Sept. 6, 1938. F. R. BICHOWSKY 2,129,300

SPIRAL HEAT INTERCHANGER

Filed April 10, 1936 2 Sheets-Sheet 1

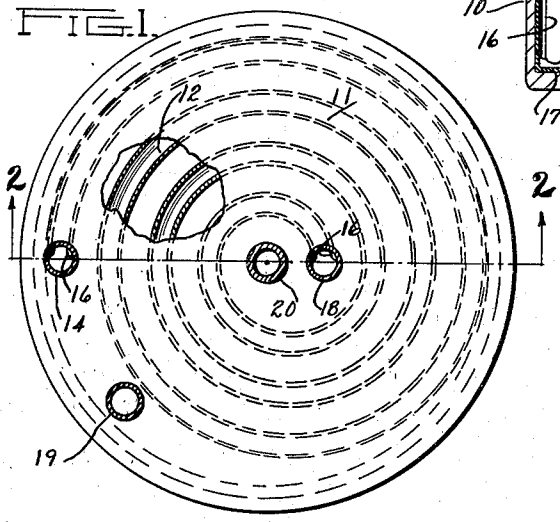


FIG. 1.

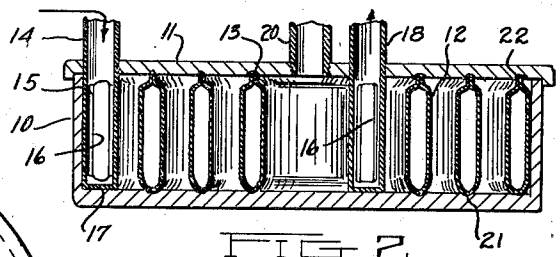


FIG. 2.

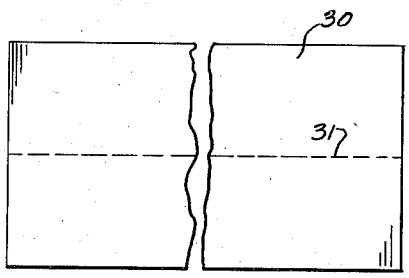


FIG. 3.

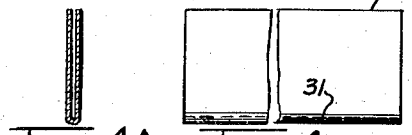


FIG. 4A FIG. 4.

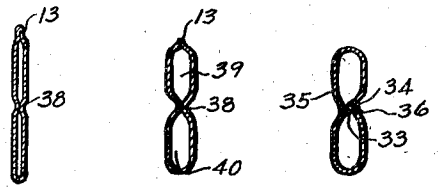


FIG. 9. FIG. 10. FIG. 11.

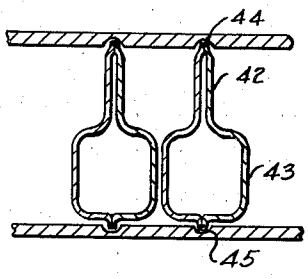


FIG. 12.

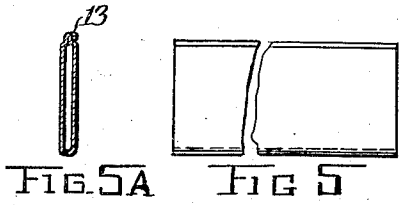


FIG. 5A FIG 5

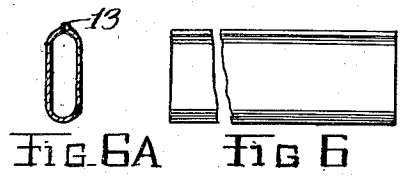


FIG. 6A FIG 6

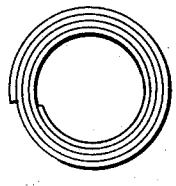


FIG. 7.

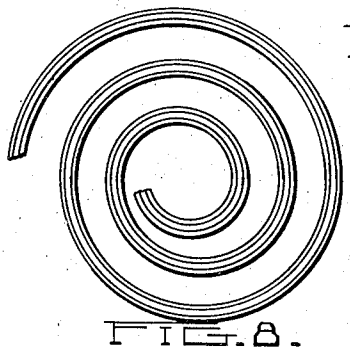


FIG. 8.

INVENTOR:
Francis R. Bichowsky

BY Charles A. Lind
ATTORNEY.

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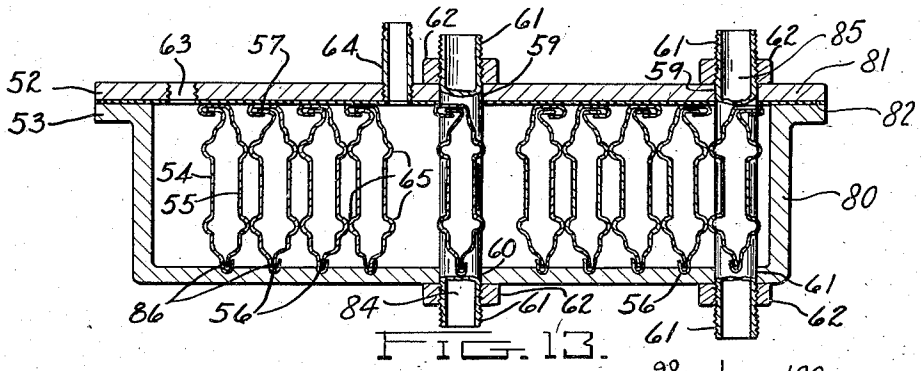


FIG. 13.

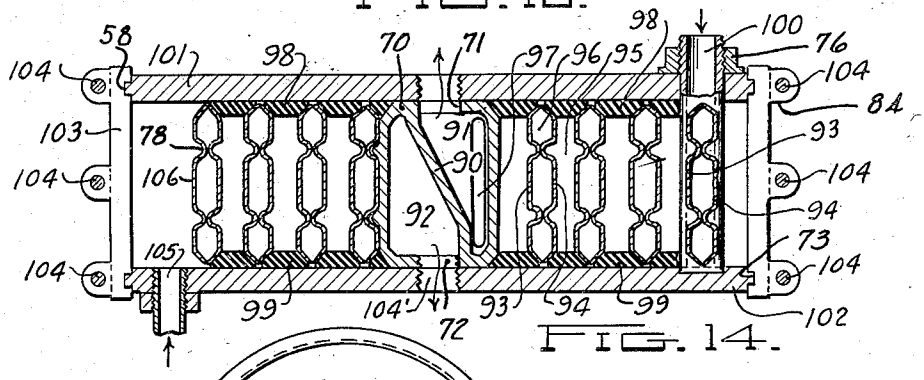


FIG. 14.

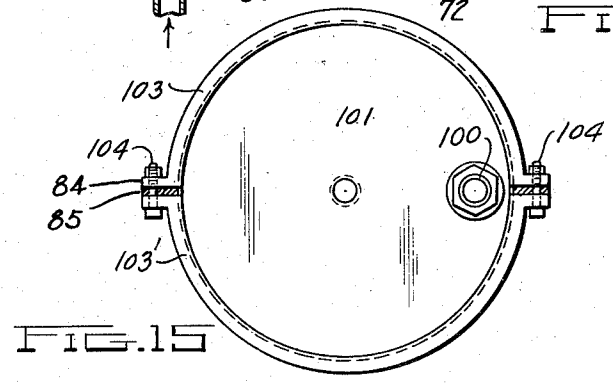


FIG. 15

INVENTOR:
Francis R. Bichowsky
BY Charles A. Lind
ATTORNEY

Patented Sept. 6, 1938 2,129,300

UNITED STATES PATENT OFFICE

2,129,300

SPIRAL HEAT INTERCHANGER

Francis R. Bichowsky, Ottawa Hills, Toledo, Ohio, assignor to The Dow Chemical Company, Midland, Mich., a corporation of Michigan

Application April 10, 1936, Serial No. 73,794

7 Claims. (Cl. 257—245)

This invention pertains to improved heat interchanger or transfer structures such as are used for coolers, condensers, heaters, evaporators, etc., and the like.

Interchangers of the double spiral type have the advantage of capacity and low material cost, but, in spite of these advantages, interchangers of this type have not been widely used because of difficulties of construction and lack of strength, more especially against pressure. Among the difficulties of construction have been the difficulty of spacing the double spiral sheets so as to leave uniform passages between them, the difficulty of forming the thin sheets so that they will withstand fluid pressure, the difficulty of removing scale or other deposits which may form on the spiral, and the difficulty of sealing the edges of the sheets so that fluid will not pass from one passage to the other.

One of the objects of this invention is to provide an improved type of interchanger sufficiently strong to withstand fluid pressure. A still further object is to construct a device of the type described which is readily cleaned. Further objects of this invention relate to spiral interchangers and will be apparent from the following description and the accompanying drawings wherein a preferred embodiment of the present invention is shown.

In the drawings, wherein like numerals represent corresponding parts in the various figures:

Figure 1 is a plan view partly broken away.

Figure 2 is a cross section view along line 2—2 of Figure 1.

Figures 3 to 8 show the tubes at different stages of their construction. More particularly, Figure 3 shows a flat sheet of metal, Figures 4 to 6 show cross-sections of the sheet at different stages of its formation into an oblong tube, while Figures 7 and 8 show the first and second step, respectively, in forming the tube into a spiral with spaced convolutions.

Figures 9 and 10 show variations in the tubular section.

Figure 11 shows a modified cross-section of a tube which can be used in the interchanger.

Figure 12 shows an irregular section.

Figures 13 and 14 show variations of Figure 2.

Figure 15 shows a plan view of the interchanger of Figure 14.

Considering the drawings in greater details, two views of an interchanger embodying features of this invention are shown in Figures 1 and 2. The interchanger as shown comprises a casing or housing 10 having a cover or end closure 11 and a spiral tube 12 housed interiorly of the casing. The particular construction illustrated embodies a tube made preferably from a folded sheet of metal and welded along adjacent edges as at 13. Each end of the tube is secured to a pipe which passes through the closure 11 and is secured thereto, for instance by press fitting. It is to be noted that round seamless tubing may be flattened and then advantageously used in the instant interchanger. Either of the pipes may be an inlet or outlet depending upon the mode of operation of the device. Said pipes are indicated at 14 and 18, the pipe 14 being adjacent the circumferential wall of the casing 10 as indicated at 15. Each pipe has a cut-out in its side wall with which the adjacent end of the tube connects, the joint being welded or brazed as indicated at 16, and inner end of each pipe is closed as indicated at 17. Since the inlet and outlet pipes 14 and 18, respectively, are secured to the closure 11 as well as to the tubular spiral 12, it is obvious that the tubular spiral is removable with the closure. The tube 12 and the two pipes provide one passageway for a fluid which is to be heated or cooled as a result of a transfer of heat between it and another fluid which flows around the outside of the tube in the passageway formed between adjacent walls of the tube and the casing. The inlet and outlet of this latter passageway is shown comprising pipes 19 and 20 extending through the end closure.

One method by which this device may be constructed, and especially its tube 12, is illustrated in Figures 3 to 8 inclusive. Figure 3 shows a sheet of metal which is folded substantially along its longitudinally extending center line 31 which results in the structure shown in Figure 4. The adjacent edges of this member are welded at 13. The tube as thus formed is then folded into the tight spiral shown in Figure 7 after which it is partly expanded as in Figure 8. This expansion is accomplished by hydraulic pressure within the tube. After this expansion the cross-section of the tube will be as illustrated in Figure 6. The casing and the end closure are preferably provided with spiral grooves 21 and 22 respectively which serve to hold the spiral in position in the casing and to provide a seal between the side walls of the casing and the side edges of the spiral.

One change from the arrangement shown in Figures 5 and 6 is easily apparent. Instead of a folded sheet welded along its adjacent edges, two sheets may be used. In such a case the tube of Figure 5 would have a weld along the bottom as

well as the top. Brazing or soldering, it will be understood, may also be used. Under some conditions, one or more of these edges may be joined by crimping or folding alone. In Figures 9 and 10 the tube walls are pressed into contact with each other and united by a series of spot welds 38 approximately midway between the edges. This creates a plurality of passages 39 and 40 in the tube. Figure 11 illustrates how the same result may be accomplished by using a strip, the adjacent edges of which may be joined to a midsection of the tube by welding, for instance. The tube may have more than two passages, three such passages being shown in Figure 14. The joints which divide the tube in Figure 14 into three passages may be welded together or they may be unattached. Still another form of tube cross-section is shown in Figure 12, one part 43 providing a narrow flow passage and another part 43 providing a flow path of larger cross-section, the edges of the tube being sealed in grooves 44 and 45 in the casing.

In Figure 11, a sheet of metal is folded in a different manner from the manner illustrated in Figure 3. In this case the metal would be folded along longitudinal lines approximately ¼ of the distance from each edge. This will then provide a figure-eight construction after the tube has been expanded, as shown in Figure 11. The edges 33 and 34 are welded to the midportion 35 at 36, the weld being preferably in the nature of a continuous seam weld, although spot welds can be used.

Variations in the device are shown in Figures 13 and 14. In Figure 13 the casing 80 and end closure 81 are of substantially the same construction as shown in Figure 2 except that flange portions 52 and 53 respectively are provided instead of the overlapping arrangement shown in Figure 2. In this arrangement the tube is formed from two strips of metal 54 and 55 having their adjacent edges crimped together as at 86. The bottom edges are arranged to fit in a groove 56 whereas the top edges 57 are arranged to be folded over and the whole construction sealed by the sealing member as gasket 82. The connections for the tube in this instance project through between the casing and its closure as at 59 and 60 respectively. The extremities 61 of the tubes 84 and 85 are threaded and provided with nuts 62 which assist in securing the closure 81 to the casing 80. The openings for the passageway between the tubing are located at 63 and 64. In this particular figure the tube is so arranged that the ribs or longitudinally extending corrugations 65 abut against each other and thereby provide a spacing means between adjacent portions of the tube and also aid in providing additional strength against pressures to which the device is subjected.

In Figure 14 a slightly different manner of constructing the device is illustrated. In this figure one connection for the tube and the passageway around the outside of the tube is provided by using a center casting 70 having openings 71 and 72 extending through the end closure members 101 and 102. One end of the tube is fastened to the central member 70. The opposite end of the tube is fastened to a pipe 103 in a manner similar to that used in the construction of Figure 1. The bolted construction 76 holds the closure and tube together. The tube 106 in this case has its ribs 78 extending in the opposite direction from that illustrated in Figure 13.

Although the abutting ribs 78 are not secured together in the showing of Figure 14, if this should be desirable, they can be so secured by means of welds or other fastening means. In this construction the end closure members are pressed together sealing the space between the tube 106 by compressing the sealing means 98 and 99 and are then secured by means of the semi-cylindrical wall sections 103 and 103' which are held by a plurality of bolts 104. Interposed between these two wall sections and their abutting flange portions 84 is positioned a gasket 85.

This device may be used as a cooler, a heater, a heat exchanger, a condenser, an evaporator, or it may even utilize a heating effect attained by running an electric resistance heating element through the tubular passage.

Other variations will be readily apparent to those skilled in the art and it is intended to cover all such variations in the true spirit and scope of this invention and the hereto appended claims.

What I claim is:

1. In a heat interchanger, the combination of a sealed housing; a separate conduit in the housing, said conduit being of oblong cross-section and provided with longitudinally and inwardly extending beads in the narrowly spaced walls of the conduit, said beads partitioning the conduit into adjoining passages and reinforcing the conduit, and said conduit being in form of a spiral with its convolutions spaced apart to define a spiral path in the housing.

2. In a heat interchanger, the combination of a sealed housing; a separate spiral conduit of oblong cross-section in the housing, said conduit being provided with longitudinally and outwardly extending beads in engagement with each other thereby reinforcing the conduit, spacing the convolutions of the conduit to define a spiral path in the housing, and partitioning said path into adjoining passages.

3. In a heat interchanger, the combination of a sealed housing having a spirally extending deformation in one wall thereof; a spiral conduit in the housing and in engagement with the deformation thereof whereby the convolutions of the conduit are kept spaced apart to define a spiral path in the housing; and a sealing member pressed between the conduit and a housing wall opposite said one wall.

4. In a heat interchanger, the combination of a sealed housing having a spiral groove in one wall thereof; a spiral conduit in the housing and in registry with the spiral groove thereof whereby the convolutions of the conduit are kept spaced apart to define a spiral path in the housing, said conduit being formed from flat stock with the edges in overlapping engagement; and a sealing member pressed between the overlapped edges of the conduit and a housing wall opposite said one wall.

5. In a heat interchanger, the combination of a sealed housing having a spiral groove in one wall thereof; a spiral conduit in the housing, said conduit being of oblong cross-section and formed from two flat strips with the edges in overlapping engagement at the narrow ends of the cross-section of the conduit, said conduit having one pair of overlapped edges in registry with the groove; and a sealing member pressed between the other overlapped edges of the conduit and a housing wall opposite said one wall.

6. In a heat exchanger, the combination of a flat tubular conduit having a continuous deformation extending lengthwise thereof in both of its side walls between its side edges to form outwardly directed ridges, said conduit being bent

to a spiral shape and said ridges spacing the opposing wall of adjacent convolutions, and means cooperating with the side edges of the convolutions to form a closed spiral passage between the convolutions.

7. In a heat exchanger, the combination of a flat tubular conduit having deformations extending longitudinally thereof in both of its side walls to form outwardly directed ridges, said conduit being bent in the form of a spiral and said ridges on the opposing wall of adjacent convolutions abutting each other to space the convolutions and means cooperating with the side edges of the convolutions to form a closed spiral passage between the convolutions.

FRANCIS R. BICHOWSKY.