein providing a second header spaced from said first named header, one of said sheet metal portions having a plurality of corrugations formed therein and providing a plurality of passageways extending between and communicating with the spaced apart headers, and said passageways being of gradually increased cross-sectional area toward one of said headers.

8. An evaporator for a refrigerating system comprising, sheet metal portions secured together in face-to-face relationship, one of said sheet metal portions having a corrugation formed therein providing an upper header, one of said sheet metal portions having a corrugation formed therein providing a lower header spaced from said upper header, one of said sheet metal portions having a plurality of corrugations formed therein and providing a plurality of passageways extending between and communicating with the spaced apart headers, and said passageways being of gradually increased cross-sectional area toward the upper header.

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