Oct. 19, 1954 T. H. POLAD 2,691,813

METHOD OF CONSTRUCTING REFRIGERATION EVAPORATORS

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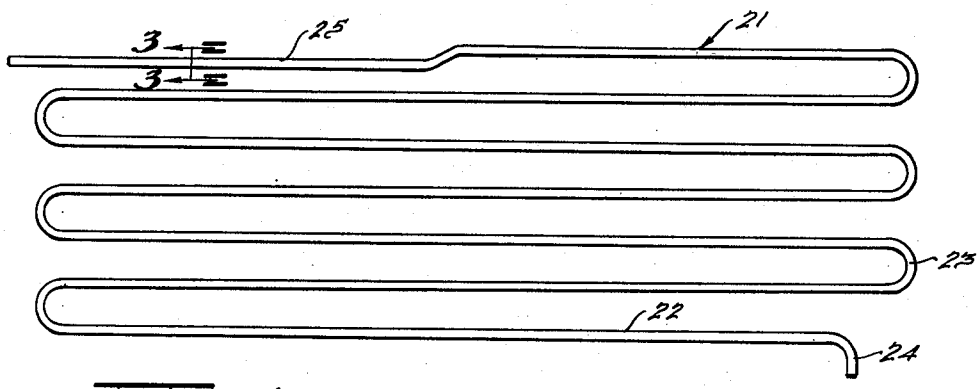

Fig. 1.

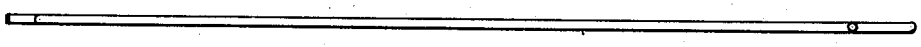

Fig. 2.

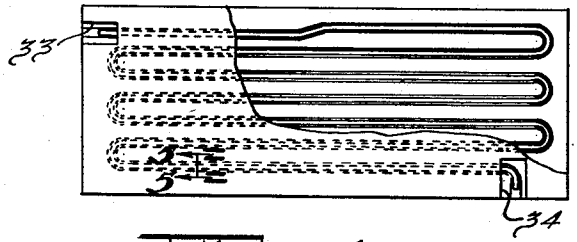

Fig. 4.

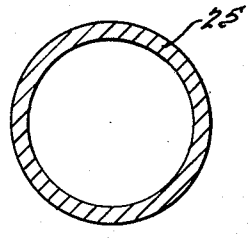

Fig. 3.

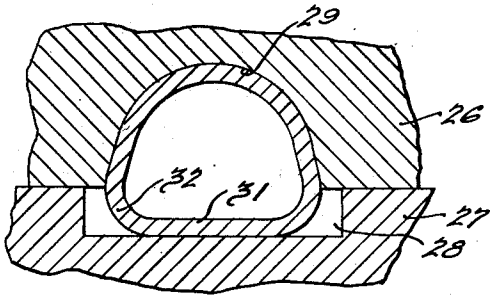

Fig. 5.

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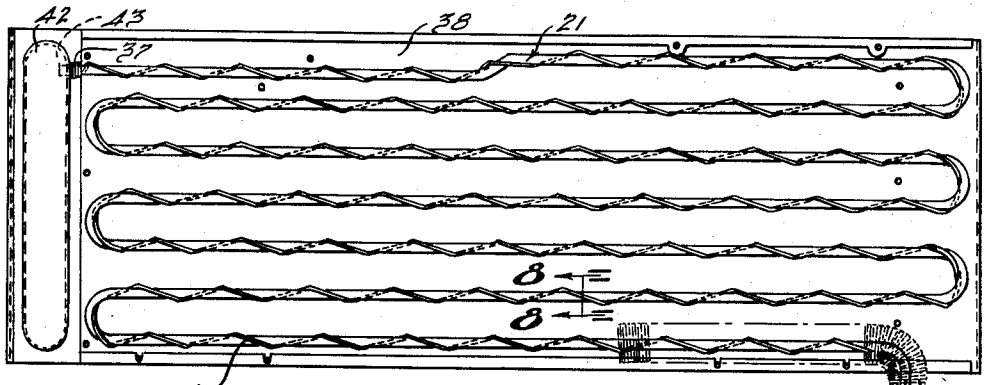


Fig. 6.

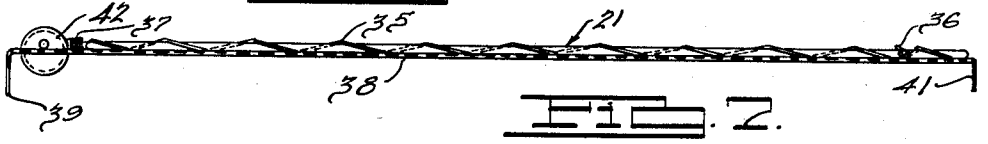


Fig. 7.

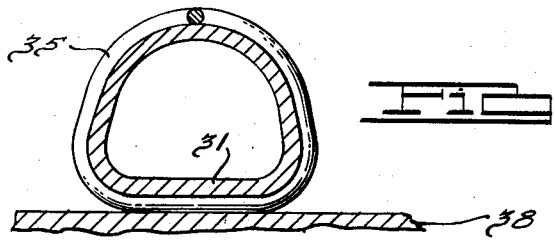
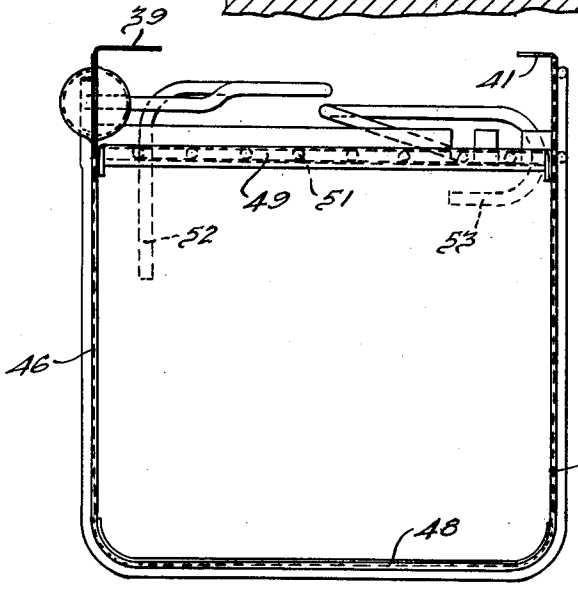


Fig. 8.



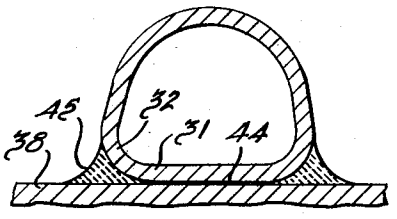


Fig. 9.

Fig. 10.

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METHOD OF CONSTRUCTING REFRIGERATION EVAPORATORS

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Application August 15, 1950, Serial No. 179,469

3 Claims. (Cl. 29—157.3)

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This invention relates to refrigeration systems and the like, and more particularly to evaporators to be used in refrigerating systems of the vapor compression type, and methods of constructing such evaporators.

It is an object of the present invention to provide an evaporator construction for use in refrigerating systems, and the like, which greatly increases the operating efficiency of the system by providing a highly efficient heat-transfer surface in the evaporator.

It is a further object to provide an evaporator as described which will serve to substantially minimize "trapping" of liquid in the evaporator tubing, and further which will afford a better surface for galvanizing the evaporator after fabrication.

It is another object to provide a method for constructing a tube-on-plate evaporator for a refrigerating system which will allow efficient attaching of the serpentine evaporator tube to the supporting plate or secondary evaporator surface. More particularly, it is within the contemplation of this invention to provide a method of constructing an evaporator whereby the brazing material may be quickly and easily positioned along the tubing prior to placing it on the sheet, and will be held by the tubing in proper position for flow along the adjoining tube and plate surfaces.

It is another object to provide a method for constructing a refrigerator evaporator as described above, in which ordinary tubing of circular cross-section may be quickly and cheaply formed into evaporator tubing of novel shape and secured to a plate member or secondary evaporator surface, and in which a large area of the tubing will braze to the plate member while going through the brazing oven more securely than has heretofore been possible.

Other objects and features of this invention will appear upon consideration of the specification, the appended claims and the drawings, in which drawings:

Figure 1 is a plan view showing the evaporator tubing after the first stage of the novel method of construction, with the tube bent into serpentine shape;

Fig. 2 is a side elevational view of the tubing of Fig. 1;

Fig. 3 is a cross-sectional view taken along the line 3—3 of Fig. 1;

Fig. 4 is a plan view, with parts broken away for clarity, showing the tubing in the second stage of construction;

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Fig. 5 is a fragmentary cross-sectional view taken along the line 5—5 of Fig. 4; showing the relation of the dies;

Fig. 6 is a plan view of the tubing after completion of the stages shown in Figs. 4 and 5, together with the evaporator body plate and brazing means, before placing assembly in the brazing oven;

Fig. 7 is a side elevational view of the assembly shown in Fig. 6;

Fig. 8 is a cross-sectional view taken along the line 8—8 of Fig. 6, showing the relation of the tube and plate surfaces;

Fig. 9 is a view similar to Fig. 8 but showing the tubing and plate after passing through the brazing oven; and

Fig. 10 is an end elevational view of the completely formed evaporator together with an additional refrigerating shelf.

As the first step in fabricating the evaporator of this invention, a length of tubing 21 sufficient to be formed into the primary evaporator surface is taken from conventional stock of round cross-section, and is bent into the substantially serpentine or sinuous shape shown in Figs. 1 and 2. The original diameter and material of the tubing to be used, as well as the size and spacing of the serpentine coils will of course be governed by the nature of the refrigerating or other system for which the particular evaporator is designed. For illustrative purposes, the tubing is shown as being bent into a plurality of straight sections 22 in spaced parallel relation and connected by semicircular sections 23, with end portions 24 and 25 offset from their corresponding straight sections to allow for later connection to the refrigerating system.

As the next step in the method of construction, the serpentine formed tube, which is originally of circular cross-section as shown in Fig. 3, is compressed between two die members 26 and 27 or similar metal-working tools, to reform the tubing cross-section into a substantial D-shape as shown best in Fig. 5. This operation is preferably performed by a pair of dies which, as shown in Fig. 4, are so designed as to simultaneously reshape the entire length of tubing, although it will be understood that the invention contemplates other means for performing this operation. As illustrated the die 27 is provided with a recess 28 of rectangular cross section which is shaped to receive the serpentine tubing 21, the width of the recess being substantially wider than the original outside diameter of the

tubing. The die 26 is provided with a recess 29 of substantially semi-circular cross section and of serpentine shape corresponding to the tubing and to recess 28. It will be seen, especially from an examination of Fig. 5, that when the tubing 21 is placed within the recess 28 and dies 26 and 27 are brought together, the portion 31 of the tubing will be flattened by the lower surface of recess 28, and since the remainder of the tubing is held within the confines of semi-circular recess 29, the tube will assume a substantially D-shaped cross section with curved portions 32 connecting the semi-circular portion and the flat portion 31 of the tubing. In order to retain the circular cross-section at the ends of the tubing for connection to the refrigerating system, openings 33 and 34 may be provided in die 26 adjacent these ends to prevent their distortion.

After the tubing 21 has received a shape such as is shown in Fig. 5, it is ready to be mounted on the evaporator plate member or body sheet. In accordance with the novel method of construction of this invention, a wire coil 35 of copper or other brazing material is provided, the original inside diameter of the coil being substantially larger than the outside diameter of the evaporator tubing. As shown by the dot-dash lines in Fig. 6, the coil 35 is first placed over one end of the tubing, an end 36 of the coil being hooked into the adjacent open end of the tube. The wire coil may then be grasped by the operator (with a pair of gloves) and slid along the length of the serpentine so that a wrapping arrangement is obtained, with the wire coil wound in spiral fashion along the tubing and in substantial contact therewith. The wire is preferably made of sufficient length so that its end 37 may be wrapped around the end of the tubing for a few turns, thus holding the wire in place. The entire serpentine may then be placed upon the evaporator body sheet 38 as shown in Figs. 6, 7 and 8. This body sheet may comprise a flat plate having flanges 39 and 41 and with an elongated recessed portion forming, in combination with a similarly recessed plate (not designated) secured thereto, a disengaging compartment 42 for receiving entrained liquid particles in the vapor. An end 43 of the tubing may be inserted in compartment 42 and coils 37 of the brazing wire placed adjacent this connection.

When the tubing 21 is in position on the evaporator body sheet, the entire assembly may be placed within a brazing oven (not shown) or other heating means maintained at sufficient temperature to melt the brazing material. During this operation, the brazing wire will liquefy and by capillary action will be drawn between flattened surface 31 of the tubing and surface 38 of the body sheet. The brazing material will thus flow from a position as shown in Fig. 8 to a position substantially as shown in Fig. 9. In this latter condition, a thin layer 44 of brazing material will be disposed between the surfaces 31 and 38, securely uniting these surfaces, and substantial fillets 45 will be formed between curved portions 32 of the tubing and the adjacent portions of body sheet 38. It will be noted that a smooth and continuous surface will be formed between the body sheet and the evaporator tube, thus affording a smooth surface for galvanizing as well as a structurally stronger union of pleasing appearance. It will also be observed that since the fillets 45 present a continuous surface between the tubing and the body sheet, a substantial heat-transfer area is presented thereby tending to increase the efficiency of the evaporator.

After the assembly shown in Figs. 6 and 7 has been removed from the brazing oven, it is ready to be formed into whatever shape is necessary for the particular adaptation of the evaporator. For illustrative purposes, Fig. 10 shows the evaporator assembly bent into a substantially U-shape, with sides 46 and 47 and bottom 48 forming a refrigerating compartment, the flanges 39 and 41 being adapted for attachment to the inside of a larger compartment (not shown). A refrigerated shelf 49 may be provided near the upper end of the compartment, the tubing 51 of the shelf being connected in series with the tubing 21. Additional tubing sections 52 and 53 may be provided for connection to the refrigeration system.

While the use of the D-shaped tubing has been described in relation to an evaporator, it is to be understood that it may be employed on condensers of the plate and other types and on plate and types of evaporators other than that specifically shown and described herein. The invention may be advantageously employed when transferring heat between a medium within a tube and an associated plate and is not restricted to the refrigeration field.

I claim:

1. In a method of constructing a heat transfer device, the steps comprising: bending a length of tubing of circular cross section into a desired shape, flattening the wall of one side of said tubing to form the shaped tubing into a substantially D-shaped cross-section, placing a coil of a plurality of turns of brazing wire over one end of said tubing, securing one end of said coil relative to said end of said tubing and while said end of said coil is thus secured longitudinally sliding said coil along said shaped tubing to spread said turns helically around the length of said tubing, placing the brazing wire entwined tubing on a plate member, and heating said brazing wire beyond its melting point to braze the flat portion of said tube directly to said plate.

2. In a method of constructing a heat transfer device, the steps comprising: bending a length of tubing of circular cross section into substantially serpentine shape, placing a coil of a plurality of turns of brazing wire over one end of said tubing, the diameter of said coil being sufficiently large to provide a clearance between its turns and said tubing, securing one end of said coil relative to said end of said tubing and while said end of said coil is thus secured sliding said coil along said tubing to spread said turns helically around the length of said tubing in engagement therewith, placing the brazing wire entwined tubing on a plate member, and heating said wire beyond its melting point to cause molten brazing wire to flow between said tubing and said plate and form fillets between the tubing and plate outwardly thereof on both sides of the tubing.

3. In a method of constructing a heat transfer device, the steps comprising: forming a cylindrical tube into a D-shaped cross-section having a flat side disposed opposite to a semicircular portion with arcuate corner portions therebetween, placing a coil of a plurality of turns of brazing wire over one end of said tube, the internal diameter of said coil being substantially greater than that of the tube, making one end of said coil fast with respect to said tube and moving said turns along said tube in the form

of an open helix of the same diameter as said tube, placing the wire entwined tube on a metal surface, and heating said wire to its melting point to braze said tube to said surface and to form heavy fillets outwardly of the flat side of said tube between the arcuate corner portions and said metal surface on both sides of the tube.

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