Feb. 22, 1944. J. W. BROWN, JR ET AL 2,342,117

HEAT EXCHANGER TUBE

Filed Aug. 7, 1941

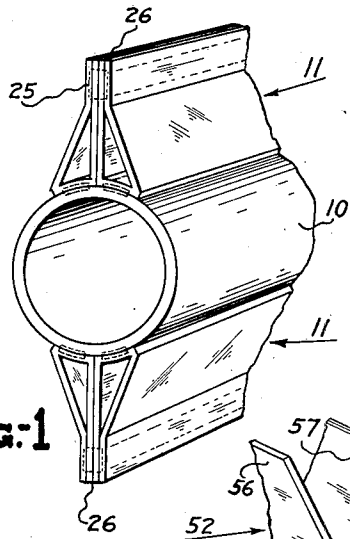


FIG.-1

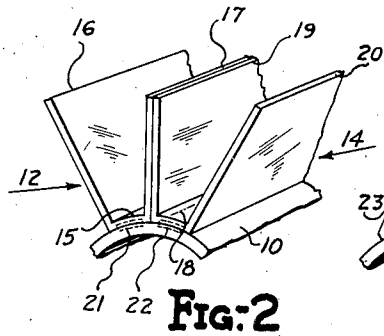


FIG.-2

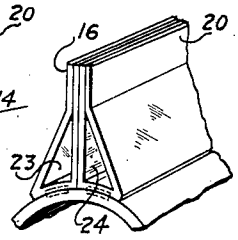


FIG.-3

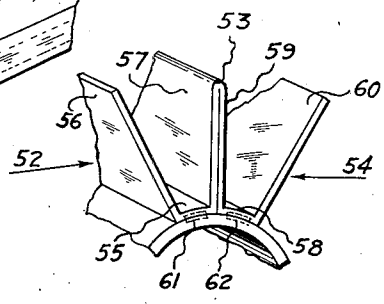


FIG.-6

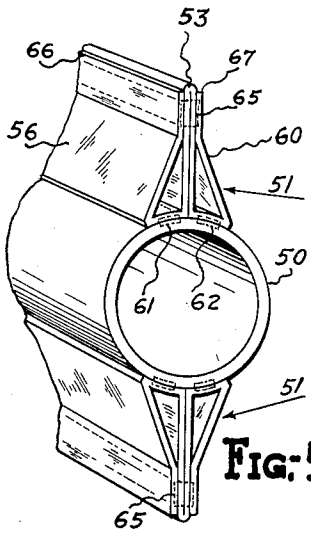


FIG.-5

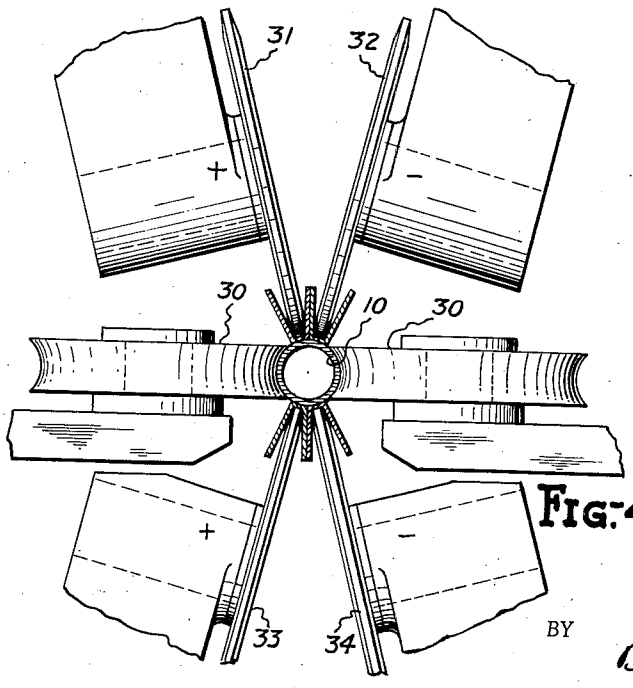


FIG.-4

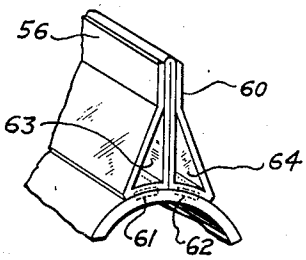


FIG.-7

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HEAT-EXCHANGER TUBE

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Application August 7, 1941, Serial No. 405,836

4 Claims. (Cl. 257—262)

This invention relates to the construction of heat exchange devices and more particularly to surfaces provided with fins for increasing the surface area thereof and thus increasing the heat transfer capacity of the surface. The invention is described herein with particular reference to finned tubes, but it is to be understood that the invention may be employed with other forms or shapes of surfaces. The prior application of John W. Brown, Jr., Serial No. 386,503, filed April 2, 1941, discloses a tube and method and apparatus for making the same wherein channel section members are welded to the exterior of the tube and the flanges of the channel subsequently are brought into contact with each other to make the two flanges into a single fin. These tubes have very advantageous characteristics, but under some circumstances of particularly severe operating conditions the temperature gradient between the tips of the flanges or fins and the tube may be so great that the outer portions of the flanges or fins are not efficient from a heat transfer standpoint, and under some circumstances where very hot gases are on the exterior of the tubes the tips of the fins may be heated to such an extent that they will be damaged or burned.

It is an object of the present invention to overcome these difficulties and to provide finned tubes or other members and a method of making the same whereby the temperature gradient between the tips or outer edges of the fins and the bases may be kept within reasonable bounds and wherein direct and adequate paths are provided for the transfer of heat from the tips of the fins to the bases thereof. It is a further object of our invention to provide such fins which can be rapidly and economically manufactured, and another object is to provide an efficient and economical method for manufacturing such finned members.

Briefly, we accomplish the above and other objects of our invention by securing to the tube, or other surface, one or more hollow fins, and providing heat conducting members extending within the hollow fins from the tip or edge portions thereof to the base portions thereof. By this means, a direct path for the flow of heat from the tip to the base of the fin is provided which is particularly efficient, for the metal heat conducting member, being spaced apart from the side walls of the fin throughout a considerable portion of its length, can receive heat by conduction only from the base of the fin or the tip. By this construction the temperature gradient between the tip or outer edge of the fin and the tube, or other surface to which the fin is secured, can be maintained at a reasonable level with the result that the fin is highly efficient in transferring heat and damage to the fin under severe operating conditions is prevented.

Preferably, we produce such hollow fins by welding, brazing or otherwise joining to the exterior surface of the tube, or other member, two channel section members, each having a base portion and two flanges with the base portions of both in engagement with the tube and one flange of one channel member in engagement with a flange of the other channel member. This operation produces a structure with four projecting fins, the two inner fins lying alongside of each other and the two outer fins being spaced therefrom. Preferably, the welding operation is carried out as described in detail in the application of John W. Brown, Jr., Serial No. 380,690, filed April 2, 1941, thus providing adequate paths for the transfer of heat from the bases of the channel members to the tube.

After the channels have been welded to the tube or other member, the outer flanges of each pair of channels are bent into engagement with the inner flanges of the channels adjacent their outer edges and the four flanges are then welded together preferably either by a continuous weld or a series of spot welds, in a zone spaced away from the bases of the channels and near the outer edges of the flanges. This produces a structure wherein the supporting member is provided with a hollow fin welded to its surface, the outer lateral surfaces of the fin being formed by the outer flanges of the two channel members, the tip of the fin being solid and being formed by the four flanges welded together. The heat conducting member for rapidly transferring heat between the base of the fin member and the tip is formed by the two inner flanges which, being disposed within the hollow portion of the fin, can receive or dissipate heat by conduction only from or to the tip of the fin or the base portion thereof. Because heat will seek the path of least resistance, the central conducting member may conduct heat from or to the lateral surfaces of the fin, but the flow will be largely through the tip portion. The two channel members may be separately formed or they may be formed in one piece with the inner flanges joined together. The various welding and bending operations may be carried out in an apparatus such as that described in the Brown application Serial No.

386,503 aforesaid, and modified as will be described in detail below.

Referring now to the drawing in which the invention is described, with particular reference to finned tubes, Fig. 1 is a perspective of a preferred form of finned tube made according to our invention and embodying longitudinally extending fins on diametrically opposite surfaces of the tube; Fig. 2 is a fragmentary view illustrating one step in the manufacture of the tube of Fig. 1; Fig. 3 is a similar view showing a subsequent step in the manufacture of the tube of Fig. 1; Fig. 4 is a somewhat diagrammatic sectional view illustrating the operation of welding opposite pairs of channel members to a tube; Fig. 5 is a perspective of a slightly modified form of our invention showing a tube embodying longitudinally extending fins on diametrically opposite surfaces of the tube; and Figs. 6 and 7 are fragmentary views illustrating steps in the manufacture of the tube shown in Fig. 5.

As illustrated in Fig. 1 of the drawing, a preferred form of our invention may comprise a tube 10 having fin members indicated generally at 11 secured to the exterior thereof at diametrically opposite points. Each fin member is made up of two channels indicated generally at 12 and 14 in Fig. 2, the channel 12 having a base portion 15, and flanges 16 and 17, and the channel 14 being similar in all material respects and having a base portion 18 and flanges 19 and 20. To produce the hollow fin structures 11 shown in Fig. 1, the channel members 12 and 14 are placed along the tube 10 with their base portions 15 and 18 in contact therewith and with the flange 17 of the channel 12 in engagement with the flange 19 of the channel 14. Then the base portions of the channels are welded to the tube as indicated diagrammatically at 21 and 22, preferably as disclosed in the aforesaid Brown applications.

Thereafter the outer flanges 16 and 20 of the channels 12 and 14, respectively, are bent inwardly into engagement with the inner flanges 17 and 19, the operation being carried out preferably so that the flanges are in contact at their outer edges for a short space inwardly and are spaced apart to leave hollows 23 and 24 as shown in Fig. 3. The operation of deforming the flanges may be carried out in any convenient manner, for example, by rolls of the general character shown in the Brown application Serial No. 386,503, aforesaid. The tube may then be completed by welding the contacting portions of the flanges 16, 17, 19 and 20 together, preferably by an electrical resistance weld indicated diagrammatically at 25 in Fig. 1, which may either be a continuous weld or a series of spaced spot welds.

In welding the channels to the tube, we prefer that oppositely disposed channels be welded simultaneously so that the heating effects on the opposite sides of the tube will be uniform and bending or deformation of the tube prevented. This operation may be carried out as indicated diagrammatically in Fig. 4 wherein the tube 10 is supported and held in accurate position by a pair of guide rolls 30 engaging the outer surface of the tube while electrode rolls 31, 32, 33 and 34 engage the bases of the fins. The tube is moved relative to the electrode rolls and the guide rolls and current caused to flow, simultaneously welding the bases of the four channel members to the exterior of the tube. The current is preferably controlled to produce a series of intermittent welds having areas and contours to provide adequate paths for the transfer of heat from the fins to the tube as described in the aforesaid applications. The diametrically opposite electrodes, that is, electrodes 31 and 34, and 32 and 33, respectively, are of opposite polarity at any given instant to provide the required flow of current and the simultaneous production of the welds.

It will be noted that the fins 11 have substantially flat surfaces 26 at their outer edges. This is accomplished by making the channels with their outer flanges 16 and 20 slightly longer than the inner flanges 17 and 19 so that when the flanges 16 and 20 are bent into engagement with the flanges 17 and 19, the edges of all four flanges will substantially coincide. This type of construction is desirable for certain purposes particularly where it is desired to abut the flanges of a number of tubes to form a wall.

In Figs. 5, 6 and 7 we have shown a slightly modified form of our invention wherein the tube 50 is provided with a pair of fins 51 which are generally similar to the fins 11 except that as shown in Fig. 6 the channels 52 and 54 are made in one piece, being joined at 53 adjacent the outer edges of the flanges 57 and 59. The base portions 55 and 58 of the channels in this modification may be welded as described above, using welds indicated diagrammatically at 61 and 62. After the welding operation the outer flanges 56 and 60 may be bent into engagement with the inner flanges 57 and 59 in the manner previously described, producing the structure shown in Fig. 7, preferably leaving spaces or hollows 63 and 64 in the fin. Thereafter, the tube may be completed by welding the engaging portions of the flanges together as indicated diagrammatically at 65 in Fig. 5.

It will be noted that in this modification the joined portion 53 of the inner flanges 57 and 59 projects beyond the edge portions 66 and 67 of the flanges 52 and 54, for the flanges 56, 57, 59 and 60 are all of the same length so that when the flanges 56 and 60 are bent into engagement with the inner flanges 57 and 59, the edges thereof do not extend radially outwardly as far as the edge portion 53 of the inner flanges. Of course, a structure with a generally flat edge as indicated at 26 in Fig. 1 may be produced with a tube made according to this modification of our invention merely by making the outer flanges 52 and 54 of slightly greater length to compensate for the bending operation. Similarly channels 12 and 14 of Fig. 1 may be made with flanges of equal length so that when the outer flanges 16 and 20 are bent inwardly, an edge structure would be produced in which the inner flanges project beyond the outer flanges.

In both modifications of our invention the inner flanges constitute heat conducting members for transferring heat through the hollow fins between the tube and the tips or outer edges of the fins, for the inner flanges are in heat conducting relationship with the bases of the channel members which constitute the bases of the fins and with the outer flange members adjacent the outer edges thereof. Thus, a direct path is provided which will insure sufficient transfer of heat between the tube and the outer edges or tips of the fins, will result in a lowered temperature gradient between these two regions, will improve the heat-transfer ability of the fins, and will give the fins the ability to withstand exceptionally severe operating conditions without damage. This makes possible the construction of heavy-

duty fins from light gage stock, reducing the cost of materials and of the welding and forming operations.

Those skilled in the art will appreciate that various changes and modifications can be made in our invention without departing from the spirit and scope thereof. For example, fins of this type may be employed with surfaces of supporting members other than tubes, different methods of securing the fins to the tubes or other supporting member may be employed, the fin members may be of different shape, the steps of the method may be carried out in other than the preferred order. Therefore, it is to be understood that the foregoing description of preferred forms is given by way of example and not by way of limitation, and that our patent is not limited thereby or in any manner other than by the scope of the appended claims.

We claim:

1. In combination, a tube, a pair of channel members each having a base portion and flange portions, the base portions of said channel members being resistance welded to the tube adjacent each other, the inner two flanges of the channels being substantially in contact with each other and the outer flanges being bent inwardly into engagement with said inner flanges and secured thereto in a region spaced away from said base portions.

2. A heat exchange conductor comprising a tube, a double channel section member having two base portions, a pair of outer flanges extending therefrom and an inner flange extending from the base portion between the outer flanges, the base portions being welded to the tube by a series of resistance welded areas, the outer flanges being bent into contact with said inner flange, and said outer and inner flanges being welded together.

3. In combination, a supporting member, a pair of channel members each having a base portion and two flange portions, the base portions of said channel members being secured to the supporting member adjacent each other, the inner two flanges of the channels being substantially in contact with each other and the outer flanges being bent inwardly into contact with the inner flanges, the four flanges being secured together in a region spaced away from said base portions.

4. A heat exchange conductor comprising a supporting member, a double channel section member having two base portions, a pair of outer flanges extending therefrom and an inner flange extending from the base portion between the outer flanges, the base portions being secured to the supporting member, the outer flanges being bent into contact with said inner flange, and said outer and inner flanges being secured together.

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