

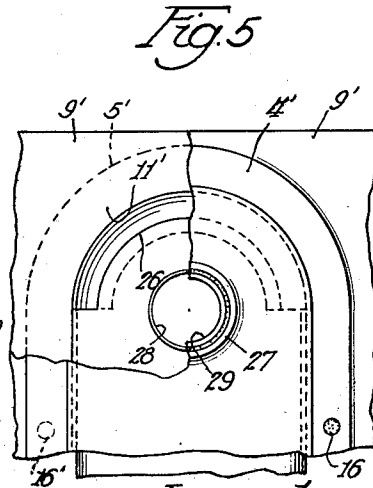
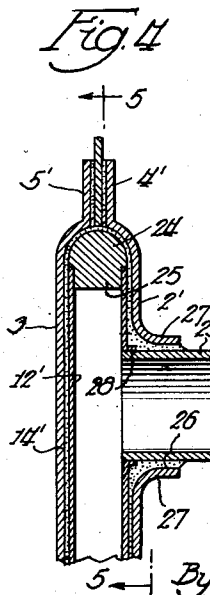
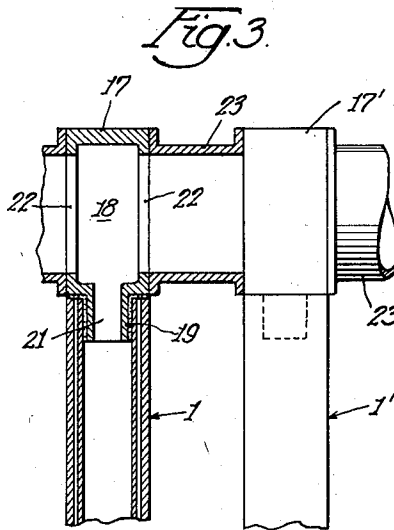
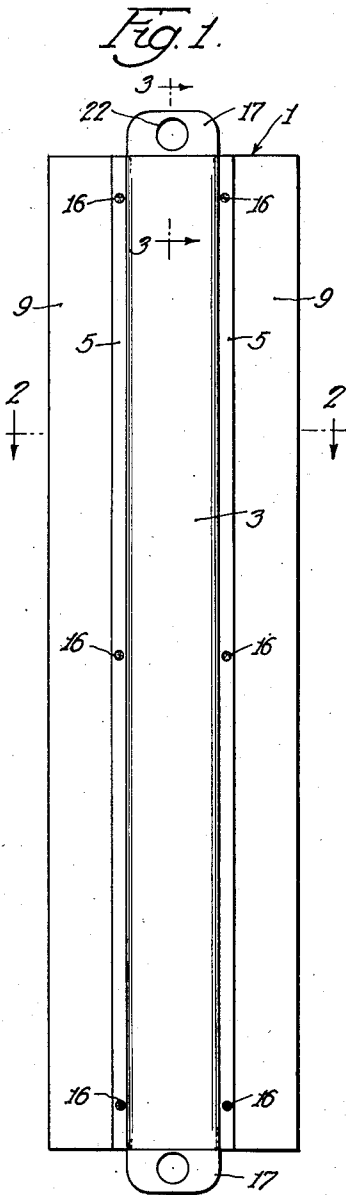
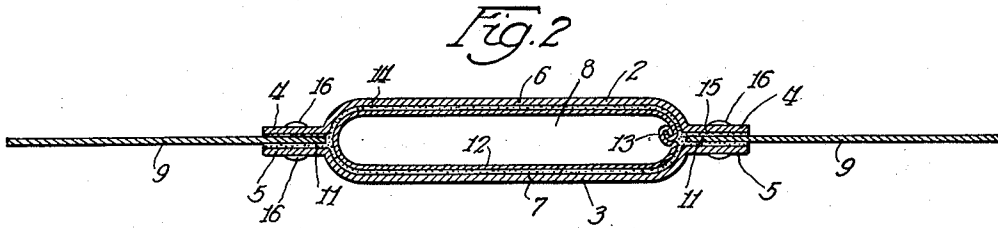
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FLUID CONDUIT STRUCTURE

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FLUID CONDUIT STRUCTURE

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1 Claim. (Cl. 257—256)

The invention relates generally to a fluid conduit for use in fluid lines, or the like, and more particularly to such a conduit having ready application to a convector, or other type of heat transfer structure, and to a novel method of producing the same. Certain features of the invention are broadly applicable to the embodiment as disclosed and claimed in my co-pending application Serial No. 205,860, filed January 13, 1951, now Patent No. 2,752,129, dated June 26, 1956.

In connection with the transfer of fluids for heat exchange, or other purposes, the conduit oftentimes must be made of materials having special or suitable characteristics, as for example, in connection with fluids having corrosive characteristics or containing material having such characteristics. The material embodying the conduit preferably is constructed of a material which is not appreciably affected by the material which it is to carry. Thus while it may, for example, oftentimes be desirable to form the conduit of steel, the particular application to which the conduit is to be put renders it necessary to fabricate it out of a different material, as for example, brass or copper, which may considerably increase the cost of the finished structure. A typical example of such a problem is in the heat exchanger field, wherein the use of steel tubing, or the like, is impractical where water or steam is to flow therethrough due to the rusting action on the tubing. Consequently, such type heat exchangers normally employ brass or copper tubing.

The present invention contemplates the production of tubing, or other fluid carrying passages, which is in the form of a bimetallic structure, the interior of the same having a lining of metal having suitable characteristics for the fluid to be carried, and the outer shell of the structure formed from a metal which may be relatively inexpensive and otherwise generally unsuitable for use in direct contact with the fluid to be carried.

Another object of the invention is to provide such a bimetallic structure which is simple in construction, durable, and easily and relatively inexpensively fabricated.

Another object of the invention is the production of such a structure which may be readily designed to form a closed passage, as for example, in use in connection with heat exchange structures, and in which case it may be readily provided with an efficient fin structure with substantially no change in the fabricating techniques required.

A further object of the invention is the production of such a structure in which the heat conductive characteristics of the respective materials employed may be effectively utilized, and a fin structure produced having, in effect, characteristics corresponding to a tapered fin with its resultant high efficiency.

The invention also has among its objects the utilization of a novel method of coating the surface of a metal object with a different material than that from which the object is constructed, as for example, in connection with the manufacture of fluid conduits, such as those here involved, where the interior of the conduit or housing,

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which may be formed of a ferrous material, is to be lined with a non-ferrous metal.

Many other objects and advantages of the construction herein shown and described will be obvious to those skilled in the art from the disclosure herein given.

To this end my invention consists in the novel construction, arrangement, and combination of parts herein shown and described, and more particularly pointed out in the claim.

In the drawings, wherein like references characters represent like or corresponding parts:

Fig. 1 is a side elevational view of a length of tubing constructed in accordance with the present invention and provided with closure elements at either end forming means for connecting the tubing in series in a fluid line, or the like;

Fig. 2 is a transverse sectional view taken approximately on the line 2—2 of Fig. 1;

Fig. 3 is a transverse sectional view taken approximately on the line 3—3 of Fig. 1 and illustrating the connection of such tube with a similar tube, shown in elevation;

Fig. 4 is a transverse sectional view similar to Fig. 3 showing a modified form of the invention; and

Fig. 5 is a fragmentary sectional view taken approximately on the line 5—5 of Fig. 4.

The invention is particularly applicable in connection with the fabricating of fluid conduits, or other structures, wherein it is desired to coat one of the surfaces of the object with metal having different characteristics than that of the object receiving the coating, for the reasons heretofore mentioned. While various metals may be readily coated with lead, zinc, and the like, by dipping, or similar operations, metals such as copper cannot be readily applied as a coating in comparable operations, as the copper has a tendency to run to the edges, etc., whereby a very non-uniform coating results, portions of the structure having substantially little, if any, coating, and other portions of the structure having excessive amounts thereon. Consequently, in applying copper coatings of this type, electrolysis, or the like, is generally employed in an effort to obtain a uniform coating on the object. The present invention embodies a method of providing a coating of copper, or the like, to a surface, as for example, the interior surface of a fluid conduit, wherein the metal is applied in liquid or molten form, a substantially uniform coating being achieved by capillary action.

Referring to the drawings, 1 indicated generally a fluid conduit which, in the embodiment illustrated, comprises a pair of similarly shaped sections 2 and 3 formed from sheet metal, and respectively having longitudinally extending flange portions 4 and 5. The sections 2 and 3 are provided with respective outwardly offset portions 6 and 7 which co-operate to form a passageway 8 between the two sections.

The embodiment of the invention illustrated also includes fin surfaces formed by a pair of longitudinally extending strips 9 having their inner edge portions 11 positioned between the opposed pairs of flanges 4 and 5.

Positioned in the passageway 8 is a hollow, tubular member 12 illustrated, in the present instance, as also formed from sheet material, with the adjacent, longitudinal edges thereof interlocked, as indicated at 13. As clearly illustrated in Fig. 2, the exterior surface of the member 12 is similar in shape to the interior surface of the housing structure formed by the sections 2 and 3, with the exterior transverse dimensions of the member 12 being slightly less than the interior dimensions of the housing structure formed by the sections 2 and 3, whereby the exterior surfaces of the member 12 may be substantially uniformly spaced from the adjacent interior surfaces of sections 2 and 3.

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Positioned in the space between the member 12 and the sections 2 and 3 is a layer of metal 14 different than that forming the housing structure, as for example, copper, which also extends, as indicated at 15, between adjacent portions of the strips 9 and flanges 4 and 5, effectively bonding the various elements into an integral, fluid-tight structure. In manufacturing the structure thus far described, the sections 2 and 3 and fin strips 9 may be assembled in their relative positions illustrated in Figs. 1 and 2, and if desired, may be initially secured together to maintain them in such assembled relation by any suitable means, as for example, spot welding 16. The tube 12 may then be inserted, and liquid metal from which the layer 14 is to be formed is then suitably admitted into the space between the tube 12 and the sections 2 and 3. As previously mentioned, the relative dimensions of the member 12 and sections 2 and 3 are such that a small space is formed between the same and, in practice, these dimensions are so selected that the space thus formed is sufficiently small to produce a capillary action by molten metal entering the space, whereby such molten metal will rapidly travel through the space and fill the same with metal. At the same time, molten metal will be evenly distributed between all unsecured surfaces of the flanges 4 and 5 and fin strips 9. In actual practice, the admission of the molten metal could be accomplished in several different ways, for example, a portion of the copper, or other metal employed for the intermediate layer, could be in powdered form and suitably applied to either the interior surfaces of the sections 2 and 3, or the external surface of the member 12, or a combination of both, whereby a portion of the metal forming the intermediate layer is initially positioned in the space the final layer is to occupy. Additional metal in the form of wire, or the like, could be positioned adjacent the edges of the flanges 4 and 5, as indicated in dotted lines in Fig. 2, which metal in liquid form would be drawn between the fins 9 and sections 2 and 3 into the space between the member 12 and the sections 2 and 3 by capillary action until the space is completely filled, as illustrated. Likewise, if desired, all of the metal forming the layer 14 could be introduced along the flanges 4, or might be introduced from either or both ends of the structure. Whatever form is utilized to introduce the metal, the structure preferably may be placed in a position to minimize the effects of gravity on the capillary action. In actual practice, the space between the member 12 and sections 2 and 3 may be in the order of three or four thousandths of an inch, with the main restriction on the maximum size of the space being dependent on the establishment of capillary action through the structure. In this connection, equations relating to surface tension of liquids may be employed, some of the factors involved being the distance between the particular surfaces, the density of the particular liquid, etc.

It will be noted that in the fluid conduit illustrated, the production of which has been described, the inner member 12 functions primarily as a means for production, the capillary action resulting in the coating of the housing sections 2 and 3. Thus in a conduit of this type, the housing sections could be constructed of ferrous metals, and in like manner, the member 12 could be constructed of the same or other material, the chief requirement of the member 12 being that it has a higher melting point than the metal 14 as, of course, would also be the case of the sections 2 and 3 and fin elements 9. If in use, the member 12 may be reacted upon by fluid flowing through the passageway 8, and may ultimately disintegrate or otherwise be destroyed; the intermediate layer 14 provides an efficient barrier between the fluid and the outer housing structure. While I have illustrated the sections 2 and 3 and fin elements 9 as being initially secured together at spaced points, such securement is primarily for the purpose of maintaining the elements of

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the structure in assembled relation, and by providing external means for holding the elements in the desired relative positions, the welding, or other securing means, could be eliminated, and the copper or the intermediate layer 14 would then form the wall bonding means between the sections 2 and 3 and fin members 9. However, I prefer to initially secure the elements in assembled relation to facilitate the handling and final bonding thereof, as well as provide the advantage of additional securing means independent of the bond.

The conduit, as illustrated in Fig. 1, may be provided with closure members 17 formed from metal having suitable characteristics with respect to the fluid to be carried in the conduit, and as illustrated in Fig. 3, each of the members 17 are hollow, forming a chamber 18 therein, and are provided at one end with an extension or stem 19 having an external size and shape to be readily received in the conduit, the stem 19 having a passageway 21 therein communicating with the chamber 18 and the interior of the conduit. Each of the members 17 may be provided with one or more outlet openings or ports 22, by means of which connection may be made to a fluid line or, as illustrated in Fig. 3, two or more of the conduit sections, such as illustrated in Fig. 1, could be connected in parallel. The connections 17 can be secured to the conduit by any suitable means, although I prefer to position each member 17 at respective ends of the conduit, as illustrated in Figs. 1 and 3, prior to bonding, whereby the connection will be bonded to the conduit by the metal forming the layer 14 simultaneously with the coating of the conduit interior. A series of sections, two of which are partially illustrated in Fig. 3, may be readily secured together by any suitable means, as for example, a tubular connecting member 23 extending between the connections 17 and 17', and secured thereto by any suitable means. Likewise, each connection 17 could be constructed with threaded or other formed fittings for engagement with co-operable connecting elements.

Illustrated in Figs. 4 and 5 is a modified form of the invention wherein the conduit structure is closed at both ends by suitably forming the sections 2 and 3 and, as illustrated, the flanges 4 and 5 are extended around the ends, as indicated at 4' and 5', so that each flange 4 extends continuously around the chamber thus formed, and each fin element 9' is provided with an arcuate edge portion 11' adapted to be positioned between the portions 4' and 5' of the flanges.

The ends of the tubular member 12' corresponding to the tube 12 are likewise closed, this being accomplished in the embodiment of the invention illustrated by an arcuate-shaped end member 24 having an inset portion 25 adapted to be positioned between the side walls of the tubular member 12', the ends of such side walls being semicircular in configuration, as indicated at 26. Thus the ends of the tube are closed, and as the closed ends are similar in shape to the inner end surface of the conduit, metal admitted into the space between the member 12 and sections 2 and 3 will likewise flow by capillary action around the outer surface of the member 24, and between the portions 4' and 5' of the flanges and adjacent portions 11' of the fin elements, whereby a closed chamber may be formed with the inner surface of the housing structure being completely coated by an intermediate layer of copper, or other metal.

Inlet and outlet openings may be provided at each end of the structure illustrated in Figs. 4 and 5 by suitably forming the metal comprising the outer housing structure, as for example, providing the section 2' with an opening 26 therein, with the metal adjacent the opening being preferably flared outwardly, as indicated at 27, and similarly forming an opening 28 in the member 12', the openings 26 and 28 being axially aligned, as illustrated. These openings would normally be made prior to the assembly

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of the structure at the time the various sections are formed, and after the elements have been assembled and initially secured, if desired, by spot welding 16', a sleeve 29 may be positioned in the openings 26 and 28, the sleeve being supported by any suitable means, as for example, a press fit in the opening 28 of the member 12', so that when the intermediate layer of metal 14' is formed, the sleeve 29 is effectively bonded to the section 2'. Obviously, as in the case of the connection 17, the sleeve 29 would preferably be constructed of a metal having suitable characteristics with respect to the fluid to be carried in the conduit. Likewise, by duplicating the structure illustrated on the section 2', an additional port may be formed in the section 3' comparable to the structure illustrated in Fig. 3, whereby several sections of conduit may be connected in parallel.

While I have illustrated the conduit as being provided with fin elements, obviously in cases where such elements are unnecessary, they may be omitted, and the sections 2 and 3 suitably proportioned to bring the flanges 4 and 5 adjacent one another, where they could be initially secured by spot welding 16, and ultimately bonded directly together by the metal forming the layer 14. Likewise, while I have illustrated in Figs. 1 and 3 closure members 17 forming means for connecting the conduit in a fluid line, the members 17 could be solid in form, serving merely to close the ends of the structure. In such case the fluid ports may be suitably formed in the side walls, for example, as illustrated in Figs. 4 and 5.

It will be noted from the above description that I have a novel structure for receiving fluids which is provided with a barrier of a different metal interposed between the fluid and the outer housing structure, together with a novel method of fabricating the same.

Having thus described my invention, it is obvious that various immaterial modifications may be made in the same without departing from the spirit of my invention; hence, I do not wish to be understood as limiting myself to the exact form, construction, arrangement, and combination of parts or method herein shown and described or uses mentioned.

What I claim as new and desire to secure by Letters Patent is:

In a heat exchange structure comprising a fluid conduit for a corrosible fluid, the combination of an outer housing structure formed from relatively thin sheet ferrous metal and comprising a pair of longitudinally extending sections substantially co-extensive in length, each of which is provided with a longitudinally extending offset portion therein, said offset portions together defining a fluid channel, corresponding edge portions of the housing sections having substantially parallel, oppositely disposed flanges, a light gauge tubular ferrous liner

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structure substantially co-extensive in length with the sections of the housing and open at its ends, the outer surface of which is generally complementary in shape to the inner surface of the housing structure, with the external transverse dimensions of the liner structure being less than the corresponding internal dimensions of the housing structure to provide a relatively small space between adjacent surfaces of the liner and housing structures, longitudinally extending fin members positioned between portions of the oppositely disposed flanges, and a hollow closure member positioned at each end of and extending into said channel of the housing structure, with the interior of the closure members communicating with said channel, and a capillary layer of copper varying from substantially 0.003" in thickness to a maximum thickness dependent upon the establishment of a capillary action between the outer housing structure and tubular liner structure and different from that of the housing structure filling the space between such surface of the latter and the liner structure, and providing a barrier of such metal between fluid to be carried in the conduit and the outer metal housing upon the tubular liner structure being substantially corroded by the corrosible fluid in contact therewith, said metal extending between adjacent surfaces of the flanges on said housing and bonding the housing sections, liner structure, fin members, and closure members into a unitary structure, said closure members each having an opening therein forming fluid inlet and outlet ports for the conduit.

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