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L. B. MANNING

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METHOD OF MAKING HEAT EXCHANGERS

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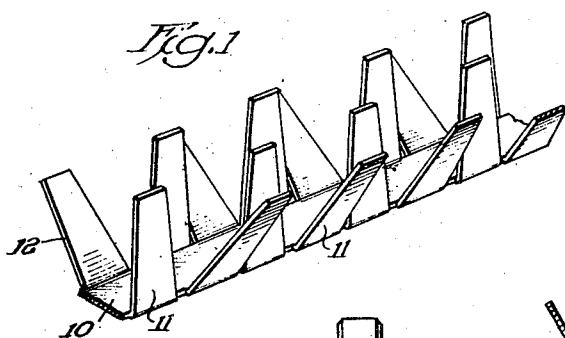


Fig. 2

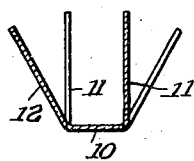


Fig. 3

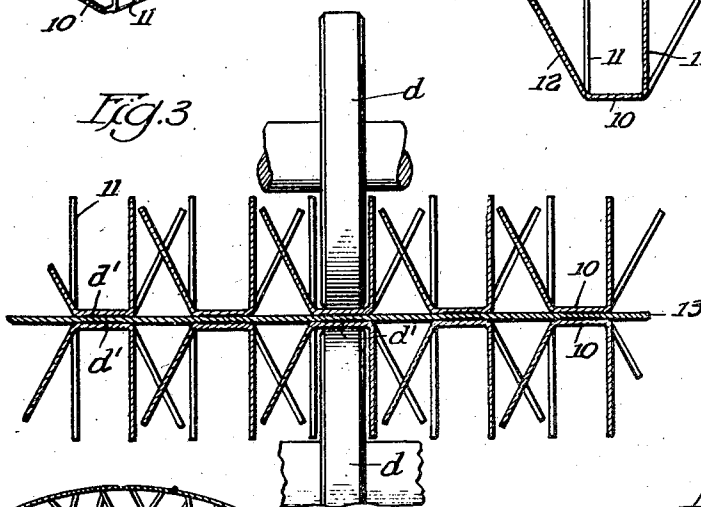


Fig. 5

Fig. 4

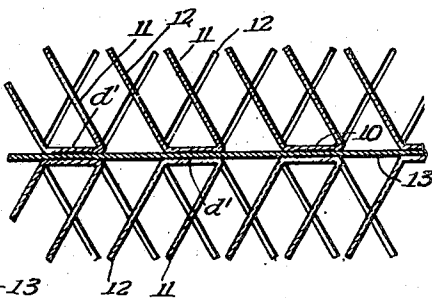
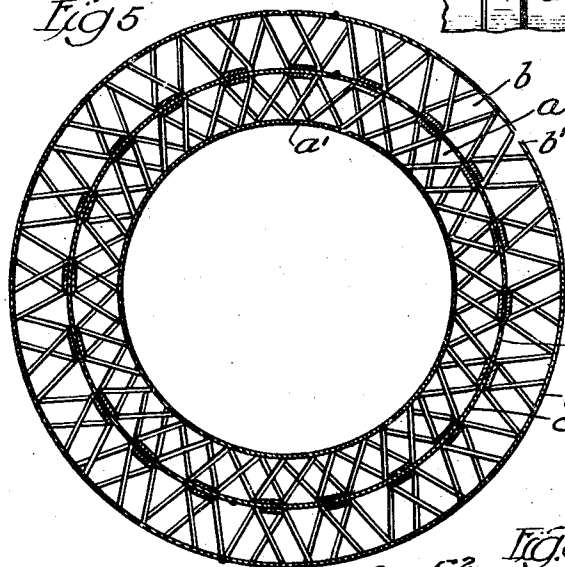
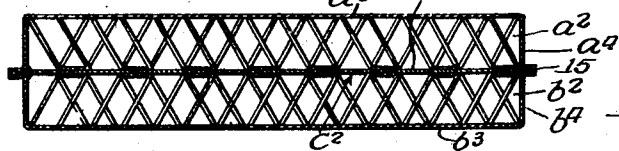


Fig. 6



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UNITED STATES PATENT OFFICE

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METHOD OF MAKING HEAT EXCHANGERS

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4 Claims. (Cl. 113—118)

The invention relates to heat exchangers provided with heat transfer elements of sheet metal.

One object of the invention is to provide an improved method for producing heat exchangers with sheet metal elements for heat conduction which utilizes continuous strips with integral rows of tongues projecting angularly from the margin of the strips to provide extended surfaces of high conductive efficiency and in which one wall of the fluid conduit is provided with transfer elements which extend from both of its faces.

Another object of the invention is to provide an improved method for producing heat exchangers with annular conduits with sheet metal heat transfer elements which comprise continuous strips and integral rows of tongues projecting angularly away from the strips for efficient heat conduction.

Another object of the invention is to provide an improved heat exchanger which is provided with sheet metal heat transfer elements composed of continuous strips and angularly extending tongues on both faces of one of the walls of a conduit.

Another object of the invention is to provide a heat exchanger of the annular conduit type with efficient heat transfer elements.

Other objects of the invention will appear from the detailed description.

The invention consists in the several novel features which are hereinafter set forth and more particularly defined by claims at the conclusion hereof.

In the drawing:

Figure 1 is a perspective of a portion of one of the heat transfer elements before it is joined to a conduit wall.

Figure 2 is a transverse section of the element shown in Fig. 1.

Figure 3 is a section illustrating the simultaneous welding of a pair of heat transfer elements to the opposite faces of a conduit wall.

Figure 4 is a section illustrating the shape in which the tongues are bent after the elements have been bonded to the conduit wall.

Figure 5 is a transverse section of a heat exchanger with two annular conduits embodying the invention.

Figure 6 is a transverse section of a heat exchanger of the box type.

The invention utilizes sheet metal elements for providing extended surfaces on walls for heat conduction. The elements are fabricated from sheet metal which is cut to provide continuous strips 10 and rows of integral tapered tongues

11 and 12 along the longitudinal margins of the strips respectively. The tongues and strips are first cut from flat sheet metal into flat blanks. The tongues are next bent to extend angularly away from one face of the strip. Strips 10 are then bonded to a sheet metal plate 13 which is adapted to form one wall of a fluid-conduit. The faces of the strips from which no tongues extend are arranged in parallel relation and in juxtaposition on opposite sides of the plate 13 and passed between electric welding rolls *d*, as illustrated in Fig. 3, to bond strips to the opposite faces of the plate 13 by continuous welds *d*¹ which extend substantially across the contiguous faces of the strips 10. Initially, the tongues 11 and 12 are bent to extend away from the strips 10 at such angles that the welding rolls *d* can pass between the rows of tongues along the opposite margins of the strips. As shown, the tongues are arranged in transverse pairs on each strip with one tongue 11 of each pair extending substantially at right angles to the face of strip 10 and the other tongue 12 of each pair extending obliquely from said face. After the strips 10 have been bonded to the plate 13 as shown in Fig. 3, the right-angled tongues 11 of each transverse pair are bent into substantially parallel relation with the oblique or inclined tongue 12 of each transverse pair, as illustrated in Fig. 4. The alternate transverse pairs of tongues are bent to extend obliquely in opposite directions from the strip so that one row of transverse pairs of tongues will extend crosswise of the next transverse row of pairs.

Fig. 5 illustrates a heat exchanger with an inner annular conduit *a* for one fluid and an outer annular conduit *b* for another fluid. In fabricating this type of heat exchanger, the plate or sheet 13, after the strips have been bonded to both of its faces, is bent to a cylindrical shape as illustrated in Fig. 5, to form a continuous cylindrical wall *c* with heat transfer elements extending outwardly from its outer periphery and inwardly from its inner periphery. This may be formed from a single plate, or if desired the plates may be bent into arcuate sections and their edges secured together to form a cylindrical wall.

A plate or sheet of metal is then extended around the outer ends of the tongues projecting from the outer periphery of the wall *c* to form an annular outer wall *b*¹ for the conduit *b*. A cylindrical shell or plate is forced between the ends of the tongues which projects inwardly from

wall *c* to form the inner wall *a*¹ for the conduit *a*. The wall *c* forms the inner wall of the conduit *b* and the outer wall of the conduit *a*. The wall *a*¹ may be made of tubing or of a sheet bent to cylindrical form with edges welded together.

This exemplifies a method of fabricating heat exchangers with sheet metal transfer elements bonded to both faces of one wall for use in separate fluid conduits and also a low-cost method for fabricating tubular conduits with heat transfer elements bonded thereto. The tongues are flexible so they will resiliently engage and contact with the inner periphery of wall *b*¹ and the outer periphery of wall *a*¹ respectively.

In Fig. 6 the invention is illustrated in connection with a box-type of heat exchanger provided with two separate compartments or conduits *a*² and *b*². In fabricating this type a sheet 13 with strips 10 bonded to its opposite faces and with tongues extending angularly therefrom, as illustrated in Fig. 4 are fabricated as before described. Sheet 13 with the heat transfer elements bonded thereto forms the dividing wall *c*² between conduits *a*² and *b*². The outer wall of compartment or conduit *a*² is formed by a metal plate *a*³ with a flanged rim *a*⁴ and the outer wall of compartment or conduit *b*² is formed by a plate of metal *b*³ with a flanged rim *b*⁴. The flanges on the rims of plates *b*³ and *c*³ with the sheet 13 between them to form the dividing wall *c*² are suitably welded or otherwise secured together as at 15, to complete the box with two separate conduits. In this case the tongues may be flexible so they will engage the outer wall of the box. Fluids flowing through the conduits or compartments *a*² and *b*² respectively will contact the edges and faces of the tongues for efficient thermal conduction. The tongues on the strips 10 may be of any desired length and extend at any desired angle across the conduit so that the desired area of extended surface for thermal conduction will be attained.

The invention exemplifies a simple method for providing a single conduit wall with sheet metal heat transfer elements on both faces thereof and of sufficient area for efficient thermal conduction. It also exemplifies a simple method for fabricating heat exchangers having annular conduits with efficient heat transfer elements. It also exemplifies a heat exchanger provided with sheet metal heat transfer elements which are efficient in thermal conduction and can be produced at a low cost of fabrication.

The invention is not to be understood as restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent is:

1. That improvement in making heat exchangers which comprises cutting flat sheet metal into continuous strips with rows of integral

tongues along their longitudinal margins, then bending the tongues to extend angularly away from the strips, then bonding a series of said strips in parallel relation to one of the faces of a flat metal plate with the tongues extending away from said faces to form extended surfaces for heat conduction, then bending the plate with the strips thereon transversely of the strips to form an annular conduit wall with the strips extending longitudinally of the conduit, and then securing an annular wall around the free end of the tongues to form an annular conduit between the walls.

2. That improvement in making heat exchangers which comprises cutting flat sheet metal into continuous strips with rows of integral tongues along their longitudinal margins, then bending the tongues to extend angularly away from the strips, then simultaneously bonding pairs of said strips in parallel relation to one of the faces of a flat metal plate with the tongues extending away from said faces to form extended surfaces for heat conduction, then bending the plate with the strips thereon transversely of the strips to form an annular conduit wall with the strips extending longitudinally of the conduit, and then securing an annular wall around the free end of the tongues to form an annular conduit between the walls.

3. That improvement in making heat exchangers which comprises cutting flat sheet metal into continuous strips with rows of integral tongues along their longitudinal margins, then bending the tongues to extend angularly away from the strips, then bonding a series of said strips in parallel relation to each of the opposite faces of a flat metal plate with the tongues extending away from the opposite faces of the plate to form extended faces for heat conduction, then bending the plate with the strips secured on the opposite faces of the sheet transversely of the strips to form an annular conduit wall with the strips extending longitudinally of the conduit, and then securing an annular wall around the free ends of the tongues on one side of the bent plate to form an annular conduit.

4. That improvement in making heat exchangers which comprises cutting flat sheet metal into continuous strips with rows of integral tongues along their longitudinal margins, then bending the tongues to extend angularly away from the strips, then simultaneously bonding pairs of said strips in parallel and transversely aligned relation to each of the opposite faces of a flat metal plate with the tongues extending away from the opposite faces of the plate to form extended faces for heat conduction, then bending the plate with the strips secured on its opposite faces transversely of the strips to form an annular conduit wall with the strips extending longitudinally of the conduit, and then securing annular walls around the free ends of the tongues on both sides of the bent plate to form a pair of annular conduits.

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