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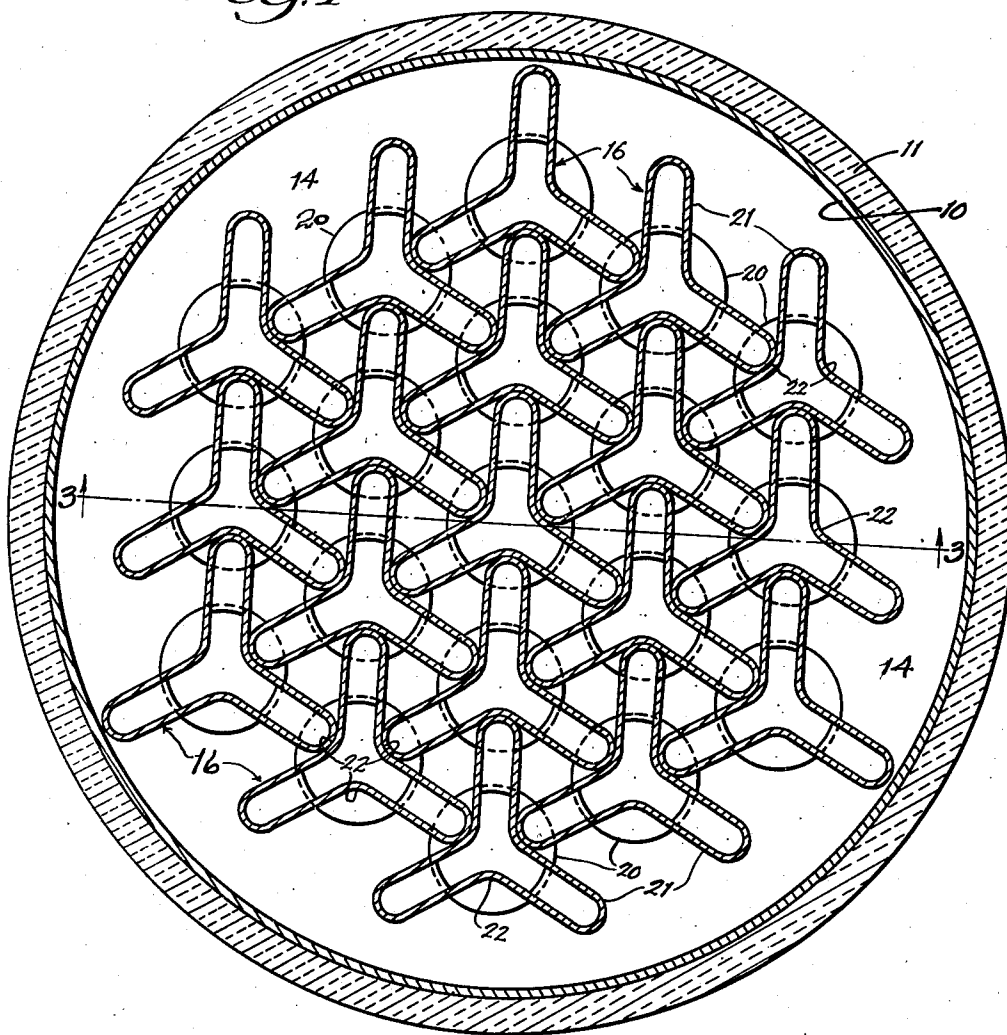
C. L. DEWEY
HEAT EXCHANGER ASSEMBLY

2,365,688

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3 Sheets-Sheet 1

Fig. 1



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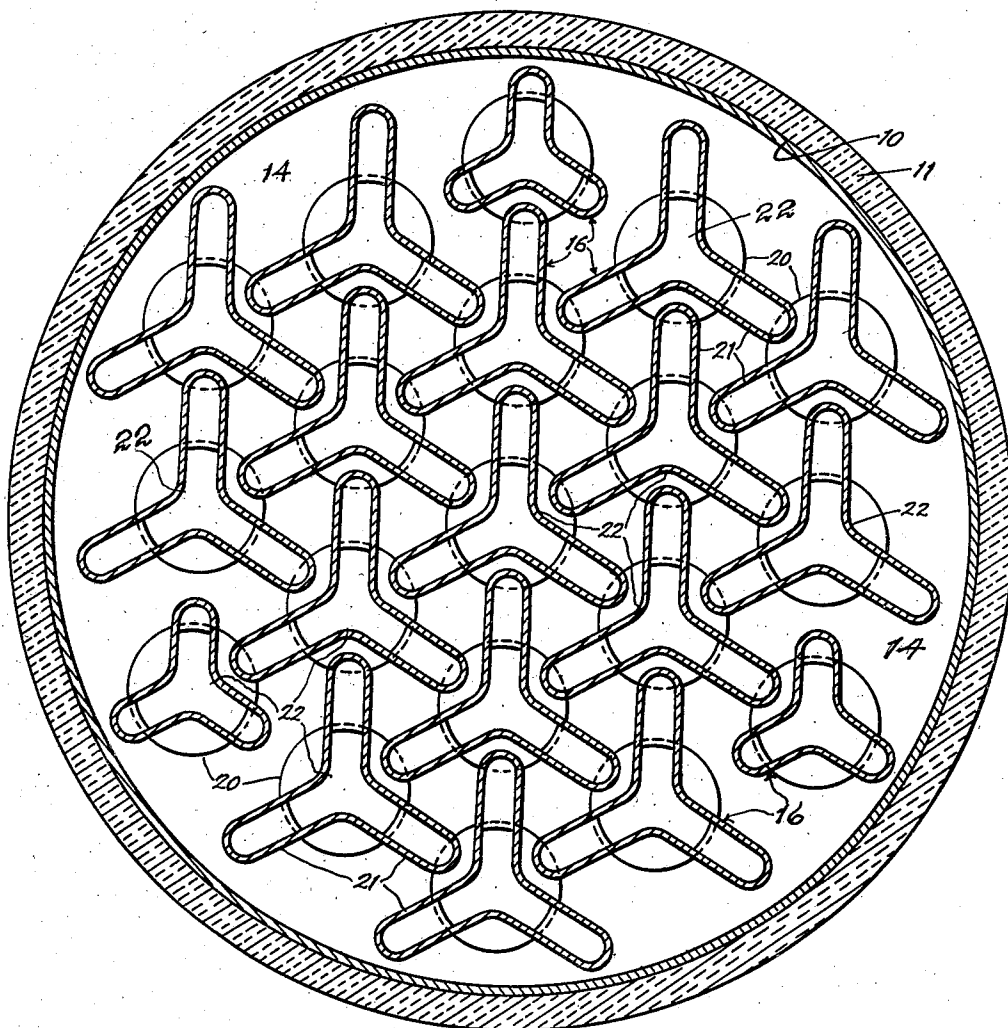
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Fig. 2



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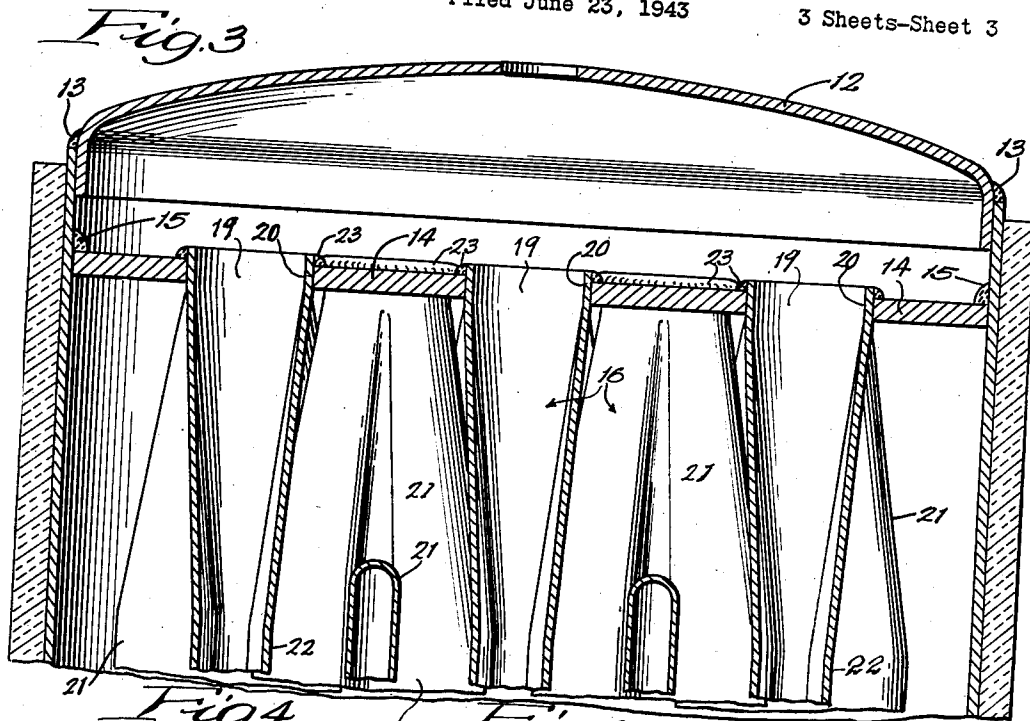
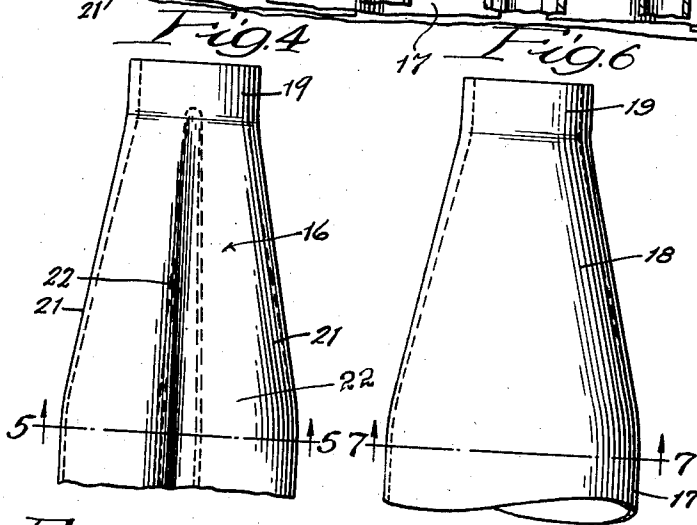
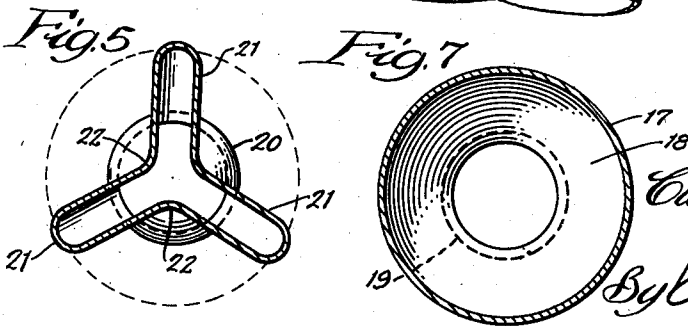
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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HEAT EXCHANGER ASSEMBLY

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Application June 23, 1943, Serial No. 491,901

6 Claims. (Cl. 257—224)

The present invention is directed to the grouping or arranging of tubes of special formation within a tank or shell in such a way as to best employ the available space and at the same time afford a widely extended surface for heat transmission without blocking the free circulation of a fluid medium between the tubes so that a rapid and effective exchange of heat may be provided for.

In one form of grouping, the tubes are so arranged as to mutually contact with one another in an interlaced arrangement which affords mutual support to the respective tubes and increases the rigidity of the structure as a whole.

Further objects and details will appear from a description of the invention in conjunction with the accompanying drawings wherein,

Figure 1 is a sectional plan view of a heat exchanger showing the tubes grouped in contacting relation to one another;

Fig. 2 is a similar view showing the tubes grouped in separated relation with respect to one another;

Fig. 3 is a sectional elevation of the upper end of the exchanger with the tubes grouped as in Fig. 1;

Fig. 4 is a side view of the upper end of one of the tubes;

Fig. 5 is a cross-sectional view taken on line 5—5 of Fig. 1 looking in the direction of the arrows;

Fig. 6 is a view of a fragment of tubing tapered toward its end, but prior to giving it the three-lobed configuration required in the completed tube; and

Fig. 7 is a cross-sectional view taken on line 7—7 of Fig. 6.

For purposes of illustration the tube assembly is shown housed within a cylindrical shell or tank 10 sealed by a jacket 11 of asbestos or the like and provided at each end with an outwardly bulged or dished head 12 fitted into the end of the shell and permanently united therewith by a welding ring 13, it being understood that the shell here shown is of uniform construction at each end.

Within the shell at each end is located a header plate 14 secured to the shell by a welding ring 15, which at each end affords a chamber for the reception of the fluid medium to be circulated through and educted from the tubes.

The header plates provide supports for the opposite ends of the tubes 16 whose form and arrangement constitute the special features of the present invention. Each tube is formed from

a section of tubing 17 which is originally of cylindrical form in its medial portion as shown in Fig. 6. At each end of the medial portion the tubing is tapered toward each end to afford a neck portion 18 of progressively increasing wall thickness and reduced diameter which terminates in a reduced cylindrical tip 19 of a size to be entered through the intended apertures 20 in the header plate.

In forming the completed tube, the body and neck portions are compressed until they assume the three-lobed formation shown which provides three hollow arms 21 radiating from a centrally disposed body 22, the arms being of ridge-like formation and affording intervening V-shaped grooves or valleys. The height of the ridge-like arms remains uniform throughout the intermediate body section of the tube, but as the arms merge into the tapered neck portions, the crests of the ridges will progressively decrease in height until they merge into the cylindrical tips at the respective ends while the bases of the intervening grooves or valleys will diverge outwardly from the axis of the tube until they merge into the cylindrical tip portions. Thus the ridge-like arms progressively increase in height throughout the neck portions while the intervening grooves progressively deepen so that throughout the body portion of the tube, the cross diameter of the center portion from which the arms radiate is much less than the diameter of the tip ends of the tube.

The tubes thus formed, when brought into contact with one another as in Fig. 1 will assume a regular pattern in which the three arms of a given tube will contact the grooves of three adjacent tubes while the grooves of the first tube are in turn contacted by the arms of three additional tubes, so that each tube makes contact with six adjacent tubes, thus affording extreme rigidity to the assembly and reinforcing each of the tubes against outward bulging by the resistance afforded by the arms of adjacent tubes. At the same time the arrangement shown in Fig. 1 enables a maximum number of tubes to be housed within a given space and in a regular sequence throughout.

In cases where the mutual reinforcement of the tubes by contact is not required, and where maximum conservation of space is not deemed necessary, the arrangement shown in Fig. 2 may be employed, which resembles that first described in all respects save that the tubes are not compacted to the extent necessary to bring them into actual contact, but merely into close

adjacency, although the general group arrangement is substantially the same in each case.

With the cylindrical tips of the tube entered through the apertures in the header plates, the parts can be permanently united by a welding ring 23 which encircles the margin of the tip and fuses with the surface of the header plate. It will, of course, be understood that the shape and dimensions of the surrounding tank or shell may be varied as required and that the size, length, and wall thickness of the tubes will be determined with reference to the intended use, but the tube formation and group arrangement here shown are of a character which readily lend themselves to variations in detail permitting a greater or lesser number of tubes to be grouped according to the arrangement shown which reaches its maximum of compactness when the tubes are brought into the contacting arrangement first described.

It will, of course, be understood that one fluid medium, such as steam, will circulate through the tubes while another fluid medium such as water may be admitted to the surrounding space within the tank, or the reverse arrangement may be employed in conformity with principles well understood in the art to which the present invention is directed.

I claim:

1. In a heat exchanger the combination of spaced header plates, a tank within which the header plates are located, and a plurality of tubes having their open tip ends entered into the header plates, each of the tubes being of three-lobed formation in cross section having three ridge-like arms radiating from a common center and separated by intervening grooves, the tubes having a group arrangement wherein the three arms of each tube project radially toward the centers and into the opposed grooves of three adjacent tubes, and the arms of three tubes intervening those last mentioned project radially toward the center and into the opposed grooves of the first mentioned tube.

2. In a heat exchanger the combination of spaced header plates, a tank within which the header plates are located, and a plurality of tubes having their open tip ends entered into the header plates, each of the tubes being of three-lobed formation in cross section having three ridge-like arms radiating from a common center and separated by intervening grooves, the arms having substantially parallel flat sides and a connecting crest wall and extending radially in greater degree than the radius of the tip ends and tapering down thereto at each end, the tubes having a group arrangement wherein the three arms of each tube project radially toward the centers and into the opposed grooves of three adjacent tubes, and the arms of three tubes intervening those last mentioned project radially toward the center and into the opposed grooves of the first mentioned tube.

3. In a heat exchanger the combination of spaced header plates, a tank within which the header plates are located, and a plurality of tubes having their open tip ends entered into the header plates, each of the tubes being of three-lobed formation in cross section having three ridge-like arms radiating from a common center and separated by intervening grooves, the

tubes having a group arrangement wherein the three arms of each tube project into the opposed grooves of three adjacent tubes, and the arms of three tubes intervening those last mentioned project into the opposed grooves of the first mentioned tube, and wherein the crests of the aforesaid arms of the respective tubes in each instance contact with the base of the groove into which the arm is projected to reenforce the group assembly.

4. In a heat exchanger the combination of spaced header plates, a tank within which the header plates are located, and a plurality of tubes having their open tip ends entered into the header plates, each of the tubes being of three-lobed formation in cross section having three ridge-like arms radiating from a common center and separated by intervening grooves, the arms having substantially parallel flat sides and a connecting crest wall and extending radially in greater degree than the radius of the tip ends and tapering down thereto at each end, the tubes having a group arrangement wherein the three arms of each tube project into the opposed grooves of three adjacent tubes, and the arms of three tubes intervening those last mentioned project into the opposed grooves of the first mentioned tube, and wherein the crests of the aforesaid arms of the respective tubes in each instance contact with the base of the groove into which the arm is projected to reenforce the group assembly.

5. In a heat exchanger the combination of spaced header plates, a tank within which the header plates are located and a plurality of tubes having their open tip ends entered through the header plates, each of the tubes being of multiple-lobed formation in cross section having a plurality of ridge-like arms radiating from a common center and separated by intervening grooves, the tubes having a group arrangement wherein the respective arms of each tube project radially toward the centers and into the grooves of a group of tubes standing into opposed relation thereto, and wherein the arms of a group of tubes intervening those last mentioned project radially toward the center and into the opposed grooves of the first mentioned tube.

6. In a heat exchanger the combination of spaced header plates, a tank within which the header plates are located and a plurality of tubes having their open tip ends entered through the header plates and united thereto in each instance by a welding ring surrounding the protruding end of the tube, each of the tubes being of multiple-lobed formation in cross section having a plurality of ridge-like arms radiating from a common center and separated by intervening grooves, the ends of the tubes being tapered from the arms and flared outwardly from the grooves into circular tip formation and the tubes having a group arrangement wherein the respective arms of each tube project radially toward the centers and into the grooves of a group of tubes standing into opposed relation thereto, and wherein the arms of a group of tubes intervening those last mentioned project radially toward the center and into the opposed grooves of the first mentioned tube.

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